12-2021

On the Development of the Self Starting Double Multivariate Exponentially Weighted Moving Average And Covariance Control Chart

Robert Eugene Resch

UNIVERSITY OF NORTHERN COLORADO

Greeley, Colorado

The Graduate School

ON THE DEVELOPMENT OF THE SELF STARTING DOUBLE MULTIVARIATE EXPONENTIALLY WEIGHTED MOVING AVERAGE AND COVARIANCE CONTROL CHART

A Dissertation Submitted in Partial Fulfillment
of the Requirement for the Degree of
Doctoral of Philosophy

Robert Eugene Resch

College of Education and Behavioral Sciences
Department of Applied Statistics and Research Methods

December 2021

This Dissertation by: Robert Eugene Resch

Entitled: *On the Development of the Self Starting Double Multivariate Exponentially Weighted Moving Average and Covariance Control Chart*

has been approved as meeting the requirement for the Degree of Doctor of Philosophy in College of Education and Behavioral Sciences in Department of Applied Statistics and Research Methods.

Accepted by the Doctoral Committee

____

William R Merchant, Ph.D., Research Advisor

____

Han Yu, Ph.D., Committee Member

____

Randy J Larkins, Ph.D, Committee Member

____

Anton Dzhamay, Ph.D., Faculty Representative

Date of Dissertation Defense ______________________________

Accepted by the Graduate School

____

Jeri-Anne Lyons, Ph.D.
Dean of the Graduate School
Associate Vice President for Research

ABSTRACT

Resch, Robert Eugene. *On the Development of the Self Starting Double Multivariate Exponentially Weighted Moving Average and Covariance Control Chart*. Published Doctoral dissertation, University of Northern Colorado, 2021.

Control charts are an important element for monitoring production processes in a wide array of industries. A strong performing control chart is one that responds quickly to undesirable changes in a production process. This work demonstrates the expansion of Multivariate Exponentially Weighted Moving Average and Covariance (MEWMAC) control chart to be doubly weighted in efforts to improve performance by reducing out of control run lengths (ARL_1) when changes occur in either the process mean vector or covariance matrix. Metric derivation and justification are provided. Simulations under different scenarios provide comparison of the new control chart mechanism to those already established in the literature. Conclusions and recommendations for future research are discussed.

ACKNOWLEDGMENTS

While it is impossible to thank everyone that has made this vision a reality, I would like to take the opportunity to thank those who have made the most impact on my ability to pursue my PhD to completion.

First, I would like to thank Dr. William Merchant for going above and beyond by taking the helm of my research committee after a series of unfortunate events looked to have left my project in the void. Without his compassion and willingness to oversee this dissertation, I can honestly say it never would have been realized.

Further, I would like to thank each of my additional committee members, Dr. Han Yu, Dr. Randy Larkins, and Dr. Anton Dzhamay. Without their support, I again would have been left drifting in the wind. I cannot thank them enough for serving on my committee.

To round out my thanks to my academic circles, I would specifically like to thank Michael Floren and Todd Connelly. Michael has been indispensable with help on LaTeXand a great friend as we worked through course material. Todd has been an incredible source of motivation as I traversed this program while assisting me get my first and second professional roles as a data scientist. Suffice it to say, I am forever in their debt.

Lastly, I would like to thank my wife, Katie. Without her understanding and constant reminder to finish, I do not think I would have seen this through to the end. She has been an incredible motivator and mother to our children while I have been occupied with work and this dissertation. I definitely could not have done this without her!

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

In a world with ever increasing demand, whether it be the manufacture of end goods such as cars and computers, or the machines that build them, quality assurance is paramount to the success of all businesses alike. Companies since the 1700's have not been able to escape the scrutiny of the perceptive buyer, with only the best being able to persevere. Companies like Apple and Honda have gone to great efforts to build entire campaigns revolving around their commitments to producing quality products. In their relentless pursuit of perfection, many successful companies today employ a variety of statistical methods to evaluate the performance of their production lines (Montgomery, 2008).

Glory was not always enjoyed by the statistician trying to break into industry. In the days of yore, what would go onto collectively be referred to as statistical process control (SPC) got its humble beginnings with the work of Walter A. Shewhart and his colleagues at Bell Laboratories in 1924. During his time at Bell, Shewhart pitched the idea of monitoring the output of production lines through graphical visualization, namely, the control chart. After a few more years, the idea of sampling was introduced into his monitoring process. It was through the effort of he and his colleagues that the foundation of statistical quality control were laid (Montgomery, 2008).

It was not until after World War II that industry as a whole began to realize the worth of statistics in minimizing production loss and maximizing customer satisfaction (Alkahtani, 2010). The American Society for Quality Control was founded in 1946. Shortly thereafter, the concepts of SPC were formalized.

“Statistical Process Control (SPC) methods are effective and powerful tools useful in understanding and monitoring production processes and ensuring that products conform to their designed specifications.” The most emphatic way to employ SPC is through the convention of control charts. They are simple to understand visualizations that deliver a wealth of information regarding individual processes, including if and when a process fails to conform to specification (Alkahtani, 2010).

Control charts themselves have evolved over time. From their humble beginnings with Shewhart in 1924, they have grown in capability and complexity. In those formative years, control charts focused on single attributes of a process. Whenever a process would fall out of conformity, an out-of-control signal would display on the control chart. In this set up, it is very easy to detect when a change has occurred and begin to search for assignable causes. Even then, it was certainly not uncommon to monitor both the process mean and dispersion. The x-bar and R chart was an early example of simultaneous monitoring (Montgomery, 2008).

In the event that more than a single process attribute needed monitoring, before 1947 there were few options outside of independent charts deployed alongside one another (Bersimis et al., 2007). In certain circumstances this is permissible while in many others, the inflation of Type I error can occur. This inflation can be dealt with by Bonferroni style corrections but this is not an ideal situation, especially in circumstances where more than two attributes are being made simultaneously (Bersimis et al., 2007).

It was not until the work of Hotelling in 1947 that a more appropriate technique for multivariate processes was discovered (Bersimis et al., 2007; Hotelling, 1947). With his introductory work, Hotellings T^2 control chart, Hotelling was able to more appropriately incorporate the relationship between process attributes natively, without the need for corrections made after the fact (Hotelling, 1947). The chart was adept at quickly identifying an out-of-control process if the overall mean vector or the variance-covariance matrix changed. Unfortunately, it is not particularly adept at figuring out whether the mean, the variance-covariance matrix, or both, that led to the out of control signal.

Hotelling's work opened the door for a multitude of appropriate procedures for multivariate processes to be dealt with. These truly multivariate procedures are increasingly more vital to industry as production processes are increasing in complexity and their data easily collected and stored for analysis (Bersimis et al., 2007; Montgomery, 2008). It is no longer difficult to collect the data required for this type of monitoring, but, it is more important than ever to have a technique that is not only able to detect changes to production operations, but also able to begin to help pinpoint what changes are specifically happening.

In pursuit of that ideal, many advances have been made, and continue to be made, that maximize the computing capacity available to production technicians. In this light, it is not uncommon to see approaches that embrace sophisticated techniques such as principal component analyses or neural networks (Bersimis et al., 2007). These may represent great technological leaps and maybe even profound capability at detecting changes, however, when they detect changes, it often takes the oversight of a highly educated statistician or data scientist to be able to interpret the results. This is not desirable as the design of the control chart was intended to be able to be robust in detecting process changes but understandable and actionable by the production staff.

It is in the spirit of the original control charts that this research was conducted; it did not pursue unnecessary complexity for the sake of computational capacity, but rather sought to improve the capability of the more traditional multivariate control charting methodologies. Namely, it aimed to ingest both current and previous sample information to create a well performing control chart that is quick to react to procedural changes as they occur.

Notation and Assumptions

For the remainder of this dissertation, vectors were to be denoted by a lower-case, bold face letter. Similarly, matrices were represented by upper-case, bold face letters. A vector of observations was considered to be of p x 1 dimension unless otherwise stated. Transposes of vectors and matrices were represented by a superscript T, i.e. $\mathbf{x}^T$ for a vector transpose and $\mathbf{X}^T$ for a matrix transpose. Further, the vector of responses was assumed to come from a p-dimension multivariate normal distribution with a mean vector $\boldsymbol{\mu}$ and a positive definite variance-covariance matrix $\boldsymbol{\Sigma}$.

Purpose of the Study

The main purpose of this study was to develop a technique that can simultaneously, but separately, monitor a multivariate process' location (mean vector) and dispersion (variance-covariance matrix). This research extended the work of Alkahtani (2010) in his derivation of the double Multivariate Exponentially Weighted Moving Average (dMEWMA) control chart to monitor multivariate location.

Specifically, it aimed to develop a variance-covariance matrix monitoring tool for multivariate processes. This particular element of the study was dubbed the double Multivariate Exponentially Weighted Moving Covariance Matrix (dMEWMC).

Further, this study sought to alleviate the assumptions in Alkahtani's (2010) study about independence in observations, by expanding upon the novel approach presented by Hawkins and Maboudou-Tchao (2007) for the more traditional, once-weighted Multivariate Exponentially Weighted Moving Average (MEWMA) charts. Specifically, this study sought to eradicate the need for phase one sampling by employing a self-starting mechanism to not only the dMEWMA chart for monitoring process location, but also the newly derived dMEWMC chart described immediately above. Self-starting mechanisms are techniques that begin monitoring processes from the very start of production without the need to perform prior sampling in order to assign control limits. With the introduction of this feature to the dMEWMA and dMEWMC, this dissertation laid the foundations for future cost savings in the deployment of the procedure as well as having alleviated concerns surrounding sampling technique utilized in future processes.

Collectively, the dMEWMA and dMEWMC with their self-starting mechanism were to be referred to as the Self-Starting Double Moving Exponentially Weighted Moving Average/Covariance (ssdMEWMAC) control chart. This self-starting chart not only simultaneously monitored process location and dispersion but will also freed the existing dMEWMA chart from its Phase I limitations as stated above.

As with other control charting paradigms, the goal of this new chart was to quickly and accurately identify shifts in a production process. Similar to the work by Hawkins and Maboudou-Tchao (2007), the observation vector was to be transformed into independent and identically distributed vectors with a known distribution.

Further, as with most control charting mechanisms, the goal of this new chart was to improve (shorten) the out-of-control average run length (ARL_1) of the chart configured for a desired in-control average run length (ARL_0). Based on these two measures, the two components of the ssdMEWMAC scheme were compared to popular existing metrics to determine if an improvement has indeed been made. The details of the comparison and how it was designed were explored at length in Chapter III. Additionally, real world performance of the chart was evaluated on an simulated data set from a hypothetical multivariate production process.

Significance of the Study

Should the performance of the proposed ssdMEWMAC scheme prove to be effective at monitoring multivariate location and dispersion, a new tool will be available to the variety of industries that regularly depend on statistical process control methods to oversee their production.

The implications of this success can be measured in dollars; not only does faster detection reduce wasted labor, raw materials, and time, it also allows companies to enjoy a reputation for producing quality merchandise and continue to operate successfully.

Research Questions to be Studied

The following questions are to be addressed in this dissertation:

Q1 How will the proposed ssdMEWMAC scheme be designed for the in-control average run length (ARL_0)?

Q2 How will the proposed control scheme perform for different deviations in both the location vector and variance-covariance matrix?

Q3 How will the proposed control scheme perform under different dimensionality?

Q4 How does the proposed control scheme perform with the utilization of different values for the smoothing parameter λ?

Q5 How does this control scheme perform relative to the SSMEWMAC (Hawkins & Maboudou-Tchao, 2007), the original dMEWMA (Alkahtani, 2010), and the original MEWMA (Lowry et al., 1992) control charts under controlled values of the smoothing parameter, magnitude of the deviation in the mean and/or covariance, and the desired in-control average run length?

Definitions

Average Run Length (ARL): the average number of consecutive points that must be plotted before an out-of-control condition is signaled.

Center Line (CL): A term used to reference the target value in a control chart. Logically occurs at the center of the monitoring chart (when directional).

In-control ARL (ARL_0): The ARL of the control chart when the process is in control.

In-control Process: A process that is operating with only the presence of chance causes of variation.

Lower Control Limit (LCL): The smallest chosen threshold, such that if crossed, signals the process is out of control. By extension, if the process is in control, the vast majority of observations must fall above this threshold.

Out-of-control ARL (ARL_1): The ARL of the control chart when the process is out of control.

Out-of-control Process: A process that is no longer operating within operational standards and an attributable cause can be found.

Target Value: A term used to describe the a value of measurement that corresponds to the specified value of the quality characteristic.

Upper Control Limit (UCL): The largest value chosen threshold such that if crossed, signals an out of control process. By extension, if a process is in control, the vast majority of points should fall below this threshold.

Study Limitations

This study is limited in the scope of the number of dimensions and average in control run lengths that it presents. It would be impossible to cover all possible scenarios, but it will present the code necessary to synthesize the custom solution needed for arbitrary dimensionality and average in control run length.

Overview

This dissertation consists of five chapters. Chapter I introduces a brief history of the field, including where the current model builds on previous research. It provides the questions this dissertation addresses, including a brief discussion of the limitations. It also provides relevant definitions commonly used throughout the dissertation.

Chapter II offers a deep discussion of the history of the field, including the derivations of the previous control charting mechanisms. The literature review provided shows whats missing from current research, and illustrates the applicability for the proposed research within.

Chapter III illustrates the development of the ssdMEWMAC control charts. The chapter closes with a discussion of how the research questions will be addressed.

Chapter IV describes the results of the simulated responses of the newly proposed metrics relative to the existing measures.

Chapter V discusses the results and presents conclusions. Limitations and calls for future work are also discussed.

CHAPTER II

LITERATURE REVIEW

As alluded to in Chapter I, control charting plays a fundamental and important role in many production and service industries today. Recall the purpose of this dissertation was to fundamentally improve upon the methods derived by Hawkins and Maboudou-Tchao (2007, 2008), and Alkahtani (2010). More specifically it was aiming to simultaneously monitor the location and dispersion of a multivariate production process in an easily understood format that was quick to respond to changes in either. The journey to this point has been nearly a hundred years in the making.

In the pages that follow, the pertinent literature surrounding the development and deployment of modern control charting techniques will be explored in detail. This exploration will begin with a review of the relevant univariate statistical process control techniques that spurred the creation of the multivariate techniques this research is hoping to expand upon. However, before any of these discussions can be made, an overview of the defining characteristics of statistical process control and control charting must be detailed first.

Ever since Shewhart pioneered the concept of the control chart in the early 1920's, the common goal of all control charts has been to detect shifts in production means and/or dispersion (Li et al., 2010). There has been some distinction made in the literature between charts that are designed for monitoring process location and others that are designed for monitoring dispersion, while others yet monitor for both simultaneously.

Regardless of the intended designs, all control charts have certain elements and goals that they share in common (Jackson, 1991). Jackson proposed that control charts must possess the following four characteristics; (1) an answer to the question 'Is the process in control?' must be available; (2) an overall probability for the event 'Procedure diagnoses an out-of-control state erroneously must be specified; (3) the relationships among the variables-attributes should be taken into account; and (4) an answer to the question 'If the process is out of control, what is the problem?' should be available.

All of these revelations make sense in the grand scheme of why control charts were created. They are valuable because, according to Montgomery; (1) control charts have proven effective in defect prevention; (2) prevent unnecessary process adjustments; (3) provide diagnostic information; and (4) provide information about the process capability (Montgomery, 2008). In this regard, capability refers to the processes ability to meet the design parameters of the product being produced. It is certainly plausible that a process is remarkably consistent, and as such, is an in-control process, but, the process is incapable of making the the product such that it is within the specification standards provided by the engineers. Due to these qualities of control charts, Montgomery reports that control charts are "a proven technique to improve productivity."

Given that the aim of statistical process control is to improve productivity, the aptitude of most control charts is then naturally assessed by how quickly they respond to changes. Formally in the literature, this is referred to as the out-of-control average run length (ARL_1). This is the number of successive samples that are required after a process deviates from target that it takes for the chart to signal the process has become out of control. Intuitively, then, shorter ARL_1 lengths are viewed favorably.

Having stated this, it is important to note that the out-of-control average run length is a direct consequence of how the desired in-control average run length (ARL_0) was selected. The upper and lower control limits are constructed in a manner such that they directly depend on a value that is relative to the desired in-control run length that was chosen. Recall that the upper and lower control limits were defined to be the thresholds in which the vast majority of the plotted fall below and above, respectively, when a process is in control. Generally speaking, the in control control limits are chosen in such a way that probabilistically, an out-of-control signal occurs due to chance alone with a certain prevalence. This is analogous to the type I error rates in traditional hypothesis testing when choosing critical regions; even with the best of designs, to the point of Jackson, there is an associated probability that a sample mean (or variance-covariance) will fall beyond an arbitrarily chosen value (Jackson, 1991).

This is the critical distinction between the two different types of average run lengths. The in-control average run length is the number of successive iterations of sampling it takes before a control chart is expected to give an out-of-control signal due to chance alone. On the other hand, the out-of control average run length is the number of successive samples required to signal a process has shifted after a shift has occurred due to an assignable cause. Assignable causes require the detective work of an engineer or technician to pinpoint what caused the change in the process.

Formally defining the concepts of average run lengths, both with respect to in-and-out of control processes, and their impact to how control limits are chosen, has led to another very important concept; a concept that is the crux of this dissertation: ‘In practice, how are control limits arrived at and implemented?”

Traditionally speaking, control charts were defined into two distinct phases: Phase I and Phase II control charts. As intuition would dictate, Phase I is the phase in which control limits are specified. It is the time at which a practitioner determines that a process is indeed in control and begins to retrospectively investigate the samples of previous runs to establish the operational control limits, based on the desired control chart to be implemented (Bersimis et al., 2007; Woodall, 2000). Beyond simply establishing the relevant control bounds and charting some initial data, this really is the opportunity in which classical control charting has the ability to ascertain whether or not a process is really in control. The implications of a process that is initially off, or a process that falters quickly, can be expected to have limited capability in indicating that a process has changed.

According to Alt (1985), Phase I can be further broken down to two distinct stages. Stage I, referred to the “Start-up Stage” is the verification that a process is in control at the time when data is being collected during the initial data collection period for defining the control chart.

Stage II, at least to Alt (1985), was referred to as the “Future Control Stage.” This was the continuous affirmation that successive control samples remain under control. It is imperative during the construction stage that both process mean and variance (mean vector and variance-covariance matrix in the multivariate case) to ensure the viability of the control chart (Alt, 1985).

Once the initial data collection, evaluation, and confirmation period has ended, process monitoring continues on to Phase II. Phase II is the active monitoring of the production process as it continues in real time. At each sampling stage, the new sample is measured and plotted, the trend displayed on the control chart exhibiting its center line, as well as the upper and control limits defined from Phase I. Note, it is important to acknowledge that the process in Phase II is no longer assumed to be from a controlled process, unless there is evidence that the process has remained unchanged.

The definitions of Phase I and II, exempting the further separation of Phase I into Stage I and II proposed by Alt (1985), is generally accepted and agreed upon (Capizzi & Masarotto, 2010; Fuchs, 1998; Lowry & Montgomery, 1995; Montgomery, 2008; Ryan, 2000). However, it is also widely acknowledged, that Phase I has serious limitations and can have great impact on the ability of the control chart to effectively detect changes (Hawkins & Maboudou-Tchao, 2007; Jensen et al., 2006; Quesenberry, 1993). All the aforementioned authors have acknowledged, to some degree, that control charts are customarily designed under the pretense that in-control parameters are assumed to be known, when in fact, they are often not. The solution is often to use the sampling in Phase I to arrive at estimates of the true operating mean and variance. These authors have all illustrated the impacts to ability of charts to detect true changes when process parameters are estimated. An alternative to Phase I is explored in detail at the end of this chapter. Suffice it to say, the limitations of the traditional control charting paradigms have been acknowledged and are constantly sought to be improved upon. What follow in the remaining sections of this chapter are the details of relevant univariate and multivariate procedures that have laid the foundation for this research.

Univariate Procedures

Nearly a century ago, Walter Shewhart proposed the initial scheme for monitoring production processes. In an era where data collection were manually performed, it is understandable that control charting began with a focus on a single quality attribute. Collectively, procedures focusing on a single production characteristic are referred to as univariate process control charts. In these rudimentary cases, Shewhart enjoys the recognition of his work as these charts are often referred to as "Shewhart Style Charts" or "Shewhart Charts."

In 1941, Shewhart formalized his contribution to the field with his submission to Fluid Mechanics and Statistical Methods in Engineering. If w is defined to be a characteristic of interest (i.e. a location, dispersion, or percentage non-conforming), then it follows that μ_w is the process mean and σ_w is the process standard deviation. Further, it was defined that the center line (CL), lower control limit (LCL) and upper control limit (UCL are as follows:

$$UCL = \mu_w + L\sigma_w, \tag{1}$$

$$CL = \mu_w, \tag{2}$$

$$LCL = \mu_w - L\sigma_w, \tag{3}$$

where L represents a desired multiple of the process standard deviation to consider reasonable to define an out-of-control threshold (or rejection region of the hypothesis that the process is in control). Typically, this value is set at 2 for warning limits or 3 for the out of control limits (Montgomery, 2008). If the process ever crosses the threshold, on either side, it is then considered to be an out-of-control process. An implicit assumption of this charting technique is that the process is a random walk about a fixed value. As Montgomery observed, no two units produced are exactly alike, so its natural to assume that over time, no two samples should be exactly alike, resulting in a random arrangement about the center line and within the control limits when a process is still under control (Montgomery, 2008).

Perhaps the most recognized Shewhart style chart for monitoring a univariate process' mean and dispersion is the combination $\bar{X}$ and R charts. $\bar{X}$ monitors the process mean and R represents the measure of the range between any two successive points.

Thematically, it worth reiterating that the true process mean, μ_0, is not known. It is rather estimated through Phase I sampling, and is defined to be:

Equation 4,

$$\bar{x} = \frac{1}{m}\sum_{i=1}^{m} x_i, \tag{4}$$

where m is the number sampled and x_i is the i^{th} value. The process standard deviation can be estimated to be:

Equation 5

$$\hat{\sigma}_0 = \frac{M\bar{R}}{d_2}, \tag{5}$$

where $M\bar{R}$ is the average moving range, and is defined to be:

Equation 6

$$M\bar{R} = \frac{1}{m-1}\sum_{i=2}^{m} MR_i, \tag{6}$$

and MR_i is defined to be:

Equation 7

$$MR_i = |x_i - x_{i-1}|, \tag{7}$$

the moving range of two successive observations. Look up values for d_i and a detailed explanation of this style of charting can be found in (Montgomery, 2008). These values are subsequently very easy to substitute back into the definitions for the upper and lower control limits provided by Shewhart.

As simple and great as these charts are at detecting large shifts, they turn out to be much less adept at tracking sustained small shifts in the process (Lowry et al., 1992; Prabhu & Runger, 1997; Stoumbos & Sullivan, 2002; G. Zhang & Chang, 2008). These charts are also solely based upon the information presented in the current sample; that is to say, Shewhart style charts are memory-less and fail to concern themselves with any sort of continual drift in a process (Lowry et al., 1992).

While certainly not the focus of the paper presented here, it would be amiss to fail to acknowledge two very prevalent alternatives to the univariate Shewhart charts: the Q-charts of Charles Quesenberry and the CUSUM charts. Q statistics are important because they allow for processes with unknown operating parameters to be effectively evaluated (Quesenberry, 1993). What's important to note with regard to this paper is that Q statistics can be used in the form of a Shewhart style chart, or, as the input to either CUSUM or EWMA control charting mechanisms.

Further, CUSUM charts are one family of charts that seek to address one of the limitations of Shewhart style charts. Specifically, they seek to incorporate information of all the samples previously taken. They accumulate the data over time and in the presence of a continual small drift, will quickly indicate a faltering process. CUSUM charts can be explored in Montgomery's (2008) introductory text.

One plausible solution to the memory-less property of Shewhart charts was proposed in the form of the Exponentially Weighted Moving Average (EWMA) charts (Roberts, 1959). These style charts embrace the collective history displayed by a process exhibiting small sustained drifts. The EWMA chart is sensitive to small shifts and filled a gap in the existing research at the time, showing that this chart was more adept at detecting small changes than the Shewhart style charts (L. Y. Zhang, 2002). Following Roberts and according to Zhang, successive studies can be classified into three categories:

1. Applications of EWMA techniques in various specific situations.

2. Studies on run length distributions of EWMA charts.

3. Further development of EWMA techniques.

Broadly speaking, the relevant works beyond Roberts' (1959) pinnacle work can be reduced to techniques evolved to handle individual observations (Macgregor & Harris, 1993); methods determining ARL run lengths (Crowder, 1987; Lucas & Saccucci, 1990; Robinson &

Ho, 1978; Srivastava & Yanhong, 1997); and the robustness of EWMA style charts to non-normality (Borror et al., 1999). One additional work that will be explored in detail at the end of this sub-section is the work of Shamma and Shamma (1992) regarding their development of the univariate Double Exponentially Weighted Moving (dEWMA) control chart.

The work of Macgregor and Harris (1993) is important to this work, in specific because it outlined the procedures necessary for mean and dispersion monitoring by augmenting the charts by single, auto-correlated observations one at time. This is a stark difference to the logical samples previously required, especially since it also acknowledges the autocorrelation between observations.

Further investigation into the literature have revealed three common methods into just how to enhance the EWMA charts by improving the mathematical derivations of the ARLs. Specifically, (1) Monte Carlo simulations have the capacity to be applied for all versions of EWMA charts, but can be time consuming and somewhat inaccurate; (2) the integral equation method, which provides very accurate results but requires the distribution of the responses to be at the very least continuous, ideally normal or exponential (Crowder, 1987); and (3) the Markov chain method (Lucas & Saccucci, 1990).

The work of Borror, et al. (1999), goes into detail to how the EWMA is resistant to the assumption of normality. With the correct smoothing constants, the EWMA can be adapted for dealing with non-normal data. This feature makes the EWMA a superb foundation to build upon for many situations in which the data structure cannot be guaranteed to be approximately normal. For additional information on the history and trajectory of the univariate EWMA, do not hesitate to review the exceptional work of Zhang (2002). This is an incredibly detailed presentation covering the success of the EWMA from its inception to modern adaptations, complete with comparisons of common implementations of EWMA style charts.

One work highlighted by Zhang (2002) and Alkahtani (2010) is the work concerning the Double Exponentially Weighted Moving Average (dEWMA) chart. This mechanism was originally put forth as an adaptation of Brown's 1962 effort to forecast a time series (Shamma &

Shamma, 1992). Specifically, the technique applies the EWMA style weighting mechanism for a second iteration.

To elaborate, the dEWMA control statistic Z_i is formulated in the following fashion:

Equation 8

$$Y_i = \lambda X_i + (1-\lambda)Y_{(i-1)}, \tag{8}$$

Equation 9

$$Z_i = \lambda Y_i + (1-\lambda)Z_{(i-1)}, \tag{9}$$

such that $0 < \lambda < 1$ and $Y_0 = Z_0 = \mu_0$. The former relationship is just the traditional EWMA control statistic while the latter is the newly applied dEWMA control statistic. It can be shown here, and is shown in detail in Alkahtani (2010), that the expectation of $Z_i = \mu_0$. It has been shown then, asymptotically:

Equation 10

$$\lim_{i\to\infty} \sigma^2_{z_i} = \sigma^2_z = \frac{\lambda(2-2\lambda+\lambda^2)}{(2-\lambda)^3}\sigma_0. \tag{10}$$

This yields the following control limits of the dEWMA chart:

$$UCL = \mu_0 + L\sigma^2_{(z_i)}, \tag{11}$$

$$CL = \mu_0, \tag{12}$$

$$LCL = \mu_0 - L\sigma^2_{(z_i)}, \tag{13}$$

such that L is the width of the designed control limits. The convention of using time specific variance allows for adaptive control limits, which, in turn, increases the sensitivity of the control chart. This was noted to have similar performance to the EWMA chart, but with reduced standard deviation run lengths (SDRLs) (Shamma & Shamma, 1992). It was further demonstrated that the dEWMA performs better than the EWMA for small shifts and very similarly to the EWMA for moderate shifts (L. Y. Zhang, 2002). Elaborated results of these two schemes can be found in their respective papers. In industry, the dEWMA enjoyed great success in the world of semiconductor manufacturing (Alkahtani, 2010).

Multivariate Procedures

Through this point, the focus has been primarily on the characteristics of good control charting in the univariate case. Historically, this has been adequate, but with modernization, the need for monitoring multiple, often related, processes has become necessary (Bersimis et al., 2007; Lowry et al., 1992). With only the established univariate tools, technicians had to rely on the implementation of several univariate charts for simultaneous monitoring to establish what was occurring in more complex processes. However, one of the major drawbacks of this set-up is that overall Type I error becomes large as the number of quality attributes increases (G. Zhang & Chang, 2008). It must also be acknowledged that as more charts are being implemented, there is also an increase in human error regarding the detection of an out-of-control signal when bombarded with too much information.

The key problem revolves around the failure of multiple univariate charts to effectively capture the relationships between quality characteristics. Industry demanded techniques be developed that can account for the variance-covariance structure while multiple characteristics are measured simultaneously. This is especially true today where modern technology easily allows for data acquisition on multiple quality characteristics (Lowry et al., 1992). The strength of what would come to be multivariate statistical process control (MSPC) is their power to consume the information of multiple variables and employ powerful algorithms that are sensitive to change (Prabhu & Runger, 1997). These techniques are also remarkably capable at consolidating that wealth of information into a single consumable chart, suitable for a single technician to oversee.

The first researcher to rise to the challenge of monitoring multiple correlated quality characteristics was Hotelling (1947). His work was able to overcome the limitations of multiple univariate charts, such as the independence assumption as well as the distortion of Type I (and Type II) error rates.

For a p-dimension observation vector, Hotelling was able to derive the following control statistic for monitoring a multivariate process:

Equation 14

$$\chi^2 = n\left(\bar{\boldsymbol{X}} - \boldsymbol{\mu_0}\right)^T \boldsymbol{\Sigma_0^{-1}} \left(\bar{\boldsymbol{X}} - \boldsymbol{\mu_0}\right), \tag{14}$$

where $\boldsymbol{\mu_0}$ and $\boldsymbol{\Sigma_0}$ are the in-control $p \times 1$ and $p \times p$ mean vector and variance-covariance matrix respectively.

The keen observer will notice that this is a quadratic form and allows for the vector relationships to be summarized by a single scalar value which can easily be monitored on a control chart. Even more conveniently, this follows Chi-square distribution with p degrees of freedom. This leads to Hotelling's control limits:

Equation 15

$$UCL = \chi_(\alpha, p)^2, \tag{15}$$

Equation 16

$$LCL = 0. \tag{16}$$

The derivations above are reliant upon fully knowing the in control parameter values. In the event that they are unknown, they will necessarily have to be estimated in the following fashion:

Equation 17

$$\hat{\boldsymbol{\mu_0}} = \bar{\bar{\boldsymbol{X}}} = \frac{1}{m} \sum_{(i=1)}^{m} (\bar{\boldsymbol{x}}_{\boldsymbol{i}}) \tag{17}$$

Equation 18

$$\hat{\boldsymbol{\Sigma_0}} = \bar{\bar{\boldsymbol{S}}} = \frac{1}{(m-1)} \sum_{(i=1)}^{m} (\bar{\boldsymbol{x}}_{\boldsymbol{i}} - \bar{\bar{\boldsymbol{x}}})(\bar{\boldsymbol{x}}_{\boldsymbol{i}} - \bar{\bar{\boldsymbol{x}}})^T \tag{18}$$

In this case, Hotelling's control statistic becomes:

Equation 19

$$T^2 = n(\bar{\boldsymbol{x}}_{\boldsymbol{i}} - \bar{\bar{\boldsymbol{x}}})^T \boldsymbol{S^{-1}} (\bar{\boldsymbol{x}}_{\boldsymbol{i}} - \bar{\bar{\boldsymbol{x}}}) \tag{19}$$

This is referred to as Hotelling's T^2 statistic and is a function of Mahalanobis distance. The visual representation based upon this statistic is Hotelling's T^2 control chart.

Further, in this estimated form, control limits have to be scrutinized. For Phase I, the control limits should be:

Equation 20

$$UCL = \frac{(p(m-1)(n-1))}{(mn-m-p+1)} F_{\alpha,p,mn-m-p+1}, \tag{20}$$

Equation 21

$$LCL = 0, \tag{21}$$

where $F_{\alpha,p,mn-m-p+1}$ is the α upper percentile of the F distribution with p and mn-m-p+1 degrees of freedom.

For Phase II it is recommended to use:

Equation 22

$$UCL = \frac{(p(m+1)(n-1))}{(mn-m-p+1)} F_{\alpha,p,mn-m-p+1}, \tag{22}$$

Equation 23

$$LCL = 0, \tag{23}$$

where $F_{\alpha,p,mn-m-p+1}$ is the α upper percentile of the F distribution with p and mn-m-p+1 degrees of freedom. Under large samples, the control limits from the χ^2 variant of the chart can be used (Montgomery, 2008).

Hotelling's work is seen as a direct extension of the Shewhart charts. They only use information from the recent while failing to incorporate any of the previous samples into its monitoring. As such, it is suitable for detecting large shifts in processes but struggles to detect small sustained shifts in a process. This is a limitation of all the multivariate Shewhart style charts.

As previously mentioned, the focus of this research is not on Shewhart style charts; however, this literature would be incomplete without their mention. Glossed over in the review of univariate procedures, an important set of charts were the Q- charts. Typically plotted on Shewhart style charts, the Q-statistics can be adapted and displayed in both a EWMA and CUSUM style manner.

In the univariate case, while the CUSUM variant is omitted, for a EWMA an adaptation of the Q statistic, the following control statistic could be employed:

Equation 24

$$Z_t = \lambda Q_t + (1-\lambda)Z_{(t-1)}, \tag{24}$$

where Z_0 is 0.

Schaffer (1997) was able to extend the Q chart into a multivariate setting by applying a probability integral transformation to the data. Under situations in which the mean vector and variance-covariance matrix are known, the control statistic is defined to be:

Equation 25

$$QP_t(\boldsymbol{X_t}) = \Phi^{-1}\left(H_p\left[(\boldsymbol{x_r}-\boldsymbol{\mu}))^T\boldsymbol{\Sigma^{-1}}(\boldsymbol{x_r}-\boldsymbol{\mu})\right]\right), r = 1,2,3... \tag{25}$$

where Φ^{-1} is the inverse of the standard normal distribution function and H_p is the Chi-square distribution function with p-degrees of freedom (Schaffer, 1997).

Under the more common situation when the process mean vector and process variance-covariance matrix are unknown, the control statistic becomes:

Equation 26

$$QP_t(\boldsymbol{X_t}) = \Phi^{-1}\left(F\left[c\left(\boldsymbol{x_r}-\boldsymbol{\bar{X}_{r-1}}\right)^T\boldsymbol{S_{r-1}^{-1}}\left(\boldsymbol{x_r}-\boldsymbol{\bar{X}_{r-1}}\right)\right]\right), r = 1,2,3... \tag{26}$$

where Φ^{-1} is the inverse of the standard normal distribution function and F is F distribution function with p and r-p-1 degrees of freedom, and

Equation 27

$$c = ((r-1)(r-p-1))/(p(r-2)(r)), \tag{27}$$

Equation 28

$$\bar{\boldsymbol{x}}_{\boldsymbol{r}} = \frac{1}{r}\sum_{j=1}^{r}\boldsymbol{x}_{\boldsymbol{j}}, \tag{28}$$

Equation 29

$$\boldsymbol{S}_{\boldsymbol{r}} = [((r-2))/((r-1))]\boldsymbol{S}_{\boldsymbol{(r-1)}} + (1/r)\left[\boldsymbol{x}_{\boldsymbol{r}} - \bar{\boldsymbol{x}}_{\boldsymbol{r-1}}\right]\left[\boldsymbol{x}_{\boldsymbol{r}} - \bar{\boldsymbol{x}}_{\boldsymbol{r-1}}\right]^{T}. \tag{29}$$

Now, in Schaffer (1997), these were charted on a Shewhart-style chart, but he also employs a EWMA style implementation of the statistic as well. Ultimately, it was concluded that the statistic, while performing well for large shifts, still struggled with small shifts and even after the employment of a EWMA style mechanism on the statistic, was still out performed by the Multivariate Exponentially Weighted Moving Average (MEWMA) control chart. The MEWMA and its important derivatives will be explored in depth in the following paragraphs, but, it is again important that transformation of the observations, in this case the probability integral transformation, allowed a multivariate scheme to be developed. This is thematically important to advancement of multivariate control schemes.

For the remainder of this narrative, the focus will be upon the MEWMA and two of its derivatives in particular, the Multivariate Exponentially Weighted Moving Covariance (MEWMC) control chart and the double Multivariate Exponentially Weighted Moving Average (dMEWMA) control chart. These developments in particular lay the foundation for the research that is to be presented in Chapter III.

Many different control charts have been developed since Hotelling's T^2 charts, but none may be as important as the MEWMA. Up to its development in 1992, advances in multivariate control charting had been focused on the multivariate CUSUM charts. At the time of its publication, the authors sought to present a multivariate control charting mechanism that was more straightforward than the CUSUM that also had better ARL performance (Lowry et al., 1992).

The advantages of a EWMA approach is two-fold. First, under the assumption of independence, can be used as a powerful tool at detecting when certain types of extra variation enters a system (process control); second, it can also be leveraged a powerful prediction tool for the next observation in certain situations (Lowry et al., 1992). Further, it was been shown that the MEWMA chart depends only upon the mean vector $\boldsymbol{\mu}$ and the covariance matrix $\boldsymbol{\Sigma}$ only through the non-centrality parameter (recall that these statistics are of quadratic forms and are asymptotically modeled by non-central Chi-square distribution).

The MEWMA control statistic is an intuitive extension of the univariate case. First, begin by defining a vector of EWMA's:

Equation 30

$$\boldsymbol{Z_i} = \boldsymbol{RX_i} + (1 - \boldsymbol{R})\boldsymbol{Z_{i-1}}, i = 1, 2, 3, ... \tag{30}$$

where $\boldsymbol{Z_0} = \mathbf{0}$ and $\mathbf{R} = diag(r1, r2, ..., rp), 0 < rj < 1, j = 1, 2, ..., p$. These are the weights assigned to the parameters. In order for the chart to be only dependent on the non-centrality parameter, this requires these weights to be equal, otherwise, the chart depends on the direction of the shift as well (Lowry et al., 1992). The MEWMA control chart then signals as soon as:

Equation 31

$$T_i^2 = \boldsymbol{Z_i^T}\boldsymbol{\Sigma_{z_i}^{-1}}\boldsymbol{Z_i} > h_4 \tag{31}$$

where h_4 is chosen to achieve a desired in-control ARL and $\boldsymbol{\Sigma_{z_i}}$ is the covariance matrix of the $\boldsymbol{Z_i}$'s. The derivation of this value can be found in the hallmark paper defining the MEWMA chart and is omitted here for brevity.

It is worth noting that using the exact variance-covariance matrix in the MEWMA test statistic yields very quick results. However, since there is a large likelihood a process will be in control for a while before needing to detect changes, in many cases, the asymptotic covariance is used. Details can be found in (Lowry et al., 1992).

Ultimately, by having shorter out-of-control ARL's, the MEWMA was better performing than the existing CUSUM charts of the time, as well as the benchmark set by Hotelling. Due to its ease of use and strong performance, the MEWMA is used as a comparison tool and a foundation in many of today's developments. That said, there are possible inertia problems. If the MEWMA statistic is on one side of the center line and then the process shifts in the opposite direction, there could be a delay in the response of the chart to indicate the change. Due to this limitation, using the MEWMA in conjunction with a multivariate Shewhart style scheme can be advantageous (Lowry et al., 1992).

Through this chapter, and Chapter I for that matter, process control has been described as pertaining to both the monitoring of the process location and dispersion, but the unstated focus in this review thus far has been on methods detecting changes to the process mean. While changes in the covariance matrix can be picked up by the methods already covered, they primarily are used in process location monitoring. Techniques to monitor multivariate dispersion have not enjoyed near the level of notoriety (Hawkins & Maboudou-Tchao, 2008). The techniques leading up to 2008 were typically only able to detect increases in process covariance matrices and not decreases. It was at this time an analogue of the MEWMA was developed for monitoring multivariate dispersion.

The Multivariate Exponentially Weighted Moving Covariance Matrix (MEWMC) control chart is an accumulative method for detecting both increases and decreases in the variance-covariance matrix. It is also designed to be used in conjunction with the MEWMA chart. Collectively, these two charts are referred to as the MEWMAC control charts.

The beauty of the MEWMC control chart lies in its elegant and simple solution to a rather difficult problem. Instead of relying on just the raw values of the observation vectors, a matrix **A** is found such that

Equation 32

$$\mathbf{A}\boldsymbol{\Sigma}_{\mathbf{0}}\mathbf{A}^{T} = \boldsymbol{I}_{\boldsymbol{p}}, \tag{32}$$

using it to create the transformation:

Equation 33

$$\boldsymbol{U}_{\boldsymbol{i}} = \mathbf{A}(\boldsymbol{X}_{\boldsymbol{i}} - \boldsymbol{\mu}_{\mathbf{0}}). \tag{33}$$

While under control, the $\boldsymbol{U_i}$'s are distributed N($\mathbf{0}$,$\boldsymbol{I_p}$). This gives an in control distribution that is easy to work with. The authors recommend using the lower triangular (inverse-Cholesky root) matrix to accomplish this task.

By continuing to define $\boldsymbol{S_0} = \boldsymbol{I_p}$, and n = 1,2,. . .

Equation 34

$$\boldsymbol{S_n} = (1-\lambda)\boldsymbol{S_{n-1}} + \lambda \boldsymbol{U_n} \boldsymbol{U_n^T} \tag{34}$$

the statistic necessary for charting can be arrived at. Hawkins and Maboudou-Tchao (2008) formally propose the following as the control statistic:

Equation 35

$$c_n = tr(\boldsymbol{S_n}) - log|\boldsymbol{S_n}| - p. \tag{35}$$

A loss of control is indicated when $c_n > h$, where h is chosen to achieve a desired in-control ARL (Hawkins & Maboudou-Tchao, 2008). A list of these has been provided by the authors in their original paper.

In their concluding remarks, the authors were successful in their pursuit to create a useful tool in monitoring for both increases and decreases in the variance-covariance matrix, though acknowledge it is slightly biased in circumstances of small changes coupled with large smoothing constants. Further, chart can be impacted by changes in the mean vector, as well as dedicated changes in the covariance matrix. This work in particular plays a very important role in establishing the foundation for the new research presented in this dissertation.

Multiple extensions of the MEWMA have since been developed since 1992; works regarding the designs of MEWMA charts have been thoroughly explored (Prabhu & Runger, 1997); there have been dedicated works towards refining the ARL's of the MEWMA (Bodden & Rigdon, 1999); and there have been investigations into the robustness of the MEWMA against multivariate non-normality (Stoumbos & Sullivan, 2002). These are all great works that demonstrate the versatility and power behind the MEWMA control chart.

There is, however, one last scheme that needs review before this subsection can come to close. In particular, the Double Multivariate Exponentially Weighted Moving Average (dMEWMA) control chart (Alkahtani & Schaffer, 2012). The dMEWMA chart is intuitively named as it is an extension of dEWMA chart (Shamma and Shamma, 1992). The guiding principle in this research is simple in that it proposes a second weighting of the observation vectors. Specifically, the dMEWMA statistics are defined to be:

Equation 36

$$\boldsymbol{y_i} = \Lambda \boldsymbol{x_i} + (\boldsymbol{I} - \Lambda)\boldsymbol{y_{i-1}}, \tag{36}$$

Equation 37

$$\boldsymbol{z_i} = \Lambda \boldsymbol{y_i} + (\boldsymbol{I} - \Lambda)\boldsymbol{z_{i-1}}. \tag{37}$$

Note that $\boldsymbol{\Lambda}$ is the same structure and dimension as the identity matrix, and itself is defined to by $\boldsymbol{\lambda I}$.

It can be demonstrated that the expected value of the $\boldsymbol{z_i}$'s is the in-control mean vector, i.e. the statistic is unbiased. The dMEWMA control statistic is then given by:

Equation 38

$$T^2_{\boldsymbol{d_i}} = \boldsymbol{z_i}^T \boldsymbol{\Sigma}^{-1}_{\boldsymbol{z_i}} \boldsymbol{z_i}, \tag{38}$$

where

Equation 39

$$\boldsymbol{\Sigma_{z_i}} = \frac{(\lambda^4[1+(1-\lambda)^2-(i+1)^2(1-\lambda)^{2i}+(2i^2+2i-1)(1-\lambda)^{(2i+2)})-i^2(1-\lambda)^{(2i+4)}}{[1-(1-\lambda])^2]^3}\boldsymbol{\Sigma_0} \tag{39}$$

is the exact variance-covariance matrix of the process (Alkahtani & Schaffer, 2012). Details on the derivation of this formula can be found in the appendix of Alkahtani and Schaffer (2012).

A simpler asymptotic variance estimate works well with a sufficiently large in-control period:

Equation 40

$$\boldsymbol{\Sigma}_{\boldsymbol{z_i}} = \left[(\lambda(2-2\lambda+\lambda^2))/(2-\lambda)^3\right]\boldsymbol{\Sigma}_{\mathbf{0}} \tag{40}$$

The chart signals that it is out of control when $T^2_{d_t} > h_3$ where h_3 is chosen to achieve a desired in control average run length.

Similar to the MEWMA, in the case that all the weighting coefficients are equal, then the ARL performance is only dependent on the process mean vector $\boldsymbol{\mu}$ and the variance-covariance matrix $\boldsymbol{\Sigma}$ through the non-centrality parameter. Also, using the exact variance-covariance matrix over the asymptotic variance covariance matrix should yield faster results (Alkahtani & Schaffer, 2012).

Ultimately, when considering very small shifts, the dMEWMA outperformed both the Hotelling's χ^2 and MEWMA charts. It performed as well as the each of these for moderate shifts as well. This work is one of two primary works the new research is looking to expand upon.

Self-Starting Control Charts

Through this point, this review has approached everything from the traditional perspective. That is to say, the control charts that have been discussed thus far have been created under the assumption that the in-control parameter true values are either known or estimated through Phase I sampling.

In practice, the true values of a parameter (or vector of parameters) is seldom known (Capizzi & Masarotto, 2010; Maboudou-Tchao & Hawkins, 2011). Because of this limitation, Phase I control charting is used to produce estimates of the sample mean (vector) and covariance (matrix). However, the effect of sampling on the efficacy of control charts has been studied and has been shown to have deleterious implications on the control limits of various control charts (Jensen et al., 2006; Quesenberry, 1993; Sullivan & Jones, 2002). In order to reduce the negative effects on the tool's capability, sufficiently large Phase I sampling has to occur, but in practice, this may be impractical, if not impossible, due to production length or costs. The required sample sizes to produce quality estimates only increases as the number of dimensions increases, especially in the case of the variance-covariance matrix. This is contradictory to industry's requirements for smaller inventories, rapid innovation, and real-time production (Sullivan & Jones, 2002).

An alternative to the historical approach of Phase I data collection is the appropriately named self-starting family of control charts. Self-starting control charts are able to begin monitoring a process near start-up (if not with the first unit produced) without the need of a dedicated Phase I collection period. Three situations in particular favor self-starting mechanisms; (1) when early production is costly; (2) when there is considerable delay between successive units; and (3) when samples sufficiently large to approximate true parameter values are not available (Sullivan & Jones, 2002).

The MEWMA is an ideal chart to apply a self starting mechanism to. It is able to ingest individual unit observations, is robust against multivariate non-normality, and is a quick to signal chart with sustained small-to-modest shifts. Further, it is relatively easy to transform "raw" observation vectors into a multivariate distribution with known mean vector and variance-covariance matrix. This is exactly what has happened in the literature; the Self-Starting Multivariate Exponentially Weighted Moving Average (SSMEWMA) control chart (Hawkins & Maboudou-Tchao, 2007) and the Self-Starting Multivariate Exponentially Weighted Moving Covariance Matrix (SSMEWMC) control chart (Hawkins & Maboudou-Tchao, 2008) have been developed to monitor process mean and dispersion respectively (Hawkins & Maboudou-Tchao, 2007, 2008; Maboudou-Tchao & Hawkins, 2011).

Collectively, these two self-starting charts are referred to as the Self Starting Multivariate Exponentially Weighted Moving Average and Covariance Matrix (SSMEWMAC) control charts (Maboudou-Tchao & Hawkins, 2011). This is the final relevant piece of the literature that this paper is looking to expand upon. For the remainder of this section, the focus will be on the development of these two charts. However, it is important to acknowledge self-starting mechanisms have been applied to other types of charts as well, such as the multivariate CUSUM charts, CUSCORE charts, and other niche schemes that will be omitted here.

While Quesenberry (1993), Schaffer (1997), and Sullivan and Jones (2002) have all proposed self-starting multivariate control charts, it is really the hallmark paper of Hawkins and Maboudou-Tchao (2007) that presents a framework in which any known parameter multivariate scheme can benefit from. It is this framework that is to be leveraged in this new work, but, before that is discussed, it is first necessary to present its application in the development of the SSMEWMA and SSMEWMC charts.

To begin the discussion of the self-starting mechanism of the SSMEWMA and SSMEWMC, one must be observing a p-dimension process reading vector that is normally distributed about a constant mean and some variance-covariance matrix, $\boldsymbol{X}$ N $\sim (\boldsymbol{\mu},\boldsymbol{\Sigma})$. As noted, these generally are unknown and must be estimated.

The first step after the collection of data is to transform the multivariate $\boldsymbol{X}$ vectors into a sequence of independent p-sized vectors, $\boldsymbol{R}$, with a mean vector of 0 and a diagonal variance-covariance matrix with unknown diagonal elements. The second step is to transform the R into a second sequence of independent p-sized vectors, $\boldsymbol{U_i}$, that then follow a multivariate standard normal N($\mathbf{0}$,$\boldsymbol{\Sigma}$) distribution. Whichever multivariate control scheme is chosen can then use changes in the manageable $\boldsymbol{U_i}$'s to track changes in the original stream of $\boldsymbol{X_i}$'s (Hawkins & Maboudou-Tchao, 2007). Conceptually simple to understand, the steps are implemented in practice as follows:

First, define :

Equation 41

$$\boldsymbol{Z} = \boldsymbol{A}(\boldsymbol{X} - \boldsymbol{\mu}), \tag{41}$$

which standardizes **X** to a N($\mathbf{0}$,**I**). **A** must be such that it satisfies $\boldsymbol{A\Sigma A^T} = \boldsymbol{I}$. Any matrix **A** that does this would suffice, but one front runner to accomplish this is the triangular Cholesky inverse root of $\boldsymbol{\Sigma}$. In this fashion, each $\boldsymbol{z_i}$ of **Z** is the regression residual of the $\boldsymbol{x_i}$ of **X** regressed upon all its preceding values, standardized to unit variance (Hawkins & Maboudou-Tchao, 2007).

The idea of recursive residuals is to repeatedly regress the $\boldsymbol{x_i}$'s against their $\boldsymbol{x_1,\ldots,x_{i-1}}$ preceding values, using the incoming stream of data points and finding the one step ahead prediction residuals standardized for constant variance. The sequence is known to be mutually independent with constant variance. Putting the recursive residuals into a matrix yields the first step in the transformation, specifically yielding n-p size **R** vectors with 0 as its mean vector and a diagonal variance-covariance matrix with constant elements. Note that the first p **R** vectors will not be fully defined (Hawkins & Maboudou-Tchao, 2007).

The final step is the to transform the **R** vectors into multivariate standard normal **U** vectors. This is accomplished by applying the probability transformation integral to each column in **R**. Noting that:

Equation 42

$$\sum_{(k=i+1)}^{(n-1)} r_{(k,i)}^2, \tag{42}$$

follow a $\sigma_i^2\chi^2$ distribution with n – i – 1 degrees of freedom and is independent of $r_{n,i}$ (Hawkins & Maboudou-Tchao, 2007) . Thus,

Equation 43

$$t_{(n,i)} = \frac{r_{(n,i)}}{\sqrt{\frac{\sum_{(k=i+1)}^{(n-1)} r_{(k,i)}^2}{(n-i-1)}}} \tag{43}$$

will follow a t distribution with n-i-1 degrees of freedom. Further, it follows:

Equation 44

$$u_{(n,i)} = \Phi^{-1}\left[F_{(n-i-1)}\left(t_{(n,i)}\right)\right], \tag{44}$$

where Φ^{-1} represents the inverse normal and $F_{(n-i-1)}$ is the cumulative distribution function of t with n-i-1 degrees of freedom. This will define a sequence of $u_{n,i}$ that are N(0,1) as desired (Hawkins & Maboudou-Tchao, 2007). This is the foundation portion of the SSMEWMAC collection of charts. What remains is simply to discuss the statistics and control statistics of each of the two charts respectively.

Beginning with the SSMEWMA, define:

Equation 45

$$\boldsymbol{M_n} = \lambda \boldsymbol{U_n} + (1-\lambda)\boldsymbol{M_{(n-1)}}, \tag{45}$$

where $0 < \lambda < 1$ is the smoothing constant and $\boldsymbol{M_0} = \mathbf{0}$.

Under this scheme, the first non-trivial $\boldsymbol{U_n}$ vector would occur at $n = p+2$. To elaborate, the nth observation yields the $(n-p-1)^{th}$ non-trivial $\boldsymbol{M_n}$, whose covariance is defined to be:

Equation 46

$$\boldsymbol{\Sigma_{M_n}} = \frac{\lambda}{(2-\lambda)}\left[1-(1-\lambda)^{(2(n-p-1))}\right]\boldsymbol{I_p} \tag{46}$$

The result is a Chi-square quantity:

Equation 47

$$T_n^2 = \boldsymbol{M_n}^T\boldsymbol{\Sigma_{M_n}^{-1}}\boldsymbol{M_n} = \frac{(2-\lambda)}{(\lambda\left[1-(1-\lambda)^{2(n-p-1)}\right])}||\boldsymbol{M_n}||^2 \tag{47}$$

The MEWMA chart is most often displayed as a result of $||\boldsymbol{M_n}||^2$ and gives an out of control signal when this quantity exceeds:

Equation 48

$$\frac{\lambda\left[1-(1-\lambda)^{2(n-p-1)}\right]}{(2-\lambda)}h, \tag{48}$$

where h is chosen to achieve a desired in-control ARL.

At the time, the work was done to benchmark the self starting MEWMA and as it turned out, their method out-performed that of both Schaffer and Quesenberry (Sullivan & Jones, 2002). What was discovered was a chart that ultimately converges to the known value MEWMA chart and it performs similarly. However, the key advantage represented in the self starting starting mechanism is that it only requires enough units such that the matrix of transformed vectors becomes full rank (Hawkins & Maboudou-Tchao, 2007).

This mechanism can be easily updated for monitoring the covariance matrix as well (Hawkins & Maboudou-Tchao, 2008). Specifically, if we use the $\boldsymbol{U_i}$'s as defined above, and define $\boldsymbol{S_0} = \boldsymbol{I_p}$, then it follows:

Equation 49

$$\boldsymbol{S_n} = (l-\lambda)\boldsymbol{S_{n-l}} + \lambda\boldsymbol{U_n}\boldsymbol{U_n}^T. \tag{49}$$

When the process is under control, then the expectation of $\boldsymbol{S_n} = \boldsymbol{I_p}$.

The control statistic is then defined to be:

Equation 50

$$c_n = tr(\boldsymbol{S_n}) - log|\boldsymbol{S_n}| - p, \tag{50}$$

and signals out-of-control when $c_n > h$, where h is chosen to achieve a specific in-control ARL.

Together, the charts with the self starting mechanism described above compose the Self-Starting Multivariate Exponentially Weighted Moving Average and Covariance Matrix (SSMEWMAC) control charts. Appropriate values to compare the control statistics for the process location and the process dispersion can be found in Hawkins and Maboudou-Tchao (2007, 2008), respectively. It is this foundation piece, in combination with the work of Alkahtani (2012) that provide the motivation for the new research about to unfold.

The Gap in Literature

This research aims to fill the gap in the current literature of statistical process control by providing an enhanced set of methods for monitoring multivariate means and dispersion. As was previously stated, many of the existing tools especially struggled with detecting deviations in multivariate covariance matrices (Hawkins & Maboudou-Tchao, 2008). This is the specific gap this research is aiming to fill– provide an enhanced detection tool for changes in the covariance matrix in a multivariate process, regardless if the change is positive or negative.

In the process, this research also aims to provide an alternative the distributional assumptions to the original dMEWMA chart while simultaneously decreasing its response time to a process change. By employing the multivariate standardization technique of Hawkins and Maboudou-Tchao (2007, 2008), the infinite number of possible distributions that could be monitored are reduced to one that is very easy to work with, namely, the multivariate standard normal. Further, computational efficiency is achieved by the creative application of the triangular Cholesky inverse root transformation combined with Chambers' numerical method for efficient calculation of recursive residuals. As a result, a compact Python package to perform all the necessary computations can be provided to industries at large.

Lastly, in industry, any incremental gain in the quickness in which a control responds to procedural changes results in mitigated losses. It is in this light that this research was undertaken; this research will serve as an instrument to ideally quicken the detection of out-of-control processes with an easy to implement code-base. Upon completion of the work, the code base will be open-sourced and hosted on GitLab for the use of anyone who may be interested.

CHAPTER III

METHODS

Overview

The goal in advancing SPC control charts is to minimize the out-of-control ARL_1 for any desired in-control ARL_0. This is to say, it is the goal of this research to continue to diminish the out-of-control ARL_1, thus producing a fast signaling set of control charts for monitoring process mean and location. It is also the goal of this work to eliminate the need for Phase I sampling and produce charts that are self-starting.

In this section, the first element to be introduced is the theoretical derivation of the control statistics. This paper looks to extend the works regarding the ssMEWMAC (Hawkins & Maboudou-Tchao, 2007, 2008; Maboudou-Tchao & Hawkins, 2011) by applying their multivariate standardization technique to build the self-starting foundation of both charts. The statistic for the ssdMEWMA will be as presented by Alkahtani and Schaffer (2012). The newly developed ssdMEWMC statistic will be presented at the end of the theoretical development section.

After the theoretical framework has been established, a discussion surrounding the simulations to be performed will occur. Generally speaking, hundreds of thousands of replications will be performed in the Python programming language and the following scenarios will be explored; (1) a shift in the mean vector of a multivariate process at a known time t; (2) a shift in the variance-covariance matrix at a known time t. In each of these settings, several magnitudes of shift, different dimensionality, and different smoothing coefficients will be investigated. For thoroughness, different values for the in-control ARL_0 constraint will be investigated. This directly addresses research questions 1-4.

Additionally, it will be investigated how different periods of the process in control affects the charts ability to respond. In all circumstances, the original MEWMA, the original dMEWMA, the ssMEWMAC, and the proposed ssdMEWMAC will all be compared to determine if in advancement (reduction in out-of control ARL_1) has occurred. This directly addresses research question 5.

Theoretical Development

As presented in the previous chapter, the Self-Starting Double Multivariate Exponentially Weighted Moving Average and Covariance Matrix (ssdMEWMAC) charts will be derived in the fashion of Hawkins and Maboudou-Tchao (2007, 2008) and Maboudou-Tchao and Hawkins (2011). While the structure of the dMEWMA statistic will remain as defined in Alkahtani and Schaffer (2012), it will benefit from ingesting independent and identically distributed standard multivariate N($\mathbf{0}$, $\boldsymbol{I_p}$) vectors. This certainly makes the expectations and derivations much more straightforward.

Begin with the supposition that $\boldsymbol{x_i} \sim$ N($\boldsymbol{\mu_0}$, $\boldsymbol{\Sigma_0}$).

To recap the work of Hawkins and Maboudou-Tchao (2007, 2008) and Maboudou-Tchao and Hawkins (2011), the first step will be to be to transform the $\boldsymbol{x_i}$'s into vectors with 0 mean and an unknown diagonal variance-covariance matrix, $\boldsymbol{R_i}$'s. The second step is to then take the $\boldsymbol{R_i}$'s, and convert them to mutually independent p-vectors, $\boldsymbol{U_i}$'s, that are multivariate standard normal vectors. This series of transformations will still monitor the changes in the process but have the desirable property of conforming to an understood distribution (Hawkins & Maboudou-Tchao, 2007, 2008; Maboudou-Tchao & Hawkins, 2011).

In the first step, the following property must be achieved: a multivariate standard normal vector $\boldsymbol{Z_i} = \boldsymbol{A}(\boldsymbol{X_i} - \boldsymbol{\mu})$ where the matrix $\mathbf{A}$ then satisfies $\mathbf{A\Sigma A} = \boldsymbol{I_p}$. This is can be achieved with many different $\mathbf{A}$ matrices, but out of convenience, the lower triangular Cholesky inverse root of $\boldsymbol{\Sigma}$ is chosen. This choice is desirable because each component of $\boldsymbol{Z_i}$ is the regression residual when the $\boldsymbol{x_j}$ is regressed on its predecessors $\boldsymbol{x_1}, \boldsymbol{x_2}, \ldots, \boldsymbol{x_{j-1}}$, standardized to unit variance (Hawkins & Maboudou-Tchao, 2007).

This framework is particularly attractive in the sense that it easily allows for the computation of recursive residuals. In principle, recursive residuals are simple; they are the result of successive fits of a regression model as more data becomes available. In the case of this research, as with its inspiring articles, the recursive residuals from fitting x_j regressed on its predecessors $x_1, x_2, ..., x_{j-1}$ are utilized. Recursive residuals are desirable to work with because they are mutually independent, independent of the observation values, and follow a normal distribution with 0 mean and diagonal variance-covariance matrix (Brown et al., 1975; Hawkins & Maboudou-Tchao, 2007).

This makes the choice of the lower triangular Cholesky inverse root matrix self-evident. It lends itself well to existing computational algorithms to make continual updates for efficiency. Specifically, through a set Givens rotation, the recursive residuals of fitting each $\boldsymbol{x_i}$ on its predecessors iteratively can be obtained. The quantity $\boldsymbol{z_j^{j-1}}$ in equation 3.3 (and produced by his GIVADD Fortran code) is then the recursive residual for the added vector's column j (Chambers, 1971). The matrix of recursive residuals is a natural by-product of the factorization.

So, using the triangular Cholesky inverse root matrix in combination with the algorithm proposed by Chambers, the first step of the transformation is complete. The result is a process centered at 0 with a diagonal variance-covariance matrix with unknown diagonal elements.

The next step, as proposed by Hawkins and Maboudou-Tchao (2007), is to then studentize the residuals so that they follow a t-distribution with i-j-1 degrees of freedom. Mathematically speaking, define:

Equation 51

$$t_{i,j} = \frac{r_{i,j}}{\sum_{k=j+1}^{i-1} r_{k,j}^2)/(i-j-1)}, (i \geq j+2), \tag{51}$$

such that $t_{i,j}$ will be independent of $t_{i,k}, j \neq k$ and $t_{i,j}$ will be independent of $t_{m,j}, i \neq m$.

The final transition to make then is to define the series of $t_{i,j}$ into a sequence of standard normals through a probability integral transformation as has been seen before in the literature. Specifically, define:

Equation 52

$$u_{i,j} = \Phi^{-1}(F_{(i-j-1)}(t_{i,j})), i \geq j+2 \tag{52}$$

where $F_{i-j-1}(.)$ is the cumulative distribution function of the Student t distribution with i-j-1 degrees of freedom, and, Φ^{-1} is the inverse normal function. By defining **U** as the matrix of all the $u_{i,j}$'s, then $\boldsymbol{U_n}$ is the n^{th} row of the matrix. Then is follows, $\boldsymbol{U_n}$ is distributed according to a multivariate standard normal distribution. That is to say, $\boldsymbol{U_n} \sim$ N($\mathbf{0}$, $\boldsymbol{I_p}$).

Thus, the transformations are complete and the self-starting mechanism has been established in line with the existing research. It is necessary to note that the matrix **U** is not fully defined for the first few observations. In fact, monitoring is not able to begin to be produced until the p+2 observation vector. However, as the number of observations increase, the transformed values approach and converge to their true values.

With the $\boldsymbol{U_n}$ in hand, the dMEWMA statistic and dMEWMC statistic are ready to be defined. The following is an extension of the work of Hawkins and Maboudou-Tchao, (2007) and Alkahtani and Schaffer (2012) . Begin by defining:

Equation 53

$$\boldsymbol{M_n} = \lambda \boldsymbol{U_n} + (1-\lambda)\boldsymbol{M_{n-1}}, \tag{53}$$

where $0 < \lambda \leq 1$ is the smoothing constant and $\boldsymbol{M_0} = \mathbf{0}$.

Again, this is the self-starting MEWMA statistic as proposed by Hawkins and Maboudou-Tchao, (2007).

Equation 54

$$\boldsymbol{M_n} \sim N(\mathbf{0}, \boldsymbol{\Sigma_{M_n}}), \tag{54}$$

where

Equation 55

$$\boldsymbol{\Sigma_{M_n}} = \frac{\lambda}{(2-\lambda)} \left[1-(1-\lambda)^{2(n-p-1)}\right] ||\boldsymbol{M_n}||^2 \boldsymbol{I_p}. \tag{55}$$

Continuing in the spirit of Alkahtani and Schaffer (2012), define:

Equation 56

$$\boldsymbol{D_n} = \lambda \boldsymbol{M_n} + (1-\lambda)\boldsymbol{D_{n-1}}. \tag{56}$$

This is the ssdMEWMA statistic ultimately defined in terms of the transformed vectors, $\boldsymbol{U_n}$'s.

The ssdMEWMA control statistic would then be defined by:

Equation 57

$$T_n^2 = \boldsymbol{D_n^T \Sigma_{D_n}^{-1} D_n}, \tag{57}$$

where

Equation 58

$$\boldsymbol{\Sigma_{D_n}} = \frac{\lambda^4\left[1+(1-\lambda)^2-(n+1)^2(1-\lambda)^{2n}+(2n^2+2n-1)(1-\lambda)^{(2n+2)}-n^2(1-\lambda)^{2n+4}\right]}{\left[1-(1-\lambda)^2\right]^3}\boldsymbol{I_p}. \tag{58}$$

Asymptotically, as $\lim n \to \infty$:

Equation 59

$$\boldsymbol{\Sigma_{D_n}} = \frac{(\lambda(2-2\lambda+\lambda^2)}{(2-\lambda)^3}\boldsymbol{I_p}. \tag{59}$$

The control chart then signals out-of-control when $T_n^2 > h_1$ where h_1 is chosen to achieve a desired in-control ARL (ARL_0) with a given λ.

Discussions around the use of the asymptotic variance are varied and generally suggest that is can be used in situations where the process will be in-control for a long length of time (Alkahtani & Schaffer, 2012) or when robustness is of a concern (Hawkins & Maboudou-Tchao, 2007). The general belief is that use of the exact variance results in quicker detection of out-of-control processes.

Having formally provided the definition of the ssdMEWMA statistics and control statistic, all that remains theoretically is to define the ssdMEWMC statistics and control statistic. It is important to note that the derivation of the ssdMEWMA statistic is fundamentally different than that proposed by Alkahtani and Schaffer (2012). It truly benefits from the multivariate standardization and recursive residual method outlined by Hawkins and Maboudou-Tchao (2007). This completes the derivation of the ssdMEWMA.

The ssdMEWMC is then an extension of the MEWMC and ssMEWMC charts proposed by Hawkins and Maboudou-Tchao (2008) and again in Maboudou-Tchao and Hawkins (2011). Specifically, the ssMEWMC chart is defined by the following:

Equation 60

$$\boldsymbol{S_n} = \lambda \boldsymbol{U_n} \boldsymbol{U_n}^T + (1-\lambda)\boldsymbol{S_{n-1}}, \tag{60}$$

where $\boldsymbol{S_0} = \boldsymbol{I_p}$ and $0 < \lambda \leq 1$ is the smoothing constant as before.

In the case for the ssdMEWMC control chart, the following extension has been designed:

Equation 61

$$\boldsymbol{V_n} = \lambda \boldsymbol{S_n} + (1-\lambda)\boldsymbol{V_{n-1}}, \tag{61}$$

where $\boldsymbol{M_0} = \boldsymbol{I_p}$ and $0 < \lambda \leq 1$ is the smoothing constant as before. This is the natural extension to MEWMC chart with a self-starting mechanism as previously defined.

Then it follows,

Equation 62

$$C_n = tr(\boldsymbol{V_n}) - log|\boldsymbol{V_n}| - p \tag{62}$$

will be the control statistic, where $tr()$ is the trace operator for matrices and $|\cdot|$ is the determinant of the matrix. The chart would then signal when $C_n > h_2$ where h_2 is chosen to achieve a specified in-control ARL (ARL_0).

In combination, these charts begin at the p + 2 observation vector and compose the ssdMEWMAC control charting scheme. The two charts are plotted simultaneously but on different graphs with separate bounds. The process is considered out of control when either signals out-of-control.

Design of the Control Chart

The Control Scheme

As has been previously mentioned, this analysis will focus on the use of Monte Carlo Simulations to generate p-variate normal observation vectors where the parameter values are controlled for. This analysis will have two different simulation phases; (1) to assess the values to be used for h_1 and h_2 to obtain desired in-control ARLs; and (2) to then determine the out-of-control average run lengths (ARL_1's) for each given in-control ARL_0.

These values will be calculated for each combination of the following situations:

1. The dimensionality of the data will assume values of p = 2-10, 15, 20, 25, and 50.

2. The smoothing parameter λ = 0.05, 0.10, 0.20, 0.30, 0.40, 0.50, 0.60, and 0.80.

3. Shifts in the process vector in magnitudes of δ = 0, 0.25, 0.50, 1.00, 1.50, 2.00, 2.50, and 3.00.

4. Shifts in the first element of the covariance matrix of magnitudes Δ = 0, 0.25, 0.50, 1.00, 1.50, 2.00, 2.50, and 3.00.

5. Different in-control periods before invoking the change at t = 20, 50, 100, and 500 (only in stances when the $ARL_0 \geq 500$).

These scenarios, in terms of their out of control average run length, will address research questions 2-4.

Remaining consistent with the new derivations presented, the magnitudes presented above are in reference to changes that will be reflected in terms the multi-standardized U_n vectors and I_p covariance matrix, not the arbitrary multivariate normal distribution from which they possibly could be obtained from.

First, h_1 and h_2 will be arrived at by simulating the multivariate data with arbitrary values from a multivariate standard normal distribution, calculating the ssdMEWMA and ssdMEWMC statistics at each time t with different values for h_1 and h_2. The values for h_1 and h_2 will iteratively be adjusted up and down until the chart reliably begins to maintain averages close to desired in-control ARL's.

Once these control limits are established, the second step will to simulate data with the shifts occurring at the times above. The number of subsequent samples after the change that are required before the chart signals out-of-control will then be recorded for each of the methods to be compared; the MEWMA, the dMEWMA, the ssMEWMAC, and the ssdMEWMAC.

All the simulations will be written in the Python programming language, version 3.7.5. All relevant packages and versions will be cited in the reference section of this study. All code will be submitted in an appendix for reproducibility.

Performance Comparisons

The ability of control charts are assessed by their out-of-control ARL's. For each combination outlined in the preceding subsection, the out-of-control ARL for the MEWMA, the dMEWMA, the ssMEWMAC, and the ssdMEWMAC schemes will be recorded. Whichever scheme that records the smallest ARL_1 will be regarded as the most successful. Results of these ARL comparisons directly applies to the final research question, how does the new metric perform against the existing methods in the literature.

Simulation Procedures

As previously mentioned, the simulations will have to occur in two phases. The first segment will be dedicated to determining the in-control control limits to achieve the different desired in-control ARL's for each dimensionality and smoothing constant outlined above. Beginning with Phase I:

1. Using the Python, multivariate normal data will be produced with a known but arbitrary mean vector and positive definite covariance matrix.

2. Initial values of h_1 and h_2 will be set close to the values in Alkahtani and Schaffer (2012) for h_1 and from Hawkins and Maboudou-Tchao (2008) for h_2. New records will continue to be produced, calculating the ssdMEWMAC statistics until each chart

signals out-of-control, due to nothing but pure random association. The will be repeated until 10,000 out-of-control signals are produced and the in-control ARL (ARL_0) will be calculated for that simulation.

3. If the initial values of h_1 and h_2 happened to result in the desired ARL_0, the process continue to the next combination of variables to be considered. In the event this is not the case, the values of h_1 and h_2 will be incremented in the appropriate direction iteratively until the desired (ARL_0) is achieved within a $\pm 0.1\%$. tolerance limit for a given combination before proceeding to the next combination of interest.

4. The process terminates when all combinations of dimension, smoothing coefficient, and ARL_0 have been exhausted and all appropriate control limits are accounted for.

This directly addresses the first research question: "How will the proposed ssdMEWMAC scheme be designed for the in-control average run length (ARL_0)?"

For consistency, this phase 1 simulation will be performed on all the existing methods the newly propose ssDMEWMAC is being compared to– the MEWMA, dMEWMA, and the ssMEWMAC processes. This is necessary because not all the combinations to be considered have published control limits and rather than piece together published and simulated control limits for the other methods to use in Phase 2, it was decided that all the comparison methods will have their control limits simulated for all pertinent combinations as well. These results will be cross referenced to published literature for consistency and used in phase to for calculation of out-of-control average run lengths. This will achieve the fairest of comparisons of performance after the simulations complete.

Once the appropriate values have been found for cut-offs, the second phase to find the out of control ARL's (ARL_1) can be pursued.

1. Similar to phase I, Python will be used to simulate multivariate normal data with known but arbitrary mean vector and positive-definite covariance matrix..

2. The simulation will continually produce new observations, calculating the MEWMA, the dMEWMA, the ssMEWMAC, and the ssdMEWMAC statistics at each new observation vector.

3. At the dedicated times t chosen previously, one of the shift combinations introduced beforehand will be performed.

4. At this point, new multivariate data that is "out-of-control" is being generated. The relevant control statistics will continue to be calculated until all processes finally signal out-of-control.

5. The number of subsequent out-of-control observation vectors required to produce an out-of-control signal in each situation will be recorded.

6. This will be repeated 10,000 times for each shift combination. The ARL_1 will then be calculated for each scheme.

7. The process terminates at the exhaustion of all possible method, dimension, smoothing coefficient, in-control ARL, magnitude of shift, and time of shift combination presented previously.

At the conclusion of the simulation process, the average out-of-control run lengths from each control charting method under each condition specified above will be reported in a series of tables. This will provide the fodder for analysis in the following chapter.

Each table will pertain to a method and desired in-control average run length, with smoothing parameter value along one axis and size of deviation and time of shift nested along the other. The elements of each table then will be the average out-of-control run lengths for the specified combination of hyper-parameters of the column and row headers. The mean and location monitoring tables will be reported separately.

Additionally, tables of all the simulated control limits for each method will also be provided.

CHAPTER IV
RESULTS

This chapter presents the design criteria and results of the two simulations presented in Chapter 3. First, a review of how the in-control hyperparameter grid search was deployed. Then, details on the out-of-control simulation implementation are provided, followed by results of the phase 2 simulation study. Finally, a discussion on how out-of-control run lengths compare between the newly proposed method the existing literature concludes the chapter.

In Control Parameter Grid Search

To address research question one, discovery of the appropriate control limits was required for all existing control schemes, as well as for the newly proposed ssDMEWMAC control charts. In order to do this, for each method, dimension, smoothing parameter, and target in-control run length specified in the previous chapter a novel h_1 value was proposed and Python used to simulate from appropriately sized multivariate normal distributions 10,000 times, calculating the relevant control scheme statistics until the process signaled out-of-control. At the end of the 10,000 replications, the average run length achieved was calculated. If the resulting average run length was above or below the target run-length, the process was repeated for a given combination but with a tuned h-value proposal until the resulting average run-length was within 0.10% of the target run length. This process is summarized succinctly in the following flow diagram.

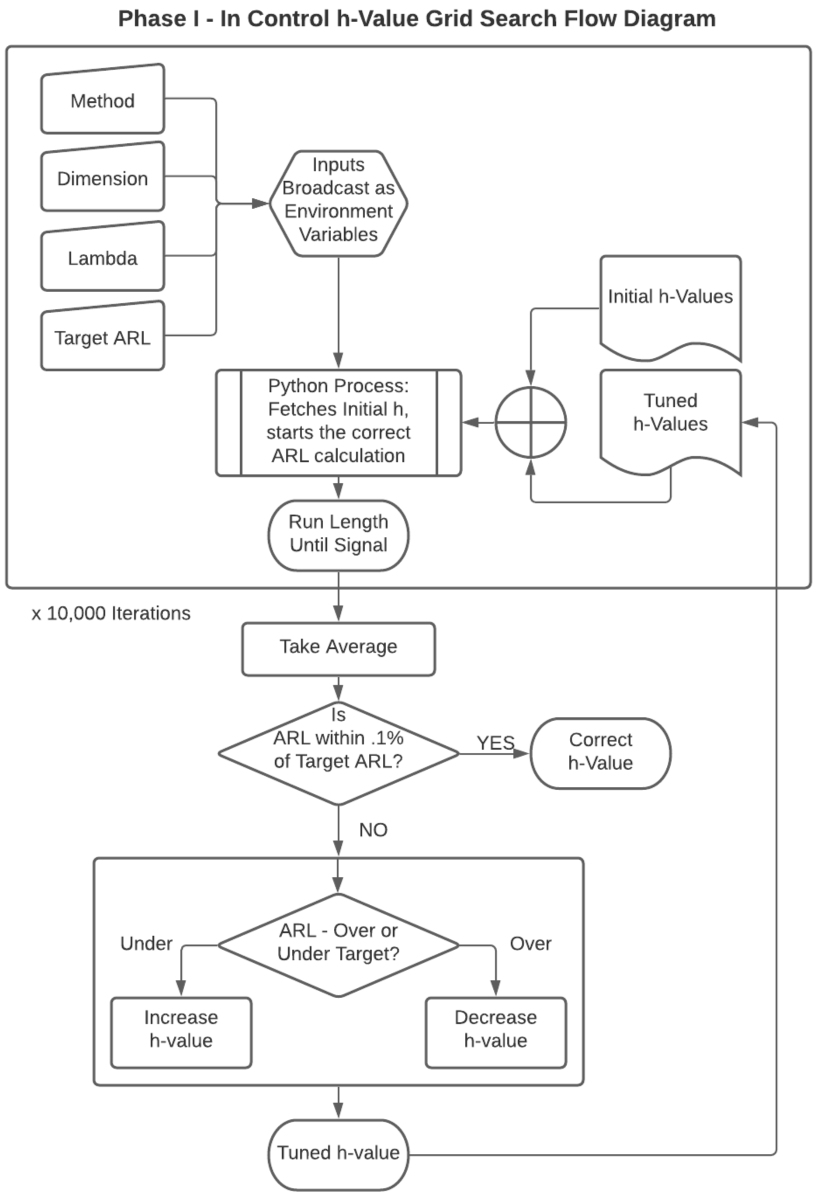

Figure 1

In Control Design Specification

Figure 1 shows the visual representation of a single combination of method, dimension, smoothing coefficient, and target ARL. Note,it was decided for every possible method, dimension, smoothing parameter, and target in-control run length combination to simulate control limits in phase 1. This allowed for consistency in all the h-values for each method across all relevant combinations; that is to say, all h-values were the result of grid search on a fixed simulation set as opposed to a mismatch of published h-values for some combinations and simulated h-values for others.

This resulted in a set of 4,290 h-values that were used in the second simulation study to determine out-of-control average run length performance. The specific values arrived in this phase of the simulation are discussed in detail at the end of this chapter and were cross-referenced in the existing literature when available. The Python code used to run phase 1 of this simulation is provided in Appendix A.

To be pedantic, the resulting set of h-values for the newly proposed ssDMEWMA and ssDMEWMC methods then fully addresses the first research question on how the in-control thresholds were designed.

Out of Control Simulation

To address research questions 2 through 5, a second simulation was performed. This simulation was very similar to the one described in the first phase, but with added functionality to control for when the underlying sampling distribution shifts and by how much. The process followed in phase 2 is summarized by the following flow chart with the Python code for this simulation provided in Appendix B.

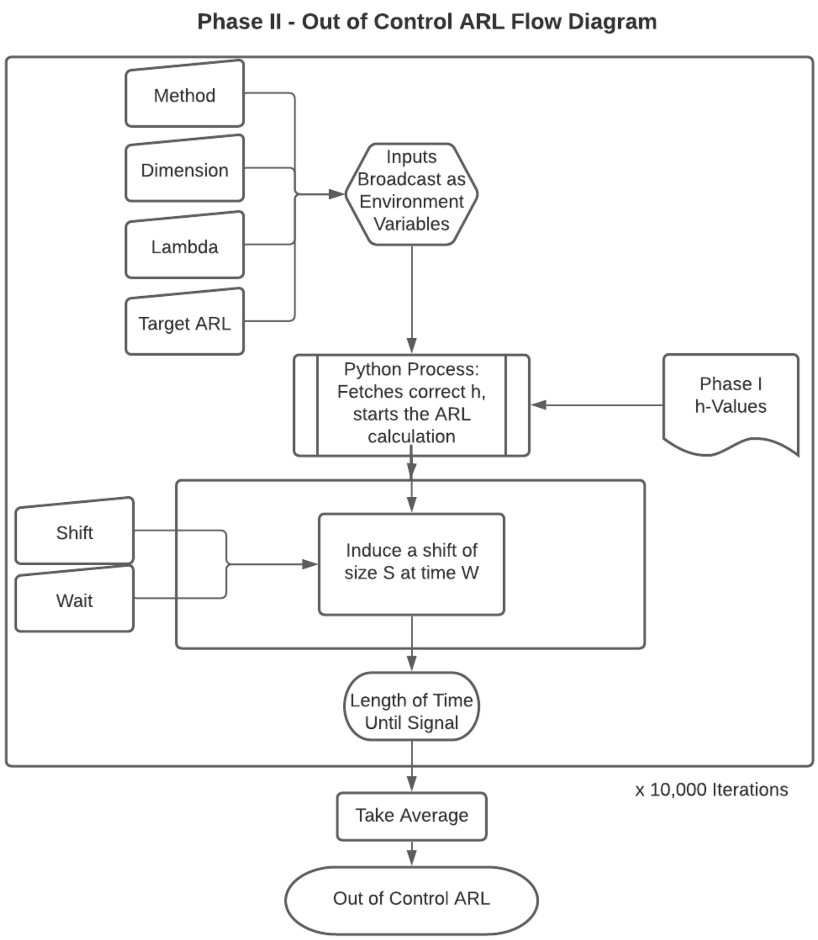

Figure 2

Out of Control ARL Performance Flow Chart

To elaborate, for each possible method, dimension, smoothing parameter, and target in-control run length combination initially proposed, the corresponding h-value from phase 1 was passed to the simulation alongside a predetermined moment to enact the distributional change and by how much. Ten thousand replications for each of these combinations were then performed, recording the number of samples it took for each method to signal out-of-control.

The resulting average run length for each combination to signal out of control was then calculated during this phase. These particular average out-of-control run lengths serve to address the research questions regarding method performance. Details of each method's performance are discussed at length at in the next section of this chapter and compared at this chapter's conclusion.

Simulation Details and Results

Phase 1 Grid Search Results

The tables below summarize for the new ssDMEWMAC control charts the dimension, smoothing coefficient the h-value derived that resulted in a desired in-control average run length. These h-values then serve as the threshold to use in the second simulation to assess method performance under different conditions. The h-values for the existing methods can be found in Appendix C.

Self Starting Double Multivariate Exponentially Weighted Moving Average Control Limits

The tables below are the results of the grid search for the h_1 control limits for the newly proposed ssDMEWMA control chart. Recall these control limits result in an average in control average run length that was within a configurable tolerance of the target listed in the table, in this case this tolerance limit was set at $\pm 1\%$.

Table 1

In Control Limits for SSDMEWMA of Dimension 2

λ	ARL				
	100	200	500	1000	2000
0.05	3.0486	4.4027	6.3774	7.9535	9.5206
0.10	4.3499	5.9154	7.9530	9.5233	11.1105
0.20	5.9844	7.5934	9.6431	11.1818	12.7163
0.30	7.0271	8.6210	10.6326	12.1497	13.6940
0.40	7.7589	9.3051	11.2745	12.8094	14.2920
0.50	8.3012	9.8033	11.7777	13.2476	14.7178
0.60	8.6778	10.1587	12.1245	13.5570	15.0033
0.70	8.9221	10.3879	12.3210	13.6956	15.1045
0.80	9.0804	10.5292	12.3828	13.7796	15.1676
0.90	9.1463	10.5707	12.4324	13.7951	15.1804
0.95	9.1646	10.5709	12.4328	13.8205	15.1955

Table 2

In Control Limits for SSDMEWMA of Dimension 3

λ	ARL				
	100	200	500	1000	2000
0.05	4.3141	5.9820	8.3173	10.0736	11.7846
0.10	5.8971	7.6806	10.0361	11.8021	13.4920
0.20	7.7863	9.5687	11.8636	13.5812	15.2035
0.30	8.9281	10.7162	12.9348	14.6114	16.1998
0.40	9.7792	11.4695	13.6932	15.2969	16.8441
0.50	10.3423	12.0070	14.1684	15.7238	17.2723
0.60	10.7399	12.3766	14.4858	15.9951	17.5237
0.70	10.9944	12.6250	14.6308	16.1518	17.6626
0.80	11.1748	12.7445	14.7407	16.2528	17.7019
0.90	11.2273	12.7578	14.7827	16.2664	17.6813
0.95	11.2340	12.7645	14.7685	16.2600	17.7061

Table 3

In Control Limits for SSDMEWMA of Dimension 4

λ	ARL				
	100	200	500	1000	2000
0.05	5.4360	7.3938	10.0045	11.9194	13.7661
0.10	7.2753	9.3374	11.9355	13.7992	15.6004
0.20	9.3815	11.3973	13.8625	15.6581	17.3719
0.30	10.6385	12.5588	14.9791	16.7164	18.4119
0.40	11.5350	13.4257	15.7219	17.4174	19.0942
0.50	12.1669	13.9834	16.2544	17.8951	19.5051
0.60	12.5878	14.3757	16.5665	18.2038	19.7761
0.70	12.8964	14.6286	16.7733	18.3627	19.8996
0.80	13.0868	14.7641	16.8513	18.4598	19.9748
0.90	13.1669	14.8036	16.8785	18.4738	20.0029
0.95	13.1835	14.7863	16.8745	18.4710	20.0091

Table 4

In Control Limits for SSDMEWMA of Dimension 5

λ	ARL				
	100	200	500	1000	2000
0.05	6.5461	8.7831	11.6309	13.6670	15.6093
0.10	8.6828	10.9128	13.6704	15.6386	17.5148
0.20	10.9410	13.0981	15.7311	17.6456	19.4243
0.30	12.2833	14.3819	16.9190	18.7435	20.5049
0.40	13.2160	15.2215	17.7040	19.4554	21.1665
0.50	13.9106	15.8215	18.2562	19.9343	21.6479
0.60	14.3590	16.2405	18.5379	20.2381	21.8995
0.70	14.6449	16.4536	18.7235	20.3958	22.0097
0.80	14.8192	16.5735	18.8255	20.4658	22.0807
0.90	14.9016	16.6469	18.8558	20.4743	22.0831
0.95	14.9310	16.6582	18.8611	20.4654	22.1019

Table 5

In Control Limits for SSDMEWMA of Dimension 6

λ	ARL				
	100	200	500	1000	2000
0.05	7.6293	10.1117	13.2087	15.3604	17.3647
0.10	9.9883	12.4555	15.3662	17.4451	19.3792
0.20	12.4778	14.7502	17.5328	19.4926	21.3232
0.30	13.8735	16.0764	18.7127	20.6240	22.4542
0.40	14.8878	16.9856	19.5078	21.3538	23.1765
0.50	15.5898	17.6322	20.0995	21.8670	23.6176
0.60	16.0753	18.0403	20.4838	22.2125	23.8939
0.70	16.3716	18.2578	20.6586	22.3826	24.0474
0.80	16.4855	18.3877	20.7512	22.4558	24.1011
0.90	16.5267	18.4116	20.7427	22.4416	24.1123
0.95	16.5680	18.4277	20.7343	22.4313	24.1157

Table 6

In Control Limits for SSDMEWMA of Dimension 7

λ	ARL				
	100	200	500	1000	2000
0.05	8.6632	11.4300	14.7332	16.9660	19.1036
0.10	11.2628	13.9480	16.9944	19.1248	21.1697
0.20	13.9319	16.4210	19.2565	21.2868	23.1620
0.30	15.4850	17.7676	20.5229	22.4663	24.3220
0.40	16.4998	18.6847	21.3188	23.2387	25.0745
0.50	17.2045	19.2834	21.9219	23.7195	25.5137
0.60	17.6925	19.7261	22.2558	24.0448	25.8006
0.70	17.9968	19.9853	22.4415	24.2221	25.9705
0.80	18.1552	20.1344	22.5460	24.3193	25.9909
0.90	18.2606	20.1640	22.5552	24.2761	26.0143
0.95	18.2722	20.1897	22.5527	24.2837	25.9850

Table 7

In Control Limits for SSDMEWMA of Dimension 8

λ	ARL				
	100	200	500	1000	2000
0.05	9.681	12.626	16.153	18.511	20.745
0.10	12.460	15.316	18.544	20.761	22.901
0.20	15.313	17.899	20.916	22.996	24.964
0.30	16.917	19.370	22.224	24.233	26.157
0.40	17.967	20.289	23.102	25.015	26.912
0.50	18.707	20.940	23.656	25.558	27.362
0.60	19.226	21.338	23.997	25.844	27.645
0.70	19.552	21.587	24.162	25.997	27.777
0.80	19.735	21.756	24.270	26.111	27.837
0.90	19.783	21.811	24.324	26.099	27.845
0.95	19.780	21.803	24.323	26.089	27.864

Table 8

In Control Limits for SSDMEWMA of Dimension 9

λ	ARL				
	100	200	500	1000	2000
0.05	10.688	13.897	17.526	20.027	22.310
0.10	13.669	16.676	20.081	22.358	24.563
0.20	16.667	19.354	22.501	24.664	26.696
0.30	18.394	20.910	23.849	25.942	27.926
0.40	19.476	21.868	24.730	26.755	28.706
0.50	20.242	22.547	25.286	27.240	29.164
0.60	20.750	22.972	25.635	27.564	29.454
0.70	21.074	23.271	25.839	27.781	29.581
0.80	21.276	23.363	25.947	27.791	29.657
0.90	21.318	23.433	25.952	27.817	29.641
0.95	21.332	23.443	25.973	27.839	29.646

Table 9

In Control Limits for SSDMEWMA of Dimension 10

λ	ARL				
	100	200	500	1000	2000
0.05	11.620	15.177	18.984	21.526	23.970
0.10	14.809	18.088	21.589	23.949	26.235
0.20	17.993	20.824	24.100	26.302	28.438
0.30	19.702	22.411	25.465	27.589	29.630
0.40	20.874	23.355	26.321	28.423	30.428
0.50	21.639	24.030	26.888	28.912	30.929
0.60	22.189	24.477	27.287	29.289	31.188
0.70	22.536	24.796	27.492	29.486	31.383
0.80	22.767	24.932	27.584	29.580	31.437
0.90	22.863	25.008	27.638	29.557	31.447
0.95	22.876	25.001	27.657	29.587	31.433

Table 10

In Control Limits for SSDMEWMA of Dimension 15

λ	ARL				
	100	200	500	1000	2000
0.05	16.387	21.070	25.700	28.773	31.417
0.10	20.598	24.616	28.678	31.465	33.990
0.20	24.403	27.840	31.506	34.063	36.445
0.30	26.396	29.612	33.112	35.519	37.796
0.40	27.779	30.746	34.090	36.406	38.662
0.50	28.656	31.482	34.768	37.009	39.189
0.60	29.258	31.991	35.166	37.386	39.498
0.70	29.638	32.297	35.370	37.555	39.659
0.80	29.851	32.454	35.476	37.602	39.706
0.90	29.978	32.510	35.520	37.628	39.713
0.95	30.014	32.538	35.504	37.649	39.695

Table 11

In Control Limits for SSDMEWMA of Dimension 20

λ	ARL				
	100	200	500	1000	2000
0.05	20.788	26.656	32.187	35.572	38.613
0.10	25.964	30.755	35.497	38.549	41.398
0.20	30.392	34.473	38.682	41.436	43.978
0.30	32.728	36.412	40.390	42.993	45.426
0.40	34.244	37.733	41.429	43.964	46.397
0.50	35.243	38.590	42.149	44.606	47.016
0.60	35.906	39.062	42.548	44.981	47.308
0.70	36.316	39.389	42.818	45.156	47.462
0.80	36.540	39.582	42.942	45.251	47.488
0.90	36.654	39.682	42.942	45.292	47.506
0.95	36.677	39.624	42.978	45.305	47.485

Table 12

In Control Limits for SSDMEWMA of Dimension 25

λ	ARL				
	100	200	500	1000	2000
0.05	25.078	32.229	38.489	42.126	45.370
0.10	31.230	36.954	42.119	45.399	48.408
0.20	36.230	40.884	45.462	48.474	51.230
0.30	38.763	42.966	47.327	50.195	52.834
0.40	40.388	44.289	48.451	51.192	53.815
0.50	41.455	45.227	49.205	51.875	54.391
0.60	42.222	45.814	49.659	52.260	54.718
0.70	42.736	46.144	49.888	52.470	54.857
0.80	42.968	46.320	49.994	52.517	54.855
0.90	43.035	46.380	50.014	52.528	54.905
0.95	43.107	46.410	50.033	52.534	54.936

Table 13

In Control Limits for SSDMEWMA of Dimension 50

λ	ARL				
	100	200	500	1000	2000
0.05	41.209	58.546	68.312	73.317	77.604
0.10	53.637	65.296	73.152	77.592	81.413
0.20	61.951	70.708	77.477	81.466	85.022
0.30	65.913	73.546	79.786	83.492	86.935
0.40	68.401	75.432	81.273	84.844	88.116
0.50	70.109	76.571	82.123	85.663	88.833
0.60	71.1559	77.3144	82.7034	86.1357	89.2509
0.70	71.7830	77.7034	83.0111	86.3966	89.4003
0.80	72.1602	77.9987	83.1431	86.4699	89.4618
0.90	72.2970	78.0596	83.2017	86.4680	89.5165
0.95	72.3498	78.0725	83.2398	86.4378	89.5507

Self Starting Double Multivariate Exponentially Weighted Moving Covariance Control Limits

The tables below are the results of the grid search for the h_2 control limits for the newly proposed ssDMEWMC control chart. Recall these control limits result in an average in control average run length that was within a configurable tolerance of the target listed in the table, in this case this tolerance limit was set at $\pm 1\%$. Also notice that for dimension 50, the table is only complete up until λ = 0.50 level. It must be noted that beyond this limit, the simulation ran into a numerical precision problem within python in which all subsequent combinations were incorrectly calculated and thus eliminated from the analysis. A similar problem was encountered with the ssMEWMC control scheme at this dimension (see Appendix C).

Table 14

In Control Limits for SSDMEWMC of Dimension 2

λ	ARL				
	100	200	500	1000	2000
0.05	0.0484	0.0730	0.1051	0.1276	0.1499
0.10	0.1501	0.2008	0.2640	0.3091	0.3521
0.20	0.4300	0.5314	0.6563	0.7471	0.8362
0.30	0.7906	0.9432	1.1365	1.2791	1.4187
0.40	1.2372	1.4514	1.7194	1.9225	2.1253
0.50	1.7955	2.0815	2.4387	2.7234	3.0109
0.60	2.5322	2.9121	3.4143	3.8209	4.2345
0.70	3.5125	4.0365	4.7570	5.3332	5.9124
0.80	4.8395	5.5617	6.5554	7.3421	8.1069
0.90	6.8160	7.7266	9.0527	10.0599	11.0645
0.95	8.3687	9.3963	10.8855	12.0031	13.1620

Table 15

In Control Limits for SSDMEWMC of Dimension 3

λ	ARL				
	100	200	500	1000	2000
0.05	0.0916	0.1267	0.1682	0.1960	0.2228
0.10	0.2626	0.3272	0.4072	0.4610	0.5110
0.20	0.7052	0.8294	0.9842	1.0908	1.1931
0.30	1.2671	1.4563	1.6876	1.8566	2.0208
0.40	1.9588	2.2199	2.5497	2.7852	3.0216
0.50	2.8310	3.1835	3.6312	3.9528	4.2824
0.60	3.9918	4.4674	5.0726	5.5377	5.9827
0.70	5.5857	6.2275	7.0783	7.7007	8.3289
0.80	7.8244	8.6780	9.8007	10.6481	11.4950
0.90	11.2888	12.4077	13.8409	14.9505	16.0307
0.95	14.2713	15.5427	17.1521	18.3946	19.6098

Table 16

In Control Limits for SSDMEWMC of Dimension 4

λ	ARL				
	100	200	500	1000	2000
0.05	0.1473	0.1945	0.2451	0.2774	0.3071
0.10	0.4000	0.4831	0.5762	0.6374	0.6943
0.20	1.0418	1.1935	1.3706	1.4915	1.6086
0.30	1.8533	2.0760	2.3468	2.5347	2.7193
0.40	2.8622	3.1745	3.5478	3.8111	4.0718
0.50	4.1449	4.5616	5.0682	5.4291	5.7852
0.60	5.8617	6.4129	7.1061	7.6016	8.1079
0.70	8.2194	8.9619	9.8931	10.5890	11.2736
0.80	11.5798	12.5715	13.7759	14.7126	15.6354
0.90	17.0303	18.2824	19.8426	21.0404	22.2527
0.95	22.0277	23.4457	25.1981	26.5456	27.8972

Table 17

In Control Limits for SSDMEWMC of Dimension 5

λ	ARL				
	100	200	500	1000	2000
0.05	0.2160	0.2742	0.3346	0.3729	0.4064
0.10	0.5668	0.6655	0.7736	0.8433	0.9086
0.20	1.4455	1.6212	1.8236	1.9612	2.0917
0.30	2.5545	2.8183	3.1206	3.3342	3.5368
0.40	3.9429	4.3100	4.7283	5.0262	5.3204
0.50	5.7383	6.2094	6.7812	7.1908	7.5890
0.60	8.1460	8.7681	9.5428	10.0965	10.6517
0.70	11.4660	12.2933	13.3389	14.0781	14.8163
0.80	16.2883	17.3601	18.7088	19.6849	20.6490
0.90	24.3496	25.6929	27.4087	28.6407	29.8827
0.95	32.0539	33.5688	35.4706	36.8597	38.2614

Table 18

In Control Limits for SSDMEWMC of Dimension 6

λ	ARL				
	100	200	500	1000	2000
0.05	0.2949	0.3654	0.4344	0.4790	0.5168
0.10	0.7591	0.8737	0.9965	1.0764	1.1488
0.20	1.9134	2.1150	2.3419	2.4990	2.6423
0.30	3.3733	3.6725	4.0171	4.2566	4.4830
0.40	5.2293	5.6408	6.1195	6.4476	6.7635
0.50	7.6452	8.1836	8.8343	9.2765	9.7007
0.60	10.9082	11.6078	12.4585	13.0591	13.6398
0.70	15.4312	16.3366	17.4543	18.2555	19.0330
0.80	22.0631	23.1942	24.6494	25.6923	26.7154
0.90	33.3752	34.8274	36.6566	37.9734	39.2976
0.95	44.4520	46.0728	48.1195	49.6025	51.0650

Table 19

In Control Limits for SSDMEWMC of Dimension 7

λ	ARL				
	100	200	500	1000	2000
0.05	0.3879	0.4722	0.5515	0.5994	0.6411
0.10	0.9809	1.1144	1.2529	1.3403	1.4201
0.20	2.4461	2.6794	2.9344	3.1072	3.2658
0.30	4.3199	4.6574	5.0401	5.3050	5.5532
0.40	6.7256	7.1870	7.7137	8.0847	8.4332
0.50	9.8863	10.5048	11.2087	11.6959	12.1604
0.60	14.1877	14.9812	15.8841	16.5513	17.1747
0.70	20.1754	21.1754	22.3531	23.2201	24.0391
0.80	28.9983	30.2366	31.7644	32.8545	33.9278
0.90	44.2967	45.8620	47.7565	49.1108	50.4820
0.95	59.4257	61.2005	63.3127	64.8200	66.3574

Table 20

In Control Limits for SSDMEWMC of Dimension 8

λ	ARL				
	100	200	500	1000	2000
0.05	0.494	0.593	0.680	0.734	0.780
0.10	1.229	1.383	1.537	1.632	1.721
0.20	3.048	3.317	3.604	3.789	3.959
0.30	5.402	5.787	6.218	6.505	6.767
0.40	8.456	8.976	9.564	9.961	10.330
0.50	12.513	13.202	13.956	14.496	14.996
0.60	18.037	18.909	19.903	20.596	21.250
0.70	25.745	26.822	28.113	29.009	29.858
0.80	37.153	38.505	40.136	41.265	42.363
0.90	57.093	58.760	60.794	62.223	63.600
0.95	77.013	78.876	81.132	82.735	84.275

Table 21

In Control Limits for SSDMEWMC of Dimension 9

λ	ARL				
	100	200	500	1000	2000
0.05	0.611	0.723	0.823	0.881	0.932
0.10	1.512	1.684	1.850	1.958	2.050
0.20	3.735	4.034	4.346	4.548	4.734
0.30	6.635	7.065	7.535	7.840	8.121
0.40	10.443	11.024	11.666	12.096	12.491
0.50	15.540	16.288	17.139	17.703	18.239
0.60	22.490	23.449	24.526	25.259	25.949
0.70	32.187	33.403	34.751	35.689	36.569
0.80	46.602	48.090	49.793	50.965	52.089
0.90	71.903	73.731	75.819	77.290	78.723
0.95	97.300	99.304	101.628	103.286	104.867

Table 22

In Control Limits for SSDMEWMC of Dimension 10

λ	ARL				
	100	200	500	1000	2000
0.05	0.741	0.869	0.978	1.043	1.098
0.10	1.818	2.013	2.195	2.308	2.413
0.20	4.499	4.826	5.169	5.387	5.580
0.30	8.028	8.489	8.997	9.334	9.640
0.40	12.716	13.328	14.020	14.474	14.919
0.50	19.033	19.813	20.709	21.323	21.908
0.60	27.629	28.627	29.753	30.541	31.295
0.70	39.623	40.865	42.291	43.283	44.229
0.80	57.425	58.962	60.737	61.970	63.162
0.90	88.765	90.661	92.847	94.398	95.896
0.95	120.318	122.393	124.856	126.580	128.241

Table 23

In Control Limits for SSDMEWMC of Dimension 15

λ	ARL				
	100	200	500	1000	2000
0.05	1.585	1.810	1.975	2.065	2.141
0.10	3.832	4.146	4.412	4.573	4.711
0.20	9.593	10.089	10.577	10.876	11.152
0.30	17.559	18.283	18.992	19.445	19.862
0.40	28.594	29.527	30.469	31.077	31.645
0.50	43.578	44.700	45.903	46.683	47.401
0.60	63.738	65.115	66.562	67.525	68.408
0.70	91.544	93.180	94.919	96.074	97.175
0.80	132.517	134.453	136.574	137.994	139.344
0.90	204.479	206.845	209.414	211.157	212.845
0.95	270.298	272.792	275.554	277.509	279.282

Table 24

In Control Limits for SSDMEWMC of Dimension 20

λ	ARL				
	100	200	500	1000	2000
0.05	2.754	3.105	3.332	3.451	3.549
0.10	6.670	7.125	7.487	7.694	7.876
0.20	17.075	17.800	18.452	18.835	19.185
0.30	32.190	33.189	34.120	34.707	35.216
0.40	53.291	54.553	55.719	56.497	57.187
0.50	81.517	83.029	84.451	85.394	86.212
0.60	118.908	120.669	122.373	123.468	124.487
0.70	169.708	171.774	173.803	175.131	176.347
0.80	243.935	246.346	248.798	250.405	251.898
0.90	363.863	366.717	369.640	371.522	373.313
0.95	444.179	446.776	449.461	451.340	453.065

Table 25

In Control Limits for SSDMEWMC of Dimension 25

λ	ARL				
	100	200	500	1000	2000
0.05	4.233	4.772	5.073	5.220	5.337
0.10	10.391	11.042	11.512	11.769	11.985
0.20	27.388	28.411	29.219	29.701	30.119
0.30	52.802	54.188	55.309	55.996	56.599
0.40	87.897	89.548	90.964	91.813	92.586
0.50	133.938	135.890	137.568	138.576	139.514
0.60	194.090	196.337	198.290	199.495	200.614
0.70	275.085	277.659	279.965	281.426	282.761
0.80	391.799	394.657	397.415	399.146	400.736
0.90	537.376	540.089	542.814	544.687	546.343
0.95	620.204	622.735	625.444	627.294	629.009

Table 26

In Control Limits for SSDMEWMC of Dimension 50

λ	ARL				
	100	200	500	1000	2000
0.05	13.673	19.263	20.055	20.363	20.604
0.10	43.016	47.742	48.901	49.432	49.860
0.20	131.278	137.418	139.206	140.088	140.809
0.30	257.999	265.853	268.062	269.170	270.118
0.40	420.047	429.560	432.142	433.456	434.589
0.50	622.253	633.690	636.668	638.168	639.480

Phase 2: Out of Control Average Run Lengths

Simulation conditions covered are presented in Chapter III. The simulation conducted 10000 trials over each of the proposed combinations of method, size, smoothing coefficient, target in-control run-length, time in control, and magnitude of shift. The number of samples it took for each combination just described to signal out-of-control was then recorded and an average calculated. These average out-of-control run lengths serve as the primary measure of each method's performance with shorter run lengths being favorable. The results are presented in the series of tables below with a discussion pertaining to the ssDMEWMAC performance to follow

Self Starting Double Multivariate Exponentially Weighted Moving Average Out of Control Average Run Lengths

The following tables record the observed out of control average run length performance for all the scenarios tested to assess the proposed control scheme's response to changes in the mean vector. These values will later be compared to the performance of the ssMEWMA control chart.

Table 27

Out of Control ARL_0 for SSDMEWMA of Dimension 2 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	λ = 0.05, Δ = 0.25				
20	73.81	148.16	398.84	857.38	1821.54
50	63.21	118.64	315.95	706.17	1551.39
100	53.71	91.82	226.84	512.00	1216.67
500	42.51	62.66	105.36	167.97	327.50
	λ = 0.05, Δ = 0.50				
20	40.80	79.01	232.40	563.01	1331.72
50	29.07	43.81	97.92	232.79	617.71
100	24.96	32.42	50.50	83.71	199.87
500	22.49	27.46	34.39	40.29	46.89
	λ = 0.05, Δ = 1.00				
20	14.98	20.47	39.37	92.03	281.83
50	14.10	16.76	20.59	23.95	29.52
100	13.49	15.89	19.09	21.37	23.54
500	13.07	15.21	17.71	19.69	21.38
	λ = 0.05, Δ = 2.00				
20	8.38	10.07	12.43	14.24	16.20
50	8.80	10.19	12.04	13.36	14.58
100	8.47	9.79	11.53	12.67	13.71
500	8.22	9.38	10.73	11.81	12.68
	λ = 0.05, Δ = 3.00				
20	6.68	7.96	9.73	11.06	12.32
50	7.01	8.09	9.52	10.54	11.47
100	6.69	7.69	9.02	9.89	10.69
500	6.34	7.24	8.23	9.04	9.69

Table 28

Out of Control ARL_0 for SSDMEWMA of Dimension 2 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	73.50	156.51	415.96	887.64	1898.02
50	61.94	128.90	352.67	784.47	1733.81
100	54.05	102.46	275.12	641.73	1524.75
500	42.65	68.79	133.37	265.77	628.31
			λ = 0.10, Δ = 0.50		
20	41.68	92.07	278.77	670.05	1570.91
50	26.37	48.28	136.25	365.18	982.37
100	21.36	31.73	65.72	151.79	449.99
500	19.81	23.85	32.47	40.64	53.19
			λ = 0.10, Δ = 1.00		
20	12.93	19.92	54.53	165.57	546.32
50	10.31	12.46	15.87	21.38	45.85
100	9.67	11.44	13.71	15.49	17.59
500	9.00	10.79	12.54	13.94	15.31
			λ = 0.10, Δ = 2.00		
20	6.30	7.45	8.91	10.27	15.77
50	5.81	6.68	7.72	8.48	9.22
100	5.53	6.34	7.30	7.96	8.58
500	5.26	6.03	6.85	7.45	8.00
			λ = 0.10, Δ = 3.00		
20	4.89	5.72	6.74	7.51	8.25
50	4.44	5.08	5.84	6.39	6.91
100	4.17	4.77	5.46	5.94	6.37
500	4.07	4.47	5.05	5.47	5.86

Table 29

Out of Control ARL_0 for SSDMEWMA of Dimension 2 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	78.35	168.48	444.75	929.03	1938.48
50	67.60	145.68	397.36	864.75	1860.47
100	57.99	124.03	347.46	779.28	1696.78
500	50.05	86.81	202.13	430.10	1053.72
	λ = 0.20, Δ = 0.50				
20	50.24	113.84	349.51	796.66	1757.10
50	31.08	68.32	214.36	558.78	1387.98
100	23.26	41.31	118.49	329.45	909.71
500	17.76	26.06	41.25	62.62	134.67
	λ = 0.20, Δ = 1.00				
20	13.13	28.93	116.75	347.80	997.39
50	8.41	10.90	20.45	63.69	225.55
100	7.67	9.24	11.82	15.11	31.81
500	8.51	8.38	10.06	11.51	13.21
	λ = 0.20, Δ = 2.00				
20	4.24	4.97	6.29	12.15	41.76
50	3.74	4.28	4.91	5.40	5.88
100	3.59	4.02	4.60	5.02	5.42
500	3.41	3.90	4.33	4.70	5.06
	λ = 0.20, Δ = 3.00				
20	3.04	3.49	4.05	4.66	5.34
50	2.66	3.01	3.40	3.69	3.99
100	2.54	2.82	3.18	3.44	3.69
500	2.32	2.71	2.97	3.21	3.43

Table 30

Out of Control ARL_0 for SSDMEWMA of Dimension 2 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.30, \Delta = 0.25$				
20	83.40	177.83	462.59	953.77	2004.79
50	74.14	160.82	418.49	905.12	1936.55
100	67.09	141.43	378.13	845.77	1845.15
500	55.81	99.77	253.93	564.51	1367.61
	$\lambda = 0.30, \Delta = 0.50$				
20	58.94	137.20	386.38	877.86	1906.54
50	38.31	89.69	282.12	696.27	1633.70
100	28.42	57.36	180.63	493.04	1272.35
500	23.12	31.01	57.58	119.23	331.59
	$\lambda = 0.30, \Delta = 1.00$				
20	17.81	48.19	191.18	554.34	1428.74
50	8.41	13.65	46.54	157.98	560.94
100	7.31	9.46	14.60	32.52	142.50
500	6.88	7.91	10.02	12.25	14.82
	$\lambda = 0.30, \Delta = 2.00$				
20	3.43	4.33	9.68	41.25	210.43
50	2.91	3.34	3.88	4.34	4.96
100	2.77	3.11	3.58	3.94	4.32
500	2.83	2.98	3.36	3.68	3.98
	$\lambda = 0.30, \Delta = 3.00$				
20	2.23	2.54	2.96	3.95	8.69
50	1.92	2.16	2.43	2.65	2.87
100	1.84	2.02	2.27	2.46	2.64
500	1.88	1.97	2.14	2.30	2.46

Table 31

Out of Control ARL_0 for SSDMEWMA of Dimension 2 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	86.19	182.91	463.56	969.76	1956.68
50	79.24	165.36	436.54	943.94	1934.62
100	73.56	146.64	407.67	895.41	1869.59
500	59.78	120.48	296.91	673.94	1531.36
	λ = 0.40, Δ = 0.50				
20	66.27	151.40	418.47	919.23	1918.52
50	46.30	106.81	335.26	794.58	1773.57
100	34.78	74.96	236.61	631.08	1522.76
500	32.08	41.42	83.56	195.20	573.64
	λ = 0.40, Δ = 1.00				
20	24.90	70.03	270.79	704.36	1648.83
50	10.09	20.92	87.82	312.27	975.19
100	7.74	11.05	24.65	92.61	401.04
500	7.13	8.34	11.34	14.76	19.59
	λ = 0.40, Δ = 2.00				
20	3.29	5.72	32.65	145.89	533.02
50	2.51	2.87	3.51	4.96	13.87
100	2.34	2.66	3.12	3.51	3.94
500	2.60	2.59	2.90	3.22	3.54
	λ = 0.40, Δ = 3.00				
20	1.79	2.05	3.19	9.68	55.10
50	1.53	1.69	1.91	2.09	2.28
100	1.46	1.60	1.79	1.94	2.09
500	1.50	1.55	1.69	1.82	1.95

Table 32

Out of Control ARL_0 for SSDMEWMA of Dimension 2 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	λ = 0.50, Δ = 0.25				
20	88.98	184.29	479.74	974.92	1970.54
50	83.46	172.53	460.49	966.46	1940.90
100	77.02	157.82	431.20	929.64	1917.35
500	72.19	132.16	337.67	757.74	1681.23
	λ = 0.50, Δ = 0.50				
20	73.18	161.89	448.52	950.41	1943.34
50	54.71	124.15	381.59	865.15	1842.03
100	42.12	91.99	299.16	742.23	1697.02
500	26.06	49.48	120.03	299.75	880.05
	λ = 0.50, Δ = 1.00				
20	33.67	96.07	349.02	820.60	1817.42
50	13.69	33.66	164.77	495.06	1329.19
100	9.37	15.63	52.91	222.44	757.36
500	5.96	9.48	14.36	20.52	40.67
	λ = 0.50, Δ = 2.00				
20	3.97	13.08	90.97	329.68	981.91
50	2.34	2.77	5.16	15.89	95.96
100	2.15	2.49	3.04	3.51	5.88
500	2.33	2.32	2.72	3.07	3.43
	λ = 0.50, Δ = 3.00				
20	1.57	2.03	9.23	47.41	217.39
50	1.34	1.45	1.64	1.81	2.64
100	1.27	1.38	1.53	1.65	1.79
500	1.44	1.31	1.45	1.55	1.65

Table 33

Out of Control ARL_0 for SSDMEWMA of Dimension 2 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	91.63	189.17	492.58	987.34	2021.88
50	86.56	179.44	481.41	973.83	2011.80
100	80.70	169.49	461.11	953.97	1989.89
500	71.63	139.70	372.79	823.44	1774.44
			λ = 0.60, Δ = 0.50		
20	79.19	172.45	474.95	972.39	2023.54
50	61.33	141.14	429.55	917.64	1965.01
100	48.96	112.93	356.57	825.02	1858.73
500	31.62	58.42	167.21	433.05	1154.96
			λ = 0.60, Δ = 1.00		
20	46.03	126.50	414.54	927.01	1990.52
50	18.96	58.79	254.00	684.59	1657.26
100	11.73	24.53	121.23	415.00	1184.00
500	8.84	11.44	19.61	36.48	124.62
			λ = 0.60, Δ = 2.00		
20	7.13	32.29	200.90	587.10	1502.41
50	2.39	3.37	17.23	89.87	392.96
100	2.15	2.59	3.29	6.90	42.55
500	2.14	2.29	2.78	3.19	3.71
			λ = 0.60, Δ = 3.00		
20	1.58	4.37	40.07	175.18	607.92
50	1.25	1.36	1.57	2.56	5.42
100	1.19	1.29	1.42	1.54	1.69
500	1.28	1.24	1.34	1.43	1.53

Table 34

Out of Control ARL_0 for SSDMEWMA of Dimension 2 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	95.63	198.73	503.83	998.88	1995.31
50	92.91	190.25	488.52	993.10	2001.29
100	91.43	186.47	480.31	985.34	1997.39
500	91.02	171.50	436.03	898.71	1895.21
			λ = 0.80, Δ = 0.50		
20	90.45	195.03	505.32	1010.94	2025.58
50	79.60	176.32	475.10	995.34	2029.48
100	68.73	153.72	446.27	954.39	1995.25
500	52.93	95.96	294.19	691.73	1636.34
			λ = 0.80, Δ = 1.00		
20	76.85	187.49	517.51	1049.04	2109.99
50	44.30	125.90	424.66	969.47	2065.71
100	26.95	76.47	314.67	822.20	1897.78
500	11.61	20.88	65.01	223.05	814.99
			λ = 0.80, Δ = 2.00		
20	41.00	141.35	488.17	1083.07	2212.48
50	6.10	28.45	199.69	623.91	1548.78
100	2.92	5.74	38.52	226.42	791.49
500	2.36	2.92	4.07	5.20	8.35
			λ = 0.80, Δ = 3.00		
20	15.27	65.47	317.65	833.69	1865.34
50	1.43	2.18	26.70	122.37	490.80
100	1.29	1.42	1.76	6.18	38.43
500	1.24	1.30	1.47	1.61	1.80

Table 35

Out of Control ARL_0 for SSDMEWMA of Dimension 3 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	73.82	152.54	412.40	886.42	1877.92
50	61.60	121.40	328.28	746.76	1640.61
100	50.77	92.63	238.83	551.23	1289.35
500	37.17	63.39	109.57	182.42	365.45
			λ = 0.05, Δ = 0.50		
20	42.83	83.85	251.61	611.70	1426.91
50	29.23	45.57	106.81	264.04	712.43
100	24.52	33.01	52.80	93.86	243.35
500	21.58	27.68	35.22	40.85	47.18
			λ = 0.05, Δ = 1.00		
20	16.18	22.31	44.96	112.90	357.92
50	14.37	17.35	21.42	24.91	30.58
100	13.66	16.23	19.42	21.64	23.78
500	13.25	15.24	17.90	19.77	21.41
			λ = 0.05, Δ = 2.00		
20	9.20	11.13	13.66	15.56	17.37
50	9.11	10.66	12.58	13.91	15.12
100	8.71	10.11	11.79	12.90	13.92
500	8.41	9.42	10.91	11.91	12.76
			λ = 0.05, Δ = 3.00		
20	7.42	8.91	10.82	12.19	13.47
50	7.34	8.54	10.04	11.07	12.00
100	6.91	7.98	9.29	10.13	10.90
500	6.53	7.29	8.40	9.14	9.76

Table 36

Out of Control ARL_0 for SSDMEWMA of Dimension 3 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	73.26	153.07	427.20	916.38	1891.84
50	60.88	126.74	363.95	817.90	1768.54
100	50.72	100.33	288.19	680.53	1529.33
500	41.26	67.98	143.25	296.62	706.93
			$\lambda = 0.10, \Delta = 0.50$		
20	43.29	93.85	301.48	713.67	1625.31
50	26.92	48.66	147.17	394.72	1017.26
100	21.75	32.02	68.58	171.04	512.06
500	17.49	24.47	32.51	41.90	57.43
			$\lambda = 0.10, \Delta = 1.00$		
20	13.77	21.42	62.71	197.56	579.83
50	10.39	12.64	16.26	25.53	62.02
100	9.78	11.59	13.85	15.69	17.68
500	8.74	10.74	12.60	13.95	15.19
			$\lambda = 0.10, \Delta = 2.00$		
20	6.75	7.92	9.49	10.83	15.61
50	5.93	6.82	7.91	8.67	9.36
100	5.64	6.48	7.39	8.03	8.62
500	5.47	6.12	6.95	7.53	8.00
			$\lambda = 0.10, \Delta = 3.00$		
20	5.30	6.15	7.23	8.02	8.76
50	4.58	5.22	6.03	6.57	7.07
100	4.28	4.90	5.55	6.01	6.43
500	4.11	4.55	5.15	5.54	5.88

Table 37

Out of Control ARL_0 for SSDMEWMA of Dimension 3 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	78.59	168.95	450.58	956.57	1950.58
50	68.77	143.97	404.08	900.32	1862.77
100	59.14	124.37	356.65	807.62	1738.87
500	52.16	82.66	220.90	484.96	1117.43
			$\lambda = 0.20, \Delta = 0.50$		
20	51.87	119.70	362.82	837.95	1786.65
50	31.63	70.31	231.08	602.19	1411.08
100	24.04	43.40	133.52	359.15	987.98
500	22.31	25.43	43.87	75.41	171.95
			$\lambda = 0.20, \Delta = 1.00$		
20	14.33	30.99	127.92	397.19	1065.34
50	8.57	11.36	24.67	74.05	260.39
100	7.54	9.28	12.15	17.48	46.42
500	7.58	8.05	9.96	11.50	13.06
			$\lambda = 0.20, \Delta = 2.00$		
20	4.44	5.21	7.29	16.06	65.54
50	3.78	4.29	4.95	5.44	5.93
100	3.58	4.05	4.62	5.04	5.43
500	3.73	3.86	4.35	4.72	5.03
			$\lambda = 0.20, \Delta = 3.00$		
20	3.20	3.65	4.23	4.68	5.19
50	2.71	3.03	3.45	3.76	4.03
100	2.54	2.86	3.21	3.46	3.70
500	2.53	2.66	3.01	3.22	3.41

Table 38

Out of Control ARL_0 for SSDMEWMA of Dimension 3 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	82.65	175.88	472.66	975.92	1985.71
50	73.79	161.41	443.77	940.85	1936.08
100	64.82	143.66	397.14	866.83	1864.89
500	54.36	103.64	272.79	625.32	1405.52
			λ = 0.30, Δ = 0.50		
20	59.31	140.64	410.56	901.31	1895.66
50	39.40	93.99	306.11	741.21	1667.67
100	29.24	61.45	200.76	536.96	1364.38
500	24.05	34.44	67.15	146.11	388.79
			λ = 0.30, Δ = 1.00		
20	18.91	52.25	209.64	589.50	1441.55
50	8.74	15.88	58.02	194.21	627.98
100	7.16	9.58	18.65	53.35	188.14
500	7.41	7.77	10.23	12.44	15.15
			λ = 0.30, Δ = 2.00		
20	3.53	4.65	14.33	63.20	254.27
50	2.90	3.33	3.88	4.46	6.78
100	2.77	3.12	3.58	3.94	4.29
500	2.55	2.85	3.31	3.64	3.93
			λ = 0.30, Δ = 3.00		
20	2.30	2.62	3.06	3.94	12.12
50	1.94	2.16	2.45	2.67	2.87
100	1.84	2.02	2.27	2.46	2.63
500	1.74	1.88	2.12	2.29	2.43

Table 39

Out of Control ARL_0 for SSDMEWMA of Dimension 3 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	87.78	181.64	487.60	989.25	1990.89
50	78.88	165.52	463.10	963.76	1961.86
100	70.49	146.66	432.63	910.21	1907.61
500	58.45	114.69	319.61	714.66	1586.10
	λ = 0.40, Δ = 0.50				
20	68.04	153.26	448.73	942.45	1950.73
50	47.71	110.90	366.14	821.81	1806.49
100	34.80	76.62	271.47	663.18	1570.48
500	29.19	40.24	100.90	241.05	668.89
	λ = 0.40, Δ = 1.00				
20	27.03	75.18	296.88	738.07	1680.62
50	10.96	23.42	108.46	359.70	1013.65
100	7.91	12.31	36.39	129.69	453.72
500	8.62	8.69	12.03	15.64	24.08
	λ = 0.40, Δ = 2.00				
20	3.42	6.57	42.49	178.10	577.25
50	2.49	2.88	3.59	6.27	28.38
100	2.36	2.66	3.12	3.48	3.98
500	2.50	2.53	2.85	3.14	3.44
	λ = 0.40, Δ = 3.00				
20	1.84	2.10	4.17	12.18	71.80
50	1.54	1.71	1.93	2.10	2.27
100	1.48	1.61	1.78	1.92	2.07
500	1.50	1.49	1.65	1.79	1.91

Table 40

Out of Control ARL_0 for SSDMEWMA of Dimension 3 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	89.55	185.51	490.90	973.70	1987.21
50	80.70	172.75	473.31	954.48	1976.18
100	74.23	157.72	440.45	926.82	1945.94
500	63.13	133.62	355.11	777.74	1666.23
			$\lambda = 0.50, \Delta = 0.50$		
20	73.97	165.57	467.56	951.54	1974.67
50	54.51	127.49	397.81	879.56	1891.32
100	41.37	93.73	320.79	755.34	1735.55
500	35.23	50.57	142.43	344.08	945.50
			$\lambda = 0.50, \Delta = 1.00$		
20	35.59	102.18	365.22	845.35	1853.75
50	14.37	38.00	177.67	521.79	1367.64
100	9.30	17.82	68.67	253.33	816.45
500	8.72	9.78	15.37	24.95	60.01
			$\lambda = 0.50, \Delta = 2.00$		
20	4.67	15.17	105.04	353.46	1012.04
50	2.34	2.91	5.96	25.25	131.08
100	2.16	2.49	3.09	3.66	7.84
500	2.09	2.32	2.66	2.99	3.33
			$\lambda = 0.50, \Delta = 3.00$		
20	1.64	2.33	12.23	59.63	247.97
50	1.34	1.46	1.65	1.81	2.19
100	1.29	1.38	1.52	1.64	1.76
500	1.29	1.31	1.41	1.52	1.62

Table 41

Out of Control ARL_0 for SSDMEWMA of Dimension 3 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	89.40	187.17	493.05	977.58	1980.92
50	83.99	179.08	481.03	974.37	1978.12
100	78.09	166.86	454.66	953.21	1960.72
500	62.15	132.34	388.26	818.15	1756.59
			$\lambda = 0.60, \Delta = 0.50$		
20	78.60	174.50	477.06	974.58	1980.74
50	61.02	143.67	430.53	923.05	1920.83
100	49.57	113.84	360.23	836.50	1830.93
500	35.38	60.22	191.64	464.53	1188.75
			$\lambda = 0.60, \Delta = 1.00$		
20	47.46	129.09	429.68	927.48	1962.09
50	20.32	60.34	265.90	687.44	1624.06
100	12.40	27.72	136.21	427.43	1182.92
500	9.13	11.73	22.23	48.71	168.75
			$\lambda = 0.60, \Delta = 2.00$		
20	8.75	36.40	207.13	580.54	1426.41
50	2.48	4.14	23.20	103.15	384.49
100	2.17	2.57	3.56	9.67	54.86
500	1.96	2.21	2.74	3.14	3.60
			$\lambda = 0.60, \Delta = 3.00$		
20	1.82	4.80	45.03	180.86	591.37
50	1.27	1.37	1.58	3.64	15.93
100	1.22	1.28	1.42	1.53	1.66
500	1.22	1.21	1.32	1.41	1.49

Table 42

Out of Control ARL_0 for SSDMEWMA of Dimension 3 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	93.57	194.92	485.81	997.94	1991.80
50	89.17	188.08	484.40	984.49	1991.60
100	87.94	182.96	476.66	975.49	1979.65
500	70.25	172.21	415.36	897.63	1882.37
			$\lambda = 0.80, \Delta = 0.50$		
20	89.40	193.27	486.98	1008.03	2012.92
50	78.36	174.77	471.95	991.17	1997.56
100	68.27	156.57	437.80	948.17	1981.61
500	42.73	111.09	294.74	708.74	1643.87
			$\lambda = 0.80, \Delta = 1.00$		
20	76.34	185.67	501.27	1046.62	2083.52
50	45.81	130.22	429.49	965.30	2021.99
100	27.84	82.79	320.85	822.28	1880.60
500	10.69	23.35	73.99	262.70	838.34
			$\lambda = 0.80, \Delta = 2.00$		
20	42.38	135.33	465.54	1046.55	2143.81
50	6.98	30.45	195.64	596.47	1504.13
100	3.29	6.89	53.97	249.65	794.56
500	2.48	3.05	4.13	5.83	10.50
			$\lambda = 0.80, \Delta = 3.00$		
20	13.39	65.14	312.69	806.27	1818.66
50	1.69	3.89	31.12	154.45	498.57
100	1.34	1.51	2.73	11.94	57.63
500	1.18	1.34	1.49	1.64	1.81

Table 43

Out of Control ARL_0 for SSDMEWMA of Dimension 4 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05$, $\Delta = 0.25$		
20	66.46	140.63	408.78	886.90	1859.88
50	56.54	113.24	317.59	711.30	1593.72
100	47.99	86.96	226.75	516.07	1234.70
500	34.08	61.27	102.67	179.32	363.07
			$\lambda = 0.05$, $\Delta = 0.50$		
20	38.00	77.18	229.35	576.78	1381.05
50	27.92	43.00	101.09	248.28	650.08
100	24.29	32.36	53.32	93.78	226.33
500	21.92	26.50	34.15	40.33	46.38
			$\lambda = 0.05$, $\Delta = 1.00$		
20	15.69	21.76	43.42	102.64	297.79
50	14.27	17.32	21.46	25.21	32.06
100	13.58	16.11	19.31	21.53	23.60
500	13.81	14.91	17.66	19.46	21.05
			$\lambda = 0.05$, $\Delta = 2.00$		
20	9.33	11.39	13.99	15.88	18.02
50	9.17	10.76	12.66	13.96	15.15
100	8.73	10.13	11.81	12.92	13.90
500	8.17	9.34	10.80	11.76	12.58
			$\lambda = 0.05$, $\Delta = 3.00$		
20	7.60	9.22	11.21	12.58	13.84
50	7.42	8.67	10.16	11.17	12.10
100	6.95	8.05	9.34	10.21	10.95
500	6.43	7.25	8.32	9.04	9.64

Table 44

Out of Control ARL_0 for SSDMEWMA of Dimension 4 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	68.10	149.36	427.62	916.22	1927.58
50	57.70	123.30	362.97	797.21	1765.04
100	47.46	96.93	287.10	661.48	1500.96
500	46.00	66.53	135.50	288.70	709.19
			λ = 0.10, Δ = 0.50		
20	39.27	86.39	290.05	687.84	1589.73
50	25.80	47.05	146.50	375.31	973.17
100	20.61	31.86	70.79	170.42	505.74
500	16.39	23.57	31.92	41.28	59.83
			λ = 0.10, Δ = 1.00		
20	13.14	20.42	61.41	177.73	552.07
50	10.31	12.75	16.65	26.11	66.04
100	9.68	11.43	13.71	15.52	17.88
500	9.64	10.92	12.41	13.61	14.82
			λ = 0.10, Δ = 2.00		
20	6.76	7.98	9.57	11.78	16.37
50	5.93	6.87	7.93	8.66	9.33
100	5.66	6.46	7.37	7.97	8.55
500	5.79	6.15	6.88	7.36	7.86
			λ = 0.10, Δ = 3.00		
20	5.35	6.25	7.35	8.11	8.85
50	4.59	5.30	6.08	6.60	7.08
100	4.32	4.90	5.56	6.01	6.41
500	4.39	4.58	5.09	5.43	5.78

Table 45

Out of Control ARL_0 for SSDMEWMA of Dimension 4 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	74.26	167.31	450.93	942.11	1969.66
50	63.91	145.53	412.58	875.70	1877.09
100	57.20	123.67	358.11	797.19	1745.20
500	45.96	81.87	216.22	489.74	1126.50
			λ = 0.20, Δ = 0.50		
20	47.33	114.83	362.15	811.83	1799.02
50	30.76	67.34	229.53	584.95	1405.29
100	23.57	42.98	131.56	358.41	958.51
500	23.64	25.23	43.65	73.85	173.69
			λ = 0.20, Δ = 1.00		
20	13.07	29.97	121.96	368.66	1009.32
50	8.34	11.45	26.51	77.82	281.15
100	7.48	9.11	12.00	18.57	56.57
500	7.86	8.20	9.78	11.13	12.61
			λ = 0.20, Δ = 2.00		
20	4.38	5.16	7.31	17.20	70.35
50	3.77	4.30	4.94	5.41	5.86
100	3.59	4.03	4.57	4.95	5.32
500	3.89	3.90	4.29	4.61	4.92
			λ = 0.20, Δ = 3.00		
20	3.20	3.66	4.24	4.68	5.12
50	2.72	3.06	3.46	3.75	4.02
100	2.56	2.84	3.19	3.43	3.64
500	2.61	2.69	2.96	3.15	3.34

Table 46

Out of Control ARL_0 for SSDMEWMA of Dimension 4 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30$, $\Delta = 0.25$		
20	79.65	173.46	466.45	942.64	1951.65
50	71.54	155.37	438.19	913.42	1912.43
100	63.14	138.90	393.37	844.51	1803.35
500	61.02	98.53	270.20	599.68	1375.20
			$\lambda = 0.30$, $\Delta = 0.50$		
20	55.69	132.21	404.39	864.51	1859.45
50	36.73	89.94	297.97	704.92	1630.34
100	27.43	58.17	198.70	509.28	1305.42
500	27.85	32.18	63.96	147.78	402.33
			$\lambda = 0.30$, $\Delta = 1.00$		
20	17.01	46.42	201.02	544.66	1362.83
50	8.75	15.03	55.90	184.68	593.33
100	7.07	9.30	19.14	53.89	198.85
500	7.17	7.63	9.80	12.05	14.80
			$\lambda = 0.30$, $\Delta = 2.00$		
20	3.47	4.50	14.69	59.23	232.71
50	2.89	3.32	3.86	4.95	8.85
100	2.73	3.06	3.51	3.84	4.20
500	2.90	3.01	3.29	3.56	3.82
			$\lambda = 0.30$, $\Delta = 3.00$		
20	2.29	2.61	3.07	3.62	9.75
50	1.95	2.17	2.45	2.65	2.85
100	1.82	2.00	2.24	2.41	2.58
500	1.93	1.94	2.10	2.24	2.38

Table 47

Out of Control ARL_0 for SSDMEWMA of Dimension 4 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	82.70	179.87	462.34	947.77	1946.05
50	75.25	166.97	442.91	928.74	1936.26
100	69.82	150.59	410.93	884.37	1876.93
500	52.58	119.00	313.77	693.12	1552.29
			$\lambda = 0.40, \Delta = 0.50$		
20	63.28	150.96	419.97	904.71	1898.05
50	45.71	109.35	344.26	796.92	1766.43
100	34.10	77.80	255.80	638.61	1524.32
500	24.72	40.82	96.15	243.43	681.21
			$\lambda = 0.40, \Delta = 1.00$		
20	23.58	70.32	275.71	688.42	1625.42
50	10.50	23.71	108.00	334.03	948.98
100	7.79	11.93	36.01	122.84	458.63
500	5.81	8.23	11.79	15.37	28.25
			$\lambda = 0.40, \Delta = 2.00$		
20	3.42	6.63	39.46	151.22	540.64
50	2.50	2.93	4.02	7.75	35.18
100	2.31	2.62	3.04	3.40	4.00
500	2.00	2.57	2.81	3.05	3.34
			$\lambda = 0.40, \Delta = 3.00$		
20	1.83	2.10	3.46	12.77	66.65
50	1.56	1.72	1.92	2.08	2.25
100	1.45	1.58	1.75	1.88	2.02
500	1.43	1.54	1.65	1.75	1.86

Table 48

Out of Control ARL_0 for SSDMEWMA of Dimension 4 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	λ = 0.50, Δ = 0.25				
20	85.55	181.58	468.55	955.16	1963.39
50	79.56	172.68	457.48	951.39	1933.64
100	74.14	161.38	436.90	923.25	1916.48
500	57.57	129.98	352.21	763.44	1675.40
	λ = 0.50, Δ = 0.50				
20	71.25	160.05	446.73	937.72	1951.10
50	51.01	127.87	387.67	866.60	1839.46
100	40.50	95.98	313.27	746.99	1679.82
500	29.31	48.80	139.19	355.05	952.14
	λ = 0.50, Δ = 1.00				
20	32.99	95.20	349.16	817.94	1796.83
50	14.69	38.82	176.74	505.85	1299.86
100	9.21	17.68	76.01	249.48	781.07
500	6.27	9.79	15.10	25.66	68.10
	λ = 0.50, Δ = 2.00				
20	4.37	14.79	97.02	325.50	941.33
50	2.38	2.97	7.30	32.71	139.31
100	2.12	2.46	2.98	5.18	16.49
500	1.77	2.26	2.60	2.92	3.22
	λ = 0.50, Δ = 3.00				
20	1.60	2.28	12.00	57.94	233.00
50	1.35	1.48	1.65	1.81	2.93
100	1.28	1.38	1.50	1.61	1.72
500	1.21	1.31	1.41	1.50	1.58

Table 49

Out of Control ARL$_0$ for SSDMEWMA of Dimension 4 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	87.14	187.14	471.00	996.52	1962.57
50	82.14	178.73	468.35	975.39	1950.12
100	77.70	169.63	459.29	956.47	1923.61
500	70.02	142.05	392.46	831.71	1783.99
			λ = 0.60, Δ = 0.50		
20	76.19	173.10	460.42	980.73	1961.21
50	59.58	144.56	420.55	928.03	1916.02
100	48.57	116.23	366.53	852.96	1800.09
500	27.90	66.37	189.78	491.14	1205.09
			λ = 0.60, Δ = 1.00		
20	44.66	126.02	404.18	930.55	1928.66
50	20.46	61.59	252.46	691.73	1600.80
100	12.32	29.18	133.79	442.14	1167.74
500	8.56	12.33	22.35	54.16	197.90
			λ = 0.60, Δ = 2.00		
20	7.99	34.22	185.76	556.98	1357.14
50	2.50	4.36	25.35	115.27	402.85
100	2.12	2.53	3.92	13.51	74.93
500	1.64	2.25	2.71	3.07	3.50
			λ = 0.60, Δ = 3.00		
20	1.98	6.15	42.73	177.01	584.29
50	1.29	1.40	1.72	4.02	20.50
100	1.21	1.30	1.43	1.52	1.64
500	1.19	1.23	1.33	1.40	1.48

Table 50

Out of Control ARL_0 for SSDMEWMA of Dimension 4 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	92.64	193.28	493.69	1019.78	1984.07
50	90.88	188.91	484.37	1015.62	1978.30
100	88.82	183.57	475.74	1008.50	1988.47
500	62.65	163.15	429.70	939.23	1922.52
			$\lambda = 0.80, \Delta = 0.50$		
20	88.81	189.77	498.13	1036.76	2009.33
50	77.89	175.19	476.53	1018.04	2001.61
100	68.99	153.53	439.47	994.34	1987.63
500	38.26	101.15	304.00	739.00	1689.84
			$\lambda = 0.80, \Delta = 1.00$		
20	73.98	182.69	503.56	1065.81	2077.26
50	44.72	128.80	426.02	996.91	2023.28
100	28.79	81.13	318.86	843.13	1870.38
500	14.90	29.32	83.40	269.60	885.36
			$\lambda = 0.80, \Delta = 2.00$		
20	40.06	132.15	448.10	1049.23	2100.31
50	7.30	38.44	193.46	596.16	1476.73
100	3.55	8.52	60.28	242.37	796.08
500	2.74	2.95	4.13	7.12	23.13
			$\lambda = 0.80, \Delta = 3.00$		
20	14.69	66.91	300.17	784.79	1775.69
50	1.71	5.33	38.41	158.79	528.07
100	1.39	1.56	3.95	18.54	88.14
500	1.35	1.31	1.50	1.67	1.85

Table 51

Out of Control ARL_0 for SSDMEWMA of Dimension 5 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	λ = 0.05, Δ = 0.25				
20	64.57	139.82	400.02	882.17	1862.61
50	53.50	108.37	311.45	704.65	1597.44
100	45.39	83.18	218.55	498.67	1243.06
500	42.29	56.34	99.27	168.97	362.42
	λ = 0.05, Δ = 0.50				
20	35.74	73.63	225.71	554.23	1347.08
50	26.64	41.26	96.50	228.66	618.35
100	23.27	31.28	48.31	89.36	224.93
500	22.80	25.63	33.10	38.74	44.69
	λ = 0.05, Δ = 1.00				
20	15.60	21.51	39.75	90.59	271.35
50	14.09	17.11	21.05	24.48	30.89
100	13.39	15.98	19.01	21.11	23.05
500	13.20	14.73	17.31	19.08	20.60
	λ = 0.05, Δ = 2.00				
20	9.53	11.71	14.29	16.09	17.95
50	9.14	10.75	12.66	13.93	15.07
100	8.69	10.11	11.70	12.77	13.71
500	8.37	9.24	10.62	11.55	12.35
	λ = 0.05, Δ = 3.00				
20	7.86	9.57	11.57	12.93	14.18
50	7.45	8.73	10.24	11.23	12.13
100	6.96	8.06	9.29	10.13	10.86
500	6.34	7.16	8.20	8.91	9.50

Table 52

Out of Control ARL_0 for SSDMEWMA of Dimension 5 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	67.90	147.85	420.59	899.62	1898.58
50	55.81	118.87	357.14	780.70	1713.70
100	46.87	94.98	278.29	648.90	1479.27
500	34.12	63.86	133.76	278.69	670.99
			$\lambda = 0.10, \Delta = 0.50$		
20	38.03	85.72	277.75	659.12	1543.40
50	24.57	44.40	137.50	362.08	955.00
100	20.39	30.52	63.84	165.01	466.38
500	13.58	21.94	30.54	39.34	57.04
			$\lambda = 0.10, \Delta = 1.00$		
20	12.99	19.79	57.11	161.95	493.62
50	10.27	12.43	16.10	23.21	58.84
100	9.53	11.25	13.35	15.02	16.94
500	7.04	10.29	12.09	13.24	14.39
			$\lambda = 0.10, \Delta = 2.00$		
20	6.85	8.05	9.56	11.00	16.68
50	5.95	6.84	7.86	8.55	9.20
100	5.58	6.38	7.25	7.84	8.37
500	4.84	5.90	6.68	7.18	7.64
			$\lambda = 0.10, \Delta = 3.00$		
20	5.45	6.36	7.42	8.18	8.89
50	4.64	5.30	6.06	6.56	7.03
100	4.27	4.86	5.49	5.92	6.31
500	3.60	4.38	4.95	5.31	5.63

Table 53

Out of Control ARL_0 for SSDMEWMA of Dimension 5 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	72.54	163.69	446.40	948.25	1952.35
50	62.19	140.27	400.23	889.25	1860.80
100	54.62	118.26	350.54	807.54	1750.37
500	42.33	78.84	211.07	481.15	1140.29
			λ = 0.20, Δ = 0.50		
20	45.09	108.98	345.56	806.82	1767.34
50	29.33	64.82	221.54	583.17	1373.97
100	21.96	42.62	128.09	360.73	965.09
500	16.17	24.30	42.71	74.39	177.15
			λ = 0.20, Δ = 1.00		
20	13.00	29.09	118.22	349.17	960.40
50	8.21	11.28	26.09	77.28	278.76
100	7.25	8.93	11.93	20.00	53.33
500	6.33	7.90	9.49	10.88	12.13
			λ = 0.20, Δ = 2.00		
20	4.37	5.14	7.09	15.46	61.32
50	3.73	4.24	4.85	5.30	6.16
100	3.49	3.96	4.47	4.83	5.18
500	3.28	3.71	4.19	4.48	4.75
			λ = 0.20, Δ = 3.00		
20	3.21	3.67	4.24	4.79	5.24
50	2.70	3.04	3.42	3.70	3.95
100	2.49	2.79	3.13	3.36	3.57
500	2.19	2.58	2.86	3.06	3.24

Table 54

Out of Control ARL_0 for SSDMEWMA of Dimension 5 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	77.21	172.30	462.59	968.32	1991.38
50	68.42	154.80	427.01	917.73	1933.88
100	60.29	136.91	396.71	851.00	1850.11
500	41.67	91.83	272.55	608.13	1407.03
			$\lambda = 0.30, \Delta = 0.50$		
20	52.72	132.09	393.94	877.07	1877.75
50	35.37	88.04	286.24	697.35	1627.64
100	26.65	58.68	198.63	524.72	1309.92
500	12.54	30.75	63.78	146.64	420.74
			$\lambda = 0.30, \Delta = 1.00$		
20	16.16	46.12	191.07	528.33	1346.16
50	8.67	15.30	59.28	196.43	598.27
100	6.87	9.28	19.40	56.45	217.63
500	5.72	7.51	9.75	11.73	14.47
			$\lambda = 0.30, \Delta = 2.00$		
20	3.46	4.63	12.21	54.59	220.63
50	2.85	3.24	3.89	4.36	8.74
100	2.66	3.01	3.42	3.73	4.06
500	2.29	2.84	3.20	3.43	3.68
			$\lambda = 0.30, \Delta = 3.00$		
20	2.29	2.61	3.31	4.47	12.39
50	1.92	2.13	2.40	2.59	2.79
100	1.78	1.97	2.20	2.36	2.51
500	1.54	1.82	2.03	2.16	2.28

Table 55

Out of Control ARL_0 for SSDMEWMA of Dimension 5 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	80.46	175.69	473.86	977.54	1999.69
50	74.74	160.88	448.77	944.95	1963.37
100	67.41	146.75	423.97	906.57	1918.72
500	61.70	106.74	308.98	701.38	1587.77
			λ = 0.40, Δ = 0.50		
20	61.54	144.96	430.77	929.10	1950.63
50	44.30	106.22	340.44	796.03	1776.78
100	32.64	74.71	257.84	643.25	1555.37
500	22.17	39.54	98.16	240.74	668.47
			λ = 0.40, Δ = 1.00		
20	23.10	68.34	273.03	696.97	1618.46
50	10.49	24.32	104.92	337.09	956.23
100	7.45	11.70	39.49	132.24	455.38
500	5.63	8.47	11.41	15.86	27.36
			λ = 0.40, Δ = 2.00		
20	3.51	6.59	39.19	156.90	506.30
50	2.43	2.82	3.84	7.90	32.32
100	2.25	2.56	2.97	3.32	3.68
500	2.03	2.43	2.69	2.92	3.18
			λ = 0.40, Δ = 3.00		
20	1.81	2.24	3.83	13.22	63.66
50	1.52	1.67	1.87	2.02	2.19
100	1.42	1.55	1.71	1.83	1.96
500	1.38	1.46	1.59	1.68	1.78

Table 56

Out of Control ARL_0 for SSDMEWMA of Dimension 5 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	λ = 0.50, Δ = 0.25				
20	84.21	180.08	491.47	966.19	2019.72
50	77.10	169.41	470.83	945.10	2005.58
100	71.91	155.93	453.08	921.84	1973.31
500	43.67	129.75	364.57	764.22	1730.25
	λ = 0.50, Δ = 0.50				
20	68.89	158.50	461.50	939.18	2003.02
50	51.57	121.96	397.16	862.38	1899.27
100	41.18	90.88	321.38	740.00	1734.62
500	21.97	50.16	141.94	343.20	947.62
	λ = 0.50, Δ = 1.00				
20	32.70	92.34	355.28	815.30	1865.68
50	14.52	37.85	177.82	501.89	1325.79
100	8.99	17.52	78.33	259.87	835.11
500	4.94	9.63	15.18	25.17	79.07
	λ = 0.50, Δ = 2.00				
20	4.69	14.27	94.76	314.41	939.58
50	2.29	2.99	9.09	31.47	145.54
100	2.06	2.39	2.97	4.41	13.54
500	1.59	2.22	2.51	2.76	3.06
	λ = 0.50, Δ = 3.00				
20	1.61	2.31	13.46	56.63	240.21
50	1.32	1.43	1.61	2.25	6.07
100	1.26	1.34	1.47	1.57	1.68
500	1.14	1.30	1.39	1.44	1.52

Table 57

Out of Control ARL_0 for SSDMEWMA of Dimension 5 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	88.13	186.20	484.47	976.44	1974.83
50	82.12	177.76	469.51	959.39	1974.64
100	76.26	169.37	458.54	944.16	1947.17
500	61.73	143.37	382.39	806.05	1803.00
			λ = 0.60, Δ = 0.50		
20	75.62	173.39	470.93	967.44	1970.70
50	60.08	143.81	420.77	908.67	1926.87
100	48.02	113.28	362.29	816.99	1798.30
500	32.29	61.66	179.60	451.83	1217.93
			λ = 0.60, Δ = 1.00		
20	44.40	124.92	409.26	915.58	1933.82
50	21.53	60.96	255.30	656.42	1612.36
100	11.80	29.18	132.96	422.43	1167.72
500	6.17	11.59	23.42	57.13	221.20
			λ = 0.60, Δ = 2.00		
20	7.97	33.76	182.77	535.92	1360.11
50	2.55	4.95	24.66	107.84	402.87
100	2.07	2.52	4.46	15.54	84.86
500	1.41	2.14	2.55	2.92	3.39
			λ = 0.60, Δ = 3.00		
20	1.89	6.27	43.57	159.89	531.24
50	1.27	1.38	1.99	5.97	24.55
100	1.20	1.27	1.39	1.49	1.62
500	1.13	1.23	1.31	1.37	1.44

Table 58

Out of Control ARL_0 for SSDMEWMA of Dimension 5 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	90.96	190.18	484.59	983.53	1995.47
50	88.28	186.26	486.57	962.90	1987.70
100	84.99	180.28	477.23	969.64	1990.94
500	93.31	168.21	425.08	914.30	1927.60
			$\lambda = 0.80, \Delta = 0.50$		
20	87.33	188.19	490.27	989.47	2015.84
50	74.79	170.42	471.70	966.37	2006.60
100	64.27	149.83	443.70	948.87	1984.03
500	37.78	100.91	305.38	722.25	1687.97
			$\lambda = 0.80, \Delta = 1.00$		
20	71.52	175.52	495.83	1022.69	2092.39
50	42.69	123.94	423.44	938.21	1985.93
100	25.40	77.42	312.02	793.06	1826.73
500	11.14	23.87	79.25	272.20	888.48
			$\lambda = 0.80, \Delta = 2.00$		
20	37.89	119.22	424.21	970.77	2071.09
50	7.49	30.26	187.87	546.58	1369.85
100	3.46	7.11	54.57	233.03	743.71
500	3.43	2.90	4.33	6.72	31.08
			$\lambda = 0.80, \Delta = 3.00$		
20	13.57	60.77	272.22	722.51	1701.15
50	1.86	4.16	41.37	161.59	517.33
100	1.35	1.51	4.61	21.14	99.09
500	1.13	1.35	1.52	1.65	1.84

Table 59

Out of Control ARL_0 for SSDMEWMA of Dimension 6 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	λ = 0.05, Δ = 0.25				
20	59.71	132.46	387.29	859.15	1790.66
50	50.54	102.32	287.95	665.98	1491.04
100	41.92	78.46	203.04	468.04	1121.70
500	30.58	56.20	98.00	161.29	332.32
	λ = 0.05, Δ = 0.50				
20	32.94	66.66	211.57	527.01	1223.43
50	24.87	38.06	89.10	208.87	540.05
100	22.05	29.43	46.11	81.16	188.69
500	20.17	25.78	32.24	36.81	42.07
	λ = 0.05, Δ = 1.00				
20	15.14	20.43	35.91	83.40	219.82
50	13.70	16.69	20.35	23.15	28.81
100	13.00	15.46	18.45	20.42	22.25
500	11.75	14.66	16.89	18.36	19.76
	λ = 0.05, Δ = 2.00				
20	9.57	11.76	14.37	16.10	17.74
50	9.00	10.63	12.49	13.71	14.79
100	8.53	9.88	11.51	12.53	13.42
500	7.33	9.20	10.40	11.18	11.93
	λ = 0.05, Δ = 3.00				
20	7.96	9.70	11.76	13.09	14.29
50	7.38	8.69	10.17	11.14	12.00
100	6.87	7.93	9.21	10.01	10.70
500	5.75	7.12	8.04	8.64	9.20

Table 60

Out of Control ARL_0 for SSDMEWMA of Dimension 6 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	62.99	143.04	408.06	898.91	1858.26
50	52.09	114.31	335.59	767.75	1680.99
100	43.96	90.44	261.29	613.36	1417.78
500	28.09	60.28	135.50	266.08	620.81
			λ = 0.10, Δ = 0.50		
20	34.40	78.29	253.77	638.17	1482.08
50	22.89	41.89	122.77	332.18	883.69
100	18.80	27.90	59.55	150.36	431.31
500	13.96	22.69	29.50	37.52	54.54
			λ = 0.10, Δ = 1.00		
20	12.30	17.90	47.30	143.41	429.22
50	9.87	11.99	15.14	23.01	51.66
100	9.08	10.79	12.82	14.45	16.99
500	8.26	10.45	11.62	12.72	13.68
			λ = 0.10, Δ = 2.00		
20	6.75	7.96	9.42	11.19	14.44
50	5.80	6.71	7.68	8.36	8.97
100	5.40	6.19	7.05	7.64	8.14
500	5.00	5.87	6.50	6.94	7.37
			λ = 0.10, Δ = 3.00		
20	5.41	6.34	7.39	8.13	8.81
50	4.55	5.23	5.95	6.46	6.90
100	4.16	4.75	5.38	5.81	6.17
500	3.65	4.37	4.82	5.14	5.44

Table 61

Out of Control ARL_0 for SSDMEWMA of Dimension 6 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	70.05	157.68	448.76	942.43	1899.53
50	59.73	136.79	397.62	866.53	1806.58
100	52.53	112.37	338.00	770.47	1660.44
500	35.09	80.94	195.23	446.16	1046.06
			λ = 0.20, Δ = 0.50		
20	42.12	102.56	335.74	781.16	1693.76
50	27.39	60.50	207.65	534.86	1300.94
100	20.06	37.81	119.89	327.50	874.64
500	16.19	23.50	40.23	72.00	162.09
			λ = 0.20, Δ = 1.00		
20	11.70	25.30	100.98	320.97	864.67
50	7.85	10.51	22.96	65.13	227.20
100	6.88	8.30	11.11	16.51	48.33
500	6.13	7.68	8.80	10.07	11.34
			λ = 0.20, Δ = 2.00		
20	4.29	5.00	6.76	15.97	49.33
50	3.62	4.10	4.69	5.11	5.52
100	3.38	3.79	4.31	4.66	4.98
500	2.94	3.55	3.95	4.27	4.54
			λ = 0.20, Δ = 3.00		
20	3.17	3.60	4.17	4.57	5.46
50	2.64	2.96	3.32	3.59	3.83
100	2.42	2.71	3.03	3.25	3.45
500	2.07	2.49	2.74	2.93	3.10

Table 62

Out of Control ARL_0 for SSDMEWMA of Dimension 6 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	74.62	167.31	458.86	951.20	1956.67
50	67.05	149.53	427.80	914.11	1902.01
100	58.31	125.81	379.64	849.19	1811.63
500	42.12	93.64	256.74	579.27	1332.32
			λ = 0.30, Δ = 0.50		
20	49.67	124.63	385.95	859.77	1839.62
50	33.71	80.25	280.60	681.82	1578.09
100	24.54	52.03	181.76	480.48	1237.02
500	18.93	28.72	58.57	138.48	387.84
			λ = 0.30, Δ = 1.00		
20	15.27	40.39	177.62	505.68	1274.79
50	7.84	13.34	50.44	170.11	547.98
100	6.39	8.47	16.21	45.53	174.95
500	5.83	6.86	8.84	10.84	13.65
			λ = 0.30, Δ = 2.00		
20	3.36	4.29	12.30	51.28	194.63
50	2.74	3.10	3.62	4.06	6.42
100	2.54	2.85	3.26	3.57	3.86
500	2.37	2.60	2.98	3.23	3.47
			λ = 0.30, Δ = 3.00		
20	2.24	2.54	3.08	3.74	13.18
50	1.85	2.06	2.30	2.50	2.68
100	1.70	1.89	2.11	2.26	2.41
500	1.68	1.73	1.92	2.05	2.18

Table 63

Out of Control ARL_0 for SSDMEWMA of Dimension 6 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	79.78	176.36	469.74	978.43	2010.78
50	71.61	164.35	453.05	945.06	1980.95
100	63.45	144.98	413.92	894.49	1899.85
500	42.62	105.51	294.94	655.79	1538.22
			$\lambda = 0.40, \Delta = 0.50$		
20	58.74	140.55	420.94	929.81	1957.56
50	40.95	102.74	337.76	785.74	1762.71
100	29.91	70.27	243.82	620.32	1482.07
500	19.81	36.16	88.46	229.21	638.19
			$\lambda = 0.40, \Delta = 1.00$		
20	21.16	62.07	257.30	667.26	1595.23
50	9.54	21.56	100.06	318.30	887.43
100	6.79	11.08	32.79	118.07	407.62
500	5.84	6.90	10.13	14.43	29.49
			$\lambda = 0.40, \Delta = 2.00$		
20	3.22	5.93	36.55	140.63	494.33
50	2.32	2.67	4.00	7.98	31.65
100	2.13	2.40	2.79	3.11	3.52
500	1.86	2.17	2.55	2.76	2.98
			$\lambda = 0.40, \Delta = 3.00$		
20	1.76	2.04	3.54	13.24	56.61
50	1.47	1.61	1.80	1.94	2.09
100	1.38	1.49	1.64	1.75	1.87
500	1.24	1.42	1.54	1.62	1.70

Table 64

Out of Control ARL_0 for SSDMEWMA of Dimension 6 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	85.06	184.78	481.19	1000.24	2007.93
50	77.92	175.26	467.69	978.67	1993.57
100	69.65	159.47	443.38	933.14	1962.46
500	54.73	118.08	339.48	759.05	1667.94
			$\lambda = 0.50, \Delta = 0.50$		
20	66.99	158.80	452.39	973.35	1985.45
50	48.26	121.91	392.24	874.50	1879.48
100	36.99	92.07	308.37	731.18	1684.76
500	23.58	46.14	133.30	327.81	916.90
			$\lambda = 0.50, \Delta = 1.00$		
20	30.41	91.46	335.29	815.22	1794.58
50	12.99	36.77	168.26	491.79	1253.38
100	8.52	16.74	72.37	232.97	733.89
500	6.19	8.01	14.39	24.51	74.04
			$\lambda = 0.50, \Delta = 2.00$		
20	4.15	14.00	87.87	301.82	858.68
50	2.17	2.79	7.74	29.13	134.69
100	1.97	2.26	2.69	4.41	11.11
500	2.00	2.04	2.34	2.59	2.90
			$\lambda = 0.50, \Delta = 3.00$		
20	1.57	2.41	10.88	53.67	201.95
50	1.30	1.40	1.55	1.69	4.48
100	1.23	1.31	1.42	1.51	1.61
500	1.31	1.24	1.33	1.41	1.47

Table 65

Out of Control ARL_0 for SSDMEWMA of Dimension 6 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	87.73	188.72	492.66	1013.26	2018.27
50	81.98	180.50	480.85	990.51	1999.82
100	75.88	166.68	465.89	971.61	1964.59
500	43.13	138.43	379.42	830.75	1773.37
			λ = 0.60, Δ = 0.50		
20	74.47	171.03	477.62	995.70	2013.72
50	58.62	140.12	428.58	929.58	1943.27
100	46.22	107.50	365.55	826.77	1802.72
500	26.73	57.73	181.63	460.03	1177.71
			λ = 0.60, Δ = 1.00		
20	43.11	119.83	407.99	923.45	1953.12
50	19.52	55.24	250.80	645.08	1562.47
100	11.91	26.88	127.75	401.46	1085.56
500	5.93	10.49	23.88	58.51	202.00
			λ = 0.60, Δ = 2.00		
20	7.61	30.87	171.95	510.09	1285.10
50	2.47	4.38	23.64	100.67	356.35
100	2.02	2.37	4.04	16.39	69.05
500	1.71	2.06	2.44	2.74	3.20
			λ = 0.60, Δ = 3.00		
20	1.85	5.09	36.01	152.84	496.02
50	1.26	1.34	1.93	4.99	24.68
100	1.19	1.26	1.37	1.46	1.56
500	1.04	1.15	1.28	1.33	1.39

Table 66

Out of Control ARL_0 for SSDMEWMA of Dimension 6 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	90.62	191.33	498.92	1025.87	2060.84
50	85.92	186.52	492.98	1019.68	2061.55
100	81.93	182.47	493.02	1006.10	2045.48
500	55.45	163.39	443.11	938.75	1934.82
			λ = 0.80, Δ = 0.50		
20	85.34	185.99	501.33	1037.00	2081.82
50	72.67	170.61	480.87	1019.36	2068.50
100	62.81	151.22	453.25	978.35	2030.25
500	34.21	95.86	306.54	726.83	1690.57
			λ = 0.80, Δ = 1.00		
20	69.51	174.92	503.23	1063.29	2155.24
50	42.28	124.75	417.44	954.77	2024.41
100	26.04	78.01	317.75	807.55	1855.46
500	14.03	27.73	85.29	276.91	854.93
			λ = 0.80, Δ = 2.00		
20	34.92	119.02	420.00	986.07	2113.22
50	8.49	32.98	176.90	547.79	1367.83
100	3.49	8.53	62.99	239.17	740.27
500	2.59	3.28	4.67	10.90	43.28
			λ = 0.80, Δ = 3.00		
20	12.98	60.11	271.14	720.25	1670.09
50	1.82	4.10	43.11	172.85	531.06
100	1.40	1.72	4.32	26.96	117.34
500	1.20	1.34	1.49	1.66	1.81

Table 67

Out of Control ARL_0 for SSDMEWMA of Dimension 7 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05$, $\Delta = 0.25$		
20	55.59	126.11	366.87	807.48	1750.78
50	46.20	95.08	272.51	613.05	1421.68
100	39.10	72.61	192.48	433.36	1070.90
500	35.41	50.81	87.65	150.10	298.41
			$\lambda = 0.05$, $\Delta = 0.50$		
20	31.22	61.67	189.34	458.40	1158.62
50	24.02	36.52	79.73	185.28	494.94
100	21.15	29.12	44.37	78.59	179.81
500	18.76	24.57	30.67	35.36	40.73
			$\lambda = 0.05$, $\Delta = 1.00$		
20	14.94	20.22	35.06	72.27	204.24
50	13.40	16.36	20.08	23.56	30.56
100	12.54	15.17	18.06	19.97	21.90
500	11.07	14.08	16.31	17.82	19.20
			$\lambda = 0.05$, $\Delta = 2.00$		
20	9.60	11.91	14.50	16.16	18.44
50	8.89	10.52	12.39	13.60	14.68
100	8.26	9.76	11.30	12.30	13.18
500	7.18	8.91	10.10	10.93	11.64
			$\lambda = 0.05$, $\Delta = 3.00$		
20	8.06	9.93	11.98	13.28	14.47
50	7.34	8.64	10.16	11.13	11.99
100	6.68	7.87	9.08	9.88	10.56
500	5.43	6.90	7.83	8.46	9.00

Table 68

Out of Control ARL_0 for SSDMEWMA of Dimension 7 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	60.23	136.34	399.54	852.44	1839.75
50	48.08	107.34	322.55	705.63	1606.28
100	40.60	84.27	245.57	569.03	1351.20
500	26.71	53.54	118.33	240.64	570.76
	λ = 0.10, Δ = 0.50				
20	32.01	71.88	240.37	581.32	1408.37
50	21.41	38.10	112.64	295.05	810.50
100	18.34	27.36	59.57	137.96	380.98
500	14.04	20.85	27.72	35.86	55.45
	λ = 0.10, Δ = 1.00				
20	11.92	17.78	42.71	119.19	377.61
50	9.57	11.69	15.12	22.86	52.44
100	8.89	10.56	12.49	13.91	16.88
500	7.71	9.73	11.21	12.23	13.19
	λ = 0.10, Δ = 2.00				
20	6.65	7.91	9.31	10.48	14.14
50	5.73	6.63	7.57	8.20	8.81
100	5.32	6.08	6.90	7.45	7.93
500	4.75	5.58	6.31	6.74	7.16
	λ = 0.10, Δ = 3.00				
20	5.38	6.34	7.37	8.10	8.77
50	4.53	5.18	5.91	6.38	6.83
100	4.10	4.67	5.29	5.69	6.05
500	3.50	4.18	4.69	5.00	5.30

Table 69

Out of Control ARL_0 for SSDMEWMA of Dimension 7 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	68.96	157.59	438.41	923.27	1891.40
50	57.49	136.64	382.21	837.84	1762.92
100	49.41	113.68	325.18	744.74	1593.29
500	34.74	71.52	184.32	408.51	989.29
			$\lambda = 0.20, \Delta = 0.50$		
20	39.44	99.79	321.60	748.68	1652.86
50	25.12	58.62	194.86	508.08	1226.39
100	19.44	37.55	113.77	312.23	808.27
500	15.77	21.29	38.78	69.23	153.02
			$\lambda = 0.20, \Delta = 1.00$		
20	11.18	23.35	92.26	294.42	802.36
50	7.52	10.25	20.28	62.20	212.50
100	6.74	8.15	11.05	16.15	48.06
500	5.35	7.02	8.32	9.51	10.57
			$\lambda = 0.20, \Delta = 2.00$		
20	4.19	4.98	6.62	12.02	53.39
50	3.56	4.02	4.58	4.99	5.37
100	3.30	3.72	4.17	4.50	4.79
500	3.00	3.39	3.79	4.08	4.33
			$\lambda = 0.20, \Delta = 3.00$		
20	3.13	3.58	4.10	4.50	5.72
50	2.59	2.92	3.28	3.53	3.75
100	2.37	2.66	2.95	3.15	3.34
500	2.29	2.37	2.64	2.81	2.97

Table 70

Out of Control ARL_0 for SSDMEWMA of Dimension 7 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	75.59	167.03	460.27	965.32	1954.29
50	65.75	147.21	421.32	904.56	1869.18
100	57.04	130.15	373.87	827.63	1750.80
500	39.07	93.59	239.68	533.99	1253.40
			λ = 0.30, Δ = 0.50		
20	49.15	120.85	379.60	851.59	1815.37
50	32.07	77.92	265.98	648.85	1497.68
100	23.83	53.10	176.12	456.46	1157.21
500	17.31	28.82	59.90	125.23	342.96
			λ = 0.30, Δ = 1.00		
20	14.44	38.38	167.10	459.56	1199.75
50	7.55	13.13	46.93	154.48	492.33
100	6.35	8.29	16.99	42.80	168.39
500	5.23	6.54	8.12	9.85	12.79
			λ = 0.30, Δ = 2.00		
20	3.27	4.29	11.99	42.49	168.75
50	2.69	3.04	3.51	4.44	7.85
100	2.47	2.77	3.16	3.40	3.67
500	2.30	2.59	2.84	3.07	3.29
			λ = 0.30, Δ = 3.00		
20	2.21	2.50	3.05	4.72	13.24
50	1.84	2.03	2.27	2.44	2.60
100	1.69	1.85	2.04	2.18	2.31
500	1.50	1.71	1.85	1.97	2.08

Table 71

Out of Control ARL_0 for SSDMEWMA of Dimension 7 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	79.36	173.44	462.67	982.54	1979.00
50	69.97	157.99	435.98	943.81	1939.05
100	61.90	145.05	402.52	883.48	1861.40
500	50.48	106.29	279.60	643.40	1474.66
	λ = 0.40, Δ = 0.50				
20	57.11	139.09	415.15	919.38	1902.24
50	38.92	97.17	325.25	762.19	1689.22
100	28.89	67.56	237.34	582.00	1422.22
500	15.87	34.31	83.92	208.24	573.97
	λ = 0.40, Δ = 1.00				
20	20.52	59.20	246.55	645.59	1508.20
50	8.90	20.03	89.56	281.56	821.76
100	6.68	10.57	34.80	112.30	376.79
500	4.48	6.23	9.05	12.85	26.47
	λ = 0.40, Δ = 2.00				
20	3.00	5.64	32.34	126.09	439.34
50	2.27	2.63	3.92	9.83	36.04
100	2.08	2.33	2.64	2.97	4.51
500	1.68	2.07	2.36	2.59	2.81
	λ = 0.40, Δ = 3.00				
20	1.74	1.99	3.44	11.70	55.22
50	1.46	1.59	1.76	1.90	2.04
100	1.36	1.46	1.59	1.69	1.79
500	1.13	1.34	1.46	1.56	1.64

Table 72

Out of Control ARL_0 for SSDMEWMA of Dimension 7 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	83.40	176.22	485.31	983.38	1969.32
50	75.40	164.30	457.53	953.63	1949.05
100	68.65	149.72	431.41	916.31	1906.43
500	53.95	123.00	321.83	722.16	1619.04
			$\lambda = 0.50, \Delta = 0.50$		
20	65.23	151.02	446.59	942.61	1928.96
50	46.67	114.34	370.08	832.16	1790.85
100	35.61	84.19	290.96	694.39	1608.77
500	28.02	42.94	131.01	303.38	819.52
			$\lambda = 0.50, \Delta = 1.00$		
20	29.82	84.54	320.26	764.44	1703.24
50	12.86	32.33	152.39	445.83	1145.01
100	8.04	16.04	65.78	217.62	678.32
500	4.81	7.46	12.91	23.10	74.79
			$\lambda = 0.50, \Delta = 2.00$		
20	4.10	12.83	82.58	263.10	760.40
50	2.12	2.72	8.26	31.18	123.01
100	1.92	2.17	2.61	4.32	15.02
500	1.75	1.89	2.18	2.41	2.68
			$\lambda = 0.50, \Delta = 3.00$		
20	1.53	1.96	10.20	44.87	178.79
50	1.29	1.37	1.54	1.72	4.38
100	1.22	1.29	1.39	1.47	1.55
500	1.24	1.20	1.31	1.36	1.42

Table 73

Out of Control ARL_0 for SSDMEWMA of Dimension 7 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	86.48	184.19	488.38	1002.20	1992.36
50	80.74	176.54	477.16	980.28	1987.50
100	72.20	159.51	454.92	949.19	1948.91
500	53.09	131.14	350.71	792.08	1743.09
			λ = 0.60, Δ = 0.50		
20	72.72	167.33	470.46	980.78	1981.46
50	55.60	136.05	413.74	909.04	1906.77
100	42.68	104.02	342.82	788.76	1754.74
500	25.56	52.49	164.82	419.73	1109.51
			λ = 0.60, Δ = 1.00		
20	40.24	115.17	387.08	885.29	1865.70
50	17.97	54.76	236.85	612.95	1461.22
100	10.81	25.60	117.96	368.61	1009.76
500	7.70	10.04	21.18	51.19	188.77
			λ = 0.60, Δ = 2.00		
20	7.33	29.22	156.82	462.28	1165.96
50	2.49	4.73	27.46	103.19	340.21
100	1.93	2.29	3.90	16.95	82.22
500	1.91	1.87	2.25	2.57	2.98
			λ = 0.60, Δ = 3.00		
20	1.62	5.09	33.31	136.32	442.67
50	1.23	1.33	1.76	7.45	30.61
100	1.18	1.25	1.35	1.42	1.85
500	1.29	1.17	1.26	1.31	1.37

Table 74

Out of Control ARL_0 for SSDMEWMA of Dimension 7 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	90.09	193.46	503.62	1043.74	2033.20
50	87.21	188.78	498.82	1032.78	2038.22
100	82.48	179.69	489.52	1017.35	2021.77
500	45.47	146.50	417.53	927.42	1909.25
			λ = 0.80, Δ = 0.50		
20	85.04	188.79	507.85	1052.50	2056.52
50	73.26	168.86	488.75	1031.06	2040.82
100	61.53	144.72	452.86	978.80	1993.31
500	27.98	85.10	284.21	695.73	1609.87
			λ = 0.80, Δ = 1.00		
20	68.20	171.76	506.52	1078.09	2100.68
50	40.71	115.78	407.12	944.11	1964.37
100	24.46	72.33	302.87	791.56	1726.08
500	9.35	19.66	80.53	247.92	791.27
			λ = 0.80, Δ = 2.00		
20	33.72	113.14	422.41	988.34	2016.02
50	8.18	32.28	175.34	531.67	1265.31
100	3.18	8.80	59.51	225.37	687.49
500	1.90	2.74	4.01	8.42	43.24
			λ = 0.80, Δ = 3.00		
20	13.38	56.18	265.24	706.12	1608.77
50	1.82	5.39	47.28	168.47	511.37
100	1.41	1.89	5.68	27.38	100.32
500	1.38	1.31	1.53	1.63	1.77

Table 75

Out of Control ARL_0 for SSDMEWMA of Dimension 8 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	51.28	118.27	349.82	768.76	1689.38
50	43.07	86.82	248.95	564.55	1323.80
100	36.75	67.18	176.00	398.96	956.71
500	31.87	50.39	82.80	136.57	283.05
			λ = 0.05, Δ = 0.50		
20	28.36	56.21	174.63	415.03	1042.87
50	22.51	33.68	72.04	165.31	433.52
100	20.11	27.02	41.44	69.15	153.96
500	17.20	23.50	29.18	33.12	37.87
			λ = 0.05, Δ = 1.00		
20	14.36	19.44	32.45	61.27	170.51
50	12.87	15.75	19.33	22.52	29.76
100	12.06	14.55	17.28	19.06	20.74
500	11.20	13.47	15.88	17.20	18.36
			λ = 0.05, Δ = 2.00		
20	9.55	11.88	14.44	16.08	17.69
50	8.67	10.32	12.19	13.36	14.44
100	7.99	9.45	10.98	11.96	12.82
500	7.00	8.41	9.84	10.59	11.22
			λ = 0.05, Δ = 3.00		
20	8.10	10.00	12.06	13.35	14.52
50	7.21	8.55	10.08	11.03	11.91
100	6.52	7.66	8.89	9.67	10.36
500	5.38	6.56	7.66	8.22	8.71

Table 76

Out of Control ARL_0 for SSDMEWMA of Dimension 8 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.10, \Delta = 0.25$				
20	55.44	130.24	385.54	844.13	1819.14
50	44.48	100.37	295.82	691.43	1564.93
100	38.75	80.87	230.23	522.33	1259.04
500	27.05	52.26	109.73	220.61	530.89
	$\lambda = 0.10, \Delta = 0.50$				
20	29.11	66.20	218.40	550.84	1324.37
50	19.86	36.10	97.43	261.08	748.29
100	17.29	25.64	52.77	126.24	356.96
500	12.67	19.31	26.49	33.13	46.07
	$\lambda = 0.10, \Delta = 1.00$				
20	11.16	16.47	39.43	108.33	354.49
50	9.15	11.07	14.58	22.34	51.12
100	8.62	10.12	11.88	13.32	15.94
500	7.52	9.27	10.73	11.71	12.57
	$\lambda = 0.10, \Delta = 2.00$				
20	6.49	7.72	9.10	10.50	13.35
50	5.55	6.41	7.36	7.99	8.58
100	5.17	5.89	6.67	7.19	7.67
500	4.48	5.36	6.05	6.49	6.87
	$\lambda = 0.10, \Delta = 3.00$				
20	5.30	6.25	7.28	7.99	8.65
50	4.42	5.07	5.80	6.28	6.71
100	4.01	4.55	5.15	5.53	5.90
500	3.48	4.05	4.51	4.83	5.09

Table 77

Out of Control ARL_0 for SSDMEWMA of Dimension 8 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.20, \Delta = 0.25$				
20	64.57	148.17	428.33	915.43	1913.50
50	52.71	123.28	369.74	800.28	1738.42
100	46.22	104.94	307.24	695.19	1559.70
500	24.65	76.94	175.59	377.32	932.41
	$\lambda = 0.20, \Delta = 0.50$				
20	36.55	91.90	299.86	702.00	1605.94
50	23.47	51.98	180.07	464.01	1135.13
100	18.26	34.57	106.72	281.27	733.22
500	13.22	22.77	36.45	61.99	146.01
	$\lambda = 0.20, \Delta = 1.00$				
20	10.22	21.91	87.55	265.31	736.72
50	7.19	9.52	21.03	59.93	185.64
100	6.45	7.79	10.81	18.86	46.09
500	4.48	6.78	8.06	9.05	10.07
	$\lambda = 0.20, \Delta = 2.00$				
20	4.07	4.74	6.30	14.08	40.15
50	3.42	3.89	4.41	4.79	5.16
100	3.18	3.57	4.01	4.31	4.60
500	2.27	3.33	3.65	3.91	4.13
	$\lambda = 0.20, \Delta = 3.00$				
20	3.06	3.49	4.02	4.39	4.98
50	2.53	2.84	3.19	3.42	3.65
100	2.32	2.57	2.86	3.06	3.24
500	1.63	2.34	2.54	2.70	2.85

Table 78

Out of Control ARL_0 for SSDMEWMA of Dimension 8 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	69.64	161.61	453.09	947.93	1960.90
50	61.17	139.41	404.19	890.49	1864.27
100	51.79	120.51	352.51	792.52	1721.93
500	48.17	89.61	226.80	513.34	1238.46
			λ = 0.30, Δ = 0.50		
20	44.33	114.50	359.24	811.29	1784.38
50	29.39	74.65	246.75	610.07	1425.46
100	22.27	48.02	160.89	424.41	1051.18
500	13.83	28.63	55.62	116.40	323.24
			λ = 0.30, Δ = 1.00		
20	12.83	35.83	154.48	438.74	1117.49
50	7.10	11.93	43.11	139.49	429.26
100	6.00	8.08	16.45	44.33	153.56
500	5.00	6.33	8.00	9.60	12.82
			λ = 0.30, Δ = 2.00		
20	3.17	4.21	10.84	41.70	150.28
50	2.58	2.92	3.36	3.89	8.61
100	2.40	2.66	3.01	3.25	3.50
500	2.20	2.47	2.74	2.92	3.12
			λ = 0.30, Δ = 3.00		
20	2.14	2.44	2.88	4.60	11.74
50	1.79	1.98	2.19	2.36	2.52
100	1.66	1.80	1.99	2.11	2.24
500	1.52	1.70	1.81	1.92	2.01

Table 79

Out of Control ARL_0 for SSDMEWMA of Dimension 8 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	74.79	166.45	468.01	954.20	1990.14
50	64.70	150.72	437.13	914.29	1907.36
100	58.22	132.88	393.19	831.98	1791.00
500	51.43	95.49	289.28	602.29	1387.96
	λ = 0.40, Δ = 0.50				
20	51.81	129.85	406.59	886.63	1890.28
50	35.06	91.23	308.41	715.89	1623.27
100	27.32	62.82	218.22	535.68	1309.82
500	22.32	31.46	86.48	191.80	526.68
	λ = 0.40, Δ = 1.00				
20	18.03	54.36	231.67	589.51	1433.60
50	8.36	19.07	87.49	263.48	762.31
100	6.61	10.33	33.40	108.32	350.52
500	5.37	6.55	9.48	13.28	23.49
	λ = 0.40, Δ = 2.00				
20	2.95	5.20	29.76	117.26	374.87
50	2.16	2.49	3.72	7.25	30.96
100	2.01	2.24	2.56	2.82	4.34
500	1.90	2.07	2.32	2.50	2.67
	λ = 0.40, Δ = 3.00				
20	1.69	2.20	3.58	9.41	44.21
50	1.43	1.55	1.72	1.84	2.43
100	1.34	1.45	1.57	1.66	1.75
500	1.30	1.36	1.48	1.54	1.60

Table 80

Out of Control ARL_0 for SSDMEWMA of Dimension 8 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.50, \Delta = 0.25$				
20	78.25	174.81	476.73	971.71	1957.33
50	70.46	159.20	448.13	940.90	1913.57
100	63.22	146.62	410.70	883.07	1855.70
500	32.37	101.12	313.37	686.99	1515.92
	$\lambda = 0.50, \Delta = 0.50$				
20	59.56	145.21	440.36	927.27	1925.31
50	42.77	106.96	356.90	817.75	1743.19
100	33.02	80.54	269.06	664.41	1503.00
500	18.67	38.13	119.04	295.34	766.71
	$\lambda = 0.50, \Delta = 1.00$				
20	26.12	76.58	303.45	737.81	1671.71
50	11.38	31.39	140.47	418.96	1088.01
100	7.77	15.35	61.42	208.72	618.80
500	4.90	7.07	12.58	24.52	69.19
	$\lambda = 0.50, \Delta = 2.00$				
20	3.40	11.17	69.59	246.57	698.84
50	2.04	2.78	7.18	29.47	105.17
100	1.85	2.11	2.66	6.12	17.89
500	1.42	1.91	2.17	2.34	2.55
	$\lambda = 0.50, \Delta = 3.00$				
20	1.54	1.89	6.88	35.42	146.95
50	1.26	1.35	1.62	1.73	2.37
100	1.22	1.28	1.37	1.46	1.53
500	1.06	1.21	1.30	1.35	1.41

Table 81

Out of Control ARL_0 for SSDMEWMA of Dimension 8 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	81.65	177.24	482.10	987.41	1969.66
50	75.08	167.21	467.16	965.26	1949.32
100	70.89	155.00	440.38	934.24	1904.49
500	48.03	125.28	345.72	746.65	1621.81
			$\lambda = 0.60, \Delta = 0.50$		
20	66.88	158.03	463.57	979.32	1969.75
50	50.21	125.42	399.74	882.86	1842.98
100	40.45	96.41	329.50	760.71	1672.54
500	17.61	55.80	155.87	391.44	1013.69
			$\lambda = 0.60, \Delta = 1.00$		
20	36.76	101.49	377.10	861.04	1831.05
50	17.09	49.48	217.69	585.92	1378.04
100	10.20	#N/A	115.22	356.54	967.34
500	4.66	9.39	19.09	48.06	170.69
			$\lambda = 0.60, \Delta = 2.00$		
20	6.67	24.12	141.62	426.70	1104.22
50	2.25	3.90	19.98	83.70	313.93
100	1.88	2.32	5.29	12.77	63.66
500	1.48	1.92	2.22	2.50	2.76
			$\lambda = 0.60, \Delta = 3.00$		
20	1.72	3.49	28.25	126.50	409.61
50	1.22	1.32	1.93	3.91	22.18
100	1.19	1.24	1.33	1.40	1.63
500	1.00	1.18	1.25	1.30	1.34

Table 82

Out of Control ARL_0 for SSDMEWMA of Dimension 8 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	89.74	189.26	492.47	1017.82	1996.08
50	83.42	181.35	483.69	999.16	1989.82
100	79.64	174.64	463.38	988.51	1978.17
500	77.12	144.39	392.75	892.25	1844.33
			λ = 0.80, Δ = 0.50		
20	82.71	184.41	498.49	1031.95	2031.34
50	69.80	162.41	461.20	988.21	2000.26
100	57.92	138.04	415.71	937.05	1927.69
500	36.94	86.65	253.42	652.06	1533.99
			λ = 0.80, Δ = 1.00		
20	65.62	166.66	491.40	1041.08	2083.79
50	38.28	113.83	388.48	889.42	1901.63
100	23.56	70.49	276.92	724.96	1652.04
500	7.53	19.97	67.94	247.06	757.67
			λ = 0.80, Δ = 2.00		
20	32.83	106.99	400.61	916.34	1977.30
50	6.95	29.54	171.11	500.05	1258.68
100	3.24	8.35	55.45	211.55	674.24
500	1.65	2.87	3.81	8.82	34.46
			λ = 0.80, Δ = 3.00		
20	12.05	50.43	250.97	669.66	1591.11
50	1.65	6.20	44.19	162.39	474.34
100	1.39	1.55	4.38	23.62	113.87
500	1.00	1.33	1.49	1.61	1.75

Table 83

Out of Control ARL_0 for SSDMEWMA of Dimension 9 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05, \Delta = 0.25$				
20	48.42	110.31	321.29	737.77	1642.71
50	39.61	80.18	222.31	528.50	1271.10
100	35.55	63.34	157.41	371.54	905.35
500	29.63	46.11	75.71	126.60	249.92
	$\lambda = 0.05, \Delta = 0.50$				
20	27.03	51.90	146.58	371.48	948.93
50	21.08	31.90	61.97	139.91	379.32
100	19.30	25.50	37.37	60.86	136.10
500	18.25	22.25	27.64	31.63	36.06
	$\lambda = 0.05, \Delta = 1.00$				
20	14.20	18.97	29.31	56.17	149.79
50	12.44	15.22	18.54	21.01	27.47
100	11.56	14.01	16.67	18.40	19.93
500	10.75	12.75	14.97	16.45	17.61
	$\lambda = 0.05, \Delta = 2.00$				
20	9.61	11.96	14.40	16.02	17.49
50	8.49	10.09	11.90	13.06	14.09
100	7.73	9.18	10.70	11.64	12.46
500	6.63	8.10	9.35	10.17	10.80
	$\lambda = 0.05, \Delta = 3.00$				
20	8.22	10.17	12.15	13.42	14.55
50	7.10	8.43	9.91	10.86	11.70
100	6.34	7.50	8.70	9.47	10.13
500	5.13	6.33	7.31	7.93	8.41

Table 84

Out of Control ARL_0 for SSDMEWMA of Dimension 9 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	51.53	121.99	371.75	818.29	1767.86
50	41.89	91.64	292.11	652.10	1499.74
100	36.12	74.02	216.16	504.83	1218.25
500	23.31	47.94	105.20	206.18	509.30
			$\lambda = 0.10, \Delta = 0.50$		
20	26.42	58.43	204.84	492.98	1227.87
50	18.93	33.16	92.31	241.22	658.15
100	16.35	23.27	47.95	113.61	318.78
500	11.75	18.39	24.62	30.18	42.46
			$\lambda = 0.10, \Delta = 1.00$		
20	10.69	15.14	35.24	93.76	285.11
50	8.77	10.58	13.37	19.68	43.77
100	8.00	9.53	11.31	12.72	14.45
500	7.19	8.93	10.23	11.05	11.91
			$\lambda = 0.10, \Delta = 2.00$		
20	6.40	7.59	8.94	9.88	11.73
50	5.41	6.21	7.15	7.74	8.31
100	4.89	5.63	6.44	6.93	7.39
500	4.18	5.13	5.79	6.17	6.54
			$\lambda = 0.10, \Delta = 3.00$		
20	5.26	6.20	7.23	7.91	8.54
50	4.34	4.95	5.66	6.13	6.56
100	3.84	4.39	4.99	5.37	5.71
500	3.29	3.85	4.34	4.61	4.89

Table 85

Out of Control ARL_0 for SSDMEWMA of Dimension 9 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	60.31	141.29	420.03	896.55	1861.08
50	51.21	115.78	354.54	788.96	1701.89
100	44.05	94.61	291.17	670.24	1502.92
500	21.81	63.13	170.22	374.01	893.98
			λ = 0.20, Δ = 0.50		
20	32.78	81.60	287.66	685.56	1518.51
50	21.36	46.81	166.63	429.10	1054.96
100	17.04	30.35	93.75	251.15	689.77
500	13.00	20.37	31.74	54.79	138.77
			λ = 0.20, Δ = 1.00		
20	9.52	18.04	73.26	229.07	650.32
50	6.57	8.86	18.44	50.00	166.87
100	5.88	7.13	9.41	15.76	37.60
500	5.06	6.31	7.61	8.44	9.36
			λ = 0.20, Δ = 2.00		
20	3.92	4.56	5.89	9.37	29.01
50	3.28	3.73	4.22	4.58	4.93
100	3.01	3.39	3.82	4.09	4.36
500	2.63	3.13	3.51	3.70	3.93
			λ = 0.20, Δ = 3.00		
20	2.98	3.41	3.92	4.29	4.64
50	2.45	2.75	3.09	3.32	3.54
100	2.20	2.46	2.74	2.92	3.10
500	1.88	2.24	2.48	2.58	2.72

Table 86

Out of Control ARL_0 for SSDMEWMA of Dimension 9 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	68.78	158.26	447.97	934.91	1932.06
50	57.99	133.78	401.35	866.66	1814.94
100	52.14	117.58	349.70	774.68	1684.17
500	45.54	78.48	220.18	494.38	1164.38
			$\lambda = 0.30, \Delta = 0.50$		
20	40.86	108.06	347.98	794.13	1730.57
50	26.97	67.10	232.40	575.58	1341.04
100	20.35	42.74	149.99	401.65	1026.20
500	14.71	22.02	47.66	110.47	302.29
			$\lambda = 0.30, \Delta = 1.00$		
20	11.82	30.58	142.66	401.20	1057.92
50	6.42	11.01	39.82	127.78	396.00
100	5.39	7.00	14.06	37.05	132.11
500	4.92	5.42	7.11	8.52	11.00
			$\lambda = 0.30, \Delta = 2.00$		
20	3.03	3.98	8.08	29.64	113.30
50	2.47	2.78	3.22	3.67	5.64
100	2.28	2.52	2.83	3.06	3.30
500	2.17	2.31	2.58	2.78	2.97
			$\lambda = 0.30, \Delta = 3.00$		
20	2.09	2.36	2.76	3.37	6.31
50	1.73	1.90	2.12	2.28	2.43
100	1.60	1.74	1.90	2.02	2.14
500	1.43	1.57	1.74	1.83	1.93

Table 87

Out of Control ARL_0 for SSDMEWMA of Dimension 9 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	72.51	165.53	461.16	967.58	1969.61
50	63.92	145.81	426.45	907.36	1883.42
100	57.37	128.94	381.58	841.54	1801.31
500	33.50	81.96	264.19	590.85	1365.77
	λ = 0.40, Δ = 0.50				
20	49.51	126.36	393.92	874.66	1852.60
50	33.91	83.92	292.86	693.47	1571.37
100	24.45	58.41	207.37	539.65	1295.70
500	9.46	26.91	74.89	182.07	520.03
	λ = 0.40, Δ = 1.00				
20	16.65	49.03	215.81	578.42	1391.45
50	7.69	17.09	76.90	247.45	728.25
100	5.70	8.64	29.21	96.05	331.41
500	4.71	5.82	8.01	11.41	27.41
	λ = 0.40, Δ = 2.00				
20	2.74	4.42	23.74	99.46	342.62
50	2.10	2.42	2.93	5.73	32.49
100	1.94	2.14	2.40	2.64	3.66
500	1.61	1.93	2.18	2.37	2.55
	λ = 0.40, Δ = 3.00				
20	1.64	1.89	3.12	7.79	37.39
50	1.41	1.51	1.67	1.79	1.90
100	1.33	1.40	1.51	1.60	1.69
500	1.10	1.32	1.41	1.48	1.55

Table 88

Out of Control ARL_0 for SSDMEWMA of Dimension 9 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	76.87	171.63	464.34	958.70	1989.01
50	67.90	157.03	434.01	913.84	1937.85
100	60.97	139.92	403.23	862.15	1861.64
500	47.90	98.06	290.62	659.53	1505.76
			λ = 0.50, Δ = 0.50		
20	58.03	141.09	423.26	907.72	1931.94
50	40.67	101.63	331.28	765.72	1701.84
100	30.40	72.19	251.97	629.29	1494.88
500	23.18	35.69	101.23	267.51	743.76
			λ = 0.50, Δ = 1.00		
20	24.78	73.64	289.51	703.69	1619.69
50	10.81	28.75	130.11	380.94	1030.07
100	7.04	13.60	52.40	186.01	586.09
500	7.00	7.51	10.85	23.14	66.00
			λ = 0.50, Δ = 2.00		
20	3.39	9.52	61.25	206.43	648.55
50	2.00	2.37	6.52	27.51	99.18
100	1.80	2.00	2.32	3.03	15.26
500	1.82	1.83	2.04	2.21	2.42
			λ = 0.50, Δ = 3.00		
20	1.48	1.88	6.26	31.06	125.08
50	1.26	1.35	1.47	1.65	4.40
100	1.22	1.27	1.35	1.41	1.49
500	1.14	1.22	1.27	1.31	1.36

Table 89

Out of Control ARL_0 for SSDMEWMA of Dimension 9 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	80.43	174.69	470.99	969.58	1994.36
50	73.24	163.88	442.84	940.58	1944.76
100	66.69	147.88	414.10	895.53	1886.32
500	53.11	106.42	327.75	725.19	1613.42
	λ = 0.60, Δ = 0.50				
20	66.01	153.13	448.69	947.71	1971.87
50	48.76	119.81	371.82	830.45	1809.73
100	37.43	92.14	302.65	717.53	1634.31
500	28.97	49.52	146.93	369.00	996.50
	λ = 0.60, Δ = 1.00				
20	34.59	100.47	355.15	824.65	1811.71
50	16.36	46.24	199.97	524.09	1311.24
100	9.64	21.37	103.40	313.02	891.16
500	8.23	10.25	17.78	44.08	165.62
	λ = 0.60, Δ = 2.00				
20	6.13	24.15	125.59	402.28	1063.88
50	2.29	4.07	22.54	85.72	282.40
100	1.85	2.15	4.31	18.59	66.84
500	1.62	1.98	2.12	2.37	2.70
	λ = 0.60, Δ = 3.00				
20	1.76	4.30	25.17	107.11	356.04
50	1.24	1.32	1.94	5.93	27.78
100	1.20	1.24	1.30	1.39	1.48
500	1.00	1.23	1.23	1.28	1.33

Table 90

Out of Control ARL_0 for SSDMEWMA of Dimension 9 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	87.37	189.15	492.80	989.93	2004.42
50	81.79	179.10	480.44	973.64	1992.55
100	75.40	164.46	464.40	962.14	1964.83
500	61.86	136.59	383.25	831.11	1815.14
			$\lambda = 0.80, \Delta = 0.50$		
20	80.57	183.67	494.66	1003.61	2033.98
50	65.46	155.88	459.89	951.00	1991.68
100	53.84	128.88	406.41	888.18	1894.22
500	31.77	75.33	248.99	608.30	1468.25
			$\lambda = 0.80, \Delta = 1.00$		
20	62.91	164.26	490.57	1016.10	2077.82
50	36.40	103.54	375.08	836.52	1839.49
100	22.31	64.26	262.39	670.94	1597.77
500	12.67	19.03	65.15	213.30	707.71
			$\lambda = 0.80, \Delta = 2.00$		
20	31.56	103.91	388.02	887.70	1932.81
50	8.01	29.10	165.05	451.17	1186.80
100	3.28	8.90	55.75	194.85	618.18
500	2.36	2.51	4.20	6.63	40.83
			$\lambda = 0.80, \Delta = 3.00$		
20	11.01	49.96	238.94	627.28	1541.80
50	2.09	7.01	40.89	147.79	457.53
100	1.40	1.72	6.19	34.90	131.18
500	1.14	1.35	1.50	1.59	1.76

Table 91

Out of Control ARL_0 for SSDMEWMA of Dimension 10 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	45.37	108.00	314.10	690.31	1556.24
50	36.18	76.67	213.65	488.07	1145.52
100	31.64	58.71	148.18	333.16	816.76
500	31.40	40.39	72.47	117.66	238.70
			λ = 0.05, Δ = 0.50		
20	25.31	49.19	136.40	333.56	862.35
50	19.89	30.10	60.78	134.43	351.05
100	17.87	24.39	36.17	59.84	130.91
500	19.10	21.93	26.79	30.56	34.84
			λ = 0.05, Δ = 1.00		
20	13.88	18.63	28.29	49.71	123.98
50	12.03	14.94	18.33	20.86	24.97
100	11.08	13.47	16.02	17.67	19.28
500	11.80	12.62	14.72	15.99	17.12
			λ = 0.05, Δ = 2.00		
20	9.62	12.10	14.48	15.99	17.69
50	8.32	10.05	11.78	12.93	13.95
100	7.55	8.91	10.40	11.32	12.17
500	7.50	7.95	9.21	9.92	10.55
			λ = 0.05, Δ = 3.00		
20	8.28	10.35	12.31	13.53	14.68
50	7.01	8.45	9.88	10.82	11.67
100	6.24	7.31	8.52	9.27	9.96
500	5.70	6.24	7.20	7.75	8.23

Table 92

Out of Control ARL_0 for SSDMEWMA of Dimension 10 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.10, \Delta = 0.25$				
20	47.70	117.27	349.30	763.39	1691.39
50	37.90	88.54	261.76	603.90	1387.13
100	33.35	69.23	199.57	451.09	1114.27
500	32.57	45.02	98.85	194.79	442.83
	$\lambda = 0.10, \Delta = 0.50$				
20	24.63	55.47	181.01	458.85	1108.89
50	17.39	30.94	85.42	224.29	603.22
100	15.19	21.87	45.60	102.44	279.82
500	17.29	17.86	23.38	29.10	40.13
	$\lambda = 0.10, \Delta = 1.00$				
20	10.36	14.26	30.56	81.51	255.74
50	8.47	10.32	13.12	17.80	38.28
100	7.80	9.22	10.77	12.12	14.18
500	8.21	8.73	9.80	10.61	11.40
	$\lambda = 0.10, \Delta = 2.00$				
20	6.31	7.53	8.91	9.96	11.66
50	5.30	6.16	7.05	7.62	8.16
100	4.79	5.50	6.23	6.71	7.15
500	4.86	5.05	5.61	5.97	6.33
	$\lambda = 0.10, \Delta = 3.00$				
20	5.22	6.18	7.20	7.87	8.49
50	4.28	4.93	5.63	6.08	6.49
100	3.77	4.31	4.85	5.23	5.56
500	3.71	3.77	4.20	4.47	4.73

Table 93

Out of Control ARL_0 for SSDMEWMA of Dimension 10 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	57.52	136.97	400.85	850.79	1831.22
50	46.68	109.76	333.88	744.63	1632.28
100	39.93	87.19	268.71	625.05	1419.26
500	32.42	62.79	152.42	333.12	801.80
	λ = 0.20, Δ = 0.50				
20	30.58	76.43	267.44	639.70	1460.80
50	20.03	43.53	152.33	394.90	998.92
100	15.95	28.15	88.64	228.73	616.39
500	12.42	17.45	32.78	51.89	123.15
	λ = 0.20, Δ = 1.00				
20	8.94	17.72	69.04	213.42	614.82
50	6.36	8.34	15.88	48.94	153.03
100	5.62	6.74	8.75	13.95	36.27
500	4.95	6.05	7.21	8.03	8.79
	λ = 0.20, Δ = 2.00				
20	3.90	4.51	5.95	9.14	30.02
50	3.22	3.65	4.14	4.47	4.80
100	2.95	3.26	3.67	3.94	4.19
500	2.78	2.95	3.34	3.56	3.74
	λ = 0.20, Δ = 3.00				
20	2.97	3.37	3.89	4.23	4.59
50	2.42	2.70	3.03	3.25	3.46
100	2.17	2.39	2.64	2.82	2.99
500	2.00	2.11	2.35	2.48	2.60

Table 94

Out of Control ARL_0 for SSDMEWMA of Dimension 10 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	63.24	151.91	430.18	894.85	1857.30
50	53.88	126.51	376.66	807.70	1706.03
100	45.38	107.55	318.42	709.65	1556.75
500	32.56	76.16	198.74	434.54	1050.70
			λ = 0.30, Δ = 0.50		
20	38.26	98.96	327.87	740.49	1617.87
50	25.05	62.78	212.32	532.22	1246.94
100	18.47	40.15	134.62	357.97	914.75
500	11.76	22.67	46.98	100.17	265.34
			λ = 0.30, Δ = 1.00		
20	10.98	29.94	128.80	370.42	967.78
50	6.22	10.83	35.72	124.13	381.16
100	5.06	6.90	14.26	34.33	131.30
500	5.36	5.55	6.92	8.00	9.71
			λ = 0.30, Δ = 2.00		
20	2.95	3.87	9.80	29.28	112.01
50	2.41	2.72	3.08	3.84	6.66
100	2.19	2.46	2.74	2.94	3.13
500	2.44	2.21	2.49	2.64	2.80
			λ = 0.30, Δ = 3.00		
20	2.07	2.34	2.68	3.61	8.73
50	1.70	1.87	2.07	2.21	2.35
100	1.56	1.69	1.84	1.95	2.06
500	1.57	1.55	1.68	1.76	1.86

Table 95

Out of Control ARL_0 for SSDMEWMA of Dimension 10 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	69.76	159.13	443.79	946.45	1924.13
50	58.88	136.55	403.68	867.22	1795.22
100	52.02	118.68	355.10	785.96	1668.50
500	31.23	85.94	234.49	534.27	1205.57
			$\lambda = 0.40, \Delta = 0.50$		
20	46.91	115.81	367.94	824.38	1770.25
50	31.93	78.12	267.77	632.11	1441.29
100	23.32	53.29	187.94	471.68	1144.37
500	14.12	29.75	67.42	163.86	455.48
			$\lambda = 0.40, \Delta = 1.00$		
20	15.82	47.11	201.63	526.05	1276.98
50	7.15	16.84	71.12	233.88	633.54
100	5.34	9.04	26.75	83.11	279.22
500	4.88	6.29	7.93	10.49	19.01
			$\lambda = 0.40, \Delta = 2.00$		
20	2.74	4.91	21.98	83.48	305.70
50	2.05	2.33	3.13	7.41	25.22
100	1.90	2.08	2.35	3.03	3.51
500	1.72	1.94	2.12	2.27	2.41
			$\lambda = 0.40, \Delta = 3.00$		
20	1.64	1.84	2.88	8.79	39.37
50	1.38	1.48	1.62	1.73	1.85
100	1.31	1.38	1.48	1.56	1.64
500	1.21	1.30	1.39	1.45	1.50

Table 96

Out of Control ARL_0 for SSDMEWMA of Dimension 10 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	72.12	162.84	455.93	942.16	1974.83
50	63.37	144.37	424.21	886.80	1905.16
100	58.47	126.87	381.30	834.31	1800.43
500	40.50	102.68	268.12	606.08	1388.51
			$\lambda = 0.50, \Delta = 0.50$		
20	52.65	130.51	401.74	873.68	1902.55
50	37.30	93.11	315.95	715.27	1631.60
100	29.07	66.81	230.94	582.71	1376.88
500	19.62	37.00	95.52	239.45	686.87
			$\lambda = 0.50, \Delta = 1.00$		
20	22.36	67.58	265.75	655.08	1563.38
50	10.27	26.82	125.10	355.18	930.79
100	6.40	12.82	49.26	169.48	536.66
500	6.26	7.06	10.96	19.67	59.40
			$\lambda = 0.50, \Delta = 2.00$		
20	3.42	9.17	56.62	195.78	629.03
50	1.93	2.32	5.45	25.26	104.41
100	1.76	1.95	2.65	4.53	16.25
500	1.78	1.81	2.03	2.16	2.34
			$\lambda = 0.50, \Delta = 3.00$		
20	1.46	2.33	8.47	33.91	134.90
50	1.23	1.31	1.44	1.54	3.58
100	1.20	1.23	1.32	1.38	1.45
500	1.35	1.20	1.25	1.29	1.34

Table 97

Out of Control ARL_0 for SSDMEWMA of Dimension 10 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60$, $\Delta = 0.25$		
20	76.16	169.89	466.13	971.86	1980.09
50	69.17	151.65	434.43	928.83	1910.85
100	63.04	136.77	406.83	869.11	1841.71
500	45.97	104.57	313.17	685.06	1535.84
			$\lambda = 0.60$, $\Delta = 0.50$		
20	61.01	144.78	436.95	940.61	1937.58
50	45.77	110.46	354.75	805.29	1733.37
100	36.11	82.98	282.72	682.39	1538.25
500	27.07	47.88	134.45	353.38	907.85
			$\lambda = 0.60$, $\Delta = 1.00$		
20	32.23	91.99	342.45	796.57	1737.71
50	15.18	43.46	187.20	501.52	1211.04
100	8.95	19.37	93.30	294.87	822.07
500	4.17	8.54	18.85	47.04	163.01
			$\lambda = 0.60$, $\Delta = 2.00$		
20	5.69	21.25	129.13	373.32	989.52
50	2.16	3.69	20.81	82.81	272.46
100	1.86	2.08	4.35	17.38	69.61
500	2.26	1.88	2.07	2.32	2.67
			$\lambda = 0.60$, $\Delta = 3.00$		
20	1.60	3.69	27.19	97.15	335.53
50	1.22	1.31	1.81	6.66	25.29
100	1.18	1.22	1.28	1.36	1.53
500	1.10	1.17	1.21	1.27	1.30

Table 98

Out of Control ARL_0 for SSDMEWMA of Dimension 10 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	83.83	182.71	482.00	1040.23	2047.44
50	78.27	173.21	467.10	1010.62	2044.33
100	73.06	161.67	449.15	978.59	2003.80
500	64.62	125.71	374.24	847.24	1810.18
			$\lambda = 0.80, \Delta = 0.50$		
20	76.53	174.73	483.78	1056.40	2076.64
50	63.20	151.20	441.47	983.32	1998.79
100	50.51	124.10	386.38	898.13	1907.94
500	28.04	69.95	230.97	591.86	1433.17
			$\lambda = 0.80, \Delta = 1.00$		
20	59.81	158.20	475.52	1050.20	2108.15
50	35.53	100.26	356.15	863.92	1878.59
100	22.06	59.67	250.02	664.57	1573.94
500	11.60	21.47	61.20	210.61	673.72
			$\lambda = 0.80, \Delta = 2.00$		
20	29.82	97.20	378.20	911.64	1986.13
50	7.93	26.11	153.19	478.11	1204.90
100	3.44	7.44	46.48	186.15	603.61
500	2.00	2.79	3.93	10.14	43.41
			$\lambda = 0.80, \Delta = 3.00$		
20	11.41	46.97	230.06	652.19	1568.38
50	1.98	5.00	40.66	156.27	494.40
100	1.46	1.59	5.84	32.89	150.65
500	1.00	1.31	1.49	1.60	3.73

Table 99

Out of Control ARL_0 for SSDMEWMA of Dimension 15 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	33.82	76.52	220.07	505.75	1166.68
50	25.99	52.18	143.31	348.66	825.31
100	23.31	41.15	94.27	217.67	552.21
500	40.67	31.71	47.42	76.12	138.47
			λ = 0.05, Δ = 0.50		
20	20.20	34.41	86.70	209.89	536.47
50	15.56	22.34	38.72	78.99	191.29
100	14.02	19.05	25.60	36.64	69.76
500	15.67	16.76	20.09	22.81	25.06
			λ = 0.05, Δ = 1.00		
20	13.00	16.99	22.26	31.63	56.28
50	10.16	12.70	15.38	17.31	21.27
100	9.18	11.35	13.47	14.82	15.95
500	8.33	10.21	11.74	12.76	13.59
			λ = 0.05, Δ = 2.00		
20	9.86	12.30	14.47	15.86	17.06
50	7.45	9.13	10.84	11.92	12.83
100	6.52	7.91	9.26	10.11	10.81
500	5.33	6.68	7.60	8.20	8.69
			λ = 0.05, Δ = 3.00		
20	8.76	10.88	12.74	13.91	14.89
50	6.46	7.92	9.40	10.33	11.11
100	5.53	6.69	7.84	8.56	9.14
500	4.33	5.33	6.07	6.54	6.94

Table 100

Out of Control ARL_0 for SSDMEWMA of Dimension 15 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	34.64	83.91	252.78	601.23	1344.66
50	27.62	59.98	180.96	453.67	1032.69
100	22.94	46.45	129.44	328.97	797.83
500	22.83	33.78	60.82	124.07	276.92
			$\lambda = 0.10, \Delta = 0.50$		
20	17.13	34.74	112.61	308.07	782.09
50	13.09	20.87	49.95	137.41	372.58
100	11.16	16.00	28.69	57.68	156.69
500	8.33	13.12	15.98	19.73	27.05
			$\lambda = 0.10, \Delta = 1.00$		
20	8.59	11.28	18.94	45.93	118.21
50	7.00	8.41	10.27	12.65	25.75
100	6.22	7.47	8.66	9.81	12.03
500	5.17	6.72	7.67	8.24	8.78
			$\lambda = 0.10, \Delta = 2.00$		
20	5.83	6.98	8.14	8.94	9.87
50	4.62	5.42	6.20	6.72	7.18
100	4.03	4.70	5.32	5.76	6.11
500	3.50	4.07	4.52	4.82	5.07
			$\lambda = 0.10, \Delta = 3.00$		
20	4.96	5.92	6.87	7.49	8.05
50	3.84	4.49	5.11	5.54	5.92
100	3.25	3.79	4.28	4.62	4.92
500	2.33	3.12	3.44	3.67	3.86

Table 101

Out of Control ARL_0 for SSDMEWMA of Dimension 15 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	41.10	101.24	302.83	695.17	1544.10
50	32.27	75.86	236.09	546.33	1274.38
100	28.37	61.06	185.61	436.13	1052.71
500	16.38	43.93	95.08	221.70	535.70
			λ = 0.20, Δ = 0.50		
20	20.00	51.71	178.92	455.64	1084.32
50	13.62	28.54	94.45	258.11	672.69
100	11.15	18.51	50.37	139.11	403.36
500	4.50	12.83	18.05	29.89	69.85
			λ = 0.20, Δ = 1.00		
20	6.65	11.51	36.95	121.30	381.47
50	5.00	6.22	10.78	28.17	86.75
100	4.39	5.22	6.68	10.09	20.07
500	3.13	4.98	5.37	5.89	6.36
			λ = 0.20, Δ = 2.00		
20	3.38	3.95	4.63	6.85	18.45
50	2.71	3.06	3.45	3.72	3.99
100	2.45	2.71	3.01	3.20	3.41
500	1.86	2.58	2.74	2.89	3.02
			λ = 0.20, Δ = 3.00		
20	2.66	3.06	3.48	3.80	4.60
50	2.10	2.35	2.63	2.82	3.00
100	1.87	2.05	2.25	2.38	2.51
500	1.80	1.96	2.01	2.11	2.20

Table 102

Out of Control ARL_0 for SSDMEWMA of Dimension 15 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	47.23	115.46	352.15	777.99	1691.22
50	37.70	89.37	281.59	635.01	1408.62
100	31.75	70.21	228.35	525.00	1217.51
500	27.00	46.26	132.00	306.18	743.71
	λ = 0.30, Δ = 0.50				
20	25.37	69.35	238.79	574.88	1312.64
50	16.79	39.78	140.96	368.48	914.66
100	13.29	25.60	88.87	240.84	635.52
500	10.90	14.33	30.00	63.00	167.92
	λ = 0.30, Δ = 1.00				
20	7.20	17.62	80.44	251.86	682.08
50	4.69	7.09	22.02	69.98	214.98
100	4.07	5.23	8.33	21.47	72.87
500	3.62	4.27	5.08	5.76	7.72
	λ = 0.30, Δ = 2.00				
20	2.52	3.09	7.20	21.72	63.64
50	2.05	2.26	2.65	2.87	4.73
100	1.93	2.11	2.29	2.43	2.56
500	1.80	1.98	2.15	2.26	2.35
	λ = 0.30, Δ = 3.00				
20	1.84	2.06	2.49	2.72	3.60
50	1.52	1.65	1.80	1.91	2.01
100	1.45	1.54	1.64	1.72	1.79
500	1.35	1.43	1.53	1.60	1.65

Table 103

Out of Control ARL_0 for SSDMEWMA of Dimension 15 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	53.06	127.28	381.33	829.97	1805.09
50	42.51	101.79	311.44	697.64	1547.58
100	36.71	84.98	260.10	587.76	1377.68
500	36.08	56.70	165.91	374.57	897.26
			λ = 0.40, Δ = 0.50		
20	31.76	85.55	282.38	673.18	1538.56
50	22.12	54.27	185.63	467.22	1132.70
100	16.50	36.71	124.86	326.33	862.45
500	15.54	18.40	46.34	110.36	303.30
			λ = 0.40, Δ = 1.00		
20	10.34	29.35	129.52	375.92	1002.26
50	5.53	10.99	46.86	143.30	445.38
100	4.38	6.41	18.25	54.08	192.80
500	3.36	4.60	5.65	7.48	14.50
			λ = 0.40, Δ = 2.00		
20	2.25	3.48	13.50	49.35	178.70
50	1.80	2.01	2.91	6.28	20.01
100	1.70	1.85	2.02	2.17	4.13
500	1.89	1.78	1.87	1.96	2.07
			λ = 0.40, Δ = 3.00		
20	1.48	1.64	2.25	5.70	19.51
50	1.29	1.38	1.47	1.55	1.62
100	1.25	1.30	1.37	1.43	1.49
500	1.17	1.26	1.29	1.33	1.37

Table 104

Out of Control ARL_0 for SSDMEWMA of Dimension 15 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.50, \Delta = 0.25$				
20	57.25	138.98	417.73	881.57	1877.93
50	47.95	113.46	349.00	753.69	1652.27
100	41.40	98.05	301.19	662.23	1494.39
500	34.80	70.07	208.00	448.71	1054.26
	$\lambda = 0.50, \Delta = 0.50$				
20	38.68	104.22	339.87	764.88	1696.33
50	28.25	69.25	240.68	572.13	1321.37
100	20.49	48.64	173.91	450.07	1062.06
500	17.16	24.94	68.26	163.32	469.70
	$\lambda = 0.50, \Delta = 1.00$				
20	15.49	49.10	204.43	519.16	1275.75
50	7.16	19.04	88.38	265.67	728.12
100	5.29	9.58	38.07	120.90	389.06
500	3.68	5.46	7.46	13.78	34.01
	$\lambda = 0.50, \Delta = 2.00$				
20	2.50	5.78	34.61	129.01	424.32
50	1.72	2.09	5.39	16.21	71.98
100	1.58	1.75	2.07	3.80	15.12
500	1.53	1.60	1.75	1.86	1.99
	$\lambda = 0.50, \Delta = 3.00$				
20	1.34	1.56	5.65	18.04	82.72
50	1.18	1.25	1.33	1.73	4.03
100	1.16	1.19	1.24	1.28	1.33
500	1.13	1.15	1.19	1.21	1.24

Table 105

Out of Control ARL_0 for SSDMEWMA of Dimension 15 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	63.54	151.88	438.92	931.65	1950.94
50	52.80	126.31	382.30	826.02	1772.73
100	44.96	108.72	334.52	762.54	1634.07
500	36.39	84.20	237.67	522.08	1211.41
	λ = 0.60, Δ = 0.50				
20	47.23	124.14	389.76	857.39	1831.03
50	33.48	88.16	295.41	694.53	1535.63
100	25.59	64.78	227.09	559.04	1308.79
500	27.78	34.07	101.09	247.17	675.32
	λ = 0.60, Δ = 1.00				
20	23.57	73.93	281.82	687.76	1560.63
50	10.24	33.63	152.19	422.99	1071.43
100	6.73	16.81	77.28	238.79	676.92
500	5.09	6.74	13.63	30.68	117.54
	λ = 0.60, Δ = 2.00				
20	4.15	15.49	92.01	290.78	821.35
50	1.85	3.30	14.92	60.46	212.46
100	1.67	1.83	4.20	14.14	57.29
500	1.47	1.68	1.79	1.95	2.16
	λ = 0.60, Δ = 3.00				
20	1.42	2.66	18.00	68.21	258.87
50	1.16	1.21	2.07	4.11	25.04
100	1.15	1.17	1.22	1.26	3.12
500	1.00	1.09	1.16	1.18	1.21

Table 106

Out of Control ARL_0 for SSDMEWMA of Dimension 15 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	75.40	175.11	488.00	1011.90	2074.56
50	65.37	155.35	452.14	946.55	1994.38
100	58.75	139.63	410.48	885.43	1889.95
500	70.46	117.26	315.96	686.92	1560.00
			$\lambda = 0.80, \Delta = 0.50$		
20	67.08	166.02	478.92	1020.65	2088.57
50	53.23	132.97	412.83	901.04	1917.95
100	41.89	106.19	349.74	796.02	1772.73
500	35.14	64.46	203.95	488.29	1223.95
			$\lambda = 0.80, \Delta = 1.00$		
20	51.55	144.81	460.30	1006.50	2115.41
50	28.35	90.43	337.27	795.53	1750.01
100	17.77	54.15	225.64	599.58	1471.33
500	8.89	14.37	59.13	189.28	561.15
			$\lambda = 0.80, \Delta = 2.00$		
20	22.35	83.69	346.78	840.22	1915.14
50	5.26	23.69	133.27	412.08	1124.92
100	2.92	8.09	47.47	170.91	553.77
500	2.00	2.19	3.92	6.95	46.06
			$\lambda = 0.80, \Delta = 3.00$		
20	7.63	36.66	198.85	540.64	1421.97
50	1.98	5.57	39.96	130.53	381.63
100	1.32	1.44	7.73	28.82	125.47
500	1.67	1.30	1.33	1.42	1.60

Table 107

Out of Control ARL_0 for SSDMEWMA of Dimension 20 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	26.74	56.52	162.83	372.77	891.27
50	19.29	38.52	103.46	243.51	603.67
100	17.90	31.29	71.90	156.57	385.16
500	0.00	23.93	35.86	52.54	100.55
			λ = 0.05, Δ = 0.50		
20	17.55	27.50	56.10	130.17	347.10
50	12.44	18.20	28.89	49.58	122.11
100	11.48	15.64	20.69	26.81	45.49
500	0.00	13.02	16.35	18.22	19.97
			λ = 0.05, Δ = 1.00		
20	12.57	16.12	19.81	23.89	37.86
50	8.75	11.37	13.81	15.39	17.04
100	7.85	9.94	11.84	13.06	14.08
500	0.00	8.24	9.85	10.64	11.36
			λ = 0.05, Δ = 2.00		
20	10.01	12.49	14.60	15.84	17.05
50	6.72	8.55	10.23	11.23	12.10
100	5.81	7.21	8.51	9.27	9.94
500	0.00	5.57	6.56	7.05	7.50
			λ = 0.05, Δ = 3.00		
20	9.04	11.22	13.08	14.15	15.09
50	5.96	7.56	9.06	9.95	10.71
100	5.04	6.25	7.38	8.04	8.62
500	0.00	4.54	5.34	5.74	6.12

Table 108

Out of Control ARL_0 for SSDMEWMA of Dimension 20 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	24.74	59.19	185.07	449.81	1060.43
50	19.90	43.52	133.77	328.56	795.68
100	17.44	34.34	96.88	227.28	577.45
500	1.00	20.74	45.68	84.28	199.41
			λ = 0.10, Δ = 0.50		
20	13.25	24.30	76.46	200.42	557.19
50	10.00	15.14	34.39	91.68	246.91
100	9.04	12.48	19.96	38.97	110.48
500	1.00	9.76	12.29	14.30	17.48
			λ = 0.10, Δ = 1.00		
20	7.56	9.63	13.83	27.39	72.48
50	5.97	7.23	8.71	10.45	15.16
100	5.36	6.39	7.46	8.11	8.91
500	1.00	5.29	6.14	6.60	7.04
			λ = 0.10, Δ = 2.00		
20	5.44	6.59	7.80	8.51	9.17
50	4.15	4.90	5.62	6.09	6.52
100	3.57	4.18	4.74	5.10	5.43
500	1.00	3.26	3.74	3.99	4.22
			λ = 0.10, Δ = 3.00		
20	4.71	5.68	6.61	7.19	7.71
50	3.52	4.14	4.75	5.14	5.51
100	2.96	3.44	3.91	4.21	4.48
500	1.00	2.59	2.92	3.11	3.27

Table 109

Out of Control ARL_0 for SSDMEWMA of Dimension 20 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	29.05	75.06	240.63	553.32	1231.94
50	23.56	56.75	183.16	439.61	991.69
100	19.57	44.76	143.91	341.53	804.34
500	21.13	30.17	68.77	158.38	406.26
			λ = 0.20, Δ = 0.50		
20	14.20	35.09	129.15	332.40	811.80
50	9.65	19.70	68.66	184.05	491.41
100	8.25	13.54	37.86	97.91	278.15
500	7.29	9.71	13.74	22.97	47.98
			λ = 0.20, Δ = 1.00		
20	5.24	8.05	24.91	81.05	237.89
50	4.04	4.97	7.59	16.25	53.45
100	3.67	4.33	5.29	7.02	13.73
500	3.71	3.83	4.38	4.75	5.35
			λ = 0.20, Δ = 2.00		
20	3.03	3.55	4.35	5.45	8.79
50	2.40	2.69	3.01	3.24	3.45
100	2.18	2.40	2.63	2.77	2.91
500	2.00	2.19	2.43	2.55	2.65
			λ = 0.20, Δ = 3.00		
20	2.44	2.81	3.23	3.50	3.76
50	1.92	2.13	2.37	2.52	2.67
100	1.72	1.88	2.03	2.13	2.23
500	1.80	1.69	1.84	1.93	2.00

Table 110

Out of Control ARL_0 for SSDMEWMA of Dimension 20 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	34.53	89.38	287.02	639.68	1402.48
50	28.58	69.76	225.51	512.12	1152.94
100	23.24	55.71	184.78	428.65	980.01
500	16.75	40.12	103.91	248.91	579.96
	λ = 0.30, Δ = 0.50				
20	18.11	50.34	182.59	445.88	1054.06
50	12.34	28.44	108.18	286.79	711.39
100	9.41	18.63	67.76	183.90	480.12
500	5.00	12.49	20.97	45.22	132.26
	λ = 0.30, Δ = 1.00				
20	5.43	12.44	56.91	173.17	483.07
50	3.72	5.17	15.32	45.31	152.67
100	3.35	4.12	7.07	13.82	45.47
500	2.25	3.59	4.21	4.75	6.15
	λ = 0.30, Δ = 2.00				
20	2.22	2.65	4.12	9.51	37.55
50	1.88	2.06	2.26	2.55	3.40
100	1.76	1.92	2.09	2.18	2.29
500	1.00	1.78	1.97	2.02	2.13
	λ = 0.30, Δ = 3.00				
20	1.70	1.89	2.24	2.51	3.64
50	1.46	1.56	1.69	1.76	1.84
100	1.35	1.46	1.56	1.61	1.67
500	1.00	1.34	1.45	1.50	1.55

Table 111

Out of Control ARL_0 for SSDMEWMA of Dimension 20 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.40, \Delta = 0.25$				
20	40.58	105.03	317.30	721.50	1567.54
50	33.56	84.72	257.43	594.08	1297.75
100	27.62	70.16	222.00	509.17	1155.36
500	19.67	55.50	132.53	320.21	762.99
	$\lambda = 0.40, \Delta = 0.50$				
20	23.87	66.14	229.56	556.95	1273.13
50	16.64	43.93	158.15	395.25	924.29
100	12.78	29.94	100.62	278.54	699.25
500	10.67	17.62	37.19	85.41	246.80
	$\lambda = 0.40, \Delta = 1.00$				
20	7.37	22.64	99.91	298.04	772.75
50	4.41	8.77	33.99	118.57	352.79
100	3.58	5.25	12.82	43.44	147.18
500	5.60	4.00	4.70	6.39	11.78
	$\lambda = 0.40, \Delta = 2.00$				
20	2.00	2.78	9.67	38.98	124.29
50	1.67	1.85	2.29	3.63	12.43
100	1.58	1.71	1.87	1.97	2.17
500	1.50	1.55	1.71	1.78	1.87
	$\lambda = 0.40, \Delta = 3.00$				
20	1.39	1.68	2.06	3.24	9.87
50	1.24	1.33	1.42	1.48	1.54
100	1.18	1.24	1.31	1.36	1.41
500	1.00	1.17	1.25	1.27	1.31

Table 112

Out of Control ARL_0 for SSDMEWMA of Dimension 20 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	λ = 0.50, Δ = 0.25				
20	46.91	121.55	357.11	793.44	1706.32
50	39.92	101.35	303.92	679.82	1494.97
100	33.64	85.50	266.30	592.52	1344.86
500	29.50	74.84	175.85	410.27	943.52
	λ = 0.50, Δ = 0.50				
20	31.16	87.81	292.65	673.57	1504.88
50	23.24	61.54	210.33	517.41	1198.13
100	16.02	41.87	152.12	398.19	965.52
500	15.14	26.59	56.53	149.10	412.31
	λ = 0.50, Δ = 1.00				
20	11.63	40.16	168.51	455.20	1102.84
50	5.86	15.86	74.58	235.34	624.63
100	4.10	8.14	31.73	102.54	343.58
500	4.57	4.46	7.86	11.22	31.96
	λ = 0.50, Δ = 2.00				
20	2.11	4.95	29.29	103.82	343.93
50	1.56	1.90	4.41	13.34	54.97
100	1.48	1.62	2.03	3.06	7.05
500	1.50	1.49	1.62	1.69	1.79
	λ = 0.50, Δ = 3.00				
20	1.28	1.57	3.52	14.73	55.65
50	1.14	1.21	1.28	1.55	1.61
100	1.11	1.15	1.20	1.23	1.28
500	1.50	1.09	1.14	1.16	1.20

Table 113

Out of Control ARL_0 for SSDMEWMA of Dimension 20 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	53.64	134.35	393.68	849.05	1869.86
50	45.52	114.24	346.35	748.62	1647.10
100	39.33	100.92	300.74	676.26	1519.06
500	28.14	71.48	209.92	475.53	1123.54
			$\lambda = 0.60, \Delta = 0.50$		
20	40.61	109.84	354.34	789.35	1747.64
50	30.10	79.32	264.52	632.17	1459.59
100	21.39	59.46	212.72	509.34	1209.93
500	18.00	27.52	88.28	219.91	601.51
			$\lambda = 0.60, \Delta = 1.00$		
20	18.67	61.71	252.52	630.01	1479.84
50	9.73	29.45	133.16	373.22	974.68
100	5.85	13.87	66.65	213.39	590.77
500	2.83	5.94	9.49	22.90	102.58
			$\lambda = 0.60, \Delta = 2.00$		
20	3.04	11.64	78.01	245.24	722.45
50	1.79	3.05	13.41	55.57	179.40
100	1.57	1.65	3.67	6.79	34.93
500	2.20	1.63	1.65	1.76	1.92
			$\lambda = 0.60, \Delta = 3.00$		
20	1.32	2.51	13.52	53.41	192.33
50	1.14	1.47	1.81	2.73	10.52
100	1.10	1.13	1.17	1.59	1.59
500	1.00	1.13	1.12	1.15	1.18

Table 114

Out of Control ARL_0 for SSDMEWMA of Dimension 20 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	66.21	167.63	485.00	1012.24	2107.53
50	58.49	147.48	435.91	926.78	1942.72
100	52.04	132.61	398.59	869.45	1815.77
500	69.45	94.86	287.99	656.92	1490.39
			λ = 0.80, Δ = 0.50		
20	60.41	159.85	479.65	1015.32	2125.09
50	46.21	126.56	406.23	894.18	1855.54
100	38.14	102.00	343.61	793.61	1685.30
500	26.90	52.45	183.42	460.18	1155.26
			λ = 0.80, Δ = 1.00		
20	44.45	139.10	456.37	1012.97	2129.58
50	24.33	83.32	329.42	791.20	1727.99
100	13.70	46.41	223.73	574.03	1352.66
500	4.75	16.10	52.18	157.33	533.50
			λ = 0.80, Δ = 2.00		
20	17.13	72.80	320.30	821.50	1908.77
50	4.47	21.22	130.12	386.17	1047.30
100	2.62	5.56	33.17	138.80	455.90
500	1.00	2.55	2.72	5.45	31.58
			λ = 0.80, Δ = 3.00		
20	5.19	27.88	173.94	501.38	1368.80
50	1.59	3.74	25.04	114.01	408.77
100	1.21	1.41	5.90	26.42	98.93
500	1.00	1.25	1.33	1.46	1.66

Table 115

Out of Control ARL_0 for SSDMEWMA of Dimension 25 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	22.92	45.00	121.68	283.90	672.66
50	15.47	30.49	76.29	175.91	448.70
100	13.94	23.84	50.43	111.91	266.92
500	0.00	18.82	27.87	40.14	68.36
			λ = 0.05, Δ = 0.50		
20	16.07	23.92	42.00	88.01	238.33
50	10.56	15.35	23.41	36.99	76.61
100	9.29	12.86	17.01	21.36	32.16
500	0.00	11.23	13.39	14.87	16.30
			λ = 0.05, Δ = 1.00		
20	12.30	15.75	18.74	21.30	26.40
50	7.77	10.40	12.73	14.03	15.33
100	6.73	8.75	10.56	11.53	12.39
500	0.00	7.37	8.35	9.00	9.56
			λ = 0.05, Δ = 2.00		
20	10.15	12.70	14.74	15.89	16.89
50	6.19	8.15	9.86	10.82	11.64
100	5.19	6.64	7.93	8.64	9.25
500	0.00	4.98	5.73	6.16	6.54
			λ = 0.05, Δ = 3.00		
20	9.28	11.55	13.35	14.36	15.23
50	5.58	7.31	8.87	9.73	10.47
100	4.59	5.87	7.00	7.64	8.20
500	0.00	4.13	4.76	5.11	5.44

Table 116

Out of Control ARL_0 for SSDMEWMA of Dimension 25 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	19.27	46.57	146.55	347.57	834.84
50	15.36	33.65	101.12	246.63	590.13
100	13.07	26.37	68.04	167.60	430.37
500	0.00	16.92	32.46	60.50	132.55
			$\lambda = 0.10, \Delta = 0.50$		
20	10.80	18.95	52.70	143.15	381.82
50	8.35	12.47	26.27	58.97	160.01
100	7.16	9.64	14.65	25.39	63.94
500	0.00	8.23	9.92	11.68	14.54
			$\lambda = 0.10, \Delta = 1.00$		
20	6.84	8.74	11.43	17.36	40.74
50	5.25	6.41	7.53	8.72	10.27
100	4.49	5.45	6.26	6.79	7.32
500	0.00	4.72	5.22	5.53	5.79
			$\lambda = 0.10, \Delta = 2.00$		
20	5.14	6.33	7.37	8.02	8.61
50	3.80	4.56	5.24	5.67	6.07
100	3.16	3.75	4.25	4.57	4.87
500	0.00	3.02	3.29	3.45	3.61
			$\lambda = 0.10, \Delta = 3.00$		
20	4.52	5.54	6.43	6.97	7.46
50	3.28	3.92	4.52	4.89	5.22
100	2.67	3.16	3.58	3.86	4.11
500	0.00	2.44	2.62	2.73	2.85

Table 117

Out of Control ARL_0 for SSDMEWMA of Dimension 25 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	22.68	58.73	192.46	453.84	1038.74
50	17.96	44.30	143.82	347.71	789.51
100	16.50	34.27	105.67	265.50	625.19
500	7.00	23.58	60.07	127.66	301.46
	λ = 0.20, Δ = 0.50				
20	10.80	25.72	98.55	262.69	665.04
50	7.55	14.87	49.42	142.42	360.16
100	6.80	10.13	24.72	71.13	204.97
500	5.00	7.69	11.21	18.74	34.68
	λ = 0.20, Δ = 1.00				
20	4.44	6.24	17.59	53.30	171.36
50	3.49	4.18	5.41	10.84	34.87
100	3.24	3.59	4.16	4.91	7.70
500	5.00	3.64	3.87	4.13	4.36
	λ = 0.20, Δ = 2.00				
20	2.76	3.22	3.72	4.12	5.70
50	2.21	2.46	2.73	2.92	3.09
100	2.03	2.18	2.35	2.47	2.57
500	4.00	2.10	2.26	2.36	2.44
	λ = 0.20, Δ = 3.00				
20	2.28	2.63	3.01	3.25	3.49
50	1.81	1.98	2.20	2.33	2.47
100	1.63	1.74	1.87	1.95	2.02
500	3.00	1.65	1.74	1.81	1.86

Table 118

Out of Control ARL_0 for SSDMEWMA of Dimension 25 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	27.23	71.11	242.64	549.85	1226.80
50	22.29	57.32	186.95	438.14	962.81
100	19.53	44.83	151.22	352.90	809.72
500	4.17	32.16	84.82	207.95	481.65
			$\lambda = 0.30, \Delta = 0.50$		
20	13.69	38.67	147.12	375.88	900.37
50	9.96	23.43	85.13	233.07	564.88
100	7.79	15.46	54.58	148.29	399.71
500	1.33	8.91	18.42	39.27	95.05
			$\lambda = 0.30, \Delta = 1.00$		
20	4.21	8.52	39.92	130.05	373.06
50	3.22	4.47	11.13	34.04	108.02
100	2.92	3.56	5.20	11.44	33.93
500	1.00	3.20	3.64	4.03	4.88
			$\lambda = 0.30, \Delta = 2.00$		
20	2.05	2.32	3.12	6.12	22.35
50	1.78	1.92	2.09	2.21	2.93
100	1.64	1.79	1.94	2.03	2.12
500	1.00	1.72	1.81	1.90	1.97
			$\lambda = 0.30, \Delta = 3.00$		
20	1.61	1.76	1.96	2.11	2.43
50	1.41	1.49	1.60	1.66	1.73
100	1.31	1.38	1.47	1.53	1.58
500	0.00	1.31	1.36	1.41	1.45

Table 119

Out of Control ARL_0 for SSDMEWMA of Dimension 25 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.40, \Delta = 0.25$				
20	32.34	85.81	280.94	632.48	1423.97
50	27.87	70.09	227.17	517.44	1173.14
100	24.61	58.05	191.59	440.15	1033.56
500	14.00	41.82	115.71	274.95	667.84
	$\lambda = 0.40, \Delta = 0.50$				
20	19.19	53.03	200.94	483.53	1133.02
50	13.51	35.46	130.33	338.77	838.76
100	11.35	24.08	92.12	243.09	632.91
500	4.33	13.87	33.14	71.86	203.84
	$\lambda = 0.40, \Delta = 1.00$				
20	5.68	17.12	81.24	244.48	654.65
50	3.90	7.22	29.78	91.07	293.40
100	3.17	4.22	11.10	36.95	117.84
500	1.50	3.08	4.00	5.18	9.67
	$\lambda = 0.40, \Delta = 2.00$				
20	1.81	2.14	6.19	21.29	83.14
50	1.60	1.74	2.26	4.68	8.45
100	1.51	1.61	1.76	1.83	2.59
500	1.00	1.52	1.59	1.67	1.75
	$\lambda = 0.40, \Delta = 3.00$				
20	1.34	1.46	1.59	2.25	4.74
50	1.22	1.29	1.36	1.42	1.48
100	1.13	1.19	1.26	1.31	1.35
500	1.00	1.17	1.18	1.21	1.24

Table 120

Out of Control ARL_0 for SSDMEWMA of Dimension 25 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	λ = 0.50, Δ = 0.25				
20	38.83	104.25	331.65	734.91	1608.90
50	32.54	85.87	278.71	625.90	1349.54
100	29.65	71.39	236.03	537.04	1180.75
500	24.11	47.54	142.49	347.60	828.28
	λ = 0.50, Δ = 0.50				
20	25.65	73.98	267.68	617.48	1411.67
50	18.26	50.62	186.35	462.73	1065.58
100	14.47	36.32	140.15	350.56	853.43
500	11.67	20.25	48.50	124.06	365.42
	λ = 0.50, Δ = 1.00				
20	9.54	32.21	153.08	402.66	983.29
50	4.93	12.58	64.80	196.24	530.23
100	3.73	6.96	26.57	89.35	286.30
500	2.17	3.58	5.64	12.57	28.60
	λ = 0.50, Δ = 2.00				
20	1.88	3.80	21.71	76.52	255.17
50	1.53	1.92	4.42	11.55	42.46
100	1.39	1.54	1.73	1.96	8.07
500	1.00	1.41	1.49	1.59	1.67
	λ = 0.50, Δ = 3.00				
20	1.23	1.46	2.35	7.11	26.98
50	1.13	1.17	1.25	1.56	2.45
100	1.09	1.11	1.16	1.19	1.22
500	1.00	1.07	1.11	1.13	1.13

Table 121

Out of Control ARL_0 for SSDMEWMA of Dimension 25 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	46.32	123.37	382.87	844.79	1789.68
50	37.88	104.49	321.01	706.18	1521.33
100	34.58	88.25	281.58	629.13	1364.47
500	24.90	62.01	182.58	444.92	979.11
			$\lambda = 0.60, \Delta = 0.50$		
20	34.37	99.81	336.76	776.87	1647.76
50	23.93	71.33	247.29	592.22	1322.63
100	18.59	51.04	188.56	473.35	1101.39
500	5.86	27.00	74.56	208.14	560.78
			$\lambda = 0.60, \Delta = 1.00$		
20	15.63	56.57	232.34	600.10	1371.17
50	8.01	26.43	120.23	352.72	853.01
100	4.75	11.43	59.29	187.62	533.77
500	1.67	4.62	10.12	25.09	80.57
			$\lambda = 0.60, \Delta = 2.00$		
20	2.57	9.02	63.54	214.14	606.76
50	1.59	2.34	8.23	44.67	131.47
100	1.38	1.62	2.09	6.73	35.43
500	1.00	1.39	1.50	1.68	1.77
			$\lambda = 0.60, \Delta = 3.00$		
20	1.21	1.65	7.50	39.16	130.62
50	1.10	1.16	1.80	2.58	8.80
100	1.08	1.10	1.13	1.22	1.25
500	0.00	1.07	1.10	1.12	1.13

Table 122

Out of Control ARL_0 for SSDMEWMA of Dimension 25 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	60.07	158.87	488.96	1015.25	2053.08
50	52.12	135.79	424.02	907.78	1866.50
100	46.00	117.63	375.86	824.20	1742.94
500	46.67	80.97	256.29	591.10	1353.25
			$\lambda = 0.80, \Delta = 0.50$		
20	52.90	149.74	473.57	1016.08	2090.99
50	42.10	118.34	397.71	866.83	1818.27
100	30.11	91.19	324.97	733.08	1604.55
500	8.17	45.17	147.39	412.97	1054.61
			$\lambda = 0.80, \Delta = 1.00$		
20	38.40	126.98	445.43	997.32	2096.43
50	21.59	77.46	316.79	754.05	1670.65
100	11.38	45.45	212.16	540.95	1319.62
500	2.40	10.01	41.27	144.08	477.46
			$\lambda = 0.80, \Delta = 2.00$		
20	13.70	65.14	314.22	774.63	1792.18
50	4.01	20.99	128.72	368.06	958.20
100	2.01	3.94	36.28	140.17	448.97
500	1.00	1.79	2.23	6.86	23.96
			$\lambda = 0.80, \Delta = 3.00$		
20	4.07	22.15	158.30	465.50	1237.32
50	1.40	2.88	25.03	96.56	318.39
100	1.24	1.58	6.11	16.53	66.71
500	0.00	1.17	1.29	1.33	1.51

Table 123

Out of Control ARL_0 for SSDMEWMA of Dimension 50 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05$, $\Delta = 0.25$				
20	13.58	26.19	50.71	103.56	244.03
50	6.74	14.73	29.90	57.35	152.86
100	5.80	12.11	21.50	36.08	90.34
500	0.00	10.69	12.46	14.49	20.16
	$\lambda = 0.05$, $\Delta = 0.50$				
20	11.91	18.39	24.11	31.63	59.85
50	5.59	10.05	13.39	16.00	22.18
100	4.88	8.09	10.34	11.68	14.27
500	0.00	6.55	7.27	7.83	8.48
	$\lambda = 0.05$, $\Delta = 1.00$				
20	10.54	15.24	17.77	19.08	20.22
50	4.78	8.06	10.28	11.37	12.27
100	4.02	6.32	7.78	8.54	9.19
500	0.00	4.68	5.06	5.40	5.80
	$\lambda = 0.05$, $\Delta = 2.00$				
20	9.37	13.18	15.13	16.11	16.93
50	4.21	6.98	8.83	9.75	10.50
100	3.47	5.34	6.55	7.20	7.74
500	0.00	3.53	3.87	4.16	4.44
	$\lambda = 0.05$, $\Delta = 3.00$				
20	8.76	12.18	13.92	14.79	15.52
50	3.94	6.51	8.23	9.07	9.77
100	3.22	4.95	6.09	6.69	7.20
500	0.00	3.13	3.42	3.68	3.94

Table 124

Out of Control ARL_0 for SSDMEWMA of Dimension 50 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	8.25	19.65	59.16	141.02	332.87
50	6.41	13.59	36.64	93.38	222.30
100	5.47	10.84	25.81	60.04	149.55
500	0.00	10.01	12.00	21.01	39.43
			λ = 0.10, Δ = 0.50		
20	6.06	9.99	18.91	41.17	109.88
50	4.42	6.52	9.29	16.91	36.51
100	3.78	5.32	6.74	9.36	15.33
500	0.00	4.28	5.18	5.73	6.09
			λ = 0.10, Δ = 1.00		
20	4.80	6.82	8.30	9.23	11.39
50	3.33	4.41	5.22	5.72	6.15
100	2.72	3.58	4.08	4.43	4.70
500	0.00	2.76	3.10	3.31	3.37
			λ = 0.10, Δ = 2.00		
20	3.99	5.52	6.53	7.09	7.56
50	2.68	3.52	4.14	4.52	4.83
100	2.16	2.77	3.17	3.42	3.63
500	0.00	2.00	2.22	2.33	2.36
			λ = 0.10, Δ = 3.00		
20	3.62	4.96	5.85	6.32	6.72
50	2.42	3.18	3.74	4.07	4.36
100	1.94	2.47	2.83	3.05	3.25
500	0.00	1.72	1.89	1.96	2.01

Table 125

Out of Control ARL_0 for SSDMEWMA of Dimension 50 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	8.29	23.10	85.26	208.78	490.39
50	6.79	17.58	65.34	158.46	364.78
100	6.52	16.33	54.52	127.38	294.40
500	0.00	12.74	30.37	73.17	187.81
			$\lambda = 0.20, \Delta = 0.50$		
20	4.70	9.74	36.68	108.09	267.23
50	3.82	6.36	17.16	53.10	147.36
100	3.76	5.25	10.69	29.80	77.38
500	0.00	4.94	6.51	8.14	13.51
			$\lambda = 0.20, \Delta = 1.00$		
20	2.84	3.64	5.54	12.55	45.80
50	2.33	2.71	3.15	4.63	9.75
100	2.26	2.59	2.83	3.03	4.52
500	0.00	2.41	2.97	3.17	3.30
			$\lambda = 0.20, \Delta = 2.00$		
20	2.07	2.47	2.86	3.10	3.44
50	1.68	1.89	2.05	2.15	2.25
100	1.62	1.79	1.87	1.92	1.95
500	0.00	1.64	1.92	2.03	2.08
			$\lambda = 0.20, \Delta = 3.00$		
20	1.78	2.10	2.42	2.61	2.79
50	1.47	1.62	1.77	1.85	1.92
100	1.39	1.51	1.59	1.63	1.65
500	0.00	1.38	1.54	1.61	1.65

Table 126

Out of Control ARL_0 for SSDMEWMA of Dimension 50 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	10.77	31.19	113.84	277.31	646.87
50	9.96	30.14	110.68	252.15	568.28
100	8.90	28.78	100.05	240.08	549.24
500	0.00	19.68	57.99	142.93	352.42
			λ = 0.30, Δ = 0.50		
20	5.78	15.67	64.83	171.47	442.54
50	4.94	11.24	48.62	126.65	325.95
100	4.44	9.30	30.67	89.31	242.26
500	0.00	6.10	9.80	19.83	46.31
			λ = 0.30, Δ = 1.00		
20	2.62	3.97	12.63	44.89	140.32
50	2.36	2.88	5.17	13.07	42.88
100	2.22	2.75	3.70	5.19	13.13
500	0.00	2.41	2.80	2.98	3.20
			λ = 0.30, Δ = 2.00		
20	1.65	1.83	2.03	2.43	3.46
50	1.53	1.65	1.76	1.81	2.41
100	1.44	1.63	1.71	1.76	1.80
500	0.00	1.56	1.60	1.63	1.72
			λ = 0.30, Δ = 3.00		
20	1.37	1.50	1.62	1.70	1.79
50	1.27	1.36	1.44	1.47	1.51
100	1.19	1.29	1.36	1.41	1.44
500	0.00	1.19	1.23	1.24	1.31

Table 127

Out of Control ARL_0 for SSDMEWMA of Dimension 50 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	15.58	47.02	177.06	416.94	935.76
50	13.98	46.10	169.65	391.83	862.58
100	12.78	41.62	143.62	363.20	834.50
500	0.00	22.14	95.10	217.59	516.83
			$\lambda = 0.40, \Delta = 0.50$		
20	8.65	27.89	120.88	317.79	754.35
50	7.01	21.70	99.68	257.40	635.82
100	5.73	15.59	64.62	189.43	499.03
500	0.00	5.88	16.50	46.04	128.42
			$\lambda = 0.40, \Delta = 1.00$		
20	3.23	7.28	44.31	131.93	375.77
50	2.69	4.03	16.85	59.57	187.87
100	2.29	2.84	5.95	18.92	66.17
500	0.00	2.00	2.78	3.21	3.65
			$\lambda = 0.40, \Delta = 2.00$		
20	1.54	1.75	2.52	5.38	20.52
50	1.40	1.54	1.72	2.34	4.79
100	1.24	1.42	1.53	1.61	1.66
500	0.00	1.25	1.36	1.42	1.47
			$\lambda = 0.40, \Delta = 3.00$		
20	1.22	1.33	1.42	1.48	1.89
50	1.13	1.19	1.26	1.31	1.35
100	1.06	1.12	1.17	1.20	1.24
500	0.00	1.03	1.07	1.08	1.11

Table 128

Out of Control ARL$_0$ for SSDMEWMA of Dimension 50 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	20.98	67.57	239.95	572.77	1297.04
50	19.15	62.20	213.34	519.81	1202.39
100	16.04	54.84	192.62	461.53	1056.79
500	0.00	30.94	117.18	280.17	697.93
			λ = 0.50, Δ = 0.50		
20	13.20	46.79	192.23	495.31	1150.46
50	10.60	38.27	153.82	404.14	980.03
100	7.23	25.44	109.02	313.02	774.78
500	0.00	7.90	28.52	86.96	288.42
			λ = 0.50, Δ = 1.00		
20	4.90	17.05	95.87	304.53	801.84
50	3.39	8.18	45.33	151.06	483.18
100	2.37	4.05	16.39	61.82	220.14
500	0.00	2.21	3.34	4.39	10.24
			λ = 0.50, Δ = 2.00		
20	1.53	2.18	7.07	34.49	131.92
50	1.32	1.51	1.76	5.80	21.25
100	1.13	1.35	1.41	1.47	3.75
500	0.00	1.19	1.24	1.27	1.32
			λ = 0.50, Δ = 3.00		
20	1.14	1.23	1.35	1.99	6.18
50	1.07	1.11	1.14	1.18	1.21
100	1.01	1.06	1.08	1.09	1.11
500	0.00	1.00	1.03	1.04	1.05

Table 129

Out of Control ARL_0 for SSDMEWMA of Dimension 50 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	25.34	87.62	322.51	744.25	1651.12
50	23.40	74.09	273.22	644.84	1471.83
100	21.11	69.10	243.89	569.51	1279.02
500	0.00	41.81	149.77	351.55	895.28
			λ = 0.60, Δ = 0.50		
20	18.33	70.03	280.94	686.23	1563.66
50	14.37	51.08	223.17	529.97	1288.44
100	11.77	39.11	169.32	435.78	1031.99
500	0.00	13.96	50.53	151.04	465.27
			λ = 0.60, Δ = 1.00		
20	7.76	34.10	184.04	520.77	1330.76
50	4.20	17.19	98.31	293.21	817.55
100	3.01	6.41	40.72	159.34	458.39
500	0.00	2.77	4.73	11.61	57.69
			λ = 0.60, Δ = 2.00		
20	1.70	4.31	36.52	127.98	420.86
50	1.30	1.66	6.24	25.83	76.12
100	1.15	1.30	1.41	2.94	14.13
500	0.00	1.06	1.22	1.23	1.29
			λ = 0.60, Δ = 3.00		
20	1.11	1.20	2.18	15.08	51.87
50	1.05	1.07	1.11	2.18	11.41
100	1.08	1.05	1.07	1.07	1.08
500	0.00	1.00	1.04	1.04	1.05

Table 130

Out of Control ARL_0 for SSDMEWMA of Dimension 50 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	36.63	133.32	437.56	1002.02	2135.68
50	31.46	110.27	386.79	881.45	1890.66
100	30.58	102.26	335.70	788.32	1702.39
500	0.00	63.16	237.06	566.38	1239.15
			λ = 0.80, Δ = 0.50		
20	30.69	121.54	433.27	1029.33	2188.73
50	24.47	94.29	356.53	870.59	1863.17
100	19.83	75.24	285.68	714.39	1580.02
500	0.00	41.46	142.05	418.82	999.60
			λ = 0.80, Δ = 1.00		
20	20.06	94.20	402.28	984.21	2109.90
50	13.84	60.43	288.60	754.03	1688.69
100	6.08	31.13	179.99	545.37	1289.79
500	0.00	9.23	29.40	101.32	371.35
			λ = 0.80, Δ = 2.00		
20	4.75	35.43	247.84	706.67	1721.46
50	2.23	13.49	93.35	325.22	938.78
100	1.77	3.28	22.66	95.31	345.68
500	0.00	1.48	1.42	2.15	2.44
			λ = 0.80, Δ = 3.00		
20	1.67	8.31	93.81	319.23	908.76
50	1.07	2.27	12.31	66.73	234.30
100	1.07	1.19	2.08	13.15	41.70
500	0.00	1.00	1.28	1.20	1.22

Self Starting Double Multivariate Exponentially Weighted Moving Covariance Out of Control Average Run Lengths

The following tables record the observed out of control average run length performance for all the scenarios tested to assess the proposed control scheme's response to changes in the covariance. These values will later be compared to the performance of the ssMEWMC control chart.

Table 131

Out of Control ARL_0 for SSDMEWMC of Dimension 2 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05, \Delta = 0.25$				
20	23.16	32.96	58.09	112.95	273.65
50	19.25	24.65	31.96	38.90	54.67
100	18.95	23.66	29.28	33.35	38.25
500	20.24	22.49	27.71	30.95	33.93
	$\lambda = 0.05, \Delta = 0.50$				
20	38.95	75.35	204.04	464.26	1053.17
50	28.49	45.76	103.30	223.03	570.84
100	25.89	36.47	58.88	102.44	233.11
500	29.88	31.12	41.63	49.78	59.32
	$\lambda = 0.05, \Delta = 1.00$				
20	77.97	177.04	469.75	952.45	1960.51
50	73.16	165.78	460.56	941.66	1949.70
100	73.12	167.96	461.29	957.71	1940.48
500	70.72	175.08	464.34	964.68	1971.38
	$\lambda = 0.05, \Delta = 2.00$				
20	44.33	100.16	312.76	711.77	1620.80
50	26.45	46.14	123.98	319.12	828.45
100	20.98	30.88	54.33	112.10	290.28
500	14.23	24.27	31.38	36.57	42.58
	$\lambda = 0.05, \Delta = 3.00$				
20	23.96	47.57	164.55	423.35	1082.62
50	14.56	19.41	31.12	57.89	156.00
100	12.62	16.20	20.27	23.51	29.62
500	9.50	14.48	17.30	19.11	20.88

Table 132

Out of Control ARL_0 for SSDMEWMC of Dimension 2 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	18.64	28.97	65.91	170.42	446.57
50	15.37	19.45	27.16	40.58	81.26
100	14.63	18.11	22.79	28.90	37.57
500	13.22	16.75	20.68	23.24	25.77
			$\lambda = 0.10, \Delta = 0.50$		
20	37.85	81.83	243.32	569.79	1297.57
50	27.80	50.76	142.51	354.84	887.26
100	23.52	36.72	81.77	195.42	533.46
500	19.31	27.47	40.87	56.47	85.33
			$\lambda = 0.10, \Delta = 1.00$		
20	81.26	179.68	476.92	973.21	1962.37
50	81.60	176.67	477.15	977.51	1970.94
100	81.20	176.03	479.74	979.48	1976.76
500	74.97	181.47	482.45	974.62	1980.69
			$\lambda = 0.10, \Delta = 2.00$		
20	47.03	108.76	338.72	764.60	1656.37
50	27.30	52.42	169.26	422.81	1044.87
100	20.17	31.30	73.05	175.64	488.19
500	17.46	22.35	29.46	37.34	47.22
			$\lambda = 0.10, \Delta = 3.00$		
20	22.84	52.00	188.74	491.18	1181.08
50	12.15	17.14	35.18	89.96	277.31
100	10.48	13.08	17.03	22.69	39.44
500	10.54	11.25	13.24	15.06	16.60

Table 133

Out of Control ARL_0 for SSDMEWMC of Dimension 2 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	19.41	36.50	116.11	333.76	883.01
50	13.52	18.99	38.85	102.59	343.52
100	12.31	16.03	23.43	39.32	106.03
500	12.87	14.67	18.48	23.27	29.86
			λ = 0.20, Δ = 0.50		
20	45.08	104.82	315.17	714.73	1597.22
50	33.47	70.28	229.51	571.87	1360.71
100	26.62	51.94	156.13	418.93	1075.63
500	22.25	34.78	66.42	140.36	371.83
			λ = 0.20, Δ = 1.00		
20	87.98	188.58	480.81	978.29	2001.01
50	89.00	185.99	480.46	978.93	2001.98
100	86.67	188.33	481.15	984.47	2000.34
500	79.02	186.80	485.55	980.14	2021.18
			λ = 0.20, Δ = 2.00		
20	54.03	123.46	360.77	787.54	1704.33
50	32.08	70.02	207.61	524.12	1224.88
100	22.23	40.32	108.08	271.29	724.02
500	15.40	21.79	34.78	48.91	83.30
			λ = 0.20, Δ = 3.00		
20	26.89	65.01	221.05	556.08	1323.21
50	11.97	19.43	55.56	158.02	465.26
100	9.75	12.47	19.21	36.82	106.65
500	7.38	9.69	12.06	13.98	15.91

Table 134

Out of Control ARL_0 for SSDMEWMC of Dimension 2 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	23.43	52.12	187.64	528.15	1304.07
50	14.87	25.44	80.70	252.18	804.02
100	12.88	18.75	38.28	103.34	423.23
500	12.31	16.11	23.55	34.88	63.88
			$\lambda = 0.30, \Delta = 0.50$		
20	52.44	123.96	370.62	831.06	1782.54
50	40.81	93.18	307.06	733.20	1656.20
100	33.92	71.11	242.25	611.53	1477.50
500	24.57	49.63	113.95	302.20	866.82
			$\lambda = 0.30, \Delta = 1.00$		
20	90.09	192.64	491.10	995.70	2010.56
50	91.38	189.71	484.32	990.94	2013.06
100	91.45	190.93	486.32	996.88	1993.24
500	87.11	183.99	491.54	1003.98	2007.72
			$\lambda = 0.30, \Delta = 2.00$		
20	57.38	128.73	368.03	805.93	1742.65
50	36.26	77.86	235.01	552.80	1297.08
100	25.05	46.99	131.43	328.68	826.49
500	15.94	25.80	41.65	63.08	124.60
			$\lambda = 0.30, \Delta = 3.00$		
20	30.54	72.45	243.77	595.35	1381.33
50	13.22	24.28	76.21	212.36	596.39
100	9.87	13.14	24.96	56.42	172.78
500	8.13	9.84	12.60	14.70	17.55

Table 135

Out of Control ARL_0 for SSDMEWMC of Dimension 2 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	29.36	75.40	274.59	719.33	1671.99
50	18.57	39.08	151.27	485.93	1351.43
100	15.27	27.26	79.01	285.33	973.97
500	15.19	19.31	35.96	73.32	200.89
			λ = 0.40, Δ = 0.50		
20	60.99	145.51	426.81	926.99	1929.32
50	49.96	120.46	382.90	867.99	1879.97
100	42.21	98.94	332.76	796.25	1817.21
500	29.79	64.00	193.47	525.03	1445.39
			λ = 0.40, Δ = 1.00		
20	91.93	197.25	495.17	1009.54	1996.35
50	92.69	195.41	495.73	1003.25	1997.64
100	93.46	192.87	494.44	998.26	1997.74
500	88.43	182.41	492.97	997.41	2033.60
			λ = 0.40, Δ = 2.00		
20	59.56	129.47	373.71	821.99	1730.57
50	38.48	84.03	247.63	577.05	1341.85
100	27.69	51.68	147.51	356.76	910.18
500	15.54	27.40	47.60	78.22	162.91
			λ = 0.40, Δ = 3.00		
20	33.40	80.36	257.32	624.59	1412.48
50	14.55	28.80	92.90	243.53	690.66
100	10.49	14.97	30.89	78.89	246.90
500	9.09	10.75	13.60	16.22	20.01

Table 136

Out of Control ARL_0 for SSDMEWMC of Dimension 2 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	38.88	106.37	365.50	902.59	1986.35
50	25.84	64.14	255.73	752.49	1861.19
100	20.25	43.00	168.46	566.66	1645.51
500	18.69	28.07	65.20	184.74	739.73
			λ = 0.50, Δ = 0.50		
20	70.22	170.37	470.98	1015.50	2091.33
50	59.86	151.41	450.34	1002.57	2095.91
100	52.98	130.90	416.87	981.58	2118.85
500	36.15	87.01	299.77	798.82	2044.38
			λ = 0.50, Δ = 1.00		
20	93.86	200.81	496.19	1011.48	2038.41
50	94.30	200.07	500.37	1005.34	2024.26
100	93.64	199.55	496.91	1007.15	2025.87
500	74.56	191.24	491.85	998.47	2023.74
			λ = 0.50, Δ = 2.00		
20	60.08	132.21	374.03	814.70	1732.18
50	40.57	85.01	246.00	585.34	1375.19
100	28.99	53.51	149.62	382.04	947.16
500	24.71	27.49	48.79	83.73	183.43
			λ = 0.50, Δ = 3.00		
20	35.46	83.83	263.98	631.64	1448.65
50	16.16	31.51	102.23	283.66	773.74
100	11.29	16.67	34.71	99.52	297.22
500	7.80	10.55	14.22	17.93	23.31

Table 137

Out of Control ARL_0 for SSDMEWMC of Dimension 2 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	55.47	149.59	488.30	1094.54	2257.44
50	39.00	105.86	419.50	1053.64	2307.10
100	29.41	77.64	343.59	966.28	2290.22
500	22.08	46.14	155.02	548.75	1774.47
			$\lambda = 0.60, \Delta = 0.50$		
20	85.95	193.89	536.65	1094.76	2194.64
50	78.52	184.81	535.32	1138.60	2319.69
100	71.39	177.32	532.51	1166.64	2427.11
500	49.71	125.43	468.48	1169.93	2609.18
			$\lambda = 0.60, \Delta = 1.00$		
20	97.25	200.06	501.59	1004.89	2033.24
50	97.63	201.95	500.27	1006.97	2033.24
100	97.12	204.25	501.57	1017.90	2032.29
500	101.25	203.81	496.54	1002.84	2035.13
			$\lambda = 0.60, \Delta = 2.00$		
20	58.95	129.35	369.85	813.31	1757.22
50	39.68	81.70	244.37	595.49	1399.19
100	29.04	53.61	149.74	388.46	990.38
500	20.82	28.70	52.25	90.16	205.06
			$\lambda = 0.60, \Delta = 3.00$		
20	35.89	84.85	263.94	645.19	1485.04
50	16.18	32.87	107.87	308.98	844.21
100	11.81	17.33	41.12	112.48	355.41
500	9.59	11.24	15.13	19.74	27.34

Table 138

Out of Control ARL_0 for SSDMEWMC of Dimension 2 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	93.31	231.35	646.30	1304.24	2472.63
50	80.58	218.89	683.43	1427.60	2726.06
100	68.99	194.97	689.79	1514.33	2921.65
500	58.34	136.90	561.89	1485.68	3267.82
			$\lambda = 0.80, \Delta = 0.50$		
20	106.36	237.31	612.20	1205.45	2292.11
50	108.79	245.50	654.27	1311.52	2467.95
100	112.20	255.87	703.92	1407.22	2651.49
500	106.16	251.85	767.65	1654.99	3217.65
			$\lambda = 0.80, \Delta = 1.00$		
20	94.10	199.11	502.98	1028.17	2002.97
50	95.17	197.43	506.12	1021.41	2004.14
100	97.47	200.02	502.24	1034.66	1997.99
500	116.34	198.84	499.45	1024.75	2024.81
			$\lambda = 0.80, \Delta = 2.00$		
20	56.67	128.06	377.06	843.82	1751.02
50	38.47	83.11	260.73	639.87	1447.30
100	29.03	57.07	170.82	436.17	1082.08
500	26.25	30.82	59.79	121.56	283.73
			$\lambda = 0.80, \Delta = 3.00$		
20	36.54	86.89	287.88	702.04	1543.59
50	17.87	38.15	134.52	372.64	974.36
100	12.33	20.03	58.70	165.14	491.37
500	12.00	12.33	18.48	26.18	41.62

Table 139

Out of Control ARL_0 for SSDMEWMC of Dimension 3 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05, \Delta = 0.25$				
20	27.67	43.78	89.19	190.05	457.80
50	21.86	29.91	46.72	75.30	148.52
100	20.68	27.36	37.56	50.23	82.17
500	24.11	25.17	31.96	36.49	42.31
	$\lambda = 0.05, \Delta = 0.50$				
20	37.57	71.96	188.64	417.94	978.80
50	28.01	45.20	101.00	221.64	557.30
100	25.49	36.72	63.03	117.01	271.86
500	24.78	31.20	43.09	51.80	62.74
	$\lambda = 0.05, \Delta = 1.00$				
20	76.82	175.08	470.05	965.06	1998.91
50	68.80	161.16	455.45	948.79	1956.63
100	68.16	159.55	451.55	946.99	1954.36
500	57.11	142.46	461.18	947.91	1964.70
	$\lambda = 0.05, \Delta = 2.00$				
20	44.40	102.38	323.16	741.64	1710.04
50	26.11	48.62	137.46	344.95	912.41
100	21.36	32.44	60.85	134.25	359.14
500	17.33	25.29	32.87	38.58	45.16
	$\lambda = 0.05, \Delta = 3.00$				
20	25.44	53.88	183.33	471.32	1218.00
50	14.88	20.58	36.73	79.87	235.32
100	13.00	16.55	21.18	25.54	35.12
500	10.33	14.59	17.50	19.38	21.11

Table 140

Out of Control ARL_0 for SSDMEWMC of Dimension 3 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	23.75	40.05	111.92	271.14	666.76
50	18.82	26.04	50.34	103.53	235.49
100	17.39	22.67	35.08	57.00	110.83
500	18.47	19.71	26.29	32.58	44.10
			$\lambda = 0.10, \Delta = 0.50$		
20	36.39	74.82	223.48	523.78	1165.66
50	27.65	49.29	140.83	341.44	814.37
100	24.77	37.77	87.74	212.08	530.39
500	16.11	28.97	44.63	65.75	117.56
			$\lambda = 0.10, \Delta = 1.00$		
20	80.15	174.63	487.50	1020.87	2013.80
50	80.33	173.03	482.64	1017.26	2018.54
100	77.36	173.83	488.23	1008.19	2007.10
500	67.32	166.57	492.04	987.15	1996.63
			$\lambda = 0.10, \Delta = 2.00$		
20	46.05	106.69	353.84	830.86	1740.31
50	28.18	55.82	177.81	469.10	1118.79
100	21.39	34.40	85.47	212.63	570.23
500	16.89	22.17	31.73	41.65	58.36
			$\lambda = 0.10, \Delta = 3.00$		
20	24.00	55.65	210.51	551.79	1322.34
50	12.75	18.81	48.51	131.52	384.57
100	10.69	13.40	18.74	29.16	67.03
500	9.05	11.03	13.70	15.26	16.94

Table 141

Out of Control ARL_0 for SSDMEWMC of Dimension 3 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	25.57	51.91	180.52	454.28	1107.20
50	18.21	29.32	83.25	216.85	625.68
100	16.43	23.72	49.03	108.85	307.99
500	14.44	18.61	28.10	43.14	81.01
			λ = 0.20, Δ = 0.50		
20	42.79	93.95	293.05	672.85	1461.71
50	31.58	67.90	219.51	514.48	1190.00
100	27.08	52.38	162.92	399.98	988.16
500	21.04	35.27	75.05	164.39	450.52
			λ = 0.20, Δ = 1.00		
20	85.48	183.68	498.23	1027.73	2029.88
50	85.80	183.79	503.19	1016.02	2031.80
100	85.60	180.44	505.85	1021.80	2008.20
500	80.38	181.03	504.35	1013.09	2055.44
			λ = 0.20, Δ = 2.00		
20	53.16	122.05	388.57	849.10	1776.62
50	33.66	70.71	238.51	570.93	1319.04
100	24.92	44.69	133.63	339.70	848.59
500	18.42	23.83	38.20	63.46	121.71
			λ = 0.20, Δ = 3.00		
20	29.50	70.12	260.90	615.15	1419.28
50	13.25	23.89	78.93	229.82	614.86
100	9.93	13.27	25.30	59.34	186.59
500	8.56	9.74	12.40	14.53	17.23

Table 142

Out of Control ARL_0 for SSDMEWMC of Dimension 3 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	31.49	73.39	252.42	616.85	1470.59
50	21.20	41.26	141.65	401.54	1042.69
100	17.96	30.01	81.61	235.05	732.94
500	13.28	22.13	39.99	75.88	178.04
			λ = 0.30, Δ = 0.50		
20	50.13	114.94	347.07	771.54	1685.69
50	40.19	88.19	277.96	657.29	1512.46
100	33.87	70.87	229.47	558.48	1333.20
500	22.28	49.68	130.37	323.22	870.45
			λ = 0.30, Δ = 1.00		
20	88.52	187.46	500.73	1003.34	2074.18
50	87.58	186.44	499.65	997.55	2059.88
100	88.01	183.85	492.58	990.22	2047.67
500	59.13	175.35	501.42	1001.52	2099.18
			λ = 0.30, Δ = 2.00		
20	58.03	129.85	388.52	840.52	1827.15
50	37.22	82.42	257.56	606.70	1436.91
100	26.58	52.01	152.53	396.82	1009.03
500	14.16	29.06	48.90	87.42	197.89
			λ = 0.30, Δ = 3.00		
20	33.97	80.37	275.06	650.18	1516.72
50	15.05	29.40	102.34	285.47	779.48
100	10.14	15.62	37.90	93.34	300.92
500	7.66	10.63	13.14	16.47	21.61

Table 143

Out of Control ARL_0 for SSDMEWMC of Dimension 3 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	39.00	94.58	320.87	740.63	1685.19
50	26.64	58.77	209.27	564.84	1410.65
100	21.46	40.84	144.66	409.81	1141.61
500	15.48	27.78	65.43	144.98	420.75
			λ = 0.40, Δ = 0.50		
20	56.93	130.93	384.13	841.94	1834.54
50	47.01	107.22	334.16	751.61	1699.07
100	41.07	92.37	289.66	679.88	1584.67
500	30.55	61.76	200.82	461.65	1226.37
			λ = 0.40, Δ = 1.00		
20	89.12	188.65	496.46	994.57	2029.49
50	87.84	187.15	493.78	986.80	2022.24
100	87.20	188.03	487.86	987.14	2025.80
500	77.05	182.28	489.65	981.34	2032.92
			λ = 0.40, Δ = 2.00		
20	59.33	132.38	388.34	836.49	1794.28
50	38.39	86.39	268.58	625.89	1440.69
100	27.65	57.34	170.86	421.07	1052.51
500	16.98	32.37	56.53	103.77	253.14
			λ = 0.40, Δ = 3.00		
20	35.99	87.23	283.42	660.93	1527.91
50	16.19	34.15	120.59	317.42	841.45
100	11.00	18.15	46.58	122.54	386.73
500	8.44	10.92	14.82	18.89	26.70

Table 144

Out of Control ARL_0 for SSDMEWMC of Dimension 3 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	λ = 0.50, Δ = 0.25				
20	47.56	117.44	384.97	848.36	1905.04
50	33.12	82.69	295.88	722.71	1757.62
100	27.98	62.05	224.29	600.13	1538.05
500	21.21	39.63	111.52	273.34	817.22
	λ = 0.50, Δ = 0.50				
20	63.14	149.56	438.34	922.66	1988.84
50	54.87	128.91	390.35	864.87	1925.83
100	48.82	114.88	358.95	812.89	1838.53
500	38.98	85.24	269.38	647.93	1582.53
	λ = 0.50, Δ = 1.00				
20	89.97	189.55	495.31	1004.66	2063.87
50	89.65	187.29	491.04	986.62	2050.06
100	89.04	191.68	489.63	989.00	2043.30
500	84.40	196.26	495.42	973.90	2023.98
	λ = 0.50, Δ = 2.00				
20	59.37	132.96	388.57	834.47	1824.87
50	40.09	88.87	273.85	631.03	1477.40
100	29.15	59.74	181.93	432.13	1098.63
500	21.16	31.84	63.50	114.64	290.35
	λ = 0.50, Δ = 3.00				
20	37.11	89.65	293.44	682.22	1583.98
50	17.83	38.09	129.97	341.85	904.39
100	11.92	19.64	50.84	142.26	447.84
500	6.98	11.03	15.39	20.50	33.41

Table 145

Out of Control ARL_0 for SSDMEWMC of Dimension 3 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	59.05	146.31	449.67	989.50	1994.68
50	44.70	114.41	386.15	924.64	1941.65
100	36.84	93.34	324.19	823.82	1852.55
500	21.86	59.37	187.99	504.44	1324.87
			λ = 0.60, Δ = 0.50		
20	73.68	169.21	478.04	1008.77	2043.19
50	66.05	154.14	452.40	989.81	2026.84
100	61.60	145.00	432.16	972.87	2015.48
500	61.76	109.27	367.38	876.96	1890.22
			λ = 0.60, Δ = 1.00		
20	90.96	187.96	487.49	998.11	1971.03
50	89.90	188.30	480.81	997.33	1956.63
100	91.03	189.94	474.39	1009.96	1961.38
500	78.54	187.51	490.24	987.87	1929.67
			λ = 0.60, Δ = 2.00		
20	59.74	131.83	377.42	844.39	1754.30
50	40.80	87.33	266.24	646.05	1429.86
100	29.85	59.34	180.00	450.80	1092.22
500	23.11	33.13	65.63	128.91	301.86
			λ = 0.60, Δ = 3.00		
20	38.68	90.73	289.99	706.39	1530.31
50	18.27	39.91	132.49	371.74	927.53
100	12.34	20.98	58.97	157.54	464.13
500	10.30	10.99	16.60	23.41	39.37

Table 146

Out of Control ARL_0 for SSDMEWMC of Dimension 3 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	87.58	201.07	549.93	1118.73	2190.12
50	75.76	183.55	535.84	1142.24	2256.89
100	66.35	164.85	512.36	1118.01	2311.75
500	44.47	125.96	403.78	928.58	2137.61
			λ = 0.80, Δ = 0.50		
20	94.26	208.55	544.02	1089.97	2148.46
50	91.06	206.73	557.35	1135.26	2217.43
100	87.17	202.00	566.28	1163.41	2308.80
500	67.89	184.88	547.62	1179.50	2408.67
			λ = 0.80, Δ = 1.00		
20	92.61	189.22	482.00	973.81	1936.89
50	93.20	190.59	479.37	977.17	1949.10
100	92.62	188.25	481.06	978.62	1955.79
500	120.09	195.32	475.59	969.46	1935.80
			λ = 0.80, Δ = 2.00		
20	60.17	133.99	377.95	829.41	1747.86
50	41.74	92.94	282.71	668.02	1480.92
100	32.99	63.94	193.78	487.71	1182.24
500	17.76	36.84	78.59	153.91	388.27
			λ = 0.80, Δ = 3.00		
20	41.34	97.43	305.21	719.64	1559.93
50	21.28	47.55	159.57	425.20	1056.19
100	14.34	25.42	75.71	214.01	614.97
500	7.84	13.37	20.31	33.76	60.67

Table 147

Out of Control ARL_0 for SSDMEWMC of Dimension 4 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	32.03	54.51	129.21	279.36	639.71
50	23.20	34.69	59.87	112.80	247.10
100	21.97	30.15	43.25	64.29	126.27
500	19.22	27.25	34.95	40.29	49.26
			$\lambda = 0.05, \Delta = 0.50$		
20	38.33	71.34	184.83	396.54	894.64
50	27.73	46.51	103.80	213.81	527.21
100	25.89	38.65	68.91	127.32	289.68
500	18.67	33.70	45.47	56.33	71.08
			$\lambda = 0.05, \Delta = 1.00$		
20	76.14	176.96	480.30	957.67	1948.05
50	64.75	159.21	452.38	940.14	1914.70
100	63.89	159.29	455.45	931.96	1910.37
500	37.44	158.23	450.09	942.90	1903.21
			$\lambda = 0.05, \Delta = 2.00$		
20	43.90	105.77	337.74	754.25	1656.30
50	24.95	48.68	146.13	362.03	917.47
100	20.62	32.68	66.83	144.92	384.30
500	14.67	23.73	32.02	38.14	45.88
			$\lambda = 0.05, \Delta = 3.00$		
20	26.42	58.65	200.21	500.45	1218.70
50	14.89	21.27	40.51	92.08	242.38
100	12.81	16.70	21.29	27.20	42.56
500	9.33	14.31	17.38	19.22	20.79

Table 148

Out of Control ARL_0 for SSDMEWMC of Dimension 4 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	27.86	52.88	155.63	365.44	855.66
50	21.23	33.27	74.71	163.95	400.94
100	19.34	26.95	46.01	88.96	203.50
500	16.61	22.80	29.61	38.64	64.21
			λ = 0.10, Δ = 0.50		
20	35.41	74.21	211.54	487.17	1077.68
50	27.86	51.18	136.54	317.60	731.62
100	24.95	41.00	92.77	204.14	502.86
500	18.87	30.84	50.66	75.98	142.43
			λ = 0.10, Δ = 1.00		
20	78.41	177.47	479.60	983.19	1968.27
50	76.78	175.00	469.49	985.89	1945.15
100	77.80	176.74	467.68	989.06	1972.34
500	69.29	187.32	473.70	962.73	1947.28
			λ = 0.10, Δ = 2.00		
20	45.69	111.42	352.49	800.30	1703.36
50	26.82	58.03	192.60	468.41	1118.68
100	20.50	35.77	93.91	235.27	618.86
500	17.58	22.90	32.74	43.49	66.27
			λ = 0.10, Δ = 3.00		
20	24.45	61.91	221.13	550.82	1300.07
50	12.74	20.55	53.97	137.53	413.29
100	10.52	13.54	19.97	37.52	95.37
500	10.38	11.67	13.79	15.39	16.91

Table 149

Out of Control ARL_0 for SSDMEWMC of Dimension 4 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	31.39	68.65	214.61	519.91	1239.60
50	23.03	42.02	121.12	307.36	780.64
100	19.86	32.14	72.09	179.48	458.87
500	16.35	23.28	37.34	61.78	134.49
			λ = 0.20, Δ = 0.50		
20	40.49	90.32	267.32	608.03	1360.24
50	32.97	67.26	199.63	461.47	1082.60
100	29.08	55.93	152.26	356.42	867.22
500	22.86	37.33	77.96	166.38	438.27
			λ = 0.20, Δ = 1.00		
20	85.12	183.04	485.69	978.32	1984.23
50	86.61	186.87	479.40	974.64	1987.43
100	84.83	184.48	483.37	976.55	1994.41
500	79.51	187.00	483.11	985.76	1999.26
			λ = 0.20, Δ = 2.00		
20	52.48	126.01	374.97	821.35	1772.53
50	32.42	74.60	240.67	565.51	1313.84
100	23.79	44.31	138.51	335.21	866.86
500	16.81	24.19	41.46	64.57	151.44
			λ = 0.20, Δ = 3.00		
20	29.51	76.08	253.55	608.34	1428.05
50	13.65	26.35	85.53	#N/A	654.31
100	9.96	14.28	31.65	76.42	223.01
500	10.22	10.24	12.87	14.94	17.71

Table 150

Out of Control ARL_0 for SSDMEWMC of Dimension 4 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	38.57	86.62	278.37	652.20	1488.22
50	27.61	56.37	176.63	462.13	1116.05
100	22.66	41.12	119.55	305.30	822.98
500	14.88	27.23	56.30	110.42	278.22
	λ = 0.30, Δ = 0.50				
20	49.40	106.60	319.83	714.88	1557.67
50	39.75	85.52	256.93	593.75	1349.54
100	35.78	70.69	206.71	497.41	1174.64
500	22.64	49.87	129.03	294.72	737.41
	λ = 0.30, Δ = 1.00				
20	88.59	184.77	488.27	991.28	1972.65
50	89.00	185.22	486.13	996.62	1974.15
100	89.64	184.78	484.06	987.64	1999.37
500	79.73	183.01	493.39	994.99	1992.23
	λ = 0.30, Δ = 2.00				
20	56.92	129.30	386.29	838.35	1782.66
50	37.21	81.68	264.89	616.33	1408.93
100	27.23	53.14	167.86	406.71	1010.18
500	18.66	29.85	48.76	86.36	221.59
	λ = 0.30, Δ = 3.00				
20	34.22	82.80	278.30	664.41	1492.55
50	15.61	32.12	115.72	312.23	823.85
100	10.75	16.62	44.18	114.02	347.78
500	9.94	10.62	13.89	17.01	23.96

Table 151

Out of Control ARL_0 for SSDMEWMC of Dimension 4 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	45.84	108.72	339.51	765.53	1614.48
50	34.28	76.01	244.47	602.70	1407.75
100	26.72	56.28	177.11	450.65	1136.11
500	17.86	36.78	85.77	195.53	507.45
			λ = 0.40, Δ = 0.50		
20	56.14	125.78	374.28	807.29	1687.94
50	46.70	106.08	313.53	711.68	1524.53
100	42.08	92.41	272.21	612.35	1409.94
500	33.19	65.33	183.00	411.76	1000.77
			λ = 0.40, Δ = 1.00		
20	89.87	187.92	490.41	977.38	1945.17
50	89.45	189.43	492.28	975.65	1954.12
100	90.35	190.94	484.77	983.63	1956.63
500	92.51	183.38	484.28	994.98	1981.51
			λ = 0.40, Δ = 2.00		
20	59.54	135.03	391.35	843.56	1754.78
50	40.46	91.05	278.47	649.94	1428.31
100	28.88	60.55	182.83	441.55	1087.34
500	27.33	31.32	59.13	109.92	278.79
			λ = 0.40, Δ = 3.00		
20	38.27	92.69	296.52	686.62	1511.37
50	17.65	38.90	136.88	361.03	905.70
100	12.10	19.60	53.37	146.17	438.67
500	9.05	10.59	15.35	20.12	31.11

Table 152

Out of Control ARL_0 for SSDMEWMC of Dimension 4 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	53.74	128.34	392.03	858.19	1831.41
50	41.31	97.36	310.21	732.22	1682.39
100	33.78	74.83	238.05	607.64	1460.59
500	34.27	51.98	127.02	309.94	803.66
			$\lambda = 0.50, \Delta = 0.50$		
20	63.46	144.24	419.52	895.85	1845.70
50	54.60	124.53	371.00	817.93	1747.84
100	49.22	112.60	332.30	751.25	1658.22
500	53.73	94.25	249.89	559.35	1322.28
			$\lambda = 0.50, \Delta = 1.00$		
20	90.43	192.32	489.73	990.05	1964.85
50	90.72	191.13	492.01	1001.06	1965.71
100	90.63	194.96	490.05	997.35	1970.02
500	95.24	201.86	489.05	997.75	1990.72
			$\lambda = 0.50, \Delta = 2.00$		
20	60.67	137.43	397.33	858.33	1765.77
50	41.83	94.46	291.77	666.98	1466.35
100	30.70	64.03	196.12	475.55	1137.58
500	21.93	34.88	66.94	133.04	320.29
			$\lambda = 0.50, \Delta = 3.00$		
20	39.38	97.37	311.01	708.87	1539.01
50	19.41	43.69	152.37	395.90	975.72
100	12.81	22.58	67.14	181.97	504.52
500	13.34	11.34	16.88	24.00	43.69

Table 153

Out of Control ARL_0 for SSDMEWMC of Dimension 4 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	64.07	148.35	443.82	942.37	2038.54
50	51.34	118.87	384.01	867.87	1937.42
100	42.32	98.17	326.80	759.48	1798.47
500	52.29	67.39	188.62	470.99	1182.76
			λ = 0.60, Δ = 0.50		
20	71.54	162.43	464.47	954.27	2049.03
50	63.66	147.59	435.66	921.35	1991.50
100	59.84	134.81	405.47	883.32	1925.81
500	49.47	121.63	314.48	724.26	1678.42
			λ = 0.60, Δ = 1.00		
20	91.99	192.00	492.46	984.29	2021.36
50	92.62	190.68	491.84	980.94	2032.93
100	93.96	194.91	499.38	982.52	2022.05
500	113.57	202.29	499.79	990.06	2021.68
			λ = 0.60, Δ = 2.00		
20	60.82	139.84	396.88	842.64	1831.59
50	42.06	95.01	295.83	671.01	1538.84
100	31.36	67.90	205.69	486.45	1209.72
500	18.94	34.11	71.44	145.40	359.92
			λ = 0.60, Δ = 3.00		
20	40.31	99.58	318.52	710.08	1619.27
50	20.38	46.10	165.66	422.43	1071.16
100	13.31	25.08	78.14	205.18	570.23
500	8.83	12.73	18.45	27.34	50.29

Table 154

Out of Control ARL_0 for SSDMEWMC of Dimension 4 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	81.07	188.47	498.27	1054.34	2155.68
50	70.36	171.15	471.59	1038.07	2168.57
100	63.60	151.71	435.88	1003.65	2154.99
500	37.33	115.17	320.51	771.10	1784.52
	λ = 0.80, Δ = 0.50				
20	87.94	196.01	515.64	1068.54	2156.59
50	81.68	189.73	515.09	1072.53	2218.08
100	78.71	184.06	499.65	1069.22	2242.39
500	69.13	184.45	444.20	1001.95	2199.06
	λ = 0.80, Δ = 1.00				
20	91.66	193.15	482.42	976.51	2000.03
50	91.03	196.80	486.41	982.43	2002.76
100	92.28	197.65	491.71	986.36	2007.99
500	108.64	201.76	486.12	979.71	2011.96
	λ = 0.80, Δ = 2.00				
20	61.69	144.64	394.51	854.57	1834.53
50	43.71	101.28	302.78	694.84	1576.15
100	32.79	72.15	214.76	534.52	1286.57
500	23.21	38.92	79.30	179.08	457.76
	λ = 0.80, Δ = 3.00				
20	43.29	105.21	322.65	739.62	1649.39
50	23.71	52.54	182.68	470.25	1188.60
100	14.79	29.31	90.59	253.18	732.89
500	8.67	13.81	22.17	36.74	82.43

Table 155

Out of Control ARL_0 for SSDMEWMC of Dimension 5 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	34.68	59.73	152.06	348.96	793.09
50	23.21	36.00	68.45	134.81	304.93
100	21.68	30.70	46.50	72.34	139.66
500	16.50	27.63	35.07	41.17	51.57
			$\lambda = 0.05, \Delta = 0.50$		
20	39.08	71.34	185.16	413.34	909.30
50	27.27	46.37	106.80	224.96	535.54
100	25.71	39.80	71.92	137.40	302.22
500	25.33	33.87	45.98	58.64	78.30
			$\lambda = 0.05, \Delta = 1.00$		
20	75.47	176.28	485.56	1007.77	1999.72
50	60.77	155.18	463.88	986.96	1960.62
100	63.22	157.77	460.53	977.06	1960.69
500	68.83	149.99	460.98	969.45	1984.03
			$\lambda = 0.05, \Delta = 2.00$		
20	43.82	108.08	343.75	799.60	1704.05
50	23.78	46.71	145.96	382.41	942.67
100	20.27	31.74	69.62	161.39	410.44
500	24.17	24.08	31.25	38.44	47.02
			$\lambda = 0.05, \Delta = 3.00$		
20	27.55	60.42	211.78	550.95	1297.14
50	14.44	21.54	45.23	106.57	298.08
100	12.74	16.46	21.75	30.39	58.37
500	18.33	15.06	16.84	18.80	20.31

Table 156

Out of Control ARL_0 for SSDMEWMC of Dimension 5 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	30.17	60.26	175.13	410.21	1000.19
50	21.78	34.93	86.06	196.66	500.70
100	19.17	27.95	51.14	99.60	234.23
500	21.36	22.74	31.53	41.67	65.37
			$\lambda = 0.10, \Delta = 0.50$		
20	35.33	72.07	210.08	479.14	1083.15
50	28.45	50.27	135.94	305.68	737.35
100	25.99	41.26	95.68	203.58	497.52
500	18.14	30.73	50.15	79.86	157.14
			$\lambda = 0.10, \Delta = 1.00$		
20	76.45	174.59	480.29	982.94	1988.86
50	72.94	172.22	470.43	963.96	1974.99
100	75.33	172.80	470.86	975.51	1965.57
500	87.43	164.43	476.60	975.36	1978.97
			$\lambda = 0.10, \Delta = 2.00$		
20	43.68	111.02	350.87	773.55	1722.57
50	26.40	56.94	189.19	451.59	1107.80
100	20.41	35.35	97.96	243.49	622.44
500	20.29	20.87	32.34	44.49	84.94
			$\lambda = 0.10, \Delta = 3.00$		
20	24.34	62.78	222.13	547.49	1337.84
50	12.78	21.33	57.79	153.31	441.79
100	10.35	13.80	21.74	41.78	117.18
500	12.29	11.19	13.28	14.97	16.57

Table 157

Out of Control ARL_0 for SSDMEWMC of Dimension 5 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	34.67	76.93	239.37	574.41	1304.08
50	24.54	45.92	138.25	349.68	888.82
100	19.96	33.03	80.41	206.20	556.40
500	20.13	24.16	39.60	70.60	144.07
			λ = 0.20, Δ = 0.50		
20	40.59	90.02	270.33	601.79	1367.81
50	32.71	65.74	201.99	459.68	1079.61
100	28.74	53.03	149.90	350.41	844.68
500	26.74	35.72	83.69	180.83	420.59
			λ = 0.20, Δ = 1.00		
20	82.58	181.64	473.63	968.17	1972.42
50	79.89	180.51	479.77	979.00	1974.00
100	84.11	183.98	474.51	975.83	1970.82
500	107.17	182.09	479.45	980.53	1973.26
			λ = 0.20, Δ = 2.00		
20	51.97	124.27	371.54	810.76	1725.26
50	31.34	73.07	237.16	560.84	1304.36
100	22.88	45.60	144.31	355.38	896.13
500	21.13	24.71	41.72	73.47	182.47
			λ = 0.20, Δ = 3.00		
20	29.96	75.99	260.52	620.97	1421.51
50	13.70	28.05	95.01	252.90	683.83
100	9.65	14.72	35.16	85.26	263.66
500	11.39	9.89	12.36	15.03	19.18

Table 158

Out of Control ARL_0 for SSDMEWMC of Dimension 5 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	41.66	97.13	296.61	688.69	1526.93
50	28.91	63.78	196.57	497.44	1183.25
100	23.38	44.09	127.11	328.76	863.24
500	17.24	30.93	60.10	122.07	302.50
			λ = 0.30, Δ = 0.50		
20	48.05	108.58	321.01	728.24	1578.51
50	39.16	84.57	253.97	590.79	1335.84
100	34.90	69.93	203.27	479.49	1124.61
500	39.30	50.07	122.06	274.42	662.70
			λ = 0.30, Δ = 1.00		
20	87.05	185.34	487.81	986.35	1979.88
50	86.13	188.88	485.78	981.70	1966.52
100	87.56	189.08	480.57	990.00	1973.66
500	88.94	185.60	480.84	1003.33	1996.18
			λ = 0.30, Δ = 2.00		
20	57.09	132.75	386.99	838.53	1758.29
50	36.68	87.02	259.98	609.75	1390.17
100	26.28	57.57	171.91	423.50	1023.92
500	17.31	28.41	53.10	112.48	279.03
			λ = 0.30, Δ = 3.00		
20	34.80	88.39	288.66	664.84	1498.48
50	16.01	36.14	129.12	325.56	823.70
100	10.32	18.24	48.50	137.04	380.70
500	9.45	10.08	13.29	17.76	28.20

Table 159

Out of Control ARL_0 for SSDMEWMC of Dimension 5 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	49.20	114.27	342.80	760.77	1698.48
50	35.52	80.36	251.78	604.41	1445.81
100	28.66	58.47	181.08	449.26	1168.14
500	26.59	37.41	94.84	202.59	509.45
			$\lambda = 0.40, \Delta = 0.50$		
20	53.10	127.38	360.20	801.29	1730.99
50	44.59	102.78	302.79	691.49	1547.71
100	39.43	88.12	257.44	583.98	1375.95
500	36.47	60.06	173.28	388.96	895.78
			$\lambda = 0.40, \Delta = 1.00$		
20	87.73	188.54	484.30	971.79	1976.77
50	86.75	187.97	483.67	964.90	1969.99
100	87.62	190.19	480.49	961.00	1964.44
500	95.16	184.65	476.81	969.76	1999.63
			$\lambda = 0.40, \Delta = 2.00$		
20	58.39	136.40	387.35	830.88	1776.81
50	38.92	93.67	276.32	626.82	1453.58
100	28.73	61.96	194.24	448.97	1098.67
500	28.00	30.02	63.47	136.76	327.99
			$\lambda = 0.40, \Delta = 3.00$		
20	38.17	95.98	298.88	687.27	1553.23
50	17.75	41.01	142.81	366.29	949.33
100	11.76	21.71	64.59	169.36	498.01
500	11.07	10.80	15.17	21.91	41.14

Table 160

Out of Control ARL_0 for SSDMEWMC of Dimension 5 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.50, \Delta = 0.25$				
20	56.17	130.86	390.04	848.21	1836.18
50	41.79	96.01	306.70	727.32	1650.52
100	34.08	75.30	239.92	586.98	1419.01
500	24.24	48.18	130.15	307.08	782.18
	$\lambda = 0.50, \Delta = 0.50$				
20	62.47	142.48	407.13	875.01	1850.30
50	51.35	119.48	358.91	799.87	1735.60
100	46.32	101.99	309.87	719.59	1604.28
500	37.07	81.65	224.01	515.87	1194.62
	$\lambda = 0.50, \Delta = 1.00$				
20	89.58	189.08	487.20	983.87	1983.77
50	87.44	186.75	486.64	977.78	1973.10
100	87.73	188.79	480.92	976.93	1985.03
500	101.33	175.50	486.94	975.26	1991.88
	$\lambda = 0.50, \Delta = 2.00$				
20	60.01	138.76	391.62	840.47	1779.76
50	40.92	96.47	286.47	665.70	1509.99
100	31.58	66.56	201.65	486.98	1167.33
500	17.70	34.16	73.72	149.43	385.65
	$\lambda = 0.50, \Delta = 3.00$				
20	39.84	98.30	314.85	715.74	1570.06
50	19.54	46.66	157.34	406.29	1023.35
100	13.02	24.31	73.25	200.87	574.63
500	6.00	11.11	17.67	27.84	51.60

Table 161

Out of Control ARL_0 for SSDMEWMC of Dimension 5 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.60, \Delta = 0.25$				
20	64.17	147.57	436.57	930.72	2000.17
50	50.25	115.68	370.20	839.23	1869.22
100	40.80	94.58	300.64	720.06	1696.15
500	39.82	64.89	182.09	424.42	1089.91
	$\lambda = 0.60, \Delta = 0.50$				
20	71.15	159.80	451.53	949.71	2027.99
50	60.44	139.23	413.54	909.37	1954.52
100	53.46	123.64	382.95	850.09	1870.54
500	47.42	110.16	294.74	676.55	1508.07
	$\lambda = 0.60, \Delta = 1.00$				
20	89.69	189.10	496.20	994.18	2046.40
50	87.80	188.59	496.25	992.85	2050.53
100	89.27	188.90	492.30	1005.02	2072.22
500	81.26	188.55	498.32	1008.24	2046.08
	$\lambda = 0.60, \Delta = 2.00$				
20	60.30	138.76	398.45	858.55	1848.12
50	42.11	95.92	298.30	688.14	1587.79
100	31.86	69.70	209.00	520.67	1252.93
500	21.91	37.32	76.81	164.35	426.85
	$\lambda = 0.60, \Delta = 3.00$				
20	41.02	100.65	327.52	740.28	1659.98
50	20.94	49.98	170.34	439.52	1115.73
100	14.14	26.80	84.84	235.71	659.11
500	6.97	11.98	19.81	31.85	73.49

Table 162

Out of Control ARL_0 for SSDMEWMC of Dimension 5 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	77.04	172.62	484.56	1019.85	2082.03
50	66.28	149.37	442.69	957.84	2013.88
100	57.50	129.15	389.23	880.94	1917.65
500	61.19	95.26	277.16	640.05	1482.09
	λ = 0.80, Δ = 0.50				
20	83.96	184.02	499.98	1043.26	2110.56
50	77.87	176.33	487.61	1021.91	2117.46
100	72.48	167.16	462.78	1002.98	2092.11
500	66.13	145.71	402.79	872.51	1908.50
	λ = 0.80, Δ = 1.00				
20	90.88	186.88	491.47	987.44	2000.52
50	89.49	187.69	489.42	982.40	1993.34
100	89.54	193.13	494.97	993.86	2010.95
500	112.96	196.81	491.30	987.94	2009.86
	λ = 0.80, Δ = 2.00				
20	60.43	139.48	400.41	865.53	1816.80
50	43.52	101.81	308.04	710.99	1559.42
100	33.41	72.95	222.42	534.85	1278.01
500	16.24	40.94	86.81	192.71	470.55
	λ = 0.80, Δ = 3.00				
20	43.50	105.66	330.80	752.63	1643.92
50	23.37	56.37	193.15	486.10	1182.86
100	15.01	31.06	97.96	271.90	737.55
500	6.75	14.19	23.75	42.51	96.96

Table 163

Out of Control ARL_0 for SSDMEWMC of Dimension 6 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	34.59	61.01	151.16	354.22	815.42
50	21.89	33.72	63.02	131.87	310.53
100	20.24	29.04	42.55	70.87	129.96
500	6.33	25.25	32.85	39.72	48.36
			$\lambda = 0.05, \Delta = 0.50$		
20	38.64	70.87	174.83	396.99	908.46
50	26.05	43.60	95.07	209.29	493.09
100	24.27	36.75	64.88	121.42	263.83
500	8.33	33.50	45.36	57.62	78.67
			$\lambda = 0.05, \Delta = 1.00$		
20	72.38	169.72	462.38	961.58	1948.43
50	56.93	149.58	436.47	948.24	1911.93
100	58.20	150.32	435.75	929.93	1902.37
500	79.00	146.42	439.84	932.79	1910.72
			$\lambda = 0.05, \Delta = 2.00$		
20	42.91	101.58	315.20	762.88	1655.99
50	22.70	45.46	133.78	351.40	902.18
100	19.37	30.77	65.26	150.02	390.92
500	11.00	23.24	30.70	36.85	47.13
			$\lambda = 0.05, \Delta = 3.00$		
20	27.73	60.23	202.00	531.92	1277.19
50	14.03	20.79	43.12	105.94	280.92
100	12.09	15.96	20.87	29.99	59.85
500	8.00	13.38	16.35	18.13	19.59

Table 164

Out of Control ARL_0 for SSDMEWMC of Dimension 6 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	30.13	60.51	182.65	449.44	1068.58
50	21.15	34.31	82.12	198.86	511.69
100	18.38	26.96	51.13	103.47	247.50
500	12.50	21.57	30.84	40.04	65.45
			$\lambda = 0.10, \Delta = 0.50$		
20	34.74	72.45	211.90	489.51	1087.01
50	26.86	47.23	127.89	297.67	719.25
100	23.65	38.30	85.56	193.30	460.80
500	19.83	32.44	51.26	79.13	153.25
			$\lambda = 0.10, \Delta = 1.00$		
20	74.51	169.78	473.73	984.56	1976.71
50	72.12	165.67	466.47	980.09	1976.61
100	72.39	167.57	463.82	971.80	1987.58
500	100.83	172.10	471.59	978.55	1994.39
			$\lambda = 0.10, \Delta = 2.00$		
20	42.24	105.90	347.90	780.34	1705.73
50	25.20	56.10	185.84	467.23	1124.41
100	19.19	33.83	93.91	234.62	625.90
500	11.92	21.18	30.78	48.39	91.68
			$\lambda = 0.10, \Delta = 3.00$		
20	24.29	61.24	224.17	570.07	1327.87
50	12.28	20.72	60.39	159.67	447.78
100	10.10	13.35	21.84	46.39	118.17
500	6.50	10.99	12.88	14.48	15.98

Table 165

Out of Control ARL_0 for SSDMEWMC of Dimension 6 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	34.13	79.40	251.75	609.89	1378.82
50	23.84	47.16	139.34	354.69	893.63
100	19.75	32.93	85.15	205.05	547.03
500	15.37	25.43	41.66	70.00	146.49
			$\lambda = 0.20, \Delta = 0.50$		
20	40.46	89.40	268.66	612.76	1368.16
50	31.58	63.62	189.60	453.12	1062.91
100	26.42	49.79	135.51	330.36	802.70
500	23.25	37.36	75.78	151.17	366.35
			$\lambda = 0.20, \Delta = 1.00$		
20	80.89	178.02	476.49	990.03	1993.47
50	82.11	178.84	477.68	993.99	1995.49
100	82.57	176.25	475.08	994.54	1993.50
500	59.89	169.88	468.02	992.83	1992.19
			$\lambda = 0.20, \Delta = 2.00$		
20	49.42	123.33	373.62	845.26	1770.28
50	30.09	69.77	234.46	590.96	1326.08
100	22.10	44.26	137.47	363.84	890.06
500	23.73	24.17	42.17	83.11	209.30
			$\lambda = 0.20, \Delta = 3.00$		
20	28.95	75.36	260.18	647.97	1448.50
50	13.14	27.35	94.89	272.83	715.58
100	9.61	14.30	34.25	90.69	281.23
500	9.84	9.65	12.46	15.23	20.42

Table 166

Out of Control ARL_0 for SSDMEWMC of Dimension 6 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	41.64	98.01	306.34	717.11	1636.48
50	28.97	62.78	201.17	499.06	1219.31
100	23.31	43.00	128.36	330.12	883.72
500	16.50	32.24	60.09	120.75	290.38
			$\lambda = 0.30, \Delta = 0.50$		
20	47.04	107.12	322.18	726.38	1617.40
50	37.77	80.65	248.23	578.27	1369.72
100	32.20	66.37	191.71	445.02	1121.08
500	30.67	46.46	116.19	248.68	584.71
			$\lambda = 0.30, \Delta = 1.00$		
20	86.24	182.70	481.54	992.23	2051.75
50	84.18	185.96	483.03	996.97	2051.38
100	83.34	187.37	481.04	1005.20	2040.10
500	93.50	191.49	478.21	999.64	2057.57
			$\lambda = 0.30, \Delta = 2.00$		
20	53.77	131.06	391.74	856.35	1845.69
50	34.94	82.97	268.13	636.29	1459.37
100	24.64	53.28	171.31	437.69	1067.03
500	19.48	27.45	55.26	124.47	298.73
			$\lambda = 0.30, \Delta = 3.00$		
20	33.50	85.46	286.70	695.06	1573.96
50	15.41	35.31	127.14	345.53	893.30
100	9.81	17.09	51.51	144.44	445.42
500	10.00	9.87	14.02	20.43	34.37

Table 167

Out of Control ARL_0 for SSDMEWMC of Dimension 6 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	48.99	117.03	357.11	807.38	1739.60
50	34.85	78.50	253.82	603.09	1429.47
100	28.10	57.36	181.48	441.06	1131.68
500	25.58	36.85	88.91	188.34	493.11
			λ = 0.40, Δ = 0.50		
20	53.23	123.89	365.82	806.08	1738.07
50	44.63	99.05	294.88	685.78	1561.47
100	38.66	83.49	241.43	566.99	1356.42
500	34.67	64.67	157.92	345.29	812.02
			λ = 0.40, Δ = 1.00		
20	86.73	186.86	493.23	982.13	1993.53
50	87.34	186.24	495.99	984.46	2009.40
100	86.57	186.13	494.11	986.16	2016.17
500	103.03	202.53	488.65	987.57	2018.05
			λ = 0.40, Δ = 2.00		
20	57.50	136.58	406.28	858.18	1813.57
50	38.79	90.09	290.06	666.67	1483.82
100	27.34	60.06	194.42	474.95	1141.41
500	17.97	30.81	70.37	141.48	369.66
			λ = 0.40, Δ = 3.00		
20	37.43	96.93	311.87	705.63	1573.53
50	18.18	44.36	157.43	396.71	968.42
100	11.34	21.22	71.50	191.64	530.99
500	10.00	11.47	17.24	27.15	56.21

Table 168

Out of Control ARL_0 for SSDMEWMC of Dimension 6 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	λ = 0.50, Δ = 0.25				
20	56.01	129.67	399.15	872.51	1855.56
50	40.32	94.50	307.87	718.51	1611.12
100	33.04	71.88	232.78	577.95	1349.64
500	34.80	45.69	121.28	279.13	694.72
	λ = 0.50, Δ = 0.50				
20	60.54	137.99	410.40	873.56	1849.46
50	50.76	114.60	350.36	784.13	1719.27
100	45.28	99.62	295.31	673.30	1544.64
500	46.69	75.69	199.36	448.94	1058.94
	λ = 0.50, Δ = 1.00				
20	87.09	186.44	499.78	996.25	2023.18
50	86.35	186.31	498.43	1003.42	2026.91
100	88.41	185.46	496.43	1008.04	2017.78
500	85.06	194.22	490.07	992.91	2034.94
	λ = 0.50, Δ = 2.00				
20	59.58	137.40	411.76	866.84	1841.96
50	40.68	95.67	306.80	684.32	1530.62
100	29.54	64.01	213.03	512.18	1190.96
500	21.13	33.11	76.47	161.98	410.03
	λ = 0.50, Δ = 3.00				
20	39.46	99.85	331.05	733.07	1637.57
50	20.10	48.62	177.07	437.14	1065.16
100	12.79	24.89	86.74	227.59	592.47
500	6.84	11.61	19.73	33.26	70.00

Table 169

Out of Control ARL_0 for SSDMEWMC of Dimension 6 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	62.31	145.44	430.55	923.03	1942.37
50	47.51	109.79	343.42	799.80	1728.46
100	39.23	88.88	274.35	666.48	1513.64
500	63.20	61.44	156.37	365.86	897.09
			$\lambda = 0.60, \Delta = 0.50$		
20	67.58	151.77	443.26	932.76	1952.23
50	58.61	130.35	388.58	856.98	1862.83
100	53.62	117.00	338.83	765.25	1724.03
500	54.64	86.23	242.32	551.73	1279.37
			$\lambda = 0.60, \Delta = 1.00$		
20	88.36	183.98	494.30	1001.71	2004.51
50	88.43	186.35	493.63	1000.96	1998.15
100	90.61	187.02	489.48	1001.50	2010.83
500	124.62	188.51	489.43	991.68	1989.60
			$\lambda = 0.60, \Delta = 2.00$		
20	60.37	137.26	402.90	884.68	1837.91
50	41.87	97.67	303.74	698.42	1547.52
100	30.58	67.35	216.62	522.87	1235.59
500	22.93	35.19	82.60	171.59	433.38
			$\lambda = 0.60, \Delta = 3.00$		
20	41.07	103.95	331.29	759.02	1648.36
50	22.81	53.81	181.83	465.79	1125.59
100	13.88	27.74	92.79	250.22	663.58
500	10.32	12.81	20.54	35.27	90.05

Table 170

Out of Control ARL_0 for SSDMEWMC of Dimension 6 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	72.65	163.14	467.44	980.64	2030.56
50	58.82	133.66	401.78	871.68	1881.34
100	49.49	111.12	342.31	778.30	1724.86
500	43.61	85.53	227.17	517.12	1214.07
			$\lambda = 0.80, \Delta = 0.50$		
20	79.28	172.55	479.80	1004.00	2049.70
50	70.66	156.47	445.05	951.77	2010.18
100	65.90	142.84	411.79	916.72	1958.25
500	42.87	117.93	323.52	727.35	1642.03
			$\lambda = 0.80, \Delta = 1.00$		
20	89.81	185.26	493.06	989.80	2005.47
50	89.36	185.54	489.93	995.51	2010.79
100	89.86	184.64	492.71	984.79	2015.25
500	81.57	191.79	496.81	1006.48	2023.25
			$\lambda = 0.80, \Delta = 2.00$		
20	61.72	138.82	404.81	876.69	1849.76
50	44.41	98.75	310.47	718.97	1603.29
100	32.18	70.48	218.45	544.00	1306.62
500	16.97	36.19	87.00	185.32	502.65
			$\lambda = 0.80, \Delta = 3.00$		
20	43.91	106.87	340.70	768.80	1686.43
50	24.75	56.87	200.06	498.53	1213.25
100	15.43	32.38	109.49	281.71	773.93
500	7.52	14.45	25.52	48.20	116.16

Table 171

Out of Control ARL_0 for SSDMEWMC of Dimension 7 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	34.32	61.14	160.51	364.68	865.60
50	20.43	33.00	63.72	131.00	296.37
100	19.00	26.96	40.87	64.15	126.53
500	10.00	22.78	30.25	35.14	44.16
			λ = 0.05, Δ = 0.50		
20	38.50	69.69	178.85	405.33	890.58
50	24.60	42.34	91.71	190.06	452.32
100	23.18	35.79	61.08	106.52	239.30
500	11.00	29.11	41.92	52.10	72.92
			λ = 0.05, Δ = 1.00		
20	71.68	171.71	474.47	973.96	1929.24
50	54.46	147.20	446.29	952.48	1896.41
100	55.22	147.61	442.39	944.33	1891.52
500	34.50	142.51	435.73	937.48	1920.58
			λ = 0.05, Δ = 2.00		
20	41.63	100.08	326.40	753.29	1629.92
50	21.11	43.63	137.23	341.10	837.61
100	17.77	29.09	62.76	146.82	385.97
500	12.50	20.64	28.61	34.90	45.78
			λ = 0.05, Δ = 3.00		
20	27.76	60.17	215.93	544.36	1288.05
50	13.32	20.65	42.69	101.14	289.68
100	11.67	15.56	20.90	30.52	54.91
500	9.00	13.01	15.48	17.17	18.53

Table 172

Out of Control ARL_0 for SSDMEWMC of Dimension 7 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	29.24	60.82	191.23	462.91	1096.45
50	20.02	33.11	84.06	199.56	505.96
100	17.20	25.23	47.00	92.86	246.00
500	7.91	18.80	27.07	35.90	55.85
			λ = 0.10, Δ = 0.50		
20	33.92	70.07	207.00	495.20	1110.16
50	25.57	46.16	118.74	281.08	677.74
100	23.19	36.16	79.35	169.97	427.17
500	15.27	28.50	44.14	69.49	147.53
			λ = 0.10, Δ = 1.00		
20	72.45	174.52	475.10	979.98	1983.42
50	68.99	166.73	469.66	971.46	1980.33
100	69.79	165.26	464.57	978.91	1972.57
500	54.73	159.50	466.07	967.44	1980.63
			λ = 0.10, Δ = 2.00		
20	39.64	103.88	340.09	777.68	1680.30
50	23.06	52.27	178.45	436.65	1054.61
100	17.84	30.96	89.03	228.70	597.96
500	13.09	19.83	30.02	46.96	91.31
			λ = 0.10, Δ = 3.00		
20	23.31	60.60	221.78	561.46	1306.36
50	11.86	20.36	60.22	166.75	454.72
100	9.75	12.94	22.13	50.78	134.01
500	8.09	10.40	12.32	13.59	15.34

Table 173

Out of Control ARL_0 for SSDMEWMC of Dimension 7 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	33.54	76.26	250.34	601.93	1418.57
50	22.17	43.11	132.07	340.28	867.82
100	18.39	30.50	80.95	197.29	531.99
500	17.35	21.46	38.37	67.99	141.55
			λ = 0.20, Δ = 0.50		
20	37.71	87.67	263.58	628.16	1408.64
50	29.72	59.61	174.07	428.45	1029.03
100	25.43	45.98	126.90	299.64	733.30
500	21.06	31.39	69.68	143.96	338.28
			λ = 0.20, Δ = 1.00		
20	78.55	178.60	474.88	987.20	1991.80
50	78.04	177.06	475.97	987.01	1999.44
100	78.21	176.49	478.65	987.67	1992.88
500	54.88	176.42	471.82	991.21	2019.82
			λ = 0.20, Δ = 2.00		
20	46.65	115.49	357.52	808.71	1769.83
50	28.65	66.84	226.40	563.15	1311.68
100	20.19	41.87	134.62	344.53	887.00
500	13.65	20.97	39.81	85.25	203.31
			λ = 0.20, Δ = 3.00		
20	27.12	73.07	253.75	627.68	1436.91
50	12.96	27.69	98.65	269.57	714.05
100	9.25	14.59	35.93	103.01	304.17
500	7.88	8.61	11.73	14.70	21.66

Table 174

Out of Control ARL_0 for SSDMEWMC of Dimension 7 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	40.25	94.26	303.81	727.76	1626.15
50	27.66	56.31	181.66	471.87	1170.91
100	21.63	40.20	114.54	305.44	804.75
500	15.14	27.67	50.23	114.97	285.83
			$\lambda = 0.30, \Delta = 0.50$		
20	44.36	101.49	313.13	736.67	1644.47
50	34.45	75.50	226.80	563.46	1314.50
100	29.60	58.33	168.57	419.69	1028.80
500	27.45	42.57	100.04	226.04	521.67
			$\lambda = 0.30, \Delta = 1.00$		
20	81.58	177.64	474.50	993.38	2043.08
50	82.95	177.35	477.28	992.96	2040.44
100	83.15	178.02	471.68	1002.74	2059.36
500	88.59	172.01	478.95	996.57	2085.07
			$\lambda = 0.30, \Delta = 2.00$		
20	51.43	122.98	368.53	832.74	1828.29
50	33.24	77.38	253.09	619.38	1412.95
100	23.33	50.68	164.82	423.91	1044.27
500	13.85	23.88	54.87	114.60	304.19
			$\lambda = 0.30, \Delta = 3.00$		
20	31.96	82.50	278.99	667.66	1539.19
50	15.53	35.16	126.55	345.54	900.17
100	10.60	18.82	56.39	161.59	452.20
500	9.61	9.95	14.61	20.02	36.66

Table 175

Out of Control ARL_0 for SSDMEWMC of Dimension 7 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	47.60	109.86	339.03	796.29	1771.00
50	31.98	70.48	228.98	574.09	1362.41
100	26.03	51.75	157.48	409.17	1017.45
500	20.25	29.52	72.45	181.14	438.00
	λ = 0.40, Δ = 0.50				
20	51.33	118.65	355.85	807.99	1798.62
50	40.05	90.07	279.01	664.14	1518.85
100	34.57	73.48	213.01	526.35	1266.92
500	28.40	51.93	130.32	299.45	721.10
	λ = 0.40, Δ = 1.00				
20	83.27	178.26	477.55	993.13	2042.38
50	85.21	180.66	478.45	981.34	2045.05
100	85.23	180.00	473.80	990.60	2052.72
500	93.15	181.53	471.33	974.64	2069.32
	λ = 0.40, Δ = 2.00				
20	53.61	126.76	378.15	845.30	1831.22
50	35.86	84.60	269.77	642.83	1461.89
100	26.10	57.49	184.72	464.69	1125.17
500	25.10	26.91	64.30	139.98	366.88
	λ = 0.40, Δ = 3.00				
20	35.78	89.31	295.06	695.65	1568.60
50	18.36	41.64	151.29	392.38	992.70
100	11.55	22.34	74.21	201.75	548.23
500	9.63	10.31	16.72	26.54	59.86

Table 176

Out of Control ARL_0 for SSDMEWMC of Dimension 7 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	λ = 0.50, Δ = 0.25				
20	52.58	124.93	383.95	860.67	1842.61
50	36.88	85.51	279.92	671.23	1504.40
100	28.91	61.77	203.72	509.45	1202.25
500	14.86	37.41	103.10	241.49	604.30
	λ = 0.50, Δ = 0.50				
20	56.35	135.40	401.06	882.60	1880.83
50	45.47	107.20	333.34	761.88	1679.23
100	39.12	88.77	262.05	628.99	1464.39
500	31.28	64.12	172.30	383.29	936.02
	λ = 0.50, Δ = 1.00				
20	84.23	181.15	485.80	1005.84	2027.90
50	83.59	184.74	484.92	998.71	2020.04
100	83.38	186.23	482.45	992.14	2027.31
500	77.29	187.28	481.65	999.99	2034.79
	λ = 0.50, Δ = 2.00				
20	54.83	133.69	394.18	864.63	1830.51
50	37.66	90.86	285.59	668.20	1508.86
100	28.16	62.22	198.19	474.18	1162.84
500	20.79	29.86	76.37	166.80	411.65
	λ = 0.50, Δ = 3.00				
20	37.23	95.54	311.83	722.93	1602.16
50	20.32	47.54	168.72	436.42	1082.05
100	13.10	25.84	84.65	237.86	631.63
500	8.63	11.84	18.52	35.67	83.14

Table 177

Out of Control ARL_0 for SSDMEWMC of Dimension 7 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	57.95	137.15	404.69	904.00	1898.96
50	42.10	101.16	312.64	733.98	1644.10
100	33.46	76.87	231.64	581.53	1376.32
500	24.36	52.08	137.08	305.10	767.77
			λ = 0.60, Δ = 0.50		
20	62.78	148.76	422.16	942.03	1963.35
50	52.51	122.66	357.81	830.38	1813.00
100	46.36	103.01	300.43	723.67	1649.11
500	45.34	80.81	200.35	489.48	1142.48
			λ = 0.60, Δ = 1.00		
20	84.86	186.10	479.29	995.85	2025.73
50	86.05	186.84	479.31	990.99	2011.63
100	84.64	185.19	475.85	990.57	2010.93
500	78.30	180.26	478.53	1010.16	2048.58
			λ = 0.60, Δ = 2.00		
20	56.67	136.54	386.59	861.33	1819.37
50	38.71	94.78	286.13	679.00	1515.22
100	29.66	67.12	203.80	493.27	1194.45
500	20.23	32.00	79.77	174.43	461.09
			λ = 0.60, Δ = 3.00		
20	38.95	98.78	311.75	735.18	1626.75
50	21.01	51.12	173.75	461.55	1110.20
100	13.71	27.12	91.17	247.55	674.03
500	6.38	12.95	20.99	42.37	101.04

Table 178

Out of Control ARL_0 for SSDMEWMC of Dimension 7 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	66.66	154.37	450.41	956.65	1966.31
50	52.23	120.72	361.01	800.32	1753.52
100	41.60	96.10	291.42	663.64	1539.93
500	39.92	62.96	181.99	417.21	1002.01
			$\lambda = 0.80, \Delta = 0.50$		
20	73.35	163.90	476.93	999.77	2029.93
50	63.37	141.86	436.03	929.30	1955.63
100	56.32	125.13	384.19	842.38	1838.40
500	62.63	92.96	283.30	636.35	1459.53
			$\lambda = 0.80, \Delta = 1.00$		
20	87.80	188.53	495.55	992.00	2014.05
50	88.17	187.06	497.65	993.41	2009.74
100	86.77	183.32	492.22	984.76	2013.10
500	81.92	178.62	484.73	1005.38	2014.99
			$\lambda = 0.80, \Delta = 2.00$		
20	57.53	135.07	402.96	858.33	1810.28
50	39.76	95.18	306.23	695.39	1544.14
100	30.91	67.09	216.06	527.67	1250.23
500	22.35	34.45	82.41	187.70	488.94
			$\lambda = 0.80, \Delta = 3.00$		
20	40.84	101.30	337.20	751.87	1661.56
50	22.55	54.88	194.65	480.45	1170.92
100	14.88	30.42	105.48	277.35	744.34
500	6.95	12.77	23.99	45.40	110.54

Table 179

Out of Control ARL_0 for SSDMEWMC of Dimension 8 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	33.65	62.71	160.90	374.73	874.82
50	18.78	30.44	58.30	121.08	281.46
100	17.38	25.18	37.61	60.25	117.40
500	36.00	21.50	27.02	32.55	40.75
			λ = 0.05, Δ = 0.50		
20	37.44	69.57	170.88	389.80	893.28
50	22.41	38.97	79.54	169.38	395.31
100	21.13	32.44	55.48	98.33	203.72
500	36.00	27.42	39.09	49.33	65.52
			λ = 0.05, Δ = 1.00		
20	72.26	175.85	472.99	987.85	1949.54
50	51.58	151.47	445.58	960.13	1937.96
100	53.07	147.28	439.34	960.78	1908.94
500	17.00	133.08	437.61	958.79	1910.39
			λ = 0.05, Δ = 2.00		
20	40.75	103.67	318.03	748.22	1607.57
50	19.83	42.08	127.43	336.68	826.47
100	17.15	28.53	62.38	143.75	365.52
500	20.00	20.11	27.54	35.06	47.50
			λ = 0.05, Δ = 3.00		
20	27.66	63.42	214.00	555.85	1278.22
50	12.83	20.25	44.22	108.41	286.21
100	11.09	15.22	21.00	31.08	59.40
500	7.00	11.73	14.91	16.49	17.79

Table 180

Out of Control ARL_0 for SSDMEWMC of Dimension 8 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	27.96	61.05	182.70	446.60	1062.76
50	18.08	30.41	77.07	178.51	459.34
100	15.75	23.13	42.53	86.90	205.22
500	16.50	19.59	26.73	33.37	53.00
			$\lambda = 0.10, \Delta = 0.50$		
20	32.01	68.45	201.55	461.35	1089.95
50	22.75	41.01	103.74	239.89	596.98
100	20.06	32.83	69.76	145.53	370.96
500	24.00	26.96	40.27	66.93	123.46
			$\lambda = 0.10, \Delta = 1.00$		
20	71.76	171.88	473.90	969.68	1999.52
50	67.41	166.32	459.59	952.36	1980.76
100	66.45	165.36	455.19	947.10	1978.08
500	115.83	155.20	464.05	948.40	1992.53
			$\lambda = 0.10, \Delta = 2.00$		
20	38.08	99.28	326.28	734.35	1654.36
50	21.65	50.05	165.88	411.21	993.27
100	17.23	32.05	89.16	216.55	555.75
500	14.17	18.57	28.83	46.62	95.53
			$\lambda = 0.10, \Delta = 3.00$		
20	22.82	59.39	216.92	538.65	1289.45
50	11.50	19.41	59.57	158.49	450.39
100	9.15	12.74	23.84	47.39	129.50
500	8.67	9.58	11.75	13.30	15.30

Table 181

Out of Control ARL_0 for SSDMEWMC of Dimension 8 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	31.16	75.44	246.93	591.12	1369.06
50	20.05	40.89	130.19	319.46	797.86
100	16.33	28.26	75.68	175.83	473.60
500	16.67	21.76	35.65	62.27	124.12
			λ = 0.20, Δ = 0.50		
20	35.04	82.66	261.78	617.97	1384.08
50	26.25	53.76	163.26	385.34	918.08
100	23.04	41.99	111.77	269.14	654.72
500	23.27	32.60	68.36	120.85	269.73
			λ = 0.20, Δ = 1.00		
20	75.56	174.00	478.98	986.43	1967.82
50	75.87	177.33	481.44	975.51	1967.15
100	76.77	173.76	479.27	987.63	1969.07
500	70.45	179.96	476.29	987.57	1992.02
			λ = 0.20, Δ = 2.00		
20	42.58	113.05	354.42	783.23	1663.62
50	26.69	65.88	223.68	541.10	1242.01
100	19.66	40.66	133.53	338.16	810.88
500	15.91	22.06	43.73	84.49	198.94
			λ = 0.20, Δ = 3.00		
20	25.57	69.85	250.94	607.77	1372.38
50	12.47	27.07	94.90	266.69	675.92
100	9.14	14.74	40.94	110.05	294.39
500	11.67	9.59	11.94	14.81	22.32

Table 182

Out of Control ARL_0 for SSDMEWMC of Dimension 8 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	38.82	92.54	301.88	702.42	1587.17
50	24.44	54.73	185.07	444.42	1066.73
100	19.15	38.07	115.89	288.46	728.85
500	17.67	26.68	51.78	107.56	240.50
			$\lambda = 0.30, \Delta = 0.50$		
20	42.07	99.49	316.42	717.66	1603.09
50	32.10	68.28	216.56	524.45	1227.62
100	27.40	51.37	156.73	387.77	910.39
500	21.33	44.18	95.51	197.69	453.26
			$\lambda = 0.30, \Delta = 1.00$		
20	79.63	176.89	489.95	987.81	1995.78
50	80.27	179.71	488.55	992.84	2004.17
100	79.71	178.57	485.14	988.60	1982.84
500	77.59	183.05	483.67	979.11	1990.59
			$\lambda = 0.30, \Delta = 2.00$		
20	50.15	119.34	371.68	819.83	1765.57
50	32.04	77.04	253.62	604.18	1368.01
100	22.52	49.86	166.58	416.77	994.94
500	19.76	26.23	60.75	120.99	301.83
			$\lambda = 0.30, \Delta = 3.00$		
20	31.01	81.97	286.97	665.04	1500.20
50	15.27	35.01	134.03	352.57	881.45
100	10.16	18.74	58.11	165.72	438.43
500	8.26	9.80	14.23	21.52	49.73

Table 183

Out of Control ARL_0 for SSDMEWMC of Dimension 8 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	44.90	108.57	335.79	774.91	1693.40
50	29.34	67.81	226.11	545.65	1249.45
100	23.66	50.47	151.29	373.93	924.23
500	20.44	29.82	68.95	151.46	373.88
			λ = 0.40, Δ = 0.50		
20	48.42	115.45	351.10	780.24	1709.75
50	36.83	83.76	262.56	611.56	1405.83
100	31.04	66.39	197.27	473.50	1121.95
500	26.68	47.38	116.81	260.36	589.31
			λ = 0.40, Δ = 1.00		
20	81.44	181.89	479.67	973.52	1951.53
50	80.54	180.43	485.50	977.64	1959.50
100	79.94	180.42	476.16	974.26	1954.48
500	107.62	175.68	477.33	986.27	1951.46
			λ = 0.40, Δ = 2.00		
20	51.78	126.88	378.43	828.54	1731.60
50	34.00	85.59	280.97	631.08	1386.78
100	24.77	56.74	188.67	464.40	1060.89
500	24.73	27.91	65.85	146.79	350.03
			λ = 0.40, Δ = 3.00		
20	34.57	92.23	302.22	693.18	1498.32
50	16.80	40.97	156.31	406.04	964.13
100	10.83	23.05	73.64	199.36	534.64
500	9.13	9.48	17.57	31.21	71.30

Table 184

Out of Control ARL_0 for SSDMEWMC of Dimension 8 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	49.33	119.59	372.00	826.91	1779.86
50	34.40	79.61	258.36	617.30	1432.78
100	27.79	59.34	183.02	456.80	1102.84
500	16.77	40.45	88.76	207.88	515.44
			λ = 0.50, Δ = 0.50		
20	54.44	128.70	382.65	843.84	1818.36
50	41.81	98.84	302.73	695.76	1571.42
100	36.92	80.53	236.32	565.39	1330.50
500	28.92	55.17	146.91	333.32	793.01
			λ = 0.50, Δ = 1.00		
20	82.52	182.79	474.49	982.73	1982.11
50	82.18	183.45	475.29	976.26	1997.48
100	81.69	184.31	471.05	979.19	1994.88
500	77.16	165.38	476.45	993.32	1986.64
			λ = 0.50, Δ = 2.00		
20	53.10	131.20	379.85	836.25	1801.67
50	36.26	89.21	278.94	651.18	1479.24
100	26.71	61.71	193.28	483.24	1157.41
500	19.72	26.79	72.09	162.74	399.58
			λ = 0.50, Δ = 3.00		
20	37.27	96.25	311.05	723.17	1599.19
50	18.75	48.56	168.83	435.69	1070.05
100	11.91	26.18	86.15	231.02	621.63
500	12.38	11.12	21.12	35.00	89.76

Table 185

Out of Control ARL_0 for SSDMEWMC of Dimension 8 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	54.13	132.72	405.20	863.92	1784.19
50	38.40	91.57	291.11	680.89	1495.04
100	31.69	69.77	220.84	526.12	1177.44
500	23.64	46.26	112.79	271.77	621.92
			$\lambda = 0.60, \Delta = 0.50$		
20	59.37	141.45	414.43	890.32	1861.45
50	47.78	113.21	338.21	758.00	1666.14
100	41.48	91.89	276.67	644.01	1455.30
500	27.48	63.77	183.53	406.49	936.23
			$\lambda = 0.60, \Delta = 1.00$		
20	84.12	183.85	480.59	974.04	1957.23
50	83.14	184.34	478.75	979.26	1960.19
100	82.25	183.56	482.45	987.55	1952.70
500	75.19	174.45	486.62	968.64	1929.12
			$\lambda = 0.60, \Delta = 2.00$		
20	54.08	133.31	390.69	833.95	1744.55
50	36.74	90.54	288.12	665.79	1464.28
100	26.60	63.09	202.01	494.98	1142.25
500	17.48	29.25	78.81	169.40	416.17
			$\lambda = 0.60, \Delta = 3.00$		
20	38.38	102.25	321.72	727.09	1573.42
50	19.35	51.37	181.14	457.21	1084.27
100	12.64	27.57	96.77	260.31	668.19
500	13.75	10.91	22.29	43.38	103.48

Table 186

Out of Control ARL_0 for SSDMEWMC of Dimension 8 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	60.87	146.63	432.48	901.73	1851.91
50	44.85	109.60	339.03	744.43	1575.19
100	36.71	85.38	266.38	606.31	1302.64
500	23.96	57.89	156.01	356.85	817.00
			λ = 0.80, Δ = 0.50		
20	67.48	159.48	455.21	954.04	1945.83
50	56.08	133.54	391.37	855.88	1792.12
100	48.92	113.30	337.43	753.18	1612.64
500	49.71	80.62	244.36	530.51	1148.87
			λ = 0.80, Δ = 1.00		
20	84.60	187.84	488.56	984.22	1945.53
50	84.73	187.95	487.89	985.25	1945.06
100	86.31	185.27	490.09	982.79	1930.67
500	106.82	183.98	484.41	977.31	1931.59
			λ = 0.80, Δ = 2.00		
20	55.47	136.26	392.84	841.43	1755.77
50	38.53	94.55	292.93	672.34	1467.30
100	29.20	65.13	214.85	509.92	1150.70
500	23.46	30.97	79.75	175.67	440.26
			λ = 0.80, Δ = 3.00		
20	40.11	105.99	332.36	734.06	1583.18
50	20.96	55.31	197.61	481.24	1115.77
100	13.66	30.27	105.87	281.80	711.93
500	12.58	11.45	25.91	49.29	119.90

Table 187

Out of Control ARL_0 for SSDMEWMC of Dimension 9 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	32.80	59.71	153.50	362.49	881.34
50	17.27	28.22	56.14	116.74	270.32
100	15.48	22.74	33.54	53.61	107.32
500	9.00	19.33	25.12	29.15	36.03
			$\lambda = 0.05, \Delta = 0.50$		
20	36.25	64.72	164.37	362.47	873.17
50	20.60	35.71	74.89	155.59	356.91
100	18.96	29.87	50.59	88.94	179.39
500	9.00	26.45	34.80	44.03	62.79
			$\lambda = 0.05, \Delta = 1.00$		
20	71.33	172.03	468.18	963.93	1947.63
50	50.12	147.01	436.93	932.63	1915.48
100	50.43	143.89	435.27	919.88	1905.50
500	12.00	147.44	430.10	908.17	1896.00
			$\lambda = 0.05, \Delta = 2.00$		
20	40.62	101.31	322.28	738.20	1633.46
50	18.58	39.72	122.39	325.08	798.60
100	15.68	25.88	55.75	132.69	360.69
500	14.00	19.31	25.35	31.73	46.69
			$\lambda = 0.05, \Delta = 3.00$		
20	27.67	63.57	222.02	549.57	1297.97
50	12.21	19.47	43.72	110.80	296.98
100	10.51	14.21	19.58	32.13	69.62
500	11.00	11.45	13.97	15.34	16.69

Table 188

Out of Control ARL_0 for SSDMEWMC of Dimension 9 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	26.90	58.77	178.91	453.46	1067.63
50	17.15	29.59	73.51	175.60	439.68
100	14.29	21.52	39.88	84.28	210.98
500	9.20	16.59	23.57	30.48	46.27
			λ = 0.10, Δ = 0.50		
20	30.32	64.49	182.45	458.17	1042.23
50	21.24	36.86	93.76	221.53	521.90
100	18.85	30.04	61.27	136.43	312.23
500	16.20	23.42	35.44	57.25	104.82
			λ = 0.10, Δ = 1.00		
20	71.86	175.70	472.87	997.54	1950.43
50	66.51	166.31	462.21	982.74	1963.08
100	65.91	166.87	465.09	982.69	1955.57
500	35.30	166.18	479.74	988.87	1949.33
			λ = 0.10, Δ = 2.00		
20	37.94	103.50	328.38	765.58	1620.72
50	20.60	49.31	160.65	417.74	978.36
100	15.21	28.42	84.56	220.39	519.72
500	5.70	16.23	27.00	42.37	88.96
			λ = 0.10, Δ = 3.00		
20	21.94	60.46	219.05	567.26	1290.20
50	10.69	19.49	60.91	172.27	454.12
100	8.79	12.17	22.32	54.91	142.63
500	5.10	8.90	10.94	12.56	14.37

Table 189

Out of Control ARL_0 for SSDMEWMC of Dimension 9 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	29.87	72.57	250.63	600.21	1378.04
50	18.82	39.38	123.10	307.01	768.39
100	14.93	27.02	70.14	179.43	461.40
500	10.44	18.49	31.82	52.68	117.75
			$\lambda = 0.20, \Delta = 0.50$		
20	33.21	78.59	250.51	597.97	1364.99
50	23.55	50.41	147.89	350.61	867.24
100	20.15	37.41	99.70	233.45	570.54
500	16.19	27.55	51.99	103.52	236.29
			$\lambda = 0.20, \Delta = 1.00$		
20	74.85	174.40	482.39	995.19	2007.79
50	76.28	176.74	477.90	987.52	1990.87
100	75.25	174.80	478.26	997.59	2005.61
500	68.75	173.21	489.76	1013.68	2004.53
			$\lambda = 0.20, \Delta = 2.00$		
20	41.58	108.17	346.47	782.95	1708.71
50	25.80	64.37	217.63	527.07	1231.36
100	17.56	39.14	126.68	339.49	812.88
500	12.69	18.05	38.10	75.68	187.00
			$\lambda = 0.20, \Delta = 3.00$		
20	24.21	69.12	254.28	601.16	1382.44
50	11.62	26.70	99.93	270.80	678.48
100	8.27	13.64	39.79	108.10	296.47
500	7.00	7.93	10.93	14.76	26.38

Table 190

Out of Control ARL_0 for SSDMEWMC of Dimension 9 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	35.60	91.19	297.06	687.37	1533.48
50	22.98	52.32	168.50	416.49	991.99
100	17.57	36.03	110.13	280.25	683.15
500	9.96	21.86	48.50	102.78	232.46
			$\lambda = 0.30, \Delta = 0.50$		
20	39.48	96.31	307.90	698.47	1549.84
50	27.99	63.16	197.34	473.58	1119.28
100	23.62	48.64	141.40	331.77	812.40
500	12.37	31.13	79.68	165.72	371.84
			$\lambda = 0.30, \Delta = 1.00$		
20	80.30	180.08	483.35	981.37	1972.02
50	78.51	179.52	485.69	985.94	1961.17
100	77.67	180.83	484.15	998.55	1965.07
500	85.07	175.26	492.66	997.54	1969.47
			$\lambda = 0.30, \Delta = 2.00$		
20	47.22	117.63	360.75	800.79	1689.54
50	29.28	76.38	256.01	591.60	1316.48
100	19.51	48.58	167.74	402.34	936.23
500	14.15	23.32	52.35	121.65	281.98
			$\lambda = 0.30, \Delta = 3.00$		
20	29.40	82.35	278.31	644.88	1438.03
50	13.70	35.33	128.31	340.05	826.48
100	9.34	18.04	60.27	160.45	416.71
500	5.81	8.29	13.15	21.20	45.45

Table 191

Out of Control ARL_0 for SSDMEWMC of Dimension 9 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	41.33	106.68	330.60	760.45	1648.90
50	27.24	63.97	212.02	506.51	1180.56
100	20.82	45.66	143.60	351.62	873.93
500	14.08	31.36	71.54	148.36	361.07
			$\lambda = 0.40, \Delta = 0.50$		
20	45.19	110.88	345.44	778.24	1691.82
50	32.36	75.87	243.10	582.05	1320.38
100	28.86	58.53	185.46	436.77	1045.37
500	16.96	40.73	112.39	241.63	530.68
			$\lambda = 0.40, \Delta = 1.00$		
20	81.10	180.71	481.84	993.48	1997.22
50	79.59	180.95	485.65	993.98	1995.23
100	79.42	178.73	487.36	990.27	2008.14
500	58.63	192.56	502.18	1008.77	1972.27
			$\lambda = 0.40, \Delta = 2.00$		
20	50.03	123.41	367.39	819.65	1712.26
50	33.73	83.20	273.96	624.86	1366.25
100	22.56	56.24	188.84	450.04	1037.82
500	10.85	24.71	65.54	143.65	357.63
			$\lambda = 0.40, \Delta = 3.00$		
20	32.88	90.11	293.75	679.71	1498.20
50	15.96	42.06	155.44	385.16	928.18
100	10.47	21.85	76.44	199.90	532.06
500	5.20	9.27	16.02	27.88	79.93

Table 192

Out of Control ARL_0 for SSDMEWMC of Dimension 9 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	45.81	116.05	360.99	800.09	1744.60
50	31.35	75.38	244.11	565.04	1327.92
100	23.78	53.75	177.59	421.66	1005.91
500	19.73	39.33	90.77	194.61	458.85
			$\lambda = 0.50, \Delta = 0.50$		
20	50.12	119.99	377.32	827.11	1783.63
50	37.59	87.28	284.71	663.01	1497.61
100	32.43	70.88	219.52	523.74	1218.23
500	31.56	56.20	142.52	314.31	707.92
			$\lambda = 0.50, \Delta = 1.00$		
20	81.43	179.82	483.57	979.83	1982.94
50	81.21	178.72	483.22	973.59	1980.17
100	82.77	177.24	485.76	980.87	1978.75
500	102.00	181.31	495.68	987.36	1978.28
			$\lambda = 0.50, \Delta = 2.00$		
20	51.28	124.85	377.31	811.90	1725.24
50	34.78	87.89	281.28	625.88	1409.74
100	25.19	61.73	197.85	469.84	1102.45
500	10.44	30.47	70.80	161.89	401.04
			$\lambda = 0.50, \Delta = 3.00$		
20	34.64	93.31	304.77	693.34	1530.52
50	17.66	47.02	170.49	415.02	1005.23
100	11.32	25.49	87.55	236.45	599.25
500	6.13	11.10	19.87	38.24	100.17

Table 193

Out of Control ARL_0 for SSDMEWMC of Dimension 9 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	48.91	124.17	379.90	856.12	1759.67
50	35.25	85.61	265.55	628.86	1385.38
100	27.66	62.39	199.80	478.86	1107.10
500	15.46	45.59	107.17	230.62	570.88
			$\lambda = 0.60, \Delta = 0.50$		
20	53.89	132.83	404.11	880.78	1810.48
50	42.03	100.19	312.92	722.67	1566.41
100	35.62	80.84	248.52	584.73	1325.61
500	29.10	58.73	163.14	363.39	798.91
			$\lambda = 0.60, \Delta = 1.00$		
20	81.24	181.67	483.15	983.82	1959.01
50	81.94	181.56	480.74	974.90	1947.72
100	81.40	181.76	482.04	979.80	1947.06
500	69.60	193.66	489.29	967.43	1938.80
			$\lambda = 0.60, \Delta = 2.00$		
20	51.12	126.96	377.71	825.29	1717.25
50	36.23	90.76	281.65	643.69	1419.98
100	25.50	64.50	197.17	476.32	1116.88
500	19.70	32.24	71.50	166.70	410.56
			$\lambda = 0.60, \Delta = 3.00$		
20	35.87	95.99	310.20	701.14	1521.26
50	19.25	50.34	178.58	440.13	1028.18
100	12.05	27.56	91.62	243.14	627.14
500	8.26	11.25	21.95	42.29	95.73

Table 194

Out of Control ARL_0 for SSDMEWMC of Dimension 9 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	55.64	138.53	406.34	877.53	1825.38
50	39.58	97.28	298.36	686.52	1470.13
100	32.69	74.01	236.18	536.39	1203.67
500	13.67	48.61	135.96	287.07	668.65
			λ = 0.80, Δ = 0.50		
20	62.17	149.71	435.95	918.88	1878.70
50	49.07	119.39	355.54	791.29	1664.42
100	43.04	97.57	288.71	686.06	1456.66
500	24.42	66.44	197.58	436.94	966.17
			λ = 0.80, Δ = 1.00		
20	81.79	184.38	485.68	980.87	1960.02
50	81.54	182.36	478.77	978.92	1956.37
100	84.00	182.93	485.68	976.49	1959.42
500	61.00	173.09	478.89	973.74	1974.36
			λ = 0.80, Δ = 2.00		
20	52.98	129.68	385.27	831.58	1709.32
50	36.38	91.24	283.43	662.33	1446.75
100	26.70	63.49	201.42	483.62	1136.37
500	10.87	28.19	75.42	169.66	415.30
			λ = 0.80, Δ = 3.00		
20	37.72	98.58	318.12	715.10	1530.78
50	20.51	53.01	185.15	455.98	1052.23
100	13.29	28.59	97.73	259.40	658.80
500	10.31	11.62	21.97	45.96	108.16

Table 195

Out of Control ARL_0 for SSDMEWMC of Dimension 10 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	31.92	57.26	150.31	354.80	854.09
50	15.74	26.04	50.27	106.11	238.48
100	14.00	20.58	31.48	48.21	93.16
500	4.00	17.53	21.96	25.30	30.28
			$\lambda = 0.05, \Delta = 0.50$		
20	34.87	61.07	151.81	347.95	797.97
50	18.80	32.04	64.80	130.67	301.34
100	17.28	26.56	42.98	72.43	153.01
500	9.00	22.49	30.63	37.76	52.67
			$\lambda = 0.05, \Delta = 1.00$		
20	69.51	166.40	460.93	958.14	1915.78
50	48.03	140.13	435.72	931.21	1902.93
100	46.76	138.28	422.73	918.22	1876.92
500	19.00	149.47	412.38	910.81	1889.07
			$\lambda = 0.05, \Delta = 2.00$		
20	39.39	96.61	309.76	702.27	1546.67
50	17.60	37.38	119.29	304.27	750.35
100	15.04	24.79	55.01	127.69	327.95
500	24.00	17.28	23.56	29.88	42.47
			$\lambda = 0.05, \Delta = 3.00$		
20	27.61	61.44	212.58	537.13	1246.86
50	11.74	19.09	41.84	100.29	283.93
100	10.06	13.68	19.12	29.58	61.28
500	9.00	11.02	13.12	14.59	15.85

Table 196

Out of Control ARL_0 for SSDMEWMC of Dimension 10 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	25.08	54.68	172.57	410.93	1042.29
50	15.25	26.16	62.44	147.71	399.60
100	12.91	19.41	36.07	74.84	185.56
500	14.00	14.36	20.54	26.67	40.25
			$\lambda = 0.10, \Delta = 0.50$		
20	27.90	59.39	172.24	399.56	996.89
50	18.90	32.06	79.63	179.11	440.60
100	16.22	26.32	51.38	104.33	257.19
500	6.00	19.93	31.76	47.46	87.51
			$\lambda = 0.10, \Delta = 1.00$		
20	69.02	169.96	465.71	942.01	1939.53
50	63.37	161.18	455.13	928.71	1937.46
100	61.83	158.45	453.72	928.91	1930.71
500	24.00	152.34	448.72	938.17	1951.36
			$\lambda = 0.10, \Delta = 2.00$		
20	35.34	95.87	307.51	694.17	1553.34
50	18.77	45.36	154.70	380.76	924.00
100	15.20	28.50	78.08	192.79	503.03
500	7.67	15.18	25.04	40.90	89.84
			$\lambda = 0.10, \Delta = 3.00$		
20	21.38	56.90	207.02	505.91	1206.34
50	10.43	19.10	56.72	151.27	425.89
100	8.55	11.70	21.56	49.20	131.73
500	6.00	8.99	10.44	11.85	14.56

Table 197

Out of Control ARL_0 for SSDMEWMC of Dimension 10 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	27.88	69.15	233.38	564.25	1282.45
50	16.96	34.45	113.47	283.00	712.08
100	14.13	24.53	66.96	161.63	406.09
500	9.40	16.97	28.70	50.01	111.04
			λ = 0.20, Δ = 0.50		
20	30.41	71.74	238.95	569.23	1282.99
50	20.80	41.73	127.48	315.69	771.43
100	17.89	31.26	82.98	198.43	481.03
500	10.80	24.86	45.23	88.68	194.47
			λ = 0.20, Δ = 1.00		
20	73.44	173.90	484.06	976.08	1937.68
50	73.36	173.18	474.54	977.78	1933.65
100	72.28	174.49	480.55	977.09	1920.92
500	49.55	170.42	478.68	982.50	1966.86
			λ = 0.20, Δ = 2.00		
20	39.38	105.24	341.87	753.65	1609.32
50	23.90	60.00	210.26	506.62	1123.06
100	16.75	38.07	123.32	316.67	753.07
500	9.45	20.22	36.85	79.50	188.00
			λ = 0.20, Δ = 3.00		
20	24.10	66.23	245.43	573.23	1306.85
50	11.63	25.69	95.04	259.11	648.26
100	8.03	13.78	39.27	102.25	289.79
500	5.40	9.07	10.27	14.87	26.17

Table 198

Out of Control ARL_0 for SSDMEWMC of Dimension 10 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	33.89	84.75	276.18	652.42	1471.01
50	21.19	47.30	155.03	391.55	958.68
100	17.21	32.33	99.92	244.42	612.58
500	12.27	18.99	41.57	85.46	209.57
			λ = 0.30, Δ = 0.50		
20	36.58	88.56	281.30	663.65	1496.12
50	25.88	53.58	171.20	422.64	1039.50
100	21.19	40.04	114.40	274.76	725.25
500	12.06	27.26	65.14	133.66	312.68
			λ = 0.30, Δ = 1.00		
20	77.14	173.44	470.18	959.19	1967.26
50	77.93	174.21	462.89	964.85	1966.14
100	78.92	174.67	472.53	964.00	1964.28
500	88.19	170.41	473.18	973.75	1951.09
			λ = 0.30, Δ = 2.00		
20	44.39	112.95	349.01	758.97	1658.23
50	28.70	70.64	236.71	542.55	1235.64
100	19.99	46.23	153.84	369.80	909.45
500	15.63	19.33	49.34	113.60	271.94
			λ = 0.30, Δ = 3.00		
20	28.79	78.77	262.35	614.76	1418.19
50	13.74	34.10	126.93	319.98	794.52
100	9.04	16.78	55.96	151.16	418.10
500	3.13	7.80	12.11	20.08	49.48

Table 199

Out of Control ARL_0 for SSDMEWMC of Dimension 10 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	40.31	97.43	313.93	706.15	1588.76
50	25.96	58.48	193.57	467.95	1132.47
100	20.73	41.32	126.14	310.97	800.44
500	15.79	29.82	54.66	125.31	322.79
			$\lambda = 0.40, \Delta = 0.50$		
20	43.76	101.33	325.53	722.37	1640.28
50	30.06	67.58	214.26	506.12	1228.16
100	25.96	51.29	149.77	359.05	921.29
500	15.04	38.30	85.11	181.59	455.42
			$\lambda = 0.40, \Delta = 1.00$		
20	78.96	178.22	478.39	951.98	1975.78
50	79.72	176.15	473.61	951.82	1976.62
100	79.75	176.36	466.56	952.65	1991.20
500	90.64	166.90	470.08	949.60	1975.33
			$\lambda = 0.40, \Delta = 2.00$		
20	48.15	120.58	359.04	776.73	1711.11
50	31.59	77.22	247.11	569.30	1342.44
100	23.57	52.75	166.03	406.16	1024.65
500	14.48	24.93	58.64	138.68	351.10
			$\lambda = 0.40, \Delta = 3.00$		
20	32.75	86.31	288.95	649.24	1479.29
50	16.08	40.47	147.03	360.08	929.70
100	10.93	21.36	73.62	188.71	537.29
500	5.50	8.84	15.74	32.29	72.85

Table 200

Out of Control ARL_0 for SSDMEWMC of Dimension 10 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	44.74	107.08	345.94	781.05	1700.49
50	29.85	67.41	226.76	542.07	1246.59
100	23.25	49.89	153.84	380.01	924.53
500	19.37	34.84	75.41	173.38	409.95
			λ = 0.50, Δ = 0.50		
20	48.66	111.81	354.94	792.90	1759.80
50	34.23	77.61	251.73	596.81	1385.87
100	28.59	59.45	180.86	443.41	1085.01
500	25.05	42.00	107.21	249.60	575.39
			λ = 0.50, Δ = 1.00		
20	81.53	177.40	474.36	972.06	2006.38
50	80.81	177.66	472.34	974.43	2001.20
100	79.88	176.91	473.63	969.67	2010.96
500	77.14	176.02	470.26	977.42	1999.21
			λ = 0.50, Δ = 2.00		
20	49.92	121.12	365.39	816.00	1739.47
50	33.35	80.05	260.65	613.89	1397.79
100	25.81	55.58	180.45	449.82	1093.51
500	17.90	29.99	65.70	151.76	402.82
			λ = 0.50, Δ = 3.00		
20	34.66	90.48	300.29	680.88	1531.45
50	17.95	44.07	163.05	415.66	984.59
100	11.76	24.90	84.51	234.16	599.79
500	5.47	9.42	19.93	37.50	93.78

Table 201

Out of Control ARL_0 for SSDMEWMC of Dimension 10 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	46.98	117.91	359.02	817.48	1737.67
50	32.41	77.97	243.88	587.21	1315.46
100	25.88	54.63	175.46	416.52	1000.06
500	18.09	38.98	91.88	203.50	493.05
			λ = 0.60, Δ = 0.50		
20	51.66	125.11	371.82	842.45	1807.95
50	38.12	86.91	273.79	657.85	1475.62
100	31.41	68.85	215.76	513.35	1193.72
500	27.42	54.64	125.84	300.97	669.20
			λ = 0.60, Δ = 1.00		
20	80.46	179.13	473.65	969.70	1994.88
50	82.77	180.81	473.32	968.17	1998.28
100	83.00	178.89	476.07	973.31	2012.16
500	60.59	186.25	476.34	969.05	1996.19
			λ = 0.60, Δ = 2.00		
20	49.63	123.52	365.63	815.09	1736.08
50	35.86	82.74	266.45	618.78	1403.79
100	25.96	58.76	185.84	457.50	1103.72
500	15.63	28.33	72.05	163.53	417.81
			λ = 0.60, Δ = 3.00		
20	36.19	94.47	303.99	696.64	1545.37
50	19.30	47.74	169.24	415.54	1028.44
100	11.98	26.35	87.04	238.89	632.51
500	6.38	9.94	19.39	39.69	109.21

Table 202

Out of Control ARL_0 for SSDMEWMC of Dimension 10 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.80, \Delta = 0.25$				
20	50.86	128.87	393.74	851.92	1819.01
50	35.75	86.15	275.81	647.59	1436.07
100	29.24	64.98	205.55	484.96	1116.55
500	40.48	45.85	112.20	252.87	570.43
	$\lambda = 0.80, \Delta = 0.50$				
20	56.17	136.81	414.74	887.72	1902.15
50	42.41	102.75	322.50	725.61	1606.92
100	36.73	83.69	252.36	598.28	1351.52
500	43.88	65.73	166.68	375.10	824.39
	$\lambda = 0.80, \Delta = 1.00$				
20	79.88	180.78	481.05	973.28	2003.68
50	80.48	179.63	475.99	973.36	2015.90
100	81.45	178.61	479.27	972.75	2010.23
500	96.81	174.25	488.02	979.41	1985.62
	$\lambda = 0.80, \Delta = 2.00$				
20	48.97	123.02	374.78	827.27	1747.08
50	34.41	85.16	273.14	634.82	1411.21
100	26.03	59.36	193.44	478.36	1105.42
500	24.36	31.39	71.58	161.70	387.64
	$\lambda = 0.80, \Delta = 3.00$				
20	36.34	95.95	313.55	731.07	1576.73
50	18.88	48.89	174.61	453.25	1070.89
100	12.99	27.55	96.04	253.44	655.47
500	8.52	11.86	21.34	44.04	115.68

Table 203

Out of Control ARL_0 for SSDMEWMC of Dimension 15 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05$, $\Delta = 0.25$		
20	30.42	58.70	166.12	414.89	995.18
50	11.30	20.61	43.41	97.31	248.15
100	9.29	14.62	23.29	34.95	73.24
500	0.00	11.10	14.88	17.02	20.97
			$\lambda = 0.05$, $\Delta = 0.50$		
20	30.54	53.23	135.86	319.72	765.97
50	12.21	21.87	42.37	85.09	191.53
100	10.27	16.48	26.43	39.16	76.97
500	0.00	13.71	18.04	21.77	30.55
			$\lambda = 0.05$, $\Delta = 1.00$		
20	64.57	168.14	475.23	991.13	1984.69
50	38.45	137.96	439.32	957.87	1949.31
100	38.62	127.80	429.59	933.35	1920.68
500	0.00	135.04	433.63	939.71	1948.12
			$\lambda = 0.05$, $\Delta = 2.00$		
20	35.28	89.54	304.96	712.24	1545.11
50	13.09	29.66	96.79	261.68	654.41
100	10.85	18.62	42.37	101.16	264.52
500	0.00	12.12	17.94	24.44	40.31
			$\lambda = 0.05$, $\Delta = 3.00$		
20	26.98	62.33	221.05	553.13	1281.66
50	9.39	16.22	40.68	103.57	281.33
100	7.58	10.86	16.27	28.08	65.15
500	0.00	8.22	10.28	11.34	12.61

Table 204

Out of Control ARL_0 for SSDMEWMC of Dimension 15 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	22.24	53.61	177.96	447.79	1083.60
50	10.71	20.02	60.69	152.22	392.77
100	9.10	14.00	29.36	64.94	168.52
500	3.00	11.09	14.72	18.77	29.20
			λ = 0.10, Δ = 0.50		
20	22.29	47.90	151.06	379.26	912.15
50	11.85	20.90	56.19	129.62	322.71
100	9.79	16.39	31.20	60.41	143.68
500	4.00	13.34	18.93	26.65	46.47
			λ = 0.10, Δ = 1.00		
20	65.00	168.74	472.38	987.41	1984.01
50	55.23	153.02	458.22	966.34	1949.95
100	51.83	153.37	452.77	959.05	1963.37
500	3.00	151.10	457.29	975.71	1927.43
			λ = 0.10, Δ = 2.00		
20	28.70	82.61	281.05	659.33	1460.39
50	13.80	35.20	129.19	323.93	755.14
100	10.68	21.25	64.40	161.00	424.06
500	2.00	13.59	20.50	33.29	69.10
			λ = 0.10, Δ = 3.00		
20	18.68	52.23	198.63	498.15	1159.56
50	8.20	15.18	53.35	150.91	385.81
100	6.60	9.35	19.04	46.42	128.80
500	3.00	7.07	8.39	9.40	12.29

Table 205

Out of Control ARL_0 for SSDMEWMC of Dimension 15 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	24.02	64.20	222.76	522.25	1214.80
50	13.34	29.55	104.99	259.31	640.83
100	10.45	18.42	53.61	134.01	352.73
500	2.00	10.93	20.86	35.01	84.26
	λ = 0.20, Δ = 0.50				
20	22.63	56.44	195.96	473.47	1126.08
50	14.18	29.22	92.78	234.06	604.66
100	11.51	21.14	55.00	129.65	330.22
500	2.33	13.72	28.05	48.21	99.52
	λ = 0.20, Δ = 1.00				
20	67.96	167.37	479.45	975.59	1980.86
50	67.19	165.70	480.05	972.14	1975.31
100	65.17	166.59	470.30	963.75	1965.31
500	60.00	157.70	474.23	962.41	1950.33
	λ = 0.20, Δ = 2.00				
20	30.27	85.23	290.32	654.31	1434.51
50	17.94	49.62	175.65	417.35	940.67
100	13.28	31.77	104.23	257.63	645.29
500	2.75	12.18	30.14	63.45	167.33
	λ = 0.20, Δ = 3.00				
20	19.05	57.68	209.58	501.48	1166.69
50	9.11	23.23	91.28	242.90	604.66
100	6.90	11.87	36.25	99.82	280.95
500	2.00	6.23	8.96	13.16	25.51

Table 206

Out of Control ARL_0 for SSDMEWMC of Dimension 15 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	28.46	78.94	263.65	597.59	1350.00
50	16.15	43.82	143.35	345.74	843.21
100	12.21	26.88	81.08	206.38	528.60
500	4.25	14.62	30.34	62.68	155.60
			$\lambda = 0.30, \Delta = 0.50$		
20	27.16	71.56	242.32	572.30	1310.81
50	17.53	41.00	134.89	335.87	816.61
100	14.31	29.45	81.45	200.53	530.11
500	5.80	17.21	39.51	79.40	182.69
			$\lambda = 0.30, \Delta = 1.00$		
20	69.77	171.05	480.73	966.42	1963.43
50	69.99	170.02	482.30	965.05	1954.25
100	67.28	170.15	476.45	952.22	1960.70
500	64.43	168.01	482.90	967.58	1970.26
			$\lambda = 0.30, \Delta = 2.00$		
20	33.65	96.16	307.29	676.40	1494.85
50	21.46	60.72	202.27	472.78	1088.01
100	15.38	41.29	134.06	325.13	796.78
500	7.00	16.02	41.27	90.34	246.44
			$\lambda = 0.30, \Delta = 3.00$		
20	22.48	69.17	236.85	550.42	1250.74
50	11.17	32.22	122.92	307.43	752.74
100	7.70	16.79	54.99	156.11	418.98
500	3.67	6.76	10.25	20.90	51.05

Table 207

Out of Control ARL_0 for SSDMEWMC of Dimension 15 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	32.88	90.22	296.36	664.79	1419.28
50	19.51	51.07	174.77	411.28	950.64
100	15.02	33.46	105.31	259.25	645.82
500	22.50	13.94	37.51	86.40	211.04
			$\lambda = 0.40, \Delta = 0.50$		
20	31.28	83.40	277.65	637.13	1417.12
50	20.91	51.00	170.30	411.86	959.02
100	17.02	35.48	109.57	278.99	658.84
500	22.00	21.27	50.44	112.79	261.42
			$\lambda = 0.40, \Delta = 1.00$		
20	70.90	169.03	479.90	979.65	1951.92
50	71.41	168.67	474.74	974.15	1946.94
100	70.13	170.01	469.84	964.00	1952.90
500	57.86	172.66	476.00	948.17	1930.41
			$\lambda = 0.40, \Delta = 2.00$		
20	37.29	102.05	321.76	704.12	1508.09
50	23.53	64.56	218.75	511.38	1154.42
100	16.87	46.30	150.24	371.76	856.81
500	14.00	15.76	50.15	113.05	278.26
			$\lambda = 0.40, \Delta = 3.00$		
20	25.63	75.06	260.27	592.70	1301.78
50	13.03	37.53	142.11	350.35	828.20
100	8.63	20.00	72.95	194.12	491.75
500	12.40	6.67	13.78	26.88	70.68

Table 208

Out of Control ARL_0 for SSDMEWMC of Dimension 15 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	35.05	94.78	317.00	707.70	1527.98
50	21.25	54.71	191.41	462.44	1067.50
100	16.03	37.18	127.65	314.81	760.25
500	14.00	19.27	50.07	100.94	249.45
			λ = 0.50, Δ = 0.50		
20	34.48	87.12	296.11	694.89	1529.97
50	23.64	56.17	190.08	470.16	1098.74
100	18.59	39.84	130.44	323.58	782.21
500	26.00	27.00	63.60	134.93	328.63
			λ = 0.50, Δ = 1.00		
20	71.52	165.50	474.12	974.02	1976.97
50	72.47	165.27	471.01	977.96	1999.40
100	71.56	166.17	473.73	980.14	2010.88
500	68.30	161.96	473.18	969.21	1988.88
			λ = 0.50, Δ = 2.00		
20	38.79	101.72	328.19	728.29	1566.59
50	24.74	67.28	234.97	541.42	1236.61
100	17.93	47.49	161.17	395.86	933.83
500	11.20	20.24	57.85	126.11	319.73
			λ = 0.50, Δ = 3.00		
20	27.51	76.85	262.66	617.79	1375.08
50	13.52	37.64	148.35	374.72	910.73
100	8.74	20.74	80.30	214.80	556.89
500	7.67	8.29	14.51	29.69	78.52

Table 209

Out of Control ARL_0 for SSDMEWMC of Dimension 15 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.60, \Delta = 0.25$				
20	36.21	100.60	321.71	725.90	1570.36
50	21.87	58.30	201.67	487.10	1112.92
100	16.33	40.04	137.08	334.09	805.03
500	6.33	23.44	48.35	109.12	285.63
	$\lambda = 0.60, \Delta = 0.50$				
20	36.07	94.57	309.89	715.29	1583.44
50	25.05	61.37	205.72	499.08	1172.33
100	18.99	44.66	143.08	351.41	849.88
500	14.91	28.92	70.07	149.84	366.57
	$\lambda = 0.60, \Delta = 1.00$				
20	69.80	166.86	471.11	974.98	1998.14
50	70.48	167.99	467.15	973.36	1999.90
100	71.09	167.46	470.45	975.48	1990.16
500	44.08	166.02	464.81	962.76	1963.28
	$\lambda = 0.60, \Delta = 2.00$				
20	38.71	102.61	325.72	731.68	1591.31
50	25.10	67.99	232.99	552.28	1235.38
100	18.52	48.35	157.20	403.74	944.28
500	10.57	22.12	56.43	123.57	330.55
	$\lambda = 0.60, \Delta = 3.00$				
20	27.44	77.84	270.35	632.32	1403.90
50	12.92	40.18	151.29	385.91	928.28
100	8.73	21.75	75.86	209.44	542.22
500	5.67	7.85	15.64	34.08	82.54

Table 210

Out of Control ARL_0 for SSDMEWMC of Dimension 15 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	38.47	105.38	333.93	770.94	1588.30
50	24.17	62.14	217.22	526.88	1150.12
100	18.92	42.35	151.85	366.75	840.88
500	16.38	24.20	59.13	146.64	343.99
	λ = 0.80, Δ = 0.50				
20	39.63	104.86	336.84	763.03	1623.88
50	27.16	69.00	230.58	551.48	1210.66
100	22.00	49.54	163.81	402.81	920.72
500	16.88	31.68	86.41	193.84	446.60
	λ = 0.80, Δ = 1.00				
20	72.13	170.37	479.44	973.82	1957.61
50	72.26	171.17	473.56	983.34	1977.51
100	70.89	173.21	470.08	989.67	1980.39
500	86.50	161.11	460.67	988.27	1963.44
	λ = 0.80, Δ = 2.00				
20	40.26	104.45	337.52	750.74	1571.25
50	26.44	70.77	237.27	565.68	1231.76
100	19.03	49.00	164.47	415.03	934.68
500	8.71	23.75	61.15	127.84	327.73
	λ = 0.80, Δ = 3.00				
20	28.72	79.89	275.10	646.82	1407.29
50	14.03	39.88	156.16	399.25	935.05
100	9.78	21.00	79.72	217.72	564.34
500	6.33	8.59	17.69	30.25	82.86

Table 211

Out of Control ARL_0 for SSDMEWMC of Dimension 20 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	30.26	62.80	193.78	486.05	1175.48
50	9.16	18.13	40.93	97.48	254.95
100	7.21	11.48	18.18	32.46	78.28
500	0.00	9.15	11.94	13.80	16.47
			$\lambda = 0.05, \Delta = 0.50$		
20	30.58	56.27	148.79	373.65	902.10
50	9.59	18.54	35.55	69.94	174.05
100	7.63	12.24	18.87	29.08	54.05
500	0.00	11.47	13.87	16.19	18.64
			$\lambda = 0.05, \Delta = 1.00$		
20	60.09	161.01	459.88	969.79	1952.58
50	31.61	130.28	430.27	941.09	1934.90
100	30.43	116.94	413.92	912.29	1923.14
500	0.00	113.47	402.62	900.21	1911.62
			$\lambda = 0.05, \Delta = 2.00$		
20	32.84	83.02	280.64	675.96	1476.26
50	10.32	24.69	81.71	217.85	546.95
100	8.35	14.92	33.80	85.61	216.20
500	0.00	10.94	15.41	18.25	25.52
			$\lambda = 0.05, \Delta = 3.00$		
20	26.81	60.16	217.59	543.78	1256.05
50	7.96	14.30	35.11	89.47	241.46
100	6.21	9.22	13.64	22.37	48.91
500	0.00	7.51	9.00	9.79	10.45

Table 212

Out of Control ARL_0 for SSDMEWMC of Dimension 20 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	21.01	54.28	199.23	491.10	1164.44
50	8.66	17.27	57.20	150.49	388.44
100	7.01	11.42	24.94	61.65	162.13
500	0.00	8.89	11.84	17.11	29.18
			λ = 0.10, Δ = 0.50		
20	20.89	48.04	158.35	403.15	988.56
50	9.01	17.06	47.19	116.19	308.11
100	7.61	11.83	23.40	48.71	124.03
500	0.00	10.97	13.35	17.53	30.06
			λ = 0.10, Δ = 1.00		
20	59.49	161.61	467.21	975.14	1983.38
50	47.06	144.20	447.92	944.00	1972.23
100	45.99	141.63	444.54	948.52	1964.62
500	0.00	133.84	440.91	950.07	1957.88
			λ = 0.10, Δ = 2.00		
20	24.75	73.33	257.55	608.31	1371.10
50	10.82	28.22	103.47	267.13	672.97
100	8.87	17.36	54.40	140.76	366.10
500	0.00	9.93	16.92	27.31	58.18
			λ = 0.10, Δ = 3.00		
20	17.51	47.89	187.17	466.98	1116.04
50	6.76	12.79	43.59	129.79	354.07
100	5.70	8.41	17.95	43.38	121.37
500	0.00	6.17	7.41	9.05	13.95

Table 213

Out of Control ARL_0 for SSDMEWMC of Dimension 20 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	19.95	59.04	222.27	520.99	1202.40
50	10.97	26.80	101.41	265.53	659.91
100	8.30	16.31	49.15	138.08	370.94
500	1.00	9.15	16.13	30.79	79.55
			$\lambda = 0.20, \Delta = 0.50$		
20	19.33	52.99	192.86	474.87	1121.51
50	11.47	25.56	90.22	232.05	587.85
100	8.93	15.87	47.46	116.28	312.44
500	0.00	12.03	18.22	31.52	69.69
			$\lambda = 0.20, \Delta = 1.00$		
20	59.75	160.21	465.85	965.51	1958.02
50	56.36	153.36	459.72	950.90	1944.33
100	56.23	155.13	455.32	946.16	1942.50
500	44.00	153.52	465.68	944.85	1960.67
			$\lambda = 0.20, \Delta = 2.00$		
20	23.16	72.28	253.67	582.29	1308.20
50	13.85	41.05	151.45	363.26	850.36
100	11.39	25.57	91.34	234.17	573.40
500	0.00	11.80	25.10	50.50	146.98
			$\lambda = 0.20, \Delta = 3.00$		
20	14.62	47.35	185.09	450.97	1062.76
50	7.74	20.82	82.98	229.21	572.08
100	6.19	10.97	36.67	98.43	281.08
500	0.00	5.57	7.71	10.72	32.17

Table 214

Out of Control ARL_0 for SSDMEWMC of Dimension 20 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.30, \Delta = 0.25$				
20	23.65	68.44	246.57	602.54	1302.50
50	13.70	35.53	130.86	355.80	858.10
100	9.62	21.31	71.54	207.32	517.10
500	4.50	11.41	22.66	48.07	125.72
	$\lambda = 0.30, \Delta = 0.50$				
20	23.02	66.13	226.77	561.67	1269.11
50	13.89	33.98	124.59	326.91	805.50
100	9.73	20.86	72.05	193.03	497.18
500	13.00	13.14	25.16	52.88	136.04
	$\lambda = 0.30, \Delta = 1.00$				
20	59.71	159.90	461.18	974.81	1996.45
50	59.01	155.64	457.89	978.26	1985.57
100	58.08	153.55	455.36	976.70	1986.36
500	76.00	160.58	453.00	987.39	2003.64
	$\lambda = 0.30, \Delta = 2.00$				
20	26.00	79.51	264.83	631.48	1390.39
50	16.42	48.82	176.62	444.21	1031.38
100	12.59	31.77	120.79	308.22	743.41
500	9.50	13.33	34.27	82.30	222.95
	$\lambda = 0.30, \Delta = 3.00$				
20	16.90	55.39	208.21	507.69	1168.39
50	9.63	26.18	107.87	296.98	749.63
100	6.54	14.33	50.39	149.12	418.17
500	7.00	6.21	10.51	19.29	50.16

Table 215

Out of Control ARL_0 for SSDMEWMC of Dimension 20 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	26.49	77.60	262.84	640.26	1384.26
50	15.43	42.06	157.33	421.22	967.38
100	10.82	25.88	89.42	253.88	626.71
500	0.00	15.02	27.12	66.20	166.45
			$\lambda = 0.40, \Delta = 0.50$		
20	26.02	76.29	252.83	618.06	1388.67
50	16.00	42.45	148.62	394.77	932.49
100	11.01	26.84	90.78	249.10	620.22
500	0.00	15.04	31.43	71.50	180.46
			$\lambda = 0.40, \Delta = 1.00$		
20	60.38	159.70	454.08	977.21	1994.92
50	59.27	157.50	448.71	967.13	1995.49
100	58.55	155.26	448.16	974.10	2013.21
500	0.00	165.30	462.28	970.81	2035.04
			$\lambda = 0.40, \Delta = 2.00$		
20	28.21	84.66	278.63	658.78	1434.43
50	17.77	54.07	189.58	473.43	1099.13
100	13.75	37.99	129.06	334.32	830.87
500	0.00	14.23	37.18	93.03	275.81
			$\lambda = 0.40, \Delta = 3.00$		
20	18.86	62.07	222.29	546.90	1245.60
50	10.25	29.45	118.31	325.90	817.55
100	7.06	15.75	57.80	169.23	479.55
500	0.00	7.03	10.53	23.58	72.64

Table 216

Out of Control ARL_0 for SSDMEWMC of Dimension 20 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	28.03	82.34	286.09	678.21	1435.55
50	16.28	47.38	179.46	448.10	997.26
100	11.42	28.42	106.75	277.79	684.81
500	1.00	12.20	37.35	76.86	201.11
			λ = 0.50, Δ = 0.50		
20	28.06	83.93	280.76	662.12	1450.17
50	16.55	49.10	170.25	437.09	1001.98
100	12.53	31.74	109.08	282.93	682.63
500	3.00	16.19	38.41	86.05	228.25
			λ = 0.50, Δ = 1.00		
20	60.99	161.62	465.17	986.13	1997.53
50	60.23	158.51	461.49	979.28	1980.78
100	59.23	158.12	463.23	984.81	1989.23
500	169.00	168.35	461.19	974.36	1989.95
			λ = 0.50, Δ = 2.00		
20	29.77	90.69	297.36	683.27	1461.85
50	18.23	55.77	206.72	500.57	1108.24
100	13.95	38.91	137.29	359.00	822.18
500	3.00	11.30	42.48	98.63	292.34
			λ = 0.50, Δ = 3.00		
20	20.02	66.21	245.10	576.24	1286.61
50	10.71	31.34	131.97	351.40	846.05
100	6.96	17.89	65.45	186.45	501.85
500	2.50	5.89	11.66	27.40	86.80

Table 217

Out of Control ARL_0 for SSDMEWMC of Dimension 20 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.60, \Delta = 0.25$				
20	29.75	85.91	300.12	682.27	1513.66
50	17.32	50.45	190.25	458.24	1075.93
100	12.14	29.73	112.29	293.91	717.94
500	0.00	13.53	41.99	89.02	233.38
	$\lambda = 0.60, \Delta = 0.50$				
20	29.92	86.58	299.91	690.12	1528.26
50	17.61	51.46	188.73	470.30	1069.32
100	13.36	33.88	116.45	317.81	777.06
500	0.00	16.68	47.91	99.82	267.24
	$\lambda = 0.60, \Delta = 1.00$				
20	60.81	162.55	468.83	984.93	2038.81
50	60.00	159.22	470.06	982.13	2027.51
100	60.93	156.80	468.70	990.79	2021.19
500	24.00	172.44	474.82	994.89	2016.30
	$\lambda = 0.60, \Delta = 2.00$				
20	30.29	92.17	304.18	689.47	1521.53
50	18.68	56.72	214.03	514.06	1145.36
100	13.87	39.91	141.64	371.25	870.72
500	1.00	12.39	47.63	102.08	296.88
	$\lambda = 0.60, \Delta = 3.00$				
20	20.48	66.40	250.98	574.60	1341.64
50	11.29	32.23	135.75	353.23	888.19
100	6.76	17.96	69.99	195.53	511.29
500	1.00	5.56	13.50	26.52	79.53

Table 218

Out of Control ARL_0 for SSDMEWMC of Dimension 20 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	31.19	93.73	315.59	708.62	1529.88
50	18.56	54.64	200.41	468.49	1070.10
100	12.22	32.88	124.40	309.16	733.21
500	4.00	19.07	40.56	90.92	235.77
			$\lambda = 0.80, \Delta = 0.50$		
20	31.55	94.52	320.70	735.19	1570.07
50	19.46	58.01	205.02	502.67	1106.25
100	14.95	37.68	138.12	333.15	789.18
500	18.67	27.08	54.92	111.93	301.38
			$\lambda = 0.80, \Delta = 1.00$		
20	61.77	161.97	471.80	991.39	1992.85
50	61.32	159.20	470.75	989.73	1986.00
100	60.97	154.71	479.59	997.95	2000.84
500	79.43	168.02	457.80	982.60	2018.35
			$\lambda = 0.80, \Delta = 2.00$		
20	30.87	90.06	319.14	714.54	1529.82
50	18.47	58.01	220.99	516.50	1168.00
100	14.01	38.44	143.85	372.03	867.13
500	4.33	16.47	46.54	102.10	275.68
			$\lambda = 0.80, \Delta = 3.00$		
20	20.56	68.60	258.10	608.68	1342.36
50	10.91	33.61	145.59	365.94	879.21
100	6.98	16.35	75.23	202.65	531.52
500	3.50	6.25	12.44	27.98	72.94

Table 219

Out of Control ARL_0 for SSDMEWMC of Dimension 25 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	30.28	68.93	231.54	561.56	1306.78
50	7.79	16.68	39.64	99.70	257.18
100	5.58	9.61	15.78	29.67	67.27
500	0.00	7.23	10.48	12.05	13.93
			$\lambda = 0.05, \Delta = 0.50$		
20	30.91	64.22	196.48	477.18	1140.85
50	8.15	17.38	36.87	82.49	204.74
100	5.99	10.41	16.48	27.35	59.48
500	0.00	8.30	11.92	15.16	16.28
			$\lambda = 0.05, \Delta = 1.00$		
20	55.17	153.90	470.63	968.48	1962.73
50	25.28	124.08	435.56	939.76	1950.03
100	20.21	108.43	414.82	921.70	1907.59
500	0.00	110.93	416.93	918.78	1887.24
			$\lambda = 0.05, \Delta = 2.00$		
20	31.31	82.20	297.38	684.85	1486.38
50	8.77	21.86	73.02	188.38	476.02
100	6.11	12.17	27.28	71.10	194.46
500	0.00	9.05	12.63	15.10	19.37
			$\lambda = 0.05, \Delta = 3.00$		
20	26.87	63.37	237.06	584.19	1318.20
50	7.01	13.80	35.45	90.17	238.66
100	4.81	7.84	11.68	20.07	42.24
500	0.00	6.32	8.11	8.94	9.35

Table 220

Out of Control ARL_0 for SSDMEWMC of Dimension 25 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	20.79	59.02	219.46	528.49	1215.99
50	7.18	15.53	54.28	143.89	395.27
100	5.81	10.37	24.29	58.45	161.32
500	0.00	8.94	10.19	15.58	28.40
			$\lambda = 0.10, \Delta = 0.50$		
20	21.22	54.34	192.19	483.93	1120.18
50	7.72	15.42	49.33	127.01	328.81
100	6.32	10.80	22.88	53.19	140.37
500	0.00	8.76	11.09	15.53	23.06
			$\lambda = 0.10, \Delta = 1.00$		
20	55.16	155.79	467.16	974.21	1957.67
50	38.83	134.45	445.88	952.96	1919.52
100	38.62	134.82	443.28	942.11	1932.88
500	0.00	123.95	447.40	955.64	1953.29
			$\lambda = 0.10, \Delta = 2.00$		
20	23.15	69.91	259.60	610.12	1321.97
50	8.66	22.84	89.45	234.50	559.03
100	6.40	13.90	46.44	126.30	322.12
500	0.00	9.77	13.44	24.73	52.67
			$\lambda = 0.10, \Delta = 3.00$		
20	17.08	49.78	201.27	487.14	1111.01
50	5.73	11.56	41.00	115.76	313.71
100	4.50	7.21	15.20	41.17	108.18
500	0.00	5.66	6.49	7.43	11.63

Table 221

Out of Control ARL_0 for SSDMEWMC of Dimension 25 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	17.98	59.00	217.49	520.77	1178.87
50	9.10	26.58	100.64	258.58	645.92
100	6.53	15.57	48.27	140.04	365.16
500	0.00	10.85	13.41	31.15	76.02
	λ = 0.20, Δ = 0.50				
20	18.10	57.66	205.18	500.13	1155.50
50	9.49	25.66	95.59	243.21	621.21
100	7.32	16.28	47.09	121.30	335.10
500	0.00	10.31	16.83	31.45	69.61
	λ = 0.20, Δ = 1.00				
20	53.77	156.39	459.66	960.24	1945.76
50	46.89	145.98	454.28	942.81	1937.97
100	46.79	144.54	451.21	938.19	1928.11
500	0.00	158.68	451.22	947.48	1950.06
	λ = 0.20, Δ = 2.00				
20	19.40	68.10	239.62	566.74	1263.05
50	10.96	35.39	136.45	343.88	806.13
100	7.16	21.68	80.19	213.45	554.99
500	0.00	12.80	18.56	46.34	117.79
	λ = 0.20, Δ = 3.00				
20	13.24	47.28	183.61	453.71	1034.62
50	6.59	18.62	74.18	203.38	534.15
100	4.46	8.89	33.16	96.93	260.26
500	0.00	5.67	6.83	11.00	28.78

Table 222

Out of Control ARL_0 for SSDMEWMC of Dimension 25 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	20.31	68.46	235.67	561.47	1243.09
50	10.53	36.05	135.36	353.07	807.16
100	7.23	20.46	75.57	205.30	492.99
500	0.00	11.16	19.31	50.52	108.31
			λ = 0.30, Δ = 0.50		
20	20.56	67.31	238.71	559.67	1230.55
50	11.33	35.99	131.45	335.31	796.29
100	7.90	21.26	75.39	195.71	508.61
500	0.00	10.67	21.63	49.07	115.72
			λ = 0.30, Δ = 1.00		
20	53.29	159.22	465.78	958.34	1962.67
50	47.82	149.68	455.19	955.20	1948.50
100	47.09	148.60	459.29	954.58	1939.27
500	0.00	161.96	456.40	945.84	1967.79
			λ = 0.30, Δ = 2.00		
20	21.05	72.90	256.75	581.30	1281.09
50	11.96	44.31	169.72	408.82	936.90
100	8.52	26.79	109.62	287.52	682.82
500	0.00	9.84	26.00	67.70	186.59
			λ = 0.30, Δ = 3.00		
20	14.66	55.25	203.39	480.94	1091.86
50	6.92	23.56	97.81	265.14	661.59
100	4.41	11.36	47.39	137.36	373.05
500	0.00	4.92	9.17	17.10	38.83

Table 223

Out of Control ARL_0 for SSDMEWMC of Dimension 25 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	23.04	75.89	268.29	600.64	1332.50
50	11.92	40.22	156.21	378.88	898.51
100	8.45	23.91	91.35	233.93	562.83
500	4.00	11.68	24.17	58.89	145.10
			$\lambda = 0.40, \Delta = 0.50$		
20	23.39	75.07	264.39	612.84	1339.42
50	12.74	39.89	157.38	382.51	883.22
100	9.21	25.58	92.14	228.61	574.62
500	1.00	11.69	27.79	61.69	152.24
			$\lambda = 0.40, \Delta = 1.00$		
20	53.36	156.17	461.40	960.08	1983.77
50	48.77	150.13	451.58	953.16	1956.11
100	48.64	149.64	461.12	952.20	1970.36
500	84.50	153.58	463.36	961.36	1981.20
			$\lambda = 0.40, \Delta = 2.00$		
20	23.51	79.01	277.49	615.11	1378.01
50	13.55	49.87	184.89	433.05	1011.55
100	9.09	29.17	122.99	307.34	737.64
500	7.00	13.97	30.57	85.30	214.04
			$\lambda = 0.40, \Delta = 3.00$		
20	16.57	61.90	223.75	518.11	1168.34
50	7.51	26.66	114.51	296.14	731.66
100	4.87	12.65	53.26	154.05	402.38
500	1.00	6.44	10.00	20.93	51.85

Table 224

Out of Control ARL_0 for SSDMEWMC of Dimension 25 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50$, $\Delta = 0.25$		
20	25.07	84.07	283.64	638.91	1435.37
50	13.10	41.77	165.45	398.02	954.18
100	9.00	25.05	100.87	243.59	585.47
500	2.00	9.14	22.13	59.45	153.61
			$\lambda = 0.50$, $\Delta = 0.50$		
20	25.52	80.63	287.41	662.34	1444.71
50	14.06	42.72	167.25	405.12	947.37
100	10.04	27.84	99.34	250.44	601.67
500	2.00	12.04	30.08	74.40	179.79
			$\lambda = 0.50$, $\Delta = 1.00$		
20	53.03	154.36	456.69	969.66	1981.51
50	48.56	149.34	448.77	966.87	1973.59
100	48.88	149.79	450.54	957.83	1974.37
500	35.50	141.05	455.39	961.43	1958.55
			$\lambda = 0.50$, $\Delta = 2.00$		
20	25.07	84.57	288.57	657.54	1437.97
50	14.21	50.54	194.07	444.72	1032.84
100	9.55	31.45	126.40	315.90	771.83
500	1.00	11.54	31.71	89.40	228.30
			$\lambda = 0.50$, $\Delta = 3.00$		
20	18.03	66.53	238.20	556.73	1263.40
50	7.86	28.67	121.43	309.28	751.41
100	5.36	14.32	54.90	165.58	436.00
500	3.00	6.12	9.77	21.11	56.45

Table 225

Out of Control ARL_0 for SSDMEWMC of Dimension 25 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	27.76	88.99	302.36	679.37	1488.71
50	13.57	45.83	166.26	403.73	956.02
100	8.66	27.09	101.31	241.47	624.41
500	2.33	9.17	23.02	57.47	163.39
	λ = 0.60, Δ = 0.50				
20	27.57	86.60	301.08	683.36	1508.56
50	14.47	45.06	168.62	418.04	967.00
100	10.14	31.24	105.28	259.80	638.48
500	1.33	11.71	36.36	78.54	202.77
	λ = 0.60, Δ = 1.00				
20	53.08	152.78	453.97	958.90	1961.12
50	49.47	148.84	440.90	950.88	1958.15
100	48.45	148.52	444.16	951.44	1952.38
500	64.25	137.69	445.86	938.27	1917.38
	λ = 0.60, Δ = 2.00				
20	26.85	89.90	297.91	677.82	1484.74
50	14.39	53.06	188.73	456.46	1050.26
100	9.93	32.36	122.71	319.37	761.85
500	7.00	12.80	33.56	82.17	230.13
	λ = 0.60, Δ = 3.00				
20	19.77	71.90	249.78	586.10	1321.31
50	8.31	29.50	117.92	304.98	777.11
100	5.68	12.76	56.69	164.64	435.57
500	1.50	5.58	9.92	17.62	59.38

Table 226

Out of Control ARL_0 for SSDMEWMC of Dimension 25 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	31.45	95.48	330.23	750.97	1612.95
50	13.48	42.21	169.39	395.12	908.56
100	8.55	25.11	90.18	238.96	587.83
500	0.00	7.59	23.70	52.45	159.78
			λ = 0.80, Δ = 0.50		
20	31.77	96.92	329.07	742.89	1583.80
50	14.72	46.83	175.14	435.09	978.20
100	9.99	29.33	106.69	269.55	625.53
500	0.00	10.51	31.19	76.36	195.32
			λ = 0.80, Δ = 1.00		
20	55.39	151.52	456.54	981.73	1970.68
50	52.06	146.73	445.60	955.35	1939.28
100	53.36	149.47	454.44	974.73	1980.17
500	0.00	152.49	466.75	945.60	1959.86
			λ = 0.80, Δ = 2.00		
20	30.24	95.44	327.64	737.60	1599.49
50	15.11	49.57	182.69	447.29	996.93
100	9.87	29.54	114.46	295.47	704.14
500	0.00	12.38	31.80	79.13	218.22
			λ = 0.80, Δ = 3.00		
20	23.28	76.08	276.93	644.28	1426.57
50	8.61	30.55	127.11	305.40	754.72
100	5.59	13.37	58.55	165.30	431.66
500	0.00	5.58	8.26	19.29	53.55

Table 227

Out of Control ARL_0 for SSDMEWMC of Dimension 50 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	21.55	91.10	331.51	754.87	1684.22
50	1.50	16.02	45.36	120.44	318.95
100	0.00	5.95	11.86	27.12	65.12
500	0.00	6.19	7.06	7.81	8.46
			$\lambda = 0.05, \Delta = 0.50$		
20	21.94	92.22	327.30	754.93	1665.50
50	1.52	17.01	47.14	126.07	312.71
100	0.00	6.63	13.59	28.03	75.35
500	0.00	7.36	7.94	9.26	10.76
			$\lambda = 0.05, \Delta = 1.00$		
20	30.03	131.22	430.96	928.28	1920.11
50	1.89	100.49	403.50	889.26	1892.46
100	0.00	69.16	361.14	850.90	1835.28
500	0.00	88.23	369.74	859.61	1863.06
			$\lambda = 0.05, \Delta = 2.00$		
20	21.50	92.63	352.75	789.23	1735.32
50	1.52	17.73	60.83	160.57	387.77
100	0.00	7.28	20.04	49.64	131.69
500	0.00	7.93	9.20	10.53	15.16
			$\lambda = 0.05, \Delta = 3.00$		
20	20.47	82.26	320.90	735.31	1627.61
50	1.49	13.72	36.26	98.37	259.03
100	0.00	5.24	8.53	16.31	43.64
500	0.00	6.23	6.06	6.67	7.69

Table 228

Out of Control ARL_0 for SSDMEWMC of Dimension 50 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	20.33	104.05	368.39	839.59	1785.90
50	2.13	10.56	45.88	134.18	316.12
100	0.00	7.20	23.28	74.36	188.71
500	0.00	5.81	6.44	9.88	15.42
	λ = 0.10, Δ = 0.50				
20	20.87	105.37	363.39	843.27	1779.25
50	2.19	11.57	47.81	137.87	343.04
100	0.00	8.72	26.65	77.74	219.17
500	0.00	5.13	7.63	12.79	23.82
	λ = 0.10, Δ = 1.00				
20	29.99	130.65	435.57	944.60	1905.50
50	4.17	100.04	407.38	910.98	1877.35
100	0.00	91.78	392.17	909.21	1875.05
500	0.00	93.22	390.14	901.31	1895.04
	λ = 0.10, Δ = 2.00				
20	20.05	104.40	390.10	852.81	1774.92
50	2.25	12.58	58.75	154.25	372.72
100	0.00	9.11	41.43	113.51	281.01
500	0.00	5.30	9.04	16.26	43.19
	λ = 0.10, Δ = 3.00				
20	18.71	94.88	359.42	809.92	1705.40
50	2.04	7.59	32.37	94.94	248.35
100	0.00	5.41	15.10	42.90	127.32
500	0.00	4.11	4.89	5.89	7.90

Table 229

Out of Control ARL_0 for SSDMEWMC of Dimension 50 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	29.79	134.77	432.29	926.29	1925.67
50	2.58	17.30	93.27	242.27	556.39
100	0.00	9.69	48.43	154.76	393.20
500	0.00	3.60	10.00	18.14	38.76
	λ = 0.20, Δ = 0.50				
20	30.07	133.71	425.15	914.72	1909.39
50	2.72	19.88	93.85	257.53	598.22
100	0.00	11.56	55.49	166.24	417.44
500	0.00	3.81	9.39	22.99	55.39
	λ = 0.20, Δ = 1.00				
20	30.04	130.28	432.87	955.08	1927.90
50	6.82	100.37	404.58	918.16	1910.49
100	0.00	100.46	400.44	908.88	1909.01
500	0.00	113.58	406.84	913.96	1918.63
	λ = 0.20, Δ = 2.00				
20	28.91	136.82	436.81	938.97	1927.69
50	2.76	20.50	106.40	275.08	636.10
100	0.00	11.88	69.47	207.41	474.31
500	0.00	4.50	13.19	38.89	103.49
	λ = 0.20, Δ = 3.00				
20	28.10	135.24	433.94	933.57	1912.93
50	2.21	11.44	61.17	182.14	451.84
100	0.00	5.81	29.43	110.27	263.87
500	0.00	2.75	4.37	5.95	10.69

Table 230

Out of Control ARL_0 for SSDMEWMC of Dimension 50 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	31.55	136.04	430.71	912.66	1905.67
50	2.31	21.07	117.32	304.13	721.07
100	0.00	11.49	62.98	179.75	459.40
500	0.00	5.17	9.42	17.98	66.08
	λ = 0.30, Δ = 0.50				
20	31.69	134.20	419.07	904.95	1903.46
50	2.63	24.37	125.33	327.49	789.92
100	0.00	13.33	67.41	212.04	558.62
500	0.00	5.20	11.04	27.71	85.29
	λ = 0.30, Δ = 1.00				
20	30.08	131.57	428.70	929.14	1933.65
50	6.28	102.01	402.29	902.85	1914.61
100	0.00	102.09	406.89	901.82	1919.32
500	0.00	89.61	399.67	889.84	1947.35
	λ = 0.30, Δ = 2.00				
20	31.09	137.56	429.99	919.43	1900.92
50	2.53	25.95	132.01	333.77	776.25
100	0.00	14.42	80.67	224.89	594.88
500	0.00	5.17	14.36	38.02	119.21
	λ = 0.30, Δ = 3.00				
20	31.05	135.54	431.40	916.93	1893.70
50	2.01	13.98	82.49	231.47	575.67
100	0.00	6.17	36.49	117.78	341.18
500	0.00	2.61	4.28	8.70	17.84

Table 231

Out of Control ARL_0 for SSDMEWMC of Dimension 50 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	31.32	135.16	426.18	911.34	1938.09
50	2.15	23.65	130.99	339.64	861.10
100	0.00	11.73	66.65	206.14	529.20
500	0.00	8.96	7.80	27.05	75.58
	λ = 0.40, Δ = 0.50				
20	31.37	133.16	417.38	904.90	1937.46
50	2.44	28.08	141.77	377.19	890.19
100	0.00	14.67	77.86	241.76	596.63
500	0.00	13.48	11.97	38.33	113.45
	λ = 0.40, Δ = 1.00				
20	30.12	130.50	427.57	927.11	1946.02
50	5.48	102.36	399.15	904.50	1935.56
100	0.00	101.29	404.68	907.47	1921.68
500	0.00	109.84	399.48	892.65	1928.83
	λ = 0.40, Δ = 2.00				
20	31.05	135.31	425.64	910.21	1919.51
50	2.26	26.77	141.78	373.71	885.01
100	0.00	14.91	84.17	264.87	654.92
500	0.00	11.74	12.30	43.15	157.64
	λ = 0.40, Δ = 3.00				
20	30.95	133.67	422.83	905.04	1903.69
50	1.85	14.19	90.76	264.21	653.70
100	0.00	5.56	40.62	138.25	360.13
500	0.00	3.96	4.38	9.74	23.43

Table 232

Out of Control ARL_0 for SSDMEWMC of Dimension 50 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	λ = 0.50, Δ = 0.25				
20	30.82	133.46	425.72	899.35	1909.98
50	1.95	26.00	135.66	367.42	876.29
100	0.00	12.64	70.61	213.12	553.76
500	0.00	7.23	9.77	24.96	71.46
	λ = 0.50, Δ = 0.50				
20	30.81	132.33	420.85	898.30	1900.97
50	2.28	30.22	145.39	394.18	943.71
100	0.00	16.59	84.15	238.04	628.26
500	0.00	13.62	17.58	41.73	110.49
	λ = 0.50, Δ = 1.00				
20	29.92	131.11	434.17	922.85	1929.05
50	4.55	101.06	402.67	900.45	1914.59
100	0.00	101.97	407.77	899.09	1900.86
500	0.00	98.88	398.88	880.32	1918.08
	λ = 0.50, Δ = 2.00				
20	30.58	132.06	429.72	902.84	1912.29
50	2.14	28.73	152.66	389.58	937.04
100	0.00	15.81	91.42	270.33	683.91
500	0.00	10.21	15.86	50.59	167.50
	λ = 0.50, Δ = 3.00				
20	30.50	131.79	427.57	895.53	1903.40
50	1.73	14.64	98.32	272.05	664.03
100	0.00	6.24	39.04	134.28	368.52
500	0.00	5.16	5.33	6.68	25.54

Self Starting Double Multivariate Exponentially Weighted Moving Average and Covariance Average Performance

While inspection of the tables of out-of-control ARL's may be useful in their own right, it is perhaps more advantageous to look at the performance visually. It is true that each particular scenario has its own nuanced performance metrics, the overall trends are consistent across the different dimensions nested within a given method.

With this understanding, the focus will be on representative examples of a small, medium, large, and extra-large dimension performance to address research questions two through four. Specifically, dimensions 2, 5, 10, and 25 will be used to assess how the newly composed metrics perform with different smoothing coefficients under different magnitudes of shift and different in control periods before the shift. This will be done independently for each the ssDMEWMA and ssDMEWMC control schemes.

Self Starting Double Multivariate Exponentially Weighted Moving Average Performance

Beginning with ssDMEWMA, what will be explained through visualization in the following paragraphs are high level patterns and take aways that apply to the whole method as opposed to the specifics of an individual combination of variables.

In the highest sense, it will be demonstrated that 1.) small lambdas are quicker to detect smaller shifts and large shifts are very quickly detected, 2.) the patterns in reaction times are consistent across dimensions but asymptotic performance is achieved at a rate directly impacted by the dimension of the process, 3.) the performance of the ssDMEWMA converges to that of DMEWMA, 4.) the ssDMEWMA is quicker to react when the shift occurs after a longer in control period, and 5.) performance gains over the ssMEWMA begin to become evident.

As noted previously, rather than exhaustively plot every out-of-control scenario that was simulated, visualizations will focus on representative examples of a small, medium, large, and extra-large dimension process and then select smoothing coefficients and target in-control ARL's. In some cases either shift is held constant or wait time is held constant to better elucidate the desired pattern. These will be explicitly pointed out in the examples below.

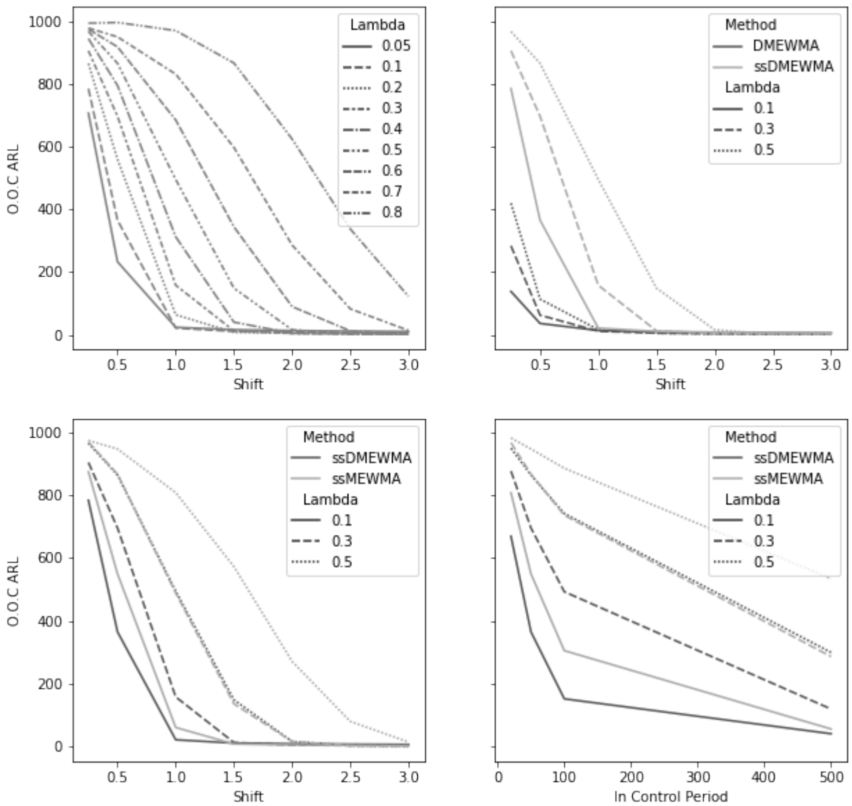

Figure 3

Out of Control Performance for ssDMEWMA of Dimension 2

Comparison of ssDMEWMA out-of-control ARL performance when different values of lambda are used with a target in-control ARL of 1000 and a in-control period of 50 observations and p = 2 (top left); Convergence of ssDMEWMA to the DMEWMA with target in control ARL of 1000 and p = 2 (top right); out-of-control ARL performance of ssDMEWMA against the ssMEWMA for lambdas = 0.1,0.3,0.5 and a in-control period of 50 and target in control ARL of 1000 and p = 2 (bottom left); out-of-control ARL performance of the ssDMEWMA against the ssMEWMA over different in control periods with fixed shift of 0.5 and target in control ARL of 1000 and p = 2 (bottom right)

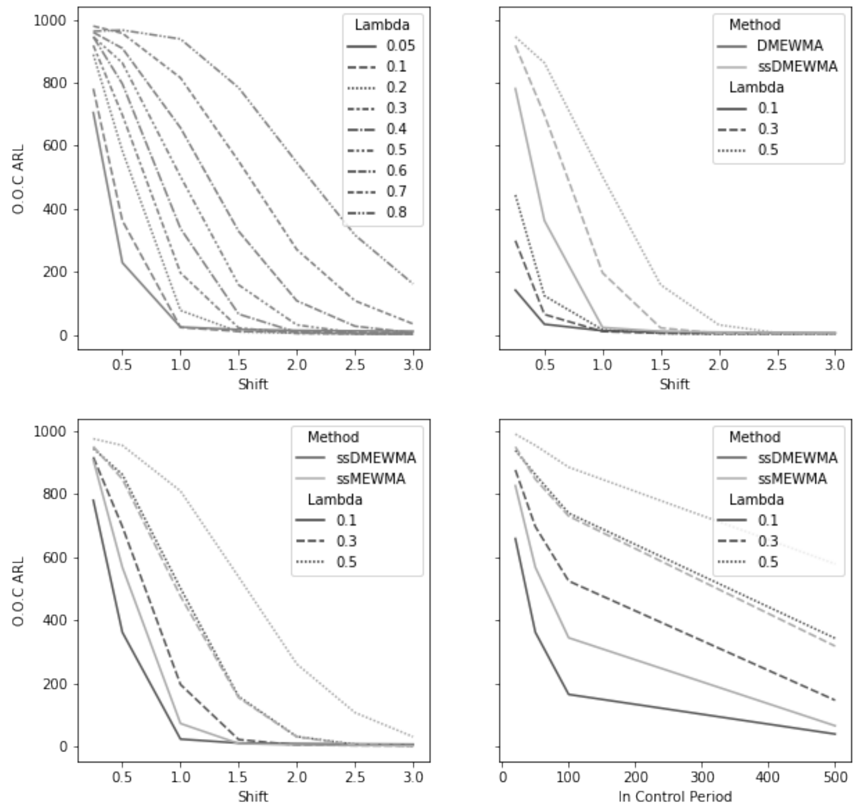

Figure 4

Out of Control Performance for ssDMEWMA of Dimension 5

Comparison of ssDMEWMA out-of-control ARL performance when different values of lambda are used with a target in-control ARL of 1000 and a in-control period of 50 observations and p = 5 (top left); Convergence of ssDMEWMA to the DMEWMA with target in control ARL of 1000 and p = 5 (top right); out-of-control ARL performance of ssDMEWMA against the ssMEWMA for lambdas = 0.1,0.3,0.5 and a in-control period of 50 and target in control ARL of 1000 and p = 5 (bottom left); out-of-control ARL performance of the ssDMEWMA against the ssMEWMA over different in control periods with fixed shift of 0.5 and target in control ARL of 1000 and p = 5 (bottom right)

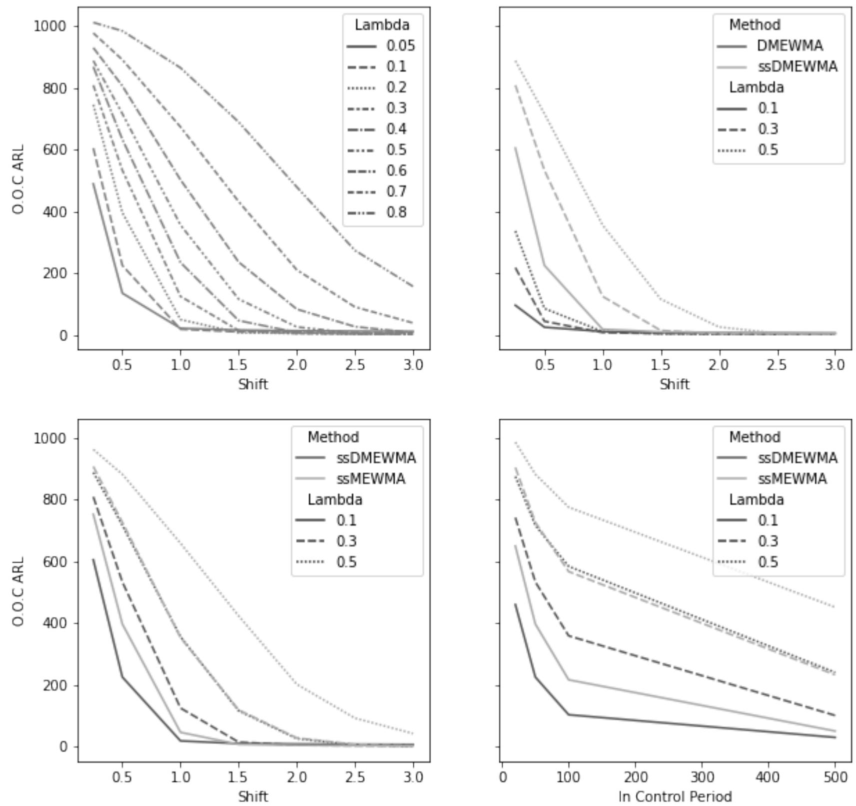

Figure 5

Out of Control Performance for ssDMEWMA of Dimension 10

Comparison of ssDMEWMA out-of-control ARL performance when different values of lambda are used with a target in-control ARL of 1000 and a in-control period of 50 observations and p = 10 (top left); Convergence of ssDMEWMA to the DMEWMA with target in control ARL of 1000 and p = 10 (top right); out-of-control ARL performance of ssDMEWMA against the ssMEWMA for lambdas = 0.1,0.3,0.5 and a in-control period of 50 and target in control ARL of 1000 and p = 10 (bottom left); out-of-control ARL performance of the ssDMEWMA against the ssMEWMA over different in control periods with fixed shift of 0.5 and target in control ARL of 1000 and p = 10 (bottom right)

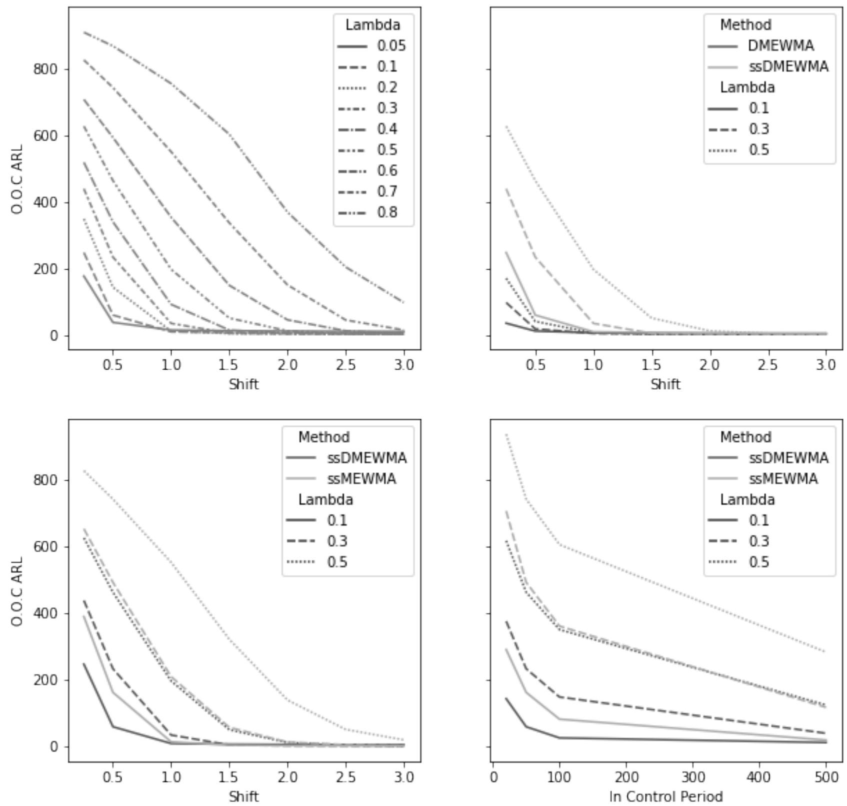

Figure 6

Out of Control Performance for ssDMEWMA of Dimension 25

Comparison of ssDMEWMA out-of-control ARL performance when different values of lambda are used with a target in-control ARL of 1000 and a in-control period of 50 observations and p = 25 (top left); Convergence of ssDMEWMA to the DMEWMA with target in control ARL of 1000 and p = 25 (top right); out-of-control ARL performance of ssDMEWMA against the ssMEWMA for lambdas = 0.1,0.3,0.5 and a in-control period of 50 and target in control ARL of 1000 and p = 25 (bottom left); out-of-control ARL performance of the ssDMEWMA against the ssMEWMA over different in control periods with fixed shift of 0.5 and target in control ARL of 1000 and p = 25 (bottom right)

In figures 3, 4, 5, and 6, one can quickly identify that for small shifts, small smoothing coefficients are advantageous to use as they respond the quickest. While it is harder to distinguish in these plots, there are instances of where if larger shifts are expected then it is more appropriate to use a larger smoothing coefficient. Additionally, it becomes rapidly apparent through these figures that really large smoothing coefficients are not particularly helpful– anything beyond 0.5 doesn't't offer enough of an upside for detecting large shifts to sacrifice small shift detection capability. This is consistent with most MEWMA based process control schemes. This partially addresses research question 4, "How does the proposed control scheme perform with the utilization of different values for the smoothing parameter λ?". The remainder of this question will be addressed in the following sections.

Also seen through figures 3,4,5, and 6 is the common theme that the ssDMEWMA converges in raw performance to the DMEWMA. This is wholly expected based off the derivation of the statistics as well as consistent with the ssMEWMA converging to the MEWMA (Hawkins2007). The real performance gain of the ssDMEWMA lies in its capabilities to bypass dedicated training samples prior to active monitoring. This is a great check to see if the simulation was coded in a way that it provided predictable patterns at high level. Though this was not a specific research question to be addressed, it does tie into the fifth research question regarding "How does this control scheme perform relative to the SSMEWMAC (Hawkins & Maboudou-Tchao, 2007), the original dMEWMA (Alkahtani, 2010), and the original MEWMA (Lowry et al., 1992) control charts under controlled values of the smoothing parameter, magnitude of the deviation in the mean and/or covariance, and the desired in-control average run length?"

In the lower left corner of each figure, the second research question for the ssDMEWMA is addressed: "How will the proposed control scheme perform for different deviations in both the location vector and variance-covariance matrix?" As was alluded to in the prior paragraphs, appropriate selection of the smoothing coefficient directly influences ARL performance in regard to fixed shift size changes. As already stated, the right selection of smoothing coefficient results in a quick responding control mechanism and as shifts get more pronounced, the quicker the response becomes. Clearly in these plots, in the event of a 1 standard deviation shift, the control charts are signaling out-of-control in just a few units. This is outstanding! Smaller shifts of course take longer to detect, but, generally speaking, the ssDMEWMA is quicker to respond to small changes than the ssMEWMA when in-control period, in control ARL, and smoothing coefficients are otherwise held constant. This is again consistent with what was proposed in the theoretical development of the control charts in previous chapters and also contributes to answering the fifth research question regarding performance relative to existing measures.

In the last subplot of each of these figures is a demonstration of how long in-control a process is before a shift occurs affects the charts performance. It is no surprise that if the process is only in control a short period of time before shifting the ssDMEWMA (and ssMEWMA) are slower to react. However, if a process is in control for longer periods of time relative to the in control ARL specified, these charts become quicker to react. It should again be noted that the ssDMEWMA is quicker to respond than the ssMEWMA when all things are held constant in regard to how in control period effects reaction time.

The third research question, " How will the proposed control scheme perform under different dimensionality?" can begin to be addressed by looking across all four plots within all the proceeding figures. As noted in the preface to this section, the patterns exhibited within the figures are consistent. Holding everything constant except dimension in the figures, it is evident that dimension primarily drives the rate at which the processes reach their asymptotic limits. As dimension increases, the rate at which the asymptotic limits of the ssDMEWMA are. reached more quickly.

To briefly summarize the ssDMEWMA performance, what was observed through the simulation was consistent with the theoretical development of the control mechanism. The charts exhibit predictable patterns in detecting shifts both small an large where small smoothing coefficients detect small shifts quickly while larger coefficients can potentially capture large shifts more quickly but at the sacrifice of small shift detection performance. The charts also predictably converge to that of the DMEWMA as was expected but bypass the need for dedicated training periods before active monitoring. It was also observed that patterns in reaction times were consistent across all dimensions considered when all other things are held consistent but that the rate when the process hits its asymptotic performance is directly influenced by the dimension itself. Additionally, the ssDMEWMA is quicker to react in many circumstances than the ssMEWMA as expected, suggesting this is an advancement of the literature. Thus, research questions 2-5 have been addressed for the ssDMEWMA.

Self Starting Double Multivariate Exponentially Weighted Moving Covariance Performance

Shifting focus to the ssDMEWMC, it will be demonstrated through a series of visualizations that this new metric also advances the ssMEWMC in a meaningful way.

In the highest sense, it will be demonstrated that 1.) small lambdas are quicker to detect smaller shifts and large shifts are very quickly detected, 2.) the patterns in reaction times are consistent across dimensions but asymptotic performance is achieved at a rate directly impacted by the dimension of the process, 3.) the ssDMEWMC is quicker to react when the shift occurs after a longer in control period, and 5.) performance gains over the ssMEWMC begin to become evident.

As noted previously, rather than exhaustively plot every out-of-control scenario that was simulated, visualizations will focus on representative examples of a small, medium, large, and extra-large dimension process and then select smoothing coefficients and target in-control ARL's. In some cases either shift is held constant or wait time is held constant to better elucidate the desired pattern. These will be explicitly pointed out in the examples below.

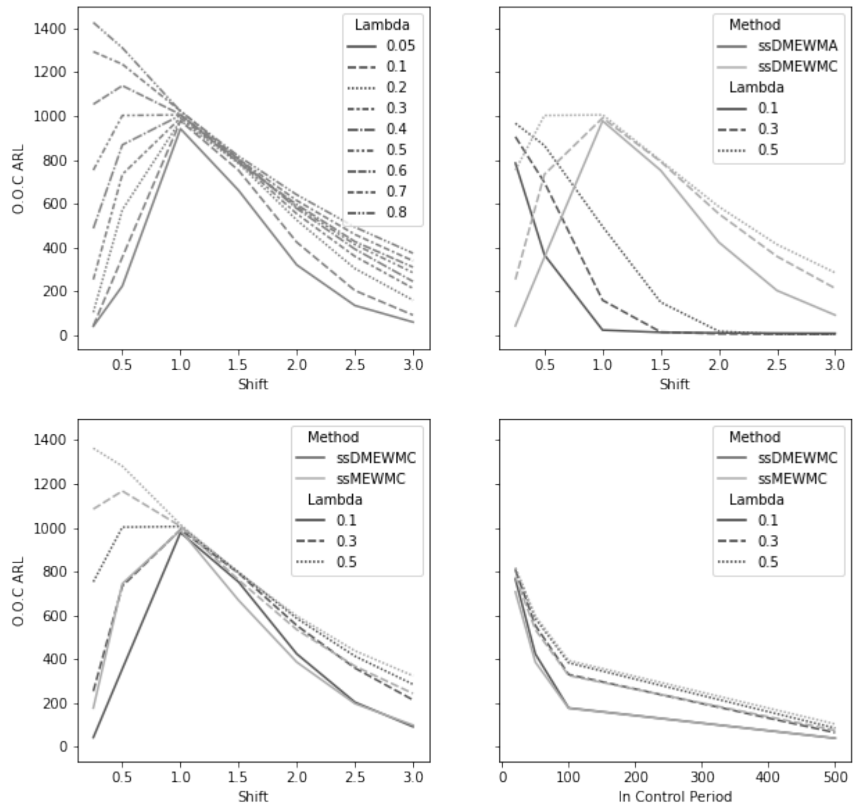

Figure 7

Out of Control Performance for ssDMEWMC of Dimension 2

Comparison of ssDMEWMC out-of-control ARL performance when different values of lambda are used with a target in-control ARL of 1000 and a in-control period of 50 observations and p = 2 (top left); Complement of ssDMEWMC to the ssDMEWMA with target in control ARL of 1000 and p = 2 (top right); out-of-control ARL performance of ssDMEWMC against the ssMEWMC for lambdas = 0.1,0.3,0.5 and a in-control period of 50 and target in control ARL of 1000 and p = 2 (bottom left); out-of-control ARL performance of the ssDMEWMC against the ssMEWMC over different in control periods with fixed shift of 0.5 and target in control ARL of 1000 and p = 2 (bottom right)

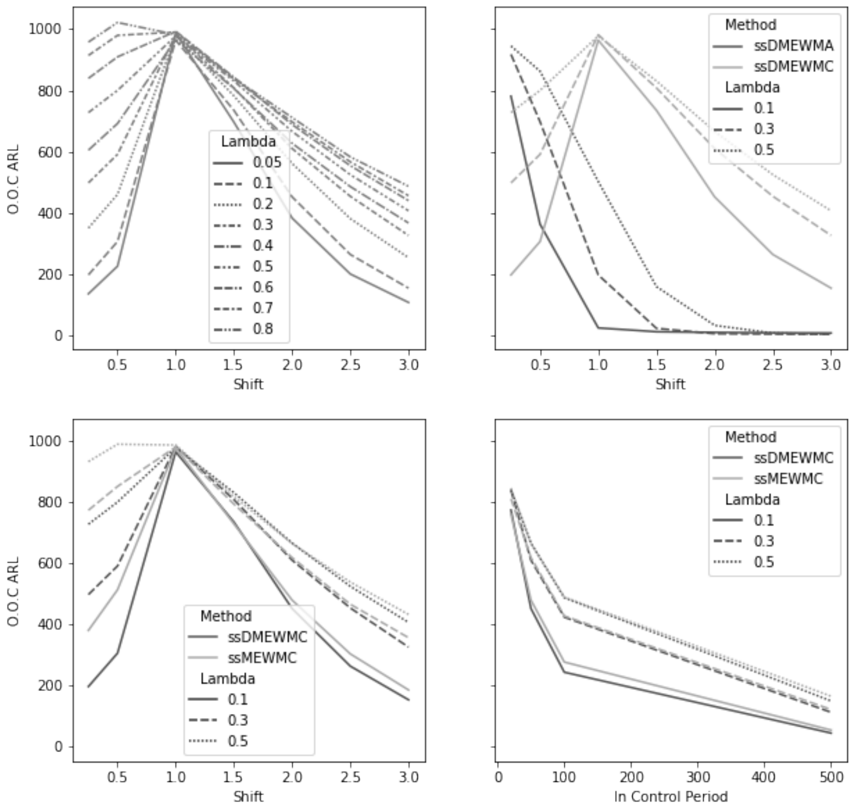

Figure 8

Out of Control Performance for ssDMEWMC of Dimension 5

Comparison of ssDMEWMC out-of-control ARL performance when different values of lambda are used with a target in-control ARL of 1000 and a in-control period of 50 observations and p = 5 (top left); Complement of ssDMEWMC to the ssDMEWMA with target in control ARL of 1000 and p = 5 (top right); out-of-control ARL performance of ssDMEWMC against the ssMEWMC for lambdas = 0.1,0.3,0.5 and a in-control period of 50 and target in control ARL of 1000 and p = 5 (bottom left); out-of-control ARL performance of the ssDMEWMC against the ssMEWMC over different in control periods with fixed shift of 0.5 and target in control ARL of 1000 and p = 5 (bottom right)

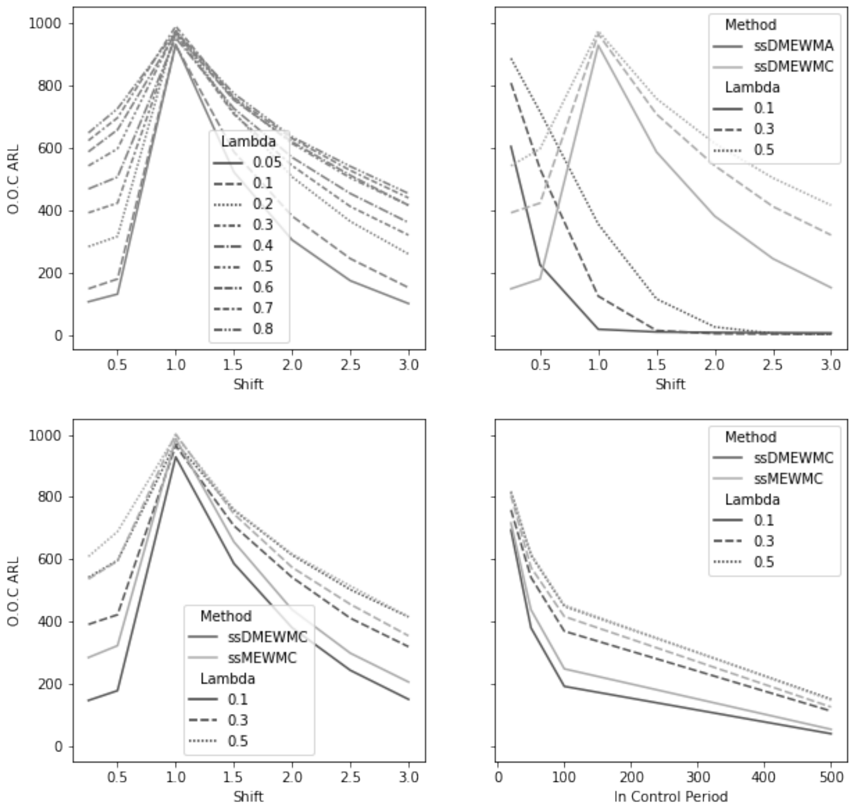

Figure 9

Out of Control Performance for ssDMEWMC of Dimension 10

Comparison of ssDMEWMC out-of-control ARL performance when different values of lambda are used with a target in-control ARL of 1000 and a in-control period of 50 observations and p = 10 (top left); Complement of ssDMEWMC to the ssDMEWMA with target in control ARL of 1000 and p = 10 (top right); out-of-control ARL performance of ssDMEWMC against the ssMEWMC for lambdas = 0.1,0.3,0.5 and a in-control period of 50 and target in control ARL of 1000 and p = 10 (bottom left); out-of-control ARL performance of the ssDMEWMC against the ssMEWMC over different in control periods with fixed shift of 0.5 and target in control ARL of 1000 and p = 10 (bottom right)

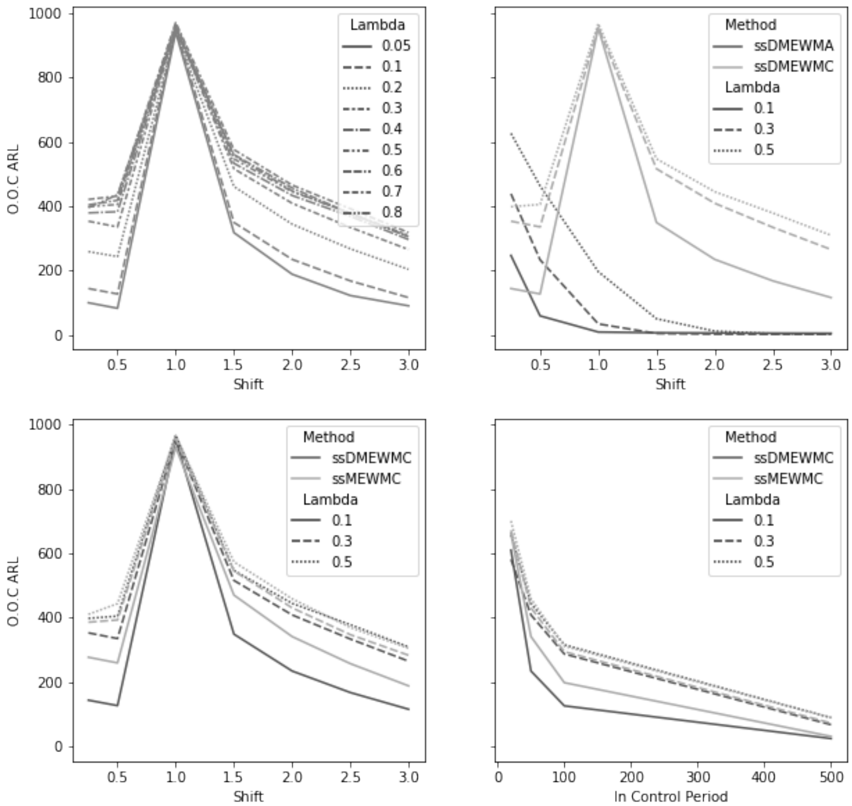

Figure 10

Out of Control Performance for ssDMEWMC of Dimension 25

Comparison of ssDMEWMC out-of-control ARL performance when different values of lambda are used with a target in-control ARL of 1000 and a in-control period of 50 observations and p = 25 (top left); Complement of ssDMEWMC to the ssDMEWMA with target in control ARL of 1000 and p = 25 (top right); out-of-control ARL performance of ssDMEWMC against the ssMEWMC for lambdas = 0.1,0.3,0.5 and a in-control period of 50 and target in control ARL of 1000 and p = 25 (bottom left); out-of-control ARL performance of the ssDMEWMC against the ssMEWMC over different in control periods with fixed shift of 0.5 and target in control ARL of 1000 and p = 25 (bottom right)

In figures 7, 8, 9, and 10, it has been again demonstrated that selection of small smoothing coefficients is advantageous in detecting small shifts. They even seem useful for detecting really large shifts. Notice that for the ssDMEWMA the change is multiplicative in the covariance matrix as opposed to additive like in the ssDMEWMA. even with that acknowledgment, the ssDMEWMC excels in detecting shifts both in expansion or contraction of the covariance matrix with small smoothing parameter selection. Further, the peakedness in the upper left plots in these figures makes sense given the multiplicative nature of the shift; that is to say, the peak at 1 represents the in-control average run length. This addresses the fourth research question, ”How does the proposed control scheme perform with the utilization of different values for the smoothing parameter λ?” for the ssDMEWMC.

The second research question, ”How will the proposed control scheme perform for different deviations in both the location vector and variance-covariance matrix?” is addressed in the plots in the upper right and lower left of each of the prior figures. Similar to what was observed previously in assessing the ssDMEWMA, the ssDMEWMC can detect both small or large shifts in the covariance of process. Further, the larger the expansion or the contraction of the covariance, the faster the chart seems to respond. This behavior is desirable in that large expansions in covariance would likely be linked to more non-conforming units rolling out of the production process.

While not specifically addressed as a research question, the length of time a process was in control before the shift does have an effect on the chart’s reaction time. As was seen with the ssDMEWMA, the longer the process is in control before a shift relative to the in control ARL specification, the faster the chart responds.

To address the third research question, ”How will the proposed control scheme perform under different dimensionality?” for the ssDMEWMC, again the narrative across the previous four figure must be observed. As with the ssDMEWMA, dimensionality again serves as a driver for how quickly average run lengths plateau. In this case, this is observed as the width of the peaks when assessing reaction time to shift size. As before with the ssDMEWMA, the large the dimension size, the quicker the charts reach asymptotic performance levels.

Further, in the upper right plot of each figure, the ssDMEWMC is plotted alongside its corresponding ssDMEWMA for same sized shifts of the appropriate entities. This illustrates how the two newly proposed methods would operate in tandem to simultaneously monitor process location and spread. They are plotted here on the same set of axes but could very well be on their own plots. That said, the key thing to note is that while changes in location are very quickly spotted, the relative reaction time to spot expansions or contractions in spread is much slower.

On a final note for the ssDMEWMC, it should be noted that all the held constant, the ssDMEWMC is a quicker responding chart than the ssMEWMC as suspected. This assists in answering the fifth and final research question on how the ssDMEWMC compares to the performance in the literature.

Out of Control Average Run Length Method Comparison

To address research question five more exhaustively than what has been demonstrated in the prior section, the performance of the newly proposed ssDMEWMAC and the existing literature will be compared in a series of visualizations where shift size and wait time are held constant and the relative out-of-control performance of the two methods contrasted. These visualizations will show that the newly proposed methods out perform the existing ssMEWMAC control charts they were based on, thus concretely showing an advancement in the literature.

Figure 11 shows for any in control ARL specification, the ssDMEWMA reacts faster than the ssMEWMA. This visualization was constructed in such a way that whenever the out-of-control ARL from the ssDMEWMA was less than that of the ssMEWMA, the square tile of the dimension by smoothing coefficient grid would be shaded black and lighter whenever the reverse is true or they are equal. As is plain to see, more often than not, the ssDMEWMA is quicker to react than the ssMEWMA that it was based upon.

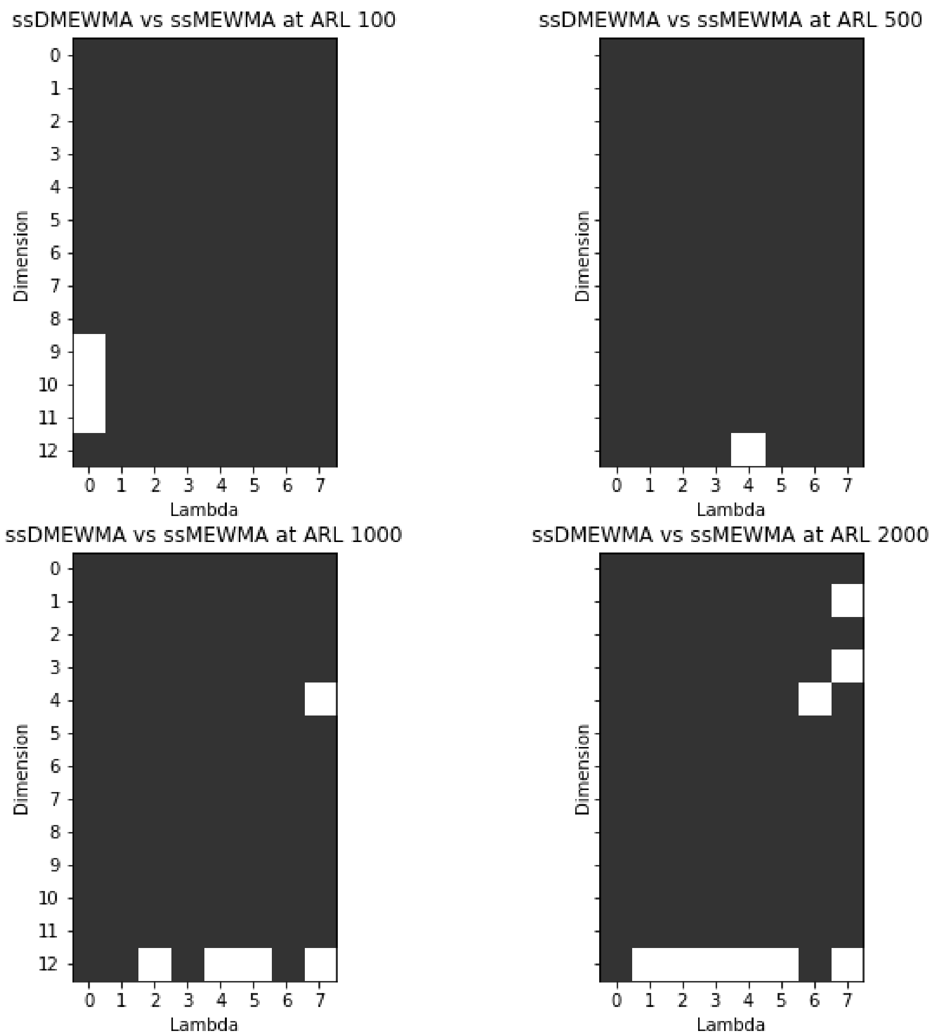

Figure 11

Out of Control Performance Comparison of ssDMEWMA vs ssMEWMA

Comparison of ssDMEWMA out-of-control ARL performance against the ssMEWMA over all dimensions and smoothing coefficients with in-control ARL specification of 1000 and an initial in control period of 50 observations

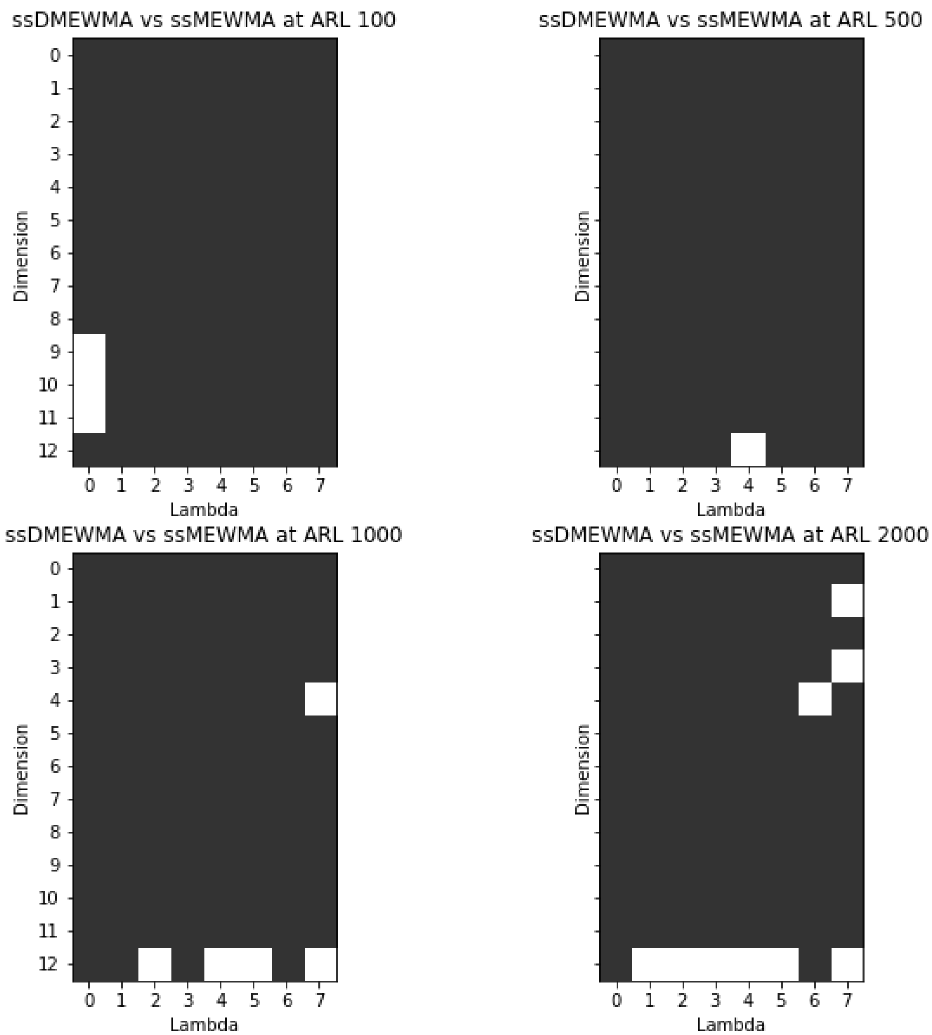

Figure 12

Out of Control Performance Comparison of ssDMEWMC vs ssMEWMC

Comparison of ssDMEWMC out-of-control ARL performance against the ssMEWMC over all dimensions and smoothing coefficients with in-control ARL specification of 1000 and an initial in control period of 50 observations

Figure 12 shows for any in control ARL specification, the ssDMEWMC reacts faster than the ssMEWMC. This visualization was constructed in such a way that whenever the out-of-control ARL from the ssDMEWMC was less than that of the ssMEWMC, the square tile of the dimension by smoothing coefficient grid would be shaded black and lighter whenever the reverse is true or they are equal. As is plain to see, more often than not, the ssDMEWMC is quicker to react than the ssMEWMC that it was based upon.

In both cases, since the newly derived metrics out perform their predecessors, these metrics can be thought ot have advanced the field to its next logical place.

Summary

In overall summary, the five research questions have now been addressed.

The in-control design thresholds were reported as a series of tables listing how to achieve a desired in control ARL with a variety of different dimensions and smoothing coefficients. Combined with the theoretical framework of the supporting metrics, this fully addresses the first research question regarding how the control scheme was to be designed.

Additionally, through a series of figures and exhaustive lists of out-of-control run lengths, the performance of the new control schemes was demonstrated. To address the second research question regarding the impact of different shifts in the location or spread of spread, it was shown that the correct selection of a smoothing coefficient led to the quick detection of shifts. Small smoothing coefficients quickly were able to identify small cumulative shifts in the process location and spread and were able to do so even more effectively if the process stayed in control longer relative to the in-control ARL specification of the chart. It was also acknowledged that big shifts were detected relatively quickly across smoothing coefficients, potentially negating the need for situational large smoothing coefficient selection.

Exploring the third research question regarding the effect of dimensionality on the charts performance, in both cases of the ssDMEWMA and ssDMEWMC, it was seen that dimension when all other things are held constant primarily drives the rate at which the mechanisms achieve their relative asymptotic performance levels, with larger dimensions reaching their respective plateaus more quickly.

The fourth research question regarding the effect of the smoothing coefficient on chart performance was addressed by comparing out-of-control ARL performance for different size shifts. In general, as was previously stated, small smoothing coefficients were well paired with small shifts. In the case of the ssDMEWMA there were situational cases where large shifts could be more quickly identified by selection of larger smoothing coefficients, there was a corresponding sacrifice in small shift detection capability. In the case of the ssDMEWMC, large lambda selection seemed unwarranted for the comparisons considered in this analysis.

Lastly, the last research question regarding performance relative to the existing literature focused on the comparisons of the ssDMEWMA to the SSMEWMA and the ssDMEWMC to the ssMEWMC. In both of these cases it was shown that the new methods out performed the mechanisms they were based upon, thus advancing the body of research.

CHAPTER V

CONCLUSION

In this dissertation, a long journey was taken through the historical origins of statistical process control; through the relevant research establishing the precedent of performing a second weighting on exponentially weighted moving average type charts; through the theoretical development of the newly proposed self starting Double Weighted Multivariate Exponentially Weighted Moving Average and Covariance control charts; and through the simulations on how the would be designed and how they would perform.

What follows is brief discussion on what this all means and how this research has extended the knowledge base in the field of statistical process control. Specifically, the performance of the newly proposed control charts will be summarized as will how they compare to the existing measures they built upon.

At the very end of this chapter, some recommendations and suggestions for future research will be made.

Discussion

Performance

As was revealed in the preceding chapter, the performance of the newly proposed ssDMEWMA and ssDMEWMC control charts revealed through simulation followed closely to what was suggested in their theoretical development.

To elaborate, in both mechanisms, specifications exist to achieve a desired monitoring paradigm. One can control the selection of smoothing coefficients in such a way to proactively set a desired average control length for when the process is running smoothly as well as to choose them in such a way to have the chart react as quickly as possible for the anticipated size of shift that may occur in the process location or covariance matrix.

Additionally, confidence can be had in the monitoring techniques as they behave consistently with the techniques they were based upon.

In the case of the ssDMEWMA, performance converges to that of the DMEWMA without the need of dedicated pre-production sampling and safety in that the underlying distribution being monitored is a series of independent multivariate normal distributions with known mean and variance that are easy to work with.

While the ssDMEWMC does not have a process that is analogous to that of the DMEWMA, users of the process monitoring technique can rest assured that it does actively catch both expansions and contractions in covariance matrix in a fashion that is very similar to that of its predecessor. As such, it too benefits from being able to abstract from an arbitrary process mean and covariance matrix to that of a series of independent multivariate normal distributions with a known center and covariance structure.

In either case, the newly proposed perform well in a simulated setting as they were designed to do. With the correct selection of a smoothing parameter, either technique will quickly (often in the singles of units) signal the process has shifted. With this expedience, there are real world cost savings to be observed.

Performance Relative to Existing Methods

More importantly, both the new proposed methods out perform those they were built upon. This is especially evident when the shift is occurring really early in the process or the shift is really small. As was stated previously, any method that reacts quicker to a change in the process has the capacity to directly save costs in the form of preventing waste or by preserving a manufacturer's reputation for quality.

Overall

As also previously stated, a fortunate consequence of this dissertation is the packaging of all the necessary code into what will be an open-sourced Python package. Given the ubiquity of Python and its ease to use, this puts sophisticated statistical process control at the finger tips of many more companies than the existing methods that were built on FORTRAN. At the cost of computing speed, this dissertation provides everything necessary to build custom control charts.

The success of this dissertation then can be directly assessed by the number of times the code is pulled and used in the community. With its high performance and high level accessibility, this dissertation has moved the needle ever so slightly forward in the world of statistical process control.

Implications

While the technical and statistical impacts of this analysis have been discussed, it may be beneficial to consider the impacts of this dissertation in industry. By reducing average out of control run lengths, the newly demonstrated control charts have a directly measurable impact to any industry looking to save costs.

For example, consider the semi-conductor industry. It is one where not only is manufacturing expensive, but, there is also a long lead time from the start of the manufacturing process until a viable unit is produced. Complicating matters, it is an industry in which even small deviance from design spec can render the whole product unusable. As one can easily imagine, errors can quickly compound and a quick out-of-control signal can make the difference between thousands of dollars in materials and production costs as well as avoiding an even costlier delay in shipment of the product. Given the quick reaction times of this new control scheme coupled with its ease of use to employ, the ssDMEWMAC is poised to make a direct impact upon its publication.

Recommendations

As for recommendations on this process, the first thing to improve is the grid search employed phase 1 of the simulation. While a dynamic approach was used to try and more optimally search for the correct h-value for each method, there is definitely a lot of room for improvement. Something along the lines of a gradient boosted search may expedite this process as it would hopefully better hone in on when the process has settled in on its best value to use. This was attempted in spirit in this dissertation but was using heuristics from observing the process in motion at the beginning of the simulation as opposed to something more rigidly defined. While this resulted in a set of acceptable h-values that preserved what was seen in the existing literature, it did so at a great computational expense.

Further, it may be of interest to loosen the constraint on how close the observed in-control ARL needed to be to its target in order for the process to kick out. A lot of time was spent trying to get within that 0.1% tolerance limit. This may not be necessary in the field and is something that should be able to be tuned by the end user.

Lastly, it is the opinion of this author that this paradigm should be used anywhere in industry that the ssMEWMAC or DMEWMA are already actively being used. There has been evidenced performance gain in the mechanisms over that of its peers which would warrant such a switch. Risks of such a switch would be small and there could be realized cost savings due to making such a switch– a primary driver of statistical process control to begin with.

Future Research

Future research stemming from this dissertation could focus on how to better refine the performance of the charts when the shift occurs very early in the production process. This is a common ailment of many control chart schemes, including that of both the ssDMEWMAC and ssMEWMAC charts investigated here within. An extreme case of this would be when the process starts off out-of-control from the very start.

Additional research could focus on the actual distributions of run lengths in each of the simulations performed. This dissertation was focused on using the average of these run lengths without giving much consideration to the underlying distributions. This could have a pronounced effect if extreme skew is present in the distribution of run lengths.

REFERENCES

Alkahtani, S. (2010). *University of Northern Colorado* (Doctoral dissertation). University of Northern Colorado.

Alkahtani, S., & Schaffer, J. (2012). A double multivariate exponentially weighted moving average (dMEWMA) control chart for a process location monitoring. *Communications in Statistics: Simulation and Computation*, *41*(2), 238–252. https://doi.org/10.1080/03610918.2011.585004

Alt, F. (1985). Multivariate Quality Control.

Bersimis, S., Psarakis, S., & Panaretos, J. (2007). Multivariate statistical process control charts: An overview. *Quality and Reliability Engineering International*, *23*(5), 517–543. https://doi.org/10.1002/qre.829

Bodden, K. M., & Rigdon, S. E. (1999). A program for approximating the in-control ARL for the MEWMA chart. *Journal of Quality Technology*, *31*(1), 120–123. https://doi.org/10.1080/00224065.1999.11979902

Borror, C. M., Montgomery, D. C., & Runger, G. C. (1999). Robustness of the ewma control chart to non-normality [Copyright - Copyright American Society for Quality Jul 1999; Last updated - 2014-05-26; CODEN - JQUTAU]. *Journal of Quality Technology*, *31*(3), 309–316. https : / / unco . idm . oclc . org / login ? url = https : / / search - proquest - com.unco.idm.oclc.org/docview/214481216?accountid=12832

Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relationships over time. *Journal of the Royal Statistical Society: Series B (Methodological)*, *37*(2), 149–163. https://doi.org/10.1111/j.2517-6161.1975.tb01532.x

Capizzi, G., & Masarotto, G. (2010). Self-starting CUSCORE control charts for individual multivariate observations. *Journal of Quality Technology*, *42*(2), 136–151. https://doi.org/10.1080/00224065.2010.11917812

Chambers, J. M. (1971). Regression updating. *Journal of the American Statistical Association*, *66*(336), 744–748. https://doi.org/10.1080/01621459.1971.10482338

Crowder, S. V. (1987). Average run lengths of exponentially weighted moving average control charts. *Journal of Quality Technology*, *19*(3), 161–164. https://doi.org/10.1080/00224065.1987.11979055

Fuchs, C. (1998). *Multivariate Quality Control: Theory and Applications*. Taylor & Francis Group, LLC.

Hawkins, D. M., & Maboudou-Tchao, E. M. (2007). Self-starting multivariate exponentially weighted moving average control charting. *Technometrics*, *49*(2), 199–209. https://doi.org/10.1198/004017007000000083

Hawkins, D. M., & Maboudou-Tchao, E. M. (2008). Multivariate exponentially weighted moving covariance matrix. *Technometrics*, *50*(2), 155–166. https://doi.org/10.1198/004017008000000163

Hotelling, H. (1947). Multivariate quality control. *Techniques of statistical analysis*.

Jackson, J. (1991). *A User's Guide to Principal Components* (I. John Wiley & Sons, Ed.).

Jensen, W. A., Jones-Farmer, L. A., Champ, C. W., & Woodall, W. H. (2006). Effects of parameter estimation on control chart properties: A literature review. *Journal of Quality Technology*, *38*(4), 349–364. https://doi.org/10.1080/00224065.2006.11918623

Li, Z., Zhang, J., & Wang, Z. (2010). Self-starting control chart for simultaneously monitoring process mean and variance. *International Journal of Production Research*, *48*(15), 4537–4553. https://doi.org/10.1080/00207540903051692

Lowry, C. A., & Montgomery, D. C. (1995). A review of multivariate control charts. *IIE Transactions*, *27*(6), 800–810. https://doi.org/10.1080/07408179508936797

Lowry, C. A., Woodall, W. H., Champ, C. W., & Rigdon, S. E. (1992). A multivariate exponentially weighted moving average control chart. *Technometrics*, *34*(1), 46–53. https://doi.org/10.1080/00401706.1992.10485232

Lucas, J. M., & Saccucci, M. S. (1990). Exponentially weighted moving average control schemes: Properties and enhancements. *Technometrics*, *32*(1), 1–12. https://doi.org/10.1080/00401706.1990.10484583

Maboudou-Tchao, E. M., & Hawkins, D. M. (2011). Self-starting multivariate control charts for location and scale. *Journal of Quality Technology*, *43*(2), 113–126. https://doi.org/10.1080/00224065.2011.11917850

Macgregor, J. F., & Harris, T. J. (1993). The exponentially weighted moving variance. *Journal of Quality Technology*, *25*(2), 106–118. https://doi.org/10.1080/00224065.1993.11979433

Montgomery, D. C. (2008). *Introduction to statistical quality control*. Wiley. https://www.xarg.org/ref/a/0470169923/

Prabhu, S. S., & Runger, G. C. (1997). Designing a multivariate ewma control chart. *Journal of Quality Technology*, *29*(1), 8–15. https://doi.org/10.1080/00224065.1997.11979720

Quesenberry, C. (1993). The Effect of Sample Size on Estimated Effects. *Journal of Quality Technology*, (25), 237–247.

Roberts, S. W. (1959). Control chart tests based on geometric moving averages. *Technometrics*, *1*(3), 239–250. http://www.jstor.org/stable/1266443

Robinson, P. B., & Ho, T. Y. (1978). Average run lengths of geometric moving average charts by numerical methods. *Technometrics*, *20*(1), 85–93. https://doi.org/10.1080/00401706.1978.10489620

Ryan, T. P. (2000). *Statistical methods for quality improvement (wiley series in probability and statistics)*. Wiley-Interscience. https://www.xarg.org/ref/a/0471197750/

Schaffer, J. (1997). A multivariate application of the Q chart.

Shamma, S. E., & Shamma, A. K. (1992). Development and Evaluation of Control Charts Using Double Exponentially Weighted Moving Averages. *International Journal of Quality & Reliability Management*, *9*(6), 1–6. https://doi.org/10.1108/02656719210018570

Srivastava, M., & Yanhong, W. (1997). On-line quality control procedures for a random walk model with measurement error. *Sequential Analysis*, *16*(1), 93–105. https://doi.org/10.1080/07474943708836374

Stoumbos, Z. G., & Sullivan, J. H. (2002). Robustness to non-normality of the multivariate EWMA control chart. *Journal of Quality Technology*, *34*(3), 260–276. https://doi.org/10.1080/00224065.2002.11980157

Sullivan, J. H., & Jones, L. A. (2002). A self-starting control chart for multivariate individual observations. *Technometrics*, *44*(1), 24–33. https://doi.org/10.1198/004017002753398290

Woodall, W. H. (2000). Controversies and contradictions in statistical process control. *Journal of Quality Technology*, *32*(4), 341–350. https://doi.org/10.1080/00224065.2000.11980013

Zhang, G., & Chang, S. I. (2008). Multivariate EWMA control charts using individual observations for process mean and variance monitoring and diagnosis. *International Journal of Production Research*, *46*(24), 6855–6881. https://doi.org/10.1080/00207540701197028

Zhang, L. Y. (2002). *Ewma control charts and extended ewma control charts* (Doctoral dissertation) [Copyright - Database copyright ProQuest LLC; ProQuest does not claim copyright in the individual underlying works; Last updated - 2019-10-18]. https://unco.idm.oclc.org/login?url=https://search-proquest-com.unco.idm.oclc.org/docview/305564470?accountid=12832

APPENDIX A

IN CONTROL DESIGN SPECIFICATION CODE

Common Functions - functions.py

```python
"""
This is part of the python program that will be used to run
the derivation and the performance of the ssDMEWMAC control
chart. It is a conversion of the work of the ssMEWMAC Fortran
95 code into something more user friendly to run.

The key principles of the routine are to perform the Cholesky
decomposition of the covariance matrix, pass it to the
converted ssMEWMA routine provided in Hawkins and Maboudou-
Tchao (2007). Within this routine, the factored matrix of
the covariance matrix is used to calculate recursive residuals
of which are then transformed into multivariate standard normal
vectors. The standardized vectors of recursive residuals are the
primary values passed to the ssMEWMA & ssDMEWMAC test statistics.
"""

import numpy as np
from scipy.stats import t
from scipy.stats import norm
from math import copysign
from sklearn.datasets import make_sparse_spd_matrix
from gcloud import storage



# the critical u transformation function
```

```
def u_transform(factor_matrix,
                obs_vector,
                n,
                p,
                epsilon=1e-20):

    #:param factor_matrix: cholesky inverse root
    #       matrix of the covariance matrix
    #:param obs_vector: p-dimension obs. vector
    #:param n: the sample n
    #:param p: the dimension of the process
    #:param epsilon: arl tolerance value
    #:return: updated factor_matrix,
    #          recursive residual vector,
    #          and u-vector


    # if n == 1, initialize the factor matrix to 0 matrix
    if n == 1:
        factor_matrix = np.zeros([p + 1, p + 1],
                                 dtype=np.float)
    else:
        factor_matrix = factor_matrix

    # initialize a zero vector for R and a missing
    # values vector for U
    r = np.zeros(p, dtype=np.float)
```

```
u = np.repeat(np.nan, p)

# initialize a copy of the diagonal elements
# of the factor_matrix
old = np.repeat(np.nan, p + 1)



# step one, take the observation vector
# and prepend a 1 to it
work = np.insert(obs_vector, 0, 1.0, axis=0)

# create the factor_matrix numerically
for i in range(p + 1):
    d1 = factor_matrix[i, i]
    old[i] = d1
    d2 = work[i]
    if i > 0:
        r[i - 1] = d2
    d0 = max(np.abs(d1), np.abs(d2))
    if d0 != 0:
        d1 = d1 / d0
        d2 = d2 / d0
        if np.abs(d2) >= epsilon:
            d = np.sqrt((d1 ** 2 + d2 ** 2))
            factor_matrix[i, i] = d * d0
            c0 = d1 / d
            s0 = d2 / d
```

```
            for j in range((i + 1), p + 1):
                d1 = factor_matrix[i, j]
                d2 = work[j]
                factor_matrix[i, j] = d1 * c0 + \
                    d2 * s0
                work[j] = -d1 * s0 + d2 * c0
for i in range(1, p + 1):
    ndf = n - i - 1
    df = ndf
    if ndf > 0 and old[i] > epsilon:
        tee = r[i - 1] * np.sqrt(df) / old[i]
        if ndf < 13:
            area = t.cdf(tee, ndf)
            # this gets the inverse normal value
            # of the area calculated
            u[i - 1] = norm.ppf(area)
    else:
        sign = copysign(1, tee)
        u[i - 1] = sign * (((1.0 - 2.0 / \
            (8.0 * df + 3.0)) * \
            np.sqrt(df * np.log(1 + tee ** 2 / df))))

return factor_matrix, r, u
```

```
# function for calculating the M vector
def m_n(smoothing, u_n, m_prior):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param u_n: the u_n vector from the
    #            u_transform function
    #:param m_prior: the previous output of this
    #                function or 0 vector size p
    #:return: m_n vector of size p
    #        (will occur at p + 2 sample)


    m = smoothing * u_n + (1 - smoothing) * m_prior

    return m
```

```python
# function for calculating the plotting statistic
def t_n(smoothing, m, n, p):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param m: the m vector at sample n
    #:param n: the sample n
    #:param p: the dimensionality of the process
    #:return: the t^2 statistic for plotting



    # need to calculate Sigma_m
    Sigma_m = (smoothing / (2 - smoothing)) * \
        (1 - (1 - smoothing) ** (2 * (n - p - 1))) * \
        np.identity(p)

    # get the inverse matrix
    Sigma_m_inv = np.linalg.inv(Sigma_m)

    # now calculate the t^2 statistic
    t = m.dot(Sigma_m_inv).dot(m)

    # and mn2 for plotting convenience
    mn2 = m.dot(m)

    return t, mn2
```

```
# function for plotting the ssMEWMA bound at sample n
def ssmewma_bound(smoothing, n, p, h):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param n: the sample n
    #:param p: the dimensionality of the process
    #:param h: the value h to control the ARL0
    #:return: the value of the confidence bound at
    #         sample n

    exponent_term = (1 - (1 - smoothing) ** \
        (2 * (n - p - 1)))

    c = ((smoothing * exponent_term) / \
        (2 - smoothing)) * h

    return c
```

```
# function for calculating the ssMEWMC control stat
def s_n(smoothing, u_n, s_prior):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param u_n: the u-vector at time n
    #:param s_prior: the prior value from the s_n
    #                function
    #:return: the current s matrix at time n

    s = (1 - smoothing) * s_prior + smoothing * \
        (np.outer(u_n, u_n.T))

    return s


# function for the plotting statistic of the ssMEWMC
def c_n(s, p):

    #:param s: the s_n out put at time n
    #:param p: the dimensionality of the process
    #:return: the plotting statistic

    c = s.trace() - np.log(np.linalg.det(s)) - p

    return c
```

```
# define the functions for the ssDMEWMAC charts
# start with the ssDMEWMA set of functions
def d_n(smoothing, m, d_prior):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param m: value of ssMEWMA m vector at
    #          sample n
    #:param d_prior: the prior value of
    #                this function
    #:return: d vector at sample n

    d = smoothing * m + (1 - smoothing) * d_prior

    return d
```

```
# function to get the ssDMEWMA plotting statistics
def dt_n(smoothing, d, n, p):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param d: the d vector at sample n
    #:param n: the sample n
    #:param p: the dimensionality of the process
    #:return: the t^2 statistic for plotting


    # need to calculate Sigma_m
    quad = (smoothing ** 4)
    sq = (1 - smoothing) ** 2
    exp1 = ((n + 1) ** 2) * ((1 - smoothing) ** \
        (2 * n))
    exp2 = ((2 * n ** 2) + (2 * n) - 1) * \
        ((1 - smoothing) ** (2 * n + 2))
    exp3 = ((n ** 2) * ((1 - smoothing) ** \
        (2 * n + 4)))
    denom = (1 - (1 - smoothing) ** 2) ** 3

    Sigma_d = ((quad * \
         (1 + sq - exp1 + exp2 - exp3)) / denom) * \
        np.identity(p)

    # get the inverse matrix
```

```
Sigma_d_inv = np.linalg.inv(Sigma_d)

# now calculate the t^2 statistic
t = d.dot(Sigma_d_inv).dot(d)

# and mn2 for plotting convenience
dn2 = d.dot(d)

return t, dn2
```

```
# function to calculate the ssDMEWMA bound at sample n
def dssmewma_bound(smoothing, n, h):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param n: the sample n
    #:param h: the value h to control the ARL0
    #:return: the value of the confidence bound
    #         at sample n

    quad = (smoothing ** 4)
    sq = (1 - smoothing) ** 2
    exp1 = ((n + 1) ** 2) * ((1 - smoothing) ** \
        (2 * n))
    exp2 = ((2 * n ** 2) + (2 * n) - 1) * \
        ((1 - smoothing) ** (2 * n + 2))
    exp3 = ((n ** 2) * ((1 - smoothing) ** \
        (2 * n + 4)))
    denom = (1 - (1 - smoothing) ** 2) ** 3

    c = ((quad * \
        (1 + sq - exp1 + exp2 - exp3)) / denom) * h

    return c
```

```
# function to calculate the c_n metric
def v_n(smoothing, s, v_prior):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param s: the s matrix at sample n
    #:param v_prior: the prior value from
    #                this function
    #:return: the v matrix at sample n

    v = smoothing * s + (1 - smoothing) * v_prior

    return v


# the control statistic for the ssDMEWMC
def cv_n(v, p):

    #:param v: the v matrix at sample n
    #:param p: the dimensionality of the process
    #:return: the value of the control statistic
    #         at sample n

    c = v.trace() - np.log(np.linalg.det(v)) - p

    return c
```

```
# functions to replicate the original (D)MEWMA
def y_vec(smoothing, x_n, y_prior):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param x_n: the value of the x vector
    #            at sample n
    #:param y_prior: the prior value from
    #                this function
    #:return: the value of the y vector
    #         at sample n

    return smoothing * x_n + (1 - smoothing) * y_prior


def z_vec(smoothing, y_n, z_prior):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param y_n: the value of the y vector
    #            at sample n
    #:param z_prior: the prior value from
    #                this function
    #:return: the value of the z vector
    #         at sample n

    return smoothing * y_n + (1 - smoothing) * z_prior
```

```
def mewma(smoothing, n, yvec, sigma_0):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param n: the sample n
    #:param y_vec: the y_vector
    #              at sample n
    #:param sigma_0: the value of the initial
    #                covariance matrix
    #:return: the value of the MEWMA algorithm
    #         at sample n


    sigma_y = ((smoothing * (1 - (1 - smoothing) ** \
        (2 * n))) / (2 - smoothing)) * sigma_0

    t2_n = yvec.dot(np.linalg.inv(sigma_y)).dot(yvec)

    return t2_n
```

```
def dmewma(smoothing, n, zvec, sigma_0):

    #:param smoothing: value of the smoothing
    #                  constant lambda
    #:param n: the sample n
    #:param z_vec: the value of the z vector
    #              at sample n
    #:param sigma_0: the value of the initial
    #                covariance matrix
    #:return: the value of the DMEWMA algorithm
    #         at sample n


    quad = (smoothing ** 4)
    sq = (1 - smoothing) ** 2
    exp1 = ((n + 1) ** 2) * ((1 - smoothing) ** \
        (2 * n))
    exp2 = ((2 * n ** 2) + (2 * n) - 1) * \
        ((1 - smoothing) ** (2 * n + 2))
    exp3 = ((n ** 2) * ((1 - smoothing) ** \
        (2 * n + 4)))
    denom = (1 - (1 - smoothing) ** 2) ** 3

    sigma_z = ((quad * \
        (1 + sq - exp1 + exp2 - exp3)) / denom) * \
        sigma_0
```

```
tz2_n = zvec.dot(np.linalg.inv(sigma_z)).dot(zvec)

return tz2_n
```

```
# function for creating random mean and
# covariance matrices size p
def sampling_distribution(p,
                          seed,
                          alpha=0.5,
                          norm_diag=True,
                          smallest_coef=0.1,
                          largest_coef=2):
    cov_mat = make_sparse_spd_matrix(dim=p,
        alpha=alpha,
        norm_diag=norm_diag,
        smallest_coef=smallest_coef,
        largest_coef=largest_coef,
        random_state=seed)

    mean_vec = np.zeros(p, dtype=float)

    return mean_vec, cov_mat
```

```
# function for running the simulation
def simulate(method,
             dimension,
             smoothing,
             h,
             iterations,
             out_of_control=False,
             delta=0.5,
                 change_after=1):

    #:param mean_vector: the multivariate mean
    #                    vector to sample from
    #:param covariance_matrix: the covariance
    #                          matrix to sample
    #:param method: either "ssMEWMAC"
    #               or "ssDMEWMAC" method
    #:param h: the h-value to test
    #          for o.o.c signaling
    #:param iterations: the number of iterations
    #                   to perform
    #:param out_of_control: Boolean indicator if an
    #                       out of control simulation
    #                       is taking place;
    #                       default False
    #:param delta: The magnitude of the out of control
    #              signal to simulate
    #:param change_after: The number of samples taken
```

```
#                       before inducing the out of
#                       control signal
#:return: the in control average run length
#         for this arrangement


# deduce p
p = dimension

# hold the arl's
arl = np.repeat(np.nan, iterations, axis=0)

for i in range(iterations):
    # print(i)
    j = int((i + 1))

    # initialize relevant variables
    factor_matrix = np.zeros([p + 1, p + 1],
                             dtype=np.float)
    n = 1
    m_prior = np.zeros(p)
    d_prior = np.zeros(p)
    s_prior = np.identity(p)
    v_prior = np.identity(p)
    y_prior = np.zeros(p)
    z_prior = np.zeros(p)
```

```
# hold the vector arrays in a list
X = list()
R = list()
U = list()
M = list()
D = list()
mewmas = list()
mns = list()
dmewmas = list()
dns = list()
cns = list()
cvns = list()

mn2 = 0
dn2 = 0
cn = 0
cvn = 0

np.random.seed(j)

if method == "ssMEWMC" or method == "ssDMEWMC":
    norm = False
else:
    norm = True

mean_vector, covariance_matrix = \
    sampling_distribution(p=p, seed=j,
```

```
alpha=np.random.uniform(0.25, 0.75, 1),
norm_diag=norm, smallest_coef=0.1,
largest_coef=1)

obs = \
np.random.multivariate_normal(
    mean_vector,
    covariance_matrix,
    20000)

if out_of_control != False:
    t = p + change_after

    if method != "ssMEWMC" and \
    method != "ssDMEWMC":
        # need to solve delta =
        # (mu' Sigma^-1 mu)^(1/2) for mu
        d = delta

        # for proof of concept, and without
        # loss of generality, add d to every
        # row after time t to simulate o.o.c
        mean_vector[0] = mean_vector[0] + d
        obs_ooc = \
          np.random.multivariate_normal(
            mean_vector,
            covariance_matrix,
```

```
                20000 - t + 1)

            obs = np.concatenate((obs[0:t - 1, :],
                obs_ooc))
        if method == "ssMEWMC" or
        method == "ssDMEWMC":
            covariance_matrix[0, 0] = delta * \
                covariance_matrix[0, 0]

            obs_ooc = \
              np.random.multivariate_normal(
                mean_vector,
                covariance_matrix,
                20000 - t + 1)

            obs = np.concatenate(
                (obs[0:t - 1, :],
                obs_ooc))

    if method == "ssMEWMA":
        while n <= 20000:
            # print(n)
            ob = obs[n - 1]

            # print(ob)
            X.append(ob)
```

```
factor_matrix, r, u = u_transform(
    factor_matrix=factor_matrix,
    obs_vector=ob,
    n=n,
    p=p,
    epsilon=1e-20)
R.append(r)
U.append(u)

if n == p + 2:
    m = m_n(
        smoothing=smoothing,
        u_n=u,
        m_prior=m_prior)
    t2, mn2 = t_n(
        smoothing=smoothing,
        m=m,
        n=n,
        p=p)
    M.append(m)
    mns.append(mn2)
elif n > p + 2:
    m_prior = m
    m = m_n(
        smoothing=smoothing,
        u_n=u,
        m_prior=m_prior)
```

```
    t2, mn2 = t_n(
        smoothing=smoothing,
        m=m,
        n=n,
        p=p)
    M.append(m)
    mns.append(mn2)
else:
    m = np.repeat(np.nan,
                  p,
                  axis=0)
    t2 = 0
    mn2 = 0
    M.append(m)
    mns.append(mn2)

if n > p + 2:
    break_val = ssmewma_bound(
        smoothing,
        n,
        p,
        h)

if n > p + 2 and mn2 > break_val:
    arl[i] = n
    break
```

```
            # prevent nulls
            if n == 20000:
                arl[i] = n
                break

            # print(mn2)

            j += 1
            n += 1

    elif method == "ssMEWMC":
        while n <= 20000:
            # print(n)
            ob = obs[n - 1]

            # print(ob)
            X.append(ob)

            factor_matrix, r, u = \
            u_transform(
                factor_matrix=factor_matrix,
                obs_vector=ob,
                n=n,
                p=p,
                epsilon=1e-20)
            R.append(r)
            U.append(u)
```

```
if n == p + 2:
    s = s_n(smoothing=smoothing,
            u_n=u,
            s_prior=s_prior)
    cn = c_n(s, p)
    cns.append(cn)
elif n > p + 2:
    s_prior = s
    s = s_n(smoothing=smoothing,
            u_n=u,
            s_prior=s_prior)
    cn = c_n(s, p)
    cns.append(cn)
else:
    s = np.identity(p)
    cn = 0
    cns.append(cn)

if n > p + 2:
    break_val = h

if n > p + 2 and cn > break_val:
    arl[i] = n
    break

# prevent nulls
```

```
        if n == 20000:
            arl[i] = n
            break

        # print(cn)

        j += 1
        n += 1

elif method == "ssDMEWMA":
    while n <= 20000:
        # print(n)
        ob = obs[n - 1]

        # print(ob)
        X.append(ob)

        factor_matrix, r, u = \
        u_transform(
            factor_matrix=factor_matrix,
            obs_vector=ob,
            n=n,
            p=p,
            epsilon=1e-20)
        R.append(r)
        U.append(u)
```

```
if n == p + 2:
    m = m_n(smoothing=smoothing,
            u_n=u,
            m_prior=m_prior)
    t2, mn2 = t_n(
        smoothing=smoothing,
        m=m,
        n=n,
        p=p)
    M.append(m)
    mns.append(mn2)
    d = d_n(smoothing=smoothing,
            m=m,
            d_prior=d_prior)
    D.append(d)
    dt2, dn2 = dt_n(smoothing,
                    d,
                    n,
                    p)
    dns.append(dn2)
elif n > p + 2:
    m_prior = m
    m = m_n(smoothing=smoothing,
            u_n=u,
            m_prior=m_prior)
    t2, mn2 = t_n(
        smoothing=smoothing,
```

```
        m=m,
        n=n,
        p=p)
    M.append(m)
    mns.append(mn2)
    d_prior = d
    d = d_n(smoothing=smoothing,
            m=m,
            d_prior=d_prior)
    D.append(d)
    dt2, dn2 = dt_n(smoothing,
                    d,
                    n,
                    p)
    dns.append(dn2)
else:
    m = np.repeat(np.nan,
                  p,
                  axis=0)
    t2 = 0
    mn2 = 0
    M.append(m)
    mns.append(mn2)
    d = np.repeat(np.nan,
                  p,
                  axis=0)
    dt2 = 0
```

```
                dn2 = 0
                D.append(d)
                dns.append(dn2)

            if n > p + 2:
                break_val = dssmewma_bound(
                    smoothing,
                    n,
                    h)

            if n > p + 2 and dn2 > break_val:
                arl[i] = n
                break

            # prevent nulls
            if n == 20000:
                arl[i] = n
                break

            # print(dn2)

            j += 1
            n += 1

    elif method == "ssDMEWMC":
        while n <= 20000:
            # print(n)
```

```
ob = obs[n - 1]

# print(ob)
X.append(ob)

factor_matrix, r, u = \
u_transform(
    factor_matrix=factor_matrix,
    obs_vector=ob,
    n=n,
    p=p,
    epsilon=1e-20)
R.append(r)
U.append(u)

if n == p + 2:
    s = s_n(smoothing=smoothing,
            u_n=u,
            s_prior=s_prior)
    cn = c_n(s, p)
    cns.append(cn)
    v = v_n(smoothing=smoothing,
            s=s,
            v_prior=v_prior)
    cvn = cv_n(v=v, p=p)
    cvns.append(cvn)
elif n > p + 2:
```

```
        s_prior = s
        s = s_n(smoothing=smoothing,
                u_n=u,
                s_prior=s_prior)
        cn = c_n(s, p)
        cns.append(cn)
        v_prior = v
        v = v_n(smoothing=smoothing,
                s=s,
                v_prior=v_prior)
        cvn = cv_n(v=v, p=p)
        cvns.append(cvn)
    else:
        s = np.identity(p)
        cn = 0
        cns.append(cn)
        v = np.identity(p)
        cvn = 0
        cvns.append(cvn)

    if n > p + 2:
        break_val = h

    if n > p + 2 and cvn > break_val:
        arl[i] = n
        break
```

```
        # prevent nulls
        if n == 20000:
            arl[i] = n
            break

        # print(cn)

        j += 1
        n += 1

elif method == 'DMEWMA':
    while n <= 20000:
        # print(n)
        ob = obs[n - 1]

        # print(ob)
        X.append(ob)

        if n == 1:
            y = y_vec(
                smoothing=smoothing,
                x_n=ob,
                y_prior=y_prior)
            z = z_vec(
                smoothing=smoothing,
                y_n=y,
                z_prior=z_prior)
```

```
        td2n = dmewma(
            smoothing=smoothing,
            n=n,
            zvec=z,
            sigma_0=covariance_matrix)
    if n > 1:
        y_prior = y
        z_prior = z
        y = y_vec(
            smoothing=smoothing,
            x_n=ob,
            y_prior=y_prior)
        z = z_vec(
            smoothing=smoothing,
            y_n=y,
            z_prior=z_prior)
        td2n = dmewma(
            smoothing=smoothing,
            n=n,
            zvec=z,
            sigma_0=covariance_matrix)

        dmewmas.append(td2n)

    if n > p + 2:
        break_val = h
```

```
        if n > p + 2 and td2n > break_val:
            arl[i] = n
            break

        # prevent nulls
        if n == 20000:
            arl[i] = n
            break

        # print(td2n)

        j += 1
        n += 1

elif method == 'MEWMA':
    while n <= 20000:
        # print(n)
        ob = obs[n - 1]

        # print(ob)
        X.append(ob)

        if n == 1:
            y = y_vec(
                smoothing=smoothing,
                x_n=ob,
                y_prior=y_prior)
```

```
        tm2n = mewma(
            smoothing=smoothing,
            n=n,
            yvec=y,
            sigma_0=covariance_matrix)
    if n > 1:
        y_prior = y
        y = y_vec(
            smoothing=smoothing,
            x_n=ob,
            y_prior=y_prior)
        tm2n = mewma(
            smoothing=smoothing,
            n=n,
            yvec=y,
            sigma_0=covariance_matrix)

        mewmas.append(tm2n)

    if n > p + 2:
        break_val = h

    if n > p + 2 and tm2n > break_val:
        arl[i] = n
        break

    # prevent nulls
```

```
            if n == 20000:
                arl[i] = n
                break

            # print(tm2n)

            j += 1
            n += 1

    else:
        print("Please specify valid method.")

return arl
```

```
# function to upload to google cloud bucket
def upload_blob(bucket_name,
                source_file_name,
                destination_blob_name):
    #Uploads a file to the bucket.
    # bucket_name = "your-bucket-name"
    # source_file_name = "local/path/to/file"
    # destination_blob_name = "storage-object-name"

    storage_client = storage.Client(project="****")
    bucket = storage_client.bucket(bucket_name)
    blob = bucket.blob(destination_blob_name)

    with open(source_file_name) as f:
        first_line = f.readline()
        blob.upload_from_string(first_line)

    print(
    "File␣{}␣uploaded␣to␣{}.".format(
    source_file_name, destination_blob_name
    )
    )
```

```
# need a function then, that increments h_init,
# up or down to get the h_final to achieve
# the desired ARL
def find_h(method,
           dimension,
           smoothing,
           target_arl,
           h_init,
           tolerance,
           iterations):
    h_list = list()

    c = 0
    delta = target_arl * tolerance

    diff = delta + 0.01

    print('Tolerance␣=␣%s' % delta)

    while diff > delta:
        print(h_init)

        arl = simulate(method=method,
                       dimension=dimension,
                       smoothing=smoothing,
                       h=h_init,
                       iterations=iterations)
```

```
arl0 = np.nanmean(arl)
print(arl0)

if c == 0:
    init_sign = copysign(1, arl0 - target_arl)

    diff = np.abs(arl0 - target_arl)
    print(diff)

    diff_prop = diff / target_arl

    if method != "ssDMEWMC" and \
    method != "ssMEWMC":
        if diff_prop > 0.50:
            dp = 0.75
        elif diff_prop > 0.25:
            dp = 0.5
        elif diff_prop > 0.125:
            dp = 0.25
        elif diff_prop > 0.0625:
            dp = 0.125
        elif diff_prop > 0.01:
            dp = 0.0625
        elif diff_prop > 0.001:
            dp = 0.01
        else:
            dp = 0.005
```

```
    else:
        if diff_prop > 0.50:
            dp = 0.75 * h_init
        elif diff_prop > 0.25:
            dp = 0.5 * h_init
        elif diff_prop > 0.125:
            dp = 0.25 * h_init
        elif diff_prop > 0.0625:
            dp = 0.125 * h_init
        elif diff_prop > 0.01:
            dp = 0.0625 * h_init
        elif diff_prop > 0.001:
            dp = 0.01 * h_init
        else:
            dp = 0.005 * h_init

if c > 0:
    sign = copysign(1, arl0 - target_arl)

    diff = np.abs(arl0 - target_arl)
    print(diff)

    if sign != init_sign:
        dp = dp / 2
        init_sign = sign

if dp < 0.0000005:
```

```
    dp = 0.0000005

if diff > delta and arl0 > target_arl:
    h_init = h_init - dp
    if h_init in h_list:
    h_init = h_init + (dp / 2)
    dp = dp / 2
    if h_init < 0.001:
    h_init = 0.001
elif diff > delta and arl0 < target_arl:
    h_init = h_init + dp
    if h_init in h_list:
        h_init = h_init - (dp / 2)
        dp = dp / 2
    if h_init < 0.001:
        h_init = 0.001
else:
    h_final = h_init
    break

# an oscillation problem that can't be worked
# around at this sample size
if c > 25 and diff < 2 * delta:
    h_final = h_init
    break

# emergency break clause
```

```
        if c > 100:
            h_final = h_init
            break

        h_list.append(h_init)

        c += 1
    return h_final, arl0
```

```
# Function to find the out of control
# run length given an h value, a dimension,
# a delta, and wait_time
def find_out_of_control_run_length(method,
                                   iterations,
                                   dimension,
                                   smoothing,
                                   h_val,
                                   delta,
                                   change_after):

    arl = simulate(method=method,
                   dimension=int(dimension),
                   smoothing=float(smoothing),
                   h=h_val,
                   iterations=int(iterations),
                   out_of_control=True,
                   delta=float(delta),
                   change_after=int(change_after))

    # so the out of control run length is the
    # length of time AFTER the change until it
    # is  detected.
    # The simulate function returns the run length
    # of the whole run. Subtract out the in-control
    # length from the mean.
    arl = arl - (int(dimension) + int(change_after))
```

```
# remove the false positives
arl = arl[arl > 0]
arl1 = np.nanmean(arl)

# print it to the repl
print(arl1)

# and return it!
return arl1
```

Simulation Code

```
import numpy as np
import pandas as pd
import ssDMEWMAC.functions as spc
import os
from os import path

# import the environment variable
# for the method to be simulated
method = os.environ['METH']
print(method)

# import the environment variable
# for the dimension to be simulated
dim = os.environ['DIME']

# import the environment variable
# for the iterations to be simulated
ite = int(os.environ['ITERATIONS'])

# set the list of dimensions to simulate
dims = list((2,3,4,5,6,7,8,9,10,15,20,25,50))
lambdas = list((0.05,0.1,0.2,0.3,0.4,0.5,
                0.6,0.7,0.8,0.9,0.95))
target_arls = list((100, 200, 500, 1000, 2000))

# Read in the completed h_init worksheet
```

```
h_init_lookup = pd.read_csv('/data/h_init_lookup.csv')


# Create nested loops to go over these combos
# and pipe the results to json
for l in lambdas:
for a in target_arls:
    f = "h_"+str(method)+"_"+\
    str(dim)+"_"+\
    str(l).replace('.', '_', 1)+\
    "_"+str(a)+\
    '.json'

    pa = "/out/h_"+str(method)+\
    "_"+str(dim)+\
    "_"+str(l).replace('.', '_', 1)+\
    "_"+str(a)+\
    '.json'

    ex = path.exists(pa)

    if ex == False:
        h_init = h_init_lookup[
        (h_init_lookup['Method'] == method) & \
        (h_init_lookup['Dimension'] == int(dim)) & \
        (h_init_lookup['Lambda'] == l) & \
        (h_init_lookup['ARL'] == a)]['h'].iloc[0]
```

```
    h, arl0 = spc.find_h(
        method=method,
        dimension=int(dim),
        smoothing=l,
        target_arl=a,
        h_init=h_init,
        tolerance=.001,
        iterations=ite)

    out = {'Method' : [method] ,
           'Dimension' : [dim],
           'Lambda' : [l],
           'ARL' : [a],
           'h' : [h],
           'ARL_observed' : [arl0]}
    out = pd.DataFrame.from_dict(out)

    out.to_json(path_or_buf=pa)

if os.environ['LOCAL_OR_GCP'] == 'GCP':
    spc.upload_blob(
        bucket_name="fresch_ssdmewmac",
        source_file_name=pa,
        destination_blob_name=f)
```

APPENDIX B

OUT-OF-CONTROL PERFORMANCE CODE

Out of Control Performance Code

```
import numpy as np
import pandas as pd
import ssDMEWMAC.functions as spc
import os
from os import path

# import the environment variable
# for the method to be simulated
method = os.environ['METH']
print(method)

# import the environment variable
# for the dimension to be simulated
dim = os.environ['DIME']

# import the environment variable
# for the iterations to be simulated
ite = int(os.environ['ITERATIONS'])

# import the environment variable
# for the smoothing parameter lambda
# to be simulated
lam = os.environ['LAMBDA']

# import the environment variable
# for the smoothing parameter lambda
```

```
# to be targeted
a = os.environ['ARL']

# import the environment variable
# for the magnitude of the shift
# to be induced
delta = os.environ['DELTA']

# import the environment variable
# for the wait time before perturbing
wait = os.environ['WAIT_TIME']

# build file paths to store
# the simulation results
f = "arl1_" + \
    str(method) + \
    "_" + str(dim) + \
    "_" + str(lam).replace('.', '_', 1) + \
    "_" + str(a) + "_" + \
    str(delta).replace('.', '_', 1) + "_" + \
    str(wait) + '.json'

pa = "/out/arl1_" + str(method) + \
    "_" + str(dim) +
    "_" + str(lam).replace('.', '_', 1) + "_" + \
    str(a) + "_" + \
    str(delta).replace('.', '_', 1) + "_" + \
```

```
    str(wait) + '.json'

print(pa)

ex = path.exists(pa)
# print(ex)

# Read in the completed h_lookup worksheet
h_lookup = pd.read_csv('/data/h_lookup.csv')

# setting up an escape clause to not run
# again if the output file already exists
if ex == False:
    # set the h_value to use in the oooc simulation
    h = h_lookup[(h_lookup['Method'] == method) & \
        (h_lookup['Dimension'] == int(dim)) & \
        (h_lookup['Lambda'] == float(lam)) & \
        (h_lookup['ARL'] == int(a))]['h'].iloc[0]

    arl1 = spc.find_out_of_control_run_length(
        method=method,
        iterations=ite,
        dimension=dim,
        smoothing=float(lam),
        h_val=h,
        delta=float(delta),
        change_after=int(wait))
```

```
    out = {'Method': [method],
           'Dimension': [dim],
           'Lambda': [lam],
           'ARL': [a],
           'h': [h],
           'Delta': [delta],
           'Wait': [wait],
           'ARL_observed': [arl1]}
    out = pd.DataFrame.from_dict(out)

    out.to_json(path_or_buf=pa)

if os.environ['LOCAL_OR_GCP'] == 'GCP':
        spc.upload_blob(
            bucket_name="fresch_ssdmewmac",
            source_file_name=pa,
            destination_blob_name=f)
```

APPENDIX C

ADDITIONAL IN-CONTROL CONTROL LIMIT TABLES

MEWMA In-Control ARL_0 Tables

Table 233

In Control Limits for MEWMA of Dimension 2

λ	ARL				
	100	200	500	1000	2000
0.05	6.0610	7.6045	9.7054	11.2690	12.8546
0.10	7.1487	8.7572	10.7879	12.3280	13.8920
0.20	8.1055	9.6891	11.6805	13.1790	14.6390
0.30	8.5569	10.0850	12.0428	13.5149	14.9332
0.40	8.7999	10.2866	12.2413	13.6766	15.0752
0.50	8.9418	10.4048	12.3402	13.7447	15.1319
0.60	9.0333	10.4927	12.3804	13.7914	15.1908
0.70	9.0901	10.5109	12.4070	13.7933	15.2129
0.80	9.1039	10.5448	12.4082	13.8069	15.2037
0.90	9.1131	10.5727	12.4011	13.8225	15.2097
0.95	9.1255	10.5592	12.4054	13.8361	15.1926

Table 234

In Control Limits for MEWMA of Dimension 3

λ	ARL				
	100	200	500	1000	2000
0.05	7.8864	9.6011	11.9462	13.6700	15.3430
0.10	9.1031	10.8466	13.1025	14.8150	16.4627
0.20	10.1388	11.8402	14.0238	15.6470	17.2231
0.30	10.6332	12.2758	14.3958	15.9737	17.5093
0.40	10.9032	12.4891	14.5956	16.1201	17.6409
0.50	11.0415	12.6477	14.6811	16.1926	17.6942
0.60	11.1188	12.7281	14.7436	16.2412	17.7346
0.70	11.1819	12.7813	14.7831	16.2777	17.7153
0.80	11.2329	12.8070	14.7846	16.2498	17.7019
0.90	11.2429	12.8105	14.8266	16.2547	17.7076
0.95	11.2536	12.8094	14.7978	16.2424	17.7207

Table 235

In Control Limits for MEWMA of Dimension 4

λ	ARL				
	100	200	500	1000	2000
0.05	9.5278	11.4778	13.9420	15.7397	17.5830
0.10	10.8534	12.7450	15.1991	16.9281	18.6903
0.20	11.9987	13.8036	16.1520	17.8390	19.4570
0.30	12.5369	14.2619	16.5299	18.1636	19.7322
0.40	12.7882	14.5175	16.7121	18.2944	19.8852
0.50	12.9677	14.6631	16.8208	18.3853	19.9230
0.60	13.0468	14.7370	16.8614	18.4382	19.9763
0.70	13.0917	14.7927	16.9022	18.4681	19.9796
0.80	13.1103	14.8109	16.9216	18.4754	19.9866
0.90	13.1396	14.8114	16.9332	18.4777	19.9951
0.95	13.1366	14.8024	16.9097	18.4749	20.0130

Table 236

In Control Limits for MEWMA of Dimension 5

λ	ARL				
	100	200	500	1000	2000
0.05	11.1750	13.1854	15.8341	17.7217	19.6230
0.10	12.5588	14.5719	17.1548	18.9835	20.7800
0.20	13.7867	15.7055	18.0681	19.8830	21.5400
0.30	14.3047	16.1378	18.4678	20.1771	21.8584
0.40	14.5627	16.4129	18.6494	20.3031	21.9985
0.50	14.7387	16.5403	18.7738	20.3884	22.0463
0.60	14.8551	16.5920	18.8231	20.4373	22.0870
0.70	14.8949	16.6177	18.8641	20.4691	22.1005
0.80	14.9169	16.6321	18.8607	20.4863	22.0866
0.90	14.9133	16.6449	18.8714	20.4509	22.1212
0.95	14.9076	16.6425	18.8650	20.4650	22.1175

Table 237

In Control Limits for MEWMA of Dimension 6

λ	ARL				
	100	200	500	1000	2000
0.05	12.6723	14.8344	17.6423	19.6124	21.5450
0.10	14.1543	16.2950	18.9990	20.8870	22.7327
0.20	15.3782	17.4241	19.9920	21.8003	23.5898
0.30	15.9301	17.9241	20.3963	22.1367	23.8664
0.40	16.2393	18.1741	20.5801	22.3303	23.9948
0.50	16.3993	18.3158	20.6815	22.4177	24.0873
0.60	16.4883	18.3841	20.7338	22.4664	24.1243
0.70	16.5400	18.3867	20.7250	22.4607	24.1197
0.80	16.5808	18.4267	20.7316	22.4480	24.0933
0.90	16.6086	18.4389	20.7349	22.4455	24.1045
0.95	16.6305	18.4394	20.7343	22.4469	24.1001

Table 238

In Control Limits for MEWMA of Dimension 7

λ	ARL				
	100	200	500	1000	2000
0.05	14.1593	16.4456	19.3790	21.4450	23.4132
0.10	15.7198	17.9890	20.7347	22.6940	24.6287
0.20	17.0022	19.1524	21.7510	23.6677	25.4784
0.30	17.5699	19.6622	22.1523	24.0151	25.7918
0.40	17.8514	19.8884	22.3617	24.1664	25.9387
0.50	18.0170	19.9709	22.4375	24.2098	25.9726
0.60	18.0948	20.0503	22.5136	24.2674	25.9959
0.70	18.1787	20.0752	22.5353	24.2690	26.0007
0.80	18.1942	20.0992	22.5342	24.2724	26.0202
0.90	18.2293	20.1445	22.5279	24.2722	25.9997
0.95	18.2214	20.1624	22.5410	24.2719	25.9967

Table 239

In Control Limits for MEWMA of Dimension 8

λ	ARL				
	100	200	500	1000	2000
0.05	15.587	17.991	21.020	23.194	25.206
0.10	17.222	19.592	22.481	24.483	26.440
0.20	18.610	20.835	23.530	25.467	27.287
0.30	19.140	21.294	23.931	25.782	27.601
0.40	19.443	21.543	24.116	25.949	27.723
0.50	19.629	21.683	24.218	26.028	27.813
0.60	19.720	21.751	24.286	26.094	27.864
0.70	19.740	21.791	24.326	26.133	27.862
0.80	19.786	21.811	24.332	26.140	27.884
0.90	19.799	21.842	24.304	26.146	27.889
0.95	19.792	21.846	24.335	26.124	27.888

Table 240

In Control Limits for MEWMA of Dimension 9

λ	ARL				
	100	200	500	1000	2000
0.05	16.956	19.519	22.657	24.859	26.974
0.10	18.689	21.161	24.132	26.192	28.227
0.20	20.019	22.393	25.196	27.185	29.130
0.30	20.633	22.900	25.607	27.524	29.419
0.40	20.968	23.176	25.826	27.751	29.585
0.50	21.130	23.316	25.950	27.845	29.632
0.60	21.248	23.374	26.034	27.846	29.674
0.70	21.285	23.435	26.022	27.851	29.698
0.80	21.322	23.447	26.017	27.853	29.669
0.90	21.361	23.452	26.022	27.858	29.653
0.95	21.387	23.454	26.016	27.854	29.640

Table 241

In Control Limits for MEWMA of Dimension 10

λ	ARL				
	100	200	500	1000	2000
0.05	18.231	20.962	24.222	26.479	28.716
0.10	20.012	22.650	25.761	27.950	30.012
0.20	21.458	23.898	26.822	28.872	30.865
0.30	22.109	24.448	27.231	29.216	31.169
0.40	22.433	24.718	27.419	29.404	31.336
0.50	22.627	24.843	27.545	29.525	31.406
0.60	22.743	24.946	27.638	29.524	31.430
0.70	22.802	25.023	27.672	29.536	31.438
0.80	22.837	25.045	27.666	29.565	31.433
0.90	22.887	25.026	27.669	29.581	31.447
0.95	22.903	25.020	27.672	29.616	31.436

Table 242

In Control Limits for MEWMA of Dimension 15

λ	ARL				
	100	200	500	1000	2000
0.05	24.719	27.929	31.692	34.312	36.767
0.10	26.817	29.874	33.456	35.880	38.139
0.20	28.474	31.285	34.638	36.954	39.141
0.30	29.161	31.866	35.082	37.292	39.466
0.40	29.514	32.144	35.276	37.481	39.600
0.50	29.725	32.341	35.350	37.577	39.681
0.60	29.876	32.421	35.400	37.608	39.715
0.70	29.927	32.488	35.479	37.626	39.700
0.80	29.978	32.540	35.487	37.637	39.677
0.90	29.963	32.533	35.497	37.633	39.696
0.95	29.982	32.569	35.515	37.620	39.660

Table 243

In Control Limits for MEWMA of Dimension 20

λ	ARL				
	100	200	500	1000	2000
0.05	30.921	34.684	38.875	41.709	44.391
0.10	33.237	36.719	40.736	43.370	45.833
0.20	34.994	38.352	41.992	44.522	46.871
0.30	35.806	38.920	42.474	44.897	47.243
0.40	36.205	39.165	42.691	45.066	47.382
0.50	36.353	39.434	42.805	45.134	47.491
0.60	36.562	39.477	42.894	45.227	47.513
0.70	36.590	39.549	42.900	45.261	47.509
0.80	36.625	39.551	42.930	45.242	47.500
0.90	36.631	39.545	42.931	45.245	47.488
0.95	36.638	39.554	42.913	45.217	47.502

Table 244

In Control Limits for MEWMA of Dimension 25

λ	ARL				
	100	200	500	1000	2000
0.05	36.727	41.116	45.784	48.829	51.652
0.10	39.328	43.388	47.721	50.555	53.198
0.20	41.339	45.020	49.118	51.838	54.330
0.30	42.122	45.732	49.583	52.211	54.738
0.40	42.521	46.046	49.839	52.411	54.852
0.50	42.776	46.193	49.984	52.496	54.871
0.60	42.917	46.277	50.034	52.483	54.911
0.70	43.009	46.296	50.041	52.553	54.933
0.80	43.031	46.332	50.053	52.534	54.949
0.90	43.011	46.333	50.002	52.534	54.952
0.95	42.982	46.363	49.995	52.522	54.953

Table 245

In Control Limits for MEWMA of Dimension 50

λ	ARL				
	100	200	500	1000	2000
0.05	63.647	71.268	77.934	82.165	85.643
0.10	67.231	74.288	80.353	84.189	87.577
0.20	70.014	76.438	82.129	85.615	88.830
0.30	71.132	77.331	82.775	86.176	89.297
0.40	71.744	77.705	83.019	86.338	89.475
0.50	72.109	77.954	83.143	86.442	89.542
0.60	72.2809	78.0292	83.1897	86.4990	89.5262
0.70	72.2830	78.0081	83.2220	86.4815	89.5526
0.80	72.3477	78.0338	83.2544	86.5168	89.5497
0.90	72.4064	78.0830	83.2134	86.4797	89.5751
0.95	72.4436	78.0959	83.2164	86.4554	89.5643

DMEWMA In-Control ARL_0 Tables

Table 246

In Control Limits for DMEWMA of Dimension 2

λ	ARL				
	100	200	500	1000	2000
0.05	3.5425	4.7793	6.5845	8.0658	9.5968
0.10	4.7044	6.0941	8.0702	9.6171	11.1164
0.20	6.1661	7.6695	9.7075	11.2199	12.7456
0.30	7.1384	8.6767	10.6854	12.1936	13.6618
0.40	7.8175	9.3256	11.3507	12.8153	14.2833
0.50	8.3324	9.8423	11.7777	13.2476	14.7149
0.60	8.6642	10.1567	12.1128	13.5766	14.9857
0.70	8.9065	10.3742	12.3210	13.7230	15.1016
0.80	9.0492	10.4941	12.4043	13.7913	15.1764
0.90	9.1111	10.5414	12.4168	13.8069	15.1921
0.95	9.1196	10.5729	12.4054	13.8283	15.1955

Table 247

In Control Limits for DMEWMA of Dimension 3

λ	ARL				
	100	200	500	1000	2000
0.05	4.9704	6.4214	8.5195	10.1292	11.8081
0.10	6.3307	7.9648	10.1650	11.8372	13.5125
0.20	8.0060	9.7122	11.9515	13.5929	15.2235
0.30	9.0453	10.7689	12.9466	14.6261	16.2144
0.40	9.8173	11.4988	13.6698	15.3057	16.8587
0.50	10.3540	11.9953	14.1508	15.7414	17.2782
0.60	10.7184	12.3688	14.4653	15.9980	17.5354
0.70	10.9827	12.6035	14.6425	16.1752	17.6479
0.80	11.1357	12.7406	14.7465	16.2586	17.7195
0.90	11.2351	12.8125	14.7973	16.2547	17.6930
0.95	11.2418	12.8055	14.8271	16.2483	17.7002

Table 248

In Control Limits for DMEWMA of Dimension 4

λ	ARL				
	100	200	500	1000	2000
0.05	6.3208	7.9651	10.2623	12.0131	13.7837
0.10	7.8202	9.6685	12.0761	13.8109	15.5828
0.20	9.6393	11.5409	13.9504	15.6728	17.3719
0.30	10.8260	12.6701	15.0553	16.7486	18.4061
0.40	11.6229	13.4257	15.7658	17.4643	19.0884
0.50	12.2294	13.9678	16.2622	17.9127	19.4992
0.60	12.6112	14.3581	16.6055	18.1941	19.7790
0.70	12.9120	14.6169	16.7772	18.3470	19.8937
0.80	13.0706	14.7406	16.8552	18.4481	19.9905
0.90	13.1200	14.8075	16.9215	18.4738	19.9834
0.95	13.1366	14.8116	16.9331	18.4749	19.9857

Table 249

In Control Limits for DMEWMA of Dimension 5

λ	ARL				
	100	200	500	1000	2000
0.05	7.6301	9.4130	11.9268	13.8369	15.6855
0.10	9.3127	11.2497	13.8344	15.7206	17.5426
0.20	11.2486	13.2622	15.8337	17.6690	19.4213
0.30	12.4708	14.4640	16.9366	18.7465	20.5108
0.40	13.3752	15.3094	17.6952	19.4789	21.1577
0.50	13.9926	15.8879	18.2094	19.9372	21.6391
0.60	14.4020	16.2483	18.5418	20.2469	21.8643
0.70	14.6683	16.5044	18.7352	20.3665	22.0214
0.80	14.8778	16.5696	18.8255	20.4511	22.0924
0.90	14.9133	16.6312	18.8558	20.4860	22.0772
0.95	14.9154	16.6503	18.8729	20.4537	22.1019

Table 250

In Control Limits for DMEWMA of Dimension 6

λ	ARL				
	100	200	500	1000	2000
0.05	8.8950	10.8969	13.5134	15.4835	17.4584
0.10	10.7324	12.8130	15.5478	17.4803	19.3968
0.20	12.7883	14.9260	17.5855	19.4926	21.3086
0.30	14.0903	16.1877	18.7889	20.6445	22.4542
0.40	14.9698	17.0413	19.5898	21.4065	23.1560
0.50	15.6132	17.6322	20.1112	21.8943	23.6205
0.60	16.0636	18.0247	20.4642	22.2320	23.9056
0.70	16.3560	18.2500	20.6508	22.4236	24.0533
0.80	16.4933	18.3798	20.7238	22.4675	24.1050
0.90	16.5836	18.4116	20.7134	22.4299	24.0889
0.95	16.6065	18.4394	20.7343	22.4469	24.0845

Table 251

In Control Limits for DMEWMA of Dimension 7

λ	ARL				
	100	200	500	1000	2000
0.05	10.1866	12.2620	15.0701	17.1652	19.1827
0.10	12.0948	14.2878	17.1878	19.2537	21.2049
0.20	14.2952	16.5763	19.3385	21.2810	23.1737
0.30	15.6608	17.8262	20.5449	22.5015	24.3718
0.40	16.5623	18.7120	21.3774	23.2856	25.1096
0.50	17.2045	19.3185	21.9297	23.8074	25.5312
0.60	17.6691	19.7417	22.2753	24.0604	25.7889
0.70	17.9522	19.9423	22.4220	24.1948	25.9617
0.80	18.1083	20.0484	22.5303	24.2529	25.9850
0.90	18.1981	20.1054	22.5318	24.2722	26.0026
0.95	18.2253	20.1467	22.5254	24.2719	25.9879

Table 252

In Control Limits for DMEWMA of Dimension 8

λ	ARL				
	100	200	500	1000	2000
0.05	11.333	13.593	16.528	18.722	20.786
0.10	13.374	15.770	18.737	20.849	22.889
0.20	15.758	18.104	20.995	23.014	24.979
0.30	17.140	19.470	22.265	24.233	26.128
0.40	18.166	20.375	23.120	25.026	26.895
0.50	18.825	21.022	23.629	25.549	27.356
0.60	19.306	21.401	23.962	25.828	27.645
0.70	19.560	21.631	24.189	26.012	27.759
0.80	19.719	21.756	24.277	26.094	27.845
0.90	19.791	21.807	24.328	26.130	27.868
0.95	19.804	21.842	24.307	26.148	27.876

Table 253

In Control Limits for DMEWMA of Dimension 9

λ	ARL				
	100	200	500	1000	2000
0.05	12.511	14.858	17.907	20.267	22.404
0.10	14.700	17.174	20.292	22.505	24.592
0.20	17.113	19.612	22.560	24.658	26.696
0.30	18.582	21.039	23.870	25.942	27.909
0.40	19.582	21.977	24.753	26.781	28.698
0.50	20.283	22.570	25.352	27.281	29.178
0.60	20.814	22.999	25.678	27.599	29.463
0.70	21.090	23.298	25.909	27.805	29.604
0.80	21.264	23.400	26.033	27.844	29.684
0.90	21.329	23.441	26.019	27.846	29.653
0.95	21.367	23.454	26.020	27.860	29.625

Table 254

In Control Limits for DMEWMA of Dimension 10

λ	ARL				
	100	200	500	1000	2000
0.05	13.677	16.191	19.441	21.752	24.038
0.10	15.898	18.551	21.785	24.025	26.246
0.20	18.415	21.058	24.147	26.343	28.462
0.30	19.925	22.464	25.506	27.625	29.665
0.40	20.957	23.449	26.376	28.429	30.422
0.50	21.752	24.108	26.951	28.935	30.909
0.60	22.235	24.548	27.267	29.274	31.188
0.70	22.560	24.829	27.527	29.501	31.371
0.80	22.763	24.959	27.670	29.525	31.414
0.90	22.840	25.034	27.677	29.557	31.424
0.95	22.888	25.026	27.672	29.585	31.436

Table 255

In Control Limits for DMEWMA of Dimension 15

λ	ARL				
	100	200	500	1000	2000
0.05	19.217	22.371	26.250	28.984	31.575
0.10	21.952	25.214	28.930	31.577	34.037
0.20	24.913	28.069	31.646	34.110	36.448
0.30	26.736	29.700	33.188	35.577	37.872
0.40	27.935	30.798	34.143	36.468	38.692
0.50	28.734	31.497	34.803	37.038	39.235
0.60	29.305	31.999	35.113	37.374	39.480
0.70	29.653	32.289	35.323	37.567	39.659
0.80	29.881	32.431	35.437	37.608	39.692
0.90	29.978	32.525	35.509	37.633	39.672
0.95	29.967	32.530	35.500	37.632	39.671

Table 256

In Control Limits for DMEWMA of Dimension 20

λ	ARL				
	100	200	500	1000	2000
0.05	24.726	28.449	32.820	35.876	38.719
0.10	27.874	31.587	35.849	38.731	41.407
0.20	31.189	34.731	38.787	41.495	43.996
0.30	33.126	36.565	40.378	43.028	45.444
0.40	34.447	37.780	41.420	43.988	46.397
0.50	35.360	38.566	42.102	44.618	46.963
0.60	35.921	38.996	42.537	44.993	47.267
0.70	36.316	39.330	42.766	45.161	47.433
0.80	36.586	39.484	42.907	45.260	47.506
0.90	36.615	39.537	42.931	45.251	47.488
0.95	36.626	39.546	42.925	45.241	47.461

Table 257

In Control Limits for DMEWMA of Dimension 25

λ	ARL				
	100	200	500	1000	2000
0.05	30.059	34.280	39.174	42.431	45.546
0.10	33.480	37.774	42.459	45.575	48.496
0.20	37.097	41.188	45.603	48.504	51.289
0.30	39.267	43.130	47.403	50.301	52.787
0.40	40.681	44.429	48.556	51.280	53.803
0.50	41.660	45.309	49.217	51.934	54.405
0.60	42.339	45.850	49.689	52.272	54.736
0.70	42.751	46.144	49.947	52.447	54.857
0.80	42.964	46.297	50.029	52.493	54.902
0.90	43.019	46.351	50.043	52.540	54.940
0.95	43.006	46.333	50.000	52.537	54.941

Table 258

In Control Limits for DMEWMA of Dimension 50

λ	ARL				
	100	200	500	1000	2000
0.05	54.522	62.093	69.367	73.844	77.809
0.10	59.153	66.858	73.650	77.838	81.577
0.20	64.233	71.469	77.758	81.583	85.080
0.30	67.100	73.979	80.003	83.691	87.053
0.40	68.869	75.713	81.413	84.949	88.251
0.50	70.515	76.853	82.287	85.815	89.044
0.60	71.4684	77.4667	82.8674	86.2177	89.3270
0.70	72.0018	77.8675	83.1166	86.4434	89.4940
0.80	72.2852	78.0104	83.2192	86.5051	89.4794
0.90	72.3595	78.0362	83.2486	86.5149	89.5048
0.95	72.4123	78.0959	83.2164	86.4847	89.5351

ssMEWMA In-Control ARL_0 Tables

Table 259

In Control Limits for ssMEWMA of Dimension 2

λ	ARL				
	100	200	500	1000	2000
0.05	6.1404	7.6313	9.7017	11.2533	12.8468
0.10	7.1683	8.7494	10.7879	12.3280	13.8995
0.20	8.1212	9.6793	11.6489	13.1740	14.6290
0.30	8.5944	10.0800	12.0057	13.5188	14.9313
0.40	8.8312	10.2866	12.2569	13.6688	15.0596
0.50	8.9613	10.4250	12.3675	13.7291	15.1085
0.60	9.0528	10.5000	12.3785	13.7797	15.1635
0.70	9.1174	10.5313	12.4031	13.7855	15.1777
0.80	9.1547	10.5750	12.4316	13.7913	15.1852
0.90	9.1678	10.5688	12.4324	13.8225	15.1921
0.95	9.1607	10.5709	12.4250	13.8127	15.1838

Table 260

In Control Limits for ssMEWMA of Dimension 3

λ	ARL				
	100	200	500	1000	2000
0.05	8.0075	9.7203	11.9423	13.7230	15.3630
0.10	9.1539	10.9013	13.1338	14.8100	16.4334
0.20	10.2053	11.8402	14.0450	15.6420	17.2192
0.30	10.6664	12.2953	14.4016	15.9591	17.4888
0.40	10.9110	12.5359	14.5838	16.0674	17.6292
0.50	11.0649	12.6613	14.6869	16.1926	17.6825
0.60	11.1461	12.7320	14.7348	16.2529	17.7112
0.70	11.2135	12.7461	14.7656	16.2660	17.7036
0.80	11.2295	12.7641	14.7817	16.2674	17.6785
0.90	11.2351	12.7656	14.7622	16.2605	17.7047
0.95	11.2301	12.7820	14.7744	16.2483	17.7237

Table 261

In Control Limits for ssMEWMA of Dimension 4

λ	ARL				
	100	200	500	1000	2000
0.05	9.6977	11.5052	13.9263	15.8000	17.6079
0.10	10.9549	12.7847	15.1679	16.9516	18.6690
0.20	12.0065	13.8309	16.1301	17.8140	19.4286
0.30	12.5213	14.2755	16.5006	18.1324	19.7166
0.40	12.7948	14.5331	16.6887	18.2729	19.8696
0.50	12.9637	14.6709	16.8130	18.3736	19.9269
0.60	13.0526	14.7527	16.8634	18.4597	19.9860
0.70	13.1464	14.8100	16.8710	18.4642	20.0031
0.80	13.1728	14.8031	16.8825	18.4794	20.0022
0.90	13.1825	14.7841	16.8746	18.4699	20.0068
0.95	13.1640	14.7823	16.8901	18.4554	19.9935

Table 262

In Control Limits for ssMEWMA of Dimension 5

λ	ARL				
	100	200	500	1000	2000
0.05	11.3234	13.2558	15.8341	17.7529	19.5980
0.10	12.6213	14.6090	17.1313	18.9960	20.7750
0.20	13.7398	15.6860	18.1071	19.9171	21.5600
0.30	14.2311	16.1495	18.4971	20.1810	21.8662
0.40	14.5158	16.3621	18.6533	20.3187	21.9985
0.50	14.6879	16.4934	18.7269	20.4294	22.0112
0.60	14.8083	16.5412	18.8329	20.4608	22.0459
0.70	14.8714	16.5982	18.8543	20.4779	22.0800
0.80	14.9091	16.6477	18.8548	20.4746	22.0807
0.90	14.9289	16.6625	18.8636	20.4655	22.1007
0.95	14.9389	16.6503	18.8631	20.4742	22.1048

Table 263

In Control Limits for ssMEWMA of Dimension 6

λ	ARL				
	100	200	500	1000	2000
0.05	12.8403	14.9535	17.6931	19.6671	21.5700
0.10	14.2246	16.3325	18.9915	20.8983	22.6980
0.20	15.4173	17.4827	19.9508	21.7740	23.5391
0.30	15.9887	17.9475	20.3963	22.1562	23.8195
0.40	16.2745	18.1819	20.5996	22.3108	23.9519
0.50	16.4118	18.3197	20.7030	22.3904	24.0521
0.60	16.4758	18.4036	20.7416	22.4430	24.0892
0.70	16.5000	18.3906	20.7407	22.4451	24.0943
0.80	16.5383	18.4072	20.7433	22.4402	24.0972
0.90	16.5661	18.4272	20.7310	22.4299	24.1162
0.95	16.5615	18.4355	20.7421	22.4274	24.1001

Table 264

In Control Limits for ssMEWMA of Dimension 7

λ	ARL				
	100	200	500	1000	2000
0.05	14.3624	16.5667	19.3915	21.4400	23.4132
0.10	15.8096	18.0203	20.7470	22.6965	24.5890
0.20	17.0647	19.1720	21.7560	23.6443	25.4745
0.30	17.6198	19.6609	22.1836	23.9839	25.7761
0.40	17.9100	19.9234	22.3539	24.1352	25.9387
0.50	18.0795	20.0351	22.5000	24.2176	25.9883
0.60	18.1339	20.1373	22.5526	24.3065	25.9647
0.70	18.2061	20.1500	22.5665	24.3198	25.9968
0.80	18.2684	20.1539	22.5538	24.2880	26.0143
0.90	18.2762	20.1913	22.5513	24.2839	25.9865
0.95	18.2957	20.2014	22.5488	24.2719	25.9615

Table 265

In Control Limits for ssMEWMA of Dimension 8

λ	ARL				
	100	200	500	1000	2000
0.05	15.822	18.101	21.028	23.226	25.237
0.10	17.300	19.658	22.466	24.507	26.452
0.20	18.547	20.776	23.525	25.479	27.295
0.30	19.132	21.263	23.945	25.811	27.628
0.40	19.443	21.492	24.139	25.945	27.730
0.50	19.625	21.651	24.250	26.036	27.817
0.60	19.728	21.733	24.274	26.100	27.833
0.70	19.763	21.764	24.322	26.082	27.859
0.80	19.782	21.811	24.324	26.101	27.854
0.90	19.783	21.803	24.320	26.087	27.862
0.95	19.780	21.814	24.315	26.105	27.879

Table 266

In Control Limits for ssMEWMA of Dimension 9

λ	ARL				
	100	200	500	1000	2000
0.05	17.139	19.597	22.634	24.839	26.952
0.10	18.728	21.130	24.117	26.201	28.231
0.20	20.136	22.416	25.177	27.177	29.110
0.30	20.695	22.902	25.607	27.547	29.411
0.40	20.984	23.149	25.767	27.724	29.533
0.50	21.162	23.305	25.864	27.806	29.600
0.60	21.259	23.366	25.924	27.810	29.653
0.70	21.289	23.434	25.967	27.793	29.657
0.80	21.330	23.431	25.955	27.832	29.640
0.90	21.329	23.441	25.972	27.834	29.641
0.95	21.321	23.423	25.957	27.830	29.634

Table 267

In Control Limits for ssMEWMA of Dimension 10

λ	ARL				
	100	200	500	1000	2000
0.05	18.532	21.087	24.285	26.510	28.716
0.10	20.098	22.675	25.745	27.906	29.996
0.20	21.489	23.937	26.822	28.868	30.855
0.30	22.093	24.409	27.227	29.248	31.154
0.40	22.371	24.656	27.413	29.427	31.332
0.50	22.616	24.792	27.506	29.498	31.402
0.60	22.759	24.930	27.580	29.539	31.466
0.70	22.833	24.970	27.605	29.560	31.453
0.80	22.860	25.006	27.639	29.561	31.453
0.90	22.879	25.003	27.657	29.589	31.439
0.95	22.872	25.005	27.661	29.577	31.440

Table 268

In Control Limits for ssMEWMA of Dimension 15

λ	ARL				
	100	200	500	1000	2000
0.05	25.125	28.226	31.770	34.371	36.783
0.10	26.989	29.921	33.432	35.860	38.129
0.20	28.552	31.324	34.588	36.896	39.133
0.30	29.218	31.901	35.094	37.316	39.431
0.40	29.519	32.230	35.326	37.476	39.594
0.50	29.725	32.364	35.413	37.589	39.663
0.60	29.825	32.413	35.459	37.626	39.720
0.70	29.942	32.500	35.493	37.626	39.688
0.80	29.986	32.509	35.523	37.620	39.709
0.90	30.010	32.541	35.501	37.645	39.696
0.95	30.006	32.530	35.500	37.649	39.706

Table 269

In Control Limits for ssMEWMA of Dimension 20

λ	ARL				
	100	200	500	1000	2000
0.05	31.316	34.871	38.914	41.724	44.360
0.10	33.362	36.883	40.697	43.350	45.856
0.20	35.138	38.438	42.016	44.493	46.879
0.30	35.876	38.975	42.474	44.874	47.175
0.40	36.212	39.258	42.721	45.101	47.370
0.50	36.407	39.465	42.887	45.192	47.450
0.60	36.515	39.547	42.923	45.239	47.478
0.70	36.609	39.611	42.956	45.232	47.486
0.80	36.665	39.676	42.936	45.289	47.512
0.90	36.678	39.615	42.977	45.298	47.488
0.95	36.653	39.628	42.942	45.288	47.497

Table 270

In Control Limits for ssMEWMA of Dimension 25

λ	ARL				
	100	200	500	1000	2000
0.05	37.313	41.354	45.755	48.829	51.663
0.10	39.504	43.452	47.727	50.591	53.207
0.20	41.316	45.009	49.071	51.808	54.259
0.30	42.114	45.720	49.595	52.205	54.639
0.40	42.575	46.035	49.851	52.423	54.793
0.50	42.854	46.234	49.902	52.455	54.824
0.60	42.964	46.313	49.981	52.483	54.835
0.70	43.064	46.366	50.017	52.523	54.886
0.80	43.039	46.385	50.012	52.534	54.914
0.90	43.097	46.415	50.035	52.531	54.940
0.95	43.084	46.433	50.059	52.528	54.936

Table 271

In Control Limits for ssMEWMA of Dimension 50

λ	ARL				
	100	200	500	1000	2000
0.05	64.584	71.538	78.039	81.977	85.537
0.10	67.481	74.288	80.400	84.060	87.448
0.20	70.045	76.391	82.024	85.591	88.795
0.30	71.132	77.226	82.622	86.117	89.185
0.40	71.651	77.588	82.925	86.344	89.411
0.50	71.952	77.907	83.084	86.424	89.454
0.60	72.1872	77.8651	83.1428	86.4638	89.4677
0.70	72.2205	77.9964	83.1869	86.4551	89.4823
0.80	72.2852	78.0573	83.2309	86.4465	89.5145
0.90	72.3595	78.0596	83.2369	86.4446	89.5458
0.95	72.3811	78.0256	83.2164	86.4495	89.5300

ssMEWMC In-Control ARL_0 Tables

Table 272

In Control Limits for ssMEWMC of Dimension 2

λ	ARL				
	100	200	500	1000	2000
0.05	0.1797	0.2311	0.2956	0.3420	0.3885
0.10	0.4425	0.5427	0.6691	0.7650	0.8638
0.20	1.0459	1.2478	1.5141	1.7224	1.9408
0.30	1.7235	2.0357	2.4618	2.7927	3.1330
0.40	2.4670	2.9034	3.4970	3.9610	4.4283
0.50	3.2874	3.8464	4.6142	5.2119	5.8082
0.60	4.2036	4.8794	5.8292	6.5651	7.2886
0.70	5.2323	6.0459	7.1714	8.0374	8.8959
0.80	6.4741	7.3931	8.7158	9.7110	10.6971
0.90	8.1465	9.1908	10.6751	11.8027	12.9425
0.95	9.4924	10.5743	12.1450	13.3381	14.5499

Table 273

In Control Limits for ssMEWMC of Dimension 3

λ	ARL				
	100	200	500	1000	2000
0.05	0.2954	0.3610	0.4413	0.4961	0.5511
0.10	0.7033	0.8249	0.9813	1.0946	1.2036
0.20	1.6255	1.8748	2.1943	2.4338	2.6685
0.30	2.6693	3.0488	3.5500	3.9178	4.2893
0.40	3.8331	4.3540	5.0222	5.5435	6.0501
0.50	5.1458	5.7959	6.6494	7.3181	7.9582
0.60	6.6202	7.4138	8.4773	9.2752	10.0605
0.70	8.3540	9.3054	10.5399	11.4984	12.4137
0.80	10.5184	11.6116	13.0409	14.1465	15.2150
0.90	13.6872	14.9429	16.5571	17.8075	19.0101
0.95	16.4377	17.7915	19.4854	20.8055	22.0936

Table 274

In Control Limits for ssMEWWMC of Dimension 4

λ	ARL				
	100	200	500	1000	2000
0.05	0.4377	0.5174	0.6109	0.6730	0.7331
0.10	1.0149	1.1627	1.3404	1.4661	1.5870
0.20	2.3275	2.6096	2.9676	3.2290	3.4892
0.30	3.8109	4.2383	4.7860	5.1932	5.5964
0.40	5.4653	6.0607	6.7927	7.3544	7.9040
0.50	7.3513	8.0949	9.0250	9.7452	10.4356
0.60	9.5227	10.4290	11.5537	12.4255	13.2748
0.70	12.1238	13.2169	14.5209	15.5529	16.5677
0.80	15.5139	16.7541	18.2710	19.4480	20.6176
0.90	20.7375	22.1295	23.8713	25.2064	26.5459
0.95	25.5273	27.0208	28.8720	30.2994	31.7131

Table 275

In Control Limits for ssMEWMC of Dimension 5

λ	ARL				
	100	200	500	1000	2000
0.05	0.6033	0.6993	0.8063	0.8765	0.9417
0.10	1.3803	1.5552	1.7543	1.8910	2.0253
0.20	3.1298	3.4621	3.8616	4.1391	4.4190
0.30	5.1231	5.6076	6.2132	6.6478	7.0769
0.40	7.3857	8.0296	8.8389	9.4269	10.0110
0.50	9.9547	10.7645	11.7948	12.5443	44.3564
0.60	12.9777	13.9507	15.2027	16.1001	17.0028
0.70	16.6811	17.8464	19.3059	20.3643	21.4242
0.80	21.6234	22.9723	24.6445	25.8670	27.0776
0.90	29.5697	31.0732	32.9637	34.3475	35.7379
0.95	37.1134	38.7062	40.7107	42.1737	43.6553

Table 276

In Control Limits for ssMEWMC of Dimension 6

λ	ARL				
	100	200	500	1000	2000
0.05	0.7913	0.9055	1.0238	1.1027	1.1762
0.10	1.7997	1.9960	2.2162	2.3665	2.5180
0.20	4.0617	4.4296	4.8686	5.1684	5.4660
0.30	6.6437	7.1845	7.8404	8.3072	8.7684
0.40	9.5917	10.3052	11.1853	11.8065	12.4206
0.50	12.9861	13.8722	14.9847	15.7642	16.5517
0.60	17.0327	18.0998	19.4370	20.3817	21.3431
0.70	22.1051	23.3316	24.9127	26.0164	27.1494
0.80	28.9810	30.3917	32.1964	33.4928	34.7947
0.90	40.2867	41.9055	43.9475	45.4019	46.8856
0.95	51.2679	52.9628	55.1219	56.6660	58.2226

Table 277

In Control Limits for ssMEWMC of Dimension 7

λ	ARL				
	100	200	500	1000	2000
0.05	1.0065	1.1377	1.2710	1.3566	1.4384
0.10	2.2711	2.4938	2.7371	2.9032	3.0619
0.20	5.1197	5.5260	5.9946	6.3273	6.6483
0.30	8.3874	8.9762	9.6787	10.1777	10.6652
0.40	12.1297	12.9110	13.8336	14.5095	15.1721
0.50	16.5159	17.4732	18.6332	19.4825	20.2995
0.60	21.7964	22.9365	24.3307	25.3521	26.3249
0.70	28.4693	29.8068	31.4241	32.6202	33.7558
0.80	37.6753	39.2145	41.0745	42.4163	43.7445
0.90	53.0693	54.8099	56.9173	58.4132	59.9322
0.95	68.1394	70.0040	72.2289	73.8158	75.4423

Table 278

In Control Limits for ssMEWMC of Dimension 8

λ	ARL				
	100	200	500	1000	2000
0.05	1.248	1.396	1.541	1.638	1.723
0.10	2.797	3.044	3.313	3.495	3.660
0.20	6.289	6.741	7.262	7.612	7.945
0.30	10.320	10.976	11.731	12.270	12.776
0.40	14.992	15.850	16.839	17.552	18.227
0.50	20.500	21.550	22.797	23.670	24.523
0.60	27.206	28.437	29.948	30.979	32.003
0.70	35.778	37.204	38.970	40.173	41.371
0.80	47.711	49.347	51.367	52.755	54.141
0.90	67.879	69.726	71.970	73.569	75.091
0.95	87.784	89.726	92.102	93.790	95.403

Table 279

In Control Limits for ssMEWMC of Dimension 9

λ	ARL				
	100	200	500	1000	2000
0.05	1.516	1.679	1.842	1.945	2.036
0.10	3.381	3.659	3.952	4.142	4.321
0.20	7.601	8.106	8.659	9.027	9.383
0.30	12.510	13.209	14.044	14.595	15.121
0.40	18.223	19.152	20.234	20.967	21.656
0.50	25.021	26.168	27.482	28.401	29.266
0.60	33.357	34.718	36.284	37.371	38.402
0.70	44.111	45.676	47.473	48.751	49.973
0.80	59.206	61.002	63.031	64.483	65.885
0.90	84.830	86.814	89.114	90.757	92.329
0.95	110.235	112.346	114.761	116.511	118.160

Table 280

In Control Limits for ssMEWMC of Dimension 10

λ	ARL				
	100	200	500	1000	2000
0.05	1.806	1.989	2.169	2.279	2.379
0.10	4.023	4.323	4.646	4.853	5.042
0.20	9.060	9.590	10.192	10.584	10.964
0.30	14.937	15.693	16.557	17.156	17.716
0.40	21.833	22.819	23.939	24.724	25.480
0.50	30.097	31.307	32.671	33.649	34.575
0.60	40.292	41.718	43.324	44.491	45.609
0.70	53.502	55.135	57.019	58.360	59.654
0.80	72.138	73.998	76.140	77.675	79.144
0.90	103.921	105.972	108.408	110.132	111.751
0.95	135.527	137.663	140.260	142.076	143.800

Table 281

In Control Limits for ssMEWMC of Dimension 15

λ	ARL				
	100	200	500	1000	2000
0.05	3.662	3.960	4.214	4.366	4.500
0.10	8.113	8.588	9.025	9.308	9.554
0.20	18.450	19.245	20.046	20.551	21.031
0.30	30.883	31.968	33.082	33.797	34.479
0.40	45.828	47.171	48.563	49.503	50.357
0.50	64.051	65.622	67.309	68.439	69.488
0.60	86.870	88.649	90.615	91.947	93.185
0.70	116.695	118.712	120.987	122.488	123.925
0.80	159.127	161.431	163.954	165.661	167.324
0.90	231.968	234.521	237.342	239.285	241.166
0.95	293.376	296.044	298.933	300.879	302.802

Table 282

In Control Limits for ssMEWMC of Dimension 20

λ	ARL				
	100	200	500	1000	2000
0.05	6.184	6.627	6.967	7.165	7.329
0.10	13.759	14.430	15.001	15.356	15.664
0.20	31.735	32.784	33.779	34.424	34.987
0.30	53.705	55.118	56.464	57.350	58.131
0.40	80.451	82.126	83.805	84.901	85.864
0.50	113.125	115.113	117.077	118.381	119.554
0.60	154.059	156.325	158.590	160.111	161.491
0.70	207.644	210.221	212.799	214.519	216.117
0.80	284.001	286.866	289.774	291.689	293.503
0.90	398.512	401.377	404.345	406.339	408.239
0.95	469.492	472.074	474.824	476.711	478.564

Table 283

In Control Limits for ssMEWMC of Dimension 25

λ	ARL				
	100	200	500	1000	2000
0.05	9.385	10.024	10.463	10.702	10.903
0.10	21.043	21.968	22.681	23.098	23.473
0.20	49.149	50.561	51.760	52.476	53.128
0.30	83.906	85.696	87.295	88.262	89.133
0.40	126.204	128.357	130.264	131.463	132.554
0.50	177.890	180.369	182.607	184.039	185.328
0.60	242.542	245.341	247.889	249.528	251.068
0.70	327.106	330.251	333.116	335.014	336.708
0.80	441.666	445.084	448.368	450.448	452.381
0.90	572.902	575.726	578.648	580.632	582.478
0.95	646.615	649.256	652.072	653.969	655.746

Table 284

In Control Limits for ssMEWMC of Dimension 50

λ	ARL				
	100	200	500	1000	2000
0.05	34.012	38.730	39.805	40.278	40.661
0.10	82.023	87.770	89.362	90.136	90.781
0.20	201.321	209.252	211.583	212.727	213.722
0.30	348.303	358.247	361.106	362.562	363.789
0.40	524.813	536.710	540.026	541.769	543.247
0.50	738.378	752.519	757.724	758.841	760.369

APPENDIX D

ADDITIONAL OUT-OF-CONTROL PERFORMANCE TABLES

MEWMA Out-of-Control ARL_1 Charts

Table 285

Out of Control ARL_0 for MEWMA of Dimension 2 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	42.01	59.83	93.35	130.10	182.77
50	42.33	59.90	94.35	129.96	182.90
100	42.62	59.92	93.43	130.55	182.11
500	40.65	62.20	94.51	130.61	182.85
			λ = 0.05, Δ = 0.50		
20	18.47	23.18	30.15	35.75	42.05
50	18.74	23.10	30.16	36.00	42.31
100	18.90	23.19	30.15	35.67	41.94
500	19.33	23.15	30.16	35.60	42.06
			λ = 0.05, Δ = 1.00		
20	7.74	9.07	10.86	12.20	13.58
50	7.95	9.25	11.06	12.41	13.72
100	7.92	9.26	11.05	12.36	13.72
500	8.42	9.20	10.90	12.24	13.63
			λ = 0.05, Δ = 2.00		
20	3.26	3.75	4.37	4.83	5.28
50	3.40	3.88	4.52	4.96	5.43
100	3.37	3.89	4.53	4.98	5.43
500	3.59	3.86	4.49	4.94	5.39
			λ = 0.05, Δ = 3.00		
20	2.01	2.27	2.62	2.88	3.12
50	2.09	2.36	2.72	2.98	3.24
100	2.08	2.36	2.72	2.98	3.24
500	2.09	2.36	2.69	2.96	3.22

Table 286

Out of Control ARL_0 for MEWMA of Dimension 2 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	44.70	69.42	122.16	188.13	299.61
50	44.37	69.42	121.92	189.29	300.12
100	44.41	68.85	121.64	188.96	300.10
500	45.43	68.10	122.43	189.26	298.32
			$\lambda = 0.10, \Delta = 0.50$		
20	18.49	24.44	33.46	43.16	56.07
50	18.43	24.14	33.20	42.98	55.94
100	18.37	24.36	33.38	42.67	55.90
500	17.94	24.42	33.79	42.93	55.84
			$\lambda = 0.10, \Delta = 1.00$		
20	6.91	8.22	9.87	11.24	12.79
50	6.91	8.20	9.86	11.24	12.72
100	6.90	8.20	9.85	11.24	12.72
500	6.77	8.09	9.80	11.08	12.58
			$\lambda = 0.10, \Delta = 2.00$		
20	2.72	3.09	3.55	3.91	4.27
50	2.73	3.10	3.55	3.90	4.25
100	2.70	3.08	3.55	3.90	4.26
500	2.62	3.06	3.53	3.87	4.22
			$\lambda = 0.10, \Delta = 3.00$		
20	1.64	1.81	2.05	2.24	2.42
50	1.63	1.81	2.05	2.22	2.41
100	1.66	1.82	2.05	2.23	2.40
500	1.58	1.82	2.03	2.22	2.39

Table 287

Out of Control ARL_0 for MEWMA of Dimension 2 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	50.98	87.40	176.85	304.71	527.54
50	50.87	87.84	176.20	303.57	526.91
100	49.78	86.49	176.13	302.93	527.09
500	47.68	86.48	179.43	301.63	526.09
			λ = 0.20, Δ = 0.50		
20	21.12	30.11	48.62	69.83	102.92
50	20.85	29.80	48.49	69.50	102.69
100	21.03	29.80	48.41	69.14	102.77
500	18.74	29.87	48.69	69.65	102.11
			λ = 0.20, Δ = 1.00		
20	6.61	8.07	10.39	12.54	14.91
50	6.63	8.09	10.38	12.51	14.87
100	6.64	8.11	10.41	12.54	14.90
500	5.36	7.98	10.40	12.52	14.88
			λ = 0.20, Δ = 2.00		
20	2.24	2.53	2.93	3.24	3.56
50	2.24	2.52	2.92	3.24	3.56
100	2.23	2.51	2.93	3.24	3.54
500	2.09	2.53	2.92	3.24	3.54
			λ = 0.20, Δ = 3.00		
20	1.33	1.44	1.58	1.70	1.82
50	1.33	1.43	1.58	1.70	1.82
100	1.33	1.44	1.59	1.71	1.83
500	1.28	1.45	1.59	1.71	1.83

Table 288

Out of Control ARL_0 for MEWMA of Dimension 2 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	57.33	103.61	223.63	408.99	734.24
50	57.46	104.12	223.79	408.63	732.59
100	56.43	103.03	222.90	408.59	732.07
500	62.19	100.10	222.08	403.55	724.08
			λ = 0.30, Δ = 0.50		
20	24.71	38.03	67.60	105.01	165.93
50	24.29	37.69	67.24	104.81	165.61
100	23.90	37.21	67.18	104.42	164.84
500	23.90	36.91	66.85	104.53	165.66
			λ = 0.30, Δ = 1.00		
20	7.05	9.06	12.42	15.88	20.31
50	7.05	9.04	12.34	15.84	20.32
100	7.03	9.04	12.45	15.88	20.31
500	5.86	8.83	12.31	15.95	20.22
			λ = 0.30, Δ = 2.00		
20	2.08	2.36	2.77	3.11	3.46
50	2.07	2.36	2.76	3.09	3.44
100	2.06	2.35	2.77	3.11	3.45
500	1.96	2.40	2.74	3.10	3.44
			λ = 0.30, Δ = 3.00		
20	1.23	1.30	1.42	1.51	1.62
50	1.23	1.30	1.42	1.52	1.62
100	1.22	1.30	1.42	1.52	1.62
500	1.30	1.33	1.41	1.53	1.62

Table 289

Out of Control ARL_0 for MEWMA of Dimension 2 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	62.41	116.80	261.70	493.04	903.75
50	62.01	116.81	260.77	491.66	903.22
100	60.91	115.74	260.89	491.05	901.12
500	67.07	113.83	259.18	488.14	898.17
	λ = 0.40, Δ = 0.50				
20	28.54	46.28	89.26	146.29	243.91
50	28.57	46.02	89.29	146.10	243.49
100	27.94	45.64	89.12	145.52	243.29
500	29.25	43.51	89.79	145.09	243.24
	λ = 0.40, Δ = 1.00				
20	7.88	10.66	15.86	21.45	29.46
50	7.90	10.61	15.76	21.40	29.34
100	7.89	10.65	15.83	21.42	29.43
500	6.20	10.65	15.88	21.39	29.40
	λ = 0.40, Δ = 2.00				
20	2.06	2.37	2.83	3.23	3.69
50	2.05	2.37	2.83	3.22	3.67
100	2.05	2.38	2.84	3.24	3.68
500	1.98	2.40	2.82	3.22	3.67
	λ = 0.40, Δ = 3.00				
20	1.19	1.26	1.37	1.45	1.56
50	1.19	1.26	1.37	1.46	1.56
100	1.18	1.26	1.38	1.46	1.56
500	1.19	1.27	1.37	1.47	1.56

Table 290

Out of Control ARL_0 for MEWMA of Dimension 2 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.50, \Delta = 0.25$				
20	66.64	126.96	294.05	555.60	1027.63
50	66.73	126.60	293.57	553.95	1025.75
100	67.15	126.21	293.72	553.20	1022.72
500	71.19	122.54	294.29	558.44	1020.87
	$\lambda = 0.50, \Delta = 0.50$				
20	32.80	55.94	112.92	193.19	328.73
50	33.13	55.78	112.68	193.31	328.57
100	32.36	55.44	112.84	194.15	328.54
500	23.20	55.01	115.01	194.21	329.45
	$\lambda = 0.50, \Delta = 1.00$				
20	9.08	12.81	20.65	29.35	42.82
50	9.05	12.77	20.61	29.36	42.65
100	9.16	12.69	20.65	29.30	42.70
500	6.79	12.36	20.97	29.09	42.76
	$\lambda = 0.50, \Delta = 2.00$				
20	2.15	2.50	3.09	3.61	4.21
50	2.14	2.49	3.10	3.58	4.18
100	2.14	2.51	3.10	3.61	4.22
500	2.17	2.44	3.09	3.59	4.20
	$\lambda = 0.50, \Delta = 3.00$				
20	1.20	1.27	1.38	1.47	1.58
50	1.20	1.26	1.37	1.47	1.58
100	1.18	1.26	1.38	1.47	1.59
500	1.20	1.26	1.38	1.47	1.59

Table 291

Out of Control ARL_0 for MEWMA of Dimension 2 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	72.00	137.88	320.40	615.94	1174.37
50	72.23	137.15	320.01	614.57	1172.29
100	72.95	137.29	321.27	613.46	1170.68
500	68.63	137.41	328.76	613.63	1169.59
	λ = 0.60, Δ = 0.50				
20	37.53	66.13	138.96	241.64	426.80
50	37.82	65.52	138.98	241.57	425.20
100	37.27	65.39	139.68	242.59	426.38
500	30.95	65.86	142.54	244.85	427.03
	λ = 0.60, Δ = 1.00				
20	10.62	15.78	26.73	40.47	61.62
50	10.53	15.67	26.79	40.55	61.54
100	10.53	15.65	26.71	40.52	61.52
500	8.07	15.18	26.99	40.44	61.92
	λ = 0.60, Δ = 2.00				
20	2.31	2.76	3.50	4.26	5.16
50	2.30	2.76	3.50	4.25	5.15
100	2.30	2.78	3.50	4.26	5.12
500	2.43	2.69	3.48	4.25	5.16
	λ = 0.60, Δ = 3.00				
20	1.23	1.30	1.42	1.55	1.69
50	1.23	1.30	1.43	1.55	1.69
100	1.21	1.29	1.43	1.56	1.70
500	1.37	1.33	1.44	1.54	1.70

Table 292

Out of Control ARL_0 for MEWMA of Dimension 2 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	77.45	151.95	366.73	721.66	1397.50
50	77.19	151.56	366.27	721.53	1394.75
100	77.11	152.98	367.64	719.56	1391.22
500	91.56	161.88	373.25	716.62	1391.65
			$\lambda = 0.80, \Delta = 0.50$		
20	46.75	85.95	190.32	343.54	636.96
50	46.91	86.27	190.20	344.46	637.03
100	46.88	86.44	189.60	344.83	636.59
500	53.05	89.47	192.57	348.00	632.61
			$\lambda = 0.80, \Delta = 1.00$		
20	14.93	23.85	45.22	73.77	120.55
50	14.86	23.91	45.24	73.76	120.85
100	14.89	23.76	45.33	74.06	120.73
500	15.68	22.96	46.23	75.04	121.86
			$\lambda = 0.80, \Delta = 2.00$		
20	2.94	3.78	5.25	6.89	9.10
50	2.92	3.78	5.29	6.89	9.14
100	2.92	3.76	5.27	6.88	9.14
500	2.22	3.58	5.20	6.92	9.11
			$\lambda = 0.80, \Delta = 3.00$		
20	1.35	1.49	1.74	1.96	2.25
50	1.34	1.49	1.74	1.96	2.25
100	1.34	1.48	1.73	1.94	2.25
500	1.35	1.45	1.74	1.96	2.25

Table 293

Out of Control ARL_0 for MEWMA of Dimension 3 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	40.89	58.67	94.57	133.78	191.65
50	41.41	58.80	95.29	134.84	191.83
100	41.18	58.52	95.69	134.55	192.69
500	39.98	61.68	94.91	134.67	191.20
			λ = 0.05, Δ = 0.50		
20	18.07	22.53	29.47	35.18	41.88
50	18.51	22.80	29.73	35.53	42.30
100	18.11	22.63	29.55	35.41	42.27
500	18.40	23.04	30.10	35.52	41.97
			λ = 0.05, Δ = 1.00		
20	7.54	8.84	10.61	11.93	13.16
50	7.74	9.03	10.83	12.16	13.40
100	7.72	9.03	10.78	12.09	13.36
500	8.18	9.17	10.83	12.06	13.28
			λ = 0.05, Δ = 2.00		
20	3.26	3.69	4.30	4.73	5.14
50	3.36	3.82	4.44	4.89	5.31
100	3.36	3.82	4.45	4.89	5.30
500	3.42	3.97	4.48	4.89	5.30
			λ = 0.05, Δ = 3.00		
20	2.01	2.24	2.58	2.83	3.05
50	2.07	2.33	2.69	2.95	3.18
100	2.08	2.32	2.68	2.94	3.18
500	2.08	2.36	2.73	2.96	3.17

Table 294

Out of Control ARL_0 for MEWMA of Dimension 3 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	44.01	69.26	127.88	205.13	334.85
50	44.12	69.49	128.33	205.09	334.50
100	44.22	69.16	128.53	203.27	334.59
500	50.38	71.91	128.49	203.02	334.10
			$\lambda = 0.10, \Delta = 0.50$		
20	18.17	23.80	33.82	44.09	57.86
50	18.14	23.75	33.72	44.29	57.61
100	17.74	23.73	33.74	44.10	57.64
500	19.05	24.44	34.42	44.19	58.01
			$\lambda = 0.10, \Delta = 1.00$		
20	6.76	7.97	9.65	10.98	12.41
50	6.74	7.98	9.62	11.00	12.42
100	6.74	7.94	9.62	10.98	12.41
500	6.80	8.03	9.70	11.02	12.29
			$\lambda = 0.10, \Delta = 2.00$		
20	2.68	3.04	3.48	3.82	4.16
50	2.65	3.03	3.48	3.83	4.15
100	2.68	3.02	3.47	3.82	4.16
500	2.41	3.10	3.49	3.83	4.15
			$\lambda = 0.10, \Delta = 3.00$		
20	1.62	1.79	2.01	2.18	2.36
50	1.62	1.79	2.02	2.18	2.35
100	1.63	1.79	2.01	2.19	2.36
500	1.57	1.87	2.04	2.20	2.35

Table 295

Out of Control ARL$_0$ for MEWMA of Dimension 3 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	50.98	88.76	186.14	331.72	579.68
50	51.16	89.39	185.08	332.30	579.73
100	51.32	88.57	185.06	330.20	579.40
500	71.80	83.00	186.02	332.93	580.24
			$\lambda = 0.20, \Delta = 0.50$		
20	20.83	30.25	50.19	74.41	111.44
50	20.81	30.15	50.34	74.52	111.72
100	20.55	30.37	49.97	73.63	110.91
500	23.33	29.71	51.20	74.94	110.84
			$\lambda = 0.20, \Delta = 1.00$		
20	6.48	7.93	10.27	12.30	14.76
50	6.47	7.91	10.21	12.28	14.73
100	6.36	7.91	10.20	12.29	14.68
500	7.89	8.26	10.34	12.42	14.66
			$\lambda = 0.20, \Delta = 2.00$		
20	2.20	2.49	2.86	3.15	3.44
50	2.19	2.48	2.86	3.15	3.44
100	2.21	2.48	2.84	3.14	3.45
500	2.22	2.46	2.87	3.14	3.44
			$\lambda = 0.20, \Delta = 3.00$		
20	1.31	1.41	1.56	1.67	1.79
50	1.33	1.42	1.56	1.67	1.78
100	1.32	1.43	1.56	1.67	1.79
500	1.28	1.45	1.57	1.67	1.78

Table 296

Out of Control ARL_0 for MEWMA of Dimension 3 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	57.16	105.65	229.18	424.80	785.06
50	57.07	105.49	228.80	424.85	786.85
100	57.03	105.18	228.62	424.21	785.67
500	61.59	101.25	228.00	426.97	785.51
			λ = 0.30, Δ = 0.50		
20	24.72	39.08	71.16	115.65	186.43
50	24.59	39.14	71.09	115.83	186.15
100	24.84	39.05	70.36	114.69	186.04
500	28.62	36.87	70.12	115.85	186.28
			λ = 0.30, Δ = 1.00		
20	7.03	9.05	12.51	16.08	20.91
50	6.99	8.96	12.41	16.01	20.84
100	6.95	8.98	12.45	15.99	20.75
500	8.20	9.28	12.41	16.18	20.72
			λ = 0.30, Δ = 2.00		
20	2.07	2.33	2.71	3.02	3.34
50	2.05	2.33	2.71	3.01	3.34
100	2.08	2.35	2.69	3.01	3.34
500	2.07	2.32	2.69	3.00	3.31
			λ = 0.30, Δ = 3.00		
20	1.23	1.29	1.40	1.49	1.58
50	1.24	1.31	1.40	1.50	1.59
100	1.23	1.30	1.40	1.49	1.60
500	1.19	1.29	1.41	1.50	1.58

Table 297

Out of Control ARL_0 for MEWMA of Dimension 3 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	62.44	117.00	270.13	502.41	949.06
50	61.76	116.37	269.91	501.83	950.60
100	61.19	117.29	270.92	501.82	950.96
500	47.33	113.87	269.62	502.66	948.88
	λ = 0.40, Δ = 0.50				
20	29.40	48.55	95.11	160.61	271.34
50	29.33	48.42	95.22	160.54	271.28
100	29.75	48.58	94.53	161.19	271.06
500	28.02	46.20	95.73	161.63	273.48
	λ = 0.40, Δ = 1.00				
20	7.96	10.70	16.25	22.24	31.10
50	7.90	10.65	16.16	22.16	31.00
100	7.88	10.69	16.09	22.20	31.12
500	8.52	11.00	15.59	22.20	31.25
	λ = 0.40, Δ = 2.00				
20	2.06	2.34	2.77	3.16	3.56
50	2.06	2.35	2.77	3.13	3.54
100	2.05	2.34	2.76	3.14	3.55
500	1.72	2.32	2.73	3.12	3.55
	λ = 0.40, Δ = 3.00				
20	1.21	1.27	1.36	1.43	1.53
50	1.22	1.27	1.36	1.45	1.54
100	1.21	1.27	1.36	1.44	1.54
500	1.15	1.24	1.36	1.44	1.53

Table 298

Out of Control ARL_0 for MEWMA of Dimension 3 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	66.65	128.66	301.53	565.48	1107.71
50	66.25	128.33	301.70	565.94	1109.66
100	67.22	128.62	300.61	565.30	1111.86
500	57.02	124.85	301.29	562.68	1106.27
			λ = 0.50, Δ = 0.50		
20	33.77	58.74	119.88	208.29	365.24
50	33.78	58.46	120.46	208.41	366.25
100	34.37	58.47	119.84	208.47	365.55
500	27.53	58.21	119.98	211.89	368.60
			λ = 0.50, Δ = 1.00		
20	9.23	13.05	21.51	31.19	45.76
50	9.19	12.94	21.49	31.09	45.68
100	9.05	13.01	21.51	31.22	45.75
500	7.91	12.87	21.30	31.01	45.96
			λ = 0.50, Δ = 2.00		
20	2.14	2.48	3.02	3.53	4.15
50	2.14	2.48	3.02	3.52	4.13
100	2.12	2.48	3.02	3.52	4.15
500	1.93	2.50	2.97	3.50	4.17
			λ = 0.50, Δ = 3.00		
20	1.22	1.28	1.38	1.46	1.57
50	1.22	1.29	1.38	1.48	1.58
100	1.21	1.29	1.38	1.47	1.58
500	1.21	1.28	1.36	1.46	1.57

Table 299

Out of Control ARL_0 for MEWMA of Dimension 3 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60$, $\Delta = 0.25$		
20	70.02	139.12	328.26	630.52	1229.16
50	69.79	138.09	327.77	632.46	1230.98
100	70.63	138.47	326.04	633.74	1232.69
500	61.86	138.40	327.53	634.26	1224.80
			$\lambda = 0.60$, $\Delta = 0.50$		
20	37.82	68.75	146.49	261.19	469.75
50	37.85	68.54	146.68	261.87	470.91
100	37.53	69.19	146.50	262.06	470.13
500	36.42	70.01	147.27	266.98	473.15
			$\lambda = 0.60$, $\Delta = 1.00$		
20	10.86	16.48	28.41	43.15	67.73
50	10.78	16.43	28.44	43.15	67.65
100	10.79	16.41	28.50	43.13	67.63
500	9.54	16.48	28.77	42.78	68.00
			$\lambda = 0.60$, $\Delta = 2.00$		
20	2.30	2.75	3.52	4.24	5.20
50	2.29	2.76	3.53	4.27	5.20
100	2.27	2.78	3.53	4.23	5.18
500	2.15	2.84	3.50	4.26	5.22
			$\lambda = 0.60$, $\Delta = 3.00$		
20	1.24	1.33	1.45	1.57	1.70
50	1.26	1.34	1.46	1.57	1.69
100	1.25	1.34	1.46	1.57	1.70
500	1.16	1.33	1.43	1.55	1.69

Table 300

Out of Control ARL_0 for MEWMA of Dimension 3 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	77.38	153.22	371.92	723.80	1403.30
50	76.73	152.31	373.27	723.84	1403.83
100	77.64	151.23	373.05	721.42	1401.65
500	70.96	156.08	378.17	721.07	1401.90
			λ = 0.80, Δ = 0.50		
20	47.67	88.96	202.40	371.03	683.29
50	47.64	88.66	202.52	371.12	683.52
100	47.65	88.92	203.19	370.96	685.33
500	38.33	85.72	206.35	374.40	684.56
			λ = 0.80, Δ = 1.00		
20	15.89	25.73	48.28	79.05	132.01
50	15.68	25.57	48.12	79.07	132.32
100	15.72	25.39	48.30	79.21	132.36
500	15.38	24.40	47.87	78.66	132.02
			λ = 0.80, Δ = 2.00		
20	3.07	3.92	5.48	7.13	9.48
50	3.01	3.92	5.46	7.12	9.50
100	3.08	3.93	5.46	7.08	9.48
500	2.51	3.78	5.44	7.19	9.54
			λ = 0.80, Δ = 3.00		
20	1.41	1.55	1.79	2.03	2.30
50	1.40	1.55	1.81	2.04	2.30
100	1.40	1.55	1.79	2.02	2.29
500	1.50	1.52	1.77	2.02	2.29

Table 301

Out of Control ARL$_0$ for MEWMA of Dimension 4 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	38.89	57.22	91.56	131.99	190.25
50	39.44	58.45	92.41	131.95	190.48
100	40.28	58.22	92.23	132.36	190.22
500	47.22	56.98	91.39	132.78	187.70
			λ = 0.05, Δ = 0.50		
20	17.48	22.05	28.56	34.08	40.90
50	17.57	22.19	28.69	34.33	41.28
100	17.75	22.34	28.93	34.36	41.35
500	21.17	21.99	28.63	34.42	41.32
			λ = 0.05, Δ = 1.00		
20	7.43	8.69	10.32	11.48	12.72
50	7.59	8.94	10.50	11.69	12.94
100	7.68	8.92	10.54	11.68	12.92
500	8.55	9.05	10.59	11.71	12.97
			λ = 0.05, Δ = 2.00		
20	3.19	3.64	4.19	4.59	4.99
50	3.35	3.78	4.33	4.72	5.14
100	3.34	3.78	4.35	4.75	5.14
500	3.61	3.82	4.37	4.75	5.16
			λ = 0.05, Δ = 3.00		
20	1.99	2.21	2.52	2.74	2.96
50	2.06	2.31	2.62	2.85	3.08
100	2.08	2.31	2.63	2.86	3.09
500	2.18	2.33	2.63	2.85	3.09

Table 302

Out of Control ARL_0 for MEWMA of Dimension 4 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	42.30	67.45	126.29	201.95	333.44
50	42.58	67.79	126.46	202.37	333.45
100	43.03	67.26	125.99	202.18	333.78
500	46.85	67.63	127.20	202.60	334.42
			$\lambda = 0.10, \Delta = 0.50$		
20	17.55	23.28	33.15	42.83	55.61
50	17.46	23.13	33.12	42.66	55.96
100	17.39	23.33	33.23	42.63	55.94
500	17.45	24.12	33.23	42.62	55.35
			$\lambda = 0.10, \Delta = 1.00$		
20	6.60	7.78	9.36	10.59	11.92
50	6.56	7.76	9.38	10.58	11.86
100	6.58	7.79	9.41	10.61	11.88
500	6.74	7.74	9.40	10.62	11.90
			$\lambda = 0.10, \Delta = 2.00$		
20	2.61	2.94	3.37	3.69	4.00
50	2.64	2.97	3.40	3.70	4.01
100	2.61	2.97	3.42	3.70	4.01
500	2.55	3.03	3.40	3.71	4.01
			$\lambda = 0.10, \Delta = 3.00$		
20	1.62	1.77	1.97	2.11	2.26
50	1.61	1.77	1.98	2.12	2.28
100	1.60	1.76	1.97	2.12	2.28
500	1.54	1.78	1.99	2.13	2.27

Table 303

Out of Control ARL_0 for MEWMA of Dimension 4 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	50.02	87.49	187.98	333.34	586.04
50	50.24	88.02	187.73	332.57	586.30
100	49.44	87.66	188.80	333.73	587.15
500	46.27	87.59	190.39	334.88	586.91
			λ = 0.20, Δ = 0.50		
20	20.54	30.07	49.62	73.59	110.73
50	20.33	29.77	49.84	73.62	110.75
100	20.66	29.90	49.82	73.37	110.82
500	25.67	30.02	49.72	73.55	110.93
			λ = 0.20, Δ = 1.00		
20	6.33	7.74	9.99	11.95	14.21
50	6.29	7.72	9.91	11.87	14.21
100	6.29	7.71	9.99	11.95	14.28
500	6.71	7.48	9.95	12.07	14.32
			λ = 0.20, Δ = 2.00		
20	2.16	2.41	2.76	3.03	3.31
50	2.17	2.43	2.78	3.05	3.30
100	2.17	2.41	2.77	3.04	3.32
500	2.27	2.41	2.80	3.04	3.31
			λ = 0.20, Δ = 3.00		
20	1.32	1.41	1.54	1.64	1.73
50	1.33	1.41	1.55	1.64	1.74
100	1.32	1.41	1.53	1.63	1.73
500	1.44	1.42	1.54	1.65	1.74

Table 304

Out of Control ARL_0 for MEWMA of Dimension 4 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	56.70	102.31	235.38	433.39	788.41
50	55.84	101.77	236.51	432.84	789.41
100	56.09	100.91	236.41	433.69	788.49
500	58.00	102.27	235.73	439.96	786.83
			$\lambda = 0.30, \Delta = 0.50$		
20	24.61	38.53	71.91	114.25	185.57
50	24.62	38.12	71.52	114.17	185.30
100	24.73	37.80	71.77	113.78	185.41
500	33.06	36.78	70.33	115.73	186.04
			$\lambda = 0.30, \Delta = 1.00$		
20	6.85	8.82	12.31	15.84	20.20
50	6.82	8.77	12.28	15.79	20.00
100	6.71	8.72	12.36	15.84	20.20
500	9.04	8.83	12.30	15.98	20.22
			$\lambda = 0.30, \Delta = 2.00$		
20	2.04	2.26	2.63	2.92	3.22
50	2.05	2.28	2.63	2.92	3.21
100	2.03	2.28	2.63	2.91	3.21
500	1.89	2.29	2.64	2.92	3.23
			$\lambda = 0.30, \Delta = 3.00$		
20	1.24	1.30	1.40	1.48	1.56
50	1.24	1.30	1.40	1.48	1.56
100	1.23	1.31	1.40	1.47	1.56
500	1.33	1.32	1.39	1.48	1.56

Table 305

Out of Control ARL_0 for MEWMA of Dimension 4 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	61.23	117.31	274.02	517.74	974.30
50	60.75	116.78	273.96	518.53	974.75
100	60.78	117.08	274.08	519.37	974.87
500	64.89	115.72	279.09	522.05	960.83
			$\lambda = 0.40, \Delta = 0.50$		
20	28.99	48.30	95.65	160.09	275.24
50	28.58	48.17	95.18	159.81	274.95
100	28.36	48.09	95.27	159.90	274.63
500	30.76	46.72	95.51	161.29	275.07
			$\lambda = 0.40, \Delta = 1.00$		
20	7.77	10.72	16.12	21.87	30.41
50	7.75	10.57	16.11	21.88	30.39
100	7.65	10.56	16.00	22.04	30.46
500	8.81	10.67	16.09	21.77	30.42
			$\lambda = 0.40, \Delta = 2.00$		
20	2.04	2.30	2.71	3.04	3.44
50	2.05	2.32	2.72	3.06	3.44
100	2.01	2.31	2.71	3.03	3.42
500	1.93	2.38	2.74	3.06	3.45
			$\lambda = 0.40, \Delta = 3.00$		
20	1.21	1.28	1.37	1.44	1.53
50	1.22	1.28	1.37	1.44	1.53
100	1.22	1.28	1.37	1.45	1.53
500	1.21	1.30	1.36	1.43	1.52

Table 306

Out of Control ARL_0 for MEWMA of Dimension 4 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	66.29	128.46	308.02	590.73	1116.64
50	65.93	127.42	308.30	591.67	1118.04
100	65.41	127.10	309.92	592.02	1117.54
500	73.18	125.76	316.04	594.67	1108.61
			λ = 0.50, Δ = 0.50		
20	33.98	58.13	122.11	212.02	374.26
50	33.72	57.67	121.47	212.18	374.36
100	33.36	57.77	121.99	212.93	374.01
500	29.43	58.82	122.99	214.02	375.87
			λ = 0.50, Δ = 1.00		
20	9.24	13.31	21.57	31.08	46.35
50	9.11	13.37	21.59	31.03	46.24
100	9.02	13.31	21.57	31.20	46.31
500	8.31	13.52	21.47	31.02	45.79
			λ = 0.50, Δ = 2.00		
20	2.14	2.47	2.99	3.41	3.95
50	2.15	2.48	2.99	3.43	3.96
100	2.13	2.48	2.96	3.42	3.97
500	2.05	2.54	3.00	3.39	3.98
			λ = 0.50, Δ = 3.00		
20	1.23	1.29	1.40	1.48	1.57
50	1.23	1.30	1.39	1.48	1.57
100	1.25	1.30	1.39	1.48	1.57
500	1.14	1.27	1.39	1.47	1.57

Table 307

Out of Control ARL_0 for MEWMA of Dimension 4 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	70.33	137.93	336.33	651.78	1256.60
50	69.89	137.06	337.21	652.90	1258.94
100	70.33	136.27	337.03	654.81	1255.70
500	88.14	138.57	343.80	656.40	1248.94
			λ = 0.60, Δ = 0.50		
20	39.22	69.46	147.81	269.80	488.44
50	38.42	69.22	147.26	270.20	489.23
100	38.44	69.56	147.29	271.14	489.31
500	48.06	70.20	146.39	272.77	486.52
			λ = 0.60, Δ = 1.00		
20	11.00	16.77	28.94	44.26	68.40
50	10.96	16.74	28.95	44.20	68.46
100	11.03	16.83	29.05	44.31	68.53
500	9.76	16.32	28.16	44.06	67.64
			λ = 0.60, Δ = 2.00		
20	2.34	2.75	3.46	4.12	5.00
50	2.33	2.74	3.46	4.12	5.02
100	2.34	2.74	3.44	4.13	5.06
500	2.19	2.79	3.50	4.13	5.01
			λ = 0.60, Δ = 3.00		
20	1.27	1.35	1.47	1.58	1.70
50	1.27	1.34	1.47	1.57	1.70
100	1.28	1.35	1.47	1.57	1.70
500	1.11	1.33	1.45	1.57	1.71

Table 308

Out of Control ARL_0 for MEWMA of Dimension 4 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	77.64	154.05	380.24	755.78	1465.21
50	77.26	155.15	380.89	755.69	1469.03
100	77.62	155.89	380.24	757.73	1470.23
500	77.54	162.06	376.23	752.84	1463.42
			λ = 0.80, Δ = 0.50		
20	49.24	92.58	206.76	385.18	715.25
50	48.91	92.81	206.67	384.64	716.02
100	49.62	94.18	208.12	385.84	717.08
500	50.63	96.76	203.98	386.08	717.22
			λ = 0.80, Δ = 1.00		
20	16.05	26.61	50.96	82.96	135.80
50	16.00	26.65	50.88	83.16	135.97
100	16.01	26.89	51.56	83.53	136.01
500	14.60	26.48	50.17	82.55	136.47
			λ = 0.80, Δ = 2.00		
20	3.07	3.88	5.52	7.30	9.64
50	3.11	3.91	5.52	7.34	9.65
100	3.10	3.89	5.60	7.34	9.68
500	3.09	3.68	5.62	7.25	9.62
			λ = 0.80, Δ = 3.00		
20	1.43	1.60	1.86	2.10	2.37
50	1.44	1.60	1.86	2.09	2.37
100	1.45	1.60	1.85	2.10	2.38
500	1.39	1.61	1.83	2.11	2.37

Table 309

Out of Control ARL_0 for MEWMA of Dimension 5 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	λ = 0.05, Δ = 0.25				
20	38.99	56.17	91.92	130.66	186.43
50	38.55	56.42	92.60	131.58	187.18
100	38.51	56.43	92.30	131.56	188.10
500	36.86	56.29	91.74	130.78	187.10
	λ = 0.05, Δ = 0.50				
20	17.13	21.35	27.60	32.69	38.74
50	17.19	21.35	27.71	32.95	38.97
100	17.29	21.52	27.79	32.88	39.10
500	17.99	21.10	27.89	32.68	38.92
	λ = 0.05, Δ = 1.00				
20	7.17	8.39	9.95	11.07	12.23
50	7.40	8.55	10.08	11.25	12.37
100	7.43	8.57	10.19	11.30	12.43
500	7.14	8.43	10.17	11.22	12.40
	λ = 0.05, Δ = 2.00				
20	3.11	3.51	4.04	4.42	4.79
50	3.21	3.62	4.16	4.54	4.91
100	3.24	3.64	4.17	4.54	4.92
500	3.25	3.61	4.17	4.52	4.91
	λ = 0.05, Δ = 3.00				
20	1.95	2.16	2.45	2.65	2.85
50	2.00	2.22	2.50	2.73	2.93
100	2.02	2.24	2.53	2.74	2.96
500	1.95	2.24	2.54	2.74	2.95

Table 310

Out of Control ARL_0 for MEWMA of Dimension 5 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	41.62	66.77	126.56	201.75	323.61
50	41.58	66.77	127.02	201.71	324.09
100	41.89	67.11	127.32	202.58	324.94
500	37.35	63.68	124.87	203.20	325.05
			$\lambda = 0.10, \Delta = 0.50$		
20	16.99	22.66	31.87	41.90	54.53
50	16.88	22.39	31.80	41.70	54.47
100	17.31	22.59	32.01	41.92	54.51
500	16.93	22.79	31.95	41.87	55.43
			$\lambda = 0.10, \Delta = 1.00$		
20	6.30	7.42	8.97	10.16	11.39
50	6.36	7.43	8.98	10.14	11.34
100	6.41	7.48	8.96	10.13	11.36
500	6.54	7.49	8.97	10.21	11.33
			$\lambda = 0.10, \Delta = 2.00$		
20	2.53	2.85	3.24	3.52	3.81
50	2.55	2.84	3.24	3.54	3.81
100	2.56	2.87	3.26	3.54	3.81
500	2.60	2.83	3.25	3.56	3.81
			$\lambda = 0.10, \Delta = 3.00$		
20	1.58	1.72	1.90	2.04	2.18
50	1.58	1.71	1.89	2.03	2.17
100	1.57	1.72	1.90	2.04	2.18
500	1.54	1.69	1.89	2.05	2.19

Table 311

Out of Control ARL_0 for MEWMA of Dimension 5 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	49.15	87.25	178.88	327.31	570.08
50	49.71	88.17	178.84	326.80	570.87
100	49.15	88.84	179.21	327.80	571.47
500	49.14	86.47	177.27	325.44	572.27
			λ = 0.20, Δ = 0.50		
20	19.80	29.28	47.77	73.22	108.55
50	19.85	29.40	48.08	73.22	108.35
100	19.85	29.33	48.31	73.30	108.50
500	23.54	29.55	48.65	74.85	108.73
			λ = 0.20, Δ = 1.00		
20	6.08	7.40	9.40	11.36	13.43
50	6.10	7.48	9.45	11.34	13.49
100	6.10	7.45	9.40	11.35	13.49
500	6.54	7.22	9.48	11.40	13.52
			λ = 0.20, Δ = 2.00		
20	2.10	2.34	2.65	2.90	3.14
50	2.10	2.34	2.64	2.88	3.13
100	2.12	2.34	2.65	2.90	3.15
500	2.35	2.34	2.66	2.92	3.15
			λ = 0.20, Δ = 3.00		
20	1.30	1.39	1.50	1.59	1.68
50	1.31	1.39	1.50	1.59	1.68
100	1.29	1.38	1.49	1.58	1.67
500	1.26	1.37	1.50	1.58	1.68

Table 312

Out of Control ARL_0 for MEWMA of Dimension 5 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	54.74	101.18	225.91	424.77	794.81
50	55.26	102.13	224.94	426.38	797.51
100	56.08	102.68	224.91	427.00	799.27
500	58.44	105.48	228.17	424.74	799.11
			λ = 0.30, Δ = 0.50		
20	23.86	37.59	68.88	111.48	182.27
50	23.67	37.76	68.88	111.56	182.42
100	23.40	37.66	68.72	111.43	182.14
500	23.48	38.46	70.48	111.93	183.58
			λ = 0.30, Δ = 1.00		
20	6.53	8.40	11.59	14.96	19.42
50	6.56	8.38	11.57	14.92	19.45
100	6.57	8.39	11.54	14.96	19.45
500	6.22	8.62	11.60	14.96	19.59
			λ = 0.30, Δ = 2.00		
20	1.97	2.19	2.52	2.78	3.04
50	1.97	2.20	2.49	2.75	3.03
100	1.94	2.20	2.50	2.76	3.04
500	1.98	2.19	2.52	2.77	3.05
			λ = 0.30, Δ = 3.00		
20	1.22	1.28	1.37	1.44	1.52
50	1.22	1.29	1.37	1.45	1.52
100	1.21	1.28	1.36	1.44	1.52
500	1.24	1.30	1.37	1.43	1.52

Table 313

Out of Control ARL_0 for MEWMA of Dimension 5 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	60.84	116.47	264.63	500.40	977.20
50	61.26	116.76	263.57	500.11	980.93
100	60.74	116.92	263.41	502.52	980.68
500	65.29	122.06	264.53	503.34	980.90
	λ = 0.40, Δ = 0.50				
20	28.16	47.43	92.57	158.06	274.46
50	27.94	47.47	92.25	157.84	274.82
100	27.45	47.24	92.02	157.30	274.90
500	27.20	47.75	93.12	159.28	275.29
	λ = 0.40, Δ = 1.00				
20	7.39	10.10	15.33	20.87	29.71
50	7.31	10.12	15.22	20.77	29.59
100	7.31	10.11	15.19	20.73	29.59
500	7.39	9.49	15.35	20.77	29.50
	λ = 0.40, Δ = 2.00				
20	1.96	2.22	2.61	2.91	3.29
50	1.96	2.24	2.57	2.90	3.28
100	1.95	2.23	2.59	2.91	3.27
500	1.98	2.17	2.58	2.91	3.27
	λ = 0.40, Δ = 3.00				
20	1.21	1.26	1.35	1.41	1.49
50	1.20	1.26	1.35	1.42	1.49
100	1.20	1.26	1.34	1.41	1.49
500	1.12	1.25	1.35	1.41	1.49

Table 314

Out of Control ARL_0 for MEWMA of Dimension 5 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	66.11	130.47	301.61	561.74	1111.63
50	66.18	129.76	300.07	560.86	1113.74
100	65.95	130.15	300.72	564.56	1116.93
500	63.54	129.90	306.58	562.18	1121.65
			λ = 0.50, Δ = 0.50		
20	32.96	57.50	120.51	210.09	369.27
50	32.66	57.01	119.86	210.48	368.85
100	32.52	56.58	119.33	209.90	369.54
500	27.06	55.42	121.89	209.43	368.64
			λ = 0.50, Δ = 1.00		
20	8.77	12.47	20.63	29.94	44.67
50	8.64	12.40	20.42	29.83	44.49
100	8.69	12.48	20.37	29.65	44.56
500	9.38	12.62	20.84	29.47	44.56
			λ = 0.50, Δ = 2.00		
20	2.08	2.37	2.88	3.32	3.85
50	2.06	2.39	2.85	3.29	3.84
100	2.02	2.38	2.87	3.28	3.82
500	2.13	2.34	2.88	3.29	3.84
			λ = 0.50, Δ = 3.00		
20	1.22	1.28	1.38	1.45	1.54
50	1.22	1.28	1.38	1.46	1.54
100	1.21	1.26	1.37	1.45	1.55
500	1.14	1.25	1.38	1.45	1.53

Table 315

Out of Control ARL_0 for MEWMA of Dimension 5 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	70.78	137.33	328.85	622.18	1234.08
50	70.59	136.73	328.97	622.33	1235.24
100	69.86	135.68	330.53	624.15	1236.56
500	57.19	135.17	333.53	622.38	1242.46
			λ = 0.60, Δ = 0.50		
20	37.55	67.94	147.94	261.03	475.61
50	36.95	67.46	148.10	261.96	476.11
100	36.61	66.69	147.72	261.83	476.27
500	32.19	62.50	149.78	263.72	472.22
			λ = 0.60, Δ = 1.00		
20	10.45	15.85	27.85	42.15	66.54
50	10.31	15.64	27.62	42.14	66.45
100	10.23	15.66	27.56	41.93	66.27
500	10.61	14.94	27.19	41.91	66.93
			λ = 0.60, Δ = 2.00		
20	2.27	2.67	3.35	4.03	4.84
50	2.27	2.67	3.33	4.00	4.84
100	2.21	2.67	3.34	4.01	4.82
500	2.34	2.63	3.34	3.94	4.87
			λ = 0.60, Δ = 3.00		
20	1.25	1.34	1.47	1.56	1.68
50	1.26	1.34	1.46	1.57	1.69
100	1.23	1.32	1.45	1.56	1.68
500	1.29	1.31	1.45	1.56	1.67

Table 316

Out of Control ARL_0 for MEWMA of Dimension 5 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	76.82	151.71	370.49	732.27	1434.56
50	76.43	151.07	371.29	733.63	1434.05
100	76.38	149.18	371.99	736.67	1432.09
500	87.67	140.47	374.13	728.25	1434.89
	λ = 0.80, Δ = 0.50				
20	46.96	87.55	204.53	371.93	697.00
50	46.77	87.05	204.54	372.92	697.39
100	46.15	86.43	205.29	372.72	700.08
500	46.88	83.80	204.44	369.02	700.00
	λ = 0.80, Δ = 1.00				
20	15.15	24.97	49.07	81.01	135.68
50	15.10	24.96	48.99	80.83	135.58
100	15.00	25.05	49.14	81.04	135.62
500	11.60	23.82	49.73	80.70	136.15
	λ = 0.80, Δ = 2.00				
20	3.07	3.87	5.35	7.04	9.33
50	3.05	3.86	5.34	7.02	9.32
100	2.91	3.87	5.36	7.03	9.35
500	3.07	4.01	5.39	6.94	9.34
	λ = 0.80, Δ = 3.00				
20	1.47	1.62	1.88	2.12	2.43
50	1.45	1.61	1.88	2.14	2.43
100	1.43	1.60	1.87	2.12	2.41
500	1.39	1.57	1.85	2.12	2.43

Table 317

Out of Control ARL$_0$ for MEWMA of Dimension 6 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	36.40	53.01	84.87	120.26	172.52
50	37.25	53.15	84.19	119.30	171.49
100	36.50	52.94	84.11	119.18	171.49
500	31.39	53.42	84.63	118.78	172.70
			λ = 0.05, Δ = 0.50		
20	16.22	20.13	25.92	30.59	36.20
50	16.44	20.23	25.87	30.54	36.24
100	16.28	20.27	25.88	30.71	36.44
500	17.44	20.28	26.01	30.46	36.02
			λ = 0.05, Δ = 1.00		
20	6.94	8.02	9.49	10.52	11.51
50	7.08	8.18	9.61	10.64	11.65
100	7.00	8.20	9.59	10.67	11.67
500	7.48	8.21	9.45	10.51	11.56
			λ = 0.05, Δ = 2.00		
20	3.01	3.38	3.88	4.23	4.57
50	3.08	3.46	3.95	4.32	4.66
100	3.04	3.49	3.97	4.33	4.69
500	3.23	3.51	3.94	4.27	4.64
			λ = 0.05, Δ = 3.00		
20	1.91	2.09	2.35	2.54	2.73
50	1.94	2.15	2.40	2.61	2.80
100	1.92	2.15	2.41	2.61	2.81
500	2.03	2.14	2.39	2.59	2.79

Table 318

Out of Control ARL_0 for MEWMA of Dimension 6 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	39.11	62.06	117.90	188.34	303.68
50	39.09	62.20	117.10	186.82	303.02
100	39.34	61.34	116.99	185.93	302.89
500	38.10	59.62	115.29	185.30	306.24
			$\lambda = 0.10, \Delta = 0.50$		
20	15.95	20.98	29.58	38.07	50.16
50	16.02	20.90	29.49	37.83	49.96
100	16.00	20.92	29.77	37.92	49.95
500	15.38	20.53	29.51	37.89	50.39
			$\lambda = 0.10, \Delta = 1.00$		
20	6.04	7.06	8.47	9.51	10.58
50	6.06	7.03	8.43	9.48	10.52
100	6.04	7.08	8.37	9.46	10.52
500	5.60	7.13	8.30	9.33	10.52
			$\lambda = 0.10, \Delta = 2.00$		
20	2.44	2.73	3.09	3.35	3.61
50	2.42	2.69	3.07	3.33	3.59
100	2.43	2.71	3.08	3.33	3.59
500	2.31	2.73	3.06	3.31	3.58
			$\lambda = 0.10, \Delta = 3.00$		
20	1.53	1.66	1.84	1.96	2.08
50	1.53	1.66	1.83	1.95	2.07
100	1.53	1.65	1.82	1.94	2.07
500	1.53	1.67	1.80	1.94	2.07

Table 319

Out of Control ARL_0 for MEWMA of Dimension 6 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	45.97	82.07	176.55	312.46	565.87
50	46.20	81.75	176.63	311.12	564.91
100	45.92	81.39	176.33	310.44	564.86
500	37.85	74.23	174.76	309.14	564.67
			$\lambda = 0.20, \Delta = 0.50$		
20	18.29	27.11	45.55	67.41	102.25
50	18.43	27.21	45.16	67.01	101.86
100	18.58	27.21	45.03	67.02	101.72
500	19.17	25.76	44.78	67.25	101.55
			$\lambda = 0.20, \Delta = 1.00$		
20	5.75	6.95	8.83	10.48	12.40
50	5.74	6.91	8.80	10.41	12.38
100	5.78	6.99	8.79	10.45	12.41
500	5.24	6.83	8.84	10.50	12.45
			$\lambda = 0.20, \Delta = 2.00$		
20	2.01	2.21	2.51	2.74	2.97
50	1.99	2.21	2.50	2.72	2.94
100	2.01	2.20	2.50	2.71	2.95
500	2.12	2.18	2.49	2.72	2.95
			$\lambda = 0.20, \Delta = 3.00$		
20	1.27	1.35	1.45	1.54	1.61
50	1.28	1.35	1.46	1.53	1.61
100	1.28	1.34	1.45	1.53	1.61
500	1.32	1.32	1.44	1.52	1.61

Table 320

Out of Control ARL_0 for MEWMA of Dimension 6 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	52.60	99.01	226.92	416.00	765.06
50	52.48	98.98	227.20	415.78	766.20
100	51.67	99.74	225.14	416.31	767.61
500	46.76	94.74	225.81	410.11	766.73
			$\lambda = 0.30, \Delta = 0.50$		
20	22.16	35.37	67.15	107.16	172.07
50	22.18	35.28	67.22	106.89	172.00
100	22.02	35.06	67.11	106.72	171.57
500	24.18	34.80	66.29	107.05	171.64
			$\lambda = 0.30, \Delta = 1.00$		
20	6.17	7.86	10.90	13.86	17.73
50	6.23	7.81	10.93	13.89	17.75
100	6.14	7.89	10.92	13.90	17.80
500	5.36	7.54	11.02	13.82	17.83
			$\lambda = 0.30, \Delta = 2.00$		
20	1.88	2.08	2.38	2.62	2.87
50	1.88	2.09	2.37	2.60	2.87
100	1.88	2.08	2.36	2.59	2.87
500	1.97	2.00	2.37	2.61	2.87
			$\lambda = 0.30, \Delta = 3.00$		
20	1.20	1.26	1.34	1.40	1.48
50	1.20	1.25	1.34	1.40	1.48
100	1.20	1.26	1.34	1.40	1.47
500	1.14	1.24	1.33	1.38	1.46

Table 321

Out of Control ARL_0 for MEWMA of Dimension 6 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	59.12	112.51	267.75	503.99	934.22
50	59.05	112.61	267.97	503.59	935.09
100	57.95	113.38	268.94	505.28	935.37
500	56.37	117.47	268.19	501.21	938.60
			$\lambda = 0.40, \Delta = 0.50$		
20	26.38	45.61	91.52	154.82	264.34
50	26.19	45.49	92.11	154.84	264.41
100	25.66	45.63	91.82	154.50	264.26
500	23.17	45.56	92.44	154.18	266.32
			$\lambda = 0.40, \Delta = 1.00$		
20	7.06	9.57	14.39	19.85	27.38
50	7.12	9.58	14.41	19.83	27.36
100	7.10	9.64	14.47	19.91	27.36
500	5.17	10.08	14.66	20.06	27.41
			$\lambda = 0.40, \Delta = 2.00$		
20	1.88	2.13	2.45	2.78	3.09
50	1.89	2.12	2.46	2.77	3.11
100	1.89	2.11	2.46	2.76	3.12
500	1.76	2.13	2.47	2.77	3.11
			$\lambda = 0.40, \Delta = 3.00$		
20	1.19	1.24	1.32	1.38	1.45
50	1.19	1.23	1.32	1.38	1.46
100	1.18	1.24	1.32	1.38	1.45
500	1.16	1.23	1.32	1.37	1.44

Table 322

Out of Control ARL_0 for MEWMA of Dimension 6 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	64.72	125.12	300.79	575.25	1104.26
50	64.60	125.25	302.01	573.14	1104.44
100	63.61	126.34	303.11	573.46	1107.14
500	63.95	129.67	301.42	577.22	1120.02
			$\lambda = 0.50, \Delta = 0.50$		
20	31.44	56.42	116.95	208.58	368.08
50	31.46	56.29	117.73	208.90	368.14
100	30.87	55.84	117.70	209.04	368.73
500	28.88	58.28	120.36	208.84	371.84
			$\lambda = 0.50, \Delta = 1.00$		
20	8.36	12.14	19.77	28.86	43.75
50	8.55	12.25	19.74	28.96	43.60
100	8.50	12.29	19.71	28.84	43.88
500	8.90	12.55	19.81	28.49	43.98
			$\lambda = 0.50, \Delta = 2.00$		
20	2.00	2.29	2.73	3.18	3.66
50	1.99	2.28	2.74	3.19	3.65
100	1.97	2.28	2.74	3.19	3.66
500	1.94	2.24	2.75	3.17	3.65
			$\lambda = 0.50, \Delta = 3.00$		
20	1.21	1.27	1.36	1.43	1.49
50	1.20	1.27	1.35	1.43	1.52
100	1.21	1.28	1.36	1.43	1.50
500	1.07	1.27	1.34	1.43	1.51

Table 323

Out of Control ARL_0 for MEWMA of Dimension 6 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	67.95	135.90	327.95	640.28	1227.54
50	67.70	136.22	328.75	639.99	1227.93
100	68.09	137.32	327.74	641.45	1228.97
500	98.35	139.50	327.81	645.05	1235.79
	λ = 0.60, Δ = 0.50				
20	36.14	66.34	146.04	261.33	469.75
50	36.45	66.44	146.91	261.21	469.90
100	36.52	66.00	146.71	262.01	470.85
500	42.91	66.15	148.11	262.57	470.55
	λ = 0.60, Δ = 1.00				
20	10.04	15.52	26.93	42.27	65.25
50	10.36	15.55	27.03	42.37	65.31
100	10.13	15.51	26.82	42.45	65.20
500	10.57	15.95	27.34	42.63	65.27
	λ = 0.60, Δ = 2.00				
20	2.20	2.62	3.23	3.86	4.69
50	2.20	2.62	3.26	3.87	4.68
100	2.20	2.62	3.25	3.87	4.66
500	2.14	2.66	3.31	3.86	4.65
	λ = 0.60, Δ = 3.00				
20	1.26	1.34	1.44	1.53	1.64
50	1.25	1.35	1.43	1.54	1.66
100	1.27	1.35	1.44	1.54	1.66
500	1.13	1.29	1.42	1.54	1.65

Table 324

Out of Control ARL_0 for MEWMA of Dimension 6 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	74.55	148.12	364.10	718.67	1415.09
50	74.65	147.15	364.49	715.35	1412.45
100	74.68	147.74	366.07	711.69	1408.39
500	98.40	137.18	368.08	712.33	1399.48
	λ = 0.80, Δ = 0.50				
20	45.76	86.10	196.14	365.97	674.07
50	46.15	86.37	196.31	365.49	673.79
100	44.96	86.29	196.49	365.67	674.72
500	54.67	82.11	195.22	364.33	668.03
	λ = 0.80, Δ = 1.00				
20	14.90	24.61	47.82	79.90	132.44
50	14.98	24.59	47.89	80.04	133.10
100	14.75	24.64	47.70	80.10	132.93
500	12.81	24.93	49.52	80.83	132.41
	λ = 0.80, Δ = 2.00				
20	3.01	3.81	5.30	7.02	9.34
50	3.04	3.80	5.30	7.02	9.36
100	3.04	3.80	5.28	6.99	9.36
500	2.84	4.12	5.44	7.05	9.35
	λ = 0.80, Δ = 3.00				
20	1.46	1.62	1.86	2.07	2.36
50	1.46	1.61	1.86	2.09	2.38
100	1.47	1.64	1.85	2.09	2.36
500	1.38	1.66	1.85	2.05	2.34

Table 325

Out of Control ARL_0 for MEWMA of Dimension 7 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	34.93	50.47	80.32	113.91	163.35
50	35.59	50.75	80.53	114.19	163.15
100	35.22	51.07	81.14	114.17	163.89
500	36.95	49.61	79.87	114.66	163.24
			$\lambda = 0.05, \Delta = 0.50$		
20	15.40	19.04	24.64	29.38	34.40
50	15.58	19.31	24.78	29.44	34.68
100	15.62	19.31	24.76	29.52	34.56
500	14.15	19.59	24.84	29.56	34.52
			$\lambda = 0.05, \Delta = 1.00$		
20	6.54	7.59	8.92	9.89	10.81
50	6.71	7.72	9.05	10.00	10.91
100	6.66	7.77	9.09	10.01	10.96
500	6.15	7.59	9.05	10.07	10.96
			$\lambda = 0.05, \Delta = 2.00$		
20	2.85	3.22	3.66	3.98	4.28
50	2.95	3.29	3.75	4.07	4.38
100	2.93	3.30	3.77	4.08	4.39
500	2.68	3.25	3.77	4.11	4.40
			$\lambda = 0.05, \Delta = 3.00$		
20	1.83	2.01	2.24	2.42	2.58
50	1.88	2.06	2.29	2.47	2.65
100	1.85	2.06	2.31	2.49	2.66
500	1.80	2.02	2.29	2.50	2.66

Table 326

Out of Control ARL_0 for MEWMA of Dimension 7 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.10$, $\Delta = 0.25$				
20	37.54	60.32	111.01	174.78	286.49
50	38.27	60.36	112.07	175.51	286.47
100	37.86	60.53	110.92	176.67	287.42
500	31.85	60.30	111.84	174.34	289.54
	$\lambda = 0.10$, $\Delta = 0.50$				
20	15.22	19.82	28.18	36.03	47.00
50	15.19	19.99	28.45	36.46	47.06
100	15.09	20.16	28.41	36.17	46.70
500	13.55	19.90	28.14	35.90	47.36
	$\lambda = 0.10$, $\Delta = 1.00$				
20	5.66	6.63	7.90	8.84	9.83
50	5.70	6.68	7.89	8.84	9.82
100	5.79	6.62	7.87	8.84	9.85
500	5.30	6.45	7.85	8.81	9.83
	$\lambda = 0.10$, $\Delta = 2.00$				
20	2.33	2.59	2.91	3.14	3.38
50	2.33	2.59	2.90	3.14	3.37
100	2.32	2.58	2.91	3.14	3.37
500	2.08	2.56	2.94	3.15	3.38
	$\lambda = 0.10$, $\Delta = 3.00$				
20	1.50	1.61	1.76	1.86	1.97
50	1.49	1.60	1.76	1.87	1.97
100	1.48	1.59	1.74	1.86	1.97
500	1.32	1.65	1.76	1.86	1.97

Table 327

Out of Control ARL_0 for MEWMA of Dimension 7 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20$, $\Delta = 0.25$		
20	44.16	79.31	169.31	301.26	528.58
50	44.40	79.42	170.81	301.60	528.30
100	44.06	79.66	170.82	301.67	530.12
500	44.87	78.51	169.82	306.65	531.97
			$\lambda = 0.20$, $\Delta = 0.50$		
20	17.25	25.77	42.67	63.78	95.70
50	17.48	26.32	42.66	63.89	95.58
100	17.48	26.29	42.77	63.99	95.35
500	17.22	25.63	43.04	64.28	95.55
			$\lambda = 0.20$, $\Delta = 1.00$		
20	5.31	6.52	8.13	9.67	11.44
50	5.32	6.49	8.19	9.73	11.47
100	5.38	6.58	8.13	9.64	11.43
500	4.47	6.10	7.99	9.52	11.36
			$\lambda = 0.20$, $\Delta = 2.00$		
20	1.92	2.12	2.38	2.58	2.77
50	1.93	2.13	2.37	2.57	2.76
100	1.91	2.13	2.37	2.57	2.76
500	1.76	2.11	2.36	2.56	2.76
			$\lambda = 0.20$, $\Delta = 3.00$		
20	1.26	1.32	1.41	1.48	1.55
50	1.27	1.33	1.41	1.48	1.56
100	1.26	1.31	1.41	1.48	1.55
500	1.10	1.30	1.41	1.47	1.55

Table 328

Out of Control ARL_0 for MEWMA of Dimension 7 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	50.55	96.38	213.94	397.49	736.34
50	50.49	96.79	213.98	396.62	735.54
100	51.41	96.95	212.28	396.72	736.46
500	52.17	97.91	213.26	399.09	735.13
			λ = 0.30, Δ = 0.50		
20	20.76	33.35	61.99	101.65	167.54
50	20.81	33.76	62.38	101.66	167.83
100	21.03	33.81	62.39	101.76	167.81
500	18.09	34.94	61.57	102.71	169.25
			λ = 0.30, Δ = 1.00		
20	5.76	7.30	9.96	12.90	16.61
50	5.71	7.35	10.04	12.95	16.49
100	5.67	7.36	10.00	13.04	16.60
500	4.54	7.05	9.91	12.98	16.74
			λ = 0.30, Δ = 2.00		
20	1.80	2.01	2.27	2.48	2.68
50	1.81	2.00	2.27	2.46	2.67
100	1.81	1.99	2.26	2.45	2.67
500	1.78	1.96	2.25	2.45	2.69
			λ = 0.30, Δ = 3.00		
20	1.19	1.24	1.31	1.37	1.43
50	1.20	1.25	1.31	1.37	1.43
100	1.18	1.25	1.32	1.37	1.43
500	1.09	1.25	1.32	1.37	1.42

Table 329

Out of Control ARL_0 for MEWMA of Dimension 7 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	56.48	108.13	250.81	481.21	920.07
50	56.35	108.16	249.67	479.42	920.51
100	57.01	108.40	248.69	478.26	919.64
500	52.40	107.65	249.48	479.94	922.14
			λ = 0.40, Δ = 0.50		
20	24.61	42.28	85.92	145.78	251.75
50	24.82	42.03	86.09	146.30	252.01
100	24.91	41.68	85.42	145.86	250.44
500	25.06	40.20	87.20	146.99	252.14
			λ = 0.40, Δ = 1.00		
20	6.56	8.88	13.29	18.33	26.30
50	6.46	8.82	13.38	18.38	26.26
100	6.45	8.71	13.35	18.43	26.41
500	6.65	8.23	13.08	18.60	26.51
			λ = 0.40, Δ = 2.00		
20	1.82	2.04	2.36	2.61	2.87
50	1.80	2.03	2.33	2.60	2.88
100	1.82	2.02	2.33	2.60	2.87
500	1.94	1.89	2.33	2.61	2.88
			λ = 0.40, Δ = 3.00		
20	1.19	1.22	1.29	1.35	1.42
50	1.19	1.22	1.29	1.36	1.42
100	1.17	1.23	1.30	1.35	1.42
500	1.15	1.23	1.30	1.35	1.42

Table 330

Out of Control ARL_0 for MEWMA of Dimension 7 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	61.09	117.43	278.99	543.44	1053.38
50	61.67	117.58	278.89	541.41	1053.05
100	62.82	116.88	276.45	539.76	1048.32
500	64.02	120.01	278.04	536.77	1047.43
			$\lambda = 0.50, \Delta = 0.50$		
20	29.34	51.17	109.26	191.79	343.44
50	29.51	51.14	109.47	191.92	343.21
100	29.64	50.88	109.32	191.31	341.82
500	29.04	50.53	111.85	190.57	339.80
			$\lambda = 0.50, \Delta = 1.00$		
20	7.73	11.07	18.25	26.57	39.65
50	7.76	11.09	18.21	26.70	39.73
100	7.63	11.01	18.08	26.49	39.73
500	6.44	9.97	17.56	26.39	39.87
			$\lambda = 0.50, \Delta = 2.00$		
20	1.91	2.18	2.60	2.97	3.42
50	1.92	2.17	2.57	2.98	3.42
100	1.93	2.16	2.57	2.97	3.41
500	1.84	2.10	2.60	2.97	3.44
			$\lambda = 0.50, \Delta = 3.00$		
20	1.20	1.24	1.32	1.40	1.47
50	1.20	1.25	1.34	1.40	1.47
100	1.19	1.23	1.33	1.40	1.48
500	1.36	1.22	1.32	1.40	1.48

Table 331

Out of Control ARL_0 for MEWMA of Dimension 7 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	64.66	126.44	310.90	608.44	1167.96
50	65.24	126.51	310.20	606.25	1168.92
100	67.46	125.86	309.88	603.67	1167.98
500	81.45	126.84	311.55	599.67	1158.52
	λ = 0.60, Δ = 0.50				
20	33.60	60.66	134.72	241.95	442.08
50	33.80	60.75	134.19	241.43	441.78
100	34.74	60.65	133.48	240.83	440.68
500	36.59	60.25	134.42	236.85	440.19
	λ = 0.60, Δ = 1.00				
20	9.29	14.19	24.77	38.39	59.41
50	9.29	14.16	24.65	38.36	59.41
100	8.95	14.01	24.34	38.02	59.34
500	7.19	13.83	23.93	38.18	59.53
	λ = 0.60, Δ = 2.00				
20	2.12	2.47	3.09	3.70	4.51
50	2.11	2.46	3.06	3.70	4.50
100	2.12	2.46	3.05	3.68	4.48
500	1.75	2.43	3.03	3.67	4.51
	λ = 0.60, Δ = 3.00				
20	1.24	1.31	1.41	1.50	1.60
50	1.23	1.31	1.42	1.51	1.60
100	1.23	1.31	1.41	1.50	1.61
500	1.30	1.28	1.42	1.51	1.62

Table 332

Out of Control ARL_0 for MEWMA of Dimension 7 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	70.54	142.35	357.28	699.81	1396.27
50	70.16	141.88	356.59	700.01	1393.38
100	70.94	141.81	352.82	695.54	1389.00
500	78.78	138.15	350.19	690.38	1383.28
	λ = 0.80, Δ = 0.50				
20	42.55	80.29	185.27	350.34	665.66
50	42.18	80.24	185.47	349.34	665.28
100	42.82	80.20	183.99	347.88	662.98
500	41.62	78.47	179.10	342.55	659.32
	λ = 0.80, Δ = 1.00				
20	14.07	22.66	43.94	71.65	120.68
50	13.99	22.63	44.05	71.68	120.31
100	14.18	22.55	43.48	71.36	119.92
500	10.64	21.47	42.35	69.93	117.66
	λ = 0.80, Δ = 2.00				
20	2.87	3.66	5.20	6.78	9.19
50	2.85	3.62	5.18	6.74	9.13
100	2.88	3.61	5.18	6.77	9.12
500	3.44	3.85	5.18	6.60	9.13
	λ = 0.80, Δ = 3.00				
20	1.44	1.61	1.82	2.02	2.29
50	1.45	1.60	1.83	2.02	2.29
100	1.43	1.58	1.79	2.01	2.29
500	1.20	1.63	1.79	2.03	2.32

Table 333

Out of Control ARL_0 for MEWMA of Dimension 8 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	32.56	45.97	74.14	105.75	147.23
50	32.76	46.56	74.72	105.94	147.55
100	33.12	47.56	75.33	105.78	147.53
500	30.64	45.68	77.09	105.40	147.18
			λ = 0.05, Δ = 0.50		
20	14.26	17.64	22.63	26.99	31.45
50	14.48	17.99	23.04	27.32	31.70
100	14.68	18.06	22.93	27.11	31.56
500	13.04	18.01	23.58	27.02	31.63
			λ = 0.05, Δ = 1.00		
20	6.13	7.10	8.33	9.25	10.10
50	6.24	7.22	8.48	9.43	10.28
100	6.31	7.27	8.50	9.40	10.24
500	6.80	7.52	8.66	9.44	10.32
			λ = 0.05, Δ = 2.00		
20	2.75	3.06	3.47	3.75	4.02
50	2.77	3.13	3.55	3.86	4.14
100	2.82	3.16	3.56	3.86	4.14
500	2.64	3.26	3.61	3.87	4.16
			λ = 0.05, Δ = 3.00		
20	1.78	1.95	2.16	2.32	2.47
50	1.81	2.00	2.22	2.38	2.53
100	1.82	2.00	2.22	2.37	2.53
500	1.76	2.07	2.26	2.40	2.55

Table 334

Out of Control ARL_0 for MEWMA of Dimension 8 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	34.89	55.62	103.67	161.93	265.67
50	34.97	55.84	104.79	162.48	264.85
100	35.01	56.10	104.69	162.91	265.60
500	34.42	59.36	105.28	164.95	267.21
			$\lambda = 0.10, \Delta = 0.50$		
20	13.87	18.45	26.09	32.93	42.00
50	13.96	18.84	26.27	33.25	42.27
100	14.17	18.94	26.24	33.11	42.38
500	18.91	20.50	26.80	33.44	42.48
			$\lambda = 0.10, \Delta = 1.00$		
20	5.30	6.19	7.35	8.20	9.06
50	5.34	6.20	7.42	8.25	9.12
100	5.44	6.28	7.42	8.24	9.11
500	5.44	6.57	7.59	8.34	9.18
			$\lambda = 0.10, \Delta = 2.00$		
20	2.25	2.48	2.77	2.97	3.18
50	2.25	2.47	2.78	2.98	3.19
100	2.26	2.49	2.80	2.99	3.20
500	2.17	2.56	2.80	3.03	3.21
			$\lambda = 0.10, \Delta = 3.00$		
20	1.46	1.56	1.71	1.80	1.90
50	1.47	1.58	1.71	1.81	1.91
100	1.47	1.59	1.72	1.82	1.91
500	1.38	1.61	1.73	1.83	1.92

Table 335

Out of Control ARL_0 for MEWMA of Dimension 8 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	42.37	75.02	159.24	279.63	490.93
50	42.23	74.93	159.25	278.98	490.39
100	42.85	76.32	159.48	280.29	490.66
500	39.70	73.05	159.93	280.93	489.45
			λ = 0.20, Δ = 0.50		
20	16.33	23.81	39.29	58.88	87.54
50	16.37	23.84	39.70	59.21	87.72
100	16.67	24.02	39.35	59.17	87.76
500	18.32	24.24	39.22	58.37	87.05
			λ = 0.20, Δ = 1.00		
20	5.04	6.06	7.65	8.99	10.59
50	5.08	6.00	7.63	9.08	10.66
100	5.11	6.14	7.72	9.06	10.62
500	5.33	6.20	7.79	9.16	10.66
			λ = 0.20, Δ = 2.00		
20	1.88	2.06	2.27	2.46	2.63
50	1.88	2.04	2.29	2.45	2.62
100	1.91	2.08	2.30	2.48	2.64
500	1.84	2.05	2.32	2.50	2.65
			λ = 0.20, Δ = 3.00		
20	1.26	1.31	1.39	1.45	1.52
50	1.25	1.30	1.38	1.45	1.51
100	1.27	1.32	1.40	1.46	1.52
500	1.11	1.29	1.41	1.46	1.52

Table 336

Out of Control ARL_0 for MEWMA of Dimension 8 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	47.78	90.55	202.70	364.05	670.59
50	48.04	90.55	203.30	365.38	671.10
100	49.22	92.24	204.46	367.21	669.45
500	48.00	93.46	208.89	369.38	671.50
			λ = 0.30, Δ = 0.50		
20	19.52	30.91	56.88	94.75	154.66
50	19.45	31.18	57.53	95.40	154.76
100	19.53	30.67	57.71	95.37	154.70
500	26.78	30.88	56.63	96.52	154.31
			λ = 0.30, Δ = 1.00		
20	5.42	6.86	9.32	12.00	15.16
50	5.41	6.84	9.36	12.00	15.24
100	5.35	6.87	9.42	12.03	15.29
500	5.73	6.96	9.48	12.18	15.35
			λ = 0.30, Δ = 2.00		
20	1.78	1.95	2.18	2.36	2.56
50	1.76	1.94	2.17	2.35	2.56
100	1.79	1.96	2.19	2.37	2.56
500	1.85	1.91	2.18	2.37	2.56
			λ = 0.30, Δ = 3.00		
20	1.20	1.24	1.30	1.35	1.40
50	1.19	1.23	1.29	1.34	1.39
100	1.21	1.24	1.31	1.36	1.41
500	1.39	1.20	1.30	1.36	1.40

Table 337

Out of Control ARL_0 for MEWMA of Dimension 8 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40$, $\Delta = 0.25$		
20	53.08	103.18	238.75	443.56	847.65
50	53.01	103.32	239.26	445.36	848.46
100	54.51	106.08	239.81	446.99	848.42
500	51.36	102.08	241.83	447.03	852.12
			$\lambda = 0.40$, $\Delta = 0.50$		
20	23.16	39.29	80.36	135.27	227.51
50	22.98	39.63	80.79	135.89	228.69
100	23.13	39.21	81.50	135.85	228.31
500	22.59	37.60	81.81	137.24	229.00
			$\lambda = 0.40$, $\Delta = 1.00$		
20	6.18	8.29	12.31	16.71	23.12
50	6.16	8.32	12.28	16.73	23.26
100	6.08	8.30	12.33	16.76	23.11
500	6.88	8.69	12.33	16.96	23.32
			$\lambda = 0.40$, $\Delta = 2.00$		
20	1.80	1.99	2.26	2.50	2.75
50	1.78	1.96	2.25	2.51	2.76
100	1.78	1.97	2.26	2.50	2.76
500	1.53	1.98	2.25	2.51	2.74
			$\lambda = 0.40$, $\Delta = 3.00$		
20	1.19	1.24	1.30	1.34	1.40
50	1.19	1.23	1.28	1.33	1.39
100	1.18	1.23	1.29	1.36	1.40
500	1.06	1.23	1.28	1.34	1.39

Table 338

Out of Control ARL_0 for MEWMA of Dimension 8 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	57.03	113.70	268.01	519.06	980.86
50	57.31	113.87	267.45	520.79	978.91
100	59.05	116.53	269.29	522.00	979.42
500	54.71	114.54	267.80	519.81	985.12
			$\lambda = 0.50, \Delta = 0.50$		
20	27.01	48.25	103.14	181.66	315.31
50	27.07	48.67	103.44	182.74	316.51
100	27.58	48.88	104.16	182.36	316.82
500	32.76	46.58	101.81	180.69	318.69
			$\lambda = 0.50, \Delta = 1.00$		
20	7.36	10.31	16.61	24.35	37.01
50	7.28	10.30	16.66	24.41	37.02
100	7.39	10.34	16.68	24.47	37.08
500	11.18	10.51	16.65	24.04	36.82
			$\lambda = 0.50, \Delta = 2.00$		
20	1.91	2.14	2.51	2.86	3.26
50	1.90	2.11	2.51	2.85	3.24
100	1.94	2.11	2.51	2.84	3.25
500	2.38	2.19	2.51	2.84	3.27
			$\lambda = 0.50, \Delta = 3.00$		
20	1.21	1.26	1.34	1.39	1.45
50	1.21	1.25	1.33	1.38	1.44
100	1.19	1.25	1.34	1.39	1.46
500	1.08	1.23	1.34	1.38	1.44

Table 339

Out of Control ARL_0 for MEWMA of Dimension 8 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	61.23	122.74	295.85	579.86	1124.75
50	61.36	123.13	296.15	579.84	1125.08
100	62.26	125.07	297.42	583.34	1126.46
500	64.39	120.11	300.52	581.26	1118.22
			λ = 0.60, Δ = 0.50		
20	31.04	57.42	127.37	229.58	413.95
50	31.47	56.89	127.84	230.50	414.50
100	32.05	57.67	128.31	231.01	414.78
500	28.00	54.03	126.87	228.99	413.49
			λ = 0.60, Δ = 1.00		
20	8.80	13.16	23.16	36.47	57.09
50	8.85	13.06	23.21	36.49	56.88
100	8.95	13.15	23.39	36.81	57.11
500	10.83	13.38	23.03	36.37	56.56
			λ = 0.60, Δ = 2.00		
20	2.10	2.46	2.98	3.52	4.23
50	2.07	2.42	2.96	3.52	4.19
100	2.08	2.41	2.96	3.50	4.16
500	3.21	2.59	3.02	3.53	4.19
			λ = 0.60, Δ = 3.00		
20	1.26	1.34	1.42	1.49	1.58
50	1.25	1.32	1.42	1.48	1.57
100	1.24	1.31	1.41	1.50	1.58
500	1.30	1.34	1.44	1.48	1.56

Table 340

Out of Control ARL_0 for MEWMA of Dimension 8 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	67.72	137.76	349.28	683.60	1331.25
50	68.01	138.63	350.51	684.41	1330.16
100	67.97	138.50	352.57	686.92	1333.77
500	69.80	135.63	355.73	687.17	1346.14
	λ = 0.80, Δ = 0.50				
20	39.62	76.18	178.88	337.10	619.40
50	39.72	76.77	179.34	337.55	620.27
100	39.85	77.45	181.01	339.53	622.24
500	35.40	74.69	184.39	337.70	625.48
	λ = 0.80, Δ = 1.00				
20	12.95	22.04	42.34	71.10	119.31
50	12.97	21.96	42.46	70.90	119.26
100	12.76	22.27	42.93	71.62	119.62
500	9.31	21.33	42.01	71.02	120.11
	λ = 0.80, Δ = 2.00				
20	2.87	3.60	4.98	6.60	8.52
50	2.79	3.59	5.00	6.60	8.52
100	2.84	3.58	4.99	6.62	8.51
500	2.45	3.78	5.09	6.78	8.62
	λ = 0.80, Δ = 3.00				
20	1.45	1.59	1.82	2.03	2.28
50	1.47	1.59	1.81	2.02	2.26
100	1.45	1.57	1.82	2.02	2.27
500	1.75	1.58	1.86	1.99	2.28

Table 341

Out of Control ARL_0 for MEWMA of Dimension 9 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	30.57	44.80	70.51	98.74	139.68
50	30.86	44.62	71.27	99.73	139.97
100	31.81	44.83	70.70	98.42	140.00
500	30.34	44.16	71.98	98.60	140.39
			λ = 0.05, Δ = 0.50		
20	13.55	16.96	21.59	25.49	29.35
50	13.63	16.94	21.71	25.46	29.60
100	13.95	17.02	21.66	25.39	29.69
500	13.95	16.96	21.77	25.40	29.46
			λ = 0.05, Δ = 1.00		
20	5.88	6.76	7.90	8.68	9.49
50	5.99	6.87	8.02	8.85	9.67
100	6.00	6.85	8.02	8.83	9.64
500	5.51	7.05	8.10	8.81	9.61
			λ = 0.05, Δ = 2.00		
20	2.67	2.98	3.34	3.60	3.86
50	2.72	3.02	3.41	3.68	3.94
100	2.74	3.03	3.41	3.66	3.92
500	2.53	3.07	3.42	3.64	3.91
			λ = 0.05, Δ = 3.00		
20	1.76	1.92	2.11	2.26	2.40
50	1.78	1.94	2.15	2.30	2.44
100	1.79	1.94	2.16	2.30	2.45
500	1.71	1.98	2.16	2.29	2.43

Table 342

Out of Control ARL_0 for MEWMA of Dimension 9 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	33.21	53.58	97.21	155.57	247.55
50	32.59	53.43	97.43	155.21	248.02
100	34.11	53.26	97.60	155.21	248.26
500	33.32	55.07	98.00	155.25	248.94
			λ = 0.10, Δ = 0.50		
20	13.11	17.20	23.91	30.69	39.39
50	13.03	17.40	23.94	30.31	39.47
100	13.22	17.45	24.03	30.54	39.68
500	13.76	18.33	24.42	30.83	39.96
			λ = 0.10, Δ = 1.00		
20	5.06	5.84	6.86	7.67	8.51
50	5.05	5.86	6.88	7.70	8.54
100	5.02	5.82	6.88	7.68	8.57
500	5.05	6.10	7.00	7.74	8.59
			λ = 0.10, Δ = 2.00		
20	2.19	2.39	2.66	2.85	3.04
50	2.16	2.39	2.67	2.85	3.04
100	2.16	2.39	2.65	2.84	3.04
500	2.14	2.37	2.64	2.86	3.04
			λ = 0.10, Δ = 3.00		
20	1.44	1.55	1.67	1.76	1.85
50	1.44	1.54	1.67	1.76	1.85
100	1.44	1.54	1.66	1.75	1.85
500	1.41	1.57	1.67	1.77	1.86

Table 343

Out of Control ARL_0 for MEWMA of Dimension 9 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	39.12	69.96	146.72	260.53	463.36
50	39.60	69.58	146.56	260.51	463.26
100	39.12	68.55	146.15	260.56	464.99
500	36.55	65.40	147.87	260.07	462.36
			$\lambda = 0.20, \Delta = 0.50$		
20	14.76	21.59	36.41	53.14	82.20
50	14.88	21.62	36.27	53.20	81.96
100	14.73	21.75	36.04	53.01	81.59
500	17.28	21.02	35.69	52.90	81.07
			$\lambda = 0.20, \Delta = 1.00$		
20	4.69	5.64	6.99	8.26	9.83
50	4.70	5.62	7.06	8.36	9.94
100	4.67	5.56	7.04	8.31	9.89
500	4.75	5.57	7.06	8.27	9.86
			$\lambda = 0.20, \Delta = 2.00$		
20	1.82	1.99	2.20	2.36	2.52
50	1.82	1.99	2.21	2.38	2.53
100	1.81	1.98	2.20	2.36	2.52
500	1.62	1.93	2.19	2.35	2.51
			$\lambda = 0.20, \Delta = 3.00$		
20	1.22	1.29	1.37	1.43	1.48
50	1.24	1.29	1.36	1.43	1.49
100	1.23	1.29	1.36	1.43	1.49
500	1.22	1.25	1.36	1.43	1.49

Table 344

Out of Control ARL_0 for MEWMA of Dimension 9 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	44.63	82.94	189.04	346.02	644.96
50	44.23	82.75	188.44	346.20	647.08
100	43.93	82.49	187.55	346.66	646.56
500	43.08	81.53	190.88	344.96	640.67
			λ = 0.30, Δ = 0.50		
20	17.68	28.16	53.10	85.58	140.73
50	17.58	28.11	52.98	84.84	141.00
100	17.70	28.27	52.74	84.74	140.52
500	17.63	29.18	51.25	85.17	138.72
			λ = 0.30, Δ = 1.00		
20	4.99	6.36	8.65	10.84	13.86
50	5.01	6.41	8.74	10.94	13.89
100	5.05	6.43	8.69	10.89	13.94
500	5.68	6.34	8.60	10.88	13.74
			λ = 0.30, Δ = 2.00		
20	1.73	1.88	2.09	2.28	2.46
50	1.70	1.89	2.11	2.29	2.47
100	1.71	1.89	2.11	2.28	2.46
500	1.65	1.89	2.07	2.26	2.46
			λ = 0.30, Δ = 3.00		
20	1.17	1.22	1.28	1.32	1.38
50	1.17	1.23	1.29	1.33	1.39
100	1.17	1.23	1.28	1.33	1.39
500	1.06	1.25	1.28	1.33	1.38

Table 345

Out of Control ARL_0 for MEWMA of Dimension 9 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	48.79	95.69	227.82	430.11	811.68
50	48.62	95.64	226.90	430.86	813.84
100	47.94	94.61	227.64	430.00	814.08
500	37.08	92.10	224.36	428.94	812.55
			$\lambda = 0.40, \Delta = 0.50$		
20	21.38	36.06	74.12	127.10	216.03
50	21.58	35.86	73.81	127.02	216.56
100	21.26	36.07	73.87	126.95	215.79
500	24.00	35.30	72.20	127.86	215.49
			$\lambda = 0.40, \Delta = 1.00$		
20	5.78	7.81	11.43	15.75	21.79
50	5.77	7.83	11.52	15.80	21.66
100	5.80	7.83	11.49	15.84	21.46
500	5.91	7.76	11.31	15.89	21.53
			$\lambda = 0.40, \Delta = 2.00$		
20	1.74	1.91	2.18	2.42	2.67
50	1.71	1.90	2.19	2.45	2.70
100	1.75	1.90	2.19	2.43	2.70
500	1.38	1.98	2.17	2.45	2.68
			$\lambda = 0.40, \Delta = 3.00$		
20	1.17	1.21	1.28	1.32	1.37
50	1.17	1.22	1.29	1.32	1.38
100	1.17	1.22	1.28	1.33	1.38
500	1.08	1.28	1.30	1.34	1.39

Table 346

Out of Control ARL_0 for MEWMA of Dimension 9 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	53.13	106.90	258.01	502.63	946.62
50	53.04	106.49	258.06	503.84	945.31
100	52.64	105.10	258.59	503.79	946.19
500	51.76	95.80	255.82	500.50	949.81
			$\lambda = 0.50, \Delta = 0.50$		
20	25.00	44.71	96.84	170.39	301.31
50	25.09	44.55	97.03	169.86	301.30
100	24.59	44.46	96.87	170.22	302.20
500	20.49	40.64	96.12	170.05	301.12
			$\lambda = 0.50, \Delta = 1.00$		
20	6.88	9.91	15.90	23.09	34.35
50	6.82	9.89	15.96	23.09	34.27
100	6.79	9.71	15.94	22.96	34.03
500	4.65	9.43	16.15	22.99	33.91
			$\lambda = 0.50, \Delta = 2.00$		
20	1.82	2.07	2.44	2.77	3.13
50	1.79	2.04	2.46	2.81	3.16
100	1.80	2.03	2.45	2.79	3.14
500	1.28	2.09	2.45	2.77	3.12
			$\lambda = 0.50, \Delta = 3.00$		
20	1.19	1.24	1.32	1.38	1.44
50	1.19	1.25	1.33	1.38	1.44
100	1.20	1.25	1.31	1.38	1.44
500	1.00	1.29	1.35	1.40	1.45

Table 347

Out of Control ARL_0 for MEWMA of Dimension 9 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	56.37	115.60	289.43	557.33	1082.97
50	56.50	116.06	288.75	557.47	1081.23
100	57.31	115.26	288.21	556.56	1077.97
500	46.47	110.21	282.12	564.01	1086.78
			λ = 0.60, Δ = 0.50		
20	29.08	52.60	120.83	215.50	396.04
50	29.10	52.61	120.61	214.66	394.65
100	29.22	52.63	119.84	215.19	395.21
500	23.53	51.52	117.23	218.96	396.17
			λ = 0.60, Δ = 1.00		
20	8.44	12.62	22.27	33.37	52.48
50	8.49	12.58	22.17	33.40	52.45
100	8.39	12.52	22.03	33.17	51.86
500	6.57	11.08	22.29	33.39	53.03
			λ = 0.60, Δ = 2.00		
20	2.00	2.35	2.87	3.42	4.04
50	1.98	2.33	2.91	3.44	4.07
100	1.98	2.34	2.88	3.40	4.08
500	2.21	2.17	2.89	3.46	4.12
			λ = 0.60, Δ = 3.00		
20	1.23	1.31	1.41	1.50	1.58
50	1.23	1.32	1.42	1.50	1.58
100	1.22	1.32	1.41	1.49	1.58
500	1.00	1.37	1.46	1.51	1.59

Table 348

Out of Control ARL_0 for MEWMA of Dimension 9 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	63.50	131.50	330.25	637.21	1247.99
50	63.94	130.65	329.06	637.08	1246.73
100	64.20	128.95	327.89	634.79	1245.69
500	63.67	129.56	328.46	638.73	1257.79
			$\lambda = 0.80, \Delta = 0.50$		
20	37.30	71.49	166.68	308.47	573.71
50	37.61	71.37	165.48	306.16	572.24
100	37.84	70.78	164.89	305.97	571.33
500	44.19	70.90	165.95	311.05	569.14
			$\lambda = 0.80, \Delta = 1.00$		
20	12.53	21.16	40.10	66.16	113.57
50	12.68	20.98	40.05	65.76	112.99
100	12.76	20.96	39.45	65.79	112.99
500	15.11	20.31	40.14	66.08	112.49
			$\lambda = 0.80, \Delta = 2.00$		
20	2.74	3.56	4.81	6.36	8.50
50	2.65	3.56	4.79	6.39	8.51
100	2.70	3.52	4.78	6.36	8.45
500	4.38	3.67	4.98	6.45	8.54
			$\lambda = 0.80, \Delta = 3.00$		
20	1.44	1.59	1.84	2.05	2.30
50	1.44	1.58	1.83	2.05	2.29
100	1.41	1.60	1.86	2.05	2.28
500	1.38	1.72	1.89	2.06	2.28

Table 349

Out of Control ARL_0 for MEWMA of Dimension 10 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	λ = 0.05, Δ = 0.25				
20	28.88	41.33	64.29	89.23	127.36
50	29.12	41.99	65.23	89.55	127.26
100	29.30	41.47	64.18	88.96	127.26
500	35.00	41.42	65.38	91.09	129.10
	λ = 0.05, Δ = 0.50				
20	12.80	15.90	20.14	23.58	27.29
50	12.86	16.07	20.36	23.79	27.32
100	12.89	15.95	20.24	23.63	27.30
500	14.92	16.50	20.63	23.86	27.48
	λ = 0.05, Δ = 1.00				
20	5.63	6.44	7.47	8.21	8.93
50	5.67	6.49	7.57	8.28	9.01
100	5.66	6.49	7.51	8.23	8.94
500	6.32	6.44	7.61	8.37	9.06
	λ = 0.05, Δ = 2.00				
20	2.57	2.85	3.20	3.44	3.67
50	2.63	2.91	3.26	3.50	3.74
100	2.61	2.89	3.23	3.48	3.71
500	2.91	2.88	3.28	3.53	3.75
	λ = 0.05, Δ = 3.00				
20	1.70	1.84	2.03	2.16	2.30
50	1.73	1.89	2.09	2.22	2.34
100	1.75	1.88	2.07	2.20	2.33
500	2.00	1.92	2.10	2.23	2.35

Table 350

Out of Control ARL_0 for MEWMA of Dimension 10 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	31.14	49.23	89.68	141.88	226.26
50	31.31	49.57	89.87	142.05	226.08
100	31.07	49.27	89.96	141.82	225.90
500	44.51	49.54	91.17	144.16	226.15
			λ = 0.10, Δ = 0.50		
20	12.36	16.28	22.62	28.39	35.88
50	12.30	16.38	22.57	28.38	36.08
100	12.39	16.35	22.51	28.36	35.90
500	15.76	16.50	23.09	28.39	35.89
			λ = 0.10, Δ = 1.00		
20	4.84	5.59	6.54	7.24	7.98
50	4.84	5.57	6.49	7.20	7.91
100	4.80	5.56	6.47	7.18	7.88
500	4.94	5.53	6.61	7.29	7.93
			λ = 0.10, Δ = 2.00		
20	2.10	2.30	2.55	2.73	2.90
50	2.10	2.31	2.55	2.74	2.91
100	2.11	2.30	2.54	2.73	2.90
500	2.40	2.27	2.57	2.74	2.90
			λ = 0.10, Δ = 3.00		
20	1.40	1.50	1.62	1.70	1.79
50	1.41	1.51	1.62	1.71	1.80
100	1.40	1.50	1.62	1.71	1.78
500	1.62	1.55	1.64	1.72	1.79

Table 351

Out of Control ARL_0 for MEWMA of Dimension 10 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	36.27	64.91	136.42	239.74	421.76
50	36.51	65.88	137.44	241.11	423.22
100	36.35	65.46	136.39	239.40	423.31
500	33.88	71.69	139.77	242.76	422.75
			$\lambda = 0.20, \Delta = 0.50$		
20	14.20	20.36	33.37	48.86	73.51
50	14.12	20.54	33.65	48.98	73.76
100	14.06	20.72	33.68	48.51	73.69
500	15.53	21.52	34.65	49.68	73.65
			$\lambda = 0.20, \Delta = 1.00$		
20	4.52	5.38	6.61	7.74	9.04
50	4.53	5.37	6.69	7.76	9.03
100	4.53	5.37	6.65	7.75	9.05
500	4.13	5.64	6.82	7.83	9.09
			$\lambda = 0.20, \Delta = 2.00$		
20	1.77	1.93	2.11	2.26	2.41
50	1.78	1.93	2.12	2.27	2.42
100	1.75	1.94	2.12	2.26	2.40
500	1.77	1.94	2.11	2.25	2.41
			$\lambda = 0.20, \Delta = 3.00$		
20	1.21	1.26	1.33	1.38	1.44
50	1.23	1.27	1.34	1.39	1.44
100	1.23	1.27	1.34	1.40	1.44
500	1.12	1.25	1.32	1.39	1.45

Table 352

Out of Control ARL_0 for MEWMA of Dimension 10 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	41.69	79.59	176.72	322.49	597.76
50	42.11	80.82	177.15	322.88	598.29
100	43.32	81.36	176.39	322.41	597.92
500	56.46	88.41	176.09	325.66	599.95
			λ = 0.30, Δ = 0.50		
20	16.84	26.71	48.82	77.74	126.90
50	16.87	26.95	48.86	78.32	127.52
100	17.23	27.29	48.89	77.85	126.71
500	22.27	27.29	49.71	79.22	127.03
			λ = 0.30, Δ = 1.00		
20	4.84	6.07	8.08	10.01	12.89
50	4.87	6.08	8.14	10.01	12.76
100	4.95	6.13	8.15	10.01	12.83
500	5.61	6.42	8.37	10.29	12.90
			λ = 0.30, Δ = 2.00		
20	1.68	1.83	2.04	2.19	2.36
50	1.69	1.83	2.03	2.18	2.36
100	1.71	1.84	2.04	2.20	2.36
500	2.20	1.91	2.03	2.21	2.37
			λ = 0.30, Δ = 3.00		
20	1.17	1.21	1.26	1.30	1.35
50	1.16	1.21	1.26	1.31	1.35
100	1.17	1.21	1.27	1.31	1.35
500	1.26	1.22	1.26	1.31	1.34

Table 353

Out of Control ARL_0 for MEWMA of Dimension 10 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	46.75	90.90	210.65	400.26	759.63
50	46.99	90.91	212.23	400.25	759.04
100	47.60	91.51	212.02	400.28	758.03
500	44.26	97.33	210.14	401.55	763.73
			λ = 0.40, Δ = 0.50		
20	20.07	34.10	66.49	113.23	195.00
50	20.21	34.54	66.78	113.89	194.62
100	20.31	34.47	66.25	113.37	194.46
500	24.56	36.05	68.40	115.79	194.86
			λ = 0.40, Δ = 1.00		
20	5.57	7.32	10.59	14.44	20.05
50	5.61	7.38	10.68	14.42	19.98
100	5.82	7.48	10.70	14.43	19.97
500	6.94	7.83	11.20	14.71	20.24
			λ = 0.40, Δ = 2.00		
20	1.71	1.88	2.11	2.32	2.55
50	1.71	1.89	2.12	2.33	2.54
100	1.74	1.90	2.14	2.35	2.55
500	2.54	1.92	2.18	2.34	2.57
			λ = 0.40, Δ = 3.00		
20	1.17	1.21	1.26	1.30	1.35
50	1.16	1.20	1.26	1.30	1.35
100	1.17	1.22	1.26	1.31	1.35
500	1.31	1.23	1.27	1.31	1.34

Table 354

Out of Control ARL_0 for MEWMA of Dimension 10 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	50.69	100.30	242.60	469.10	890.34
50	51.10	101.17	243.92	469.42	887.51
100	52.48	102.59	243.76	469.69	886.31
500	59.42	105.05	244.48	466.57	886.88
			λ = 0.50, Δ = 0.50		
20	23.99	42.36	88.22	154.10	280.82
50	24.45	42.31	89.08	154.74	279.76
100	24.94	42.58	88.83	154.25	279.94
500	35.28	42.54	90.34	154.57	278.85
			λ = 0.50, Δ = 1.00		
20	6.57	9.22	14.70	21.71	32.44
50	6.63	9.34	14.93	21.87	32.33
100	6.94	9.45	14.90	21.84	32.58
500	7.86	10.27	15.07	21.95	32.87
			λ = 0.50, Δ = 2.00		
20	1.83	2.04	2.37	2.68	3.02
50	1.84	2.02	2.38	2.69	3.03
100	1.87	2.07	2.41	2.70	3.03
500	2.08	2.09	2.50	2.70	3.04
			λ = 0.50, Δ = 3.00		
20	1.19	1.23	1.31	1.35	1.42
50	1.19	1.23	1.29	1.36	1.41
100	1.18	1.25	1.30	1.37	1.41
500	1.25	1.22	1.33	1.36	1.41

Table 355

Out of Control ARL_0 for MEWMA of Dimension 10 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	55.18	109.71	271.68	513.89	1019.38
50	55.33	110.82	272.82	513.85	1020.13
100	56.29	110.14	273.88	514.32	1018.55
500	67.59	115.51	273.16	516.04	1020.16
	λ = 0.60, Δ = 0.50				
20	27.84	50.97	110.07	195.83	364.18
50	28.20	51.77	110.67	196.42	364.04
100	28.18	52.22	111.05	196.45	363.13
500	44.71	54.54	114.61	198.72	360.01
	λ = 0.60, Δ = 1.00				
20	8.03	11.99	20.78	31.68	49.73
50	8.10	12.06	21.02	31.84	49.92
100	8.51	12.08	21.09	32.12	50.03
500	13.52	12.74	21.91	32.35	49.90
	λ = 0.60, Δ = 2.00				
20	2.03	2.35	2.84	3.31	3.93
50	2.05	2.33	2.86	3.34	3.94
100	2.06	2.38	2.90	3.30	3.96
500	2.41	2.46	2.99	3.33	3.99
	λ = 0.60, Δ = 3.00				
20	1.24	1.29	1.39	1.48	1.58
50	1.24	1.30	1.38	1.47	1.57
100	1.24	1.31	1.39	1.48	1.56
500	1.30	1.38	1.43	1.49	1.57

Table 356

Out of Control ARL_0 for MEWMA of Dimension 10 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	63.93	127.30	312.89	616.27	1205.64
50	64.27	128.28	314.22	617.17	1207.37
100	64.66	128.85	314.84	617.56	1208.49
500	64.14	132.66	319.35	615.04	1209.76
			λ = 0.80, Δ = 0.50		
20	36.45	69.87	154.82	284.44	540.55
50	37.18	70.22	155.34	284.34	540.10
100	37.89	71.37	155.28	285.06	540.00
500	35.39	72.18	156.04	283.18	540.35
			λ = 0.80, Δ = 1.00		
20	12.14	20.04	38.13	62.73	102.45
50	12.36	20.30	38.28	62.81	102.67
100	12.58	20.53	38.43	63.05	103.02
500	12.33	19.80	38.16	62.21	101.96
			λ = 0.80, Δ = 2.00		
20	2.83	3.56	4.80	6.15	8.11
50	2.82	3.59	4.81	6.17	8.12
100	2.88	3.60	4.80	6.16	8.15
500	2.60	3.34	5.11	6.27	8.05
			λ = 0.80, Δ = 3.00		
20	1.46	1.62	1.83	2.07	2.38
50	1.46	1.62	1.81	2.07	2.35
100	1.49	1.64	1.83	2.08	2.36
500	1.33	1.57	1.82	2.00	2.35

Table 357

Out of Control ARL_0 for MEWMA of Dimension 15 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	20.89	28.76	43.49	60.56	83.17
50	20.50	29.12	43.61	60.53	83.57
100	20.11	28.62	43.45	60.28	83.43
500	20.88	29.68	43.84	60.25	83.48
			λ = 0.05, Δ = 0.50		
20	9.52	11.56	14.18	16.29	18.60
50	9.60	11.58	14.21	16.37	18.65
100	9.30	11.41	14.27	16.39	18.55
500	9.62	11.12	14.47	16.35	18.77
			λ = 0.05, Δ = 1.00		
20	4.49	5.10	5.81	6.33	6.77
50	4.50	5.11	5.88	6.38	6.85
100	4.42	5.07	5.82	6.34	6.81
500	4.45	5.03	5.97	6.41	6.89
			λ = 0.05, Δ = 2.00		
20	2.24	2.46	2.72	2.91	3.07
50	2.24	2.48	2.76	2.93	3.11
100	2.22	2.45	2.75	2.94	3.09
500	2.44	2.43	2.77	2.93	3.12
			λ = 0.05, Δ = 3.00		
20	1.56	1.68	1.82	1.92	2.01
50	1.57	1.69	1.84	1.94	2.04
100	1.55	1.68	1.83	1.93	2.04
500	1.64	1.64	1.85	1.94	2.05

Table 358

Out of Control ARL_0 for MEWMA of Dimension 15 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	21.96	33.70	60.55	94.30	147.98
50	21.53	33.73	60.91	95.02	148.27
100	21.90	33.19	59.88	94.42	148.65
500	21.69	33.83	59.95	93.33	146.81
	λ = 0.10, Δ = 0.50				
20	9.06	11.47	15.39	19.06	23.70
50	9.05	11.48	15.42	19.14	23.60
100	9.00	11.55	15.33	19.03	23.38
500	7.44	11.69	15.77	18.67	23.64
	λ = 0.10, Δ = 1.00				
20	3.89	4.40	5.07	5.56	6.03
50	3.89	4.45	5.11	5.55	6.04
100	3.87	4.40	5.07	5.56	6.01
500	3.84	4.58	5.17	5.60	6.07
	λ = 0.10, Δ = 2.00				
20	1.85	1.99	2.19	2.33	2.46
50	1.85	2.01	2.20	2.33	2.46
100	1.83	2.02	2.19	2.33	2.46
500	1.71	2.05	2.22	2.33	2.46
	λ = 0.10, Δ = 3.00				
20	1.32	1.38	1.46	1.53	1.60
50	1.30	1.37	1.46	1.54	1.60
100	1.30	1.38	1.46	1.53	1.59
500	1.09	1.41	1.48	1.53	1.58

Table 359

Out of Control ARL_0 for MEWMA of Dimension 15 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	26.46	45.07	93.91	164.94	289.85
50	25.96	45.35	93.21	165.35	290.31
100	26.34	45.69	92.53	165.86	290.73
500	11.00	41.55	92.76	164.65	291.30
	λ = 0.20, Δ = 0.50				
20	10.16	14.64	23.13	34.01	50.61
50	10.11	14.43	22.97	33.96	50.23
100	10.05	14.76	22.90	34.01	50.45
500	5.90	14.71	23.61	33.73	50.56
	λ = 0.20, Δ = 1.00				
20	3.68	4.27	5.13	5.88	6.69
50	3.69	4.29	5.15	5.88	6.74
100	3.74	4.33	5.13	5.89	6.69
500	3.22	4.38	5.24	5.90	6.71
	λ = 0.20, Δ = 2.00				
20	1.57	1.69	1.85	1.95	2.06
50	1.59	1.71	1.85	1.95	2.06
100	1.62	1.71	1.84	1.95	2.07
500	1.67	1.77	1.87	1.94	2.07
	λ = 0.20, Δ = 3.00				
20	1.16	1.20	1.25	1.29	1.32
50	1.15	1.20	1.25	1.28	1.32
100	1.17	1.20	1.24	1.28	1.32
500	1.00	1.23	1.26	1.28	1.32

Table 360

Out of Control ARL_0 for MEWMA of Dimension 15 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	30.71	55.29	124.49	227.92	426.13
50	30.46	55.07	125.05	228.07	426.87
100	31.01	55.48	124.74	229.07	428.61
500	26.82	48.68	127.99	228.68	425.88
			$\lambda = 0.30, \Delta = 0.50$		
20	12.27	19.30	34.71	55.59	87.51
50	12.30	19.06	34.42	55.18	87.21
100	12.19	19.01	34.36	55.36	87.68
500	13.80	19.27	34.97	55.77	87.78
			$\lambda = 0.30, \Delta = 1.00$		
20	3.93	4.78	6.10	7.58	9.41
50	3.96	4.79	6.11	7.56	9.38
100	4.03	4.78	6.06	7.53	9.28
500	5.83	4.65	6.28	7.54	9.34
			$\lambda = 0.30, \Delta = 2.00$		
20	1.50	1.62	1.77	1.89	2.01
50	1.53	1.64	1.78	1.89	2.02
100	1.55	1.64	1.76	1.88	2.01
500	2.43	1.68	1.77	1.89	2.01
			$\lambda = 0.30, \Delta = 3.00$		
20	1.13	1.15	1.20	1.23	1.25
50	1.12	1.16	1.20	1.23	1.26
100	1.11	1.15	1.19	1.22	1.25
500	1.00	1.16	1.20	1.22	1.25

Table 361

Out of Control ARL_0 for MEWMA of Dimension 15 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	34.21	64.48	152.71	289.08	550.46
50	34.09	64.64	152.99	291.35	553.12
100	34.35	65.36	152.82	290.08	552.58
500	29.38	64.86	158.48	290.37	548.85
			λ = 0.40, Δ = 0.50		
20	15.12	24.48	47.69	80.17	140.09
50	15.07	24.47	47.27	80.02	140.38
100	14.74	24.29	47.66	80.18	140.48
500	14.60	24.56	48.99	79.59	138.69
			λ = 0.40, Δ = 1.00		
20	4.47	5.61	8.15	10.85	14.52
50	4.63	5.73	8.15	10.76	14.46
100	4.73	5.66	8.15	10.67	14.37
500	2.96	5.63	8.15	10.64	14.38
			λ = 0.40, Δ = 2.00		
20	1.53	1.65	1.84	1.99	2.12
50	1.54	1.68	1.86	1.98	2.14
100	1.57	1.67	1.84	1.96	2.13
500	1.50	1.70	1.85	1.96	2.14
			λ = 0.40, Δ = 3.00		
20	1.13	1.15	1.20	1.23	1.27
50	1.14	1.16	1.20	1.23	1.27
100	1.13	1.15	1.19	1.22	1.25
500	1.00	1.10	1.21	1.24	1.26

Table 362

Out of Control ARL_0 for MEWMA of Dimension 15 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	38.55	75.52	175.07	343.69	662.58
50	38.76	75.57	176.96	345.46	665.67
100	37.87	76.52	178.19	344.43	665.64
500	39.48	76.65	179.69	346.95	662.38
			$\lambda = 0.50, \Delta = 0.50$		
20	17.98	31.14	63.74	114.67	200.65
50	18.07	31.07	63.35	115.03	201.65
100	17.93	30.86	63.69	115.11	201.90
500	23.00	29.51	63.57	113.80	200.32
			$\lambda = 0.50, \Delta = 1.00$		
20	5.21	7.19	11.00	15.98	23.89
50	5.41	7.28	10.93	15.83	23.68
100	5.29	7.19	10.95	15.75	23.49
500	3.12	7.24	10.97	15.46	23.44
			$\lambda = 0.50, \Delta = 2.00$		
20	1.61	1.81	2.02	2.23	2.51
50	1.62	1.84	2.03	2.25	2.53
100	1.66	1.80	2.02	2.22	2.51
500	1.71	1.74	1.98	2.17	2.49
			$\lambda = 0.50, \Delta = 3.00$		
20	1.15	1.19	1.24	1.27	1.31
50	1.16	1.20	1.23	1.27	1.32
100	1.13	1.19	1.22	1.26	1.30
500	1.00	1.15	1.25	1.27	1.31

Table 363

Out of Control ARL_0 for MEWMA of Dimension 15 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	42.32	85.27	200.52	393.60	770.65
50	42.11	85.40	201.63	395.85	771.18
100	41.70	86.10	201.93	396.23	770.78
500	35.52	84.98	198.91	398.58	773.79
			$\lambda = 0.60, \Delta = 0.50$		
20	21.38	39.02	82.19	151.74	274.46
50	21.51	39.29	82.28	152.41	275.23
100	21.33	39.55	83.38	152.33	276.03
500	24.33	42.60	81.00	153.38	275.70
			$\lambda = 0.60, \Delta = 1.00$		
20	6.42	9.29	15.77	24.65	37.60
50	6.62	9.51	15.59	24.53	37.47
100	6.52	9.36	15.65	24.41	37.15
500	3.67	8.91	14.92	24.16	36.28
			$\lambda = 0.60, \Delta = 2.00$		
20	1.79	2.06	2.41	2.79	3.23
50	1.79	2.07	2.42	2.81	3.24
100	1.84	2.04	2.40	2.82	3.24
500	1.57	1.80	2.26	2.76	3.17
			$\lambda = 0.60, \Delta = 3.00$		
20	1.20	1.24	1.32	1.36	1.41
50	1.21	1.25	1.31	1.36	1.41
100	1.23	1.23	1.31	1.36	1.40
500	1.00	1.19	1.29	1.35	1.42

Table 364

Out of Control ARL_0 for MEWMA of Dimension 15 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	48.64	104.19	251.78	497.09	952.74
50	48.54	104.72	253.61	498.44	951.50
100	47.62	104.58	254.49	499.94	949.38
500	51.29	97.42	255.55	497.47	947.19
			λ = 0.80, Δ = 0.50		
20	28.78	56.94	125.41	237.37	435.93
50	28.51	56.85	125.43	238.67	437.72
100	28.34	56.64	125.86	238.37	437.73
500	50.30	54.95	127.65	234.79	436.31
			λ = 0.80, Δ = 1.00		
20	9.67	16.32	31.31	51.87	83.45
50	9.97	16.58	31.06	52.08	84.37
100	9.92	16.54	30.89	52.45	84.05
500	14.20	14.55	29.53	50.54	82.74
			λ = 0.80, Δ = 2.00		
20	2.40	3.09	4.13	5.29	6.91
50	2.45	3.13	4.12	5.34	6.92
100	2.35	3.04	4.14	5.34	6.87
500	3.25	2.77	4.20	5.26	6.86
			λ = 0.80, Δ = 3.00		
20	1.37	1.50	1.69	1.87	2.10
50	1.36	1.52	1.67	1.88	2.09
100	1.33	1.53	1.66	1.86	2.08
500	1.00	1.31	1.64	1.92	2.08

Table 365

Out of Control ARL_0 for MEWMA of Dimension 20 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	16.97	23.46	34.99	46.56	62.27
50	17.10	23.40	34.35	46.29	62.24
100	17.10	23.47	34.71	46.41	62.77
500	20.86	24.30	34.51	46.29	62.28
			λ = 0.05, Δ = 0.50		
20	8.24	9.82	12.11	13.66	15.12
50	8.26	9.90	11.93	13.55	15.16
100	8.30	9.89	11.99	13.66	15.21
500	11.54	10.36	11.97	13.50	15.10
			λ = 0.05, Δ = 1.00		
20	4.04	4.56	5.17	5.56	5.92
50	4.11	4.56	5.17	5.57	5.94
100	4.10	4.55	5.19	5.58	5.94
500	5.15	4.67	5.17	5.57	5.93
			λ = 0.05, Δ = 2.00		
20	2.10	2.27	2.50	2.65	2.80
50	2.12	2.29	2.52	2.67	2.81
100	2.11	2.27	2.51	2.66	2.81
500	2.17	2.27	2.49	2.66	2.81
			λ = 0.05, Δ = 3.00		
20	1.49	1.58	1.70	1.79	1.87
50	1.49	1.59	1.72	1.80	1.88
100	1.48	1.57	1.72	1.79	1.89
500	1.70	1.53	1.70	1.79	1.87

Table 366

Out of Control ARL_0 for MEWMA of Dimension 20 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	18.03	27.51	48.41	73.94	111.82
50	18.04	27.45	47.78	74.44	111.91
100	18.10	27.48	48.19	74.41	112.23
500	21.50	27.71	46.75	73.08	108.58
			λ = 0.10, Δ = 0.50		
20	7.77	9.87	12.81	15.28	18.74
50	7.74	9.90	12.70	15.37	18.74
100	7.60	9.83	12.74	15.31	18.76
500	8.33	10.52	12.64	15.26	18.68
			λ = 0.10, Δ = 1.00		
20	3.48	3.94	4.49	4.85	5.20
50	3.49	3.95	4.51	4.83	5.19
100	3.49	3.93	4.48	4.86	5.20
500	3.67	3.94	4.51	4.85	5.19
			λ = 0.10, Δ = 2.00		
20	1.72	1.86	2.02	2.13	2.24
50	1.73	1.86	2.02	2.13	2.24
100	1.76	1.87	2.02	2.12	2.23
500	1.67	1.90	2.01	2.11	2.21
			λ = 0.10, Δ = 3.00		
20	1.24	1.30	1.38	1.44	1.49
50	1.25	1.32	1.40	1.45	1.50
100	1.27	1.31	1.39	1.44	1.49
500	1.00	1.31	1.40	1.45	1.48

Table 367

Out of Control ARL_0 for MEWMA of Dimension 20 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	21.95	39.01	79.39	137.11	233.56
50	21.74	39.14	79.02	137.31	232.98
100	21.12	39.42	79.48	137.97	234.17
500	29.87	41.67	79.61	136.70	230.47
			λ = 0.20, Δ = 0.50		
20	8.58	12.53	18.78	26.49	37.97
50	8.67	12.58	18.85	26.60	37.56
100	8.51	12.49	18.84	26.64	37.59
500	16.31	13.40	18.62	26.23	37.46
			λ = 0.20, Δ = 1.00		
20	3.25	3.79	4.44	5.08	5.70
50	3.22	3.79	4.47	5.09	5.74
100	3.19	3.74	4.39	5.07	5.75
500	3.55	3.88	4.50	5.07	5.65
			λ = 0.20, Δ = 2.00		
20	1.50	1.60	1.71	1.79	1.88
50	1.51	1.60	1.71	1.80	1.89
100	1.50	1.57	1.70	1.79	1.87
500	2.20	1.66	1.73	1.81	1.87
			λ = 0.20, Δ = 3.00		
20	1.14	1.15	1.19	1.22	1.25
50	1.13	1.16	1.20	1.23	1.26
100	1.14	1.15	1.19	1.22	1.26
500	1.50	1.15	1.21	1.23	1.26

Table 368

Out of Control ARL_0 for MEWMA of Dimension 20 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	25.84	49.04	108.04	194.28	354.36
50	25.87	48.88	107.43	193.04	353.49
100	25.74	47.98	107.36	192.84	354.41
500	38.30	49.31	108.66	194.43	351.32
			λ = 0.30, Δ = 0.50		
20	10.59	16.46	28.74	44.13	70.91
50	10.59	16.49	28.75	43.88	70.56
100	10.42	16.42	29.03	44.04	70.54
500	11.14	16.79	29.44	43.93	70.57
			λ = 0.30, Δ = 1.00		
20	3.43	4.13	5.38	6.51	7.86
50	3.32	4.13	5.43	6.55	7.89
100	3.36	4.04	5.40	6.53	7.78
500	3.43	4.43	5.43	6.38	7.74
			λ = 0.30, Δ = 2.00		
20	1.42	1.53	1.64	1.74	1.84
50	1.44	1.53	1.67	1.75	1.83
100	1.40	1.52	1.65	1.74	1.81
500	1.00	1.47	1.67	1.74	1.84
			λ = 0.30, Δ = 3.00		
20	1.11	1.12	1.16	1.17	1.19
50	1.11	1.11	1.15	1.17	1.20
100	1.07	1.11	1.15	1.18	1.21
500	1.00	1.07	1.15	1.19	1.22

Table 369

Out of Control ARL_0 for MEWMA of Dimension 20 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	29.65	57.42	133.14	244.28	468.22
50	29.96	57.64	133.05	242.99	467.37
100	30.18	56.81	133.35	241.88	464.42
500	21.67	55.86	129.94	243.83	460.41
			$\lambda = 0.40, \Delta = 0.50$		
20	13.13	21.09	41.76	68.49	117.15
50	13.44	21.14	41.71	68.48	116.82
100	13.17	21.24	42.07	68.55	116.63
500	5.80	22.21	42.29	68.31	116.95
			$\lambda = 0.40, \Delta = 1.00$		
20	3.86	4.92	7.14	9.12	12.18
50	3.88	4.94	7.27	9.22	12.10
100	3.72	4.84	7.28	9.09	12.12
500	3.00	4.87	7.10	9.10	12.02
			$\lambda = 0.40, \Delta = 2.00$		
20	1.45	1.56	1.71	1.84	1.95
50	1.46	1.55	1.71	1.84	1.95
100	1.42	1.57	1.72	1.83	1.94
500	1.00	1.54	1.68	1.85	1.95
			$\lambda = 0.40, \Delta = 3.00$		
20	1.10	1.14	1.16	1.19	1.20
50	1.10	1.11	1.16	1.18	1.20
100	1.08	1.11	1.16	1.19	1.21
500	0.00	1.16	1.14	1.20	1.22

Table 370

Out of Control ARL_0 for MEWMA of Dimension 20 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	33.10	67.88	155.40	294.81	593.68
50	32.98	68.10	155.30	294.87	591.92
100	33.11	67.74	153.34	294.50	590.43
500	46.50	60.24	146.13	286.58	586.47
			λ = 0.50, Δ = 0.50		
20	15.04	27.47	56.52	97.31	168.34
50	15.33	27.71	56.58	96.97	168.28
100	14.87	27.16	56.30	97.28	168.28
500	15.57	25.43	54.56	94.47	167.13
			λ = 0.50, Δ = 1.00		
20	4.50	6.47	9.78	13.17	18.54
50	4.58	6.59	9.90	13.36	18.53
100	4.54	6.48	9.83	13.23	18.42
500	4.00	6.73	9.25	13.31	18.29
			λ = 0.50, Δ = 2.00		
20	1.53	1.69	1.88	2.04	2.25
50	1.56	1.68	1.90	2.05	2.25
100	1.59	1.69	1.91	2.05	2.23
500	2.33	1.62	1.83	2.08	2.25
			λ = 0.50, Δ = 3.00		
20	1.12	1.16	1.20	1.22	1.26
50	1.11	1.13	1.21	1.22	1.27
100	1.10	1.13	1.21	1.24	1.27
500	1.00	1.17	1.19	1.23	1.28

Table 371

Out of Control ARL_0 for MEWMA of Dimension 20 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60$, $\Delta = 0.25$		
20	36.43	74.95	180.38	347.31	689.77
50	36.74	75.46	180.16	347.91	692.13
100	36.96	75.06	179.32	345.38	684.95
500	6.25	68.38	171.87	337.28	676.92
			$\lambda = 0.60$, $\Delta = 0.50$		
20	17.95	33.62	72.69	129.01	230.65
50	18.04	33.87	72.64	128.28	229.64
100	17.68	33.38	72.53	127.78	228.06
500	7.67	31.95	70.42	124.77	225.58
			$\lambda = 0.60$, $\Delta = 1.00$		
20	5.61	8.30	13.29	19.27	29.27
50	5.69	8.42	13.41	19.36	29.47
100	5.87	8.52	13.30	19.19	29.50
500	0.00	7.88	13.05	18.78	29.42
			$\lambda = 0.60$, $\Delta = 2.00$		
20	1.67	1.91	2.19	2.49	2.86
50	1.68	1.91	2.23	2.47	2.86
100	1.64	1.92	2.22	2.49	2.82
500	0.00	1.82	2.20	2.51	2.82
			$\lambda = 0.60$, $\Delta = 3.00$		
20	1.15	1.22	1.28	1.32	1.37
50	1.14	1.21	1.30	1.33	1.39
100	1.09	1.23	1.29	1.34	1.40
500	0.00	1.22	1.30	1.35	1.37

Table 372

Out of Control ARL_0 for MEWMA of Dimension 20 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	42.48	88.33	224.26	431.66	840.90
50	42.29	88.50	224.23	432.81	842.08
100	41.21	87.81	222.73	432.65	840.29
500	41.75	87.87	221.82	423.82	826.92
			$\lambda = 0.80, \Delta = 0.50$		
20	24.61	47.49	109.47	206.14	374.30
50	24.35	47.22	109.36	205.66	375.42
100	23.62	47.16	108.12	205.71	372.48
500	35.40	43.79	107.96	202.05	364.98
			$\lambda = 0.80, \Delta = 1.00$		
20	8.64	13.66	25.49	41.53	68.39
50	8.80	13.75	25.64	41.51	68.28
100	8.45	13.53	25.16	41.46	68.12
500	4.25	13.45	25.72	39.87	67.98
			$\lambda = 0.80, \Delta = 2.00$		
20	2.31	2.69	3.78	4.67	5.93
50	2.29	2.69	3.85	4.71	6.03
100	2.32	2.69	3.80	4.75	5.99
500	1.67	2.56	3.85	4.50	5.86
			$\lambda = 0.80, \Delta = 3.00$		
20	1.35	1.52	1.69	1.84	2.04
50	1.33	1.55	1.71	1.84	2.02
100	1.39	1.51	1.70	1.84	2.02
500	0.00	1.61	1.78	1.89	2.00

Table 373

Out of Control ARL_0 for MEWMA of Dimension 25 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	14.08	19.52	27.77	37.41	49.19
50	14.08	19.55	27.74	36.73	48.35
100	13.67	19.77	27.85	36.44	48.22
500	15.36	17.83	28.60	36.87	48.78
			λ = 0.05, Δ = 0.50		
20	7.13	8.61	10.24	11.45	12.72
50	7.03	8.60	10.23	11.39	12.71
100	6.95	8.48	10.24	11.50	12.83
500	8.44	8.22	10.42	11.52	12.78
			λ = 0.05, Δ = 1.00		
20	3.64	4.10	4.61	4.92	5.26
50	3.63	4.12	4.65	5.00	5.28
100	3.60	4.08	4.58	4.94	5.26
500	4.29	3.98	4.67	4.99	5.27
			λ = 0.05, Δ = 2.00		
20	1.94	2.13	2.32	2.46	2.58
50	1.94	2.15	2.34	2.48	2.59
100	1.92	2.11	2.31	2.45	2.57
500	1.67	2.17	2.36	2.46	2.59
			λ = 0.05, Δ = 3.00		
20	1.40	1.51	1.62	1.70	1.77
50	1.42	1.52	1.64	1.71	1.78
100	1.40	1.50	1.60	1.70	1.76
500	1.00	1.54	1.63	1.70	1.77

Table 374

Out of Control ARL_0 for MEWMA of Dimension 25 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	15.11	22.64	39.57	58.51	89.96
50	14.50	22.91	39.68	58.11	89.49
100	14.06	22.85	39.79	58.90	90.54
500	9.17	25.66	41.60	60.12	91.81
			λ = 0.10, Δ = 0.50		
20	6.72	8.42	10.79	12.91	15.40
50	6.62	8.49	10.78	12.92	15.24
100	6.58	8.26	10.88	12.96	15.38
500	3.50	8.43	11.06	13.09	15.33
			λ = 0.10, Δ = 1.00		
20	3.15	3.54	3.98	4.30	4.61
50	3.18	3.55	4.04	4.32	4.62
100	3.09	3.50	3.98	4.26	4.57
500	2.25	3.47	4.02	4.30	4.59
			λ = 0.10, Δ = 2.00		
20	1.62	1.75	1.90	2.00	2.09
50	1.65	1.77	1.91	2.01	2.09
100	1.62	1.75	1.89	1.98	2.07
500	1.33	1.72	1.89	2.00	2.06
			λ = 0.10, Δ = 3.00		
20	1.20	1.25	1.33	1.37	1.41
50	1.22	1.28	1.34	1.38	1.42
100	1.18	1.25	1.33	1.37	1.41
500	1.00	1.30	1.32	1.37	1.40

Table 375

Out of Control ARL_0 for MEWMA of Dimension 25 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	18.32	31.88	66.75	113.36	199.75
50	18.17	32.02	66.46	112.75	200.67
100	18.63	32.21	66.62	113.59	202.22
500	28.22	37.37	64.85	110.54	202.07
			$\lambda = 0.20, \Delta = 0.50$		
20	7.45	10.52	15.90	22.48	32.30
50	7.44	10.50	15.86	22.52	32.29
100	7.22	10.49	16.24	22.95	32.36
500	13.00	11.29	15.22	22.21	31.37
			$\lambda = 0.20, \Delta = 1.00$		
20	2.91	3.32	3.96	4.41	4.87
50	2.91	3.33	3.93	4.42	4.88
100	2.90	3.31	3.87	4.37	4.87
500	3.00	3.61	3.84	4.44	4.93
			$\lambda = 0.20, \Delta = 2.00$		
20	1.41	1.49	1.60	1.68	1.77
50	1.41	1.52	1.61	1.69	1.76
100	1.39	1.48	1.60	1.68	1.76
500	1.00	1.44	1.56	1.66	1.74
			$\lambda = 0.20, \Delta = 3.00$		
20	1.10	1.12	1.15	1.18	1.21
50	1.10	1.12	1.16	1.19	1.22
100	1.10	1.12	1.15	1.17	1.20
500	1.00	1.10	1.14	1.17	1.20

Table 376

Out of Control ARL_0 for MEWMA of Dimension 25 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	21.27	41.00	91.38	164.41	311.32
50	20.68	40.89	91.32	163.84	310.32
100	20.88	40.56	91.83	165.67	312.25
500	13.00	42.37	91.67	165.32	311.35
	λ = 0.30, Δ = 0.50				
20	8.90	13.73	24.70	37.27	58.42
50	8.76	13.67	24.67	37.07	57.90
100	8.84	13.82	24.77	37.39	58.40
500	8.14	16.02	24.23	36.28	56.42
	λ = 0.30, Δ = 1.00				
20	3.04	3.58	4.58	5.54	6.56
50	3.02	3.57	4.63	5.53	6.52
100	3.01	3.51	4.53	5.53	6.55
500	2.80	4.07	4.67	5.58	6.59
	λ = 0.30, Δ = 2.00				
20	1.35	1.42	1.53	1.61	1.69
50	1.36	1.43	1.54	1.61	1.69
100	1.33	1.39	1.51	1.62	1.70
500	1.00	1.37	1.53	1.60	1.67
	λ = 0.30, Δ = 3.00				
20	1.08	1.11	1.12	1.14	1.16
50	1.09	1.11	1.12	1.14	1.16
100	1.06	1.08	1.11	1.13	1.16
500	0.00	1.11	1.12	1.14	1.15

Table 377

Out of Control ARL_0 for MEWMA of Dimension 25 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	24.49	49.52	114.58	219.33	410.78
50	23.72	48.73	114.88	219.89	412.40
100	23.87	48.96	116.79	221.26	413.38
500	12.75	52.84	114.87	218.48	411.33
			$\lambda = 0.40, \Delta = 0.50$		
20	10.91	18.09	36.23	57.55	95.13
50	10.72	17.79	36.15	57.30	94.82
100	10.95	17.94	36.34	57.46	94.50
500	3.50	19.52	35.76	56.28	92.93
			$\lambda = 0.40, \Delta = 1.00$		
20	3.37	4.27	5.88	7.61	10.08
50	3.40	4.29	5.87	7.62	10.17
100	3.29	4.17	5.90	7.46	10.16
500	1.00	4.45	5.84	7.39	9.94
			$\lambda = 0.40, \Delta = 2.00$		
20	1.35	1.43	1.55	1.67	1.77
50	1.38	1.45	1.58	1.68	1.78
100	1.34	1.39	1.53	1.67	1.79
500	0.00	1.43	1.54	1.67	1.78
			$\lambda = 0.40, \Delta = 3.00$		
20	1.09	1.10	1.13	1.16	1.17
50	1.09	1.11	1.13	1.14	1.17
100	1.10	1.09	1.13	1.15	1.17
500	0.00	1.11	1.13	1.15	1.16

Table 378

Out of Control ARL_0 for MEWMA of Dimension 25 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	27.83	57.58	141.13	268.14	501.41
50	27.44	57.06	141.74	267.29	501.72
100	27.59	58.10	141.76	271.37	506.41
500	31.88	56.84	138.70	261.67	502.99
			λ = 0.50, Δ = 0.50		
20	13.40	22.58	49.19	81.85	144.54
50	13.47	22.19	49.11	81.99	144.07
100	13.44	22.52	49.27	82.80	144.07
500	28.88	23.53	50.35	80.71	142.52
			λ = 0.50, Δ = 1.00		
20	3.92	5.40	7.92	11.41	16.39
50	3.97	5.39	7.93	11.33	16.54
100	3.73	5.19	7.83	11.34	16.32
500	3.50	5.56	7.52	10.99	15.86
			λ = 0.50, Δ = 2.00		
20	1.39	1.52	1.70	1.82	1.97
50	1.43	1.54	1.72	1.83	1.99
100	1.40	1.48	1.68	1.82	1.99
500	1.00	1.54	1.61	1.84	2.00
			λ = 0.50, Δ = 3.00		
20	1.10	1.12	1.18	1.19	1.21
50	1.11	1.15	1.18	1.18	1.22
100	1.11	1.12	1.17	1.19	1.21
500	1.00	1.05	1.12	1.19	1.23

Table 379

Out of Control ARL_0 for MEWMA of Dimension 25 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	30.78	64.71	163.93	312.11	606.49
50	30.28	64.31	163.76	311.75	604.72
100	30.57	64.51	165.59	315.90	607.78
500	21.62	66.24	164.93	317.35	601.76
			λ = 0.60, Δ = 0.50		
20	15.57	28.70	63.04	109.97	197.12
50	15.56	28.56	63.53	110.29	196.07
100	15.78	28.88	63.56	110.59	196.65
500	16.45	27.46	60.38	109.79	192.80
			λ = 0.60, Δ = 1.00		
20	4.82	6.74	11.73	16.67	25.95
50	4.80	6.62	11.75	17.29	26.28
100	4.60	6.69	11.61	17.04	26.12
500	2.67	5.60	10.84	16.62	25.38
			λ = 0.60, Δ = 2.00		
20	1.49	1.71	1.93	2.13	2.50
50	1.53	1.69	1.91	2.15	2.49
100	1.52	1.63	1.91	2.13	2.49
500	1.00	1.58	1.88	2.21	2.52
			λ = 0.60, Δ = 3.00		
20	1.13	1.18	1.24	1.26	1.31
50	1.14	1.20	1.24	1.27	1.31
100	1.16	1.20	1.25	1.27	1.33
500	0.00	1.14	1.19	1.28	1.34

Table 380

Out of Control ARL_0 for MEWMA of Dimension 25 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	36.86	78.56	203.65	400.08	778.27
50	36.09	79.04	205.19	399.57	777.47
100	36.67	78.71	205.38	400.97	778.66
500	28.50	71.56	204.60	406.69	776.95
	λ = 0.80, Δ = 0.50				
20	21.99	41.74	99.22	183.42	342.14
50	21.67	42.01	99.71	183.34	341.63
100	22.64	42.33	100.04	182.42	342.46
500	13.11	38.32	98.77	182.63	338.72
	λ = 0.80, Δ = 1.00				
20	7.16	12.10	22.66	38.44	60.84
50	7.11	12.04	22.38	38.59	61.25
100	7.55	11.97	22.62	38.49	61.45
500	5.40	10.83	22.12	37.59	60.27
	λ = 0.80, Δ = 2.00				
20	1.92	2.40	3.22	3.99	4.64
50	1.92	2.41	3.13	3.98	4.66
100	2.10	2.36	3.22	4.00	4.70
500	1.50	2.07	3.10	3.75	4.70
	λ = 0.80, Δ = 3.00				
20	1.29	1.46	1.56	1.68	1.80
50	1.32	1.45	1.56	1.68	1.85
100	1.32	1.45	1.52	1.63	1.84
500	0.00	1.58	1.56	1.62	1.88

Table 381

Out of Control ARL_0 for MEWMA of Dimension 50 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	9.50	13.74	18.22	22.81	27.33
50	9.61	13.73	18.50	22.91	27.13
100	9.33	13.97	18.41	22.77	27.26
500	0.00	14.61	18.01	23.24	27.50
			$\lambda = 0.05, \Delta = 0.50$		
20	5.26	6.43	7.46	8.30	8.98
50	5.26	6.38	7.47	8.37	8.97
100	5.22	6.61	7.58	8.37	8.98
500	0.00	6.48	7.47	8.37	9.01
			$\lambda = 0.05, \Delta = 1.00$		
20	2.86	3.25	3.63	3.87	4.07
50	2.78	3.26	3.64	3.90	4.07
100	2.85	3.36	3.72	3.94	4.12
500	0.00	3.46	3.62	3.85	4.08
			$\lambda = 0.05, \Delta = 2.00$		
20	1.55	1.73	1.90	2.00	2.10
50	1.51	1.72	1.89	2.00	2.08
100	1.56	1.77	1.92	2.03	2.09
500	0.00	2.04	1.97	2.03	2.10
			$\lambda = 0.05, \Delta = 3.00$		
20	1.17	1.27	1.34	1.40	1.45
50	1.17	1.27	1.35	1.40	1.45
100	1.21	1.29	1.37	1.43	1.47
500	0.00	1.44	1.41	1.44	1.49

Table 382

Out of Control ARL_0 for MEWMA of Dimension 50 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	9.52	15.61	23.89	33.86	50.74
50	9.48	14.86	23.98	34.15	50.31
100	9.60	15.40	24.29	33.96	50.37
500	0.00	16.61	22.86	34.22	50.34
			$\lambda = 0.10, \Delta = 0.50$		
20	4.75	6.10	7.41	8.37	9.41
50	4.70	6.00	7.29	8.32	9.49
100	4.59	6.26	7.39	8.33	9.44
500	0.00	6.31	7.20	8.40	9.58
			$\lambda = 0.10, \Delta = 1.00$		
20	2.39	2.77	3.06	3.25	3.43
50	2.35	2.74	3.04	3.25	3.44
100	2.44	2.78	3.11	3.29	3.50
500	0.00	2.64	3.05	3.31	3.46
			$\lambda = 0.10, \Delta = 2.00$		
20	1.31	1.42	1.52	1.59	1.64
50	1.29	1.42	1.50	1.56	1.63
100	1.31	1.46	1.56	1.61	1.66
500	0.00	1.40	1.57	1.64	1.68
			$\lambda = 0.10, \Delta = 3.00$		
20	1.07	1.08	1.12	1.14	1.17
50	1.07	1.11	1.13	1.15	1.18
100	1.04	1.12	1.14	1.18	1.19
500	0.00	1.15	1.15	1.18	1.20

Table 383

Out of Control ARL_0 for MEWMA of Dimension 50 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	11.10	21.53	42.49	71.74	123.27
50	11.41	21.34	42.40	72.40	124.00
100	10.71	21.23	43.80	71.32	123.88
500	0.00	18.99	44.15	71.92	126.72
			$\lambda = 0.20, \Delta = 0.50$		
20	4.83	7.00	9.69	11.82	16.76
50	5.05	6.85	9.54	11.73	16.92
100	4.62	6.86	9.72	11.95	16.87
500	0.00	6.55	10.06	11.84	17.02
			$\lambda = 0.20, \Delta = 1.00$		
20	2.12	2.49	2.82	3.05	3.25
50	2.05	2.42	2.76	2.99	3.25
100	2.09	2.41	2.82	3.07	3.29
500	0.00	2.18	2.81	3.03	3.27
			$\lambda = 0.20, \Delta = 2.00$		
20	1.14	1.21	1.28	1.33	1.37
50	1.16	1.22	1.28	1.33	1.38
100	1.17	1.23	1.26	1.32	1.37
500	0.00	1.08	1.32	1.33	1.36
			$\lambda = 0.20, \Delta = 3.00$		
20	1.04	1.03	1.04	1.05	1.06
50	1.05	1.05	1.05	1.06	1.07
100	1.02	1.06	1.07	1.07	1.08
500	0.00	1.00	1.05	1.05	1.07

Table 384

Out of Control ARL_0 for MEWMA of Dimension 50 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	13.61	27.76	66.94	118.78	216.77
50	13.60	27.36	66.56	117.71	218.34
100	12.92	27.93	67.78	117.27	219.68
500	0.00	24.93	71.50	118.74	224.77
			λ = 0.30, Δ = 0.50		
20	5.64	8.93	14.58	21.28	30.91
50	5.48	8.53	14.59	21.33	30.78
100	5.85	8.70	14.67	21.36	31.19
500	0.00	8.90	15.73	21.83	31.31
			λ = 0.30, Δ = 1.00		
20	2.08	2.50	2.96	3.36	3.79
50	2.04	2.44	2.90	3.37	3.76
100	2.05	2.44	2.94	3.42	3.83
500	0.00	2.55	2.91	3.42	3.82
			λ = 0.30, Δ = 2.00		
20	1.12	1.15	1.21	1.26	1.29
50	1.15	1.18	1.23	1.26	1.29
100	1.13	1.18	1.22	1.25	1.28
500	0.00	1.24	1.22	1.26	1.29
			λ = 0.30, Δ = 3.00		
20	1.02	1.03	1.03	1.03	1.04
50	1.02	1.03	1.04	1.06	1.06
100	1.00	1.04	1.03	1.06	1.06
500	0.00	1.00	1.04	1.05	1.05

Table 385

Out of Control ARL_0 for MEWMA of Dimension 50 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	15.51	35.37	89.20	166.63	315.39
50	15.61	35.93	90.27	167.25	313.40
100	14.81	37.07	90.94	167.19	313.55
500	0.00	39.43	90.12	173.88	319.72
			λ = 0.40, Δ = 0.50		
20	6.47	11.78	22.23	34.51	55.58
50	6.48	11.52	22.55	34.32	55.23
100	6.19	11.57	23.25	34.46	54.78
500	0.00	10.30	23.67	35.90	56.88
			λ = 0.40, Δ = 1.00		
20	2.20	2.76	3.61	4.40	5.17
50	2.11	2.73	3.63	4.37	5.12
100	2.28	2.70	3.68	4.47	5.16
500	0.00	2.55	3.59	4.22	5.27
			λ = 0.40, Δ = 2.00		
20	1.12	1.15	1.21	1.24	1.29
50	1.21	1.17	1.24	1.27	1.30
100	1.14	1.20	1.22	1.25	1.28
500	0.00	1.04	1.24	1.28	1.28
			λ = 0.40, Δ = 3.00		
20	1.02	1.04	1.04	1.04	1.04
50	1.00	1.05	1.04	1.04	1.07
100	1.00	1.05	1.06	1.06	1.06
500	0.00	1.00	1.11	1.06	1.08

Table 386

Out of Control ARL_0 for MEWMA of Dimension 50 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	17.24	44.54	113.20	217.49	402.10
50	16.90	44.60	114.55	217.72	402.34
100	17.06	45.42	115.74	218.67	402.84
500	0.00	32.37	113.77	226.66	409.96
			$\lambda = 0.50, \Delta = 0.50$		
20	7.87	15.20	32.80	54.15	90.30
50	7.67	14.80	32.51	54.19	89.87
100	6.55	14.64	33.19	53.85	90.09
500	0.00	13.12	34.09	53.03	89.75
			$\lambda = 0.50, \Delta = 1.00$		
20	2.44	3.49	4.83	5.91	7.80
50	2.44	3.37	4.77	5.90	7.73
100	2.31	3.33	4.78	5.97	7.79
500	0.00	3.41	4.65	5.67	7.43
			$\lambda = 0.50, \Delta = 2.00$		
20	1.13	1.17	1.26	1.30	1.35
50	1.18	1.21	1.30	1.33	1.36
100	1.12	1.25	1.27	1.30	1.33
500	0.00	1.25	1.29	1.31	1.36
			$\lambda = 0.50, \Delta = 3.00$		
20	1.03	1.05	1.07	1.06	1.07
50	1.00	1.05	1.06	1.11	1.11
100	1.00	1.07	1.10	1.09	1.09
500	0.00	1.00	1.09	1.15	1.11

Table 387

Out of Control ARL_0 for MEWMA of Dimension 50 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	19.64	51.01	135.62	260.39	492.72
50	19.47	51.96	135.73	259.65	494.04
100	20.38	53.10	136.60	260.51	489.44
500	0.00	42.99	138.01	270.43	493.87
			λ = 0.60, Δ = 0.50		
20	9.68	19.64	46.23	78.97	143.14
50	9.58	19.78	45.51	78.31	143.67
100	9.53	19.82	46.15	78.07	142.57
500	0.00	12.33	44.29	79.09	145.67
			λ = 0.60, Δ = 1.00		
20	2.86	4.41	6.38	9.15	12.15
50	2.83	4.30	6.22	9.06	12.03
100	2.66	4.39	6.29	8.89	12.10
500	0.00	4.04	6.03	8.52	11.61
			λ = 0.60, Δ = 2.00		
20	1.19	1.27	1.35	1.43	1.50
50	1.24	1.29	1.40	1.46	1.50
100	1.28	1.35	1.37	1.39	1.46
500	0.00	1.44	1.39	1.39	1.49
			λ = 0.60, Δ = 3.00		
20	1.00	1.06	1.16	1.13	1.11
50	1.00	1.02	1.17	1.16	1.16
100	1.17	1.09	1.21	1.16	1.15
500	0.00	1.00	1.22	1.13	1.14

Table 388

Out of Control ARL_0 for MEWMA of Dimension 50 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	22.63	64.23	177.89	357.57	668.57
50	23.42	64.43	176.25	360.19	668.75
100	22.51	65.92	177.25	362.21	670.22
500	0.00	73.71	186.34	355.15	673.93
	λ = 0.80, Δ = 0.50				
20	12.82	30.73	75.37	143.07	263.79
50	13.07	30.30	74.20	143.02	265.08
100	13.56	32.13	75.04	143.64	266.47
500	0.00	29.53	72.29	139.48	270.68
	λ = 0.80, Δ = 1.00				
20	4.28	6.96	12.94	21.91	33.54
50	4.15	6.85	12.68	22.28	33.85
100	4.20	7.12	12.76	21.91	33.66
500	0.00	6.19	12.32	22.56	33.83
	λ = 0.80, Δ = 2.00				
20	1.51	1.57	1.80	1.94	2.37
50	1.56	1.56	1.83	1.99	2.49
100	1.91	1.61	1.79	1.95	2.45
500	0.00	1.79	1.80	1.98	2.40
	λ = 0.80, Δ = 3.00				
20	1.13	1.28	1.33	1.40	1.41
50	1.11	1.38	1.31	1.36	1.44
100	2.00	1.43	1.33	1.40	1.43
500	0.00	1.00	1.43	1.43	1.39

DMEWMA Out-of-Control ARL_1 Charts

Table 389

Out of Control ARL_0 for DMEWMA of Dimension 2 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	45.20	59.32	83.13	107.15	137.14
50	45.84	60.16	84.28	107.89	138.36
100	45.92	59.87	84.43	108.23	138.66
500	45.52	59.22	83.89	108.66	138.10
			$\lambda = 0.05, \Delta = 0.50$		
20	22.51	27.00	32.82	37.42	42.35
50	23.63	28.01	33.79	38.39	43.36
100	23.70	28.12	33.76	38.53	43.31
500	22.82	27.38	33.43	38.15	43.04
			$\lambda = 0.05, \Delta = 1.00$		
20	12.29	14.17	16.47	18.10	19.69
50	13.64	15.48	17.75	19.45	21.07
100	13.68	15.62	17.90	19.56	21.15
500	13.57	15.34	17.74	19.42	20.99
			$\lambda = 0.05, \Delta = 2.00$		
20	7.28	8.27	9.47	10.29	11.07
50	8.41	9.44	10.69	11.58	12.42
100	8.51	9.58	10.83	11.72	12.53
500	8.43	9.39	10.72	11.61	12.45
			$\lambda = 0.05, \Delta = 3.00$		
20	5.45	6.16	7.00	7.59	8.15
50	6.42	7.18	8.11	8.76	9.38
100	6.52	7.32	8.23	8.89	9.49
500	6.47	7.21	8.15	8.81	9.43

Table 390

Out of Control ARL_0 for DMEWMA of Dimension 2 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	43.11	61.28	97.32	138.02	197.13
50	43.11	60.91	97.52	138.09	197.09
100	43.78	60.62	96.72	138.13	197.35
500	47.89	61.10	97.11	138.94	197.08
			$\lambda = 0.10, \Delta = 0.50$		
20	19.37	23.82	30.56	36.31	42.66
50	19.31	23.53	30.36	36.26	42.77
100	19.33	23.81	30.29	36.08	42.39
500	21.16	23.40	30.25	36.09	42.25
			$\lambda = 0.10, \Delta = 1.00$		
20	9.52	10.86	12.57	13.84	14.99
50	9.61	10.88	12.58	13.85	15.02
100	9.52	10.89	12.55	13.81	14.98
500	9.53	10.72	12.43	13.69	14.89
			$\lambda = 0.10, \Delta = 2.00$		
20	5.38	6.01	6.81	7.34	7.84
50	5.47	6.10	6.88	7.42	7.92
100	5.44	6.11	6.88	7.42	7.91
500	5.49	6.05	6.81	7.34	7.85
			$\lambda = 0.10, \Delta = 3.00$		
20	3.96	4.40	4.95	5.34	5.67
50	4.03	4.49	5.04	5.43	5.76
100	4.01	4.49	5.03	5.42	5.76
500	4.04	4.45	5.00	5.36	5.72

Table 391

Out of Control ARL$_0$ for DMEWMA of Dimension 2 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	45.82	71.02	131.75	209.00	333.67
50	45.45	71.65	132.40	209.62	334.94
100	45.31	70.96	132.33	208.64	335.75
500	49.45	70.87	131.42	210.01	332.71
			λ = 0.20, Δ = 0.50		
20	18.63	24.54	35.09	46.14	60.96
50	18.52	24.44	34.77	46.02	61.04
100	18.63	24.60	35.12	46.02	60.98
500	19.67	25.40	35.15	45.77	60.63
			λ = 0.20, Δ = 1.00		
20	7.26	8.38	9.95	11.24	12.67
50	7.25	8.36	9.96	11.23	12.62
100	7.23	8.33	9.94	11.21	12.64
500	7.44	8.32	9.93	11.15	12.47
			λ = 0.20, Δ = 2.00		
20	3.48	3.87	4.36	4.70	5.04
50	3.48	3.86	4.34	4.68	5.01
100	3.46	3.85	4.34	4.67	5.00
500	3.61	3.81	4.35	4.66	4.97
			λ = 0.20, Δ = 3.00		
20	2.42	2.66	2.98	3.19	3.40
50	2.41	2.65	2.97	3.18	3.39
100	2.41	2.65	2.97	3.17	3.38
500	2.48	2.64	2.96	3.16	3.37

Table 392

Out of Control ARL_0 for DMEWMA of Dimension 2 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	50.54	84.63	167.01	283.34	482.72
50	50.53	84.35	167.45	283.55	481.77
100	49.54	83.53	166.86	282.98	481.62
500	58.96	82.80	168.68	281.54	480.12
			$\lambda = 0.30, \Delta = 0.50$		
20	20.32	28.49	44.20	62.88	90.26
50	20.17	28.36	44.32	62.58	90.24
100	20.19	28.23	44.49	62.74	89.78
500	23.42	27.03	45.28	62.27	89.25
			$\lambda = 0.30, \Delta = 1.00$		
20	6.63	7.90	9.78	11.60	13.63
50	6.63	7.88	9.79	11.58	13.63
100	6.61	7.86	9.81	11.66	13.69
500	6.98	7.89	9.76	11.51	13.58
			$\lambda = 0.30, \Delta = 2.00$		
20	2.67	2.97	3.36	3.65	3.93
50	2.67	2.97	3.35	3.64	3.93
100	2.66	2.95	3.34	3.63	3.92
500	2.73	2.96	3.35	3.63	3.91
			$\lambda = 0.30, \Delta = 3.00$		
20	1.75	1.91	2.13	2.29	2.43
50	1.74	1.91	2.12	2.27	2.43
100	1.76	1.91	2.12	2.28	2.42
500	1.83	1.89	2.13	2.27	2.41

Table 393

Out of Control ARL_0 for DMEWMA of Dimension 2 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	55.25	95.64	200.72	354.21	625.66
50	55.09	95.89	200.58	353.71	627.31
100	54.43	94.43	200.08	353.93	627.22
500	61.25	92.89	201.45	354.45	626.68
			$\lambda = 0.40, \Delta = 0.50$		
20	22.75	33.39	57.38	85.87	131.25
50	22.41	33.25	57.56	85.82	130.76
100	22.26	32.93	57.35	85.23	130.46
500	28.58	33.23	57.73	86.35	129.59
			$\lambda = 0.40, \Delta = 1.00$		
20	6.65	8.12	10.84	13.36	16.43
50	6.65	8.18	10.85	13.35	16.37
100	6.64	8.12	10.89	13.38	16.42
500	6.84	7.98	10.71	13.35	16.32
			$\lambda = 0.40, \Delta = 2.00$		
20	2.25	2.52	2.87	3.16	3.45
50	2.24	2.50	2.87	3.16	3.45
100	2.23	2.50	2.87	3.15	3.45
500	2.23	2.55	2.86	3.16	3.45
			$\lambda = 0.40, \Delta = 3.00$		
20	1.40	1.51	1.67	1.79	1.91
50	1.40	1.51	1.66	1.79	1.91
100	1.41	1.52	1.68	1.79	1.91
500	1.52	1.53	1.68	1.80	1.91

Table 394

Out of Control ARL_0 for DMEWMA of Dimension 2 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.50, \Delta = 0.25$				
20	60.00	107.20	231.09	419.48	771.56
50	59.78	107.23	231.15	419.63	771.47
100	58.99	106.39	231.54	420.37	771.38
500	59.35	110.61	229.90	420.21	765.90
	$\lambda = 0.50, \Delta = 0.50$				
20	25.92	39.99	71.84	114.21	183.96
50	25.81	40.12	71.53	113.83	183.82
100	25.72	39.80	71.42	113.72	183.00
500	25.51	42.62	70.99	113.81	182.57
	$\lambda = 0.50, \Delta = 1.00$				
20	7.04	9.13	12.76	16.40	21.64
50	7.02	9.11	12.72	16.33	21.71
100	7.07	9.15	12.71	16.41	21.66
500	7.38	9.17	12.60	16.40	21.66
	$\lambda = 0.50, \Delta = 2.00$				
20	2.05	2.30	2.68	2.99	3.33
50	2.03	2.28	2.67	2.98	3.32
100	2.03	2.28	2.67	2.99	3.33
500	2.05	2.32	2.66	3.00	3.33
	$\lambda = 0.50, \Delta = 3.00$				
20	1.23	1.31	1.42	1.52	1.62
50	1.23	1.30	1.42	1.52	1.62
100	1.23	1.30	1.42	1.52	1.63
500	1.25	1.32	1.42	1.52	1.62

Table 395

Out of Control ARL_0 for DMEWMA of Dimension 2 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	63.85	117.40	268.89	498.91	929.12
50	63.84	117.95	268.45	498.18	926.91
100	62.52	117.96	268.46	499.47	923.50
500	63.03	116.67	265.47	496.89	919.06
			λ = 0.60, Δ = 0.50		
20	29.04	47.38	92.62	152.61	255.32
50	29.14	47.59	92.40	152.19	254.67
100	28.51	47.15	92.23	151.64	254.08
500	30.32	46.80	92.01	151.14	253.84
			λ = 0.60, Δ = 1.00		
20	7.82	10.74	16.05	22.23	30.54
50	7.79	10.67	15.96	22.28	30.47
100	7.81	10.75	15.93	22.24	30.55
500	7.40	11.07	15.68	21.94	30.64
			λ = 0.60, Δ = 2.00		
20	1.99	2.28	2.72	3.11	3.54
50	1.98	2.26	2.70	3.10	3.53
100	1.99	2.26	2.71	3.12	3.53
500	1.86	2.25	2.68	3.09	3.52
			λ = 0.60, Δ = 3.00		
20	1.17	1.22	1.32	1.40	1.49
50	1.16	1.22	1.32	1.41	1.50
100	1.16	1.23	1.32	1.41	1.49
500	1.19	1.22	1.32	1.41	1.50

Table 396

Out of Control ARL_0 for DMEWMA of Dimension 2 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	74.08	140.95	336.18	647.26	1229.18
50	73.97	139.84	335.30	645.77	1226.39
100	74.63	139.87	337.01	644.86	1224.35
500	64.36	138.74	341.40	643.65	1215.94
			λ = 0.80, Δ = 0.50		
20	39.93	71.24	152.69	265.43	475.41
50	40.21	70.80	152.58	265.48	474.37
100	39.99	70.78	153.63	267.08	475.39
500	39.21	72.08	154.99	270.01	476.97
			λ = 0.80, Δ = 1.00		
20	11.52	17.53	30.72	47.59	73.02
50	11.44	17.50	30.81	47.66	73.11
100	11.41	17.59	30.81	47.67	72.93
500	10.09	16.56	30.85	47.82	73.53
			λ = 0.80, Δ = 2.00		
20	2.38	2.89	3.77	4.64	5.77
50	2.37	2.89	3.76	4.63	5.77
100	2.36	2.90	3.76	4.65	5.77
500	2.55	2.81	3.71	4.64	5.80
			λ = 0.80, Δ = 3.00		
20	1.22	1.30	1.44	1.56	1.72
50	1.23	1.30	1.43	1.56	1.72
100	1.21	1.29	1.43	1.56	1.72
500	1.39	1.32	1.44	1.56	1.73

Table 397

Out of Control ARL_0 for DMEWMA of Dimension 3 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	43.83	58.44	82.72	106.03	140.12
50	45.07	59.15	83.98	107.42	140.89
100	45.70	58.72	83.31	107.70	140.25
500	51.32	60.30	85.14	107.62	141.22
			$\lambda = 0.05, \Delta = 0.50$		
20	22.32	26.54	32.14	36.47	41.32
50	23.60	27.61	33.45	37.76	42.58
100	23.55	27.41	33.31	37.63	42.38
500	25.24	27.87	33.22	37.76	42.69
			$\lambda = 0.05, \Delta = 1.00$		
20	12.41	14.16	16.34	17.85	19.35
50	13.65	15.39	17.70	19.23	20.77
100	13.68	15.39	17.71	19.25	20.79
500	14.17	15.88	17.70	19.26	20.83
			$\lambda = 0.05, \Delta = 2.00$		
20	7.41	8.32	9.44	10.21	10.94
50	8.50	9.44	10.69	11.49	12.28
100	8.55	9.51	10.75	11.56	12.37
500	8.79	9.79	10.74	11.57	12.41
			$\lambda = 0.05, \Delta = 3.00$		
20	5.57	6.21	7.01	7.56	8.08
50	6.53	7.21	8.12	8.72	9.29
100	6.58	7.28	8.19	8.78	9.37
500	6.74	7.48	8.21	8.81	9.41

Table 398

Out of Control ARL_0 for DMEWMA of Dimension 3 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.10, \Delta = 0.25$				
20	42.05	60.72	98.15	142.16	209.91
50	41.79	61.03	98.65	142.52	210.10
100	41.88	60.51	98.07	142.90	210.55
500	41.77	62.83	97.43	143.39	208.91
	$\lambda = 0.10, \Delta = 0.50$				
20	19.06	23.51	29.85	35.53	42.72
50	19.10	23.51	30.00	35.61	42.99
100	18.93	23.42	29.87	35.75	42.87
500	17.97	23.66	30.37	35.78	42.67
	$\lambda = 0.10, \Delta = 1.00$				
20	9.44	10.75	12.35	13.56	14.71
50	9.46	10.81	12.41	13.63	14.78
100	9.49	10.77	12.40	13.60	14.76
500	9.19	10.84	12.47	13.63	14.75
	$\lambda = 0.10, \Delta = 2.00$				
20	5.40	6.01	6.74	7.25	7.72
50	5.46	6.10	6.84	7.36	7.82
100	5.49	6.08	6.82	7.34	7.83
500	5.52	6.18	6.87	7.37	7.84
	$\lambda = 0.10, \Delta = 3.00$				
20	3.98	4.40	4.92	5.27	5.60
50	4.04	4.50	5.02	5.38	5.71
100	4.07	4.48	5.01	5.37	5.70
500	4.20	4.58	5.04	5.39	5.72

Table 399

Out of Control ARL_0 for DMEWMA of Dimension 3 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	45.13	73.38	138.99	228.69	371.07
50	45.54	72.82	138.53	228.59	371.28
100	45.23	71.10	138.27	227.99	370.54
500	48.35	74.00	137.05	229.09	370.30
	λ = 0.20, Δ = 0.50				
20	18.45	24.49	35.72	47.29	62.85
50	18.66	24.45	35.71	47.25	62.78
100	18.48	24.49	35.70	47.03	62.77
500	22.29	25.79	36.39	47.34	63.17
	λ = 0.20, Δ = 1.00				
20	7.11	8.23	9.79	11.02	12.33
50	7.05	8.21	9.75	10.98	12.36
100	7.00	8.18	9.74	10.96	12.29
500	7.27	8.19	9.71	10.95	12.30
	λ = 0.20, Δ = 2.00				
20	3.46	3.84	4.31	4.64	4.94
50	3.44	3.83	4.29	4.62	4.93
100	3.42	3.83	4.29	4.62	4.94
500	3.37	3.86	4.33	4.62	4.95
	λ = 0.20, Δ = 3.00				
20	2.41	2.65	2.95	3.16	3.34
50	2.39	2.64	2.94	3.14	3.33
100	2.39	2.65	2.94	3.14	3.34
500	2.32	2.65	2.97	3.16	3.35

Table 400

Out of Control ARL_0 for DMEWMA of Dimension 3 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	49.56	86.48	174.62	309.80	531.26
50	49.80	86.33	174.79	309.00	530.72
100	49.16	85.04	173.78	308.40	529.73
500	47.70	88.74	176.49	304.73	526.64
			$\lambda = 0.30, \Delta = 0.50$		
20	20.00	28.70	45.95	66.86	98.93
50	20.12	28.68	45.91	66.83	98.87
100	20.26	28.61	45.84	66.58	98.13
500	22.34	30.51	46.79	67.00	97.99
			$\lambda = 0.30, \Delta = 1.00$		
20	6.47	7.75	9.66	11.51	13.47
50	6.43	7.69	9.60	11.49	13.46
100	6.46	7.61	9.62	11.39	13.46
500	6.57	8.05	9.60	11.44	13.51
			$\lambda = 0.30, \Delta = 2.00$		
20	2.63	2.93	3.30	3.59	3.85
50	2.62	2.92	3.29	3.57	3.85
100	2.62	2.92	3.29	3.58	3.84
500	2.85	2.92	3.28	3.58	3.85
			$\lambda = 0.30, \Delta = 3.00$		
20	1.73	1.89	2.09	2.24	2.38
50	1.73	1.89	2.08	2.24	2.38
100	1.73	1.89	2.08	2.24	2.39
500	1.85	1.90	2.10	2.25	2.38

Table 401

Out of Control ARL_0 for DMEWMA of Dimension 3 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	54.50	97.90	210.50	383.71	682.91
50	54.56	97.77	209.60	384.13	682.71
100	53.86	96.53	207.87	382.96	683.71
500	62.57	98.66	208.79	384.22	685.55
			$\lambda = 0.40, \Delta = 0.50$		
20	22.57	34.39	60.44	93.15	143.92
50	22.64	34.22	60.45	93.09	144.58
100	22.27	34.21	60.03	92.32	143.66
500	27.72	36.03	60.53	91.95	143.93
			$\lambda = 0.40, \Delta = 1.00$		
20	6.51	8.08	10.86	13.47	16.71
50	6.51	8.04	10.79	13.43	16.65
100	6.37	7.99	10.77	13.39	16.64
500	7.20	8.60	10.89	13.51	16.56
			$\lambda = 0.40, \Delta = 2.00$		
20	2.21	2.47	2.82	3.09	3.36
50	2.22	2.46	2.82	3.08	3.35
100	2.22	2.46	2.81	3.09	3.35
500	2.32	2.51	2.82	3.09	3.34
			$\lambda = 0.40, \Delta = 3.00$		
20	1.38	1.50	1.64	1.76	1.87
50	1.39	1.49	1.64	1.76	1.87
100	1.39	1.49	1.64	1.76	1.87
500	1.40	1.51	1.65	1.76	1.87

Table 402

Out of Control ARL_0 for DMEWMA of Dimension 3 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	59.35	107.82	243.39	450.43	830.53
50	58.67	107.25	242.64	450.56	831.34
100	58.32	106.11	241.79	450.50	828.08
500	62.00	103.17	240.94	449.51	837.42
			λ = 0.50, Δ = 0.50		
20	25.79	40.90	76.91	125.33	204.59
50	25.49	40.65	76.64	125.79	204.92
100	25.85	40.83	76.16	125.06	204.47
500	28.06	39.48	75.81	125.55	205.87
			λ = 0.50, Δ = 1.00		
20	6.97	9.10	13.00	16.92	22.41
50	6.91	9.02	12.96	16.86	22.32
100	6.88	9.04	12.95	16.88	22.35
500	9.24	9.50	12.89	16.98	22.31
			λ = 0.50, Δ = 2.00		
20	2.01	2.26	2.61	2.91	3.21
50	2.00	2.25	2.61	2.91	3.22
100	2.02	2.25	2.60	2.90	3.23
500	2.17	2.24	2.64	2.91	3.21
			λ = 0.50, Δ = 3.00		
20	1.22	1.29	1.40	1.49	1.58
50	1.23	1.30	1.40	1.49	1.58
100	1.22	1.30	1.40	1.49	1.59
500	1.27	1.30	1.40	1.49	1.58

Table 403

Out of Control ARL_0 for DMEWMA of Dimension 3 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	62.67	117.90	273.62	515.60	968.42
50	61.99	116.70	273.55	514.62	969.54
100	61.75	116.34	273.68	514.97	968.97
500	51.16	117.05	274.08	511.37	963.11
			λ = 0.60, Δ = 0.50		
20	29.53	50.14	97.89	165.22	285.05
50	29.27	50.06	97.62	165.19	285.28
100	29.60	49.61	97.06	164.89	285.70
500	26.25	50.07	97.10	165.06	288.50
			λ = 0.60, Δ = 1.00		
20	7.90	10.85	16.54	23.05	32.28
50	7.78	10.76	16.42	22.93	32.21
100	7.79	10.79	16.43	22.94	32.29
500	8.58	10.92	16.46	22.77	32.45
			λ = 0.60, Δ = 2.00		
20	1.96	2.23	2.64	3.00	3.42
50	1.95	2.24	2.65	3.00	3.40
100	1.96	2.23	2.63	2.99	3.40
500	1.94	2.20	2.65	2.97	3.38
			λ = 0.60, Δ = 3.00		
20	1.17	1.22	1.30	1.38	1.46
50	1.17	1.23	1.31	1.38	1.47
100	1.17	1.22	1.31	1.39	1.47
500	1.21	1.21	1.31	1.37	1.46

Table 404

Out of Control ARL_0 for DMEWMA of Dimension 3 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	72.06	143.74	340.24	667.65	1270.08
50	71.64	142.61	340.61	669.84	1270.88
100	72.82	141.71	338.73	671.17	1269.89
500	65.21	140.59	339.92	674.44	1263.34
			$\lambda = 0.80, \Delta = 0.50$		
20	40.06	73.64	161.64	292.83	524.75
50	40.05	73.40	161.55	294.05	525.71
100	40.03	73.66	161.38	293.64	524.99
500	37.97	71.13	162.47	298.85	526.80
			$\lambda = 0.80, \Delta = 1.00$		
20	11.82	18.52	32.60	51.07	81.39
50	11.76	18.53	32.58	51.08	81.27
100	11.73	18.39	32.56	51.04	81.26
500	10.85	17.89	32.70	50.62	81.55
			$\lambda = 0.80, \Delta = 2.00$		
20	2.37	2.92	3.80	4.67	5.88
50	2.36	2.92	3.80	4.69	5.87
100	2.33	2.95	3.81	4.67	5.86
500	2.17	2.95	3.80	4.70	5.92
			$\lambda = 0.80, \Delta = 3.00$		
20	1.24	1.33	1.47	1.59	1.73
50	1.25	1.33	1.47	1.58	1.73
100	1.24	1.33	1.47	1.58	1.72
500	1.19	1.32	1.46	1.57	1.72

Table 405

Out of Control ARL_0 for DMEWMA of Dimension 4 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	λ = 0.05, Δ = 0.25				
20	42.19	56.01	80.74	103.96	135.53
50	43.71	57.75	82.18	105.26	136.29
100	44.64	58.26	81.66	104.95	135.29
500	43.49	57.53	82.76	106.61	135.66
	λ = 0.05, Δ = 0.50				
20	21.77	25.94	31.51	35.87	40.26
50	23.09	27.11	32.70	36.89	41.41
100	23.22	27.32	32.89	37.12	41.48
500	23.24	27.21	32.94	37.21	41.67
	λ = 0.05, Δ = 1.00				
20	12.28	14.02	16.13	17.60	19.03
50	13.57	15.30	17.48	18.95	20.34
100	13.71	15.37	17.56	19.10	20.49
500	13.96	15.22	17.62	19.15	20.53
	λ = 0.05, Δ = 2.00				
20	7.41	8.32	9.39	10.13	10.84
50	8.46	9.41	10.58	11.36	12.07
100	8.60	9.51	10.69	11.50	12.22
500	8.68	9.39	10.71	11.52	12.23
	λ = 0.05, Δ = 3.00				
20	5.57	6.23	7.00	7.53	8.03
50	6.50	7.18	8.05	8.62	9.15
100	6.60	7.28	8.14	8.75	9.27
500	6.62	7.16	8.16	8.76	9.28

Table 406

Out of Control ARL_0 for DMEWMA of Dimension 4 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	40.20	59.03	96.95	140.52	207.47
50	39.85	59.87	96.98	140.55	207.68
100	40.96	59.99	96.75	140.26	206.70
500	41.33	58.33	95.56	140.40	206.31
			$\lambda = 0.10, \Delta = 0.50$		
20	18.41	22.77	29.13	34.74	41.32
50	18.37	22.78	29.22	34.75	41.38
100	18.50	22.92	29.18	34.70	41.52
500	19.43	23.00	29.23	34.91	41.31
			$\lambda = 0.10, \Delta = 1.00$		
20	9.27	10.56	12.13	13.22	14.31
50	9.34	10.68	12.23	13.29	14.40
100	9.42	10.69	12.24	13.28	14.37
500	9.32	10.81	12.28	13.31	14.40
			$\lambda = 0.10, \Delta = 2.00$		
20	5.33	5.93	6.65	7.11	7.57
50	5.42	6.05	6.75	7.22	7.67
100	5.45	6.05	6.76	7.23	7.68
500	5.39	6.09	6.79	7.22	7.68
			$\lambda = 0.10, \Delta = 3.00$		
20	3.95	4.36	4.86	5.19	5.50
50	4.01	4.47	4.96	5.29	5.61
100	4.04	4.47	4.96	5.29	5.61
500	4.01	4.49	4.97	5.29	5.61

Table 407

Out of Control ARL_0 for DMEWMA of Dimension 4 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	42.94	71.55	137.80	225.27	372.03
50	44.04	72.18	137.85	226.71	373.11
100	44.49	72.60	138.69	227.14	372.98
500	41.29	75.59	140.26	228.00	373.62
			$\lambda = 0.20, \Delta = 0.50$		
20	17.65	23.87	34.71	46.23	60.81
50	17.76	23.75	34.65	46.17	60.81
100	17.62	23.86	34.75	46.15	60.64
500	18.80	24.62	34.56	46.22	61.06
			$\lambda = 0.20, \Delta = 1.00$		
20	6.92	8.04	9.53	10.69	11.87
50	6.95	8.05	9.50	10.65	11.85
100	6.95	8.01	9.56	10.72	11.91
500	7.20	8.21	9.54	10.64	11.92
			$\lambda = 0.20, \Delta = 2.00$		
20	3.39	3.77	4.21	4.51	4.80
50	3.42	3.77	4.21	4.52	4.81
100	3.42	3.78	4.22	4.52	4.81
500	3.52	3.80	4.24	4.53	4.81
			$\lambda = 0.20, \Delta = 3.00$		
20	2.37	2.60	2.88	3.07	3.25
50	2.38	2.61	2.88	3.08	3.26
100	2.37	2.61	2.89	3.08	3.26
500	2.44	2.63	2.89	3.09	3.26

Table 408

Out of Control ARL_0 for DMEWMA of Dimension 4 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	48.50	84.68	178.29	308.05	532.19
50	48.47	84.59	178.96	309.04	532.08
100	48.66	85.74	178.56	310.95	533.73
500	47.19	87.88	178.84	307.98	534.52
			λ = 0.30, Δ = 0.50		
20	19.66	28.23	45.08	65.44	95.30
50	19.68	28.12	45.03	65.71	95.65
100	19.34	28.31	45.12	65.68	95.92
500	21.79	28.55	45.53	65.78	95.72
			λ = 0.30, Δ = 1.00		
20	6.33	7.52	9.45	11.06	12.88
50	6.30	7.55	9.40	11.02	12.84
100	6.33	7.49	9.42	11.13	12.98
500	7.58	7.56	9.41	11.14	13.04
			λ = 0.30, Δ = 2.00		
20	2.59	2.87	3.21	3.46	3.71
50	2.60	2.86	3.22	3.47	3.73
100	2.60	2.86	3.23	3.49	3.73
500	2.85	2.94	3.25	3.49	3.74
			λ = 0.30, Δ = 3.00		
20	1.71	1.85	2.05	2.18	2.32
50	1.72	1.86	2.05	2.19	2.32
100	1.71	1.86	2.05	2.18	2.31
500	1.82	1.89	2.06	2.20	2.33

Table 409

Out of Control ARL_0 for DMEWMA of Dimension 4 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	53.16	94.79	210.36	383.93	689.41
50	52.99	95.53	211.47	383.31	687.98
100	52.84	95.97	211.21	383.84	689.47
500	46.47	96.22	212.16	384.70	693.10
			$\lambda = 0.40, \Delta = 0.50$		
20	22.32	33.53	59.05	92.42	146.54
50	22.12	33.34	59.23	92.71	147.33
100	22.37	33.51	59.03	93.00	147.81
500	16.28	34.62	59.75	92.46	148.43
			$\lambda = 0.40, \Delta = 1.00$		
20	6.33	7.89	10.53	13.05	16.11
50	6.32	7.92	10.53	12.92	16.13
100	6.28	7.92	10.51	13.04	16.23
500	6.00	7.83	10.52	13.07	16.29
			$\lambda = 0.40, \Delta = 2.00$		
20	2.17	2.41	2.74	2.99	3.23
50	2.18	2.43	2.75	2.99	3.23
100	2.17	2.42	2.73	3.00	3.24
500	2.24	2.49	2.74	2.99	3.25
			$\lambda = 0.40, \Delta = 3.00$		
20	1.37	1.48	1.61	1.72	1.81
50	1.38	1.48	1.62	1.72	1.82
100	1.37	1.47	1.60	1.71	1.81
500	1.40	1.52	1.61	1.72	1.82

Table 410

Out of Control ARL_0 for DMEWMA of Dimension 4 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	57.86	104.94	245.11	449.64	821.69
50	57.57	104.94	245.92	450.35	821.35
100	57.11	105.11	243.70	450.97	822.18
500	43.59	106.65	240.17	454.83	827.14
			λ = 0.50, Δ = 0.50		
20	25.44	40.43	76.84	123.95	205.38
50	25.22	40.22	76.89	123.60	205.97
100	25.27	39.72	76.60	124.17	206.19
500	24.07	38.48	77.83	126.47	207.55
			λ = 0.50, Δ = 1.00		
20	6.85	8.93	12.71	16.68	21.76
50	6.79	8.94	12.68	16.61	21.68
100	6.55	8.90	12.69	16.69	21.83
500	6.22	9.07	12.96	16.69	21.85
			λ = 0.50, Δ = 2.00		
20	1.98	2.20	2.55	2.82	3.09
50	1.99	2.21	2.54	2.81	3.09
100	1.96	2.21	2.54	2.82	3.10
500	1.77	2.27	2.56	2.81	3.11
			λ = 0.50, Δ = 3.00		
20	1.22	1.29	1.39	1.47	1.55
50	1.23	1.29	1.39	1.47	1.55
100	1.21	1.29	1.39	1.47	1.54
500	1.26	1.33	1.40	1.47	1.55

Table 411

Out of Control ARL_0 for DMEWMA of Dimension 4 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	60.92	117.88	278.77	528.03	990.83
50	60.22	117.46	279.09	529.25	992.22
100	60.58	117.46	278.53	532.38	991.70
500	59.67	120.27	284.31	528.64	982.62
			λ = 0.60, Δ = 0.50		
20	29.42	49.63	100.36	167.63	287.82
50	29.00	49.22	100.17	167.32	287.95
100	28.71	49.08	99.85	167.49	287.96
500	28.28	48.57	101.59	168.49	289.30
			λ = 0.60, Δ = 1.00		
20	7.74	10.66	16.60	22.79	31.77
50	7.65	10.66	16.56	22.78	31.67
100	7.56	10.48	16.47	22.92	31.78
500	6.75	10.61	16.55	22.67	31.72
			λ = 0.60, Δ = 2.00		
20	1.93	2.20	2.58	2.91	3.31
50	1.95	2.19	2.59	2.92	3.29
100	1.93	2.18	2.59	2.90	3.29
500	1.63	2.22	2.62	2.93	3.29
			λ = 0.60, Δ = 3.00		
20	1.16	1.23	1.32	1.38	1.45
50	1.17	1.23	1.32	1.38	1.45
100	1.18	1.22	1.31	1.38	1.46
500	1.15	1.25	1.31	1.37	1.45

Table 412

Out of Control ARL_0 for DMEWMA of Dimension 4 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	72.52	141.97	343.18	683.62	1327.56
50	72.02	141.82	344.33	684.60	1330.59
100	72.29	140.09	343.40	684.87	1330.09
500	83.91	144.56	349.13	687.62	1327.06
			$\lambda = 0.80, \Delta = 0.50$		
20	41.79	75.17	160.93	301.57	547.32
50	41.29	75.08	160.73	302.58	548.32
100	41.35	75.48	160.73	303.35	549.17
500	55.81	77.63	160.04	305.77	549.16
			$\lambda = 0.80, \Delta = 1.00$		
20	12.09	18.86	33.43	52.11	82.46
50	12.04	18.79	33.49	52.03	82.34
100	12.01	18.93	33.63	52.23	82.55
500	13.58	18.59	32.92	52.10	81.50
			$\lambda = 0.80, \Delta = 2.00$		
20	2.40	2.89	3.73	4.55	5.69
50	2.41	2.89	3.74	4.55	5.71
100	2.41	2.87	3.72	4.58	5.76
500	2.33	2.90	3.76	4.57	5.75
			$\lambda = 0.80, \Delta = 3.00$		
20	1.27	1.35	1.47	1.61	1.75
50	1.27	1.35	1.47	1.60	1.74
100	1.28	1.35	1.48	1.60	1.74
500	1.19	1.29	1.47	1.59	1.74

Table 413

Out of Control ARL_0 for DMEWMA of Dimension 5 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	41.69	54.75	78.66	103.32	133.25
50	42.60	56.21	80.33	104.13	133.71
100	42.61	56.08	79.54	104.14	133.68
500	40.41	56.69	79.14	104.23	133.32
			λ = 0.05, Δ = 0.50		
20	21.64	25.42	30.75	34.89	38.94
50	22.67	26.39	31.79	35.93	39.87
100	22.90	26.84	32.00	36.08	40.02
500	22.78	26.86	31.76	35.86	40.01
			λ = 0.05, Δ = 1.00		
20	12.25	13.79	15.84	17.30	18.62
50	13.34	14.93	17.02	18.48	19.80
100	13.56	15.20	17.25	18.67	19.99
500	12.92	15.11	17.13	18.62	19.96
			λ = 0.05, Δ = 2.00		
20	7.40	8.21	9.26	10.02	10.67
50	8.33	9.20	10.31	11.10	11.77
100	8.53	9.40	10.49	11.24	11.93
500	7.96	9.33	10.45	11.25	11.93
			λ = 0.05, Δ = 3.00		
20	5.57	6.15	6.92	7.44	7.92
50	6.39	7.02	7.84	8.41	8.91
100	6.54	7.20	7.99	8.54	9.05
500	6.03	7.12	7.97	8.56	9.06

Table 414

Out of Control ARL_0 for DMEWMA of Dimension 5 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	39.97	58.12	96.19	140.14	203.07
50	39.35	58.14	96.25	141.59	202.99
100	40.14	57.58	96.29	140.39	203.66
500	41.88	57.31	94.56	140.87	202.12
	λ = 0.10, Δ = 0.50				
20	18.16	22.17	28.32	33.48	39.43
50	18.16	22.08	28.19	33.51	39.55
100	18.39	22.35	28.26	33.59	39.65
500	19.27	21.61	27.80	33.27	39.76
	λ = 0.10, Δ = 1.00				
20	9.14	10.30	11.79	12.86	13.88
50	9.18	10.37	11.88	12.93	13.93
100	9.28	10.41	11.91	12.99	13.95
500	9.39	10.38	11.78	12.86	13.90
	λ = 0.10, Δ = 2.00				
20	5.25	5.81	6.49	6.95	7.37
50	5.32	5.89	6.57	7.04	7.44
100	5.36	5.92	6.59	7.05	7.46
500	5.60	5.90	6.53	7.00	7.44
	λ = 0.10, Δ = 3.00				
20	3.88	4.27	4.74	5.07	5.36
50	3.95	4.34	4.83	5.15	5.44
100	3.99	4.36	4.85	5.17	5.44
500	4.17	4.34	4.80	5.14	5.43

Table 415

Out of Control ARL_0 for DMEWMA of Dimension 5 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	43.28	70.02	137.08	224.84	365.03
50	43.28	69.88	136.52	224.71	364.84
100	43.76	70.22	136.58	223.44	365.49
500	38.06	69.09	138.06	222.54	363.71
			λ = 0.20, Δ = 0.50		
20	17.22	23.25	33.92	45.33	60.40
50	17.16	22.92	33.83	45.29	60.35
100	17.39	23.23	33.86	45.39	60.57
500	16.23	23.27	33.74	45.42	60.61
			λ = 0.20, Δ = 1.00		
20	6.70	7.70	9.19	10.26	11.41
50	6.68	7.77	9.18	10.29	11.39
100	6.69	7.75	9.18	10.28	11.40
500	5.52	7.68	9.12	10.22	11.35
			λ = 0.20, Δ = 2.00		
20	3.31	3.66	4.09	4.38	4.64
50	3.31	3.66	4.08	4.38	4.64
100	3.32	3.67	4.09	4.38	4.65
500	2.92	3.60	4.09	4.37	4.63
			λ = 0.20, Δ = 3.00		
20	2.31	2.53	2.80	2.98	3.15
50	2.30	2.53	2.79	2.98	3.15
100	2.31	2.54	2.80	2.98	3.15
500	2.19	2.52	2.79	2.98	3.14

Table 416

Out of Control ARL_0 for DMEWMA of Dimension 5 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	47.26	82.80	173.16	300.33	528.07
50	47.51	82.59	171.92	298.62	527.43
100	47.67	83.05	173.42	297.92	526.91
500	67.77	82.67	170.49	296.41	526.39
			$\lambda = 0.30, \Delta = 0.50$		
20	18.64	27.22	44.00	64.88	95.95
50	18.74	27.21	43.96	64.64	96.42
100	19.03	27.24	43.65	64.62	96.18
500	24.35	27.48	43.39	65.18	96.26
			$\lambda = 0.30, \Delta = 1.00$		
20	6.02	7.19	8.99	10.52	12.34
50	6.02	7.28	9.00	10.55	12.35
100	5.97	7.22	8.99	10.54	12.28
500	7.18	7.15	8.94	10.60	12.39
			$\lambda = 0.30, \Delta = 2.00$		
20	2.50	2.77	3.10	3.34	3.57
50	2.51	2.77	3.10	3.34	3.58
100	2.52	2.78	3.11	3.35	3.57
500	2.70	2.77	3.12	3.35	3.58
			$\lambda = 0.30, \Delta = 3.00$		
20	1.67	1.80	1.98	2.11	2.23
50	1.66	1.80	1.98	2.10	2.22
100	1.67	1.80	1.99	2.11	2.23
500	1.75	1.79	1.99	2.11	2.23

Table 417

Out of Control ARL_0 for DMEWMA of Dimension 5 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	52.48	95.19	205.61	373.52	671.59
50	52.10	94.84	206.40	373.51	672.31
100	51.88	95.57	207.54	374.49	672.57
500	60.33	93.17	207.98	375.74	669.67
			$\lambda = 0.40, \Delta = 0.50$		
20	21.34	33.04	58.03	90.55	139.16
50	21.40	32.80	58.00	90.43	138.65
100	21.30	32.75	58.05	90.12	138.71
500	28.21	33.59	58.79	91.39	138.50
			$\lambda = 0.40, \Delta = 1.00$		
20	6.07	7.54	9.89	12.30	15.38
50	6.07	7.59	9.93	12.29	15.34
100	5.98	7.54	9.90	12.26	15.35
500	6.93	7.32	10.07	12.35	15.47
			$\lambda = 0.40, \Delta = 2.00$		
20	2.10	2.33	2.62	2.86	3.08
50	2.11	2.33	2.62	2.84	3.07
100	2.10	2.34	2.63	2.84	3.08
500	2.19	2.32	2.63	2.87	3.09
			$\lambda = 0.40, \Delta = 3.00$		
20	1.34	1.44	1.56	1.66	1.74
50	1.35	1.44	1.56	1.65	1.74
100	1.34	1.42	1.56	1.65	1.75
500	1.28	1.45	1.56	1.66	1.74

Table 418

Out of Control ARL_0 for DMEWMA of Dimension 5 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	56.36	105.79	237.98	442.96	837.21
50	56.10	105.43	238.82	443.40	838.28
100	55.94	106.22	239.23	443.31	840.17
500	61.30	108.81	245.56	444.64	836.60
			λ = 0.50, Δ = 0.50		
20	24.68	39.80	74.01	123.63	201.44
50	24.53	39.50	73.85	123.64	201.07
100	24.29	39.39	74.07	123.66	201.39
500	27.08	38.84	76.98	125.09	200.66
			λ = 0.50, Δ = 1.00		
20	6.49	8.43	12.05	15.85	21.29
50	6.50	8.44	12.04	15.86	21.27
100	6.52	8.42	12.03	15.78	21.27
500	5.72	8.40	12.03	15.86	21.29
			λ = 0.50, Δ = 2.00		
20	1.91	2.13	2.43	2.68	2.95
50	1.92	2.13	2.41	2.66	2.93
100	1.89	2.13	2.42	2.67	2.94
500	1.80	2.22	2.43	2.65	2.92
			λ = 0.50, Δ = 3.00		
20	1.21	1.27	1.36	1.43	1.50
50	1.20	1.27	1.36	1.43	1.50
100	1.20	1.26	1.35	1.42	1.50
500	1.24	1.28	1.34	1.42	1.50

Table 419

Out of Control ARL_0 for DMEWMA of Dimension 5 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	61.31	116.07	271.13	517.50	975.54
50	61.88	116.00	270.03	516.80	977.53
100	61.91	116.75	270.32	517.86	976.66
500	72.10	119.94	269.89	519.33	980.60
			$\lambda = 0.60, \Delta = 0.50$		
20	28.93	48.64	96.10	165.71	281.62
50	28.96	48.44	95.88	165.34	281.83
100	28.43	48.40	95.48	165.53	281.94
500	30.54	49.60	97.57	166.11	284.04
			$\lambda = 0.60, \Delta = 1.00$		
20	7.30	10.14	15.65	22.19	30.67
50	7.23	10.12	15.62	22.06	30.66
100	7.15	10.13	15.60	22.01	30.71
500	5.45	9.69	15.49	22.29	30.87
			$\lambda = 0.60, \Delta = 2.00$		
20	1.87	2.11	2.47	2.79	3.14
50	1.87	2.12	2.46	2.77	3.12
100	1.86	2.12	2.48	2.79	3.12
500	1.56	2.10	2.46	2.76	3.13
			$\lambda = 0.60, \Delta = 3.00$		
20	1.16	1.21	1.29	1.35	1.41
50	1.16	1.21	1.29	1.35	1.42
100	1.15	1.21	1.28	1.34	1.41
500	1.13	1.22	1.29	1.34	1.41

Table 420

Out of Control ARL_0 for DMEWMA of Dimension 5 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	72.45	139.83	340.26	652.28	1286.71
50	72.38	138.68	340.62	652.52	1287.72
100	72.05	137.79	341.30	655.03	1288.83
500	49.54	140.89	343.02	657.95	1288.66
			$\lambda = 0.80, \Delta = 0.50$		
20	40.09	72.76	161.47	289.80	529.13
50	39.86	72.51	161.47	290.47	530.63
100	39.51	71.68	161.64	290.82	531.95
500	28.33	66.66	162.68	290.73	527.39
			$\lambda = 0.80, \Delta = 1.00$		
20	11.45	17.68	32.18	49.87	80.96
50	11.27	17.50	31.92	49.90	81.02
100	11.15	17.45	31.92	49.64	80.96
500	11.02	16.40	31.85	49.72	81.73
			$\lambda = 0.80, \Delta = 2.00$		
20	2.35	2.81	3.64	4.42	5.54
50	2.36	2.79	3.62	4.40	5.52
100	2.30	2.78	3.63	4.38	5.52
500	2.56	2.67	3.59	4.33	5.54
			$\lambda = 0.80, \Delta = 3.00$		
20	1.25	1.34	1.49	1.59	1.74
50	1.25	1.34	1.48	1.60	1.74
100	1.23	1.32	1.47	1.60	1.74
500	1.19	1.30	1.47	1.59	1.72

Table 421

Out of Control ARL_0 for DMEWMA of Dimension 6 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	39.90	53.00	74.67	96.03	123.99
50	41.08	54.11	74.81	95.74	124.11
100	41.18	53.96	75.77	96.06	124.54
500	41.00	54.99	76.49	96.92	125.26
			λ = 0.05, Δ = 0.50		
20	21.03	24.72	29.76	33.45	37.21
50	21.92	25.67	30.48	34.16	37.97
100	22.12	25.76	30.69	34.47	38.31
500	23.74	26.13	30.62	34.20	37.98
			λ = 0.05, Δ = 1.00		
20	12.01	13.61	15.55	16.88	18.13
50	13.02	14.61	16.51	17.88	19.17
100	13.18	14.72	16.65	18.03	19.35
500	13.88	14.85	16.52	17.85	19.22
			λ = 0.05, Δ = 2.00		
20	7.31	8.15	9.15	9.83	10.47
50	8.15	9.02	10.07	10.80	11.47
100	8.31	9.16	10.19	10.92	11.62
500	8.81	9.21	10.10	10.83	11.54
			λ = 0.05, Δ = 3.00		
20	5.52	6.12	6.84	7.33	7.79
50	6.25	6.90	7.67	8.20	8.69
100	6.39	7.02	7.77	8.31	8.83
500	6.73	7.08	7.70	8.24	8.77

Table 422

Out of Control ARL$_0$ for DMEWMA of Dimension 6 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	38.07	54.94	89.68	129.58	190.05
50	38.17	54.93	89.03	128.32	189.68
100	37.48	54.61	89.75	129.48	188.92
500	37.59	55.87	89.45	129.40	188.99
			λ = 0.10, Δ = 0.50		
20	17.39	21.12	26.64	31.25	36.87
50	17.43	21.08	26.42	31.07	36.63
100	17.28	20.94	26.45	31.24	36.94
500	17.61	20.98	26.69	31.20	36.91
			λ = 0.10, Δ = 1.00		
20	8.89	10.06	11.46	12.41	13.33
50	8.94	10.03	11.44	12.40	13.32
100	8.94	10.00	11.44	12.43	13.37
500	9.23	10.11	11.37	12.29	13.26
			λ = 0.10, Δ = 2.00		
20	5.15	5.69	6.34	6.77	7.16
50	5.18	5.71	6.36	6.80	7.19
100	5.18	5.71	6.37	6.82	7.21
500	5.26	5.76	6.34	6.75	7.16
			λ = 0.10, Δ = 3.00		
20	3.81	4.19	4.64	4.95	5.22
50	3.84	4.22	4.68	4.98	5.26
100	3.83	4.22	4.68	5.00	5.28
500	3.94	4.23	4.66	4.95	5.24

Table 423

Out of Control ARL_0 for DMEWMA of Dimension 6 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.20, \Delta = 0.25$				
20	40.69	66.01	127.30	207.66	340.64
50	40.41	65.88	126.31	206.77	340.20
100	40.57	65.40	127.10	206.06	339.15
500	50.11	67.44	125.07	205.03	337.86
	$\lambda = 0.20, \Delta = 0.50$				
20	16.16	21.38	31.01	41.40	55.33
50	16.19	21.23	31.03	41.03	55.06
100	16.22	21.31	31.10	41.14	55.10
500	19.35	20.64	30.83	42.09	55.20
	$\lambda = 0.20, \Delta = 1.00$				
20	6.45	7.43	8.70	9.65	10.64
50	6.47	7.41	8.66	9.61	10.59
100	6.43	7.48	8.63	9.59	10.61
500	7.53	7.46	8.62	9.58	10.52
	$\lambda = 0.20, \Delta = 2.00$				
20	3.20	3.53	3.94	4.20	4.45
50	3.18	3.51	3.90	4.18	4.43
100	3.17	3.52	3.90	4.18	4.43
500	3.67	3.53	3.89	4.16	4.41
	$\lambda = 0.20, \Delta = 3.00$				
20	2.24	2.44	2.70	2.87	3.02
50	2.23	2.43	2.68	2.85	3.01
100	2.23	2.45	2.68	2.85	3.01
500	2.43	2.43	2.66	2.85	2.99

Table 424

Out of Control ARL$_0$ for DMEWMA of Dimension 6 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	44.92	77.97	164.95	290.45	506.83
50	44.73	77.74	164.21	288.25	503.73
100	45.18	77.64	163.17	288.45	504.65
500	38.17	74.07	161.42	288.79	506.00
			λ = 0.30, Δ = 0.50		
20	17.51	25.28	40.81	60.06	88.17
50	17.33	25.39	40.47	59.70	87.97
100	17.59	25.42	40.62	59.68	87.99
500	14.89	24.80	40.92	59.61	87.75
			λ = 0.30, Δ = 1.00		
20	5.79	6.84	8.39	9.71	11.29
50	5.73	6.84	8.37	9.68	11.29
100	5.79	6.89	8.38	9.70	11.25
500	5.62	6.92	8.35	9.71	11.31
			λ = 0.30, Δ = 2.00		
20	2.40	2.65	2.96	3.18	3.39
50	2.39	2.63	2.93	3.16	3.37
100	2.39	2.64	2.95	3.17	3.38
500	2.33	2.70	2.93	3.15	3.37
			λ = 0.30, Δ = 3.00		
20	1.61	1.73	1.90	2.02	2.13
50	1.61	1.73	1.88	2.00	2.12
100	1.61	1.73	1.89	2.01	2.12
500	1.58	1.74	1.87	2.00	2.12

Table 425

Out of Control ARL_0 for DMEWMA of Dimension 6 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	48.69	91.41	201.15	365.90	662.07
50	48.66	90.82	201.24	365.55	660.40
100	48.50	91.49	200.25	364.76	660.65
500	46.53	88.91	197.75	359.72	663.66
			λ = 0.40, Δ = 0.50		
20	19.69	30.51	54.49	84.85	134.16
50	19.57	30.56	54.30	84.39	134.02
100	19.45	30.68	54.47	84.38	133.93
500	20.84	32.04	53.51	83.80	133.89
			λ = 0.40, Δ = 1.00		
20	5.78	7.09	9.25	11.32	13.93
50	5.74	7.05	9.22	11.32	14.02
100	5.77	7.07	9.26	11.38	14.01
500	5.54	7.17	9.19	11.32	14.02
			λ = 0.40, Δ = 2.00		
20	2.00	2.21	2.48	2.70	2.91
50	1.99	2.20	2.47	2.66	2.88
100	2.00	2.20	2.47	2.68	2.89
500	1.91	2.18	2.47	2.69	2.89
			λ = 0.40, Δ = 3.00		
20	1.31	1.39	1.51	1.58	1.66
50	1.31	1.39	1.51	1.59	1.67
100	1.30	1.39	1.50	1.59	1.67
500	1.27	1.41	1.51	1.59	1.67

Table 426

Out of Control ARL_0 for DMEWMA of Dimension 6 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	53.38	102.27	236.63	439.91	809.36
50	53.43	102.41	236.26	439.82	809.38
100	54.01	103.27	235.99	439.82	809.16
500	44.27	95.22	231.44	440.17	806.77
			$\lambda = 0.50, \Delta = 0.50$		
20	22.83	37.01	72.30	118.51	193.51
50	22.59	36.94	72.02	118.22	192.88
100	22.56	36.94	72.05	118.34	193.06
500	20.49	35.31	69.98	117.84	192.18
			$\lambda = 0.50, \Delta = 1.00$		
20	6.11	7.93	11.18	14.51	18.89
50	6.12	7.91	11.19	14.51	18.90
100	6.10	7.92	11.23	14.59	19.01
500	6.31	7.52	11.18	14.87	19.14
			$\lambda = 0.50, \Delta = 2.00$		
20	1.80	2.00	2.30	2.51	2.75
50	1.80	2.01	2.27	2.49	2.73
100	1.81	1.99	2.26	2.50	2.75
500	2.02	1.96	2.28	2.52	2.75
			$\lambda = 0.50, \Delta = 3.00$		
20	1.18	1.24	1.32	1.38	1.45
50	1.18	1.24	1.31	1.38	1.45
100	1.18	1.24	1.32	1.38	1.44
500	1.26	1.22	1.31	1.38	1.44

Table 427

Out of Control ARL_0 for DMEWMA of Dimension 6 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	59.16	114.83	273.50	515.10	954.83
50	58.49	114.51	273.36	514.12	954.52
100	57.79	116.26	274.53	515.14	956.28
500	51.12	110.04	272.64	510.09	963.40
			$\lambda = 0.60, \Delta = 0.50$		
20	27.01	45.82	94.74	161.26	278.53
50	26.45	45.51	94.94	161.20	278.34
100	26.03	45.25	95.22	161.17	277.66
500	21.84	40.87	94.81	158.23	277.23
			$\lambda = 0.60, \Delta = 1.00$		
20	6.91	9.62	14.56	20.18	28.76
50	6.96	9.66	14.56	20.20	28.69
100	6.89	9.67	14.69	20.20	28.74
500	5.12	9.54	14.99	20.41	29.08
			$\lambda = 0.60, \Delta = 2.00$		
20	1.78	2.00	2.32	2.62	2.94
50	1.79	2.00	2.32	2.61	2.94
100	1.78	1.98	2.31	2.62	2.95
500	1.57	1.92	2.33	2.62	2.97
			$\lambda = 0.60, \Delta = 3.00$		
20	1.15	1.19	1.26	1.32	1.38
50	1.14	1.19	1.26	1.31	1.38
100	1.13	1.18	1.26	1.32	1.38
500	1.16	1.18	1.26	1.31	1.37

Table 428

Out of Control ARL_0 for DMEWMA of Dimension 6 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	69.26	139.25	337.40	668.18	1277.78
50	69.02	139.50	337.44	667.30	1276.66
100	69.46	139.98	337.03	668.13	1276.77
500	104.12	136.83	340.62	669.70	1280.17
			λ = 0.80, Δ = 0.50		
20	38.28	70.53	157.53	290.04	521.49
50	38.67	70.44	158.34	289.97	521.00
100	38.32	70.29	159.19	291.25	520.85
500	46.94	69.57	160.49	289.40	515.79
			λ = 0.80, Δ = 1.00		
20	10.97	17.25	31.50	50.28	79.85
50	11.22	17.36	31.58	50.48	79.96
100	10.99	17.30	31.49	50.38	79.73
500	11.64	17.90	32.19	50.33	80.33
			λ = 0.80, Δ = 2.00		
20	2.27	2.77	3.49	4.33	5.32
50	2.29	2.78	3.51	4.35	5.30
100	2.29	2.78	3.50	4.31	5.31
500	2.38	2.84	3.58	4.31	5.29
			λ = 0.80, Δ = 3.00		
20	1.26	1.34	1.46	1.56	1.68
50	1.26	1.35	1.46	1.58	1.70
100	1.28	1.36	1.46	1.58	1.70
500	1.06	1.27	1.43	1.57	1.71

Table 429

Out of Control ARL_0 for DMEWMA of Dimension 7 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	38.38	50.20	71.02	91.59	117.10
50	39.30	50.94	71.96	91.75	117.72
100	40.20	51.65	72.82	92.23	117.66
500	37.43	51.99	71.45	92.57	117.61
			λ = 0.05, Δ = 0.50		
20	20.21	23.72	28.52	32.15	35.66
50	20.97	24.64	29.34	32.92	36.46
100	21.64	25.03	29.69	33.13	36.61
500	19.96	24.71	29.33	33.04	36.61
			λ = 0.05, Δ = 1.00		
20	11.64	13.10	14.93	16.23	17.41
50	12.53	14.10	15.94	17.23	18.41
100	12.84	14.31	16.13	17.43	18.55
500	11.78	13.97	16.06	17.44	18.59
			λ = 0.05, Δ = 2.00		
20	7.12	7.88	8.84	9.50	10.10
50	7.89	8.74	9.73	10.42	11.05
100	8.08	8.90	9.90	10.57	11.18
500	7.43	8.70	9.84	10.58	11.19
			λ = 0.05, Δ = 3.00		
20	5.39	5.93	6.62	7.10	7.53
50	6.06	6.67	7.42	7.92	8.38
100	6.22	6.82	7.55	8.05	8.50
500	5.62	6.66	7.52	8.06	8.50

Table 430

Out of Control ARL_0 for DMEWMA of Dimension 7 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	36.14	51.49	84.15	120.61	177.30
50	36.46	51.55	84.11	120.91	177.15
100	36.80	51.52	84.19	120.94	177.65
500	37.97	51.20	84.11	121.64	177.00
			λ = 0.10, Δ = 0.50		
20	16.53	20.05	25.42	30.15	35.34
50	16.61	20.19	25.47	30.03	35.08
100	16.83	20.23	25.48	29.99	35.19
500	16.21	20.21	25.68	30.15	35.07
			λ = 0.10, Δ = 1.00		
20	8.49	9.59	10.90	11.83	12.68
50	8.58	9.63	10.98	11.85	12.71
100	8.64	9.72	11.00	11.89	12.75
500	7.97	9.58	11.08	11.91	12.77
			λ = 0.10, Δ = 2.00		
20	4.93	5.46	6.07	6.48	6.84
50	5.00	5.51	6.14	6.53	6.90
100	5.03	5.53	6.15	6.54	6.92
500	4.87	5.52	6.18	6.56	6.92
			λ = 0.10, Δ = 3.00		
20	3.64	4.01	4.45	4.74	5.00
50	3.70	4.07	4.50	4.79	5.05
100	3.73	4.09	4.51	4.80	5.06
500	3.60	4.07	4.53	4.82	5.07

Table 431

Out of Control ARL_0 for DMEWMA of Dimension 7 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	38.62	63.47	122.11	194.34	324.33
50	39.38	63.61	123.52	195.80	324.90
100	39.07	63.40	122.67	195.42	325.36
500	44.27	61.19	122.23	194.07	323.02
			λ = 0.20, Δ = 0.50		
20	15.40	20.50	29.51	38.87	51.30
50	15.60	20.49	30.02	39.10	51.59
100	15.60	20.47	29.91	38.97	51.25
500	16.83	19.76	29.35	39.06	51.12
			λ = 0.20, Δ = 1.00		
20	6.13	7.04	8.20	9.10	9.99
50	6.14	7.04	8.23	9.11	10.01
100	6.19	7.02	8.22	9.11	10.05
500	5.98	6.84	8.18	9.14	9.95
			λ = 0.20, Δ = 2.00		
20	3.06	3.39	3.73	3.98	4.21
50	3.07	3.38	3.74	3.99	4.21
100	3.06	3.36	3.74	3.98	4.22
500	3.18	3.33	3.73	4.00	4.21
			λ = 0.20, Δ = 3.00		
20	2.15	2.35	2.57	2.73	2.88
50	2.15	2.35	2.57	2.73	2.88
100	2.14	2.33	2.57	2.72	2.87
500	2.24	2.30	2.58	2.74	2.87

Table 432

Out of Control ARL_0 for DMEWMA of Dimension 7 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	43.03	74.04	157.56	278.39	482.55
50	43.54	74.24	159.37	279.16	484.05
100	43.54	74.76	161.20	278.72	483.88
500	48.06	73.71	160.10	275.73	481.31
			$\lambda = 0.30, \Delta = 0.50$		
20	16.61	23.89	38.74	56.46	83.28
50	16.56	24.31	39.18	56.66	83.22
100	16.74	24.26	39.24	56.22	83.24
500	19.35	25.23	40.06	56.54	82.50
			$\lambda = 0.30, \Delta = 1.00$		
20	5.35	6.38	7.85	9.11	10.57
50	5.36	6.37	7.88	9.14	10.65
100	5.42	6.41	7.83	9.07	10.56
500	5.61	6.43	7.92	9.01	10.49
			$\lambda = 0.30, \Delta = 2.00$		
20	2.29	2.52	2.79	3.00	3.19
50	2.30	2.53	2.80	3.00	3.20
100	2.30	2.51	2.80	3.00	3.20
500	2.38	2.48	2.80	2.99	3.19
			$\lambda = 0.30, \Delta = 3.00$		
20	1.56	1.68	1.81	1.92	2.02
50	1.56	1.67	1.82	1.93	2.03
100	1.55	1.66	1.81	1.92	2.02
500	1.57	1.69	1.82	1.91	2.02

Table 433

Out of Control ARL_0 for DMEWMA of Dimension 7 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	47.73	86.85	194.01	350.37	632.03
50	47.62	86.92	195.26	351.62	631.59
100	48.12	87.17	194.89	351.51	631.22
500	49.46	87.29	196.45	357.78	630.17
			$\lambda = 0.40, \Delta = 0.50$		
20	18.69	28.63	52.11	80.72	127.13
50	18.91	29.06	51.92	80.84	127.25
100	18.89	29.29	52.10	80.93	127.80
500	15.83	29.22	52.51	80.43	126.55
			$\lambda = 0.40, \Delta = 1.00$		
20	5.26	6.56	8.56	10.46	13.00
50	5.32	6.54	8.62	10.55	13.12
100	5.33	6.61	8.56	10.53	13.10
500	4.21	6.14	8.59	10.45	13.04
			$\lambda = 0.40, \Delta = 2.00$		
20	1.91	2.09	2.35	2.54	2.73
50	1.92	2.11	2.37	2.54	2.73
100	1.93	2.09	2.35	2.54	2.72
500	1.97	2.08	2.36	2.54	2.73
			$\lambda = 0.40, \Delta = 3.00$		
20	1.28	1.35	1.45	1.53	1.61
50	1.28	1.36	1.46	1.53	1.60
100	1.29	1.35	1.45	1.52	1.59
500	1.30	1.33	1.46	1.53	1.60

Table 434

Out of Control ARL_0 for DMEWMA of Dimension 7 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	51.71	98.84	226.93	428.94	766.62
50	51.81	98.89	227.02	426.65	766.92
100	53.47	98.99	225.55	424.72	766.50
500	49.81	101.25	226.81	427.09	772.12
			$\lambda = 0.50, \Delta = 0.50$		
20	21.23	35.35	67.93	113.84	185.06
50	21.65	35.68	67.92	114.02	184.98
100	21.88	35.61	67.65	113.83	185.18
500	22.96	37.12	67.79	114.23	186.05
			$\lambda = 0.50, \Delta = 1.00$		
20	5.65	7.32	10.39	13.56	17.87
50	5.66	7.25	10.43	13.71	17.85
100	5.65	7.28	10.39	13.71	17.98
500	5.28	6.73	10.33	13.68	17.98
			$\lambda = 0.50, \Delta = 2.00$		
20	1.73	1.91	2.17	2.37	2.57
50	1.74	1.91	2.18	2.37	2.56
100	1.72	1.90	2.17	2.37	2.56
500	1.63	1.85	2.15	2.36	2.55
			$\lambda = 0.50, \Delta = 3.00$		
20	1.17	1.22	1.29	1.34	1.40
50	1.17	1.23	1.29	1.34	1.40
100	1.16	1.22	1.29	1.34	1.40
500	1.11	1.22	1.28	1.34	1.40

Table 435

Out of Control ARL_0 for DMEWMA of Dimension 7 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	56.84	109.30	261.13	482.64	908.20
50	57.15	110.31	260.62	481.35	908.24
100	58.16	110.50	260.80	481.19	906.13
500	59.91	117.92	260.20	483.16	899.70
			λ = 0.60, Δ = 0.50		
20	24.89	43.36	90.39	151.78	256.17
50	25.20	43.17	90.27	152.15	256.87
100	25.18	42.90	90.42	151.56	255.75
500	20.17	44.37	91.99	152.51	255.95
			λ = 0.60, Δ = 1.00		
20	6.40	8.86	13.65	18.91	26.78
50	6.36	8.85	13.74	18.95	26.83
100	6.31	8.79	13.72	19.09	26.93
500	4.52	8.99	13.46	19.03	27.01
			λ = 0.60, Δ = 2.00		
20	1.72	1.90	2.22	2.47	2.72
50	1.72	1.90	2.21	2.44	2.71
100	1.71	1.89	2.19	2.43	2.71
500	1.73	1.83	2.19	2.43	2.70
			λ = 0.60, Δ = 3.00		
20	1.14	1.18	1.24	1.29	1.34
50	1.14	1.18	1.24	1.29	1.34
100	1.13	1.17	1.24	1.29	1.34
500	1.17	1.17	1.24	1.29	1.34

Table 436

Out of Control ARL_0 for DMEWMA of Dimension 7 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	66.51	130.25	322.89	628.15	1226.11
50	66.91	130.46	322.73	626.59	1225.87
100	69.25	129.47	322.76	626.36	1223.79
500	81.50	129.06	322.61	620.42	1214.86
			λ = 0.80, Δ = 0.50		
20	35.91	65.98	148.39	266.58	493.69
50	36.05	66.06	147.90	265.80	492.85
100	37.00	65.48	146.98	264.76	492.94
500	38.65	64.05	145.12	261.89	491.03
			λ = 0.80, Δ = 1.00		
20	10.30	15.79	28.77	45.39	71.96
50	10.27	15.63	28.64	45.46	71.76
100	9.95	15.46	28.22	45.06	71.61
500	7.89	15.10	28.23	45.05	72.02
			λ = 0.80, Δ = 2.00		
20	2.17	2.58	3.35	4.19	5.14
50	2.17	2.59	3.35	4.17	5.13
100	2.18	2.57	3.32	4.16	5.11
500	2.00	2.50	3.24	4.15	5.16
			λ = 0.80, Δ = 3.00		
20	1.24	1.31	1.44	1.53	1.65
50	1.22	1.32	1.44	1.54	1.65
100	1.24	1.32	1.43	1.53	1.66
500	1.29	1.25	1.44	1.54	1.66

Table 437

Out of Control ARL_0 for DMEWMA of Dimension 8 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	35.85	46.59	65.17	83.97	106.48
50	36.69	47.63	65.69	84.86	107.57
100	37.12	47.96	65.98	84.96	108.34
500	37.38	49.00	66.37	83.85	106.46
			$\lambda = 0.05, \Delta = 0.50$		
20	19.24	22.56	26.85	30.15	33.28
50	20.20	23.62	27.83	31.09	34.23
100	20.37	23.58	27.84	31.10	34.26
500	21.14	23.96	27.90	31.12	34.33
			$\lambda = 0.05, \Delta = 1.00$		
20	11.24	12.63	14.35	15.58	16.66
50	12.05	13.54	15.33	16.59	17.68
100	12.21	13.65	15.41	16.64	17.74
500	12.95	13.72	15.44	16.73	17.79
			$\lambda = 0.05, \Delta = 2.00$		
20	6.90	7.65	8.56	9.20	9.75
50	7.59	8.41	9.39	10.06	10.64
100	7.70	8.52	9.46	10.14	10.72
500	8.08	8.58	9.50	10.20	10.76
			$\lambda = 0.05, \Delta = 3.00$		
20	5.22	5.77	6.43	6.89	7.29
50	5.83	6.44	7.16	7.65	8.08
100	5.92	6.52	7.22	7.72	8.15
500	6.22	6.53	7.26	7.77	8.18

Table 438

Out of Control ARL_0 for DMEWMA of Dimension 8 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	33.37	47.76	78.04	111.78	160.60
50	33.54	48.19	77.98	111.39	161.21
100	33.79	48.44	77.78	111.86	161.30
500	28.53	47.53	77.44	110.91	159.28
			$\lambda = 0.10, \Delta = 0.50$		
20	15.55	18.79	23.49	27.68	32.31
50	15.61	18.93	23.76	27.91	32.52
100	15.84	18.91	23.66	27.80	32.43
500	14.08	18.78	24.08	27.85	32.32
			$\lambda = 0.10, \Delta = 1.00$		
20	8.11	9.13	10.36	11.22	12.03
50	8.13	9.19	10.42	11.31	12.12
100	8.23	9.24	10.43	11.30	12.09
500	8.12	9.02	10.48	11.34	12.11
			$\lambda = 0.10, \Delta = 2.00$		
20	4.73	5.23	5.82	6.19	6.55
50	4.77	5.29	5.87	6.26	6.61
100	4.82	5.31	5.85	6.26	6.61
500	4.63	5.15	5.87	6.28	6.62
			$\lambda = 0.10, \Delta = 3.00$		
20	3.50	3.85	4.26	4.54	4.78
50	3.55	3.91	4.32	4.60	4.84
100	3.59	3.92	4.31	4.60	4.84
500	3.50	3.81	4.32	4.60	4.85

Table 439

Out of Control ARL_0 for DMEWMA of Dimension 8 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	36.12	59.04	112.56	182.16	301.84
50	36.67	58.87	112.48	182.04	300.52
100	36.03	58.70	112.54	180.94	301.42
500	39.51	56.99	113.49	181.37	297.11
			$\lambda = 0.20, \Delta = 0.50$		
20	14.28	18.86	27.28	35.29	46.46
50	14.30	19.16	27.50	35.55	46.68
100	14.57	19.25	27.48	35.36	46.54
500	17.74	20.56	28.05	35.66	46.74
			$\lambda = 0.20, \Delta = 1.00$		
20	5.78	6.61	7.72	8.52	9.38
50	5.80	6.63	7.73	8.55	9.38
100	5.95	6.67	7.77	8.56	9.38
500	5.56	6.72	7.82	8.55	9.44
			$\lambda = 0.20, \Delta = 2.00$		
20	2.92	3.20	3.55	3.78	4.00
50	2.95	3.22	3.56	3.79	4.00
100	2.97	3.23	3.58	3.80	4.02
500	2.79	3.22	3.58	3.79	4.01
			$\lambda = 0.20, \Delta = 3.00$		
20	2.07	2.24	2.45	2.60	2.74
50	2.08	2.25	2.47	2.61	2.75
100	2.08	2.25	2.47	2.61	2.76
500	2.02	2.26	2.48	2.61	2.75

Table 440

Out of Control ARL_0 for DMEWMA of Dimension 8 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	40.43	71.71	148.52	254.22	435.00
50	40.40	71.64	147.96	253.54	436.16
100	40.91	72.23	148.94	254.00	436.36
500	35.55	71.32	147.96	254.04	433.81
			$\lambda = 0.30, \Delta = 0.50$		
20	15.37	22.13	35.49	50.44	74.12
50	15.42	22.09	35.90	50.43	74.39
100	15.80	22.26	35.93	50.47	74.64
500	20.40	23.42	35.95	51.10	74.98
			$\lambda = 0.30, \Delta = 1.00$		
20	5.10	6.01	7.27	8.42	9.71
50	5.15	6.02	7.29	8.40	9.73
100	5.23	6.10	7.35	8.45	9.77
500	6.43	6.27	7.40	8.57	9.83
			$\lambda = 0.30, \Delta = 2.00$		
20	2.20	2.40	2.66	2.84	3.01
50	2.23	2.41	2.65	2.83	3.01
100	2.23	2.44	2.69	2.85	3.02
500	2.33	2.43	2.68	2.87	3.03
			$\lambda = 0.30, \Delta = 3.00$		
20	1.52	1.61	1.75	1.84	1.94
50	1.52	1.63	1.76	1.85	1.95
100	1.54	1.65	1.77	1.86	1.95
500	1.49	1.64	1.78	1.87	1.96

Table 441

Out of Control ARL_0 for DMEWMA of Dimension 8 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	44.31	83.06	180.75	322.02	573.89
50	44.18	83.23	181.09	321.68	573.55
100	45.63	84.20	182.78	322.45	573.21
500	47.47	79.72	183.35	324.64	574.55
			λ = 0.40, Δ = 0.50		
20	17.60	26.31	47.11	73.27	115.87
50	17.47	26.60	47.34	73.66	115.96
100	18.13	26.73	47.36	73.89	116.31
500	22.37	27.78	47.87	74.42	116.44
			λ = 0.40, Δ = 1.00		
20	5.02	6.14	8.10	9.79	12.03
50	5.01	6.12	8.06	9.79	12.03
100	5.12	6.18	8.14	9.89	12.07
500	7.76	6.29	8.36	10.01	12.17
			λ = 0.40, Δ = 2.00		
20	1.86	2.02	2.24	2.40	2.57
50	1.85	2.03	2.24	2.40	2.57
100	1.89	2.05	2.25	2.40	2.57
500	1.91	2.02	2.28	2.43	2.58
			λ = 0.40, Δ = 3.00		
20	1.27	1.34	1.42	1.49	1.55
50	1.26	1.33	1.42	1.48	1.55
100	1.29	1.35	1.43	1.49	1.56
500	1.31	1.33	1.44	1.51	1.56

Table 442

Out of Control ARL_0 for DMEWMA of Dimension 8 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	49.38	95.21	210.15	389.80	704.10
50	49.47	95.31	209.98	390.24	704.91
100	51.27	96.33	211.17	390.99	703.11
500	53.75	96.34	214.69	391.48	689.21
			$\lambda = 0.50, \Delta = 0.50$		
20	20.29	32.61	61.86	102.80	164.67
50	20.10	32.72	62.30	103.43	164.61
100	20.91	32.95	62.38	103.37	165.13
500	24.11	32.54	62.73	104.90	166.30
			$\lambda = 0.50, \Delta = 1.00$		
20	5.39	6.94	9.60	12.50	16.29
50	5.43	6.92	9.56	12.51	16.39
100	5.48	6.95	9.61	12.56	16.43
500	6.38	7.11	9.67	12.52	16.57
			$\lambda = 0.50, \Delta = 2.00$		
20	1.70	1.86	2.08	2.25	2.43
50	1.69	1.85	2.06	2.25	2.43
100	1.71	1.89	2.08	2.25	2.43
500	1.52	1.83	2.09	2.25	2.44
			$\lambda = 0.50, \Delta = 3.00$		
20	1.16	1.21	1.27	1.32	1.36
50	1.16	1.20	1.26	1.31	1.36
100	1.17	1.22	1.27	1.32	1.37
500	1.10	1.20	1.27	1.32	1.37

Table 443

Out of Control ARL_0 for DMEWMA of Dimension 8 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	54.06	104.75	241.27	449.62	854.01
50	54.04	104.90	241.22	449.41	855.57
100	56.46	106.81	241.56	449.30	854.77
500	52.60	104.76	243.03	452.64	852.64
	λ = 0.60, Δ = 0.50				
20	23.85	40.48	81.42	140.12	235.63
50	23.74	40.71	81.85	140.31	236.79
100	24.25	41.16	81.89	140.89	236.19
500	22.60	40.51	81.12	141.79	236.44
	λ = 0.60, Δ = 1.00				
20	6.17	8.34	12.44	17.13	24.07
50	6.20	8.32	12.37	17.02	24.10
100	6.16	8.33	12.34	17.17	24.08
500	7.38	8.98	12.09	17.07	24.14
	λ = 0.60, Δ = 2.00				
20	1.70	1.87	2.11	2.36	2.61
50	1.68	1.85	2.10	2.34	2.61
100	1.69	1.86	2.12	2.35	2.60
500	1.43	1.94	2.08	2.34	2.61
	λ = 0.60, Δ = 3.00				
20	1.14	1.18	1.23	1.27	1.32
50	1.14	1.17	1.22	1.26	1.31
100	1.13	1.17	1.23	1.28	1.33
500	1.06	1.17	1.21	1.28	1.32

Table 444

Out of Control ARL$_0$ for DMEWMA of Dimension 8 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	62.56	126.67	307.11	609.37	1182.78
50	62.37	127.59	307.51	610.65	1183.18
100	63.14	129.90	309.16	613.48	1187.13
500	60.88	126.07	313.69	604.01	1189.61
			λ = 0.80, Δ = 0.50		
20	33.15	62.34	138.98	255.78	460.07
50	33.51	62.28	139.33	256.01	460.17
100	33.80	63.24	140.23	256.83	461.24
500	28.14	58.25	139.57	253.70	460.59
			λ = 0.80, Δ = 1.00		
20	9.60	14.83	26.91	43.17	68.71
50	9.67	14.77	27.10	43.24	68.60
100	9.84	14.86	27.41	43.57	68.83
500	15.17	13.95	27.22	42.41	68.66
			λ = 0.80, Δ = 2.00		
20	2.15	2.57	3.26	3.90	4.87
50	2.13	2.52	3.25	3.91	4.84
100	2.17	2.52	3.24	3.88	4.80
500	2.96	2.61	3.29	3.88	4.83
			λ = 0.80, Δ = 3.00		
20	1.26	1.34	1.44	1.51	1.62
50	1.25	1.32	1.44	1.51	1.61
100	1.25	1.31	1.43	1.51	1.62
500	1.17	1.35	1.47	1.49	1.62

Table 445

Out of Control ARL_0 for DMEWMA of Dimension 9 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	34.86	45.42	62.36	80.22	101.60
50	35.64	46.19	63.34	81.24	102.56
100	36.12	46.24	63.22	81.06	102.00
500	40.72	45.48	63.64	81.02	103.06
			λ = 0.05, Δ = 0.50		
20	18.70	21.87	25.92	29.10	32.08
50	19.41	22.59	26.75	30.03	32.97
100	19.65	22.80	26.81	30.07	32.97
500	22.64	23.00	26.59	30.02	32.99
			λ = 0.05, Δ = 1.00		
20	10.95	12.27	13.90	15.08	16.09
50	11.74	13.09	14.78	15.98	17.02
100	11.86	13.16	14.88	16.12	17.14
500	13.21	13.39	14.68	16.00	17.09
			λ = 0.05, Δ = 2.00		
20	6.75	7.46	8.31	8.93	9.46
50	7.41	8.17	9.06	9.71	10.28
100	7.50	8.22	9.15	9.82	10.37
500	8.21	8.36	9.06	9.74	10.32
			λ = 0.05, Δ = 3.00		
20	5.13	5.64	6.24	6.70	7.08
50	5.70	6.24	6.91	7.38	7.80
100	5.77	6.29	6.99	7.48	7.90
500	6.32	6.42	6.92	7.43	7.85

Table 446

Out of Control ARL_0 for DMEWMA of Dimension 9 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	31.88	46.18	72.97	105.36	154.53
50	31.99	45.81	73.65	106.12	154.38
100	33.07	46.04	73.84	105.89	154.34
500	26.16	47.28	72.46	105.80	156.52
			λ = 0.10, Δ = 0.50		
20	14.89	18.02	22.71	26.34	30.60
50	14.91	17.95	22.64	26.44	30.54
100	15.16	18.11	22.54	26.31	30.69
500	16.86	18.43	22.79	26.39	30.41
			λ = 0.10, Δ = 1.00		
20	7.84	8.81	9.93	10.74	11.46
50	7.86	8.83	10.01	10.83	11.56
100	7.87	8.79	10.00	10.82	11.55
500	8.45	9.11	10.06	10.80	11.54
			λ = 0.10, Δ = 2.00		
20	4.59	5.07	5.59	5.96	6.29
50	4.64	5.09	5.65	6.01	6.34
100	4.65	5.07	5.65	6.01	6.34
500	4.98	5.20	5.66	5.99	6.32
			λ = 0.10, Δ = 3.00		
20	3.41	3.74	4.11	4.37	4.60
50	3.45	3.77	4.15	4.43	4.65
100	3.46	3.75	4.16	4.41	4.65
500	3.70	3.85	4.18	4.40	4.63

Table 447

Out of Control ARL_0 for DMEWMA of Dimension 9 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	34.09	56.27	106.39	171.58	283.59
50	34.19	56.33	106.67	171.80	284.49
100	34.84	56.61	106.16	172.78	284.53
500	32.86	56.70	109.04	171.33	285.77
			$\lambda = 0.20, \Delta = 0.50$		
20	13.42	17.69	25.02	32.75	43.41
50	13.44	17.77	25.05	32.55	43.46
100	13.56	17.93	25.20	32.56	43.58
500	13.35	18.61	26.09	33.37	44.28
			$\lambda = 0.20, \Delta = 1.00$		
20	5.47	6.25	7.23	7.96	8.76
50	5.48	6.26	7.27	8.00	8.80
100	5.47	6.26	7.26	8.02	8.79
500	5.12	6.17	7.41	8.12	8.85
			$\lambda = 0.20, \Delta = 2.00$		
20	2.82	3.07	3.39	3.61	3.81
50	2.81	3.08	3.40	3.61	3.82
100	2.80	3.07	3.39	3.61	3.81
500	2.53	3.03	3.44	3.61	3.81
			$\lambda = 0.20, \Delta = 3.00$		
20	2.01	2.17	2.36	2.50	2.62
50	2.01	2.17	2.37	2.50	2.63
100	2.00	2.16	2.35	2.49	2.62
500	1.84	2.14	2.40	2.51	2.62

Table 448

Out of Control ARL_0 for DMEWMA of Dimension 9 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	38.04	67.33	138.69	240.67	414.67
50	38.64	67.49	139.13	241.50	415.88
100	38.42	67.27	139.31	242.85	417.09
500	27.72	69.05	138.66	246.70	412.83
			$\lambda = 0.30, \Delta = 0.50$		
20	14.18	20.25	32.57	46.90	68.51
50	14.27	20.49	32.59	47.06	68.50
100	14.24	20.42	32.87	47.04	68.18
500	12.23	20.34	33.00	46.81	68.13
			$\lambda = 0.30, \Delta = 1.00$		
20	4.72	5.57	6.73	7.77	8.90
50	4.75	5.60	6.77	7.79	9.01
100	4.71	5.58	6.81	7.76	8.96
500	4.45	5.55	6.81	7.83	8.93
			$\lambda = 0.30, \Delta = 2.00$		
20	2.12	2.31	2.55	2.71	2.87
50	2.12	2.32	2.55	2.72	2.87
100	2.10	2.30	2.55	2.71	2.88
500	1.89	2.25	2.53	2.70	2.87
			$\lambda = 0.30, \Delta = 3.00$		
20	1.48	1.59	1.70	1.79	1.87
50	1.48	1.58	1.70	1.79	1.88
100	1.48	1.57	1.70	1.79	1.88
500	1.35	1.55	1.69	1.79	1.87

Table 449

Out of Control ARL_0 for DMEWMA of Dimension 9 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	42.73	78.65	167.94	307.86	549.87
50	42.52	78.77	167.80	307.94	552.32
100	42.72	78.19	167.31	309.07	554.06
500	29.90	74.77	164.50	306.58	554.30
			$\lambda = 0.40, \Delta = 0.50$		
20	15.73	24.57	44.09	67.11	105.83
50	15.77	24.77	44.01	67.45	106.21
100	15.71	24.78	43.61	67.29	106.44
500	13.36	24.47	42.77	66.96	106.83
			$\lambda = 0.40, \Delta = 1.00$		
20	4.59	5.65	7.27	8.87	10.89
50	4.60	5.65	7.35	8.89	10.98
100	4.53	5.63	7.35	8.95	10.94
500	3.64	5.52	7.38	8.77	10.96
			$\lambda = 0.40, \Delta = 2.00$		
20	1.80	1.95	2.14	2.29	2.44
50	1.79	1.95	2.16	2.31	2.47
100	1.79	1.94	2.15	2.31	2.44
500	1.50	1.90	2.15	2.29	2.45
			$\lambda = 0.40, \Delta = 3.00$		
20	1.25	1.31	1.39	1.45	1.51
50	1.25	1.32	1.40	1.46	1.52
100	1.24	1.31	1.39	1.45	1.52
500	1.08	1.31	1.39	1.44	1.51

Table 450

Out of Control ARL_0 for DMEWMA of Dimension 9 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	46.36	86.75	201.32	367.18	682.12
50	46.18	86.57	201.02	367.97	685.65
100	45.88	86.65	200.27	368.38	687.04
500	51.23	80.57	200.09	366.49	687.78
			λ = 0.50, Δ = 0.50		
20	18.19	30.21	56.64	93.39	155.03
50	18.08	30.04	56.63	93.17	155.40
100	18.19	30.35	56.45	93.52	155.43
500	21.42	31.47	55.93	92.88	155.69
			λ = 0.50, Δ = 1.00		
20	4.87	6.28	8.81	11.37	15.00
50	4.84	6.31	8.87	11.42	15.13
100	4.81	6.30	8.91	11.44	15.09
500	5.63	6.66	8.64	11.32	15.01
			λ = 0.50, Δ = 2.00		
20	1.66	1.80	1.99	2.15	2.33
50	1.64	1.80	2.00	2.16	2.35
100	1.63	1.80	2.00	2.17	2.33
500	1.57	1.83	1.98	2.15	2.34
			λ = 0.50, Δ = 3.00		
20	1.15	1.19	1.25	1.29	1.34
50	1.16	1.20	1.26	1.30	1.35
100	1.14	1.19	1.25	1.30	1.35
500	1.04	1.20	1.25	1.29	1.34

Table 451

Out of Control ARL$_0$ for DMEWMA of Dimension 9 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	50.12	96.52	230.09	427.59	809.94
50	50.21	96.61	229.75	428.23	812.32
100	50.00	96.46	229.79	429.31	814.90
500	41.74	100.62	225.09	428.78	810.27
			λ = 0.60, Δ = 0.50		
20	21.65	37.01	75.03	129.68	224.00
50	21.55	36.69	75.30	130.14	224.34
100	21.40	36.74	75.17	129.55	224.35
500	16.50	38.86	74.54	128.69	223.39
			λ = 0.60, Δ = 1.00		
20	5.65	7.67	11.51	15.75	22.87
50	5.61	7.67	11.59	15.96	22.91
100	5.70	7.68	11.57	15.90	22.93
500	5.05	8.45	11.54	15.70	22.76
			λ = 0.60, Δ = 2.00		
20	1.64	1.79	2.04	2.26	2.48
50	1.63	1.79	2.05	2.28	2.50
100	1.64	1.81	2.04	2.28	2.52
500	1.60	1.92	2.08	2.26	2.48
			λ = 0.60, Δ = 3.00		
20	1.13	1.16	1.21	1.26	1.29
50	1.13	1.17	1.22	1.26	1.30
100	1.13	1.17	1.21	1.26	1.31
500	1.13	1.19	1.22	1.25	1.30

Table 452

Out of Control ARL_0 for DMEWMA of Dimension 9 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	58.63	119.84	302.97	576.76	1140.12
50	58.45	119.77	302.57	576.94	1139.12
100	59.48	119.40	300.69	575.14	1135.64
500	47.56	115.09	293.56	579.42	1146.30
			λ = 0.80, Δ = 0.50		
20	30.70	57.49	132.78	240.75	446.67
50	30.89	57.60	132.07	240.13	446.05
100	31.16	57.10	131.90	239.86	445.81
500	23.62	57.95	129.79	244.61	449.06
			λ = 0.80, Δ = 1.00		
20	9.25	14.35	25.72	40.54	65.32
50	9.31	14.19	25.61	40.40	65.36
100	9.27	14.17	25.58	39.93	64.85
500	10.14	13.16	25.34	40.29	66.10
			λ = 0.80, Δ = 2.00		
20	2.07	2.47	3.16	3.74	4.66
50	2.04	2.45	3.18	3.75	4.71
100	2.03	2.47	3.14	3.76	4.68
500	1.76	2.36	3.18	3.80	4.76
			λ = 0.80, Δ = 3.00		
20	1.23	1.32	1.44	1.52	1.63
50	1.24	1.32	1.44	1.52	1.63
100	1.22	1.32	1.44	1.52	1.63
500	1.00	1.36	1.47	1.52	1.64

Table 453

Out of Control ARL_0 for DMEWMA of Dimension 10 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	33.30	42.49	58.42	72.87	92.10
50	33.97	43.35	58.89	73.62	92.08
100	33.37	42.95	58.21	72.99	91.52
500	35.08	42.92	59.44	74.00	92.77
			$\lambda = 0.05, \Delta = 0.50$		
20	17.85	20.85	24.89	27.66	30.41
50	18.65	21.75	25.59	28.35	31.12
100	18.42	21.50	25.48	28.28	31.00
500	20.39	21.80	25.85	28.54	31.17
			$\lambda = 0.05, \Delta = 1.00$		
20	10.53	11.82	13.44	14.49	15.50
50	11.23	12.61	14.21	15.29	16.29
100	11.21	12.58	14.19	15.31	16.29
500	12.05	12.67	14.32	15.45	16.41
			$\lambda = 0.05, \Delta = 2.00$		
20	6.50	7.20	8.06	8.62	9.15
50	7.08	7.86	8.72	9.31	9.84
100	7.12	7.87	8.75	9.36	9.89
500	7.47	7.93	8.80	9.44	9.96
			$\lambda = 0.05, \Delta = 3.00$		
20	4.92	5.44	6.06	6.47	6.86
50	5.44	6.01	6.65	7.08	7.48
100	5.49	6.04	6.68	7.13	7.53
500	5.77	6.09	6.73	7.19	7.59

Table 454

Out of Control ARL_0 for DMEWMA of Dimension 10 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	29.92	42.78	67.26	95.15	137.18
50	30.34	42.82	67.18	95.27	136.37
100	30.56	42.60	66.58	94.36	136.05
500	28.45	41.02	68.59	95.73	139.61
	λ = 0.10, Δ = 0.50				
20	14.07	17.02	21.13	24.50	28.53
50	14.18	17.25	21.22	24.45	28.39
100	14.27	17.09	21.04	24.42	28.26
500	13.76	17.97	21.66	24.47	28.42
	λ = 0.10, Δ = 1.00				
20	7.46	8.43	9.52	10.24	10.95
50	7.54	8.47	9.55	10.27	10.96
100	7.54	8.41	9.50	10.21	10.92
500	7.58	8.52	9.63	10.31	11.01
	λ = 0.10, Δ = 2.00				
20	4.38	4.85	5.37	5.70	6.03
50	4.43	4.89	5.42	5.75	6.06
100	4.44	4.86	5.38	5.70	6.03
500	4.27	4.88	5.46	5.76	6.07
	λ = 0.10, Δ = 3.00				
20	3.26	3.58	3.95	4.19	4.41
50	3.31	3.62	3.99	4.22	4.44
100	3.31	3.61	3.96	4.19	4.41
500	3.22	3.60	4.01	4.23	4.46

Table 455

Out of Control ARL_0 for DMEWMA of Dimension 10 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20$, $\Delta = 0.25$		
20	32.09	52.16	95.16	157.65	253.89
50	32.31	52.76	95.61	158.62	254.20
100	32.76	52.64	95.43	157.56	253.50
500	39.51	56.21	96.89	156.96	251.42
			$\lambda = 0.20$, $\Delta = 0.50$		
20	12.64	16.64	23.51	30.39	39.40
50	12.50	16.63	23.65	30.59	39.51
100	12.78	16.69	23.65	30.33	39.39
500	14.38	17.99	24.35	30.83	39.57
			$\lambda = 0.20$, $\Delta = 1.00$		
20	5.26	5.99	6.87	7.53	8.19
50	5.25	5.99	6.83	7.51	8.18
100	5.27	5.96	6.82	7.46	8.16
500	5.44	6.06	6.90	7.53	8.18
			$\lambda = 0.20$, $\Delta = 2.00$		
20	2.70	2.96	3.25	3.45	3.63
50	2.70	2.96	3.25	3.45	3.63
100	2.71	2.94	3.23	3.44	3.61
500	2.74	2.96	3.26	3.44	3.62
			$\lambda = 0.20$, $\Delta = 3.00$		
20	1.93	2.10	2.28	2.41	2.53
50	1.94	2.10	2.28	2.41	2.53
100	1.94	2.10	2.27	2.39	2.51
500	2.00	2.12	2.28	2.39	2.51

Table 456

Out of Control ARL_0 for DMEWMA of Dimension 10 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	35.07	61.70	126.47	215.78	378.19
50	35.67	62.26	126.91	216.83	378.34
100	35.08	62.09	126.34	215.23	377.92
500	37.74	65.08	127.49	215.69	377.67
			λ = 0.30, Δ = 0.50		
20	13.23	19.23	29.96	43.43	63.64
50	13.31	19.18	29.97	43.58	64.05
100	13.23	19.32	30.12	43.63	64.31
500	16.14	20.03	30.35	43.91	64.66
			λ = 0.30, Δ = 1.00		
20	4.53	5.28	6.34	7.22	8.31
50	4.54	5.33	6.31	7.21	8.27
100	4.52	5.27	6.29	7.23	8.27
500	4.94	5.44	6.35	7.27	8.27
			λ = 0.30, Δ = 2.00		
20	2.05	2.23	2.44	2.59	2.73
50	2.06	2.24	2.44	2.59	2.74
100	2.05	2.22	2.43	2.59	2.74
500	2.27	2.24	2.42	2.58	2.73
			λ = 0.30, Δ = 3.00		
20	1.44	1.53	1.65	1.73	1.81
50	1.45	1.54	1.64	1.73	1.81
100	1.44	1.54	1.65	1.72	1.79
500	1.59	1.56	1.64	1.72	1.80

Table 457

Out of Control ARL_0 for DMEWMA of Dimension 10 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	38.94	72.79	156.50	278.59	501.43
50	39.62	73.65	157.54	279.32	500.69
100	39.23	73.60	157.29	278.46	498.96
500	44.26	74.01	160.56	280.47	504.11
			λ = 0.40, Δ = 0.50		
20	15.04	22.92	39.38	61.15	95.60
50	15.02	23.14	39.32	61.60	95.79
100	15.10	23.26	39.38	61.34	95.46
500	17.71	24.95	40.54	62.04	95.78
			λ = 0.40, Δ = 1.00		
20	4.40	5.33	6.84	8.18	9.93
50	4.43	5.39	6.87	8.17	9.91
100	4.39	5.34	6.78	8.17	9.92
500	3.36	5.60	6.85	8.30	9.98
			λ = 0.40, Δ = 2.00		
20	1.74	1.89	2.06	2.20	2.34
50	1.74	1.90	2.06	2.20	2.33
100	1.73	1.90	2.06	2.20	2.34
500	1.72	1.95	2.06	2.20	2.34
			λ = 0.40, Δ = 3.00		
20	1.22	1.27	1.35	1.41	1.47
50	1.23	1.28	1.35	1.41	1.46
100	1.23	1.28	1.35	1.41	1.46
500	1.36	1.30	1.34	1.41	1.47

Table 458

Out of Control ARL_0 for DMEWMA of Dimension 10 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	42.91	81.16	186.34	335.63	624.43
50	42.94	81.76	186.92	335.76	624.98
100	43.13	81.85	185.62	335.77	623.57
500	43.26	85.67	190.01	338.32	626.41
			λ = 0.50, Δ = 0.50		
20	17.38	27.74	51.88	85.00	141.42
50	17.21	27.75	51.88	84.94	141.77
100	17.55	28.15	51.45	84.82	140.84
500	15.26	28.61	52.49	86.86	141.57
			λ = 0.50, Δ = 1.00		
20	4.65	5.96	8.19	10.42	13.70
50	4.67	6.02	8.21	10.40	13.70
100	4.71	6.04	8.23	10.45	13.65
500	4.75	6.01	8.29	10.61	13.76
			λ = 0.50, Δ = 2.00		
20	1.61	1.75	1.93	2.07	2.22
50	1.62	1.74	1.92	2.07	2.22
100	1.62	1.75	1.93	2.08	2.23
500	1.80	1.78	1.94	2.09	2.24
			λ = 0.50, Δ = 3.00		
20	1.14	1.17	1.22	1.27	1.30
50	1.13	1.17	1.23	1.27	1.31
100	1.14	1.18	1.23	1.27	1.31
500	1.23	1.17	1.23	1.27	1.31

Table 459

Out of Control ARL_0 for DMEWMA of Dimension 10 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	47.03	91.39	213.18	400.34	757.75
50	47.06	91.24	213.75	401.09	757.28
100	47.51	91.39	213.80	400.94	756.45
500	56.90	89.30	214.83	406.59	752.64
			$\lambda = 0.60, \Delta = 0.50$		
20	20.27	34.09	68.16	119.05	201.64
50	20.26	34.24	68.39	118.93	201.99
100	20.31	34.62	68.37	118.54	200.86
500	23.33	34.90	69.45	120.52	200.28
			$\lambda = 0.60, \Delta = 1.00$		
20	5.41	7.18	10.65	14.67	20.57
50	5.42	7.25	10.69	14.73	20.59
100	5.52	7.40	10.68	14.77	20.61
500	7.11	7.82	10.81	14.93	20.61
			$\lambda = 0.60, \Delta = 2.00$		
20	1.60	1.75	1.98	2.17	2.37
50	1.61	1.76	1.98	2.16	2.35
100	1.61	1.77	1.99	2.18	2.35
500	1.97	1.78	2.05	2.21	2.39
			$\lambda = 0.60, \Delta = 3.00$		
20	1.13	1.16	1.19	1.23	1.27
50	1.12	1.15	1.19	1.23	1.27
100	1.11	1.16	1.20	1.24	1.28
500	1.17	1.16	1.21	1.23	1.27

Table 460

Out of Control ARL_0 for DMEWMA of Dimension 10 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	57.03	115.31	285.17	542.39	1069.83
50	57.54	116.59	285.88	542.30	1068.87
100	58.86	116.80	285.49	541.76	1069.19
500	65.96	125.86	286.82	541.34	1066.07
			$\lambda = 0.80, \Delta = 0.50$		
20	29.68	55.46	122.86	218.44	407.75
50	30.02	56.36	123.59	218.28	407.50
100	29.97	56.94	123.95	218.60	406.23
500	38.11	59.08	127.23	216.79	403.32
			$\lambda = 0.80, \Delta = 1.00$		
20	8.86	13.55	24.66	37.75	61.01
50	9.02	13.63	24.96	37.95	61.26
100	9.31	13.56	25.11	38.25	61.45
500	12.88	13.90	25.54	38.41	61.34
			$\lambda = 0.80, \Delta = 2.00$		
20	2.09	2.48	3.08	3.72	4.42
50	2.13	2.45	3.09	3.71	4.44
100	2.14	2.51	3.11	3.70	4.46
500	2.50	2.54	3.20	3.72	4.51
			$\lambda = 0.80, \Delta = 3.00$		
20	1.25	1.30	1.42	1.52	1.63
50	1.25	1.30	1.40	1.51	1.62
100	1.25	1.30	1.41	1.51	1.61
500	1.20	1.36	1.43	1.53	1.61

Table 461

Out of Control ARL_0 for DMEWMA of Dimension 15 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	24.57	31.17	41.42	51.67	62.98
50	25.33	31.90	41.92	52.09	63.39
100	24.87	31.47	41.77	52.04	63.08
500	27.69	33.79	42.51	52.75	63.97
			λ = 0.05, Δ = 0.50		
20	13.97	16.18	18.94	20.88	22.69
50	14.52	16.78	19.49	21.42	23.20
100	14.32	16.66	19.40	21.41	23.22
500	16.55	17.99	19.58	21.57	23.25
			λ = 0.05, Δ = 1.00		
20	8.49	9.53	10.75	11.56	12.30
50	9.00	10.06	11.30	12.11	12.86
100	8.90	9.97	11.25	12.12	12.87
500	10.32	10.61	11.34	12.18	12.89
			λ = 0.05, Δ = 2.00		
20	5.39	5.94	6.60	7.03	7.43
50	5.75	6.34	7.03	7.48	7.89
100	5.75	6.32	7.03	7.50	7.92
500	6.58	6.71	7.06	7.53	7.92
			λ = 0.05, Δ = 3.00		
20	4.18	4.56	5.04	5.36	5.64
50	4.47	4.90	5.40	5.73	6.03
100	4.47	4.89	5.41	5.77	6.07
500	5.05	5.17	5.44	5.78	6.06

Table 462

Out of Control ARL_0 for DMEWMA of Dimension 15 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	21.54	29.87	45.56	63.54	90.12
50	21.28	30.07	45.84	63.96	90.41
100	20.44	29.53	45.40	63.69	90.02
500	21.11	30.67	46.00	62.75	90.45
			$\lambda = 0.10, \Delta = 0.50$		
20	10.50	12.55	15.04	17.08	19.32
50	10.45	12.62	15.16	17.27	19.38
100	10.18	12.47	15.01	17.14	19.38
500	11.76	12.60	15.22	17.24	19.34
			$\lambda = 0.10, \Delta = 1.00$		
20	5.86	6.59	7.34	7.87	8.34
50	5.85	6.63	7.40	7.94	8.41
100	5.76	6.55	7.33	7.87	8.35
500	5.82	6.68	7.48	7.91	8.41
			$\lambda = 0.10, \Delta = 2.00$		
20	3.59	3.95	4.31	4.56	4.79
50	3.60	3.98	4.34	4.59	4.81
100	3.53	3.94	4.32	4.58	4.81
500	3.55	4.00	4.39	4.59	4.81
			$\lambda = 0.10, \Delta = 3.00$		
20	2.75	3.00	3.25	3.42	3.59
50	2.75	3.01	3.28	3.45	3.60
100	2.72	2.98	3.26	3.44	3.60
500	2.78	3.00	3.31	3.44	3.60

Table 463

Out of Control ARL_0 for DMEWMA of Dimension 15 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	22.04	35.34	65.09	102.31	167.05
50	21.39	34.96	65.27	102.45	167.53
100	21.19	34.63	64.34	101.05	168.22
500	23.57	34.24	64.82	101.52	165.45
			$\lambda = 0.20, \Delta = 0.50$		
20	8.81	11.27	15.43	19.60	25.44
50	8.82	11.23	15.45	19.61	25.41
100	8.79	11.32	15.23	19.52	25.46
500	9.32	11.15	15.38	19.61	25.44
			$\lambda = 0.20, \Delta = 1.00$		
20	4.07	4.57	5.16	5.63	6.04
50	4.05	4.57	5.17	5.61	6.02
100	4.07	4.56	5.15	5.58	6.04
500	5.00	4.65	5.21	5.69	6.08
			$\lambda = 0.20, \Delta = 2.00$		
20	2.28	2.48	2.69	2.83	2.96
50	2.28	2.47	2.69	2.83	2.96
100	2.26	2.46	2.68	2.82	2.95
500	2.68	2.49	2.71	2.85	2.97
			$\lambda = 0.20, \Delta = 3.00$		
20	1.72	1.84	1.97	2.07	2.15
50	1.71	1.83	1.98	2.07	2.16
100	1.70	1.83	1.97	2.07	2.16
500	2.00	1.85	1.97	2.07	2.15

Table 464

Out of Control ARL_0 for DMEWMA of Dimension 15 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	24.49	42.33	86.24	148.14	254.13
50	23.87	41.91	86.09	148.35	255.52
100	24.57	42.32	84.71	147.69	255.10
500	25.62	41.78	87.35	149.07	253.79
			$\lambda = 0.30, \Delta = 0.50$		
20	9.21	12.80	20.12	28.89	41.41
50	9.03	12.64	19.95	28.85	41.36
100	8.99	12.72	19.87	28.53	41.07
500	11.68	12.69	20.50	28.40	41.38
			$\lambda = 0.30, \Delta = 1.00$		
20	3.54	4.05	4.77	5.31	5.87
50	3.53	4.05	4.74	5.27	5.87
100	3.52	4.06	4.76	5.28	5.86
500	3.91	4.13	4.90	5.34	5.94
			$\lambda = 0.30, \Delta = 2.00$		
20	1.79	1.92	2.08	2.20	2.30
50	1.79	1.92	2.09	2.20	2.30
100	1.77	1.92	2.09	2.20	2.31
500	1.94	1.94	2.10	2.20	2.31
			$\lambda = 0.30, \Delta = 3.00$		
20	1.33	1.40	1.49	1.54	1.61
50	1.33	1.40	1.49	1.55	1.61
100	1.31	1.39	1.49	1.54	1.61
500	1.58	1.44	1.50	1.54	1.61

Table 465

Out of Control ARL_0 for DMEWMA of Dimension 15 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	27.58	50.00	107.50	194.02	346.61
50	26.88	49.79	107.66	194.24	349.08
100	27.08	50.21	107.64	194.87	350.01
500	18.95	45.03	108.38	194.01	349.63
			$\lambda = 0.40, \Delta = 0.50$		
20	10.46	15.67	27.40	41.17	65.27
50	10.17	15.25	27.42	41.14	65.22
100	10.54	15.45	27.09	40.54	65.23
500	5.32	15.53	27.76	40.98	65.47
			$\lambda = 0.40, \Delta = 1.00$		
20	3.49	4.10	5.01	5.86	6.92
50	3.47	4.14	4.99	5.84	6.95
100	3.44	4.18	4.96	5.78	6.90
500	2.53	4.42	5.10	5.90	6.92
			$\lambda = 0.40, \Delta = 2.00$		
20	1.55	1.65	1.79	1.88	1.99
50	1.55	1.66	1.79	1.89	1.99
100	1.54	1.66	1.79	1.90	2.00
500	1.70	1.76	1.82	1.90	2.00
			$\lambda = 0.40, \Delta = 3.00$		
20	1.16	1.20	1.25	1.29	1.34
50	1.16	1.21	1.26	1.30	1.34
100	1.16	1.20	1.25	1.29	1.33
500	1.29	1.26	1.27	1.30	1.34

Table 466

Out of Control ARL_0 for DMEWMA of Dimension 15 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	30.94	57.03	131.45	240.70	447.86
50	30.73	57.04	131.70	241.10	448.90
100	31.58	57.41	131.87	240.87	448.53
500	18.32	54.77	136.45	239.98	447.92
			λ = 0.50, Δ = 0.50		
20	12.32	19.72	36.41	59.59	97.34
50	12.19	19.39	36.30	59.56	97.79
100	12.16	19.43	36.65	59.60	97.43
500	6.64	19.32	37.64	60.02	98.84
			λ = 0.50, Δ = 1.00		
20	3.67	4.58	5.97	7.53	9.46
50	3.74	4.61	6.00	7.53	9.46
100	3.86	4.55	6.00	7.41	9.38
500	5.00	4.46	5.89	7.41	9.33
			λ = 0.50, Δ = 2.00		
20	1.44	1.53	1.67	1.78	1.90
50	1.45	1.54	1.68	1.78	1.90
100	1.46	1.54	1.67	1.79	1.91
500	1.62	1.55	1.66	1.78	1.89
			λ = 0.50, Δ = 3.00		
20	1.10	1.13	1.16	1.19	1.22
50	1.09	1.13	1.17	1.20	1.22
100	1.10	1.12	1.16	1.18	1.21
500	1.13	1.15	1.16	1.19	1.22

Table 467

Out of Control ARL_0 for DMEWMA of Dimension 15 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	34.78	66.12	152.88	292.40	549.19
50	34.75	66.11	153.62	293.41	550.08
100	35.21	66.96	153.59	293.94	550.44
500	31.96	69.05	160.00	294.76	546.11
			$\lambda = 0.60, \Delta = 0.50$		
20	14.94	24.93	48.46	83.67	142.30
50	14.95	24.56	48.07	83.61	142.17
100	14.56	24.81	48.41	84.26	142.42
500	12.72	24.70	49.45	85.19	140.65
			$\lambda = 0.60, \Delta = 1.00$		
20	4.25	5.47	7.93	10.70	14.52
50	4.25	5.53	7.99	10.62	14.38
100	4.21	5.45	7.95	10.56	14.40
500	3.05	5.38	8.00	10.52	14.39
			$\lambda = 0.60, \Delta = 2.00$		
20	1.43	1.54	1.71	1.84	2.00
50	1.45	1.57	1.71	1.84	1.99
100	1.44	1.57	1.72	1.84	1.99
500	1.50	1.59	1.70	1.84	1.99
			$\lambda = 0.60, \Delta = 3.00$		
20	1.09	1.12	1.14	1.17	1.20
50	1.09	1.12	1.14	1.17	1.20
100	1.08	1.11	1.14	1.17	1.19
500	1.00	1.10	1.15	1.18	1.19

Table 468

Out of Control ARL_0 for DMEWMA of Dimension 15 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	44.41	89.27	214.75	417.38	814.30
50	45.19	89.56	216.94	419.37	816.74
100	44.98	90.08	217.84	419.97	816.14
500	38.88	86.67	216.95	419.11	815.53
			λ = 0.80, Δ = 0.50		
20	23.19	42.63	92.80	172.18	313.33
50	23.63	42.54	93.20	172.72	314.56
100	23.57	43.05	93.96	173.57	314.67
500	34.32	44.33	90.92	174.11	312.35
			λ = 0.80, Δ = 1.00		
20	6.91	10.60	18.55	29.73	46.64
50	7.18	10.77	18.47	29.75	46.70
100	7.01	10.72	18.57	29.66	46.46
500	6.33	9.64	17.83	29.04	45.12
			λ = 0.80, Δ = 2.00		
20	1.84	2.17	2.62	3.10	3.65
50	1.85	2.21	2.60	3.12	3.68
100	1.88	2.16	2.58	3.12	3.68
500	1.71	2.05	2.52	3.13	3.61
			λ = 0.80, Δ = 3.00		
20	1.20	1.25	1.34	1.37	1.45
50	1.21	1.25	1.31	1.37	1.44
100	1.25	1.24	1.31	1.37	1.44
500	1.50	1.19	1.30	1.37	1.44

Table 469

Out of Control ARL_0 for DMEWMA of Dimension 20 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	19.70	24.87	32.52	38.90	46.56
50	19.65	24.97	32.53	39.23	46.40
100	19.52	25.10	32.85	39.07	47.02
500	24.86	24.30	32.77	39.19	46.88
			λ = 0.05, Δ = 0.50		
20	11.53	13.28	15.37	16.79	18.08
50	11.74	13.54	15.65	17.07	18.43
100	11.65	13.52	15.70	17.17	18.54
500	13.40	13.43	15.86	17.17	18.62
			λ = 0.05, Δ = 1.00		
20	7.26	8.08	9.01	9.65	10.19
50	7.45	8.33	9.31	9.95	10.50
100	7.41	8.33	9.34	9.99	10.54
500	8.55	8.32	9.44	9.96	10.56
			λ = 0.05, Δ = 2.00		
20	4.76	5.23	5.75	6.09	6.39
50	4.93	5.43	5.98	6.32	6.64
100	4.93	5.43	5.98	6.34	6.66
500	5.78	5.44	6.06	6.36	6.68
			λ = 0.05, Δ = 3.00		
20	3.76	4.11	4.49	4.75	4.97
50	3.92	4.28	4.70	4.95	5.18
100	3.93	4.31	4.70	4.96	5.19
500	4.50	4.32	4.76	4.98	5.22

Table 470

Out of Control ARL_0 for DMEWMA of Dimension 20 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	16.96	22.89	34.37	46.36	63.51
50	17.01	22.79	34.22	46.04	63.17
100	16.94	23.07	34.08	45.91	63.34
500	17.00	23.67	34.27	45.53	62.26
			$\lambda = 0.10, \Delta = 0.50$		
20	8.63	10.10	12.07	13.51	14.79
50	8.64	10.12	11.99	13.42	14.82
100	8.69	10.08	11.98	13.48	14.92
500	10.36	10.39	11.93	13.18	14.63
			$\lambda = 0.10, \Delta = 1.00$		
20	5.08	5.61	6.25	6.61	6.94
50	5.10	5.63	6.23	6.61	6.96
100	5.10	5.61	6.20	6.61	6.95
500	6.60	5.69	6.23	6.61	6.93
			$\lambda = 0.10, \Delta = 2.00$		
20	3.24	3.50	3.84	4.03	4.19
50	3.25	3.52	3.84	4.04	4.21
100	3.25	3.53	3.82	4.03	4.21
500	4.00	3.67	3.84	4.02	4.18
			$\lambda = 0.10, \Delta = 3.00$		
20	2.52	2.72	2.95	3.10	3.22
50	2.55	2.72	2.95	3.10	3.23
100	2.52	2.73	2.95	3.10	3.22
500	3.05	2.84	2.94	3.09	3.21

Table 471

Out of Control ARL_0 for DMEWMA of Dimension 20 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	17.18	26.66	47.85	75.81	118.35
50	17.37	26.54	47.64	76.02	117.93
100	17.30	27.10	48.32	76.36	117.61
500	14.58	26.54	47.85	75.68	115.58
			λ = 0.20, Δ = 0.50		
20	7.36	9.23	12.16	14.61	18.40
50	7.33	9.19	12.14	14.66	18.46
100	7.35	9.15	12.06	14.69	18.41
500	7.24	9.48	12.03	14.45	18.32
			λ = 0.20, Δ = 1.00		
20	3.61	4.00	4.47	4.78	5.08
50	3.60	4.03	4.48	4.77	5.11
100	3.63	3.99	4.43	4.76	5.09
500	4.54	4.03	4.44	4.77	5.08
			λ = 0.20, Δ = 2.00		
20	2.12	2.28	2.46	2.56	2.67
50	2.09	2.27	2.45	2.56	2.68
100	2.13	2.28	2.46	2.57	2.67
500	2.08	2.28	2.45	2.56	2.67
			λ = 0.20, Δ = 3.00		
20	1.62	1.73	1.84	1.91	1.98
50	1.61	1.72	1.84	1.91	1.98
100	1.63	1.73	1.85	1.92	1.99
500	1.70	1.70	1.83	1.90	1.98

Table 472

Out of Control ARL$_0$ for DMEWMA of Dimension 20 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	19.75	34.46	67.54	113.90	191.82
50	19.53	35.06	67.32	114.28	193.14
100	19.83	35.06	67.72	114.57	193.05
500	22.41	33.13	68.08	113.63	190.28
			λ = 0.30, Δ = 0.50		
20	7.84	10.45	15.78	21.56	30.03
50	7.68	10.62	15.88	21.49	30.22
100	7.93	10.56	15.67	21.51	30.01
500	14.19	10.40	15.37	20.60	29.83
			λ = 0.30, Δ = 1.00		
20	3.15	3.54	4.04	4.44	4.88
50	3.12	3.56	4.07	4.46	4.93
100	3.17	3.56	4.04	4.42	4.91
500	4.08	3.43	4.02	4.40	4.91
			λ = 0.30, Δ = 2.00		
20	1.68	1.80	1.93	2.01	2.10
50	1.67	1.79	1.93	2.02	2.10
100	1.67	1.81	1.92	2.02	2.09
500	1.70	1.72	1.91	1.99	2.07
			λ = 0.30, Δ = 3.00		
20	1.27	1.33	1.41	1.45	1.50
50	1.27	1.34	1.41	1.46	1.50
100	1.27	1.34	1.41	1.46	1.51
500	1.50	1.33	1.40	1.46	1.51

Table 473

Out of Control ARL_0 for DMEWMA of Dimension 20 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	22.80	41.44	88.26	155.46	271.76
50	22.74	41.88	88.36	155.02	270.38
100	22.63	41.57	89.07	155.98	270.83
500	17.33	42.94	90.13	155.90	266.67
			$\lambda = 0.40, \Delta = 0.50$		
20	8.92	13.20	21.49	31.54	47.97
50	8.84	13.22	21.57	31.34	47.62
100	8.84	13.08	21.58	31.38	47.82
500	10.57	13.20	21.41	31.59	47.42
			$\lambda = 0.40, \Delta = 1.00$		
20	3.03	3.54	4.29	5.03	5.73
50	2.94	3.56	4.28	5.06	5.77
100	2.94	3.54	4.26	5.04	5.78
500	3.17	3.57	4.24	4.98	5.64
			$\lambda = 0.40, \Delta = 2.00$		
20	1.46	1.56	1.66	1.74	1.82
50	1.45	1.56	1.67	1.75	1.82
100	1.45	1.56	1.66	1.74	1.81
500	1.27	1.54	1.67	1.73	1.80
			$\lambda = 0.40, \Delta = 3.00$		
20	1.12	1.16	1.20	1.23	1.27
50	1.12	1.16	1.20	1.24	1.27
100	1.12	1.16	1.20	1.23	1.27
500	1.14	1.16	1.21	1.24	1.28

Table 474

Out of Control ARL_0 for DMEWMA of Dimension 20 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	25.70	49.70	109.95	197.33	363.94
50	26.13	49.35	109.20	197.05	363.99
100	26.03	49.38	109.10	197.59	363.19
500	10.80	51.36	110.68	197.63	364.42
			$\lambda = 0.50, \Delta = 0.50$		
20	10.62	16.83	29.80	46.94	77.28
50	10.67	16.89	29.62	46.87	77.26
100	10.43	16.91	29.37	47.01	77.35
500	11.29	19.57	28.76	47.79	76.72
			$\lambda = 0.50, \Delta = 1.00$		
20	3.19	3.94	5.20	6.39	7.83
50	3.16	3.92	5.20	6.42	7.83
100	3.07	3.87	5.15	6.46	7.85
500	2.86	3.89	5.16	6.52	7.74
			$\lambda = 0.50, \Delta = 2.00$		
20	1.36	1.46	1.56	1.63	1.72
50	1.36	1.45	1.57	1.64	1.73
100	1.33	1.46	1.55	1.63	1.71
500	1.25	1.54	1.55	1.64	1.71
			$\lambda = 0.50, \Delta = 3.00$		
20	1.07	1.09	1.12	1.14	1.16
50	1.07	1.09	1.12	1.15	1.17
100	1.05	1.10	1.13	1.14	1.17
500	1.00	1.13	1.12	1.15	1.17

Table 475

Out of Control ARL_0 for DMEWMA of Dimension 20 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	29.11	57.28	134.01	247.01	464.44
50	29.20	57.07	133.88	245.80	462.32
100	29.02	56.46	132.93	244.65	461.23
500	35.54	55.36	137.23	248.02	462.94
			$\lambda = 0.60, \Delta = 0.50$		
20	12.67	21.38	41.74	70.11	119.02
50	12.97	21.48	41.62	69.75	119.00
100	12.49	21.39	41.34	69.65	119.03
500	18.33	23.22	40.96	69.64	119.24
			$\lambda = 0.60, \Delta = 1.00$		
20	3.59	4.77	7.08	9.23	12.19
50	3.61	4.75	7.18	9.23	12.07
100	3.60	4.73	7.07	9.08	12.17
500	3.09	5.40	7.50	9.17	12.21
			$\lambda = 0.60, \Delta = 2.00$		
20	1.36	1.46	1.59	1.69	1.79
50	1.37	1.47	1.61	1.70	1.80
100	1.34	1.48	1.59	1.69	1.80
500	1.40	1.40	1.62	1.72	1.81
			$\lambda = 0.60, \Delta = 3.00$		
20	1.07	1.09	1.12	1.13	1.14
50	1.06	1.09	1.12	1.13	1.14
100	1.06	1.08	1.11	1.14	1.15
500	1.00	1.08	1.12	1.15	1.17

Table 476

Out of Control ARL_0 for DMEWMA of Dimension 20 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	37.73	78.14	191.10	379.25	738.15
50	37.88	78.53	191.13	379.86	740.65
100	37.95	77.78	189.93	377.77	735.80
500	6.25	69.93	177.33	367.78	726.22
			λ = 0.80, Δ = 0.50		
20	19.83	36.64	82.22	148.27	269.24
50	19.87	37.05	81.98	147.99	268.17
100	19.57	36.33	81.49	146.84	267.64
500	7.67	33.32	78.57	145.07	263.50
			λ = 0.80, Δ = 1.00		
20	6.10	9.40	15.61	23.51	36.98
50	6.23	9.50	15.66	23.68	36.99
100	6.29	9.49	15.53	23.60	37.05
500	0.00	8.42	15.77	23.40	37.67
			λ = 0.80, Δ = 2.00		
20	1.71	2.01	2.34	2.72	3.29
50	1.72	2.01	2.38	2.73	3.32
100	1.67	2.01	2.38	2.73	3.35
500	0.00	1.91	2.33	2.70	3.37
			λ = 0.80, Δ = 3.00		
20	1.16	1.22	1.29	1.35	1.42
50	1.15	1.23	1.32	1.35	1.42
100	1.08	1.23	1.32	1.36	1.43
500	0.00	1.14	1.35	1.37	1.42

Table 477

Out of Control ARL_0 for DMEWMA of Dimension 25 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	16.10	20.01	25.32	29.89	35.84
50	16.40	20.05	25.32	29.83	35.77
100	15.88	19.76	25.25	29.67	35.49
500	16.22	19.90	25.83	30.54	35.53
			λ = 0.05, Δ = 0.50		
20	9.90	11.29	12.84	13.93	14.96
50	9.98	11.35	12.95	14.04	15.08
100	9.78	11.29	13.02	14.06	15.08
500	11.20	11.54	13.14	14.17	15.07
			λ = 0.05, Δ = 1.00		
20	6.50	7.22	7.95	8.44	8.90
50	6.57	7.28	8.05	8.55	9.03
100	6.49	7.24	8.09	8.58	9.06
500	7.35	7.47	8.15	8.64	9.05
			λ = 0.05, Δ = 2.00		
20	4.36	4.79	5.23	5.51	5.77
50	4.47	4.86	5.32	5.62	5.90
100	4.42	4.83	5.35	5.63	5.91
500	4.71	4.96	5.40	5.66	5.92
			λ = 0.05, Δ = 3.00		
20	3.51	3.80	4.14	4.34	4.55
50	3.58	3.88	4.23	4.45	4.66
100	3.56	3.86	4.24	4.46	4.67
500	3.84	3.94	4.29	4.49	4.69

Table 478

Out of Control ARL_0 for DMEWMA of Dimension 25 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	13.56	18.34	26.64	34.98	47.16
50	13.57	18.20	26.40	34.58	47.06
100	13.32	18.08	26.41	34.17	46.16
500	11.14	19.01	26.75	35.37	47.25
			λ = 0.10, Δ = 0.50		
20	7.41	8.58	10.04	11.11	12.16
50	7.39	8.51	10.00	11.01	12.08
100	7.31	8.44	9.98	11.05	12.16
500	7.10	8.78	10.27	10.99	12.10
			λ = 0.10, Δ = 1.00		
20	4.55	5.02	5.53	5.84	6.12
50	4.52	4.98	5.51	5.83	6.11
100	4.51	4.94	5.49	5.80	6.09
500	4.37	5.06	5.55	5.84	6.10
			λ = 0.10, Δ = 2.00		
20	2.99	3.23	3.49	3.66	3.82
50	2.96	3.22	3.49	3.68	3.81
100	2.95	3.19	3.50	3.66	3.81
500	2.71	3.25	3.54	3.70	3.81
			λ = 0.10, Δ = 3.00		
20	2.37	2.55	2.75	2.86	2.98
50	2.33	2.53	2.74	2.86	2.97
100	2.31	2.51	2.73	2.85	2.97
500	2.06	2.57	2.77	2.88	2.97

Table 479

Out of Control ARL_0 for DMEWMA of Dimension 25 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	14.07	21.53	38.09	59.43	93.40
50	13.90	21.55	38.50	59.50	93.86
100	13.75	21.35	38.40	59.60	94.38
500	9.19	21.25	39.74	59.48	94.58
			λ = 0.20, Δ = 0.50		
20	6.23	7.72	9.88	11.75	14.59
50	6.21	7.83	9.81	11.67	14.45
100	6.07	7.66	9.94	11.70	14.55
500	4.07	7.59	10.18	11.72	14.52
			λ = 0.20, Δ = 1.00		
20	3.27	3.63	4.00	4.22	4.47
50	3.27	3.63	3.99	4.25	4.48
100	3.21	3.62	3.99	4.22	4.45
500	4.00	3.48	4.06	4.22	4.45
			λ = 0.20, Δ = 2.00		
20	1.99	2.14	2.30	2.39	2.49
50	2.01	2.14	2.29	2.39	2.48
100	1.97	2.13	2.29	2.38	2.48
500	2.43	2.04	2.32	2.40	2.48
			λ = 0.20, Δ = 3.00		
20	1.54	1.64	1.74	1.81	1.87
50	1.55	1.65	1.75	1.82	1.88
100	1.53	1.63	1.73	1.80	1.86
500	2.20	1.58	1.76	1.80	1.87

Table 480

Out of Control ARL_0 for DMEWMA of Dimension 25 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	16.24	27.51	54.91	96.42	154.86
50	16.25	27.28	54.92	96.50	155.13
100	16.36	27.69	54.81	97.07	155.71
500	55.22	29.15	54.10	96.00	156.48
	λ = 0.30, Δ = 0.50				
20	6.60	8.72	12.61	17.56	23.25
50	6.59	8.81	12.51	17.49	23.24
100	6.70	8.72	12.79	17.77	23.49
500	6.71	9.22	12.64	16.86	22.53
	λ = 0.30, Δ = 1.00				
20	2.83	3.16	3.59	3.93	4.21
50	2.83	3.15	3.61	3.95	4.24
100	2.87	3.16	3.60	3.95	4.23
500	3.67	3.26	3.53	3.92	4.17
	λ = 0.30, Δ = 2.00				
20	1.59	1.70	1.81	1.90	1.96
50	1.61	1.72	1.82	1.89	1.96
100	1.61	1.69	1.80	1.88	1.96
500	1.67	1.71	1.78	1.87	1.94
	λ = 0.30, Δ = 3.00				
20	1.23	1.28	1.35	1.40	1.43
50	1.25	1.30	1.36	1.41	1.45
100	1.22	1.28	1.34	1.39	1.43
500	1.20	1.34	1.35	1.39	1.43

Table 481

Out of Control ARL_0 for DMEWMA of Dimension 25 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	18.43	33.94	75.10	128.60	224.49
50	18.56	34.16	74.93	128.47	226.36
100	18.81	34.23	74.83	129.36	228.36
500	38.78	33.91	71.47	127.68	227.91
			λ = 0.40, Δ = 0.50		
20	7.45	10.84	18.05	26.81	38.46
50	7.43	10.52	18.16	26.83	38.13
100	7.50	10.73	18.37	27.37	38.99
500	11.22	11.34	17.56	25.72	38.01
			λ = 0.40, Δ = 1.00		
20	2.70	3.08	3.73	4.31	4.92
50	2.72	3.08	3.71	4.33	4.90
100	2.68	3.08	3.68	4.33	4.91
500	3.78	3.12	3.68	4.33	4.96
			λ = 0.40, Δ = 2.00		
20	1.38	1.47	1.57	1.65	1.71
50	1.39	1.48	1.58	1.65	1.71
100	1.38	1.48	1.57	1.65	1.70
500	1.86	1.52	1.56	1.64	1.70
			λ = 0.40, Δ = 3.00		
20	1.09	1.12	1.16	1.19	1.22
50	1.09	1.13	1.17	1.20	1.23
100	1.09	1.12	1.15	1.19	1.21
500	1.14	1.16	1.14	1.19	1.21

Table 482

Out of Control ARL_0 for DMEWMA of Dimension 25 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	21.61	42.33	92.42	169.39	314.77
50	20.94	42.30	92.03	169.30	315.05
100	21.27	42.35	92.75	169.63	315.83
500	17.70	40.02	91.26	170.60	316.81
			λ = 0.50, Δ = 0.50		
20	8.84	14.08	25.36	39.75	61.27
50	8.59	13.83	25.37	39.93	61.30
100	9.07	14.03	25.56	40.30	61.39
500	9.22	14.38	24.23	39.13	60.19
			λ = 0.50, Δ = 1.00		
20	2.82	3.43	4.39	5.34	6.46
50	2.81	3.41	4.39	5.28	6.49
100	2.80	3.33	4.43	5.31	6.49
500	3.00	3.75	4.53	5.31	6.54
			λ = 0.50, Δ = 2.00		
20	1.28	1.36	1.46	1.54	1.61
50	1.31	1.36	1.45	1.53	1.61
100	1.27	1.34	1.45	1.53	1.62
500	1.50	1.36	1.46	1.53	1.61
			λ = 0.50, Δ = 3.00		
20	1.06	1.07	1.10	1.11	1.12
50	1.06	1.08	1.10	1.11	1.13
100	1.05	1.07	1.10	1.11	1.13
500	1.50	1.09	1.10	1.11	1.13

Table 483

Out of Control ARL_0 for DMEWMA of Dimension 25 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	25.05	50.35	114.64	215.28	411.93
50	24.20	49.64	114.23	215.37	411.17
100	25.20	49.84	115.62	216.88	415.30
500	37.14	46.32	112.40	215.91	416.73
			λ = 0.60, Δ = 0.50		
20	10.83	18.08	35.84	58.30	96.21
50	10.28	17.69	35.87	58.25	96.49
100	10.53	17.96	36.03	58.49	97.18
500	28.43	18.49	34.67	56.30	96.75
			λ = 0.60, Δ = 1.00		
20	3.21	4.14	5.83	7.46	9.73
50	3.21	4.14	5.82	7.40	9.59
100	3.06	4.12	5.83	7.43	9.64
500	3.67	4.13	5.70	7.30	9.69
			λ = 0.60, Δ = 2.00		
20	1.28	1.34	1.47	1.56	1.65
50	1.31	1.36	1.47	1.56	1.64
100	1.29	1.33	1.45	1.57	1.65
500	1.00	1.33	1.44	1.55	1.65
			λ = 0.60, Δ = 3.00		
20	1.05	1.07	1.09	1.11	1.12
50	1.05	1.07	1.09	1.10	1.12
100	1.04	1.06	1.08	1.10	1.12
500	1.00	1.11	1.08	1.11	1.12

Table 484

Out of Control ARL_0 for DMEWMA of Dimension 25 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	32.50	68.45	174.76	333.80	641.88
50	31.54	68.39	174.85	332.06	640.40
100	31.99	68.56	177.21	335.64	643.26
500	14.56	73.23	179.27	333.32	637.12
			$\lambda = 0.80, \Delta = 0.50$		
20	17.03	32.01	71.74	124.81	231.55
50	16.82	31.92	71.97	124.60	231.51
100	16.88	32.47	72.13	124.89	231.22
500	10.71	33.45	68.78	124.00	227.90
			$\lambda = 0.80, \Delta = 1.00$		
20	5.18	7.67	13.56	20.42	32.64
50	5.18	7.73	13.49	20.72	32.93
100	5.14	7.66	13.25	20.50	32.86
500	3.67	7.51	12.16	19.77	32.67
			$\lambda = 0.80, \Delta = 2.00$		
20	1.54	1.75	2.03	2.38	2.75
50	1.55	1.76	2.02	2.39	2.77
100	1.53	1.71	1.97	2.38	2.79
500	1.00	1.63	1.98	2.45	2.82
			$\lambda = 0.80, \Delta = 3.00$		
20	1.15	1.20	1.25	1.28	1.34
50	1.15	1.20	1.26	1.28	1.35
100	1.22	1.20	1.25	1.29	1.35
500	0.00	1.14	1.16	1.30	1.34

Table 485

Out of Control ARL_0 for DMEWMA of Dimension 50 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	10.25	13.01	15.62	17.44	19.22
50	10.45	12.92	15.69	17.52	19.36
100	10.61	13.11	15.44	17.36	19.24
500	4.50	13.20	15.53	17.33	19.46
			λ = 0.05, Δ = 0.50		
20	7.03	8.20	9.20	9.80	10.31
50	7.05	8.18	9.23	9.85	10.35
100	7.23	8.23	9.17	9.77	10.33
500	3.50	8.24	9.18	9.79	10.30
			λ = 0.05, Δ = 1.00		
20	5.01	5.66	6.16	6.52	6.79
50	4.99	5.64	6.19	6.54	6.81
100	5.13	5.68	6.19	6.53	6.80
500	3.00	5.55	6.16	6.51	6.80
			λ = 0.05, Δ = 2.00		
20	3.62	3.99	4.33	4.54	4.72
50	3.60	4.02	4.35	4.58	4.76
100	3.72	4.03	4.35	4.55	4.74
500	3.00	3.93	4.34	4.54	4.72
			λ = 0.05, Δ = 3.00		
20	3.00	3.29	3.55	3.71	3.85
50	2.99	3.30	3.56	3.75	3.89
100	3.09	3.33	3.56	3.72	3.87
500	3.00	3.26	3.59	3.72	3.84

Table 486

Out of Control ARL_0 for DMEWMA of Dimension 50 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	8.55	11.63	15.17	18.42	22.90
50	8.50	11.50	15.44	18.38	22.92
100	8.57	11.94	15.31	18.40	22.94
500	0.00	11.51	15.78	18.25	23.13
			$\lambda = 0.10, \Delta = 0.50$		
20	5.33	6.22	7.04	7.60	8.14
50	5.28	6.24	7.13	7.62	8.13
100	5.42	6.43	7.11	7.68	8.15
500	0.00	6.05	6.96	7.44	8.19
			$\lambda = 0.10, \Delta = 1.00$		
20	3.58	3.99	4.38	4.58	4.74
50	3.52	4.00	4.39	4.57	4.77
100	3.63	4.09	4.44	4.62	4.81
500	0.00	4.06	4.35	4.52	4.76
			$\lambda = 0.10, \Delta = 2.00$		
20	2.48	2.71	2.95	3.07	3.18
50	2.43	2.72	2.95	3.07	3.18
100	2.52	2.80	2.99	3.09	3.20
500	0.00	2.82	2.88	3.03	3.19
			$\lambda = 0.10, \Delta = 3.00$		
20	2.00	2.18	2.36	2.46	2.55
50	1.97	2.18	2.37	2.46	2.53
100	2.03	2.24	2.39	2.47	2.56
500	0.00	2.30	2.33	2.41	2.53

Table 487

Out of Control ARL_0 for DMEWMA of Dimension 50 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	8.31	13.67	21.55	32.75	51.27
50	8.16	13.50	22.05	31.95	50.41
100	7.91	13.42	22.02	32.60	50.99
500	0.00	12.22	21.23	33.07	51.30
			λ = 0.20, Δ = 0.50		
20	4.43	5.44	6.51	7.23	8.52
50	4.32	5.40	6.58	7.21	8.45
100	4.27	5.54	6.49	7.19	8.36
500	0.00	4.96	6.41	7.27	8.69
			λ = 0.20, Δ = 1.00		
20	2.59	2.90	3.17	3.33	3.47
50	2.57	2.89	3.16	3.32	3.45
100	2.58	2.98	3.22	3.35	3.48
500	0.00	2.72	3.18	3.32	3.46
			λ = 0.20, Δ = 2.00		
20	1.65	1.83	1.95	2.03	2.11
50	1.64	1.82	1.96	2.04	2.10
100	1.65	1.85	1.99	2.06	2.13
500	0.00	1.63	1.98	2.06	2.12
			λ = 0.20, Δ = 3.00		
20	1.32	1.42	1.51	1.57	1.62
50	1.30	1.41	1.51	1.56	1.61
100	1.32	1.45	1.53	1.58	1.63
500	0.00	1.35	1.53	1.59	1.63

Table 488

Out of Control ARL_0 for DMEWMA of Dimension 50 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	9.39	17.67	33.53	55.59	91.76
50	9.34	17.54	33.67	55.27	91.32
100	9.28	17.89	33.94	56.48	91.33
500	0.00	16.70	32.71	55.39	92.22
			$\lambda = 0.30, \Delta = 0.50$		
20	4.27	5.70	7.55	9.70	12.55
50	4.37	5.75	7.43	9.45	12.57
100	4.11	5.75	7.50	9.49	12.50
500	0.00	6.00	7.43	10.08	12.96
			$\lambda = 0.30, \Delta = 1.00$		
20	2.19	2.49	2.74	2.91	3.07
50	2.19	2.48	2.72	2.87	3.05
100	2.22	2.52	2.79	2.92	3.07
500	0.00	2.33	2.77	2.92	3.08
			$\lambda = 0.30, \Delta = 2.00$		
20	1.33	1.44	1.54	1.59	1.64
50	1.30	1.41	1.51	1.58	1.63
100	1.33	1.43	1.55	1.59	1.65
500	0.00	1.35	1.58	1.62	1.65
			$\lambda = 0.30, \Delta = 3.00$		
20	1.08	1.12	1.16	1.19	1.23
50	1.07	1.12	1.16	1.19	1.22
100	1.10	1.13	1.18	1.21	1.23
500	0.00	1.03	1.19	1.21	1.24

Table 489

Out of Control ARL_0 for DMEWMA of Dimension 50 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	10.77	22.39	48.30	87.62	145.44
50	10.68	21.90	49.34	87.51	144.93
100	10.34	22.13	49.58	88.79	145.04
500	0.00	18.77	45.76	88.48	147.60
			$\lambda = 0.40, \Delta = 0.50$		
20	4.54	6.76	9.99	14.30	19.98
50	4.46	6.52	9.96	14.21	20.25
100	4.44	6.55	10.15	14.10	19.94
500	0.00	6.33	10.37	13.72	19.37
			$\lambda = 0.40, \Delta = 1.00$		
20	2.02	2.31	2.61	2.83	3.06
50	1.96	2.26	2.57	2.80	3.08
100	1.97	2.27	2.63	2.87	3.07
500	0.00	2.14	2.61	2.90	3.10
			$\lambda = 0.40, \Delta = 2.00$		
20	1.17	1.23	1.31	1.35	1.40
50	1.15	1.22	1.29	1.34	1.38
100	1.15	1.23	1.31	1.36	1.40
500	0.00	1.18	1.30	1.36	1.39
			$\lambda = 0.40, \Delta = 3.00$		
20	1.03	1.03	1.04	1.05	1.07
50	1.02	1.04	1.05	1.06	1.08
100	1.02	1.05	1.06	1.07	1.08
500	0.00	1.03	1.06	1.06	1.07

Table 490

Out of Control ARL$_0$ for DMEWMA of Dimension 50 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	13.29	27.21	64.90	124.19	228.22
50	13.07	26.78	65.71	125.82	229.43
100	12.08	26.95	67.19	127.16	228.60
500	0.00	15.59	67.72	129.35	228.05
			λ = 0.50, Δ = 0.50		
20	5.38	8.57	15.20	21.81	32.72
50	5.16	8.40	14.95	22.10	33.05
100	4.82	8.45	15.41	22.36	33.01
500	0.00	6.20	16.51	21.98	33.45
			λ = 0.50, Δ = 1.00		
20	2.00	2.35	2.76	3.10	3.51
50	1.90	2.31	2.72	3.05	3.50
100	1.91	2.36	2.77	3.11	3.58
500	0.00	1.89	2.74	3.14	3.59
			λ = 0.50, Δ = 2.00		
20	1.10	1.14	1.19	1.24	1.26
50	1.12	1.15	1.19	1.22	1.26
100	1.12	1.15	1.19	1.22	1.25
500	0.00	1.15	1.22	1.24	1.26
			λ = 0.50, Δ = 3.00		
20	1.01	1.02	1.02	1.03	1.03
50	1.04	1.02	1.04	1.03	1.04
100	1.00	1.02	1.03	1.04	1.04
500	0.00	1.00	1.02	1.04	1.04

Table 491

Out of Control ARL_0 for DMEWMA of Dimension 50 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	15.27	34.88	88.44	162.28	318.63
50	15.06	35.15	87.95	164.19	318.98
100	14.41	35.97	88.25	164.27	319.28
500	9.00	38.48	93.54	165.56	324.20
	λ = 0.60, Δ = 0.50				
20	6.42	11.34	22.14	34.69	55.64
50	6.03	11.12	22.07	34.85	55.90
100	5.32	11.24	22.53	34.90	55.45
500	4.00	11.48	25.12	36.35	56.05
	λ = 0.60, Δ = 1.00				
20	2.07	2.63	3.44	4.19	4.88
50	2.03	2.56	3.38	4.17	4.87
100	2.10	2.61	3.40	4.28	4.99
500	2.00	2.30	3.54	4.17	4.85
	λ = 0.60, Δ = 2.00				
20	1.09	1.12	1.17	1.20	1.24
50	1.15	1.13	1.19	1.21	1.23
100	1.11	1.15	1.17	1.20	1.23
500	0.00	1.13	1.19	1.21	1.23
	λ = 0.60, Δ = 3.00				
20	1.01	1.02	1.02	1.02	1.03
50	1.02	1.03	1.02	1.02	1.03
100	1.00	1.03	1.03	1.03	1.04
500	0.00	1.08	1.05	1.04	1.04

Table 492

Out of Control ARL_0 for DMEWMA of Dimension 50 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	20.34	54.11	148.00	280.01	531.96
50	20.56	54.07	147.67	280.36	534.81
100	21.69	54.86	149.18	279.81	531.37
500	0.00	44.70	148.98	288.26	532.47
			$\lambda = 0.80, \Delta = 0.50$		
20	10.13	22.47	52.84	92.07	168.17
50	10.26	22.81	52.10	91.36	168.17
100	11.03	23.35	53.29	91.88	168.01
500	0.00	18.03	52.36	91.14	167.70
			$\lambda = 0.80, \Delta = 1.00$		
20	3.22	4.85	7.80	10.94	15.45
50	3.19	4.74	7.60	10.88	15.38
100	2.72	4.77	7.71	10.62	15.44
500	0.00	4.02	7.24	9.69	14.88
			$\lambda = 0.80, \Delta = 2.00$		
20	1.21	1.28	1.37	1.45	1.58
50	1.24	1.33	1.39	1.50	1.58
100	1.28	1.36	1.38	1.42	1.51
500	0.00	1.60	1.45	1.41	1.53
			$\lambda = 0.80, \Delta = 3.00$		
20	1.00	1.06	1.16	1.14	1.15
50	1.00	1.02	1.14	1.16	1.19
100	1.00	1.09	1.17	1.18	1.17
500	0.00	1.00	1.19	1.13	1.14

ssMEWMA Out-of-Control ARL_1 Charts

Table 493

Out of Control ARL_0 for ssMEWMA of Dimension 2 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05, \Delta = 0.25$				
20	87.66	171.72	440.68	909.39	1878.83
50	73.19	139.07	373.42	796.99	1711.77
100	62.46	112.88	292.53	646.68	1477.75
500	46.20	71.91	134.45	252.04	579.35
	$\lambda = 0.05, \Delta = 0.50$				
20	49.60	101.94	296.63	693.31	1546.89
50	30.38	52.83	146.64	370.10	971.11
100	23.23	33.40	65.02	148.85	443.14
500	18.98	24.86	32.67	40.19	51.88
	$\lambda = 0.05, \Delta = 1.00$				
20	13.63	21.38	65.85	192.60	574.85
50	9.58	11.69	15.67	21.64	49.41
100	8.67	10.30	12.71	14.72	17.05
500	7.52	9.42	11.22	12.64	14.15
	$\lambda = 0.05, \Delta = 2.00$				
20	4.50	5.46	6.98	8.68	15.45
50	3.93	4.56	5.46	6.16	6.90
100	3.66	4.21	4.98	5.56	6.14
500	3.31	3.97	4.55	5.07	5.54
	$\lambda = 0.05, \Delta = 3.00$				
20	2.88	3.42	4.22	4.88	5.64
50	2.50	2.85	3.38	3.78	4.21
100	2.29	2.60	3.06	3.40	3.74
500	2.09	2.42	2.77	3.05	3.32

Table 494

Out of Control ARL_0 for ssMEWMA of Dimension 2 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	84.47	174.92	453.47	955.75	1962.57
50	73.01	151.50	401.64	875.27	1861.71
100	61.43	125.04	341.44	776.42	1726.84
500	57.95	81.17	189.02	400.56	1004.95
	λ = 0.10, Δ = 0.50				
20	54.27	119.49	353.49	808.40	1787.11
50	33.62	68.44	216.48	550.06	1365.59
100	24.06	41.43	112.03	305.36	857.05
500	22.48	26.10	39.19	55.66	111.55
	λ = 0.10, Δ = 1.00				
20	14.61	31.98	125.28	376.39	1025.81
50	8.63	11.18	21.10	60.48	209.07
100	7.64	9.34	12.07	15.14	25.88
500	8.08	8.08	10.03	11.55	13.39
	λ = 0.10, Δ = 2.00				
20	3.80	4.66	6.97	15.85	65.57
50	3.12	3.62	4.30	4.86	5.47
100	2.89	3.32	3.90	4.35	4.82
500	2.95	3.09	3.58	3.95	4.35
	λ = 0.10, Δ = 3.00				
20	2.31	2.73	3.31	4.01	4.73
50	1.90	2.15	2.49	2.77	3.07
100	1.77	1.98	2.27	2.49	2.72
500	1.62	1.85	2.09	2.26	2.46

Table 495

Out of Control ARL_0 for ssMEWMA of Dimension 2 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	86.15	182.19	470.80	967.42	1985.60
50	78.24	165.51	440.34	940.97	1930.87
100	70.58	145.55	393.70	879.81	1864.90
500	58.50	117.36	273.07	622.07	1403.90
			$\lambda = 0.20, \Delta = 0.50$		
20	64.46	145.14	416.27	909.02	1924.76
50	43.45	98.31	308.70	762.15	1709.99
100	32.47	64.74	205.51	558.33	1394.07
500	22.59	33.56	65.99	144.00	421.65
			$\lambda = 0.20, \Delta = 1.00$		
20	22.84	62.04	246.68	668.19	1596.54
50	9.62	17.16	63.85	242.46	770.06
100	7.67	10.52	19.54	54.60	231.54
500	6.11	8.17	10.85	13.48	16.73
			$\lambda = 0.20, \Delta = 2.00$		
20	3.50	5.58	25.03	129.90	471.49
50	2.57	3.03	3.67	4.51	9.28
100	2.39	2.76	3.24	3.66	4.11
500	2.52	2.56	2.98	3.30	3.65
			$\lambda = 0.20, \Delta = 3.00$		
20	1.83	2.14	3.81	10.24	49.16
50	1.50	1.66	1.89	2.09	2.30
100	1.41	1.55	1.72	1.88	2.05
500	1.49	1.46	1.61	1.73	1.86

Table 496

Out of Control ARL_0 for ssMEWMA of Dimension 2 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	90.67	185.60	475.24	992.02	1980.95
50	84.61	170.24	460.12	970.27	1949.24
100	77.13	159.72	432.96	940.71	1912.80
500	63.96	133.58	326.60	745.49	1637.47
	λ = 0.30, Δ = 0.50				
20	74.18	162.63	444.97	967.87	1943.50
50	53.81	121.98	368.91	867.67	1847.55
100	39.85	88.65	288.44	736.90	1656.63
500	28.18	45.22	111.42	286.36	834.04
	λ = 0.30, Δ = 1.00				
20	33.67	97.23	344.74	841.34	1831.64
50	13.21	32.03	153.16	489.06	1270.77
100	9.01	14.46	46.78	206.47	698.52
500	6.15	8.93	13.62	18.84	30.27
	λ = 0.30, Δ = 2.00				
20	4.37	13.57	99.44	366.28	1083.05
50	2.44	2.93	4.61	15.93	88.26
100	2.22	2.63	3.20	3.68	4.49
500	2.32	2.41	2.81	3.19	3.55
	λ = 0.30, Δ = 3.00				
20	1.71	2.54	12.23	69.46	313.75
50	1.35	1.49	1.70	1.89	2.09
100	1.28	1.39	1.54	1.68	1.83
500	1.38	1.31	1.45	1.55	1.66

Table 497

Out of Control ARL_0 for ssMEWMA of Dimension 2 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	91.90	188.02	494.35	1001.27	1972.54
50	86.91	178.17	483.05	985.89	1938.22
100	83.47	167.95	470.52	964.51	1928.34
500	89.07	148.74	381.28	818.16	1711.26
			$\lambda = 0.40, \Delta = 0.50$		
20	80.68	172.83	480.09	992.92	1971.84
50	61.28	141.45	427.78	926.31	1899.64
100	49.58	108.83	361.89	833.53	1805.77
500	31.05	60.45	167.45	417.65	1123.92
			$\lambda = 0.40, \Delta = 1.00$		
20	47.06	127.48	424.56	939.99	1944.51
50	18.67	55.38	261.65	689.51	1613.36
100	11.65	23.32	116.30	396.96	1142.76
500	7.23	10.78	19.06	31.45	105.94
			$\lambda = 0.40, \Delta = 2.00$		
20	8.18	35.98	217.96	642.60	1539.20
50	2.55	3.40	18.68	93.82	381.90
100	2.24	2.73	3.48	6.36	35.58
500	2.08	2.49	2.92	3.34	3.83
			$\lambda = 0.40, \Delta = 3.00$		
20	1.87	5.88	52.52	236.15	745.95
50	1.31	1.44	1.70	2.12	10.02
100	1.24	1.34	1.50	1.64	1.79
500	1.36	1.26	1.38	1.48	1.60

Table 498

Out of Control ARL_0 for ssMEWMA of Dimension 2 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	94.17	191.01	505.60	983.03	1957.08
50	90.39	183.28	495.33	975.12	1952.10
100	84.27	176.34	482.26	959.79	1937.57
500	67.68	155.21	409.35	859.11	1777.12
			$\lambda = 0.50, \Delta = 0.50$		
20	85.49	181.87	496.98	983.09	1960.38
50	68.89	154.70	458.31	948.01	1933.04
100	55.98	126.99	407.26	886.64	1877.45
500	34.02	75.19	219.95	534.75	1328.01
			$\lambda = 0.50, \Delta = 1.00$		
20	59.62	153.32	481.14	990.26	2001.95
50	27.09	82.73	342.91	808.96	1806.98
100	15.51	39.46	201.45	585.09	1486.81
500	7.93	14.57	30.24	71.41	298.86
			$\lambda = 0.50, \Delta = 2.00$		
20	16.47	72.35	354.56	852.46	1865.11
50	2.92	7.18	65.48	270.87	824.22
100	2.43	3.00	6.30	36.14	183.99
500	2.37	2.52	3.20	3.74	4.52
			$\lambda = 0.50, \Delta = 3.00$		
20	3.26	20.12	146.29	464.83	1223.23
50	1.34	1.49	2.95	13.96	76.59
100	1.24	1.35	1.54	1.69	1.90
500	1.30	1.27	1.41	1.50	1.62

Table 499

Out of Control ARL_0 for ssMEWMA of Dimension 2 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	94.45	194.61	502.41	994.89	1986.03
50	91.58	187.34	490.36	987.79	2002.31
100	88.99	184.17	478.48	979.66	1982.05
500	83.52	169.27	430.42	886.56	1850.62
	λ = 0.60, Δ = 0.50				
20	88.42	190.60	500.88	1003.29	2014.29
50	75.36	168.49	471.01	974.35	2009.00
100	64.37	144.28	432.15	934.31	1957.27
500	42.31	93.53	268.88	636.90	1541.38
	λ = 0.60, Δ = 1.00				
20	71.69	175.63	506.93	1038.10	2075.06
50	37.70	109.94	400.95	928.15	1989.20
100	21.82	62.89	276.93	757.05	1779.33
500	9.59	18.25	48.90	159.64	627.38
	λ = 0.60, Δ = 2.00				
20	31.26	119.65	448.27	1039.84	2133.84
50	4.23	17.81	152.27	511.61	1322.19
100	2.71	4.12	22.58	140.11	562.49
500	2.50	2.82	3.70	4.64	6.05
	λ = 0.60, Δ = 3.00				
20	9.78	50.98	269.28	748.61	1731.69
50	1.41	2.11	15.33	74.07	308.51
100	1.29	1.41	1.65	2.22	15.94
500	1.15	1.30	1.46	1.59	1.76

Table 500

Out of Control ARL_0 for ssMEWMA of Dimension 2 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	97.55	201.12	516.48	998.24	2005.58
50	96.17	195.12	506.99	993.40	2013.44
100	92.99	191.40	500.75	994.46	2011.67
500	84.56	174.76	466.47	931.21	1956.86
			$\lambda = 0.80, \Delta = 0.50$		
20	96.22	203.06	520.51	1016.61	2036.55
50	86.63	191.20	508.71	1012.97	2041.70
100	77.99	169.59	487.79	1004.10	2055.13
500	45.25	121.73	352.33	803.12	1827.50
			$\lambda = 0.80, \Delta = 1.00$		
20	92.99	207.85	562.39	1089.69	2155.71
50	63.09	162.53	518.98	1081.21	2188.80
100	39.53	112.72	431.70	1005.51	2153.45
500	17.08	33.97	137.28	434.03	1382.48
			$\lambda = 0.80, \Delta = 2.00$		
20	77.17	207.71	632.61	1257.96	2418.96
50	18.11	81.92	401.48	993.38	2157.79
100	4.70	21.12	172.97	582.16	1610.64
500	3.07	3.86	6.28	12.12	110.10
			$\lambda = 0.80, \Delta = 3.00$		
20	45.52	162.89	576.95	1250.17	2502.66
50	3.28	17.31	145.05	509.92	1384.40
100	1.51	1.81	12.07	83.00	392.32
500	1.50	1.55	1.79	2.10	2.47

Table 501

Out of Control ARL_0 for ssMEWMA of Dimension 3 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05, \Delta = 0.25$				
20	89.69	178.49	448.77	949.30	1935.46
50	76.02	147.35	383.04	837.44	1772.72
100	61.70	115.88	300.41	674.47	1518.62
500	51.26	74.45	143.08	278.11	644.38
	$\lambda = 0.05, \Delta = 0.50$				
20	53.31	111.04	319.79	745.47	1626.72
50	31.53	57.07	154.35	404.83	1006.17
100	23.91	35.03	70.87	168.81	478.04
500	18.44	25.16	33.32	41.98	55.73
	$\lambda = 0.05, \Delta = 1.00$				
20	14.78	24.45	71.64	220.38	642.61
50	9.81	12.07	15.86	25.74	67.65
100	8.78	10.53	12.86	14.93	17.08
500	7.28	9.41	11.24	12.60	13.93
	$\lambda = 0.05, \Delta = 2.00$				
20	4.88	5.95	7.58	9.55	20.79
50	4.06	4.72	5.61	6.36	7.08
100	3.74	4.31	5.02	5.63	6.16
500	3.42	4.01	4.59	5.05	5.48
	$\lambda = 0.05, \Delta = 3.00$				
20	3.14	3.75	4.60	5.35	6.10
50	2.58	2.99	3.51	3.92	4.34
100	2.35	2.68	3.10	3.45	3.76
500	2.04	2.47	2.81	3.05	3.30

Table 502

Out of Control ARL_0 for ssMEWMA of Dimension 3 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.10, \Delta = 0.25$				
20	87.57	180.00	465.05	958.79	1998.15
50	75.25	155.72	416.54	900.24	1897.74
100	61.85	129.67	360.94	792.31	1780.19
500	54.58	93.38	205.53	455.27	1068.39
	$\lambda = 0.10, \Delta = 0.50$				
20	57.35	130.07	371.61	834.37	1834.97
50	35.02	74.34	232.45	591.00	1433.46
100	25.02	44.91	125.76	335.91	928.21
500	14.94	27.93	39.79	63.76	130.29
	$\lambda = 0.10, \Delta = 1.00$				
20	16.12	35.42	140.49	417.57	1113.97
50	8.85	11.66	24.62	73.44	255.09
100	7.64	9.36	12.25	16.36	38.99
500	6.08	8.42	10.02	11.52	13.05
	$\lambda = 0.10, \Delta = 2.00$				
20	4.05	4.98	8.43	24.14	101.96
50	3.15	3.66	4.36	4.92	5.52
100	2.93	3.36	3.93	4.34	4.78
500	2.49	3.09	3.56	3.92	4.27
	$\lambda = 0.10, \Delta = 3.00$				
20	2.48	2.91	3.54	4.13	6.55
50	1.92	2.19	2.54	2.82	3.11
100	1.79	2.00	2.27	2.49	2.71
500	1.64	1.87	2.07	2.25	2.42

Table 503

Out of Control ARL_0 for ssMEWMA of Dimension 3 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	90.21	178.57	477.40	970.50	1996.87
50	78.30	162.75	452.84	936.01	1951.93
100	70.91	145.02	407.72	879.16	1895.28
500	62.33	102.35	284.31	641.51	1499.22
	λ = 0.20, Δ = 0.50				
20	67.49	146.77	426.72	912.66	1942.58
50	44.72	102.43	331.61	777.13	1759.31
100	32.62	68.15	231.70	581.13	1462.66
500	25.03	35.42	76.87	172.30	485.02
	λ = 0.20, Δ = 1.00				
20	24.89	65.19	265.36	666.24	1638.14
50	10.12	19.56	80.23	263.50	854.86
100	7.93	11.06	22.53	77.25	296.22
500	7.79	8.23	11.10	13.68	18.31
	λ = 0.20, Δ = 2.00				
20	3.73	6.26	33.90	149.40	536.55
50	2.57	3.02	3.71	5.04	15.72
100	2.40	2.74	3.24	3.61	4.06
500	2.26	2.51	2.90	3.23	3.53
	λ = 0.20, Δ = 3.00				
20	1.90	2.23	4.16	13.78	73.88
50	1.51	1.67	1.90	2.10	2.32
100	1.43	1.54	1.72	1.88	2.03
500	1.24	1.42	1.57	1.70	1.83

Table 504

Out of Control ARL_0 for ssMEWMA of Dimension 3 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	89.84	184.49	481.62	974.26	1986.91
50	81.22	172.41	463.68	951.78	1965.24
100	74.70	156.58	430.41	928.81	1933.08
500	68.63	125.79	340.84	742.03	1645.72
			$\lambda = 0.30, \Delta = 0.50$		
20	74.09	163.64	456.93	950.01	1969.07
50	55.26	125.59	384.36	853.91	1855.07
100	41.18	93.82	303.85	726.77	1701.32
500	28.97	46.82	128.76	308.71	854.21
			$\lambda = 0.30, \Delta = 1.00$		
20	35.83	100.73	355.92	834.59	1833.67
50	13.83	34.84	165.09	492.01	1312.43
100	9.56	16.47	57.32	220.11	767.11
500	8.51	9.45	14.15	21.15	45.97
			$\lambda = 0.30, \Delta = 2.00$		
20	5.04	16.35	111.14	374.41	1071.61
50	2.47	3.06	5.83	22.15	110.06
100	2.29	2.59	3.17	3.73	6.33
500	1.87	2.32	2.76	3.10	3.45
			$\lambda = 0.30, \Delta = 3.00$		
20	1.78	2.78	18.10	78.81	326.15
50	1.37	1.50	1.71	1.89	2.25
100	1.31	1.40	1.55	1.67	1.80
500	1.19	1.30	1.41	1.51	1.62

Table 505

Out of Control ARL_0 for ssMEWMA of Dimension 3 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.40, \Delta = 0.25$				
20	89.95	189.39	482.69	969.73	1992.77
50	84.37	180.86	469.70	954.95	1982.52
100	78.04	166.22	447.26	928.04	1974.91
500	61.39	139.34	375.43	798.09	1761.73
	$\lambda = 0.40, \Delta = 0.50$				
20	79.71	176.65	471.01	957.70	1989.01
50	62.05	146.52	425.21	899.28	1925.09
100	49.68	114.03	356.99	802.94	1832.64
500	38.03	61.34	181.79	432.74	1161.57
	$\lambda = 0.40, \Delta = 1.00$				
20	47.86	130.81	424.73	909.90	1965.81
50	20.04	60.51	262.00	658.32	1622.19
100	12.18	27.63	125.76	401.16	1170.75
500	9.28	11.57	20.81	41.88	162.37
	$\lambda = 0.40, \Delta = 2.00$				
20	9.35	40.38	220.17	603.15	1536.99
50	2.64	4.42	22.22	101.37	392.22
100	2.28	2.75	3.61	8.60	49.63
500	1.84	2.30	2.88	3.25	3.78
	$\lambda = 0.40, \Delta = 3.00$				
20	2.09	7.53	60.31	218.98	767.62
50	1.34	1.46	1.86	3.56	20.59
100	1.27	1.35	1.50	1.63	1.79
500	1.21	1.26	1.39	1.46	1.57

Table 506

Out of Control ARL$_0$ for ssMEWMA of Dimension 3 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	91.31	192.05	484.19	979.41	1981.13
50	86.91	181.23	476.99	971.28	1974.33
100	82.15	174.58	458.69	964.11	1947.18
500	63.10	150.51	393.55	864.65	1815.51
			λ = 0.50, Δ = 0.50		
20	83.23	183.77	478.43	982.58	2006.54
50	68.50	159.59	448.17	943.66	1961.35
100	56.24	132.96	397.84	884.48	1901.74
500	33.49	78.61	232.00	559.28	1417.16
			λ = 0.50, Δ = 1.00		
20	60.61	155.35	468.59	983.51	2009.01
50	29.67	88.86	338.91	816.84	1830.44
100	16.33	45.91	210.92	596.24	1521.41
500	8.58	15.14	34.20	93.66	377.12
			λ = 0.50, Δ = 2.00		
20	18.44	76.93	334.05	829.67	1864.26
50	3.51	9.24	67.36	271.48	831.02
100	2.48	3.10	9.33	49.22	237.50
500	1.89	2.55	3.18	3.75	4.63
			λ = 0.50, Δ = 3.00		
20	4.13	19.86	148.55	468.41	1232.80
50	1.37	1.56	4.33	19.49	100.83
100	1.30	1.37	1.73	1.89	6.00
500	1.24	1.26	1.40	1.49	1.63

Table 507

Out of Control ARL_0 for ssMEWMA of Dimension 3 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	92.66	194.31	483.91	1003.25	1999.86
50	87.67	186.85	482.22	994.45	1987.22
100	86.97	179.31	468.45	978.70	1982.10
500	55.67	164.69	412.03	893.49	1859.79
			$\lambda = 0.60, \Delta = 0.50$		
20	87.07	191.03	483.43	1017.77	2021.34
50	74.17	170.19	464.10	978.87	2006.74
100	65.45	148.67	423.71	934.51	1958.20
500	35.44	99.27	270.17	671.53	1581.83
			$\lambda = 0.60, \Delta = 1.00$		
20	71.85	176.65	490.78	1041.82	2073.80
50	40.58	117.23	400.10	928.93	1988.18
100	22.79	69.25	284.32	756.76	1796.53
500	10.91	19.97	56.34	201.28	685.27
			$\lambda = 0.60, \Delta = 2.00$		
20	33.88	119.30	430.88	1005.56	2092.73
50	5.67	21.30	150.36	494.91	1314.61
100	2.89	5.17	29.55	160.56	584.56
500	2.23	2.84	3.75	4.95	6.94
			$\lambda = 0.60, \Delta = 3.00$		
20	9.68	50.11	269.67	721.03	1707.24
50	1.60	3.19	15.74	94.76	348.30
100	1.34	1.46	1.97	5.11	27.85
500	1.19	1.33	1.47	1.61	1.76

Table 508

Out of Control ARL_0 for ssMEWMA of Dimension 3 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	93.27	192.61	493.65	993.79	1954.01
50	91.33	188.87	492.93	994.06	1958.33
100	88.26	184.74	489.26	986.25	1955.82
500	78.39	177.72	456.89	955.13	1882.92
			$\lambda = 0.80, \Delta = 0.50$		
20	92.00	193.89	502.93	1018.71	1977.89
50	84.80	183.14	493.39	1008.00	1994.15
100	75.45	166.31	466.33	994.64	1979.15
500	53.00	130.08	366.43	824.83	1767.55
			$\lambda = 0.80, \Delta = 1.00$		
20	88.28	199.58	538.28	1076.90	2069.31
50	62.72	159.64	498.30	1054.54	2083.24
100	39.96	116.06	418.66	974.52	2016.34
500	19.10	39.84	150.26	476.06	1354.82
			$\lambda = 0.80, \Delta = 2.00$		
20	72.74	192.93	584.00	1192.77	2265.07
50	19.21	78.10	382.74	952.92	2036.25
100	5.85	22.52	178.30	580.24	1503.24
500	4.02	4.25	7.04	25.89	142.89
			$\lambda = 0.80, \Delta = 3.00$		
20	42.21	145.12	534.77	1176.77	2347.21
50	3.91	17.51	154.62	522.25	1314.82
100	1.56	2.71	22.97	112.93	457.48
500	1.45	1.61	1.92	2.22	2.59

Table 509

Out of Control ARL_0 for ssMEWMA of Dimension 4 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05, \Delta = 0.25$				
20	85.34	168.75	437.87	935.79	1974.13
50	71.77	141.54	371.26	819.71	1792.15
100	59.69	109.46	291.29	657.06	1536.32
500	46.14	67.99	134.97	272.95	642.70
	$\lambda = 0.05, \Delta = 0.50$				
20	50.27	99.85	298.68	699.97	1637.59
50	30.49	52.78	149.43	382.40	1002.26
100	23.58	34.20	69.82	164.79	484.32
500	18.07	23.47	31.61	40.97	54.05
	$\lambda = 0.05, \Delta = 1.00$				
20	13.99	22.17	69.55	196.98	624.73
50	9.70	12.14	17.24	26.77	70.88
100	8.69	10.31	12.62	14.65	17.43
500	7.70	9.28	10.75	12.23	13.58
	$\lambda = 0.05, \Delta = 2.00$				
20	4.86	5.83	7.59	10.56	20.16
50	4.07	4.70	5.58	6.29	6.99
100	3.76	4.27	4.96	5.51	6.05
500	3.44	3.94	4.47	4.91	5.33
	$\lambda = 0.05, \Delta = 3.00$				
20	3.17	3.74	4.60	5.34	6.14
50	2.62	2.99	3.51	3.93	4.33
100	2.37	2.66	3.07	3.39	3.71
500	2.22	2.45	2.71	2.97	3.21

Table 510

Out of Control ARL_0 for ssMEWMA of Dimension 4 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	85.83	173.09	452.32	949.30	1971.97
50	72.10	149.39	410.84	885.08	1876.02
100	61.97	125.36	346.24	781.81	1723.91
500	42.42	84.72	197.10	447.85	1088.83
	λ = 0.10, Δ = 0.50				
20	54.66	119.95	353.83	819.29	1800.41
50	34.11	68.93	224.23	558.52	1380.10
100	24.73	43.24	116.41	324.90	897.88
500	20.27	25.46	40.46	63.97	137.17
	λ = 0.10, Δ = 1.00				
20	14.82	32.29	128.40	384.00	1063.83
50	8.70	11.93	24.45	74.59	262.34
100	7.51	9.29	12.11	16.39	47.44
500	7.81	8.10	9.71	11.15	12.63
	λ = 0.10, Δ = 2.00				
20	4.00	4.90	8.42	22.40	93.54
50	3.16	3.64	4.31	4.87	5.42
100	2.91	3.31	3.82	4.25	4.64
500	3.07	3.14	3.48	3.81	4.14
	λ = 0.10, Δ = 3.00				
20	2.48	2.89	3.52	4.14	5.66
50	1.96	2.21	2.53	2.80	3.07
100	1.78	1.98	2.24	2.44	2.66
500	1.77	1.89	2.03	2.19	2.35

Table 511

Out of Control ARL_0 for ssMEWMA of Dimension 4 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.20, \Delta = 0.25$				
20	85.74	179.65	467.12	968.39	1954.17
50	76.33	163.36	445.08	943.54	1935.03
100	67.35	146.64	404.41	878.23	1854.22
500	60.42	101.07	298.80	633.20	1448.12
	$\lambda = 0.20, \Delta = 0.50$				
20	63.29	145.11	415.64	909.98	1891.48
50	42.74	97.87	325.80	769.15	1701.71
100	31.16	67.00	225.84	570.89	1399.41
500	21.19	34.26	76.22	176.60	484.94
	$\lambda = 0.20, \Delta = 1.00$				
20	22.86	63.26	254.17	656.48	1568.30
50	10.14	19.61	78.33	261.46	784.05
100	7.57	10.79	24.29	79.47	296.29
500	7.23	8.34	10.60	13.64	18.31
	$\lambda = 0.20, \Delta = 2.00$				
20	3.61	6.40	33.11	136.06	487.50
50	2.59	3.03	3.96	5.86	19.80
100	2.36	2.69	3.14	3.55	4.10
500	2.28	2.58	2.85	3.14	3.41
	$\lambda = 0.20, \Delta = 3.00$				
20	1.89	2.22	3.98	12.00	70.45
50	1.53	1.69	1.91	2.09	2.29
100	1.42	1.54	1.70	1.84	1.98
500	1.31	1.49	1.57	1.68	1.78

Table 512

Out of Control ARL_0 for ssMEWMA of Dimension 4 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	86.32	184.03	464.89	976.05	1957.78
50	81.13	172.03	451.82	970.84	1951.66
100	72.74	156.50	426.09	917.24	1927.99
500	58.83	131.94	344.13	757.99	1640.82
			$\lambda = 0.30, \Delta = 0.50$		
20	71.33	159.98	436.59	954.06	1935.39
50	51.87	124.04	373.44	871.55	1827.85
100	40.54	89.67	293.09	727.22	1657.60
500	24.98	50.09	128.29	331.85	869.52
			$\lambda = 0.30, \Delta = 1.00$		
20	33.65	95.71	340.77	821.21	1804.68
50	14.39	37.29	159.79	485.78	1252.75
100	9.19	16.78	64.18	220.17	727.34
500	7.00	9.40	14.41	21.77	55.35
			$\lambda = 0.30, \Delta = 2.00$		
20	4.94	16.27	102.79	347.03	1024.60
50	2.50	3.11	6.95	29.63	134.02
100	2.24	2.55	3.12	4.26	11.62
500	1.84	2.30	2.71	3.03	3.35
			$\lambda = 0.30, \Delta = 3.00$		
20	1.84	2.59	14.96	73.51	287.38
50	1.39	1.52	1.72	1.89	2.39
100	1.31	1.40	1.54	1.65	1.77
500	1.14	1.33	1.43	1.50	1.59

Table 513

Out of Control ARL$_0$ for ssMEWMA of Dimension 4 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	89.07	190.23	476.50	968.65	1990.71
50	83.99	180.32	473.07	965.40	1991.69
100	78.75	170.54	454.01	944.19	1971.98
500	64.82	152.21	380.79	829.06	1747.11
			λ = 0.40, Δ = 0.50		
20	77.93	174.53	464.57	962.47	1992.84
50	60.98	143.94	424.57	914.21	1939.95
100	50.35	113.68	355.54	823.31	1826.06
500	35.32	70.15	181.79	456.59	1166.83
			λ = 0.40, Δ = 1.00		
20	46.19	131.26	410.77	908.23	1968.10
50	21.19	61.49	250.36	673.16	1619.56
100	12.80	30.40	123.54	404.30	1143.37
500	10.64	12.30	22.53	53.68	175.93
			λ = 0.40, Δ = 2.00		
20	9.81	37.93	200.09	584.16	1493.61
50	2.72	4.37	24.08	111.01	421.79
100	2.28	2.76	3.83	12.32	66.83
500	2.00	2.41	2.83	3.20	3.64
			λ = 0.40, Δ = 3.00		
20	2.14	7.87	57.49	220.76	732.21
50	1.36	1.49	1.82	6.13	20.14
100	1.28	1.37	1.50	1.63	1.77
500	1.22	1.29	1.38	1.46	1.55

Table 514

Out of Control ARL_0 for ssMEWMA of Dimension 4 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	91.06	192.27	492.52	995.66	2002.58
50	86.71	186.66	480.57	992.65	1990.14
100	83.44	178.13	465.87	974.59	1983.49
500	74.10	156.76	414.24	879.62	1827.22
			$\lambda = 0.50, \Delta = 0.50$		
20	82.64	182.18	487.49	998.72	2021.52
50	68.60	159.97	455.80	968.32	1981.05
100	58.85	133.32	401.14	903.88	1915.95
500	37.33	86.19	240.58	575.71	1412.68
			$\lambda = 0.50, \Delta = 1.00$		
20	58.63	155.21	467.70	987.31	2044.18
50	29.61	90.53	339.56	829.49	1828.70
100	18.57	48.25	205.00	588.92	1487.89
500	9.83	17.40	42.48	107.97	405.00
			$\lambda = 0.50, \Delta = 2.00$		
20	19.30	72.64	315.39	801.15	1820.75
50	3.48	10.57	74.10	261.55	842.44
100	2.58	3.23	12.39	62.17	251.44
500	2.11	2.60	3.11	3.68	6.19
			$\lambda = 0.50, \Delta = 3.00$		
20	4.04	21.63	137.01	439.67	1205.62
50	1.40	1.61	6.01	26.32	130.51
100	1.31	1.42	1.56	1.74	5.55
500	1.18	1.31	1.40	1.50	1.60

Table 515

Out of Control ARL_0 for ssMEWMA of Dimension 4 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	91.69	195.01	497.02	1021.58	2017.61
50	89.26	190.32	488.05	1013.27	2015.60
100	86.32	184.37	479.24	1012.17	2005.35
500	70.09	156.47	438.19	923.75	1935.97
			$\lambda = 0.60, \Delta = 0.50$		
20	86.23	189.82	498.08	1033.24	2038.00
50	74.12	171.45	474.45	1013.82	2032.56
100	64.99	147.63	436.85	981.45	1983.77
500	38.25	99.32	286.60	689.53	1642.41
			$\lambda = 0.60, \Delta = 1.00$		
20	68.88	176.75	498.10	1047.94	2093.68
50	40.44	116.60	403.42	954.99	2010.29
100	25.11	70.77	288.50	780.75	1788.50
500	9.51	24.47	66.87	217.60	722.01
			$\lambda = 0.60, \Delta = 2.00$		
20	32.00	115.48	419.10	996.23	2076.92
50	5.72	27.66	153.85	485.94	1301.71
100	3.09	5.58	38.84	166.01	623.67
500	2.55	2.78	3.71	5.69	14.80
			$\lambda = 0.60, \Delta = 3.00$		
20	10.79	53.74	257.67	705.45	1686.98
50	1.57	3.98	24.38	106.00	389.72
100	1.37	1.53	2.04	9.26	46.71
500	1.39	1.35	1.47	1.63	1.79

Table 516

Out of Control ARL_0 for ssMEWMA of Dimension 4 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	95.93	194.01	502.68	1025.67	2051.09
50	93.37	194.70	498.30	1014.66	2047.46
100	89.78	189.42	491.38	1015.58	2036.36
500	71.81	170.54	457.65	964.80	1999.99
			$\lambda = 0.80, \Delta = 0.50$		
20	93.86	197.07	511.06	1039.94	2074.79
50	85.48	189.08	502.18	1032.14	2090.16
100	76.70	170.51	477.80	1027.40	2073.37
500	64.98	122.06	363.30	835.76	1881.40
			$\lambda = 0.80, \Delta = 1.00$		
20	89.39	202.01	533.41	1096.27	2167.62
50	63.08	163.42	499.89	1076.39	2190.87
100	43.08	116.29	414.30	996.76	2130.89
500	23.36	40.77	153.96	480.42	1398.58
			$\lambda = 0.80, \Delta = 2.00$		
20	69.19	189.93	560.17	1178.38	2350.37
50	22.33	86.40	358.91	925.95	2070.90
100	7.03	29.26	177.25	583.46	1529.85
500	3.04	4.30	9.25	29.00	159.80
			$\lambda = 0.80, \Delta = 3.00$		
20	44.99	147.23	501.28	1141.82	2335.50
50	5.81	24.18	153.71	534.23	1348.71
100	1.84	3.93	24.83	134.28	509.11
500	1.56	1.63	1.96	2.29	3.07

Table 517

Out of Control ARL_0 for ssMEWMA of Dimension 5 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05, \Delta = 0.25$				
20	85.96	169.90	448.59	913.22	1914.22
50	71.14	139.10	379.67	795.47	1721.83
100	58.20	108.28	290.04	660.30	1469.11
500	41.08	70.43	135.66	273.78	615.14
	$\lambda = 0.05, \Delta = 0.50$				
20	47.49	97.75	298.82	678.68	1563.58
50	29.35	50.69	143.80	370.03	972.51
100	22.93	32.98	65.34	157.24	451.04
500	17.49	23.52	30.62	39.35	52.41
	$\lambda = 0.05, \Delta = 1.00$				
20	13.78	21.46	63.34	182.09	548.98
50	9.63	11.59	16.30	27.21	60.58
100	8.45	10.01	12.22	14.13	16.35
500	7.67	8.91	10.45	11.79	13.03
	$\lambda = 0.05, \Delta = 2.00$				
20	4.88	5.86	7.43	9.85	21.37
50	4.05	4.64	5.49	6.14	6.82
100	3.63	4.18	4.85	5.35	5.83
500	3.41	3.81	4.29	4.71	5.12
	$\lambda = 0.05, \Delta = 3.00$				
20	3.22	3.79	4.64	5.35	6.09
50	2.61	2.97	3.48	3.87	4.25
100	2.31	2.62	3.01	3.31	3.61
500	2.07	2.33	2.62	2.87	3.09

Table 518

Out of Control ARL_0 for ssMEWMA of Dimension 5 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	83.18	174.99	457.56	975.30	1999.02
50	71.07	148.98	410.45	908.64	1895.90
100	61.85	123.43	353.68	803.39	1734.01
500	38.24	77.35	202.17	459.69	1101.77
	λ = 0.10, Δ = 0.50				
20	52.36	117.37	354.37	827.06	1792.24
50	32.81	68.05	226.85	568.26	1366.07
100	23.51	42.03	123.24	344.71	916.30
500	19.37	25.97	41.24	65.57	154.39
	λ = 0.10, Δ = 1.00				
20	14.72	31.70	125.56	375.96	1029.04
50	8.50	11.61	24.67	72.81	258.52
100	7.39	8.91	12.29	17.74	51.87
500	7.37	7.78	9.40	10.80	12.24
	λ = 0.10, Δ = 2.00				
20	3.99	4.86	7.83	22.29	98.23
50	3.09	3.57	4.23	4.75	5.61
100	2.82	3.23	3.73	4.11	4.49
500	3.11	2.89	3.35	3.69	3.95
	λ = 0.10, Δ = 3.00				
20	2.49	2.91	3.53	4.19	6.49
50	1.92	2.15	2.49	2.75	3.01
100	1.75	1.94	2.20	2.39	2.58
500	1.81	1.72	1.96	2.13	2.27

Table 519

Out of Control ARL_0 for ssMEWMA of Dimension 5 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.20$, $\Delta = 0.25$				
20	84.18	179.55	477.27	997.61	2027.58
50	74.28	161.04	448.46	953.58	1972.36
100	68.91	144.36	411.52	918.68	1898.71
500	52.78	100.41	285.83	666.18	1496.72
	$\lambda = 0.20$, $\Delta = 0.50$				
20	61.05	142.71	422.09	933.55	1961.22
50	42.58	99.94	317.88	773.95	1727.82
100	30.81	66.55	220.71	602.04	1445.38
500	16.44	36.57	76.90	194.11	515.73
	$\lambda = 0.20$, $\Delta = 1.00$				
20	22.21	62.83	248.21	677.03	1597.73
50	9.73	19.98	81.44	277.50	787.68
100	7.56	10.68	25.78	92.97	318.43
500	6.30	7.92	10.42	13.35	17.86
	$\lambda = 0.20$, $\Delta = 2.00$				
20	3.74	6.32	34.52	143.13	481.92
50	2.53	2.95	3.75	7.07	19.27
100	2.30	2.62	3.06	3.42	3.80
500	2.16	2.38	2.75	3.02	3.26
	$\lambda = 0.20$, $\Delta = 3.00$				
20	1.89	2.34	4.19	17.40	72.59
50	1.49	1.64	1.86	2.05	2.23
100	1.38	1.49	1.66	1.80	1.93
500	1.42	1.42	1.53	1.63	1.72

Table 520

Out of Control ARL_0 for ssMEWMA of Dimension 5 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	84.51	183.20	483.10	974.45	2016.46
50	78.14	169.22	460.51	951.34	1975.64
100	71.57	155.86	442.22	922.06	1944.13
500	55.83	125.98	334.53	749.84	1674.61
	λ = 0.30, Δ = 0.50				
20	68.91	160.94	455.51	950.30	1991.39
50	50.18	119.31	381.47	847.82	1866.33
100	38.15	90.53	304.54	730.64	1677.20
500	18.83	49.55	125.46	318.24	899.21
	λ = 0.30, Δ = 1.00				
20	32.29	92.30	348.76	820.89	1852.51
50	13.81	36.06	163.07	476.49	1268.39
100	8.94	16.41	64.89	232.44	727.77
500	5.25	9.51	14.38	22.95	61.60
	λ = 0.30, Δ = 2.00				
20	4.79	14.97	101.49	349.09	1014.85
50	2.41	3.25	7.51	30.59	139.26
100	2.13	2.53	3.05	4.13	12.08
500	1.44	2.28	2.60	2.86	3.20
	λ = 0.30, Δ = 3.00				
20	1.86	2.82	18.93	77.82	293.69
50	1.36	1.49	1.68	2.80	5.46
100	1.27	1.37	1.50	1.61	1.74
500	1.04	1.32	1.41	1.46	1.55

Table 521

Out of Control ARL_0 for ssMEWMA of Dimension 5 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	88.14	185.01	484.81	975.17	2015.97
50	81.27	177.06	468.95	955.81	2011.77
100	75.15	168.40	457.92	936.71	1993.11
500	79.32	141.00	369.73	808.54	1803.57
	λ = 0.40, Δ = 0.50				
20	76.00	172.00	467.87	961.67	2019.86
50	58.45	142.42	420.17	902.55	1964.45
100	46.32	111.27	356.11	809.04	1833.49
500	30.42	61.68	176.39	441.66	1209.32
	λ = 0.40, Δ = 1.00				
20	43.36	124.64	412.54	915.71	1985.10
50	20.35	59.91	250.13	650.33	1645.54
100	10.93	27.92	128.51	401.05	1168.39
500	8.31	11.48	20.75	46.91	216.36
	λ = 0.40, Δ = 2.00				
20	9.20	36.29	198.45	572.65	1499.33
50	2.79	5.05	25.11	111.59	427.62
100	2.21	2.68	4.12	14.57	75.60
500	2.12	2.22	2.66	3.07	3.55
	λ = 0.40, Δ = 3.00				
20	2.25	8.17	54.31	209.48	709.02
50	1.34	1.48	2.20	8.08	28.51
100	1.25	1.34	1.48	1.60	1.75
500	1.42	1.28	1.37	1.44	1.53

Table 522

Out of Control ARL_0 for ssMEWMA of Dimension 5 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	89.24	189.08	478.66	990.03	1965.38
50	83.41	180.82	471.50	975.92	1969.64
100	80.21	171.27	460.41	959.39	1949.60
500	70.18	156.54	392.49	867.91	1826.46
			$\lambda = 0.50, \Delta = 0.50$		
20	81.32	181.07	472.88	990.66	1984.71
50	65.67	155.32	442.26	954.95	1961.05
100	52.75	127.25	387.75	885.85	1872.03
500	38.65	76.15	229.22	578.81	1405.52
			$\lambda = 0.50, \Delta = 1.00$		
20	55.51	149.67	449.22	994.29	2010.08
50	28.76	85.12	322.32	810.19	1806.66
100	15.79	44.48	192.49	586.38	1464.25
500	8.92	15.07	35.00	106.67	405.01
			$\lambda = 0.50, \Delta = 2.00$		
20	17.52	68.54	300.20	783.27	1763.77
50	3.69	10.19	67.31	261.60	782.38
100	2.48	3.48	12.24	62.84	258.34
500	1.97	2.51	3.06	3.65	4.48
			$\lambda = 0.50, \Delta = 3.00$		
20	4.44	20.90	136.21	438.77	1139.26
50	1.40	1.63	7.24	30.76	129.28
100	1.27	1.39	1.56	2.84	10.83
500	1.17	1.36	1.39	1.49	1.60

Table 523

Out of Control ARL_0 for ssMEWMA of Dimension 5 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	90.70	189.40	491.48	985.40	1980.27
50	87.78	183.50	486.38	963.11	1974.91
100	82.91	176.38	476.45	968.37	1965.52
500	79.98	168.00	424.46	904.82	1891.17
			$\lambda = 0.60, \Delta = 0.50$		
20	85.16	184.59	492.09	994.09	2006.93
50	72.93	164.54	469.09	961.27	1990.27
100	61.87	141.95	430.21	926.10	1947.75
500	38.04	95.75	285.09	683.21	1597.13
			$\lambda = 0.60, \Delta = 1.00$		
20	66.60	165.45	491.30	1013.24	2051.45
50	39.24	110.46	395.89	903.81	1931.80
100	22.37	64.37	278.19	736.45	1703.28
500	10.22	21.64	64.50	203.64	713.67
			$\lambda = 0.60, \Delta = 2.00$		
20	31.56	104.36	399.10	923.18	1986.56
50	5.87	22.61	144.95	453.96	1202.84
100	3.04	5.40	35.78	154.09	555.80
500	2.19	2.76	3.76	4.81	12.34
			$\lambda = 0.60, \Delta = 3.00$		
20	10.65	46.63	242.66	665.45	1587.41
50	1.62	3.28	24.66	110.31	366.00
100	1.36	1.48	3.59	9.70	42.02
500	1.21	1.38	1.50	1.60	1.77

Table 524

Out of Control ARL_0 for ssMEWMA of Dimension 5 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	92.24	192.47	492.89	989.43	1957.50
50	89.95	190.09	490.45	990.86	1959.97
100	87.70	186.02	487.50	990.10	1981.58
500	82.28	177.84	451.03	950.08	1936.73
			λ = 0.80, Δ = 0.50		
20	91.28	194.63	502.91	1010.02	1988.89
50	81.98	183.11	491.46	1005.40	1999.13
100	74.83	168.87	473.56	988.69	2018.92
500	48.04	114.44	355.32	833.34	1843.16
			λ = 0.80, Δ = 1.00		
20	84.49	194.34	526.77	1059.69	2084.49
50	59.15	156.73	490.14	1035.47	2097.91
100	39.72	114.67	412.39	953.44	2040.75
500	13.28	37.53	147.81	470.69	1368.58
			λ = 0.80, Δ = 2.00		
20	63.49	174.20	543.47	1124.63	2258.26
50	18.62	79.85	340.73	841.29	1887.56
100	7.24	26.22	164.68	517.37	1363.56
500	3.00	4.98	8.82	30.95	197.65
			λ = 0.80, Δ = 3.00		
20	41.10	134.69	479.25	1060.31	2230.04
50	4.84	25.95	154.92	476.90	1249.03
100	1.84	4.85	33.16	137.38	501.26
500	1.60	1.50	2.04	2.35	5.08

Table 525

Out of Control ARL_0 for ssMEWMA of Dimension 6 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	81.16	165.44	447.72	927.44	1914.72
50	65.39	130.86	366.25	789.17	1699.32
100	54.45	101.07	276.19	627.14	1414.23
500	42.62	64.54	131.33	248.91	569.77
			$\lambda = 0.05, \Delta = 0.50$		
20	43.11	93.05	285.91	668.03	1494.61
50	26.75	46.26	134.03	338.95	878.93
100	20.55	30.01	63.26	145.21	404.25
500	16.79	22.16	29.51	37.57	51.68
			$\lambda = 0.05, \Delta = 1.00$		
20	12.46	19.25	56.01	162.15	494.55
50	8.98	11.06	14.79	24.24	53.44
100	7.92	9.38	11.53	13.17	15.90
500	7.32	8.51	9.87	11.15	12.20
			$\lambda = 0.05, \Delta = 2.00$		
20	4.74	5.70	7.23	9.52	15.95
50	3.89	4.48	5.33	5.94	6.56
100	3.49	3.97	4.62	5.13	5.61
500	3.04	3.64	4.10	4.49	4.82
			$\lambda = 0.05, \Delta = 3.00$		
20	3.15	3.73	4.55	5.22	5.94
50	2.54	2.90	3.37	3.75	4.11
100	2.27	2.53	2.89	3.18	3.46
500	1.99	2.23	2.50	2.73	2.92

Table 526

Out of Control ARL_0 for ssMEWMA of Dimension 6 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	79.43	170.45	458.37	959.51	1915.04
50	67.81	145.45	406.31	872.06	1804.61
100	57.41	117.57	339.57	758.01	1634.42
500	43.51	77.87	182.90	403.11	953.41
			$\lambda = 0.10, \Delta = 0.50$		
20	48.32	111.13	343.76	783.42	1712.66
50	29.72	61.72	204.28	516.47	1241.28
100	21.98	39.03	111.94	288.87	785.37
500	16.59	21.97	37.96	61.33	132.51
			$\lambda = 0.10, \Delta = 1.00$		
20	13.26	26.78	105.71	332.16	895.30
50	7.95	10.68	20.68	59.38	206.69
100	6.82	8.21	10.88	15.63	34.72
500	5.67	7.07	8.79	10.00	11.31
			$\lambda = 0.10, \Delta = 2.00$		
20	3.85	4.76	7.51	19.50	73.88
50	2.97	3.41	4.03	4.51	4.99
100	2.69	3.04	3.53	3.90	4.24
500	2.47	2.76	3.15	3.45	3.70
			$\lambda = 0.10, \Delta = 3.00$		
20	2.43	2.84	3.44	4.09	6.29
50	1.86	2.09	2.40	2.63	2.86
100	1.70	1.87	2.10	2.28	2.45
500	1.55	1.67	1.88	2.02	2.14

Table 527

Out of Control ARL_0 for ssMEWMA of Dimension 6 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.20, \Delta = 0.25$				
20	82.98	180.39	474.11	971.54	1981.52
50	74.40	165.33	448.55	933.84	1937.26
100	64.19	143.05	402.16	873.20	1857.64
500	36.71	103.78	270.82	610.40	1423.25
	$\lambda = 0.20, \Delta = 0.50$				
20	58.27	139.17	416.77	902.63	1914.49
50	39.57	96.10	315.78	741.07	1651.49
100	27.92	62.54	212.41	551.11	1350.42
500	16.13	30.99	70.45	166.72	475.63
	$\lambda = 0.20, \Delta = 1.00$				
20	20.01	56.12	231.60	620.34	1515.48
50	9.25	17.69	77.62	245.44	733.84
100	6.85	10.08	23.57	81.59	268.64
500	6.02	7.20	9.44	11.93	16.59
	$\lambda = 0.20, \Delta = 2.00$				
20	3.40	5.78	29.00	122.66	447.26
50	2.42	2.79	3.43	5.61	18.28
100	2.19	2.48	2.88	3.21	3.59
500	2.32	2.28	2.55	2.81	3.05
	$\lambda = 0.20, \Delta = 3.00$				
20	1.84	2.21	3.72	11.93	65.75
50	1.47	1.60	1.78	1.95	2.13
100	1.35	1.47	1.61	1.72	1.84
500	1.45	1.34	1.45	1.55	1.65

Table 528

Out of Control ARL_0 for ssMEWMA of Dimension 6 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	86.63	185.36	489.19	1000.30	1995.00
50	79.81	174.38	467.56	983.60	1957.03
100	70.80	158.21	440.35	948.09	1914.79
500	46.17	120.97	339.19	747.50	1661.52
			$\lambda = 0.30, \Delta = 0.50$		
20	68.64	159.00	458.53	967.58	1977.13
50	49.65	123.79	377.05	878.01	1832.96
100	36.66	86.82	297.81	721.54	1624.80
500	19.35	45.88	126.98	313.36	831.33
			$\lambda = 0.30, \Delta = 1.00$		
20	30.62	89.22	331.56	820.39	1802.50
50	12.76	33.92	159.11	471.43	1201.11
100	8.47	16.28	62.18	206.28	647.17
500	5.75	8.52	14.20	22.15	56.48
			$\lambda = 0.30, \Delta = 2.00$		
20	4.46	14.53	91.11	335.34	953.26
50	2.32	2.98	6.81	27.43	122.36
100	2.07	2.36	2.84	4.06	7.59
500	1.88	2.18	2.46	2.72	2.99
			$\lambda = 0.30, \Delta = 3.00$		
20	1.75	3.03	14.76	71.91	281.21
50	1.35	1.46	1.63	1.79	3.33
100	1.26	1.34	1.46	1.57	1.68
500	1.20	1.26	1.35	1.42	1.50

Table 529

Out of Control ARL_0 for ssMEWMA of Dimension 6 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	88.98	185.70	497.49	1001.89	1967.15
50	83.21	179.96	482.33	986.66	1951.33
100	76.03	167.72	461.25	958.75	1924.10
500	54.10	147.62	377.60	820.41	1754.76
			λ = 0.40, Δ = 0.50		
20	75.95	169.98	483.10	988.97	1961.57
50	58.98	141.02	428.57	920.24	1903.40
100	45.86	108.47	359.77	821.45	1761.21
500	26.30	60.89	178.14	441.85	1140.40
			λ = 0.40, Δ = 1.00		
20	44.35	121.10	412.20	923.26	1919.75
50	19.80	55.10	246.15	650.26	1536.14
100	11.65	25.87	124.33	381.31	1046.02
500	7.46	10.92	23.56	51.72	190.70
			λ = 0.40, Δ = 2.00		
20	8.66	33.86	193.92	557.48	1379.63
50	2.60	4.62	25.98	105.58	387.21
100	2.18	2.51	4.49	15.34	64.72
500	2.07	2.18	2.56	2.91	3.35
			λ = 0.40, Δ = 3.00		
20	2.24	6.97	52.04	201.16	640.36
50	1.33	1.46	1.97	5.51	26.91
100	1.26	1.33	1.45	1.56	2.47
500	1.25	1.24	1.33	1.40	1.48

Table 530

Out of Control ARL_0 for ssMEWMA of Dimension 6 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	89.54	188.28	502.11	1004.80	2005.55
50	85.29	184.30	488.83	996.40	1997.87
100	79.07	177.15	481.40	979.58	1986.22
500	63.16	150.38	404.49	874.94	1859.59
			λ = 0.50, Δ = 0.50		
20	80.15	180.68	494.78	1002.13	2012.12
50	66.06	156.07	456.46	968.31	1983.49
100	52.22	126.79	406.72	907.05	1920.30
500	33.48	71.71	242.51	570.25	1420.13
			λ = 0.50, Δ = 1.00		
20	56.03	150.70	462.69	993.72	2040.53
50	27.34	85.02	328.52	800.84	1798.29
100	15.79	44.08	205.85	567.72	1446.17
500	10.44	15.17	38.62	118.14	406.40
			λ = 0.50, Δ = 2.00		
20	16.98	64.66	295.49	755.40	1756.19
50	3.61	10.56	72.36	252.95	744.93
100	2.46	3.32	14.33	64.39	248.10
500	2.29	2.57	2.92	3.53	4.37
			λ = 0.50, Δ = 3.00		
20	4.31	19.81	135.56	399.87	1086.63
50	1.38	1.70	6.62	31.55	124.77
100	1.28	1.37	1.55	2.89	8.22
500	1.36	1.29	1.38	1.45	1.55

Table 531

Out of Control ARL_0 for ssMEWMA of Dimension 6 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	89.49	191.89	499.08	1019.24	2028.35
50	85.30	186.77	490.77	1021.44	2027.79
100	80.59	181.07	491.67	1010.68	2016.65
500	62.05	154.16	434.90	927.98	1898.75
			λ = 0.60, Δ = 0.50		
20	83.28	186.42	497.26	1024.20	2044.39
50	70.82	168.80	473.74	1008.51	2035.64
100	59.83	144.04	444.67	975.44	1985.43
500	32.83	85.85	287.63	680.18	1581.80
			λ = 0.60, Δ = 1.00		
20	66.07	168.98	490.45	1044.38	2093.41
50	37.01	113.71	397.31	911.58	1940.26
100	22.14	65.57	282.80	732.96	1711.43
500	13.50	22.97	67.94	217.90	661.39
			λ = 0.60, Δ = 2.00		
20	28.60	105.04	392.37	938.49	2027.08
50	5.92	24.28	135.67	448.21	1192.26
100	3.04	6.26	40.46	166.29	557.92
500	2.42	2.85	3.73	6.55	18.45
			λ = 0.60, Δ = 3.00		
20	9.85	46.95	230.18	658.09	1570.90
50	1.58	2.65	26.44	113.87	398.85
100	1.37	1.54	2.80	10.42	65.57
500	1.41	1.37	1.48	1.58	1.73

Table 532

Out of Control ARL_0 for ssMEWMA of Dimension 6 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	89.55	190.26	496.46	990.51	2018.30
50	86.06	185.96	489.41	1000.66	2038.58
100	81.40	181.87	485.05	1000.16	2039.04
500	62.39	162.41	464.25	929.27	1984.51
			$\lambda = 0.80, \Delta = 0.50$		
20	88.01	191.81	503.93	1009.44	2057.10
50	77.63	178.98	494.49	1013.19	2072.18
100	67.69	165.23	475.15	996.76	2068.63
500	37.90	108.70	354.92	805.84	1869.15
			$\lambda = 0.80, \Delta = 1.00$		
20	80.71	192.32	527.93	1067.33	2156.07
50	56.95	153.82	479.92	1028.36	2156.18
100	38.68	109.75	403.96	952.69	2092.18
500	13.88	41.57	153.96	459.58	1337.24
			$\lambda = 0.80, \Delta = 2.00$		
20	59.96	170.62	533.70	1138.33	2325.48
50	19.01	77.31	340.95	844.97	1943.99
100	6.47	28.36	167.78	522.90	1403.77
500	2.50	4.52	12.00	47.43	218.83
			$\lambda = 0.80, \Delta = 3.00$		
20	39.93	126.68	460.60	1084.26	2291.90
50	5.48	28.97	161.27	493.02	1298.62
100	1.96	5.00	38.70	161.90	518.61
500	1.31	1.69	2.04	2.40	4.33

Table 533

Out of Control ARL_0 for ssMEWMA of Dimension 7 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	79.42	158.75	414.87	872.84	1825.56
50	63.83	125.19	337.44	736.65	1618.41
100	52.94	96.51	257.27	587.89	1330.80
500	32.38	56.67	117.25	228.76	530.54
			λ = 0.05, Δ = 0.50		
20	41.06	84.84	257.18	599.99	1407.04
50	25.50	44.51	122.71	311.52	813.62
100	20.27	28.87	61.06	133.60	373.85
500	15.86	20.69	27.81	34.26	47.77
			λ = 0.05, Δ = 1.00		
20	11.98	18.24	49.73	141.54	418.89
50	8.71	10.67	14.92	22.13	56.68
100	7.75	9.13	11.11	13.00	15.92
500	7.44	7.95	9.47	10.46	11.52
			λ = 0.05, Δ = 2.00		
20	4.59	5.54	6.98	8.56	13.44
50	3.79	4.39	5.17	5.73	6.34
100	3.40	3.86	4.47	4.92	5.33
500	3.13	3.40	3.92	4.26	4.59
			λ = 0.05, Δ = 3.00		
20	3.11	3.65	4.45	5.09	5.80
50	2.51	2.85	3.32	3.67	4.01
100	2.20	2.47	2.81	3.07	3.33
500	1.99	2.15	2.42	2.61	2.80

Table 534

Out of Control ARL_0 for ssMEWMA of Dimension 7 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.10, \Delta = 0.25$				
20	78.18	164.63	445.65	912.41	1894.28
50	64.77	136.82	382.44	821.09	1761.50
100	54.65	112.33	324.30	715.64	1564.84
500	41.68	72.73	168.33	378.05	921.14
	$\lambda = 0.10, \Delta = 0.50$				
20	45.66	103.46	328.60	736.09	1643.55
50	27.89	57.83	189.71	479.95	1174.86
100	20.45	36.31	105.53	283.58	748.90
500	12.53	22.12	34.30	56.58	127.05
	$\lambda = 0.10, \Delta = 1.00$				
20	12.86	26.06	102.44	292.22	831.65
50	7.67	10.20	21.22	58.72	192.21
100	6.62	8.06	10.48	15.99	38.34
500	5.10	6.83	8.17	9.25	10.43
	$\lambda = 0.10, \Delta = 2.00$				
20	3.71	4.53	6.81	16.54	64.94
50	2.89	3.32	3.88	4.33	4.81
100	2.60	2.95	3.37	3.70	4.02
500	2.37	2.67	2.99	3.24	3.49
	$\lambda = 0.10, \Delta = 3.00$				
20	2.38	2.77	3.34	4.10	5.56
50	1.84	2.05	2.34	2.57	2.79
100	1.65	1.82	2.03	2.19	2.35
500	1.55	1.66	1.80	1.91	2.03

Table 535

Out of Control ARL_0 for ssMEWMA of Dimension 7 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.20, \Delta = 0.25$				
20	81.49	176.16	463.94	974.88	1986.28
50	71.03	158.23	428.56	925.74	1926.79
100	61.92	138.60	383.55	855.75	1844.71
500	45.08	95.95	249.75	585.00	1379.13
	$\lambda = 0.20, \Delta = 0.50$				
20	56.52	134.27	398.84	886.62	1893.55
50	36.81	91.65	287.95	710.15	1620.24
100	26.10	60.34	200.44	528.97	1292.72
500	11.42	30.15	66.70	154.73	428.99
	$\lambda = 0.20, \Delta = 1.00$				
20	19.09	54.66	219.47	586.06	1461.64
50	8.74	16.61	66.42	229.48	686.45
100	6.49	9.26	22.65	73.49	260.48
500	4.37	6.11	8.46	10.77	16.62
	$\lambda = 0.20, \Delta = 2.00$				
20	3.26	5.78	27.80	115.54	421.50
50	2.33	2.70	3.50	5.51	21.23
100	2.10	2.39	2.74	3.03	3.38
500	1.67	2.06	2.40	2.60	2.86
	$\lambda = 0.20, \Delta = 3.00$				
20	1.80	2.15	3.84	15.63	57.31
50	1.43	1.58	1.76	1.91	2.07
100	1.34	1.44	1.57	1.66	1.77
500	1.03	1.33	1.42	1.50	1.59

Table 536

Out of Control ARL$_0$ for ssMEWMA of Dimension 7 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	84.19	181.29	480.01	995.30	1994.19
50	76.74	171.37	461.29	959.12	1977.49
100	69.16	153.60	425.25	918.53	1908.39
500	43.96	110.56	308.99	706.68	1587.63
			λ = 0.30, Δ = 0.50		
20	66.14	155.00	443.99	948.89	1963.13
50	47.26	116.98	366.04	829.54	1813.81
100	35.65	82.58	275.42	689.50	1582.66
500	26.57	43.10	106.30	280.53	769.45
			λ = 0.30, Δ = 1.00		
20	29.82	88.25	329.32	780.61	1739.42
50	12.06	31.98	144.78	439.57	1124.51
100	7.90	15.27	57.84	203.50	626.31
500	6.48	7.44	11.75	20.25	59.36
			λ = 0.30, Δ = 2.00		
20	4.52	13.97	91.66	298.73	871.52
50	2.25	2.91	8.72	30.76	125.67
100	2.01	2.29	2.72	4.15	14.15
500	2.03	1.93	2.26	2.52	2.80
			λ = 0.30, Δ = 3.00		
20	1.69	2.53	15.18	63.39	262.37
50	1.33	1.44	1.62	1.87	3.26
100	1.26	1.35	1.44	1.53	1.62
500	1.25	1.23	1.32	1.40	1.46

Table 537

Out of Control ARL_0 for ssMEWMA of Dimension 7 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.40, \Delta = 0.25$				
20	87.60	187.77	485.89	999.45	2028.88
50	80.79	178.11	473.60	989.87	2009.08
100	72.83	162.43	448.19	963.27	1972.27
500	66.35	120.93	345.72	814.62	1751.94
	$\lambda = 0.40, \Delta = 0.50$				
20	73.56	168.79	469.63	988.44	2027.42
50	55.29	136.97	408.64	919.43	1936.12
100	42.71	104.86	337.07	809.01	1785.97
500	36.33	51.50	163.31	406.69	1119.85
	$\lambda = 0.40, \Delta = 1.00$				
20	42.38	118.98	397.93	897.81	1929.07
50	18.25	53.79	235.55	626.73	1496.67
100	11.06	25.58	111.95	372.24	1038.91
500	8.51	9.86	18.88	47.37	176.98
	$\lambda = 0.40, \Delta = 2.00$				
20	8.75	33.66	176.06	516.23	1342.47
50	2.72	4.93	28.13	105.78	377.68
100	2.11	2.43	4.06	15.67	85.37
500	1.65	2.02	2.37	2.69	3.11
	$\lambda = 0.40, \Delta = 3.00$				
20	2.07	7.04	51.64	190.80	603.28
50	1.32	1.46	2.11	7.65	33.82
100	1.26	1.33	1.43	1.53	2.37
500	1.11	1.24	1.31	1.38	1.46

Table 538

Out of Control ARL_0 for ssMEWMA of Dimension 7 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
	λ = 0.50, Δ = 0.25				
20	88.63	189.77	505.23	1012.20	2029.04
50	83.56	180.97	491.96	1000.37	2030.69
100	76.92	170.28	479.34	982.89	2001.64
500	57.50	142.02	389.86	861.97	1849.26
	λ = 0.50, Δ = 0.50				
20	79.17	179.32	501.62	1004.87	2051.14
50	64.09	150.13	457.77	962.82	2002.55
100	50.38	120.60	397.52	876.16	1902.40
500	32.43	70.13	211.71	526.60	1386.91
	λ = 0.50, Δ = 1.00				
20	54.06	142.47	464.44	977.78	2039.18
50	27.29	78.87	313.84	760.34	1758.14
100	15.39	40.92	188.92	528.68	1378.89
500	9.26	12.25	31.55	96.97	387.91
	λ = 0.50, Δ = 2.00				
20	16.44	60.47	285.72	725.47	1713.81
50	3.84	11.45	67.32	232.50	702.32
100	2.27	3.36	14.33	65.60	252.93
500	2.18	2.24	2.73	3.34	5.80
	λ = 0.50, Δ = 3.00				
20	4.07	18.48	123.51	368.52	1076.94
50	1.38	1.81	8.11	34.67	134.00
100	1.29	1.39	1.65	2.17	9.95
500	1.23	1.26	1.37	1.44	1.53

Table 539

Out of Control ARL_0 for ssMEWMA of Dimension 7 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	89.43	193.86	505.43	1036.49	2013.28
50	86.70	188.27	501.27	1028.02	2005.61
100	80.06	180.21	490.17	1018.01	1980.25
500	55.00	152.47	410.61	908.09	1864.18
			λ = 0.60, Δ = 0.50		
20	82.69	187.74	506.24	1045.72	2025.57
50	70.63	165.01	481.48	1017.54	2005.96
100	57.23	138.80	438.26	956.77	1925.30
500	32.92	84.58	263.13	643.56	1526.43
			λ = 0.60, Δ = 1.00		
20	63.75	165.59	493.83	1057.07	2060.95
50	35.79	104.70	381.44	902.63	1891.54
100	20.83	60.82	262.49	707.38	1616.66
500	7.79	15.68	58.36	189.36	642.74
			λ = 0.60, Δ = 2.00		
20	27.45	99.65	391.51	928.54	1936.84
50	5.65	25.12	137.69	434.53	1080.77
100	2.80	6.18	41.14	156.19	504.14
500	2.27	2.59	3.48	5.43	16.90
			λ = 0.60, Δ = 3.00		
20	9.65	43.75	232.68	635.88	1498.99
50	1.62	3.20	28.70	110.73	368.98
100	1.39	1.68	2.52	11.80	56.08
500	1.27	1.33	1.49	1.60	1.71

Table 540

Out of Control ARL_0 for ssMEWMA of Dimension 7 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	92.82	195.24	499.47	1019.20	2025.31
50	89.69	192.18	502.08	1014.46	2029.56
100	87.28	187.03	496.26	1005.42	2017.60
500	69.44	160.88	458.14	940.31	1964.10
			$\lambda = 0.80, \Delta = 0.50$		
20	91.20	195.28	509.77	1036.43	2062.25
50	80.42	181.65	502.18	1037.96	2068.98
100	69.83	165.07	474.66	995.80	2050.03
500	54.09	107.20	350.72	802.59	1804.83
			$\lambda = 0.80, \Delta = 1.00$		
20	83.91	195.08	531.23	1086.46	2139.74
50	57.27	152.15	481.17	1043.76	2134.98
100	36.11	109.49	396.64	922.25	1984.86
500	15.38	35.07	131.03	433.52	1266.81
			$\lambda = 0.80, \Delta = 2.00$		
20	59.76	170.08	536.88	1129.29	2285.27
50	21.76	76.25	334.32	844.94	1884.97
100	6.30	25.16	160.88	504.28	1296.57
500	5.14	4.74	9.41	40.51	210.61
			$\lambda = 0.80, \Delta = 3.00$		
20	39.00	128.87	463.94	1076.95	2241.17
50	7.78	27.93	169.82	499.70	1266.24
100	1.94	4.38	40.96	167.66	542.76
500	1.33	1.66	1.98	2.98	4.53

Table 541

Out of Control ARL_0 for ssMEWMA of Dimension 8 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	λ = 0.05, Δ = 0.25				
20	74.28	151.13	406.23	887.09	1857.10
50	59.33	115.90	317.31	724.25	1579.54
100	50.29	89.58	235.92	546.41	1259.22
500	37.80	57.99	112.67	221.92	494.49
	λ = 0.05, Δ = 0.50				
20	37.65	79.67	237.16	585.81	1364.88
50	24.69	41.53	109.00	285.47	745.64
100	19.28	27.02	50.99	119.81	342.07
500	17.18	19.10	26.39	32.60	44.93
	λ = 0.05, Δ = 1.00				
20	11.27	17.51	44.79	128.89	384.47
50	8.36	10.05	13.39	23.21	50.57
100	7.41	8.65	10.35	11.94	14.88
500	7.25	7.68	9.00	9.95	10.86
	λ = 0.05, Δ = 2.00				
20	4.49	5.33	6.70	8.52	13.13
50	3.69	4.20	4.94	5.52	6.06
100	3.28	3.69	4.26	4.67	5.08
500	3.12	3.24	3.73	4.06	4.34
	λ = 0.05, Δ = 3.00				
20	3.05	3.58	4.33	4.95	5.60
50	2.45	2.76	3.21	3.56	3.89
100	2.13	2.38	2.69	2.95	3.18
500	2.01	2.08	2.34	2.51	2.67

Table 542

Out of Control ARL_0 for ssMEWMA of Dimension 8 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	73.43	159.15	441.79	933.45	1941.04
50	60.36	129.92	369.90	817.23	1762.41
100	51.21	105.05	302.85	681.55	1563.54
500	38.20	75.53	166.21	367.79	850.77
			$\lambda = 0.10, \Delta = 0.50$		
20	41.33	97.33	313.02	721.60	1630.20
50	25.90	54.99	174.15	453.05	1128.76
100	20.41	34.11	99.24	252.34	683.23
500	14.93	22.35	34.01	54.50	115.23
			$\lambda = 0.10, \Delta = 1.00$		
20	11.43	23.71	94.47	282.04	805.53
50	7.27	9.72	19.64	54.53	181.74
100	6.39	7.62	10.21	16.65	36.20
500	6.40	6.47	7.81	8.83	9.83
			$\lambda = 0.10, \Delta = 2.00$		
20	3.64	4.41	6.64	16.25	59.56
50	2.82	3.20	3.73	4.14	4.82
100	2.55	2.83	3.22	3.54	3.83
500	2.78	2.61	2.90	3.10	3.33
			$\lambda = 0.10, \Delta = 3.00$		
20	2.33	2.71	3.24	3.75	5.43
50	1.82	2.01	2.29	2.49	2.70
100	1.64	1.78	1.98	2.13	2.28
500	1.78	1.65	1.77	1.88	1.99

Table 543

Out of Control ARL_0 for ssMEWMA of Dimension 8 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	76.98	168.84	458.97	977.25	1965.28
50	66.24	144.37	424.37	922.45	1890.65
100	56.95	126.52	371.47	832.10	1762.20
500	53.43	85.06	254.43	561.55	1276.53
			λ = 0.20, Δ = 0.50		
20	52.04	124.39	386.27	885.24	1854.94
50	33.85	81.56	283.14	678.87	1519.98
100	25.39	54.55	188.74	487.05	1176.66
500	18.78	29.79	64.10	147.48	382.24
			λ = 0.20, Δ = 1.00		
20	16.44	48.45	209.57	570.32	1356.12
50	8.07	15.75	65.94	211.24	604.21
100	6.45	9.28	21.74	70.73	224.73
500	6.22	6.32	8.74	10.89	15.52
			λ = 0.20, Δ = 2.00		
20	3.18	5.42	24.50	106.04	360.37
50	2.28	2.61	3.18	5.91	15.11
100	2.06	2.31	2.65	2.94	3.22
500	2.22	2.13	2.39	2.59	2.74
			λ = 0.20, Δ = 3.00		
20	1.77	2.09	3.51	13.66	49.01
50	1.43	1.55	1.72	1.86	2.01
100	1.33	1.43	1.55	1.65	1.73
500	1.38	1.34	1.44	1.51	1.56

Table 544

Out of Control ARL$_0$ for ssMEWMA of Dimension 8 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	81.13	173.73	474.90	984.94	1970.07
50	71.59	160.21	451.73	946.95	1928.31
100	64.78	145.42	416.83	890.77	1840.22
500	48.39	104.27	304.54	647.28	1485.49
	λ = 0.30, Δ = 0.50				
20	60.79	143.26	438.72	937.05	1940.19
50	43.17	105.82	353.72	807.12	1732.43
100	33.13	74.49	260.88	637.40	1481.90
500	21.83	36.83	110.10	260.02	709.99
	λ = 0.30, Δ = 1.00				
20	26.65	77.36	307.02	761.81	1700.77
50	11.49	29.53	134.29	404.47	1061.18
100	7.83	14.06	57.07	186.31	575.43
500	4.46	7.35	11.46	18.60	57.55
	λ = 0.30, Δ = 2.00				
20	4.10	12.81	76.87	280.56	814.31
50	2.19	2.73	6.56	28.54	108.35
100	1.99	2.21	2.69	4.32	13.61
500	1.50	1.99	2.27	2.47	2.68
	λ = 0.30, Δ = 3.00				
20	1.67	2.27	10.59	58.51	238.74
50	1.31	1.41	1.73	1.84	5.39
100	1.26	1.32	1.43	1.50	1.60
500	1.13	1.24	1.33	1.38	1.45

Table 545

Out of Control ARL_0 for ssMEWMA of Dimension 8 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.40, \Delta = 0.25$				
20	84.06	177.49	491.89	988.81	1953.43
50	75.91	167.31	467.31	954.67	1933.74
100	70.32	153.41	441.41	925.24	1897.04
500	42.59	116.12	332.58	727.28	1599.31
	$\lambda = 0.40, \Delta = 0.50$				
20	69.01	158.55	472.15	974.86	1957.35
50	51.56	122.78	399.71	870.37	1834.09
100	39.48	96.25	329.03	754.15	1656.56
500	18.06	48.70	150.25	373.04	962.82
	$\lambda = 0.40, \Delta = 1.00$				
20	38.38	107.14	388.12	870.46	1854.89
50	16.65	47.68	219.45	579.68	1385.56
100	10.61	24.37	114.05	340.00	933.71
500	4.60	9.20	17.92	39.44	150.85
	$\lambda = 0.40, \Delta = 2.00$				
20	7.53	27.33	166.56	480.11	1227.29
50	2.46	4.42	21.94	89.50	337.05
100	2.03	2.42	4.93	16.62	65.72
500	1.63	2.08	2.35	2.64	2.95
	$\lambda = 0.40, \Delta = 3.00$				
20	1.95	5.58	45.34	178.92	580.56
50	1.31	1.42	2.08	7.02	27.64
100	1.26	1.31	1.42	1.51	1.89
500	1.00	1.21	1.31	1.38	1.42

Table 546

Out of Control ARL_0 for ssMEWMA of Dimension 8 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	87.58	184.97	495.74	1003.19	1984.48
50	80.24	173.18	484.24	984.76	1964.84
100	74.65	163.38	463.23	960.85	1950.24
500	39.42	130.38	364.66	807.20	1712.41
			λ = 0.50, Δ = 0.50		
20	76.05	174.09	492.07	1010.02	2001.48
50	60.59	141.22	439.58	934.29	1915.41
100	48.29	114.02	372.87	843.90	1807.73
500	24.37	61.00	192.57	499.69	1214.36
			λ = 0.50, Δ = 1.00		
20	50.55	136.00	450.37	968.97	1984.81
50	23.82	73.96	305.43	733.61	1646.58
100	14.44	38.22	178.11	501.15	1264.00
500	11.52	11.77	31.26	90.41	337.13
			λ = 0.50, Δ = 2.00		
20	14.20	56.52	269.05	696.15	1597.46
50	3.41	9.66	63.53	229.25	671.87
100	2.30	3.29	14.90	58.27	217.29
500	2.00	2.24	2.71	3.13	5.40
			λ = 0.50, Δ = 3.00		
20	3.51	17.04	113.99	363.44	991.76
50	1.38	1.97	7.06	30.93	115.50
100	1.29	1.38	1.54	2.66	10.10
500	1.13	1.25	1.36	1.42	1.51

Table 547

Out of Control ARL_0 for ssMEWMA of Dimension 8 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	89.21	187.49	496.71	1015.10	1983.97
50	82.81	178.05	480.02	999.00	1987.94
100	77.85	170.43	460.23	980.49	1973.00
500	64.39	144.95	384.60	867.11	1811.26
			$\lambda = 0.60, \Delta = 0.50$		
20	81.02	181.29	499.43	1028.28	2017.13
50	67.23	156.32	453.42	973.93	1976.30
100	55.72	131.14	403.32	917.64	1893.16
500	29.47	75.23	233.54	606.14	1428.44
			$\lambda = 0.60, \Delta = 1.00$		
20	61.49	158.49	482.91	1035.90	2066.86
50	33.75	100.45	363.68	847.92	1826.65
100	19.69	58.25	247.70	651.62	1545.07
500	7.45	16.32	54.11	189.71	614.95
			$\lambda = 0.60, \Delta = 2.00$		
20	26.83	91.10	367.42	885.95	1899.20
50	5.63	20.98	132.34	415.38	1079.92
100	2.73	5.73	37.29	148.45	491.83
500	1.95	2.61	3.32	4.97	15.06
			$\lambda = 0.60, \Delta = 3.00$		
20	8.40	38.00	212.41	605.83	1477.09
50	1.60	3.26	25.37	105.78	350.43
100	1.38	1.50	2.65	11.90	57.52
500	1.18	1.31	1.45	1.55	1.68

Table 548

Out of Control ARL$_0$ for ssMEWMA of Dimension 8 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	89.36	193.22	501.32	1006.85	2004.21
50	86.56	185.83	492.08	994.19	1999.30
100	82.49	180.18	479.04	975.31	2005.64
500	76.91	159.01	429.33	914.62	1946.23
	λ = 0.80, Δ = 0.50				
20	87.82	192.70	511.45	1024.33	2048.30
50	76.82	173.98	491.69	1011.54	2044.48
100	66.42	157.15	462.10	966.76	2034.75
500	47.48	108.18	328.08	761.46	1769.64
	λ = 0.80, Δ = 1.00				
20	80.39	188.13	534.84	1076.26	2142.40
50	53.59	145.27	461.45	999.65	2083.77
100	36.00	103.74	373.76	881.10	1946.07
500	9.87	36.00	137.04	416.32	1190.80
	λ = 0.80, Δ = 2.00				
20	55.80	163.87	527.22	1111.14	2257.36
50	18.87	74.02	323.46	807.53	1843.60
100	7.44	27.05	156.64	496.00	1289.97
500	2.33	4.29	10.70	38.40	180.08
	λ = 0.80, Δ = 3.00				
20	33.79	119.76	466.08	1031.24	2200.99
50	6.12	25.67	161.13	493.23	1219.00
100	1.98	5.44	37.78	150.07	503.23
500	1.22	1.69	2.10	2.45	6.17

Table 549

Out of Control ARL_0 for ssMEWMA of Dimension 9 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05, \Delta = 0.25$				
20	67.61	139.93	394.28	866.21	1809.63
50	54.85	107.61	303.85	698.50	1511.67
100	46.27	85.55	222.61	520.30	1207.21
500	33.08	57.23	104.75	194.07	447.73
	$\lambda = 0.05, \Delta = 0.50$				
20	34.01	68.24	216.43	536.62	1283.52
50	22.36	37.71	100.03	256.05	669.87
100	17.81	25.00	48.16	107.20	303.90
500	13.30	19.02	23.94	29.55	39.14
	$\lambda = 0.05, \Delta = 1.00$				
20	10.33	15.52	37.70	110.50	334.79
50	7.75	9.45	12.62	21.06	44.81
100	6.78	8.06	9.76	11.17	13.22
500	6.10	7.25	8.34	9.24	10.09
	$\lambda = 0.05, \Delta = 2.00$				
20	4.25	5.09	6.33	7.81	12.06
50	3.49	4.03	4.69	5.21	5.74
100	3.06	3.48	4.00	4.40	4.78
500	2.91	3.23	3.52	3.81	4.07
	$\lambda = 0.05, \Delta = 3.00$				
20	2.92	3.45	4.17	4.78	5.40
50	2.37	2.67	3.07	3.40	3.73
100	2.05	2.28	2.59	2.81	3.03
500	1.87	2.10	2.23	2.40	2.53

Table 550

Out of Control ARL_0 for ssMEWMA of Dimension 9 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	68.49	150.34	430.76	916.16	1933.56
50	55.71	120.42	364.36	793.46	1744.01
100	48.10	98.27	288.20	662.05	1511.46
500	42.50	66.33	158.03	337.97	826.87
	λ = 0.10, Δ = 0.50				
20	37.18	87.49	288.94	688.65	1585.59
50	23.40	48.17	163.63	411.11	1079.38
100	18.07	29.24	87.82	227.25	643.27
500	13.96	18.97	29.61	46.75	109.34
	λ = 0.10, Δ = 1.00				
20	10.37	20.24	79.15	245.51	726.18
50	6.64	8.79	18.80	47.04	167.51
100	5.69	6.94	9.04	13.64	35.96
500	5.05	6.03	7.29	8.14	9.17
	λ = 0.10, Δ = 2.00				
20	3.40	4.08	5.86	12.81	44.09
50	2.65	3.02	3.52	3.89	4.30
100	2.40	2.67	3.05	3.31	3.59
500	2.10	2.46	2.76	2.92	3.16
	λ = 0.10, Δ = 3.00				
20	2.23	2.59	3.10	3.53	4.12
50	1.75	1.95	2.19	2.38	2.58
100	1.58	1.72	1.91	2.05	2.19
500	1.46	1.57	1.73	1.81	1.91

Table 551

Out of Control ARL_0 for ssMEWMA of Dimension 9 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	75.71	167.87	460.40	950.27	1975.53
50	64.56	144.15	414.85	892.11	1859.44
100	56.43	122.65	366.40	811.20	1731.42
500	39.35	86.88	235.35	541.03	1235.52
	λ = 0.20, Δ = 0.50				
20	49.97	121.74	384.52	851.76	1821.48
50	32.26	76.20	265.53	639.87	1476.73
100	23.15	48.67	171.86	462.20	1148.32
500	16.15	26.77	58.00	139.50	369.71
	λ = 0.20, Δ = 1.00				
20	16.14	44.09	193.87	537.68	1324.04
50	7.59	14.10	58.31	194.23	562.85
100	5.82	7.88	18.43	57.99	207.06
500	5.26	5.88	7.57	9.37	15.42
	λ = 0.20, Δ = 2.00				
20	2.95	4.47	17.13	82.66	319.80
50	2.19	2.50	3.02	4.35	15.20
100	1.99	2.22	2.51	2.76	4.15
500	1.79	1.96	2.24	2.42	2.62
	λ = 0.20, Δ = 3.00				
20	1.72	1.97	2.89	7.47	30.47
50	1.40	1.52	1.69	1.82	1.95
100	1.32	1.41	1.51	1.59	1.68
500	1.21	1.29	1.38	1.45	1.53

Table 552

Out of Control ARL$_0$ for ssMEWMA of Dimension 9 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	78.75	173.30	462.97	978.28	1965.27
50	68.97	155.66	436.40	929.02	1917.33
100	64.11	136.87	398.32	875.67	1827.98
500	69.94	101.71	286.72	656.43	1456.46
			λ = 0.30, Δ = 0.50		
20	59.83	140.42	420.76	925.67	1915.77
50	40.80	100.41	334.18	765.42	1683.24
100	30.15	68.90	246.13	615.72	1451.93
500	25.33	38.14	99.68	245.72	687.47
			λ = 0.30, Δ = 1.00		
20	25.31	75.11	297.95	731.20	1646.08
50	10.78	28.65	128.87	373.13	995.78
100	7.19	12.40	48.09	169.75	542.90
500	6.88	7.80	10.73	17.34	54.34
			λ = 0.30, Δ = 2.00		
20	3.95	10.71	69.32	254.54	775.86
50	2.18	2.54	5.99	25.82	98.91
100	1.93	2.11	2.50	3.45	9.74
500	2.07	1.89	2.17	2.35	2.57
			λ = 0.30, Δ = 3.00		
20	1.68	2.30	9.47	50.77	199.69
50	1.32	1.42	1.56	1.99	5.43
100	1.28	1.31	1.41	1.49	1.57
500	1.23	1.26	1.32	1.35	1.40

Table 553

Out of Control ARL_0 for ssMEWMA of Dimension 9 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	81.62	176.04	471.03	987.70	1979.39
50	73.09	164.66	447.05	963.29	1940.31
100	65.83	146.05	412.87	916.13	1854.10
500	61.03	107.26	319.97	737.65	1574.73
			$\lambda = 0.40, \Delta = 0.50$		
20	65.30	156.21	448.63	960.44	1978.86
50	47.79	119.91	370.51	854.03	1796.46
100	36.88	87.88	297.83	729.32	1613.34
500	22.84	49.79	137.30	373.23	959.96
			$\lambda = 0.40, \Delta = 1.00$		
20	35.33	103.23	360.88	855.27	1844.92
50	16.17	47.80	202.02	543.02	1320.94
100	9.31	22.67	100.51	322.52	877.71
500	7.77	10.31	17.28	42.30	148.81
			$\lambda = 0.40, \Delta = 2.00$		
20	6.83	28.43	150.89	467.54	1199.49
50	2.43	4.59	22.67	94.46	315.86
100	1.95	2.30	3.93	14.81	67.24
500	1.93	2.01	2.27	2.55	2.87
			$\lambda = 0.40, \Delta = 3.00$		
20	2.04	6.30	41.04	161.57	504.43
50	1.33	1.44	2.03	6.86	31.14
100	1.26	1.32	1.41	1.51	2.56
500	1.25	1.29	1.30	1.37	1.40

Table 554

Out of Control ARL_0 for ssMEWMA of Dimension 9 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	85.23	182.76	480.66	998.79	1983.99
50	77.15	171.59	459.27	978.64	1968.40
100	67.68	156.34	435.03	946.68	1899.92
500	62.90	118.20	341.43	785.67	1692.04
			$\lambda = 0.50, \Delta = 0.50$		
20	72.90	170.52	468.66	998.58	1984.67
50	55.10	136.19	410.27	918.27	1873.54
100	44.18	108.85	342.86	817.89	1727.72
500	33.63	62.25	179.70	491.82	1184.79
			$\lambda = 0.50, \Delta = 1.00$		
20	47.29	133.42	420.16	953.99	1961.74
50	23.57	70.00	276.60	709.93	1569.60
100	13.72	36.49	160.11	483.65	1200.22
500	11.13	12.97	30.48	93.73	331.73
			$\lambda = 0.50, \Delta = 2.00$		
20	14.05	56.01	250.44	677.00	1571.19
50	3.18	9.52	62.70	213.70	669.25
100	2.26	3.34	13.27	53.68	225.11
500	1.74	2.03	2.61	3.33	5.91
			$\lambda = 0.50, \Delta = 3.00$		
20	3.83	15.06	107.04	343.76	945.50
50	1.43	1.82	8.31	40.37	147.62
100	1.29	1.39	1.53	3.95	22.54
500	1.07	1.33	1.36	1.44	1.49

Table 555

Out of Control ARL_0 for ssMEWMA of Dimension 9 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	86.45	186.90	491.53	993.89	2004.81
50	80.60	177.55	473.27	980.92	1984.86
100	74.55	162.37	455.31	961.34	1952.28
500	53.71	120.03	368.35	819.63	1782.85
			λ = 0.60, Δ = 0.50		
20	78.19	180.46	489.50	1012.94	2036.93
50	61.94	149.72	444.63	949.13	1965.75
100	50.17	123.02	389.41	878.99	1861.58
500	39.98	68.61	230.48	568.57	1389.91
			λ = 0.60, Δ = 1.00		
20	58.37	154.13	473.14	1009.93	2062.56
50	32.16	93.84	349.93	805.44	1790.66
100	18.54	52.61	228.83	619.30	1498.84
500	10.75	18.14	52.22	161.75	565.52
			λ = 0.60, Δ = 2.00		
20	25.55	91.24	353.36	846.57	1893.36
50	5.33	21.83	126.93	381.35	1043.78
100	3.02	5.73	35.86	142.08	467.17
500	1.96	2.23	3.89	4.77	17.62
			λ = 0.60, Δ = 3.00		
20	8.69	38.84	203.64	563.54	1451.27
50	1.78	4.11	28.88	107.51	344.36
100	1.38	1.58	2.52	16.60	80.48
500	1.25	1.43	1.46	1.57	1.67

Table 556

Out of Control ARL_0 for ssMEWMA of Dimension 9 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	88.82	193.55	487.33	983.32	1973.03
50	83.62	185.71	481.30	981.20	1970.68
100	79.44	173.84	475.42	970.61	1969.43
500	73.05	151.05	402.52	896.86	1864.32
			$\lambda = 0.80, \Delta = 0.50$		
20	86.59	193.34	499.50	1016.64	2015.21
50	72.93	172.57	480.90	983.94	1993.83
100	63.28	150.04	442.55	947.64	1969.44
500	40.38	96.89	293.06	723.06	1652.25
			$\lambda = 0.80, \Delta = 1.00$		
20	76.76	191.45	520.69	1071.14	2112.81
50	50.90	143.72	444.92	978.47	2016.38
100	33.83	98.92	355.82	848.68	1857.04
500	9.94	31.11	122.15	378.73	1086.80
			$\lambda = 0.80, \Delta = 2.00$		
20	55.65	161.60	505.32	1095.66	2206.99
50	19.47	72.34	306.98	762.05	1747.65
100	7.50	25.44	146.28	445.04	1191.34
500	2.95	4.23	8.87	42.80	202.41
			$\lambda = 0.80, \Delta = 3.00$		
20	32.68	113.67	436.96	1023.05	2144.59
50	7.92	27.07	150.41	471.00	1163.75
100	2.04	5.18	47.96	172.24	542.13
500	1.00	1.90	2.06	2.38	9.25

Table 557

Out of Control ARL_0 for ssMEWMA of Dimension 10 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05$, $\Delta = 0.25$				
20	65.83	139.35	374.05	799.61	1740.66
50	51.68	104.33	285.38	632.68	1420.93
100	42.01	78.59	208.08	470.12	1113.60
500	37.46	47.19	94.81	183.39	423.95
	$\lambda = 0.05$, $\Delta = 0.50$				
20	32.39	67.86	199.87	485.48	1191.08
50	20.66	35.84	96.95	236.43	635.92
100	16.56	23.43	46.78	97.61	291.25
500	15.69	17.97	22.73	28.07	39.53
	$\lambda = 0.05$, $\Delta = 1.00$				
20	10.01	14.70	37.19	98.58	307.74
50	7.54	9.09	12.01	17.38	41.39
100	6.50	7.69	9.18	10.37	12.68
500	6.43	6.91	7.86	8.71	9.55
	$\lambda = 0.05$, $\Delta = 2.00$				
20	4.26	5.09	6.32	7.74	10.69
50	3.45	3.95	4.60	5.09	5.59
100	3.01	3.37	3.85	4.20	4.56
500	2.88	3.03	3.39	3.68	3.91
	$\lambda = 0.05$, $\Delta = 3.00$				
20	2.94	3.47	4.16	4.72	5.33
50	2.35	2.65	3.04	3.35	3.66
100	2.04	2.23	2.51	2.71	2.92
500	2.03	1.95	2.17	2.32	2.45

Table 558

Out of Control ARL_0 for ssMEWMA of Dimension 10 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	65.74	146.87	406.84	861.86	1840.69
50	53.54	116.24	327.01	751.20	1629.05
100	43.32	92.78	260.49	618.48	1390.03
500	31.13	61.17	143.05	312.83	744.29
			λ = 0.10, Δ = 0.50		
20	35.51	85.19	269.53	648.38	1486.83
50	21.89	46.97	148.87	396.01	977.02
100	16.52	28.67	81.36	215.54	575.32
500	14.52	19.60	29.06	49.71	105.25
			λ = 0.10, Δ = 1.00		
20	10.12	20.16	81.59	230.75	674.01
50	6.40	8.62	16.69	45.52	161.73
100	5.47	6.63	8.79	12.39	31.72
500	4.31	5.99	7.05	7.75	8.52
			λ = 0.10, Δ = 2.00		
20	3.40	4.10	5.79	11.64	41.07
50	2.62	2.98	3.43	3.80	4.17
100	2.36	2.62	2.96	3.21	3.45
500	1.71	2.40	2.67	2.84	3.01
			λ = 0.10, Δ = 3.00		
20	2.24	2.60	3.09	3.50	4.29
50	1.74	1.93	2.16	2.34	2.53
100	1.58	1.71	1.87	1.99	2.11
500	1.19	1.60	1.69	1.77	1.84

Table 559

Out of Control ARL_0 for ssMEWMA of Dimension 10 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	70.79	161.46	442.43	923.71	1911.30
50	59.87	136.64	392.34	833.98	1779.43
100	51.19	116.34	336.42	737.30	1643.37
500	36.39	77.08	218.92	471.74	1125.72
			$\lambda = 0.20, \Delta = 0.50$		
20	46.66	114.99	355.96	802.89	1757.50
50	31.02	72.17	242.99	587.38	1372.76
100	21.73	47.28	160.09	416.29	1044.65
500	12.08	25.06	55.11	116.18	341.46
			$\lambda = 0.20, \Delta = 1.00$		
20	15.16	42.49	178.05	486.22	1234.23
50	7.30	14.18	55.15	182.19	549.17
100	5.54	7.62	18.96	57.54	207.02
500	4.48	6.19	7.67	9.09	12.66
			$\lambda = 0.20, \Delta = 2.00$		
20	2.96	4.61	20.06	83.62	303.24
50	2.19	2.45	2.98	5.58	16.74
100	2.02	2.18	2.47	2.68	3.73
500	1.65	2.02	2.20	2.33	2.49
			$\lambda = 0.20, \Delta = 3.00$		
20	1.72	1.97	3.17	8.08	42.94
50	1.40	1.50	1.65	1.77	1.91
100	1.32	1.38	1.49	1.57	1.66
500	1.20	1.30	1.37	1.43	1.49

Table 560

Out of Control ARL_0 for ssMEWMA of Dimension 10 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	74.35	165.04	459.89	962.57	1949.08
50	65.33	146.90	419.76	905.79	1870.87
100	59.02	130.25	376.72	837.45	1756.38
500	38.14	90.97	266.36	598.10	1360.04
			$\lambda = 0.30, \Delta = 0.50$		
20	55.12	131.20	409.00	902.55	1877.02
50	38.39	92.77	310.73	725.01	1594.22
100	28.34	66.29	222.79	565.82	1342.33
500	17.03	35.31	90.47	231.75	628.31
			$\lambda = 0.30, \Delta = 1.00$		
20	23.49	69.78	269.94	683.50	1581.73
50	10.22	27.16	120.68	352.30	911.00
100	6.61	12.17	46.14	158.01	500.40
500	4.61	6.96	10.46	16.37	44.92
			$\lambda = 0.30, \Delta = 2.00$		
20	3.75	11.24	64.97	236.78	726.97
50	2.10	2.64	6.64	27.37	105.19
100	1.90	2.10	2.55	4.69	15.53
500	1.88	1.89	2.12	2.30	2.48
			$\lambda = 0.30, \Delta = 3.00$		
20	1.65	2.65	10.65	50.57	201.80
50	1.31	1.40	1.53	2.06	4.54
100	1.23	1.29	1.38	1.45	2.08
500	1.07	1.22	1.29	1.34	1.38

Table 561

Out of Control ARL_0 for ssMEWMA of Dimension 10 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	75.80	171.44	466.07	978.46	1999.12
50	68.11	155.18	438.08	931.86	1945.48
100	62.15	139.46	403.22	879.83	1861.97
500	62.76	107.95	314.19	699.31	1563.95
			$\lambda = 0.40, \Delta = 0.50$		
20	60.22	147.78	434.88	949.91	1973.52
50	45.12	111.19	357.34	811.98	1765.14
100	34.40	83.51	285.00	695.70	1570.19
500	26.31	41.70	132.40	349.99	912.57
			$\lambda = 0.40, \Delta = 1.00$		
20	33.77	96.74	348.46	836.07	1820.15
50	14.74	44.02	190.13	523.78	1291.44
100	8.88	19.25	92.59	304.11	841.81
500	5.00	9.07	16.91	42.11	160.04
			$\lambda = 0.40, \Delta = 2.00$		
20	6.20	25.20	148.40	448.06	1197.20
50	2.38	4.03	23.18	89.49	320.84
100	1.97	2.25	5.49	18.71	80.99
500	2.33	1.99	2.25	2.51	2.82
			$\lambda = 0.40, \Delta = 3.00$		
20	1.92	5.03	38.27	150.47	519.83
50	1.31	1.41	2.13	7.76	40.54
100	1.24	1.29	1.38	1.48	2.56
500	1.56	1.24	1.29	1.34	1.39

Table 562

Out of Control ARL_0 for ssMEWMA of Dimension 10 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50$, $\Delta = 0.25$		
20	80.34	173.35	469.53	994.12	2035.76
50	73.53	160.52	447.84	960.88	2010.09
100	67.31	146.91	422.76	919.54	1934.86
500	59.93	115.03	343.90	757.31	1701.35
			$\lambda = 0.50$, $\Delta = 0.50$		
20	68.52	158.66	459.70	984.81	2035.16
50	53.07	126.98	394.12	880.72	1904.16
100	41.57	99.28	328.47	774.21	1738.51
500	28.97	55.00	170.21	450.57	1148.05
			$\lambda = 0.50$, $\Delta = 1.00$		
20	45.07	121.28	407.85	928.53	1980.64
50	22.16	64.30	258.48	657.46	1575.35
100	12.87	30.81	152.04	434.77	1159.14
500	8.88	12.14	29.54	92.46	324.96
			$\lambda = 0.50$, $\Delta = 2.00$		
20	13.09	51.26	238.76	657.22	1582.35
50	3.37	8.54	57.98	201.14	647.38
100	2.19	3.25	12.89	52.05	221.02
500	2.73	2.37	2.58	3.09	4.03
			$\lambda = 0.50$, $\Delta = 3.00$		
20	3.51	15.00	100.81	332.74	968.55
50	1.41	1.80	8.52	41.62	138.30
100	1.30	1.35	1.57	2.85	19.94
500	1.00	1.35	1.35	1.40	1.47

Table 563

Out of Control ARL_0 for ssMEWMA of Dimension 10 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	83.86	181.49	482.44	1017.91	2052.98
50	78.22	172.26	465.73	992.24	2032.22
100	71.80	159.48	448.56	956.19	1998.42
500	80.54	127.07	361.08	814.80	1774.88
			$\lambda = 0.60, \Delta = 0.50$		
20	74.93	171.98	483.45	1028.25	2083.33
50	61.47	145.70	430.12	943.68	1972.82
100	48.60	118.07	374.75	855.50	1868.30
500	42.46	66.86	212.69	524.44	1369.86
			$\lambda = 0.60, \Delta = 1.00$		
20	55.55	149.72	465.15	1010.92	2104.21
50	30.71	89.68	330.38	800.74	1803.92
100	18.13	50.46	221.08	597.86	1483.16
500	13.82	18.66	48.75	154.33	544.67
			$\lambda = 0.60, \Delta = 2.00$		
20	24.25	85.76	344.36	843.88	1946.25
50	5.74	19.79	119.40	380.14	1061.05
100	2.98	5.19	32.41	125.89	465.29
500	2.50	2.74	3.38	5.52	25.89
			$\lambda = 0.60, \Delta = 3.00$		
20	8.83	37.48	199.47	572.97	1479.98
50	1.80	3.52	29.19	112.32	367.34
100	1.40	1.54	2.88	20.39	93.18
500	1.50	1.33	1.45	1.54	1.67

Table 564

Out of Control ARL_0 for ssMEWMA of Dimension 10 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	86.56	185.90	492.64	1023.49	2093.13
50	83.31	182.69	483.61	1021.62	2085.65
100	78.21	171.38	470.72	999.44	2078.32
500	55.93	154.00	413.58	907.08	1951.43
			λ = 0.80, Δ = 0.50		
20	83.18	187.72	503.19	1052.32	2143.26
50	73.49	170.15	474.42	1024.03	2118.89
100	61.40	147.89	435.90	965.20	2048.13
500	23.25	102.11	296.43	736.97	1722.46
			λ = 0.80, Δ = 1.00		
20	75.91	187.17	522.94	1107.73	2244.15
50	51.48	140.01	440.95	1004.81	2132.42
100	34.59	97.74	346.78	856.44	1929.11
500	10.24	36.70	120.12	374.42	1096.40
			λ = 0.80, Δ = 2.00		
20	54.23	158.07	507.05	1118.67	2351.17
50	19.94	70.14	302.88	787.64	1839.10
100	7.69	26.59	148.28	464.66	1262.25
500	2.20	3.90	11.24	38.82	192.01
			λ = 0.80, Δ = 3.00		
20	35.02	115.60	441.63	1036.04	2282.15
50	7.32	30.23	160.37	458.91	1217.19
100	2.21	7.67	46.19	158.34	543.24
500	1.40	1.62	2.04	3.08	22.18

Table 565

Out of Control ARL_0 for ssMEWMA of Dimension 15 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05$, $\Delta = 0.25$				
20	47.17	99.59	275.10	633.18	1375.14
50	37.57	71.51	198.02	468.08	1057.14
100	29.69	53.18	136.11	331.53	786.93
500	17.20	34.86	59.39	117.06	259.92
	$\lambda = 0.05$, $\Delta = 0.50$				
20	21.75	41.28	123.96	325.28	812.72
50	14.91	23.32	54.22	142.96	372.10
100	12.30	16.13	27.48	59.10	144.98
500	8.29	12.85	15.35	18.69	23.98
	$\lambda = 0.05$, $\Delta = 1.00$				
20	7.57	10.05	19.17	46.69	141.46
50	5.92	7.06	8.66	12.67	21.44
100	5.33	6.06	7.06	7.81	9.75
500	4.45	5.46	6.11	6.71	7.20
	$\lambda = 0.05$, $\Delta = 2.00$				
20	3.66	4.33	5.21	6.00	8.26
50	2.93	3.33	3.82	4.20	4.57
100	2.61	2.91	3.27	3.51	3.76
500	2.58	2.62	2.85	3.07	3.25
	$\lambda = 0.05$, $\Delta = 3.00$				
20	2.63	3.08	3.64	4.13	4.61
50	2.09	2.34	2.65	2.89	3.13
100	1.85	2.01	2.23	2.40	2.54
500	1.78	1.78	1.90	2.05	2.15

Table 566

Out of Control ARL_0 for ssMEWMA of Dimension 15 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.10, \Delta = 0.25$				
20	49.25	108.84	316.09	709.79	1559.65
50	39.15	82.29	239.35	552.10	1268.40
100	32.11	62.39	186.03	431.86	1031.16
500	26.66	41.24	91.73	194.71	486.74
	$\lambda = 0.10, \Delta = 0.50$				
20	24.11	55.69	187.55	469.93	1110.24
50	16.21	30.16	96.12	252.00	680.86
100	12.77	19.49	47.49	135.51	380.61
500	8.89	12.82	18.52	29.45	60.32
	$\lambda = 0.10, \Delta = 1.00$				
20	7.39	12.79	42.52	129.04	408.96
50	5.13	6.56	11.28	30.22	81.33
100	4.63	5.31	7.13	10.97	22.74
500	3.70	4.75	5.45	5.95	6.43
	$\lambda = 0.10, \Delta = 2.00$				
20	2.92	3.44	4.47	8.07	24.69
50	2.31	2.56	2.91	3.18	3.46
100	2.12	2.30	2.57	2.76	2.92
500	1.72	2.14	2.29	2.42	2.57
	$\lambda = 0.10, \Delta = 3.00$				
20	2.01	2.29	2.68	3.03	4.88
50	1.60	1.75	1.93	2.08	2.21
100	1.50	1.57	1.70	1.80	1.89
500	1.24	1.46	1.50	1.57	1.65

Table 567

Out of Control ARL$_0$ for ssMEWMA of Dimension 15 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	55.38	125.27	366.53	811.34	1760.29
50	44.53	100.89	294.47	676.26	1483.77
100	37.50	83.05	244.98	556.42	1312.16
500	26.67	55.37	143.38	328.41	814.93
	λ = 0.20, Δ = 0.50				
20	32.72	81.72	270.01	649.32	1512.05
50	21.82	51.13	172.60	434.22	1067.32
100	16.41	33.09	105.06	287.95	785.55
500	10.48	16.43	36.87	78.52	233.45
	λ = 0.20, Δ = 1.00				
20	10.39	26.76	120.01	354.21	966.56
50	5.66	9.90	35.75	118.77	381.67
100	4.60	6.41	13.33	37.32	138.22
500	4.07	4.65	5.88	7.00	9.28
	λ = 0.20, Δ = 2.00				
20	2.51	3.60	13.51	48.16	193.97
50	1.94	2.17	2.74	4.54	15.28
100	1.79	1.96	2.18	2.34	2.70
500	1.67	1.80	1.96	2.05	2.17
	λ = 0.20, Δ = 3.00				
20	1.59	1.76	2.22	6.31	22.77
50	1.32	1.42	1.53	1.62	1.72
100	1.27	1.31	1.38	1.44	1.51
500	1.23	1.25	1.31	1.32	1.36

Table 568

Out of Control ARL_0 for ssMEWMA of Dimension 15 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	60.53	140.91	420.98	893.32	1855.28
50	50.01	116.05	349.57	760.32	1636.72
100	42.89	96.92	297.50	676.11	1467.46
500	36.70	66.29	198.50	431.16	1010.59
			$\lambda = 0.30, \Delta = 0.50$		
20	40.75	107.59	347.21	786.15	1715.95
50	28.51	70.47	242.54	575.26	1328.50
100	20.93	49.21	171.51	437.17	1045.44
500	7.47	24.41	65.07	156.54	426.63
			$\lambda = 0.30, \Delta = 1.00$		
20	16.77	51.73	214.48	561.46	1365.01
50	7.63	19.26	89.11	271.39	744.27
100	5.51	9.86	37.01	118.60	374.00
500	3.06	5.42	7.46	12.50	31.79
			$\lambda = 0.30, \Delta = 2.00$		
20	3.03	7.25	45.36	164.81	529.37
50	1.88	2.19	5.06	18.85	78.29
100	1.72	1.89	2.23	3.43	12.01
500	1.44	1.74	1.88	1.99	2.12
			$\lambda = 0.30, \Delta = 3.00$		
20	1.48	1.82	7.89	29.08	129.66
50	1.23	1.31	1.43	2.23	2.32
100	1.22	1.24	1.30	1.35	1.40
500	1.25	1.15	1.22	1.26	1.28

Table 569

Out of Control ARL_0 for ssMEWMA of Dimension 15 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	64.80	157.80	448.55	936.49	1982.83
50	54.92	130.50	392.06	836.03	1772.26
100	46.83	110.74	338.08	748.92	1634.43
500	43.64	80.79	237.96	505.63	1190.13
			$\lambda = 0.40, \Delta = 0.50$		
20	49.19	130.67	410.16	877.89	1898.77
50	34.50	90.38	306.81	704.49	1537.76
100	27.36	64.62	229.91	566.24	1297.18
500	26.74	32.48	95.08	251.19	648.51
			$\lambda = 0.40, \Delta = 1.00$		
20	25.50	79.13	309.22	732.93	1672.53
50	10.96	36.71	156.83	446.14	1102.92
100	6.95	17.56	77.18	239.24	686.77
500	4.19	6.59	11.36	32.49	116.80
			$\lambda = 0.40, \Delta = 2.00$		
20	5.16	19.47	111.16	359.98	985.62
50	2.10	3.55	15.28	67.43	241.33
100	1.80	2.04	3.97	12.54	55.33
500	1.73	1.62	1.94	2.11	2.39
			$\lambda = 0.40, \Delta = 3.00$		
20	1.65	4.12	26.97	108.27	392.92
50	1.25	1.32	1.91	6.62	24.39
100	1.21	1.24	1.32	1.37	2.65
500	1.00	1.09	1.20	1.25	1.29

Table 570

Out of Control ARL_0 for ssMEWMA of Dimension 15 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	70.58	168.79	465.26	990.58	2021.42
50	59.10	144.13	416.95	898.97	1860.77
100	52.11	125.75	375.94	821.39	1745.75
500	51.45	92.05	279.38	589.53	1330.30
			λ = 0.50, Δ = 0.50		
20	58.34	146.95	442.31	965.96	2000.18
50	41.16	111.66	356.73	809.14	1730.11
100	31.93	82.87	282.26	679.11	1518.10
500	28.37	38.70	145.49	343.49	889.07
			λ = 0.50, Δ = 1.00		
20	36.32	108.02	378.92	879.40	1931.16
50	17.04	56.08	236.69	607.36	1416.81
100	10.80	30.61	131.27	401.71	1021.17
500	9.26	7.98	21.65	74.65	250.62
			λ = 0.50, Δ = 2.00		
20	9.91	40.73	207.33	579.83	1455.77
50	2.55	7.62	47.09	182.21	536.21
100	2.07	2.81	11.00	47.63	172.31
500	2.25	1.73	2.29	2.80	4.74
			λ = 0.50, Δ = 3.00		
20	2.81	11.22	77.91	263.42	793.45
50	1.32	1.90	11.30	33.52	116.77
100	1.25	1.28	1.51	2.65	10.17
500	1.00	1.13	1.26	1.28	1.34

Table 571

Out of Control ARL_0 for ssMEWMA of Dimension 15 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	74.99	174.22	479.18	1013.63	2058.58
50	63.72	150.42	441.72	943.56	1965.32
100	57.45	133.73	396.02	872.57	1865.44
500	61.89	106.08	302.22	656.45	1496.72
			$\lambda = 0.60, \Delta = 0.50$		
20	64.20	160.35	465.85	1019.62	2080.17
50	49.53	124.60	398.77	892.62	1884.80
100	38.72	98.12	326.15	766.88	1713.47
500	22.39	54.89	173.20	446.55	1096.51
			$\lambda = 0.60, \Delta = 1.00$		
20	45.79	134.22	438.43	995.07	2118.80
50	24.34	79.02	304.88	756.26	1687.44
100	15.09	46.97	195.64	544.85	1343.72
500	7.61	12.61	41.95	143.08	447.83
			$\lambda = 0.60, \Delta = 2.00$		
20	17.67	68.62	309.51	805.94	1846.04
50	4.33	16.44	103.19	350.30	948.34
100	2.52	5.78	30.85	121.39	411.44
500	1.50	2.47	3.25	5.42	24.63
			$\lambda = 0.60, \Delta = 3.00$		
20	5.92	27.60	157.88	482.39	1305.24
50	1.68	4.17	26.28	95.17	297.93
100	1.34	1.37	3.61	15.41	67.63
500	1.33	1.23	1.31	1.40	1.48

Table 572

Out of Control ARL_0 for ssMEWMA of Dimension 15 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	80.41	184.13	505.17	1030.05	2090.46
50	72.10	169.34	480.19	989.97	2053.20
100	65.21	153.73	450.24	946.66	1988.03
500	47.87	122.49	355.48	777.56	1712.44
	λ = 0.80, Δ = 0.50				
20	76.56	183.23	515.26	1061.08	2164.63
50	63.27	158.26	460.27	980.36	2074.46
100	54.15	131.29	410.30	907.08	1936.82
500	44.92	84.46	267.39	628.74	1454.06
	λ = 0.80, Δ = 1.00				
20	68.46	179.06	525.01	1108.09	2249.70
50	45.54	128.78	432.21	965.71	2065.03
100	28.93	87.83	337.64	808.34	1813.48
500	9.78	19.71	115.31	339.01	960.02
	λ = 0.80, Δ = 2.00				
20	45.68	144.50	488.12	1107.61	2285.72
50	15.81	65.70	299.88	788.23	1749.36
100	6.85	25.90	143.63	434.31	1153.03
500	1.67	3.28	11.56	43.45	198.30
	λ = 0.80, Δ = 3.00				
20	27.11	100.22	400.87	1003.94	2084.16
50	4.60	23.79	145.28	458.55	1201.05
100	1.75	5.29	46.98	188.67	547.66
500	0.00	1.43	2.00	3.41	27.71

Table 573

Out of Control ARL_0 for ssMEWMA of Dimension 20 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	λ = 0.05, Δ = 0.25				
20	34.59	72.09	205.10	468.38	1073.24
50	27.16	53.47	147.61	348.81	816.66
100	23.49	42.21	104.22	232.79	597.22
500	17.85	25.76	47.85	85.92	189.80
	λ = 0.05, Δ = 0.50				
20	15.81	29.25	84.45	221.18	586.85
50	11.49	16.78	38.59	89.60	260.05
100	10.02	13.13	22.62	42.01	110.02
500	11.61	10.47	12.64	14.76	18.21
	λ = 0.05, Δ = 1.00				
20	6.35	8.07	13.88	29.68	86.87
50	5.18	6.01	7.28	8.75	14.38
100	4.71	5.35	6.26	6.80	7.71
500	4.56	4.67	5.32	5.75	6.15
	λ = 0.05, Δ = 2.00				
20	3.29	3.85	4.74	5.33	6.21
50	2.68	3.06	3.45	3.74	4.03
100	2.45	2.68	2.96	3.18	3.38
500	2.27	2.33	2.58	2.76	2.90
	λ = 0.05, Δ = 3.00				
20	2.46	2.83	3.32	3.72	4.15
50	1.96	2.22	2.48	2.68	2.87
100	1.79	1.93	2.10	2.24	2.37
500	1.58	1.59	1.76	1.87	1.97

Table 574

Out of Control ARL_0 for ssMEWMA of Dimension 20 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	36.06	85.17	252.62	567.13	1264.58
50	29.57	65.32	191.12	446.41	1011.91
100	24.95	50.53	150.37	352.91	824.95
500	17.25	31.62	74.46	160.82	399.28
			λ = 0.10, Δ = 0.50		
20	18.07	40.88	138.19	352.34	835.69
50	11.79	23.30	74.03	197.75	512.09
100	9.66	16.04	40.18	101.89	282.35
500	11.12	11.32	14.54	21.90	44.51
			λ = 0.10, Δ = 1.00		
20	5.87	9.27	29.96	87.65	274.16
50	4.38	5.48	8.88	20.08	57.08
100	3.93	4.73	5.92	7.05	16.12
500	3.94	3.90	4.55	5.16	5.79
			λ = 0.10, Δ = 2.00		
20	2.69	3.11	3.97	5.87	10.56
50	2.11	2.38	2.70	2.90	3.29
100	1.94	2.16	2.36	2.51	2.68
500	1.85	1.95	2.06	2.19	2.31
			λ = 0.10, Δ = 3.00		
20	1.90	2.15	2.48	2.73	3.11
50	1.52	1.67	1.84	1.96	2.09
100	1.37	1.52	1.62	1.70	1.79
500	1.22	1.37	1.43	1.50	1.56

Table 575

Out of Control ARL_0 for ssMEWMA of Dimension 20 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.20, \Delta = 0.25$				
20	44.67	105.99	317.63	726.87	1580.00
50	36.51	86.04	255.04	589.95	1305.30
100	30.68	72.18	215.99	489.93	1144.35
500	23.92	53.16	119.94	283.46	704.01
	$\lambda = 0.20, \Delta = 0.50$				
20	26.71	67.81	231.31	561.31	1302.28
50	17.27	43.26	150.53	380.03	918.06
100	12.59	28.23	91.98	245.96	647.60
500	23.50	15.83	30.28	63.55	179.73
	$\lambda = 0.20, \Delta = 1.00$				
20	8.16	21.67	99.56	295.26	782.56
50	4.76	8.37	27.84	91.53	309.25
100	3.92	5.31	10.48	27.12	101.09
500	7.14	4.41	5.11	6.17	8.37
	$\lambda = 0.20, \Delta = 2.00$				
20	2.29	3.22	8.04	32.36	127.81
50	1.80	2.02	2.34	2.96	6.00
100	1.67	1.83	2.00	2.12	2.32
500	2.00	1.68	1.79	1.87	1.95
	$\lambda = 0.20, \Delta = 3.00$				
20	1.50	1.69	2.21	4.08	11.82
50	1.26	1.35	1.47	1.54	1.64
100	1.18	1.26	1.32	1.37	1.43
500	1.00	1.17	1.24	1.26	1.30

Table 576

Out of Control ARL_0 for ssMEWMA of Dimension 20 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	51.10	122.07	366.60	827.96	1757.87
50	42.53	102.35	308.77	687.84	1485.01
100	35.03	85.60	263.88	594.21	1313.60
500	46.60	65.35	168.23	379.01	900.94
			λ = 0.30, Δ = 0.50		
20	34.78	90.71	310.20	724.81	1592.59
50	23.90	63.96	214.37	524.02	1184.11
100	17.10	41.87	148.83	396.04	928.62
500	11.50	24.17	50.83	137.79	381.86
			λ = 0.30, Δ = 1.00		
20	13.35	42.52	194.12	509.36	1220.69
50	6.65	16.41	72.62	233.71	651.73
100	4.83	8.29	31.50	102.37	311.02
500	3.00	5.62	6.75	10.99	32.56
			λ = 0.30, Δ = 2.00		
20	2.50	6.10	37.21	146.35	442.52
50	1.71	2.05	4.63	15.51	55.47
100	1.58	1.74	1.96	2.94	9.35
500	1.00	1.66	1.73	1.83	1.91
			λ = 0.30, Δ = 3.00		
20	1.41	1.60	3.66	19.83	93.54
50	1.20	1.27	1.37	1.45	2.33
100	1.15	1.20	1.24	1.30	1.34
500	1.00	1.13	1.16	1.20	1.24

Table 577

Out of Control ARL_0 for ssMEWMA of Dimension 20 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	56.58	137.81	414.72	901.78	1915.51
50	46.99	116.25	353.61	780.03	1675.17
100	41.51	99.45	313.59	692.41	1496.97
500	53.71	65.78	215.62	493.02	1106.33
	λ = 0.40, Δ = 0.50				
20	42.98	115.45	377.95	852.15	1819.80
50	30.25	82.13	274.69	657.02	1462.35
100	22.66	59.65	213.94	530.25	1204.83
500	14.29	28.88	86.73	234.17	608.05
	λ = 0.40, Δ = 1.00				
20	21.01	69.16	286.09	712.35	1599.90
50	9.63	30.50	145.79	394.12	997.40
100	6.41	13.90	69.56	207.71	589.59
500	2.50	5.90	9.83	26.92	96.72
	λ = 0.40, Δ = 2.00				
20	3.90	14.67	100.64	324.78	917.02
50	1.82	3.55	16.01	60.18	207.71
100	1.66	1.86	3.37	8.30	37.11
500	1.00	1.67	1.84	1.91	2.18
	λ = 0.40, Δ = 3.00				
20	1.59	3.20	20.65	97.47	303.79
50	1.20	1.29	2.45	4.05	14.50
100	1.14	1.18	1.24	1.32	1.38
500	1.00	1.11	1.19	1.21	1.25

Table 578

Out of Control ARL_0 for ssMEWMA of Dimension 20 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	60.80	153.76	458.02	964.49	2014.65
50	53.49	131.26	392.41	854.84	1797.20
100	45.13	114.33	355.36	774.52	1654.79
500	60.11	86.95	246.82	565.18	1290.98
			$\lambda = 0.50, \Delta = 0.50$		
20	51.50	136.18	434.07	936.18	1989.01
50	38.61	100.43	336.31	771.15	1685.57
100	29.80	78.29	276.39	645.83	1432.34
500	17.38	38.87	121.33	329.61	852.89
			$\lambda = 0.50, \Delta = 1.00$		
20	30.86	101.00	370.40	865.70	1927.30
50	15.19	53.00	222.19	562.87	1348.18
100	8.86	26.24	122.01	359.27	936.13
500	5.17	8.14	19.78	63.10	234.88
			$\lambda = 0.50, \Delta = 2.00$		
20	7.46	35.32	185.28	551.12	1395.19
50	2.44	6.39	43.40	161.33	486.36
100	1.87	2.46	9.82	39.04	150.97
500	1.33	1.82	2.08	2.32	4.53
			$\lambda = 0.50, \Delta = 3.00$		
20	2.37	8.71	59.62	217.96	719.82
50	1.34	1.87	4.66	23.43	83.88
100	1.15	1.21	1.33	6.42	19.58
500	1.00	1.12	1.24	1.26	1.32

Table 579

Out of Control ARL_0 for ssMEWMA of Dimension 20 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	63.99	163.97	476.60	999.15	2066.11
50	56.60	142.46	422.36	903.39	1895.04
100	49.99	124.92	380.01	839.83	1748.05
500	55.58	90.17	283.54	619.95	1423.76
			$\lambda = 0.60, \Delta = 0.50$		
20	58.22	152.70	467.08	1000.59	2076.24
50	43.36	118.73	383.11	853.95	1812.71
100	34.40	93.16	317.04	749.95	1605.37
500	30.89	49.18	164.09	418.35	1067.66
			$\lambda = 0.60, \Delta = 1.00$		
20	40.46	128.92	435.68	985.94	2087.21
50	21.24	71.23	291.46	723.68	1626.06
100	11.55	39.42	190.11	490.97	1219.50
500	7.25	12.97	35.81	116.00	418.37
			$\lambda = 0.60, \Delta = 2.00$		
20	13.01	61.64	292.14	755.46	1807.15
50	3.64	14.84	96.93	300.93	876.76
100	2.27	4.13	23.57	93.18	341.63
500	2.00	2.40	2.37	3.66	16.53
			$\lambda = 0.60, \Delta = 3.00$		
20	4.04	21.14	145.86	436.76	1238.12
50	1.39	2.84	17.70	69.72	268.25
100	1.22	1.39	2.50	17.38	62.79
500	1.00	1.25	1.31	1.40	1.53

Table 580

Out of Control ARL_0 for ssMEWMA of Dimension 20 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	72.51	180.63	496.88	1044.26	2112.32
50	64.38	161.55	462.66	1000.73	2009.27
100	60.14	147.08	420.48	935.03	1925.59
500	76.50	112.22	329.42	742.50	1625.99
			$\lambda = 0.80, \Delta = 0.50$		
20	69.57	176.81	502.46	1072.90	2158.47
50	55.11	149.36	453.69	1000.53	2025.95
100	47.56	127.17	400.82	902.20	1867.72
500	61.60	70.60	232.81	589.74	1399.99
			$\lambda = 0.80, \Delta = 1.00$		
20	60.51	170.95	513.74	1117.34	2233.06
50	38.88	125.53	415.95	967.56	2003.33
100	25.53	80.99	310.88	789.18	1723.61
500	21.86	25.60	100.11	320.00	873.28
			$\lambda = 0.80, \Delta = 2.00$		
20	37.76	129.70	459.81	1090.07	2246.09
50	14.92	61.06	262.21	750.94	1703.29
100	6.77	22.24	124.42	440.64	1125.38
500	1.33	3.45	9.28	32.01	143.29
			$\lambda = 0.80, \Delta = 3.00$		
20	19.59	82.32	359.60	927.37	2090.54
50	4.79	22.12	142.98	464.56	1138.45
100	2.77	7.21	37.38	141.46	521.25
500	0.00	1.69	2.13	2.28	13.70

Table 581

Out of Control ARL_0 for ssMEWMA of Dimension 25 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05$, $\Delta = 0.25$				
20	26.53	56.43	154.56	371.48	859.44
50	22.10	41.91	116.80	269.72	637.67
100	18.39	32.12	79.25	188.54	467.97
500	10.20	22.97	38.73	67.49	145.98
	$\lambda = 0.05$, $\Delta = 0.50$				
20	12.28	21.61	57.37	155.71	442.00
50	9.65	13.74	29.11	65.21	183.97
100	8.31	10.67	16.52	28.26	72.57
500	6.45	8.98	11.06	12.86	16.23
	$\lambda = 0.05$, $\Delta = 1.00$				
20	5.59	6.90	9.59	18.78	49.47
50	4.60	5.33	6.37	7.40	10.06
100	4.04	4.64	5.35	5.86	6.30
500	3.89	4.29	4.80	5.15	5.47
	$\lambda = 0.05$, $\Delta = 2.00$				
20	3.05	3.54	4.20	4.72	5.26
50	2.56	2.86	3.19	3.44	3.68
100	2.23	2.46	2.72	2.91	3.08
500	1.56	2.22	2.41	2.56	2.68
	$\lambda = 0.05$, $\Delta = 3.00$				
20	2.32	2.66	3.10	3.46	3.82
50	1.94	2.13	2.38	2.54	2.71
100	1.66	1.81	1.97	2.10	2.20
500	1.25	1.60	1.68	1.78	1.85

Table 582

Out of Control ARL_0 for ssMEWMA of Dimension 25 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	28.94	68.12	209.01	490.53	1109.15
50	23.58	53.24	164.62	389.70	872.90
100	21.46	40.52	124.48	306.58	716.03
500	23.90	26.65	61.03	137.65	334.62
	λ = 0.10, Δ = 0.50				
20	13.98	30.15	106.06	290.61	723.78
50	9.83	18.94	59.06	162.04	415.60
100	8.49	12.74	31.01	81.66	232.87
500	13.56	8.59	12.10	18.92	39.38
	λ = 0.10, Δ = 1.00				
20	5.07	7.24	19.57	67.41	212.96
50	4.02	4.73	6.71	13.59	51.26
100	3.60	4.03	4.88	6.04	11.30
500	3.75	3.51	4.07	4.47	4.82
	λ = 0.10, Δ = 2.00				
20	2.47	2.83	3.32	4.06	9.02
50	2.08	2.28	2.52	2.70	2.88
100	1.83	1.99	2.19	2.33	2.46
500	1.86	1.69	1.91	2.05	2.15
	λ = 0.10, Δ = 3.00				
20	1.81	2.04	2.31	2.53	2.75
50	1.50	1.62	1.79	1.90	2.00
100	1.33	1.42	1.53	1.62	1.70
500	1.14	1.30	1.34	1.41	1.47

Table 583

Out of Control ARL_0 for ssMEWMA of Dimension 25 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	36.34	90.74	296.31	683.51	1465.73
50	29.32	73.77	240.24	544.57	1180.27
100	24.56	59.60	193.82	453.86	1015.42
500	20.00	38.11	105.84	260.55	595.01
			λ = 0.20, Δ = 0.50		
20	20.84	54.75	207.73	528.17	1204.95
50	14.41	35.61	133.55	353.49	816.64
100	10.75	21.99	80.63	235.25	597.50
500	9.30	12.42	24.15	54.26	146.11
			λ = 0.20, Δ = 1.00		
20	6.26	17.63	81.32	262.86	687.92
50	4.13	6.92	24.76	79.33	248.70
100	3.43	4.50	7.52	24.97	84.38
500	4.00	3.44	4.04	5.24	7.63
			λ = 0.20, Δ = 2.00		
20	2.09	2.58	5.24	21.22	86.69
50	1.74	1.96	2.19	3.09	9.07
100	1.57	1.72	1.87	2.01	2.15
500	1.75	1.45	1.62	1.72	1.81
			λ = 0.20, Δ = 3.00		
20	1.42	1.59	1.81	2.28	6.82
50	1.24	1.32	1.43	1.51	1.58
100	1.12	1.19	1.26	1.31	1.37
500	1.00	1.10	1.16	1.19	1.23

Table 584

Out of Control ARL$_0$ for ssMEWMA of Dimension 25 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	43.19	111.84	356.11	809.73	1753.33
50	34.66	91.23	288.64	653.10	1391.78
100	31.34	74.75	241.47	561.63	1220.75
500	24.40	54.46	156.55	346.52	805.74
			λ = 0.30, Δ = 0.50		
20	29.53	82.42	295.32	706.81	1574.46
50	19.30	54.68	195.61	492.41	1128.39
100	15.06	37.16	139.09	361.12	853.48
500	12.67	20.41	47.50	117.02	337.75
			λ = 0.30, Δ = 1.00		
20	11.06	39.06	172.42	472.02	1198.94
50	5.24	13.05	65.27	209.37	573.86
100	3.86	6.96	22.65	90.60	273.73
500	3.60	4.32	5.90	13.41	23.06
			λ = 0.30, Δ = 2.00		
20	2.18	4.63	28.26	116.02	375.26
50	1.64	2.14	4.46	12.74	39.73
100	1.48	1.68	1.85	2.43	7.36
500	1.00	1.50	1.59	1.68	1.76
			λ = 0.30, Δ = 3.00		
20	1.31	1.66	4.14	17.27	60.03
50	1.17	1.25	1.57	1.75	1.98
100	1.09	1.15	1.19	1.24	1.28
500	1.00	1.08	1.15	1.16	1.17

Table 585

Out of Control ARL_0 for ssMEWMA of Dimension 25 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	49.24	130.11	402.95	910.91	1905.00
50	40.74	106.54	337.78	758.01	1588.78
100	36.10	87.88	287.23	658.86	1398.22
500	11.44	68.86	189.78	429.91	987.93
	λ = 0.40, Δ = 0.50				
20	36.17	106.88	368.27	854.43	1807.70
50	25.83	73.39	265.53	639.04	1417.24
100	20.25	50.53	194.21	488.78	1163.30
500	4.67	28.68	72.26	206.48	549.34
	λ = 0.40, Δ = 1.00				
20	17.48	62.38	267.30	698.05	1593.77
50	8.37	25.31	134.50	373.79	954.77
100	5.09	10.88	60.41	199.21	584.01
500	1.75	5.46	10.14	21.96	73.65
	λ = 0.40, Δ = 2.00				
20	3.14	10.42	87.03	290.94	843.53
50	1.82	2.62	11.41	45.36	190.99
100	1.52	1.74	2.42	8.51	36.05
500	0.00	1.65	1.63	1.76	1.92
	λ = 0.40, Δ = 3.00				
20	1.36	2.29	14.50	63.79	240.73
50	1.18	1.25	1.70	3.06	11.00
100	1.12	1.13	1.19	1.31	1.87
500	0.00	1.12	1.15	1.19	1.18

Table 586

Out of Control ARL_0 for ssMEWMA of Dimension 25 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	54.99	143.06	441.53	967.40	2007.69
50	45.87	120.75	373.30	827.62	1723.42
100	39.45	102.57	320.38	719.87	1546.85
500	45.00	66.59	211.23	499.13	1133.70
			λ = 0.50, Δ = 0.50		
20	43.52	126.54	416.49	937.37	1982.31
50	32.58	90.07	315.90	742.21	1602.36
100	24.63	67.41	243.52	605.82	1349.58
500	15.00	35.85	97.74	282.82	782.47
			λ = 0.50, Δ = 1.00		
20	25.75	91.47	352.73	844.52	1862.87
50	13.25	44.11	207.27	552.56	1291.72
100	6.75	19.18	115.95	331.46	896.27
500	3.00	5.72	14.23	51.87	161.68
			λ = 0.50, Δ = 2.00		
20	6.10	25.69	164.73	537.39	1295.02
50	2.22	5.64	40.34	139.14	430.29
100	1.59	1.99	5.10	33.59	114.23
500	1.00	1.72	1.75	1.99	2.41
			λ = 0.50, Δ = 3.00		
20	1.80	5.08	43.57	194.31	558.26
50	1.23	1.34	3.15	19.41	51.35
100	1.14	1.18	1.42	3.01	13.87
500	0.00	1.26	1.21	1.21	1.23

Table 587

Out of Control ARL_0 for ssMEWMA of Dimension 25 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	59.17	155.14	476.85	997.90	2042.22
50	50.60	132.45	410.63	877.04	1852.69
100	44.43	113.77	361.19	784.80	1688.03
500	44.44	74.69	240.51	572.17	1283.71
			$\lambda = 0.60, \Delta = 0.50$		
20	50.71	144.09	461.08	989.48	2078.53
50	39.28	112.03	377.60	832.33	1773.92
100	28.24	83.79	301.99	685.18	1513.12
500	8.75	44.82	134.94	365.32	958.69
			$\lambda = 0.60, \Delta = 1.00$		
20	34.38	118.63	424.24	965.48	2053.56
50	19.11	68.02	285.89	697.48	1600.68
100	10.07	32.86	179.87	476.75	1181.40
500	2.83	9.28	28.33	99.69	363.00
			$\lambda = 0.60, \Delta = 2.00$		
20	11.49	52.26	276.49	735.67	1697.95
50	3.32	13.88	87.08	305.70	808.05
100	1.90	3.16	20.32	96.02	312.92
500	1.00	1.67	2.14	4.01	14.45
			$\lambda = 0.60, \Delta = 3.00$		
20	2.85	16.46	122.13	424.68	1064.57
50	1.37	2.26	15.51	60.21	212.33
100	1.22	1.55	3.45	5.75	40.95
500	0.00	1.04	1.23	1.31	1.42

Table 588

Out of Control ARL_0 for ssMEWMA of Dimension 25 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	65.84	170.86	503.28	1052.08	2137.92
50	59.73	152.99	463.53	985.20	2019.57
100	52.17	135.62	420.02	913.94	1898.09
500	5.40	105.34	303.31	689.19	1522.65
			λ = 0.80, Δ = 0.50		
20	61.50	168.65	512.10	1080.27	2195.31
50	52.30	142.19	453.25	984.02	2040.41
100	40.12	117.08	383.60	884.41	1872.73
500	7.00	65.22	211.64	559.97	1317.56
			λ = 0.80, Δ = 1.00		
20	53.25	156.63	510.20	1101.86	2246.36
50	35.71	115.44	406.03	949.44	2030.55
100	20.59	73.34	320.99	778.09	1744.25
500	5.00	27.59	90.12	295.28	876.70
			λ = 0.80, Δ = 2.00		
20	31.65	118.11	446.17	1057.19	2224.31
50	10.67	53.77	268.48	747.84	1750.66
100	5.53	16.23	122.48	414.79	1074.72
500	1.00	2.61	6.23	27.48	162.42
			λ = 0.80, Δ = 3.00		
20	15.41	74.20	359.47	917.81	2006.41
50	3.07	21.63	134.42	406.00	1075.60
100	1.62	3.38	29.31	135.40	439.19
500	0.00	1.75	1.85	4.65	28.57

Table 589

Out of Control ARL_0 for ssMEWMA of Dimension 50 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	12.70	26.00	73.94	163.33	379.04
50	12.30	22.75	60.35	139.95	330.39
100	12.56	21.13	49.95	102.30	252.34
500	0.00	18.31	21.97	35.62	70.22
			$\lambda = 0.05, \Delta = 0.50$		
20	7.15	10.52	21.92	49.93	138.40
50	6.36	8.58	13.64	24.27	60.78
100	6.21	8.11	10.68	13.85	25.64
500	0.00	6.73	8.05	9.13	9.92
			$\lambda = 0.05, \Delta = 1.00$		
20	4.01	4.93	5.95	6.93	10.37
50	3.63	4.18	4.70	5.06	6.03
100	3.42	3.96	4.41	4.67	4.93
500	0.00	3.33	3.88	4.10	4.33
			$\lambda = 0.05, \Delta = 2.00$		
20	2.52	2.95	3.43	3.75	4.10
50	2.19	2.49	2.77	2.93	3.10
100	1.88	2.26	2.47	2.61	2.71
500	0.00	1.94	2.08	2.21	2.29
			$\lambda = 0.05, \Delta = 3.00$		
20	1.96	2.28	2.64	2.85	3.10
50	1.71	1.92	2.15	2.28	2.41
100	1.52	1.72	1.84	1.93	2.03
500	0.00	1.49	1.52	1.57	1.63

Table 590

Out of Control ARL_0 for ssMEWMA of Dimension 50 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	14.28	35.96	115.98	276.57	625.13
50	14.02	32.44	108.94	258.20	587.90
100	12.34	27.42	86.26	208.34	504.78
500	0.00	19.17	38.50	88.43	221.71
			$\lambda = 0.10, \Delta = 0.50$		
20	7.69	15.42	50.53	147.04	369.09
50	6.58	11.56	33.88	92.49	239.60
100	5.71	8.85	18.45	43.00	124.77
500	0.00	6.58	9.18	10.78	12.86
			$\lambda = 0.10, \Delta = 1.00$		
20	3.71	4.77	7.41	18.48	63.06
50	3.27	3.91	4.86	6.69	14.18
100	2.81	3.49	3.97	4.33	7.05
500	0.00	2.71	3.18	3.51	3.67
			$\lambda = 0.10, \Delta = 2.00$		
20	2.11	2.43	2.79	3.01	3.40
50	1.77	2.04	2.26	2.39	2.51
100	1.60	1.82	1.96	2.08	2.20
500	0.00	1.64	1.64	1.74	1.79
			$\lambda = 0.10, \Delta = 3.00$		
20	1.60	1.81	2.03	2.18	2.32
50	1.35	1.49	1.65	1.74	1.83
100	1.28	1.34	1.42	1.48	1.54
500	0.00	1.18	1.18	1.22	1.26

Table 591

Out of Control ARL_0 for ssMEWMA of Dimension 50 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	20.24	59.29	208.13	511.73	1218.16
50	17.78	51.64	181.12	442.49	1027.43
100	15.72	45.23	151.12	374.85	886.38
500	4.00	24.22	83.56	199.29	511.19
			λ = 0.20, Δ = 0.50		
20	10.96	35.17	142.12	383.62	983.26
50	8.76	24.88	100.99	272.99	719.05
100	6.65	15.78	56.42	168.21	467.40
500	0.00	8.32	13.96	31.07	95.25
			λ = 0.20, Δ = 1.00		
20	4.20	8.68	43.21	149.55	469.52
50	3.27	4.72	12.66	46.37	177.78
100	2.53	3.34	4.86	11.63	42.73
500	0.00	2.65	2.89	3.25	3.64
			λ = 0.20, Δ = 2.00		
20	1.81	2.15	2.83	6.54	32.24
50	1.52	1.69	1.92	2.13	4.56
100	1.28	1.50	1.59	1.70	1.78
500	0.00	1.26	1.31	1.39	1.46
			λ = 0.20, Δ = 3.00		
20	1.27	1.45	1.62	1.73	1.86
50	1.15	1.21	1.30	1.35	1.42
100	1.10	1.11	1.15	1.19	1.23
500	0.00	1.04	1.05	1.07	1.09

Table 592

Out of Control ARL_0 for ssMEWMA of Dimension 50 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	24.74	81.17	291.76	721.57	1634.28
50	21.65	69.34	238.15	604.30	1330.88
100	18.88	56.47	204.18	511.38	1149.54
500	0.00	28.59	124.11	293.67	714.47
			$\lambda = 0.30, \Delta = 0.50$		
20	16.23	55.01	238.76	642.54	1521.52
50	12.34	41.53	171.26	472.33	1086.04
100	8.74	27.63	117.75	341.12	824.45
500	0.00	11.32	28.84	82.94	247.61
			$\lambda = 0.30, \Delta = 1.00$		
20	5.72	20.85	122.40	400.45	1087.37
50	3.82	8.12	46.65	178.15	513.78
100	2.92	4.01	12.24	59.96	207.50
500	0.00	2.22	3.54	4.14	7.12
			$\lambda = 0.30, \Delta = 2.00$		
20	1.74	2.64	9.79	54.51	210.09
50	1.43	1.64	2.18	7.32	26.16
100	1.20	1.41	1.51	1.60	3.02
500	0.00	1.11	1.27	1.32	1.35
			$\lambda = 0.30, \Delta = 3.00$		
20	1.19	1.33	1.63	4.13	20.20
50	1.12	1.13	1.18	1.24	1.30
100	1.10	1.08	1.11	1.12	1.13
500	0.00	1.00	1.07	1.07	1.07

Table 593

Out of Control ARL_0 for ssMEWMA of Dimension 50 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	27.94	99.59	357.41	870.18	1906.32
50	23.98	81.76	291.46	696.71	1541.19
100	21.24	71.96	247.76	597.78	1350.95
500	0.00	45.33	166.04	388.33	889.81
			$\lambda = 0.40, \Delta = 0.50$		
20	20.39	78.34	319.49	817.90	1832.71
50	16.30	56.09	228.10	595.94	1414.25
100	10.90	42.63	166.34	469.69	1102.39
500	0.00	15.93	57.67	155.17	448.14
			$\lambda = 0.40, \Delta = 1.00$		
20	8.60	40.88	210.72	658.66	1581.26
50	4.57	18.66	103.64	346.17	964.13
100	3.18	6.46	40.22	173.02	511.68
500	0.00	2.57	5.23	9.56	38.21
			$\lambda = 0.40, \Delta = 2.00$		
20	1.93	5.00	44.53	185.00	585.71
50	1.40	1.73	6.92	31.83	106.52
100	1.26	1.40	1.56	1.77	14.37
500	0.00	1.07	1.28	1.32	1.38
			$\lambda = 0.40, \Delta = 3.00$		
20	1.18	1.48	3.69	17.00	63.91
50	1.09	1.12	1.19	5.33	9.37
100	1.17	1.09	1.10	1.12	1.14
500	0.00	1.00	1.11	1.08	1.07

Table 594

Out of Control ARL_0 for ssMEWMA of Dimension 50 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	32.51	116.62	409.98	949.58	2059.07
50	27.40	93.82	340.42	784.28	1723.92
100	25.22	83.20	290.90	684.15	1504.92
500	0.00	57.72	184.30	465.08	1054.85
			$\lambda = 0.50, \Delta = 0.50$		
20	25.35	100.87	382.06	924.78	2057.60
50	19.71	74.39	287.62	721.09	1583.82
100	13.87	56.22	223.52	581.17	1301.38
500	0.00	23.73	93.33	270.99	714.51
			$\lambda = 0.50, \Delta = 1.00$		
20	13.08	65.49	305.14	821.80	1921.47
50	7.39	33.50	180.28	543.20	1343.83
100	4.38	16.25	98.64	314.00	857.94
500	0.00	3.35	13.01	32.66	114.08
			$\lambda = 0.50, \Delta = 2.00$		
20	2.43	12.65	112.45	385.84	1131.11
50	1.60	3.18	21.53	88.88	359.88
100	1.30	1.50	4.42	22.74	61.62
500	0.00	1.18	1.36	1.42	1.53
			$\lambda = 0.50, \Delta = 3.00$		
20	1.20	2.22	10.94	74.99	299.16
50	1.06	1.17	1.26	7.55	57.04
100	1.11	1.09	1.12	1.15	1.19
500	0.00	1.00	1.17	1.11	1.10

Table 595

Out of Control ARL_0 for ssMEWMA of Dimension 50 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	36.00	125.85	435.13	1008.40	2135.08
50	31.36	103.35	378.89	868.61	1850.87
100	29.86	92.98	322.59	754.70	1690.72
500	0.00	64.47	221.17	538.43	1184.04
			$\lambda = 0.60, \Delta = 0.50$		
20	30.22	112.78	421.52	1019.45	2153.79
50	23.23	88.14	339.98	837.00	1835.30
100	20.44	67.97	269.99	668.66	1548.82
500	0.00	40.56	130.25	369.14	910.68
			$\lambda = 0.60, \Delta = 1.00$		
20	18.49	85.24	376.28	971.04	2077.13
50	11.72	49.27	255.07	719.01	1588.62
100	5.81	23.20	155.37	480.53	1218.22
500	0.00	6.47	20.94	73.68	263.44
			$\lambda = 0.60, \Delta = 2.00$		
20	4.31	27.52	211.59	643.24	1638.75
50	2.09	7.80	65.93	253.40	759.42
100	1.76	2.52	14.03	56.20	249.61
500	0.00	1.35	1.41	1.65	2.05
			$\lambda = 0.60, \Delta = 3.00$		
20	1.50	5.51	56.87	257.25	759.53
50	1.08	1.27	8.28	44.68	174.98
100	1.07	1.12	1.24	6.70	50.30
500	0.00	1.00	1.26	1.20	1.16

Table 596

Out of Control ARL_0 for ssMEWMA of Dimension 50 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	41.58	137.88	468.38	1032.66	2190.07
50	36.65	126.30	423.80	960.46	2078.95
100	37.33	112.62	379.64	878.81	1965.51
500	0.00	94.89	291.05	649.10	1553.87
			λ = 0.80, Δ = 0.50		
20	37.50	132.24	477.13	1057.89	2229.60
50	31.53	115.83	419.41	978.57	2080.17
100	27.62	93.09	360.98	828.38	1901.29
500	0.00	65.11	213.05	535.06	1368.62
			λ = 0.80, Δ = 1.00		
20	28.18	123.68	458.75	1057.99	2255.89
50	21.06	91.83	379.21	929.32	2053.55
100	12.28	62.02	299.95	714.48	1768.10
500	0.00	14.58	80.96	255.49	899.63
			λ = 0.80, Δ = 2.00		
20	12.88	78.38	384.64	966.62	2222.65
50	5.61	34.22	253.21	714.72	1777.82
100	2.93	12.22	107.71	357.15	988.10
500	0.00	1.71	2.58	19.98	110.17
			λ = 0.80, Δ = 3.00		
20	4.63	40.54	276.78	764.83	1880.02
50	1.41	14.83	99.77	403.83	1169.34
100	1.15	9.53	21.19	90.90	319.57
500	0.00	1.33	1.38	1.57	1.62

ssMEWMC Out-of-Control ARL_1 Charts

Table 597

Out of Control ARL_0 for ssMEWMC of Dimension 2 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	21.03	34.43	90.34	236.61	655.28
50	16.15	21.44	32.96	57.45	138.85
100	15.17	19.37	25.92	32.82	46.71
500	14.90	17.92	22.72	26.40	30.19
			$\lambda = 0.05, \Delta = 0.50$		
20	43.89	97.26	294.51	677.47	1544.14
50	31.96	61.58	181.61	465.18	1167.21
100	26.58	42.20	109.03	273.57	779.84
500	25.18	31.85	47.59	67.55	123.00
			$\lambda = 0.05, \Delta = 1.00$		
20	84.95	185.45	485.40	986.29	2004.70
50	84.03	182.60	480.26	986.18	2001.72
100	82.66	178.64	484.01	990.15	1994.75
500	74.92	190.84	481.88	977.40	1984.60
			$\lambda = 0.05, \Delta = 2.00$		
20	41.73	94.66	297.13	682.08	1531.25
50	23.41	43.77	126.44	321.33	833.73
100	17.63	25.86	53.86	117.28	322.49
500	15.63	18.70	25.02	31.22	38.56
			$\lambda = 0.05, \Delta = 3.00$		
20	19.28	41.96	146.51	389.53	1010.69
50	10.22	13.95	24.32	54.83	184.79
100	8.65	10.84	13.74	17.31	26.70
500	7.57	9.31	10.95	12.49	14.02

Table 598

Out of Control ARL_0 for ssMEWMC of Dimension 2 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	23.22	48.40	173.62	482.25	1254.69
50	15.87	23.74	56.37	175.48	623.57
100	14.40	19.29	30.98	63.51	227.16
500	15.68	16.92	23.09	29.52	40.98
			$\lambda = 0.10, \Delta = 0.50$		
20	53.38	128.49	385.44	847.35	1847.58
50	39.63	90.68	312.21	744.21	1727.15
100	31.06	67.28	229.01	623.50	1534.20
500	31.52	40.76	91.13	240.76	844.10
			$\lambda = 0.10, \Delta = 1.00$		
20	89.48	190.01	488.45	990.65	1993.24
50	89.65	189.66	492.83	988.29	2002.13
100	89.00	192.67	493.37	980.50	1997.67
500	76.49	200.98	495.02	976.76	1985.25
			$\lambda = 0.10, \Delta = 2.00$		
20	45.47	104.19	308.12	706.54	1579.11
50	26.04	52.65	155.50	385.24	1011.59
100	18.79	30.52	72.99	174.45	508.34
500	12.98	19.20	28.07	37.48	54.59
			$\lambda = 0.10, \Delta = 3.00$		
20	21.09	48.90	169.22	442.47	1145.20
50	10.22	15.75	35.19	97.19	321.92
100	8.63	10.87	15.23	22.89	54.02
500	6.21	8.94	10.99	12.53	14.22

Table 599

Out of Control ARL_0 for ssMEWMC of Dimension 2 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.20$, $\Delta = 0.25$				
20	36.14	97.83	377.92	904.85	1988.51
50	21.47	50.19	237.46	730.22	1835.38
100	17.06	30.95	132.23	504.49	1596.25
500	15.42	21.48	44.60	112.13	523.80
	$\lambda = 0.20$, $\Delta = 0.50$				
20	72.44	174.58	495.70	1038.36	2131.03
50	59.81	154.30	483.96	1037.66	2144.56
100	51.38	129.36	460.90	1040.57	2213.89
500	36.81	79.13	317.56	880.79	2219.76
	$\lambda = 0.20$, $\Delta = 1.00$				
20	93.67	198.27	504.90	999.70	2014.60
50	94.07	196.27	500.41	996.60	2013.19
100	94.12	196.88	500.43	992.74	2009.05
500	100.16	193.26	506.81	976.36	1996.41
	$\lambda = 0.20$, $\Delta = 2.00$				
20	48.68	110.67	331.82	752.05	1666.69
50	30.08	62.10	192.40	484.22	1203.11
100	21.86	38.26	100.26	268.50	733.44
500	16.97	21.64	35.46	54.68	112.68
	$\lambda = 0.20$, $\Delta = 3.00$				
20	25.15	61.01	208.29	533.77	1318.81
50	11.41	19.43	61.20	178.13	558.99
100	9.03	12.07	21.31	45.71	154.06
500	5.46	9.07	12.00	14.34	17.77

Table 600

Out of Control ARL$_0$ for ssMEWMC of Dimension 2 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	53.96	152.16	521.57	1103.62	2244.69
50	35.62	104.58	455.64	1084.86	2314.80
100	25.91	69.39	359.64	1006.40	2299.30
500	16.18	37.94	145.83	553.78	1800.45
			λ = 0.30, Δ = 0.50		
20	88.54	204.20	553.51	1115.16	2214.89
50	81.32	199.33	572.01	1167.65	2312.25
100	72.80	188.33	581.71	1215.28	2433.93
500	45.89	144.92	543.88	1263.06	2698.36
			λ = 0.30, Δ = 1.00		
20	96.81	200.04	508.08	1009.03	2010.21
50	95.70	200.62	504.56	1006.21	2002.92
100	95.93	202.48	506.97	996.50	1996.32
500	81.66	201.21	498.92	982.96	1998.51
			λ = 0.30, Δ = 2.00		
20	50.69	116.46	349.47	776.13	1693.71
50	31.83	68.27	215.22	533.89	1296.14
100	23.38	43.98	123.03	324.02	867.99
500	16.25	24.13	42.55	72.89	160.82
			λ = 0.30, Δ = 3.00		
20	27.77	69.06	236.13	584.18	1388.60
50	12.76	23.32	82.08	241.85	715.97
100	9.71	14.27	28.63	76.39	263.21
500	7.31	10.14	13.18	17.01	22.08

Table 601

Out of Control ARL_0 for ssMEWMC of Dimension 2 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	72.74	196.13	596.37	1218.58	2394.17
50	53.55	161.27	581.36	1273.84	2555.60
100	39.34	125.85	529.77	1278.74	2655.14
500	21.98	68.47	335.99	1025.40	2525.18
			λ = 0.40, Δ = 0.50		
20	98.77	224.78	591.94	1161.17	2285.15
50	97.34	228.58	617.95	1245.45	2431.89
100	93.42	228.31	650.31	1327.22	2575.27
500	66.79	203.91	661.36	1499.55	3005.79
			λ = 0.40, Δ = 1.00		
20	96.09	201.39	510.84	1017.90	2025.10
50	96.01	200.26	508.33	1014.40	2024.74
100	98.71	202.29	508.50	1014.50	2025.69
500	88.80	207.60	503.65	1006.62	2022.35
			λ = 0.40, Δ = 2.00		
20	52.34	119.44	361.69	801.01	1735.31
50	33.18	73.18	230.47	581.09	1365.72
100	24.71	47.46	142.29	366.54	963.61
500	15.08	25.99	47.85	87.44	199.59
			λ = 0.40, Δ = 3.00		
20	29.72	74.24	257.15	625.87	1464.42
50	14.34	27.04	99.51	284.27	826.45
100	10.38	15.57	37.05	101.19	352.79
500	7.68	10.73	14.73	19.41	27.42

Table 602

Out of Control ARL_0 for ssMEWMC of Dimension 2 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	88.27	222.82	637.59	1268.87	2465.62
50	71.31	200.67	652.17	1363.02	2694.49
100	55.07	177.93	642.36	1425.10	2855.74
500	28.07	103.76	493.65	1281.67	2984.19
			λ = 0.50, Δ = 0.50		
20	107.06	236.32	609.23	1176.03	2310.25
50	108.51	247.56	654.25	1281.17	2476.94
100	107.55	254.16	690.68	1370.92	2643.34
500	89.32	246.18	754.03	1595.14	3135.28
			λ = 0.50, Δ = 1.00		
20	95.57	200.29	508.94	1016.59	2022.09
50	96.80	199.35	509.92	1013.56	2024.26
100	96.75	199.92	512.60	1014.43	2025.43
500	88.01	196.90	506.34	1013.37	2027.10
			λ = 0.50, Δ = 2.00		
20	53.91	120.07	373.06	815.33	1749.86
50	34.43	76.36	246.93	596.08	1415.68
100	25.83	49.27	153.35	392.53	1036.71
500	17.67	28.07	53.00	102.31	239.25
			λ = 0.50, Δ = 3.00		
20	31.93	77.16	272.24	653.37	1515.30
50	15.33	30.43	114.11	322.69	901.04
100	10.69	16.73	43.26	125.66	419.77
500	7.76	11.48	15.90	21.61	33.86

Table 603

Out of Control ARL_0 for ssMEWMC of Dimension 2 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	100.78	241.97	658.92	1309.86	2514.54
50	87.34	231.93	696.98	1441.92	2769.77
100	74.64	216.58	710.03	1516.15	2954.19
500	47.59	151.88	608.36	1487.79	3248.77
			λ = 0.60, Δ = 0.50		
20	113.08	243.13	623.71	1208.57	2318.25
50	117.63	255.42	672.83	1320.22	2493.53
100	121.55	267.38	716.18	1415.91	2702.20
500	94.40	279.99	803.74	1682.80	3243.61
			λ = 0.60, Δ = 1.00		
20	95.60	197.58	507.07	1022.71	2020.19
50	96.64	197.21	504.59	1019.01	2007.65
100	98.23	197.27	509.03	1030.14	2013.20
500	82.40	199.65	497.78	1018.45	2025.54
			λ = 0.60, Δ = 2.00		
20	55.57	120.67	374.28	833.31	1756.16
50	36.18	78.24	250.66	624.11	1440.60
100	27.36	52.21	160.60	419.46	1070.72
500	19.28	30.58	57.35	116.02	266.13
			λ = 0.60, Δ = 3.00		
20	33.78	79.66	279.92	683.22	1535.08
50	16.52	33.43	123.06	354.13	960.81
100	11.39	18.47	51.18	149.85	469.57
500	8.89	11.90	17.31	24.41	37.61

Table 604

Out of Control ARL_0 for ssMEWMC of Dimension 2 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	116.73	261.19	694.29	1347.92	2527.19
50	109.41	263.98	763.55	1504.16	2830.27
100	99.20	260.35	805.09	1625.58	3064.81
500	77.91	217.12	773.54	1731.44	3546.42
	λ = 0.80, Δ = 0.50				
20	120.97	251.52	633.11	1210.49	2319.83
50	126.38	269.28	687.06	1338.96	2506.42
100	132.30	285.05	751.72	1454.04	2720.47
500	173.20	305.00	877.05	1770.56	3360.42
	λ = 0.80, Δ = 1.00				
20	94.86	194.68	506.12	1028.36	2007.69
50	95.68	194.69	508.43	1020.54	2010.83
100	98.26	195.98	505.92	1027.16	2008.57
500	106.25	196.46	495.50	1015.33	2043.44
	λ = 0.80, Δ = 2.00				
20	56.34	126.06	383.46	844.79	1765.88
50	38.34	82.66	271.11	638.89	1469.28
100	29.79	55.66	177.43	454.99	1115.70
500	19.34	29.87	63.63	129.88	307.52
	λ = 0.80, Δ = 3.00				
20	36.84	87.19	293.21	710.25	1562.75
50	18.13	38.65	145.31	392.00	1021.88
100	13.21	21.72	60.29	181.16	527.99
500	11.09	12.88	20.04	28.53	48.12

Table 605

Out of Control ARL_0 for ssMEWMC of Dimension 3 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	26.39	47.36	134.60	337.05	891.26
50	20.05	28.98	56.08	121.61	328.93
100	18.32	24.68	39.35	66.96	136.94
500	15.50	21.16	28.97	35.88	49.94
			$\lambda = 0.05, \Delta = 0.50$		
20	41.51	87.74	267.85	595.65	1355.61
50	30.84	57.84	170.14	415.79	999.63
100	26.84	43.78	108.67	276.74	714.81
500	20.71	33.07	51.04	81.29	171.67
			$\lambda = 0.05, \Delta = 1.00$		
20	82.17	181.78	494.51	1000.75	2048.93
50	79.80	174.44	484.46	990.76	2047.64
100	78.52	172.79	488.96	984.97	2050.57
500	78.70	185.20	484.02	976.66	2023.58
			$\lambda = 0.05, \Delta = 2.00$		
20	41.36	95.93	321.04	718.44	1654.26
50	23.88	46.53	144.21	362.71	949.41
100	18.04	29.17	64.89	149.15	427.84
500	12.91	19.83	26.26	34.06	46.26
			$\lambda = 0.05, \Delta = 3.00$		
20	20.44	46.66	173.29	453.95	1175.16
50	10.32	15.32	36.16	90.01	285.59
100	8.61	10.84	15.05	20.54	41.81
500	9.36	9.22	11.11	12.46	14.22

Table 606

Out of Control ARL_0 for ssMEWMC of Dimension 3 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	29.59	63.69	225.08	575.38	1350.65
50	20.77	34.50	104.92	311.44	859.69
100	18.37	27.26	59.16	153.33	474.46
500	15.11	21.81	35.28	50.60	95.43
			$\lambda = 0.10, \Delta = 0.50$		
20	48.73	109.22	337.59	761.12	1630.94
50	37.52	82.95	264.12	631.93	1421.68
100	31.38	63.56	211.81	518.46	1234.04
500	24.36	41.35	102.42	261.88	735.13
			$\lambda = 0.10, \Delta = 1.00$		
20	85.68	183.39	495.31	1017.86	2009.37
50	85.80	181.35	490.99	1012.38	2010.53
100	84.41	184.00	489.66	1001.22	1998.94
500	78.56	184.63	485.73	1005.97	2013.61
			$\lambda = 0.10, \Delta = 2.00$		
20	45.14	103.86	337.09	762.37	1671.89
50	26.86	54.43	177.43	450.03	1124.84
100	19.28	34.17	91.64	230.53	627.76
500	17.23	20.43	30.75	44.95	78.60
			$\lambda = 0.10, \Delta = 3.00$		
20	23.22	53.29	205.13	519.66	1254.54
50	10.85	17.58	52.92	149.33	446.80
100	8.39	11.23	18.16	36.64	110.19
500	9.00	8.77	10.86	12.84	14.96

Table 607

Out of Control ARL_0 for ssMEWMC of Dimension 3 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	42.81	109.71	370.71	838.35	1829.76
50	28.52	69.90	261.18	691.33	1624.99
100	23.26	48.71	178.48	530.64	1378.79
500	17.80	30.12	73.33	194.92	637.86
			$\lambda = 0.20, \Delta = 0.50$		
20	62.16	147.51	429.05	923.82	1935.68
50	52.58	124.63	385.09	867.26	1838.48
100	46.00	109.19	351.10	810.97	1787.75
500	37.23	77.85	262.36	651.91	1541.86
			$\lambda = 0.20, \Delta = 1.00$		
20	87.67	186.31	494.14	1006.47	2023.96
50	88.48	187.81	486.87	1000.35	2018.88
100	85.44	188.89	486.65	993.93	1989.94
500	82.61	186.61	495.62	995.15	1990.84
			$\lambda = 0.20, \Delta = 2.00$		
20	49.83	115.32	349.12	795.34	1714.80
50	30.62	68.01	213.89	537.33	1291.95
100	22.14	43.97	123.42	331.27	860.30
500	19.46	23.21	41.83	74.08	163.28
			$\lambda = 0.20, \Delta = 3.00$		
20	27.62	67.48	232.57	594.19	1399.55
50	12.76	25.42	82.94	245.13	677.24
100	8.96	13.54	30.62	82.60	257.51
500	5.83	9.38	12.47	15.73	20.51

Table 608

Out of Control ARL$_0$ for ssMEWMC of Dimension 3 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	57.01	146.10	457.44	975.77	2054.11
50	41.11	109.81	381.77	897.75	1982.26
100	32.39	84.52	316.45	794.18	1867.86
500	23.90	48.85	170.18	452.62	1302.13
			λ = 0.30, Δ = 0.50		
20	74.92	174.18	487.65	1010.50	2066.77
50	64.16	154.74	468.72	989.07	2042.72
100	60.19	145.27	437.65	963.09	2038.50
500	54.60	114.63	362.43	867.82	1926.32
			λ = 0.30, Δ = 1.00		
20	90.15	187.48	498.14	993.32	1991.99
50	88.58	187.38	491.40	990.00	1989.11
100	87.56	188.16	487.47	986.31	1969.95
500	89.15	196.45	491.53	979.41	1980.57
			λ = 0.30, Δ = 2.00		
20	52.07	119.14	361.75	805.62	1749.54
50	33.37	73.99	236.96	580.90	1391.48
100	24.71	48.68	145.33	386.29	984.41
500	17.80	25.86	52.94	101.22	232.27
			λ = 0.30, Δ = 3.00		
20	30.90	75.29	261.12	641.81	1487.54
50	14.66	30.22	103.88	295.02	848.47
100	10.07	16.52	41.29	114.61	372.83
500	7.06	9.91	14.24	18.95	27.25

Table 609

Out of Control ARL_0 for ssMEWMC of Dimension 3 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
	λ = 0.40, Δ = 0.25				
20	69.93	170.95	489.94	1067.86	2128.07
50	55.45	143.01	445.97	1019.80	2121.91
100	45.38	120.39	396.82	952.80	2094.87
500	28.44	80.01	255.94	664.80	1684.21
	λ = 0.40, Δ = 0.50				
20	83.34	190.68	509.13	1064.82	2116.61
50	75.66	179.33	502.27	1068.73	2145.69
100	71.97	169.90	484.07	1063.65	2192.82
500	52.31	141.31	436.43	1018.13	2171.00
	λ = 0.40, Δ = 1.00				
20	91.25	188.05	482.58	992.89	1983.88
50	89.65	188.53	479.48	988.18	1963.02
100	88.96	187.86	476.86	990.22	1973.95
500	101.94	193.23	478.06	975.18	1958.09
	λ = 0.40, Δ = 2.00				
20	53.95	124.58	360.49	820.91	1758.50
50	36.00	80.31	244.91	610.82	1436.28
100	26.45	53.74	157.10	421.60	1055.93
500	18.63	29.93	59.80	114.40	283.71
	λ = 0.40, Δ = 3.00				
20	33.48	81.24	269.36	671.29	1531.23
50	16.26	35.31	115.38	342.11	920.16
100	11.17	18.94	49.80	152.22	448.95
500	8.57	10.65	15.97	22.10	35.81

Table 610

Out of Control ARL_0 for ssMEWMC of Dimension 3 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	81.77	187.40	518.18	1107.66	2151.19
50	66.90	167.70	494.49	1095.48	2191.54
100	58.94	146.33	456.35	1057.25	2198.09
500	46.02	101.16	333.57	816.39	1917.08
			$\lambda = 0.50, \Delta = 0.50$		
20	91.68	199.97	530.58	1090.15	2123.62
50	87.30	196.28	534.92	1112.37	2176.85
100	83.88	191.30	530.64	1119.89	2256.17
500	77.13	165.69	499.18	1118.82	2306.46
			$\lambda = 0.50, \Delta = 1.00$		
20	92.83	188.99	481.43	996.58	1935.60
50	93.04	188.31	476.31	993.82	1943.65
100	91.23	187.93	471.08	989.12	1950.25
500	99.11	190.59	481.88	968.92	1937.27
			$\lambda = 0.50, \Delta = 2.00$		
20	56.22	128.07	365.35	835.05	1737.80
50	38.02	85.60	253.67	645.37	1431.61
100	29.20	56.61	168.49	451.14	1111.06
500	18.09	31.23	65.29	129.16	317.24
			$\lambda = 0.50, \Delta = 3.00$		
20	36.97	88.09	280.22	696.86	1538.61
50	17.97	38.66	128.64	383.59	959.83
100	12.32	20.92	58.70	171.68	507.05
500	9.41	11.37	17.83	25.73	45.13

Table 611

Out of Control ARL_0 for ssMEWMC of Dimension 3 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	88.75	200.58	555.25	1128.72	2204.85
50	76.73	184.63	540.68	1143.33	2261.92
100	69.01	167.02	510.16	1121.25	2318.44
500	56.63	126.56	406.14	930.60	2129.82
			λ = 0.60, Δ = 0.50		
20	96.93	207.60	553.51	1102.09	2156.90
50	94.54	207.93	564.25	1137.78	2218.56
100	92.11	205.85	572.00	1159.24	2312.53
500	94.98	182.46	548.18	1195.48	2464.07
			λ = 0.60, Δ = 1.00		
20	92.78	188.58	488.40	987.86	1947.70
50	93.85	188.68	482.73	985.72	1952.66
100	91.80	188.28	480.23	985.25	1938.30
500	118.88	197.32	491.27	977.99	1948.06
			λ = 0.60, Δ = 2.00		
20	57.06	128.17	378.19	836.99	1745.95
50	39.01	87.57	269.51	654.68	1457.85
100	30.22	59.59	185.19	473.18	1145.98
500	25.46	32.63	70.12	143.84	356.72
			λ = 0.60, Δ = 3.00		
20	38.11	91.09	298.05	707.56	1540.51
50	19.13	41.90	143.34	408.54	1019.41
100	12.81	22.43	66.02	192.16	571.17
500	9.73	12.13	19.23	29.46	53.17

Table 612

Out of Control ARL_0 for ssMEWMC of Dimension 3 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	99.51	219.14	572.62	1172.41	2243.74
50	91.00	209.12	583.66	1204.33	2341.47
100	83.15	197.17	570.28	1211.01	2440.14
500	79.51	157.09	478.75	1091.99	2400.93
			λ = 0.80, Δ = 0.50		
20	104.06	224.05	563.70	1135.27	2192.59
50	102.57	226.13	584.21	1181.23	2289.56
100	101.10	226.61	598.21	1217.16	2386.79
500	96.66	220.94	595.23	1276.47	2591.45
			λ = 0.80, Δ = 1.00		
20	92.84	190.82	481.19	993.41	1951.86
50	93.97	192.94	480.97	997.69	1961.63
100	92.37	188.90	477.02	989.24	1947.20
500	128.53	193.88	473.91	995.04	1940.48
			λ = 0.80, Δ = 2.00		
20	59.97	135.68	378.34	843.66	1758.29
50	42.52	93.89	280.00	677.84	1498.37
100	33.53	65.54	197.49	499.15	1192.72
500	16.55	39.25	80.46	169.61	400.33
			λ = 0.80, Δ = 3.00		
20	41.87	99.05	305.51	724.38	1591.18
50	21.86	48.15	164.49	450.82	1106.42
100	14.51	26.60	80.07	228.90	648.72
500	9.41	14.76	22.75	37.12	65.21

Table 613

Out of Control ARL_0 for ssMEWMC of Dimension 4 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.05$, $\Delta = 0.25$				
20	31.08	59.31	178.42	429.18	1014.93
50	22.82	35.42	83.97	187.10	491.68
100	20.57	29.22	50.63	97.42	232.96
500	18.36	24.24	32.38	43.47	66.90
	$\lambda = 0.05$, $\Delta = 0.50$				
20	40.52	81.72	240.14	545.06	1246.04
50	31.17	57.34	161.95	370.05	885.22
100	27.56	44.65	108.36	247.68	627.68
500	24.91	33.56	57.09	90.48	185.70
	$\lambda = 0.05$, $\Delta = 1.00$				
20	81.97	181.62	490.45	985.56	2017.60
50	78.78	172.89	480.86	987.37	2018.85
100	79.73	175.35	484.42	980.53	2021.76
500	99.95	178.17	479.08	960.18	1987.23
	$\lambda = 0.05$, $\Delta = 2.00$				
20	41.43	100.94	323.90	742.13	1648.23
50	23.36	48.47	157.62	383.29	1002.65
100	17.72	28.69	70.18	169.12	482.12
500	12.10	18.48	27.07	35.98	50.14
	$\lambda = 0.05$, $\Delta = 3.00$				
20	20.85	51.45	189.03	479.16	1203.94
50	10.31	16.40	39.52	107.44	327.88
100	8.26	10.85	15.67	24.32	60.28
500	6.19	8.97	11.12	12.66	14.10

Table 614

Out of Control ARL_0 for ssMEWMC of Dimension 4 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	34.19	76.40	254.77	606.00	1367.71
50	25.08	46.10	137.19	366.96	942.08
100	21.54	33.79	81.11	213.07	579.07
500	19.13	25.50	41.74	69.91	156.86
			$\lambda = 0.10, \Delta = 0.50$		
20	46.21	100.81	309.17	682.90	1509.29
50	36.36	76.76	230.39	546.44	1230.80
100	32.64	61.79	183.05	442.80	1038.72
500	23.72	46.06	100.31	238.26	582.13
			$\lambda = 0.10, \Delta = 1.00$		
20	86.50	182.32	488.29	977.40	1963.95
50	85.60	180.98	485.68	975.39	1965.49
100	84.88	183.38	484.51	979.63	1964.99
500	77.33	189.27	483.44	981.32	1946.83
			$\lambda = 0.10, \Delta = 2.00$		
20	44.34	107.93	344.46	751.65	1659.73
50	26.47	57.15	192.92	472.66	1147.09
100	19.61	33.66	95.79	251.54	668.56
500	16.11	20.15	32.41	49.86	85.68
			$\lambda = 0.10, \Delta = 3.00$		
20	23.35	58.87	213.51	525.96	1274.89
50	10.98	19.01	57.53	167.82	501.96
100	8.43	11.61	20.70	46.63	131.48
500	8.66	9.08	10.99	13.06	15.24

Table 615

Out of Control ARL_0 for ssMEWMC of Dimension 4 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	48.64	114.96	370.69	819.55	1798.30
50	34.77	78.27	271.53	672.90	1580.50
100	27.87	55.56	191.70	510.79	1306.19
500	20.62	37.10	91.37	207.30	616.13
	λ = 0.20, Δ = 0.50				
20	59.51	134.82	399.26	866.67	1821.26
50	50.05	111.79	350.20	781.14	1698.71
100	45.07	98.05	306.25	710.97	1581.61
500	35.36	76.06	213.14	504.18	1190.48
	λ = 0.20, Δ = 1.00				
20	89.84	186.49	486.64	986.10	1985.01
50	90.33	185.80	489.00	984.73	1996.64
100	89.81	188.69	490.26	997.53	1992.04
500	83.67	187.35	481.10	996.10	1987.40
	λ = 0.20, Δ = 2.00				
20	50.90	116.36	357.23	816.45	1736.92
50	31.28	70.13	229.11	577.65	1360.41
100	23.07	45.74	137.00	372.35	948.19
500	16.29	25.22	43.56	78.82	193.94
	λ = 0.20, Δ = 3.00				
20	28.56	70.77	248.75	632.93	1453.71
50	13.42	26.88	92.33	283.54	778.94
100	9.47	14.32	35.47	100.13	328.19
500	8.10	9.89	12.62	16.47	21.62

Table 616

Out of Control ARL_0 for ssMEWMC of Dimension 4 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	60.72	141.41	432.83	939.26	1992.20
50	46.24	107.84	358.04	836.35	1879.23
100	38.06	86.56	286.31	722.39	1708.21
500	30.31	56.59	160.71	395.51	1056.37
			λ = 0.30, Δ = 0.50		
20	70.16	159.54	456.13	964.93	2001.25
50	61.19	142.55	417.99	918.38	1923.01
100	56.84	128.55	393.14	868.74	1860.59
500	65.74	107.46	311.13	691.35	1592.69
			λ = 0.30, Δ = 1.00		
20	92.04	189.22	485.30	990.47	1999.35
50	92.59	190.69	487.66	990.61	2012.94
100	91.09	192.22	486.65	999.09	2003.35
500	121.90	200.28	497.23	995.13	2029.01
			λ = 0.30, Δ = 2.00		
20	54.98	124.93	372.96	833.59	1784.85
50	35.85	79.63	258.42	630.81	1455.41
100	26.46	52.30	163.75	431.58	1071.45
500	22.54	29.67	54.52	111.04	270.29
			λ = 0.30, Δ = 3.00		
20	32.94	81.78	280.90	673.11	1525.34
50	15.54	33.72	128.92	355.49	924.95
100	10.88	18.24	52.95	154.57	456.02
500	8.35	10.69	15.00	20.84	34.44

Table 617

Out of Control ARL_0 for ssMEWMC of Dimension 4 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	68.74	163.10	464.59	998.58	2090.49
50	55.17	136.55	413.90	935.74	2025.30
100	47.06	112.29	357.62	853.12	1915.82
500	45.54	84.32	225.50	538.64	1388.23
			λ = 0.40, Δ = 0.50		
20	76.66	177.25	485.28	1018.11	2094.31
50	68.44	163.18	464.55	997.78	2075.89
100	64.20	152.50	444.85	965.47	2042.29
500	64.15	127.02	376.81	814.81	1851.56
			λ = 0.40, Δ = 1.00		
20	90.65	190.33	483.34	995.32	1989.95
50	92.19	190.51	486.63	989.52	2007.65
100	91.38	195.45	491.99	997.77	2010.19
500	102.17	191.01	497.95	1003.40	2023.73
			λ = 0.40, Δ = 2.00		
20	56.15	131.53	376.61	848.65	1786.59
50	37.50	86.40	274.45	662.06	1494.45
100	28.18	57.76	184.71	469.39	1158.78
500	16.48	32.08	60.89	131.44	333.37
			λ = 0.40, Δ = 3.00		
20	35.57	90.45	291.16	703.96	1574.17
50	17.30	40.32	147.50	400.76	1010.76
100	12.06	21.41	64.64	191.28	552.25
500	6.32	11.26	16.98	24.62	46.40

Table 618

Out of Control ARL_0 for ssMEWMC of Dimension 4 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	75.85	176.91	486.78	1043.91	2114.61
50	63.22	152.87	448.87	1000.60	2085.06
100	55.52	131.97	401.55	951.31	2030.17
500	50.76	98.81	278.45	653.83	1582.47
			$\lambda = 0.50, \Delta = 0.50$		
20	83.04	187.94	510.48	1059.39	2114.18
50	77.13	175.03	497.58	1048.74	2152.65
100	72.23	167.98	478.36	1035.30	2152.87
500	76.28	149.13	423.57	925.79	2007.05
			$\lambda = 0.50, \Delta = 1.00$		
20	91.81	189.38	483.46	991.60	1977.10
50	93.81	191.01	483.81	994.79	1994.86
100	90.89	193.29	490.55	1000.61	2004.76
500	94.49	194.22	500.32	996.70	1990.04
			$\lambda = 0.50, \Delta = 2.00$		
20	58.49	133.56	386.74	860.36	1801.67
50	39.47	92.36	286.00	679.70	1520.92
100	30.22	62.55	194.95	500.93	1203.15
500	22.45	31.42	67.79	152.35	377.84
			$\lambda = 0.50, \Delta = 3.00$		
20	37.77	96.24	307.49	723.55	1594.46
50	19.25	44.38	162.25	426.47	1071.26
100	13.04	23.99	72.80	221.85	622.62
500	8.64	11.95	18.92	29.25	55.63

Table 619

Out of Control ARL_0 for ssMEWMC of Dimension 4 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	81.33	184.61	502.78	1056.58	2155.49
50	70.78	165.62	475.04	1028.59	2147.99
100	63.63	146.37	432.71	998.27	2118.75
500	52.47	109.21	320.15	734.25	1730.66
			λ = 0.60, Δ = 0.50		
20	87.87	196.85	522.08	1077.92	2157.18
50	83.91	186.77	519.29	1075.10	2208.27
100	79.70	180.16	504.89	1067.47	2222.32
500	62.79	168.32	452.84	982.25	2153.07
			λ = 0.60, Δ = 1.00		
20	91.73	190.56	483.72	980.69	1995.21
50	93.14	194.79	488.00	989.79	2001.44
100	91.85	194.93	492.02	991.66	2000.76
500	100.90	201.89	505.52	1005.09	2010.12
			λ = 0.60, Δ = 2.00		
20	58.99	138.09	388.63	851.26	1824.75
50	40.21	94.78	296.11	679.11	1552.34
100	31.40	66.85	209.04	505.86	1239.60
500	21.84	35.73	71.56	163.87	417.14
			λ = 0.60, Δ = 3.00		
20	38.99	100.37	312.94	721.74	1629.82
50	20.75	47.27	171.41	441.98	1145.71
100	13.64	25.64	80.83	240.98	677.16
500	7.02	12.92	20.56	31.59	72.40

Table 620

Out of Control ARL_0 for ssMEWMC of Dimension 4 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	88.90	201.96	522.04	1064.10	2161.51
50	80.79	184.46	502.98	1061.01	2215.71
100	72.73	168.94	471.90	1045.06	2234.02
500	52.44	137.19	370.31	879.44	1965.27
	λ = 0.80, Δ = 0.50				
20	94.85	211.88	532.75	1084.35	2171.00
50	90.94	205.24	539.38	1100.08	2249.67
100	88.58	200.85	533.55	1125.71	2321.24
500	77.00	191.61	505.31	1079.98	2343.87
	λ = 0.80, Δ = 1.00				
20	91.67	196.59	480.71	964.08	1992.49
50	92.81	196.35	480.68	971.98	1993.95
100	91.19	197.46	487.93	970.53	1994.72
500	101.34	192.81	484.89	984.82	2004.48
	λ = 0.80, Δ = 2.00				
20	62.26	144.62	393.21	851.58	1823.99
50	43.38	101.66	302.35	692.20	1588.18
100	32.48	71.54	218.30	538.46	1298.08
500	22.64	36.60	82.59	185.13	463.09
	λ = 0.80, Δ = 3.00				
20	42.93	105.30	324.93	740.04	1651.38
50	23.08	53.58	183.60	475.00	1187.43
100	14.69	30.64	94.53	265.15	735.97
500	9.29	14.29	23.56	40.05	89.30

Table 621

Out of Control ARL_0 for ssMEWMC of Dimension 5 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	32.93	65.69	191.30	458.76	1111.26
50	23.25	37.30	90.49	213.49	550.62
100	20.35	29.57	54.48	106.82	259.09
500	23.93	25.36	34.17	45.67	68.80
			λ = 0.05, Δ = 0.50		
20	40.01	80.94	237.23	536.42	1200.17
50	30.69	55.22	150.94	355.47	856.15
100	27.70	45.44	107.07	244.63	593.97
500	31.86	36.41	58.06	92.72	203.90
			λ = 0.05, Δ = 1.00		
20	78.47	177.03	476.92	988.48	2007.66
50	73.81	171.22	473.45	980.97	1985.34
100	74.72	171.71	480.06	977.52	1957.03
500	112.50	163.53	478.81	993.04	1985.76
			λ = 0.05, Δ = 2.00		
20	40.07	100.45	320.66	745.49	1643.05
50	21.97	47.92	155.49	388.08	963.29
100	17.04	28.86	71.64	184.90	487.19
500	20.50	18.32	26.83	35.79	55.59
			λ = 0.05, Δ = 3.00		
20	21.14	52.61	194.99	502.41	1209.09
50	10.26	16.68	40.74	117.08	341.98
100	8.03	10.69	16.73	29.58	74.36
500	10.69	9.00	10.75	12.11	13.64

Table 622

Out of Control ARL_0 for ssMEWMC of Dimension 5 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	37.04	82.96	259.02	619.97	1436.46
50	26.14	48.99	146.99	380.21	965.21
100	21.79	35.52	89.08	219.70	624.64
500	18.52	26.88	43.92	74.08	161.38
			$\lambda = 0.10, \Delta = 0.50$		
20	44.28	99.53	296.18	672.05	1499.02
50	35.29	72.96	219.84	513.06	1186.10
100	31.27	59.29	171.92	402.17	975.12
500	32.52	43.61	94.04	213.47	527.39
			$\lambda = 0.10, \Delta = 1.00$		
20	80.98	181.67	481.07	974.85	2005.00
50	79.68	179.50	477.46	976.35	1976.38
100	79.28	180.93	484.34	969.50	1974.45
500	70.33	178.98	490.81	983.49	1985.89
			$\lambda = 0.10, \Delta = 2.00$		
20	44.28	108.55	335.19	759.93	1689.27
50	25.37	59.74	189.81	479.22	1183.10
100	18.74	36.34	105.43	276.70	719.28
500	9.83	20.36	32.40	54.23	116.56
			$\lambda = 0.10, \Delta = 3.00$		
20	23.66	61.28	223.24	549.94	1324.72
50	11.02	21.47	63.95	185.48	540.52
100	8.26	11.36	24.53	53.69	176.48
500	8.82	8.83	10.59	13.15	15.51

Table 623

Out of Control ARL_0 for ssMEWMC of Dimension 5 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	47.95	116.05	363.87	802.98	1730.76
50	33.69	79.27	262.77	635.52	1457.06
100	27.43	57.81	191.53	470.29	1172.65
500	23.74	38.96	88.86	207.15	543.23
	λ = 0.20, Δ = 0.50				
20	55.10	130.10	392.07	835.48	1777.79
50	45.39	105.93	328.83	734.90	1604.51
100	41.13	88.04	277.97	636.04	1457.93
500	40.34	71.96	187.43	424.30	1000.78
	λ = 0.20, Δ = 1.00				
20	85.71	185.48	487.98	976.36	1958.97
50	84.97	184.06	488.99	970.90	1940.40
100	86.04	182.97	482.46	968.51	1945.24
500	80.06	181.29	485.80	978.22	1953.90
	λ = 0.20, Δ = 2.00				
20	48.70	121.54	364.83	787.99	1694.43
50	31.24	71.59	237.60	568.57	1315.72
100	23.16	45.58	150.38	374.01	940.85
500	22.82	23.64	47.19	90.97	235.06
	λ = 0.20, Δ = 3.00				
20	29.40	74.87	262.22	632.85	1437.97
50	13.61	28.78	105.22	289.87	753.33
100	9.35	14.80	41.44	116.86	342.96
500	8.68	9.27	12.36	16.45	24.49

Table 624

Out of Control ARL_0 for ssMEWWMC of Dimension 5 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	57.29	136.46	414.16	897.68	1878.20
50	43.18	103.25	337.53	773.06	1702.75
100	34.72	79.90	265.09	638.90	1480.90
500	26.83	57.62	142.96	344.73	893.65
			λ = 0.30, Δ = 0.50		
20	65.54	150.65	432.97	930.81	1918.18
50	56.47	129.52	392.00	850.95	1820.80
100	51.46	112.10	342.72	791.76	1734.48
500	55.14	90.94	249.62	597.81	1332.19
			λ = 0.30, Δ = 1.00		
20	88.80	186.40	487.64	981.98	1967.42
50	87.85	184.79	486.35	979.77	1953.28
100	90.08	185.36	483.31	980.74	1952.76
500	92.90	178.77	484.61	991.77	1940.54
			λ = 0.30, Δ = 2.00		
20	53.44	126.52	376.81	810.69	1734.02
50	34.53	80.18	260.11	618.12	1415.14
100	26.23	55.59	171.22	427.59	1083.39
500	22.34	26.66	56.94	121.52	319.08
			λ = 0.30, Δ = 3.00		
20	33.90	85.15	285.77	676.17	1520.85
50	15.92	36.98	127.82	356.36	913.97
100	10.75	18.36	57.99	163.02	467.25
500	7.33	10.46	15.35	21.09	40.36

Table 625

Out of Control ARL_0 for ssMEWMC of Dimension 5 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	65.76	153.40	448.57	953.94	1993.54
50	52.40	123.04	386.62	863.82	1869.22
100	42.66	100.36	319.87	740.44	1689.50
500	31.58	69.91	202.27	452.36	1149.39
			λ = 0.40, Δ = 0.50		
20	73.37	166.84	468.62	976.94	2023.34
50	65.30	147.96	436.95	930.75	1974.32
100	58.97	132.33	393.29	888.06	1900.00
500	50.67	108.62	319.84	709.56	1596.30
			λ = 0.40, Δ = 1.00		
20	90.07	189.61	488.61	979.58	2006.15
50	89.18	188.12	490.31	982.28	1998.53
100	90.51	186.10	489.70	981.79	1988.70
500	102.11	186.93	497.42	994.10	1987.03
			λ = 0.40, Δ = 2.00		
20	55.89	131.32	381.79	828.07	1777.20
50	37.72	87.87	276.78	643.69	1506.57
100	28.28	60.87	191.57	464.72	1160.12
500	20.08	31.11	68.55	142.79	375.56
			λ = 0.40, Δ = 3.00		
20	36.95	91.71	303.18	700.66	1601.13
50	18.37	43.27	149.65	391.44	1030.17
100	11.67	21.81	71.74	197.59	572.57
500	5.73	11.76	17.64	27.35	56.76

Table 626

Out of Control ARL$_0$ for ssMEWMC of Dimension 5 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	70.28	163.18	469.99	993.39	19975.00
50	57.75	135.09	414.84	932.08	19945.00
100	49.55	114.29	357.17	817.47	19895.00
500	35.76	77.92	237.54	550.84	19487.21
			$\lambda = 0.50, \Delta = 0.50$		
20	77.94	176.87	485.77	1024.16	19975.00
50	71.81	158.82	468.29	988.96	19945.00
100	65.66	148.28	435.06	961.45	19895.00
500	66.00	120.55	363.63	787.89	19491.10
			$\lambda = 0.50, \Delta = 1.00$		
20	90.51	187.03	485.47	996.87	19975.00
50	89.97	185.41	485.66	986.23	19945.00
100	88.66	188.53	488.48	997.05	19895.00
500	101.40	175.57	498.45	979.71	19495.00
			$\lambda = 0.50, \Delta = 2.00$		
20	57.64	135.10	387.61	845.55	19975.00
50	39.82	93.03	286.97	664.17	19945.00
100	29.58	64.97	202.92	489.49	19895.00
500	19.55	33.29	74.09	164.82	19479.41
			$\lambda = 0.50, \Delta = 3.00$		
20	39.21	96.92	311.54	721.09	19975.00
50	20.11	47.26	162.00	432.26	19943.01
100	12.64	23.68	79.44	225.79	19881.07
500	7.70	11.72	19.58	33.12	19261.09

Table 627

Out of Control ARL$_0$ for ssMEWMC of Dimension 5 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	75.53	170.38	479.06	1003.49	2060.72
50	62.99	145.98	432.41	946.32	2008.74
100	55.59	125.62	382.59	859.42	1876.39
500	43.00	89.26	265.22	614.40	1431.84
			λ = 0.60, Δ = 0.50		
20	82.43	182.30	497.32	1036.09	2103.16
50	76.30	170.49	481.10	1009.98	2090.09
100	71.37	160.89	457.13	994.40	2059.65
500	76.58	137.64	395.87	842.59	1871.18
			λ = 0.60, Δ = 1.00		
20	90.93	186.83	488.38	988.89	1994.04
50	91.04	187.22	485.47	982.49	1986.54
100	89.24	189.25	484.29	988.07	1999.27
500	104.17	186.84	499.25	987.86	1978.06
			λ = 0.60, Δ = 2.00		
20	58.80	134.98	390.82	841.64	1789.94
50	40.95	95.73	297.91	673.83	1529.24
100	31.74	68.12	209.80	509.77	1216.49
500	26.31	34.20	82.65	175.49	443.72
			λ = 0.60, Δ = 3.00		
20	40.82	101.79	319.36	724.95	1623.82
50	21.21	51.42	175.61	450.46	1122.02
100	13.85	26.63	89.05	245.33	677.16
500	6.46	12.17	22.48	37.06	79.49

Table 628

Out of Control ARL_0 for ssMEWMC of Dimension 5 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	81.27	183.29	492.26	1028.89	2100.62
50	70.21	162.90	461.49	976.99	2042.80
100	62.16	143.77	418.47	910.14	1964.10
500	48.03	113.32	306.79	715.68	1568.92
			$\lambda = 0.80, \Delta = 0.50$		
20	86.96	196.57	512.78	1051.43	2117.56
50	83.59	188.29	505.64	1047.93	2153.36
100	77.50	179.94	493.22	1038.51	2138.63
500	62.21	167.06	429.99	925.25	2026.58
			$\lambda = 0.80, \Delta = 1.00$		
20	90.34	188.94	483.19	975.64	1994.92
50	90.83	190.98	486.41	973.05	1976.27
100	89.93	192.52	490.21	982.47	1986.07
500	79.53	205.86	489.64	982.50	1973.17
			$\lambda = 0.80, \Delta = 2.00$		
20	59.83	138.60	396.07	851.63	1817.96
50	42.94	101.33	307.28	700.70	1552.68
100	32.64	72.76	222.05	537.33	1282.44
500	20.67	38.94	87.18	187.43	489.88
			$\lambda = 0.80, \Delta = 3.00$		
20	43.41	107.14	328.11	744.42	1640.26
50	22.91	57.47	192.74	493.60	1172.43
100	14.68	30.91	102.10	274.18	751.45
500	9.39	14.27	25.44	43.03	96.29

Table 629

Out of Control ARL_0 for ssMEWMC of Dimension 6 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	32.51	65.56	196.01	482.37	1160.28
50	21.72	36.12	86.47	207.17	560.20
100	19.11	28.74	51.80	103.27	263.39
500	18.91	22.83	32.40	43.37	72.38
			$\lambda = 0.05, \Delta = 0.50$		
20	38.52	79.90	229.81	530.02	1192.66
50	28.96	52.64	138.35	331.49	786.93
100	25.26	42.43	94.97	209.21	521.52
500	24.09	34.07	55.06	89.56	182.12
			$\lambda = 0.05, \Delta = 1.00$		
20	75.67	171.87	470.50	968.58	1984.49
50	72.16	166.66	460.57	971.68	1980.14
100	71.93	168.03	455.44	964.42	1975.21
500	79.64	174.54	460.97	963.57	1983.42
			$\lambda = 0.05, \Delta = 2.00$		
20	37.89	96.81	318.24	746.29	1633.25
50	21.00	45.44	150.16	397.02	980.21
100	15.75	28.42	68.50	173.43	508.65
500	17.27	18.79	26.33	33.94	56.98
			$\lambda = 0.05, \Delta = 3.00$		
20	20.58	53.40	195.01	512.76	1246.78
50	9.91	16.34	42.92	122.11	374.33
100	7.80	10.39	15.82	28.36	80.04
500	6.27	8.36	10.45	11.65	13.16

Table 630

Out of Control ARL_0 for ssMEWMC of Dimension 6 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	36.06	82.22	258.52	625.24	1485.16
50	24.36	46.79	142.98	360.44	981.61
100	20.63	34.54	84.52	209.95	591.19
500	11.84	25.65	41.58	70.46	154.00
	λ = 0.10, Δ = 0.50				
20	43.14	96.58	289.56	638.34	1478.74
50	33.22	68.48	204.72	475.85	1150.97
100	29.35	55.82	153.93	351.48	873.72
500	16.11	42.86	88.57	175.70	423.10
	λ = 0.10, Δ = 1.00				
20	80.23	179.68	473.34	978.50	2022.39
50	80.97	180.02	475.95	972.51	2044.80
100	79.13	178.60	477.82	963.93	2035.34
500	65.85	168.92	483.44	966.79	2030.38
	λ = 0.10, Δ = 2.00				
20	43.51	109.13	336.82	767.31	1714.29
50	25.68	57.99	195.54	488.15	1219.43
100	17.47	35.03	104.83	270.52	755.81
500	16.56	20.52	31.52	55.27	133.66
	λ = 0.10, Δ = 3.00				
20	23.09	61.83	221.68	558.35	1358.02
50	11.20	21.02	69.77	194.66	581.26
100	8.07	11.63	23.30	56.61	194.48
500	4.71	8.65	10.81	12.41	16.28

Table 631

Out of Control ARL_0 for ssMEWMC of Dimension 6 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	46.65	112.83	360.23	795.56	1726.35
50	31.62	72.70	243.13	597.22	1384.28
100	26.52	53.53	170.22	433.57	1079.33
500	18.70	36.07	80.51	174.15	444.67
			$\lambda = 0.20, \Delta = 0.50$		
20	53.17	123.24	373.66	806.43	1738.74
50	42.88	98.88	298.51	686.63	1530.72
100	37.24	80.05	240.64	563.04	1315.60
500	38.59	55.26	165.56	346.60	827.39
			$\lambda = 0.20, \Delta = 1.00$		
20	85.23	185.13	489.47	980.94	1965.59
50	86.13	185.94	493.37	976.63	1982.76
100	84.41	181.88	494.99	978.38	1951.64
500	82.89	185.99	509.36	983.97	1969.67
			$\lambda = 0.20, \Delta = 2.00$		
20	49.38	119.89	368.17	800.70	1737.64
50	31.20	75.95	245.49	579.52	1340.71
100	22.24	45.86	153.82	381.06	930.24
500	18.00	23.45	49.26	98.38	247.19
			$\lambda = 0.20, \Delta = 3.00$		
20	28.85	77.39	274.33	627.64	1449.51
50	14.11	31.91	118.54	309.98	795.42
100	9.48	15.08	44.83	127.49	361.83
500	7.83	9.83	13.00	17.36	30.47

Table 632

Out of Control ARL_0 for ssMEWMC of Dimension 6 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	55.64	131.40	408.48	889.93	1893.93
50	40.12	96.21	309.24	723.01	1650.68
100	32.65	70.92	235.55	577.44	1383.04
500	29.77	47.42	125.77	299.80	758.09
	λ = 0.30, Δ = 0.50				
20	62.15	142.26	417.39	899.99	1917.81
50	51.81	116.78	359.53	817.89	1804.33
100	46.01	100.53	303.88	705.84	1633.80
500	52.87	80.96	215.49	491.19	1174.03
	λ = 0.30, Δ = 1.00				
20	87.02	188.23	487.86	994.30	2007.10
50	87.71	185.88	487.60	998.67	2017.91
100	86.63	182.71	490.75	1004.98	2014.48
500	110.00	197.25	504.94	990.40	2044.62
	λ = 0.30, Δ = 2.00				
20	53.26	126.96	388.66	840.62	1799.95
50	35.80	83.57	268.29	647.93	1463.40
100	24.69	54.37	177.61	441.30	1087.78
500	19.69	30.98	60.35	136.24	324.31
	λ = 0.30, Δ = 3.00				
20	33.91	87.72	298.01	697.22	1572.11
50	16.97	40.15	145.76	378.74	940.08
100	10.50	19.94	64.30	173.59	504.08
500	9.22	10.83	15.82	24.99	55.89

Table 633

Out of Control ARL_0 for ssMEWMC of Dimension 6 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	62.41	146.66	438.69	940.77	1945.30
50	47.25	110.94	352.58	810.53	1731.39
100	39.55	87.47	285.03	678.88	1530.84
500	36.91	57.81	158.88	383.95	944.60
			$\lambda = 0.40, \Delta = 0.50$		
20	69.36	156.84	452.83	962.39	1996.99
50	61.03	133.34	403.30	894.82	1893.28
100	53.88	118.05	351.23	809.57	1779.36
500	44.94	98.27	261.34	589.30	1353.17
			$\lambda = 0.40, \Delta = 1.00$		
20	88.77	187.24	494.94	997.06	1989.17
50	89.22	186.65	493.67	1007.39	1983.40
100	89.26	187.55	487.56	998.42	1989.76
500	88.24	196.05	505.62	1004.60	2017.42
			$\lambda = 0.40, \Delta = 2.00$		
20	56.23	133.13	395.11	865.29	1784.83
50	39.35	89.02	288.34	672.98	1502.34
100	27.08	61.06	194.23	475.09	1166.78
500	22.09	31.67	68.58	149.98	382.12
			$\lambda = 0.40, \Delta = 3.00$		
20	37.53	95.74	317.23	724.65	1593.44
50	19.64	46.14	163.72	423.29	1046.05
100	11.79	23.36	76.33	210.08	604.51
500	11.27	12.52	18.56	30.77	73.50

Table 634

Out of Control ARL$_0$ for ssMEWMC of Dimension 6 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	66.44	154.30	453.32	951.27	2013.56
50	52.54	120.44	376.21	833.64	1822.16
100	42.93	99.07	312.97	719.15	1642.32
500	29.34	72.04	192.79	437.70	1063.29
			λ = 0.50, Δ = 0.50		
20	74.03	163.83	470.05	978.35	2033.89
50	64.72	143.69	430.61	924.55	1964.69
100	59.38	129.55	380.50	851.73	1862.73
500	45.48	110.12	293.75	645.38	1488.85
			λ = 0.50, Δ = 1.00		
20	88.35	184.36	494.35	987.35	2011.23
50	88.85	183.18	489.68	991.73	2009.43
100	88.94	184.56	494.96	982.38	2023.71
500	92.32	193.35	499.39	984.78	2010.89
			λ = 0.50, Δ = 2.00		
20	57.63	133.67	396.43	861.33	1814.13
50	40.13	92.91	294.31	682.95	1539.99
100	29.09	63.94	199.96	502.83	1212.83
500	20.14	34.23	74.79	162.63	421.06
			λ = 0.50, Δ = 3.00		
20	38.92	97.84	321.36	731.32	1633.06
50	21.38	48.85	175.41	446.09	1104.98
100	13.41	26.60	87.45	236.01	653.79
500	9.86	14.31	20.61	34.53	87.37

Table 635

Out of Control ARL$_0$ for ssMEWMC of Dimension 6 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
	λ = 0.60, Δ = 0.25				
20	69.94	161.59	464.84	956.46	2025.93
50	56.80	129.26	394.14	855.18	1859.62
100	46.72	107.26	336.19	744.00	1703.24
500	41.31	74.44	213.04	472.38	1158.90
	λ = 0.60, Δ = 0.50				
20	77.18	173.32	477.55	998.43	2054.89
50	68.05	153.98	441.70	940.89	2010.95
100	63.48	140.00	409.84	889.41	1957.34
500	35.74	117.82	320.56	715.57	1604.70
	λ = 0.60, Δ = 1.00				
20	88.38	185.74	496.57	973.47	2002.26
50	88.26	184.65	493.16	987.70	2001.55
100	87.62	185.51	493.27	986.40	2001.81
500	82.43	193.51	496.96	984.06	2020.32
	λ = 0.60, Δ = 2.00				
20	58.28	136.00	401.51	861.01	1825.77
50	41.68	95.22	300.86	693.46	1558.14
100	29.40	68.53	207.11	520.16	1252.52
500	16.48	34.77	80.80	172.38	459.09
	λ = 0.60, Δ = 3.00				
20	40.10	100.74	327.14	738.05	1653.63
50	22.73	52.57	188.29	465.39	1157.57
100	14.03	28.54	95.69	251.23	703.51
500	7.03	14.22	22.70	40.89	100.96

Table 636

Out of Control ARL_0 for ssMEWMC of Dimension 6 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	74.69	168.91	478.81	992.16	2070.05
50	61.19	139.83	418.68	897.21	1945.28
100	52.58	118.52	360.76	809.45	1802.18
500	45.51	90.92	245.03	552.41	1318.60
			$\lambda = 0.80, \Delta = 0.50$		
20	82.27	178.64	492.97	1024.52	2107.47
50	74.97	164.18	472.79	993.76	2089.24
100	68.41	151.96	438.23	951.11	2037.97
500	56.76	126.80	358.02	801.53	1765.60
			$\lambda = 0.80, \Delta = 1.00$		
20	89.43	184.08	492.95	988.59	2031.38
50	88.48	182.14	493.23	992.09	2025.48
100	90.09	183.44	490.92	989.04	2039.79
500	90.15	180.01	492.00	989.37	2047.08
			$\lambda = 0.80, \Delta = 2.00$		
20	60.21	135.28	403.18	879.12	1867.42
50	43.46	96.51	311.35	717.31	1633.52
100	31.86	70.56	217.21	548.78	1324.13
500	23.03	37.96	87.77	192.96	501.18
			$\lambda = 0.80, \Delta = 3.00$		
20	43.40	103.94	338.87	766.44	1699.81
50	24.39	56.14	199.03	496.76	1244.90
100	15.06	32.67	104.48	288.47	784.78
500	8.05	14.50	25.37	48.98	113.54

Table 637

Out of Control ARL_0 for ssMEWMC of Dimension 7 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	30.95	65.78	201.20	483.97	1187.23
50	20.13	33.92	85.38	208.58	553.80
100	17.57	25.85	48.24	95.63	259.98
500	16.70	20.14	28.24	38.07	63.35
			$\lambda = 0.05, \Delta = 0.50$		
20	36.37	76.73	224.85	523.20	1214.38
50	26.75	48.85	127.39	296.22	741.78
100	23.88	39.03	86.83	186.13	470.53
500	19.50	29.72	48.90	77.02	168.45
			$\lambda = 0.05, \Delta = 1.00$		
20	73.69	175.72	473.20	976.62	1988.16
50	67.21	166.51	467.64	958.24	1978.99
100	68.58	165.27	468.83	963.21	1978.13
500	36.42	151.25	467.76	959.61	1988.04
			$\lambda = 0.05, \Delta = 2.00$		
20	35.89	95.46	312.87	722.23	1633.58
50	19.52	42.93	146.99	371.38	951.06
100	14.74	25.95	69.70	178.03	496.92
500	12.83	15.82	23.27	32.81	52.82
			$\lambda = 0.05, \Delta = 3.00$		
20	19.47	52.57	193.94	500.14	1245.92
50	9.18	16.40	46.61	126.23	385.06
100	7.37	10.04	16.62	34.58	93.34
500	7.75	8.14	9.63	10.85	12.34

Table 638

Out of Control ARL_0 for ssMEWMC of Dimension 7 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	34.29	81.03	258.10	617.35	1470.69
50	22.98	43.92	135.41	336.71	895.11
100	19.14	32.65	79.49	194.29	529.15
500	21.72	21.63	36.48	64.94	135.17
			$\lambda = 0.10, \Delta = 0.50$		
20	40.44	91.29	281.13	648.54	1497.29
50	30.65	63.22	186.43	448.94	1100.72
100	26.40	49.60	133.10	313.87	797.06
500	33.17	36.01	77.35	157.18	361.39
			$\lambda = 0.10, \Delta = 1.00$		
20	78.68	177.83	474.90	979.01	2017.17
50	77.14	177.11	477.89	982.33	2018.42
100	76.54	177.13	477.28	983.98	2029.75
500	70.89	178.26	475.93	984.44	2012.66
			$\lambda = 0.10, \Delta = 2.00$		
20	40.47	101.79	328.26	750.72	1698.76
50	23.54	55.34	188.63	471.92	1178.58
100	17.47	33.08	102.12	268.87	715.07
500	12.50	17.64	29.52	50.74	123.39
			$\lambda = 0.10, \Delta = 3.00$		
20	22.49	59.75	217.55	544.04	1341.76
50	10.59	21.15	72.08	201.58	582.06
100	7.55	11.71	26.28	68.60	215.94
500	6.13	8.01	9.72	12.02	14.76

Table 639

Out of Control ARL_0 for ssMEWMC of Dimension 7 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	44.58	106.65	340.93	781.26	1746.26
50	30.42	67.00	223.58	557.76	1346.96
100	23.93	49.23	152.45	379.35	987.65
500	23.89	28.83	67.43	153.26	412.09
	λ = 0.20, Δ = 0.50				
20	50.71	118.13	363.56	819.92	1799.28
50	39.77	88.29	281.04	656.14	1515.06
100	34.62	71.04	220.21	523.17	1268.25
500	30.46	51.89	135.60	296.94	709.23
	λ = 0.20, Δ = 1.00				
20	83.52	182.29	484.94	992.14	2034.26
50	85.54	181.91	490.62	996.44	2025.51
100	83.40	182.68	485.86	1007.18	2029.58
500	105.24	185.04	486.75	1012.55	2067.61
	λ = 0.20, Δ = 2.00				
20	46.89	116.64	357.98	812.88	1758.00
50	29.48	71.36	230.53	579.02	1345.56
100	21.04	44.13	146.10	377.03	944.11
500	21.77	20.99	47.73	95.76	243.21
	λ = 0.20, Δ = 3.00				
20	28.62	75.69	261.47	638.57	1468.98
50	13.39	30.56	113.83	316.99	839.58
100	9.27	15.93	50.83	135.19	396.12
500	6.50	8.56	12.89	18.56	33.10

Table 640

Out of Control ARL_0 for ssMEWMC of Dimension 7 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	53.27	127.54	386.56	875.75	1853.90
50	36.90	85.47	281.41	671.15	1531.56
100	29.87	66.37	201.89	517.61	1237.57
500	30.71	37.50	106.05	247.03	641.24
			$\lambda = 0.30, \Delta = 0.50$		
20	59.88	136.52	412.70	909.55	1920.21
50	48.36	110.32	335.57	779.12	1742.69
100	41.53	91.62	276.07	663.98	1511.33
500	45.09	65.80	185.48	416.46	978.04
			$\lambda = 0.30, \Delta = 1.00$		
20	87.03	184.63	485.74	994.19	2031.46
50	87.80	185.66	485.77	997.29	2037.94
100	87.44	186.91	483.08	990.83	2032.27
500	95.70	185.04	483.67	1003.64	2073.71
			$\lambda = 0.30, \Delta = 2.00$		
20	50.64	123.20	371.64	835.29	1799.50
50	32.73	78.63	252.67	624.63	1440.53
100	24.59	51.83	166.48	430.59	1068.95
500	16.27	25.72	59.05	126.07	338.25
			$\lambda = 0.30, \Delta = 3.00$		
20	33.23	84.50	282.53	682.82	1537.37
50	15.90	38.86	139.12	376.49	967.34
100	10.88	20.61	65.90	184.43	513.16
500	7.75	10.14	15.67	26.22	53.95

Table 641

Out of Control ARL_0 for ssMEWMC of Dimension 7 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	58.01	138.67	407.76	910.98	1930.44
50	41.08	101.30	309.09	745.19	1634.49
100	34.59	77.11	235.77	590.45	1376.41
500	34.36	48.62	132.20	312.95	789.60
			λ = 0.40, Δ = 0.50		
20	64.69	149.39	435.68	947.82	1985.12
50	53.59	122.91	374.54	843.18	1834.75
100	46.73	108.01	312.40	742.95	1654.85
500	47.39	85.03	215.91	510.97	1173.44
			λ = 0.40, Δ = 1.00		
20	85.33	185.86	484.18	999.59	2024.94
50	87.28	189.94	486.34	993.58	2029.27
100	86.72	190.30	482.21	991.20	2025.08
500	85.88	187.01	476.34	1005.05	2069.82
			λ = 0.40, Δ = 2.00		
20	52.75	126.93	377.50	850.78	1815.97
50	35.37	86.35	270.35	658.27	1499.54
100	26.32	58.73	181.10	465.62	1147.01
500	18.58	28.73	65.79	145.24	385.77
			λ = 0.40, Δ = 3.00		
20	35.42	90.18	295.57	706.29	1593.15
50	17.68	43.69	155.44	410.63	1041.76
100	11.91	23.77	77.70	212.19	590.80
500	8.21	11.23	17.75	30.81	76.18

Table 642

Out of Control ARL$_0$ for ssMEWMC of Dimension 7 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	62.65	146.64	424.60	937.43	1959.57
50	46.04	109.75	335.46	781.36	1705.57
100	37.27	84.46	261.55	639.23	1472.07
500	23.10	53.57	153.40	361.90	889.94
			λ = 0.50, Δ = 0.50		
20	69.37	156.34	454.67	979.36	2025.16
50	58.01	132.76	398.69	893.29	1896.16
100	51.71	117.39	348.09	799.74	1759.96
500	34.58	91.78	248.75	580.78	1318.26
			λ = 0.50, Δ = 1.00		
20	87.26	184.90	491.14	1003.90	2012.47
50	87.96	189.47	486.41	1001.64	2023.75
100	86.81	188.43	484.19	989.99	2035.28
500	79.75	185.51	484.02	1015.97	2043.92
			λ = 0.50, Δ = 2.00		
20	54.48	130.18	387.36	857.20	1812.83
50	36.76	87.52	281.73	680.65	1510.74
100	28.13	62.11	192.17	490.37	1188.15
500	18.26	28.69	71.27	163.14	423.21
			λ = 0.50, Δ = 3.00		
20	37.57	93.45	309.14	732.13	1606.04
50	19.63	47.24	171.96	448.02	1070.36
100	12.69	25.13	84.97	239.77	630.19
500	7.12	11.50	19.98	35.82	89.18

Table 643

Out of Control ARL_0 for ssMEWMC of Dimension 7 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	65.65	152.88	442.36	958.07	1959.08
50	49.35	115.77	354.40	809.22	1742.10
100	39.15	90.95	281.86	675.16	1526.53
500	39.03	58.57	170.81	406.57	964.09
			λ = 0.60, Δ = 0.50		
20	72.85	162.92	473.01	1001.50	2032.27
50	61.52	142.45	425.30	929.06	1933.87
100	54.95	124.00	370.27	849.03	1800.38
500	52.55	89.72	271.69	634.19	1390.88
			λ = 0.60, Δ = 1.00		
20	87.51	185.71	494.09	1012.18	2004.53
50	89.13	187.77	488.67	1012.36	2003.74
100	86.62	187.94	482.69	1004.42	2013.23
500	91.25	184.38	480.44	1025.39	2013.87
			λ = 0.60, Δ = 2.00		
20	56.12	133.08	395.95	866.30	1795.27
50	38.38	91.96	292.68	688.59	1533.35
100	28.82	64.28	201.32	512.92	1198.33
500	24.67	31.61	77.92	171.27	440.61
			λ = 0.60, Δ = 3.00		
20	38.81	96.69	321.57	746.71	1613.30
50	20.92	50.37	181.55	463.39	1097.56
100	13.65	27.85	93.43	259.58	679.65
500	10.16	11.75	22.01	39.55	95.00

Table 644

Out of Control ARL_0 for ssMEWMC of Dimension 7 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	68.99	162.91	457.80	966.62	1954.79
50	53.97	126.86	373.37	822.03	1761.87
100	44.33	104.52	309.93	701.81	1562.91
500	33.39	73.11	197.47	458.42	1047.27
			λ = 0.80, Δ = 0.50		
20	75.50	172.85	482.51	1013.38	2028.51
50	65.63	151.68	449.27	946.09	1962.56
100	59.96	135.42	405.24	870.79	1852.79
500	44.68	110.65	317.13	680.51	1503.49
			λ = 0.80, Δ = 1.00		
20	87.65	188.72	495.33	995.92	1989.66
50	88.28	189.39	492.73	993.24	1988.39
100	86.43	186.35	490.68	992.96	1987.49
500	63.82	183.62	484.98	987.11	1987.48
			λ = 0.80, Δ = 2.00		
20	56.95	135.80	402.65	859.10	1789.06
50	38.99	95.19	303.63	699.18	1539.42
100	30.13	67.57	211.67	524.73	1232.54
500	15.74	33.54	81.74	179.80	470.73
			λ = 0.80, Δ = 3.00		
20	39.70	100.97	334.13	753.75	1649.67
50	22.33	56.13	191.22	480.89	1173.30
100	14.65	29.74	105.07	274.69	752.84
500	7.89	12.65	24.33	44.35	110.88

Table 645

Out of Control ARL_0 for ssMEWMC of Dimension 8 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	29.33	63.19	191.87	467.19	1113.45
50	18.45	31.29	76.79	186.53	481.19
100	16.00	24.01	44.42	90.98	218.33
500	22.00	19.72	26.43	34.02	49.99
			$\lambda = 0.05, \Delta = 0.50$		
20	34.26	72.73	206.72	493.21	1105.51
50	24.05	43.33	109.33	253.65	600.70
100	21.12	34.72	73.38	161.28	373.37
500	32.00	26.30	43.14	69.81	128.98
			$\lambda = 0.05, \Delta = 1.00$		
20	72.83	173.67	468.08	972.95	1950.90
50	66.58	164.66	450.23	948.16	1935.02
100	65.70	163.48	445.87	950.46	1950.08
500	78.00	168.23	453.21	968.33	1932.93
			$\lambda = 0.05, \Delta = 2.00$		
20	34.72	93.03	299.84	711.63	1576.71
50	18.67	41.88	138.61	362.41	888.36
100	14.35	26.80	70.78	183.04	471.39
500	13.00	16.14	23.34	34.26	63.69
			$\lambda = 0.05, \Delta = 3.00$		
20	19.41	52.07	190.06	499.12	1194.35
50	8.97	15.65	46.46	130.76	368.76
100	7.14	10.12	18.31	35.59	96.37
500	7.75	7.45	9.23	10.62	12.41

Table 646

Out of Control ARL$_0$ for ssMEWMC of Dimension 8 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	32.61	76.12	245.42	609.91	1399.19
50	21.25	41.19	120.28	320.27	808.88
100	17.73	29.45	71.94	178.20	477.42
500	11.08	22.03	36.63	57.85	118.11
			λ = 0.10, Δ = 0.50		
20	37.39	84.45	267.22	634.88	1416.67
50	27.58	55.19	161.83	403.46	939.88
100	23.92	42.66	114.18	272.13	653.15
500	21.00	36.29	64.36	126.59	292.93
			λ = 0.10, Δ = 1.00		
20	75.70	173.64	469.68	971.99	1954.56
50	75.15	173.64	466.33	971.39	1955.43
100	75.94	171.02	465.07	977.71	1931.79
500	80.50	176.30	475.37	977.94	1932.22
			λ = 0.10, Δ = 2.00		
20	38.88	100.06	322.83	740.06	1620.40
50	22.34	52.81	183.81	467.78	1092.35
100	16.75	33.31	104.30	270.74	673.23
500	11.08	20.76	30.97	56.61	134.67
			λ = 0.10, Δ = 3.00		
20	21.30	58.59	215.11	555.35	1303.27
50	10.35	20.73	68.34	208.91	551.37
100	7.64	12.01	27.39	73.76	208.92
500	4.90	7.50	9.69	12.55	17.21

Table 647

Out of Control ARL_0 for ssMEWMC of Dimension 8 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	41.59	100.93	327.89	754.23	1636.69
50	27.27	61.31	201.89	499.67	1174.59
100	21.93	44.32	137.80	336.08	843.32
500	17.00	26.90	63.86	137.73	337.71
			λ = 0.20, Δ = 0.50		
20	46.21	112.12	348.13	784.40	1704.70
50	34.34	78.25	249.47	602.23	1359.89
100	29.91	62.71	189.73	450.43	1060.26
500	21.77	44.58	115.23	251.10	571.65
			λ = 0.20, Δ = 1.00		
20	79.75	176.38	484.63	964.83	1931.33
50	79.45	178.21	485.66	967.27	1932.21
100	80.72	178.45	481.76	970.61	1940.00
500	76.25	170.56	474.90	950.67	1937.19
			λ = 0.20, Δ = 2.00		
20	45.23	110.65	352.49	781.26	1661.42
50	27.95	69.24	235.24	556.69	1272.99
100	20.06	45.02	147.20	370.20	902.37
500	13.42	23.57	48.50	94.83	236.89
			λ = 0.20, Δ = 3.00		
20	26.90	73.72	263.18	622.61	1412.23
50	12.30	30.26	117.88	309.31	796.93
100	9.15	15.73	49.40	140.90	380.60
500	6.61	8.42	12.64	18.99	39.27

Table 648

Out of Control ARL$_0$ for ssMEWMC of Dimension 8 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	48.09	120.74	363.61	820.15	1763.07
50	32.28	77.97	250.11	597.88	1402.56
100	27.22	57.57	180.26	450.88	1067.22
500	14.59	35.42	89.50	207.80	500.69
	λ = 0.30, Δ = 0.50				
20	53.63	128.53	387.05	862.56	1829.51
50	40.64	98.59	304.56	699.98	1560.48
100	36.55	79.63	242.31	562.73	1288.92
500	22.43	58.65	151.93	339.99	779.57
	λ = 0.30, Δ = 1.00				
20	81.48	183.67	479.13	956.84	1951.79
50	81.85	183.95	473.36	966.10	1958.76
100	80.48	182.00	471.30	960.42	1944.30
500	73.50	174.72	466.09	969.67	1947.84
	λ = 0.30, Δ = 2.00				
20	48.58	120.12	359.85	799.72	1716.25
50	30.86	78.83	255.83	607.79	1350.06
100	22.41	52.03	169.10	425.73	1014.23
500	14.03	26.28	58.12	123.90	312.19
	λ = 0.30, Δ = 3.00				
20	30.86	85.07	282.33	671.45	1493.31
50	14.79	37.90	142.62	372.63	928.96
100	9.94	20.24	67.19	188.67	498.49
500	9.33	9.53	15.29	25.94	58.55

Table 649

Out of Control ARL_0 for ssMEWMC of Dimension 8 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	53.03	133.84	387.24	856.24	1799.16
50	37.54	91.03	278.98	655.25	1468.33
100	30.71	67.68	213.53	511.59	1180.26
500	26.92	44.46	110.56	270.89	612.43
			$\lambda = 0.40, \Delta = 0.50$		
20	59.32	143.11	411.30	892.95	1870.13
50	46.56	113.73	334.41	752.73	1677.22
100	41.79	93.57	276.03	642.49	1422.77
500	37.27	70.24	182.43	403.42	922.40
			$\lambda = 0.40, \Delta = 1.00$		
20	83.64	185.19	475.31	958.22	1943.89
50	82.67	186.83	470.79	956.43	1942.42
100	81.80	184.43	473.32	952.65	1938.85
500	83.29	183.67	469.83	957.15	1922.76
			$\lambda = 0.40, \Delta = 2.00$		
20	51.18	126.38	366.30	803.15	1730.51
50	34.11	85.25	267.44	620.56	1393.71
100	25.29	56.11	177.66	452.36	1074.30
500	16.56	26.39	62.40	143.72	352.28
			$\lambda = 0.40, \Delta = 3.00$		
20	34.70	91.92	295.27	689.95	1519.55
50	17.04	43.69	157.16	412.29	996.91
100	11.18	23.73	77.45	215.94	573.44
500	10.92	10.51	18.20	33.06	81.23

Table 650

Out of Control ARL_0 for ssMEWMC of Dimension 8 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	56.51	139.04	408.36	882.85	1845.69
50	41.24	102.39	305.26	704.12	1544.97
100	33.35	76.60	240.70	559.96	1262.80
500	29.30	54.79	134.76	305.07	729.11
			λ = 0.50, Δ = 0.50		
20	63.68	152.45	435.40	926.30	1928.81
50	51.64	124.32	360.89	813.92	1751.55
100	45.95	102.04	305.56	694.59	1535.08
500	33.90	77.53	211.64	456.90	1048.52
			λ = 0.50, Δ = 1.00		
20	85.28	186.10	479.35	975.01	1976.45
50	82.93	187.74	477.36	972.53	1979.10
100	83.23	184.38	478.93	976.85	1980.65
500	77.47	181.44	478.41	943.80	1968.56
			λ = 0.50, Δ = 2.00		
20	53.43	131.13	379.00	814.06	1757.31
50	35.92	88.27	280.13	637.80	1456.44
100	26.80	60.26	194.75	473.39	1119.42
500	18.71	29.06	70.49	158.27	390.89
			λ = 0.50, Δ = 3.00		
20	36.79	96.82	313.77	700.41	1562.81
50	18.71	47.46	180.48	442.48	1080.52
100	12.13	25.78	91.21	239.99	636.04
500	10.77	10.80	21.08	37.41	97.08

Table 651

Out of Control ARL$_0$ for ssMEWMC of Dimension 8 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	59.81	143.53	424.32	888.43	1850.01
50	44.62	107.80	326.10	718.03	1567.84
100	35.96	81.25	255.98	587.17	1301.73
500	29.13	55.72	149.14	342.45	789.26
			λ = 0.60, Δ = 0.50		
20	66.30	157.82	451.16	943.87	1947.44
50	55.68	128.85	382.05	836.04	1782.10
100	48.13	108.23	325.36	727.14	1595.89
500	39.13	78.78	232.23	503.73	1132.67
			λ = 0.60, Δ = 1.00		
20	85.82	185.95	485.10	978.32	1965.17
50	84.05	186.90	485.07	973.36	1958.03
100	84.88	182.73	479.23	975.47	1968.13
500	103.06	176.59	477.00	959.60	1963.08
			λ = 0.60, Δ = 2.00		
20	54.92	131.73	384.59	826.44	1755.82
50	37.25	89.37	289.11	653.95	1470.17
100	28.28	60.68	204.35	486.69	1136.74
500	21.17	30.05	73.94	169.15	412.03
			λ = 0.60, Δ = 3.00		
20	39.04	99.47	322.23	711.56	1577.12
50	19.95	49.73	191.92	457.51	1092.35
100	12.98	27.70	98.55	257.46	665.91
500	9.74	11.09	23.21	44.34	107.65

Table 652

Out of Control ARL_0 for ssMEWMC of Dimension 8 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	62.47	151.92	440.71	907.79	1894.48
50	46.97	113.57	349.79	750.78	1643.46
100	38.31	88.39	277.12	618.56	1384.97
500	27.95	62.95	172.79	390.74	876.26
			$\lambda = 0.80, \Delta = 0.50$		
20	69.83	163.57	464.77	960.82	1996.59
50	58.51	138.16	405.37	872.21	1837.15
100	52.04	118.70	358.47	774.94	1664.43
500	23.89	89.34	262.74	568.05	1258.36
			$\lambda = 0.80, \Delta = 1.00$		
20	85.38	186.68	491.39	975.50	1981.32
50	83.10	186.17	493.71	974.73	1966.16
100	84.45	184.31	486.19	976.28	1966.60
500	72.00	184.25	493.17	982.07	1965.81
			$\lambda = 0.80, \Delta = 2.00$		
20	55.14	133.80	393.64	830.79	1791.38
50	38.29	92.20	296.95	669.55	1500.83
100	27.93	64.10	212.91	503.72	1186.96
500	18.63	28.33	77.48	173.86	440.21
			$\lambda = 0.80, \Delta = 3.00$		
20	40.01	103.67	330.81	731.89	1617.39
50	20.49	53.31	201.21	482.59	1147.89
100	13.59	29.05	107.29	275.25	728.72
500	6.71	11.35	24.44	46.79	124.77

Table 653

Out of Control ARL_0 for ssMEWMC of Dimension 9 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	27.94	60.12	189.73	477.13	1119.16
50	16.71	29.38	72.72	187.80	468.44
100	14.04	21.73	40.25	85.64	213.99
500	4.25	16.62	22.80	31.46	46.71
			$\lambda = 0.05, \Delta = 0.50$		
20	32.74	66.81	196.04	467.20	1089.69
50	22.19	39.11	99.47	231.36	563.52
100	19.50	31.14	63.19	140.09	330.67
500	10.75	24.06	40.94	62.62	116.73
			$\lambda = 0.05, \Delta = 1.00$		
20	72.49	171.61	472.60	970.69	1948.32
50	65.72	161.57	460.20	961.37	1949.73
100	65.39	160.46	452.65	954.64	1947.65
500	22.00	160.88	459.88	964.06	1936.19
			$\lambda = 0.05, \Delta = 2.00$		
20	34.23	92.49	304.86	712.69	1570.70
50	17.21	39.67	138.20	359.78	883.09
100	12.83	23.47	66.81	173.32	447.36
500	5.25	13.55	20.88	32.35	56.31
			$\lambda = 0.05, \Delta = 3.00$		
20	19.23	52.42	196.83	515.85	1212.02
50	8.37	15.14	44.51	132.96	383.70
100	6.76	9.18	17.38	39.03	100.25
500	4.25	6.79	8.68	10.21	11.58

Table 654

Out of Control ARL_0 for ssMEWMC of Dimension 9 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	30.92	72.74	243.58	577.26	1353.75
50	19.52	40.50	120.92	301.37	743.07
100	15.48	27.17	68.54	168.66	427.89
500	6.92	18.80	29.90	54.66	112.86
			$\lambda = 0.10, \Delta = 0.50$		
20	34.85	78.91	250.86	585.77	1350.37
50	25.14	50.58	146.93	353.05	859.29
100	21.76	38.78	99.06	231.06	574.54
500	27.00	28.67	53.14	105.60	231.64
			$\lambda = 0.10, \Delta = 1.00$		
20	75.70	176.57	481.42	959.75	1949.55
50	74.71	174.80	477.00	956.55	1938.92
100	73.88	173.48	472.21	950.83	1943.92
500	71.00	179.16	489.11	965.79	1919.43
			$\lambda = 0.10, \Delta = 2.00$		
20	36.70	98.88	314.93	714.93	1567.16
50	20.93	53.07	185.22	442.04	1052.56
100	14.71	30.67	99.89	253.84	634.39
500	8.82	14.76	26.45	51.89	122.23
			$\lambda = 0.10, \Delta = 3.00$		
20	20.86	59.43	217.71	531.87	1246.08
50	9.42	20.15	73.30	196.97	535.89
100	6.96	10.96	26.65	66.86	198.74
500	5.00	6.65	9.44	11.55	17.29

Table 655

Out of Control ARL_0 for ssMEWMC of Dimension 9 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
	λ = 0.20, Δ = 0.25				
20	38.46	98.06	317.78	706.99	1583.11
50	25.49	58.90	190.73	452.29	1079.94
100	19.57	40.54	127.01	304.79	762.15
500	12.76	24.77	57.90	118.68	293.23
	λ = 0.20, Δ = 0.50				
20	42.97	105.06	325.45	720.23	1630.67
50	31.43	70.69	221.57	518.17	1246.59
100	26.85	57.27	165.64	383.23	943.78
500	20.52	40.85	98.19	205.16	476.89
	λ = 0.20, Δ = 1.00				
20	79.72	179.59	481.46	955.37	1927.58
50	80.19	178.83	477.09	948.02	1922.41
100	80.20	179.43	474.06	948.00	1935.71
500	69.40	178.53	489.40	960.05	1954.18
	λ = 0.20, Δ = 2.00				
20	42.79	110.02	337.81	738.34	1628.03
50	26.31	69.24	226.13	530.98	1230.63
100	17.74	41.90	142.48	348.68	851.73
500	13.04	18.50	45.08	91.95	242.19
	λ = 0.20, Δ = 3.00				
20	25.92	72.08	259.73	587.64	1345.05
50	11.93	29.98	112.59	287.40	731.87
100	8.28	16.68	49.87	126.89	347.15
500	4.50	7.72	12.66	17.72	34.21

Table 656

Out of Control ARL_0 for ssMEWMC of Dimension 9 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	44.93	109.70	357.13	785.59	1676.87
50	31.30	70.98	240.24	549.28	1260.96
100	24.09	51.36	171.57	402.99	954.66
500	22.42	32.37	87.35	183.56	454.84
			$\lambda = 0.30, \Delta = 0.50$		
20	50.95	119.04	377.42	821.97	1753.79
50	37.99	86.24	279.92	627.79	1453.11
100	31.78	69.66	214.39	488.79	1168.79
500	24.95	49.82	135.90	289.59	662.44
			$\lambda = 0.30, \Delta = 1.00$		
20	82.80	176.95	483.80	964.13	1935.82
50	83.27	177.63	482.66	965.46	1928.23
100	81.55	176.71	488.30	961.29	1936.47
500	79.40	180.75	498.22	958.81	1959.58
			$\lambda = 0.30, \Delta = 2.00$		
20	47.55	116.39	357.25	762.06	1660.11
50	30.99	76.46	249.61	573.59	1304.42
100	21.96	49.12	166.78	400.35	966.18
500	18.60	24.86	53.04	120.48	306.46
			$\lambda = 0.30, \Delta = 3.00$		
20	30.17	80.66	279.79	632.94	1426.95
50	14.82	36.67	141.34	353.49	865.95
100	9.93	20.49	65.26	179.74	458.35
500	4.68	8.90	15.19	24.03	56.79

Table 657

Out of Control ARL_0 for ssMEWMC of Dimension 9 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	49.11	124.09	377.95	829.57	1720.68
50	34.38	82.14	267.46	608.58	1338.57
100	28.34	61.63	193.69	460.66	1073.87
500	23.92	40.44	104.81	223.17	548.34
			$\lambda = 0.40, \Delta = 0.50$		
20	55.08	130.99	404.66	874.90	1795.84
50	41.66	98.37	311.55	717.03	1538.36
100	35.65	79.57	241.08	581.52	1288.37
500	30.23	59.64	164.18	357.87	802.13
			$\lambda = 0.40, \Delta = 1.00$		
20	82.99	180.43	482.66	980.14	1925.71
50	82.49	182.56	479.85	969.31	1914.84
100	81.85	182.20	481.41	973.43	1925.90
500	82.70	185.44	488.21	975.98	1940.54
			$\lambda = 0.40, \Delta = 2.00$		
20	48.87	121.01	367.98	795.95	1671.16
50	34.46	81.88	262.42	609.28	1344.09
100	24.12	54.77	182.76	431.40	1029.39
500	18.77	28.00	61.04	131.32	345.63
			$\lambda = 0.40, \Delta = 3.00$		
20	32.80	88.86	293.47	674.63	1457.12
50	17.27	42.83	156.24	390.55	948.37
100	11.19	23.18	76.38	217.27	531.14
500	7.15	9.79	16.30	31.98	76.88

Table 658

Out of Control ARL_0 for ssMEWMC of Dimension 9 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	52.09	129.30	389.21	856.38	1789.45
50	36.84	89.76	280.74	643.14	1415.15
100	30.12	68.56	208.29	502.39	1135.59
500	24.91	45.55	121.20	259.53	596.20
			$\lambda = 0.50, \Delta = 0.50$		
20	58.19	140.20	415.77	912.27	1830.48
50	44.82	108.58	331.82	750.75	1592.47
100	38.84	88.96	268.25	625.10	1376.58
500	26.16	64.15	177.60	403.34	890.08
			$\lambda = 0.50, \Delta = 1.00$		
20	82.96	183.16	480.82	984.69	1949.50
50	82.84	184.20	477.88	978.29	1946.50
100	81.13	184.28	482.22	981.55	1942.04
500	73.59	179.04	472.52	974.23	1953.84
			$\lambda = 0.50, \Delta = 2.00$		
20	49.75	123.28	367.73	816.45	1679.21
50	35.52	86.10	266.25	632.19	1389.28
100	25.46	57.21	185.59	457.79	1070.14
500	26.21	29.40	64.93	144.59	374.63
			$\lambda = 0.50, \Delta = 3.00$		
20	34.00	92.86	299.86	691.57	1489.28
50	18.16	47.41	162.02	422.15	1010.07
100	12.04	25.47	84.18	234.22	593.04
500	6.35	10.84	18.26	39.03	97.29

Table 659

Out of Control ARL_0 for ssMEWMC of Dimension 9 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	53.45	134.71	395.16	872.47	1792.96
50	38.08	93.85	293.12	668.04	1450.03
100	31.36	72.86	223.90	534.68	1161.19
500	17.76	48.70	124.08	281.14	650.86
			$\lambda = 0.60, \Delta = 0.50$		
20	60.73	145.61	425.24	919.41	1872.98
50	47.43	115.37	345.74	777.19	1630.57
100	40.88	95.89	285.51	653.44	1434.51
500	18.17	64.95	187.39	425.15	955.27
			$\lambda = 0.60, \Delta = 1.00$		
20	82.58	182.22	482.18	989.21	1935.25
50	82.41	181.55	476.78	984.72	1943.29
100	83.84	184.90	477.14	983.53	1941.87
500	74.20	180.63	471.50	968.69	1959.54
			$\lambda = 0.60, \Delta = 2.00$		
20	50.98	126.61	371.77	815.36	1693.22
50	35.20	89.88	272.40	636.10	1416.52
100	26.34	60.39	188.45	464.55	1090.34
500	12.45	27.85	70.48	153.04	385.40
			$\lambda = 0.60, \Delta = 3.00$		
20	35.29	95.66	306.93	696.94	1504.27
50	19.48	50.41	170.03	432.42	1021.44
100	12.44	27.59	88.33	242.93	620.66
500	5.52	11.65	19.55	42.43	99.11

Table 660

Out of Control ARL_0 for ssMEWMC of Dimension 9 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	$\lambda = 0.80, \Delta = 0.25$				
20	56.49	142.98	411.01	887.54	1826.16
50	41.39	101.26	307.07	701.81	1494.35
100	34.16	77.45	238.77	560.18	1216.19
500	23.74	56.20	142.69	306.49	713.72
	$\lambda = 0.80, \Delta = 0.50$				
20	64.15	154.13	440.69	936.70	1901.81
50	50.86	125.20	363.73	808.67	1678.46
100	45.45	104.18	306.60	695.51	1489.27
500	42.35	68.64	213.00	459.32	1029.24
	$\lambda = 0.80, \Delta = 1.00$				
20	82.28	186.19	476.51	970.23	1943.69
50	83.65	182.75	477.71	978.94	1931.99
100	84.26	184.01	477.27	984.70	1935.52
500	86.00	179.17	473.91	981.55	1943.60
	$\lambda = 0.80, \Delta = 2.00$				
20	52.56	129.30	378.70	812.92	1704.46
50	36.80	93.14	279.23	645.85	1414.33
100	27.18	63.57	193.23	473.90	1110.40
500	16.19	30.25	70.50	162.38	425.36
	$\lambda = 0.80, \Delta = 3.00$				
20	37.30	98.86	309.14	697.19	1537.93
50	21.57	52.40	178.66	440.83	1059.73
100	13.41	28.70	93.81	256.64	652.80
500	14.19	11.64	22.55	43.10	116.00

Table 661

Out of Control ARL_0 for ssMEWMC of Dimension 10 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	25.87	57.01	186.20	453.79	1100.75
50	15.35	26.82	70.47	168.61	425.87
100	13.16	19.94	38.10	75.70	188.03
500	10.29	16.38	20.87	27.46	39.58
			$\lambda = 0.05, \Delta = 0.50$		
20	29.78	61.67	188.46	450.87	1076.49
50	19.37	33.89	85.61	199.55	494.31
100	16.77	27.46	55.27	121.23	276.56
500	13.67	21.23	33.07	53.66	106.10
			$\lambda = 0.05, \Delta = 1.00$		
20	70.20	169.30	473.39	975.07	1977.80
50	62.44	157.18	457.94	967.90	1958.01
100	60.46	154.57	456.05	954.29	1967.63
500	51.10	158.12	456.53	949.35	1954.30
			$\lambda = 0.05, \Delta = 2.00$		
20	32.35	87.37	304.05	696.85	1535.69
50	16.05	37.75	134.44	339.31	858.59
100	11.80	23.51	63.50	162.32	438.30
500	13.38	13.79	20.29	31.86	62.67
			$\lambda = 0.05, \Delta = 3.00$		
20	18.45	50.35	199.04	497.97	1171.84
50	8.21	14.75	44.90	127.34	364.03
100	6.50	9.31	16.33	36.52	100.93
500	5.86	6.88	8.21	9.53	11.47

Table 662

Out of Control ARL_0 for ssMEWMC of Dimension 10 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	28.72	67.87	233.96	583.78	1339.71
50	18.28	35.38	110.91	285.37	731.74
100	14.58	24.68	62.76	154.08	415.13
500	11.17	18.14	29.00	44.49	98.18
			$\lambda = 0.10, \Delta = 0.50$		
20	31.80	71.37	237.53	580.18	1359.14
50	21.79	43.15	125.53	323.37	812.91
100	18.38	32.18	83.83	203.64	503.57
500	15.36	29.26	49.17	89.93	201.06
			$\lambda = 0.10, \Delta = 1.00$		
20	73.37	171.38	477.95	980.13	1994.50
50	73.11	169.59	476.04	986.78	1988.19
100	71.29	167.11	471.63	987.15	1986.08
500	101.93	174.81	469.55	988.35	1988.98
			$\lambda = 0.10, \Delta = 2.00$		
20	35.48	93.68	309.29	716.80	1578.32
50	20.04	48.31	177.13	438.67	1034.74
100	14.36	30.08	95.39	248.99	640.06
500	10.00	16.51	26.84	54.96	115.65
			$\lambda = 0.10, \Delta = 3.00$		
20	20.12	55.11	215.20	538.72	1237.81
50	9.78	20.28	74.34	206.78	535.70
100	6.85	10.98	27.76	78.51	211.68
500	4.00	7.42	8.97	10.88	15.70

Table 663

Out of Control ARL_0 for ssMEWMC of Dimension 10 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	36.34	91.29	309.69	697.82	1567.74
50	23.24	51.25	178.92	436.97	1052.58
100	19.24	36.44	115.52	288.83	705.17
500	27.78	21.56	51.21	100.99	264.99
			λ = 0.20, Δ = 0.50		
20	39.19	96.98	321.88	724.77	1624.28
50	27.88	61.35	204.02	487.00	1188.02
100	23.14	47.00	141.43	348.35	854.67
500	15.00	30.58	81.96	175.69	418.10
			λ = 0.20, Δ = 1.00		
20	77.65	176.86	482.09	968.94	2002.50
50	77.80	179.38	490.43	968.45	2019.61
100	76.78	175.44	486.41	969.32	2006.22
500	59.36	168.16	482.84	975.97	1984.48
			λ = 0.20, Δ = 2.00		
20	40.92	106.73	344.36	743.02	1644.26
50	26.74	62.96	218.71	518.01	1211.32
100	19.32	42.21	137.91	346.02	873.76
500	16.33	18.44	44.62	92.08	217.99
			λ = 0.20, Δ = 3.00		
20	25.76	70.79	252.20	584.83	1375.50
50	12.84	28.86	113.16	304.01	761.22
100	8.40	15.59	50.21	139.84	368.36
500	4.00	7.16	10.98	17.54	43.12

Table 664

Out of Control ARL_0 for ssMEWMC of Dimension 10 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	41.73	107.28	339.55	786.45	1692.61
50	26.88	64.83	218.45	537.20	1211.08
100	21.40	46.28	149.74	371.45	893.40
500	11.13	30.98	66.60	159.17	391.70
			$\lambda = 0.30, \Delta = 0.50$		
20	45.83	112.59	352.54	813.79	1758.63
50	32.67	75.03	245.73	594.96	1372.96
100	27.23	57.52	177.31	444.52	1081.84
500	18.17	47.63	110.22	248.10	578.77
			$\lambda = 0.30, \Delta = 1.00$		
20	78.77	177.69	483.69	995.16	2009.80
50	78.63	181.09	480.22	1001.85	2006.80
100	78.62	179.01	479.89	1001.28	2010.97
500	82.25	176.25	480.34	986.97	1997.89
			$\lambda = 0.30, \Delta = 2.00$		
20	44.06	115.15	354.28	804.43	1703.82
50	29.43	71.98	244.22	574.48	1302.86
100	21.75	48.06	158.64	416.93	970.81
500	7.89	22.41	54.09	126.60	300.66
			$\lambda = 0.30, \Delta = 3.00$		
20	30.33	81.32	279.91	653.76	1469.13
50	15.05	36.48	133.81	354.94	878.88
100	9.94	19.77	65.37	176.46	478.23
500	5.08	8.12	14.63	24.25	61.84

Table 665

Out of Control ARL_0 for ssMEWMC of Dimension 10 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	45.17	116.41	364.64	816.66	1768.83
50	29.92	73.69	242.74	579.45	1314.63
100	24.48	53.49	171.34	414.60	1002.24
500	15.30	37.46	84.09	198.91	457.46
			$\lambda = 0.40, \Delta = 0.50$		
20	49.73	121.28	378.98	846.30	1848.77
50	36.10	85.46	279.21	657.43	1493.96
100	30.09	67.95	210.54	511.90	1209.45
500	15.26	57.30	130.98	305.17	699.11
			$\lambda = 0.40, \Delta = 1.00$		
20	79.45	180.10	482.20	985.77	2021.86
50	79.92	181.52	479.81	998.62	2025.36
100	79.48	178.95	479.71	993.51	2032.41
500	51.34	181.73	491.91	1000.54	2015.03
			$\lambda = 0.40, \Delta = 2.00$		
20	46.32	118.33	360.13	799.21	1755.43
50	30.22	76.34	255.91	596.90	1364.62
100	23.09	52.87	175.00	444.40	1021.47
500	11.38	27.68	62.35	139.72	339.54
			$\lambda = 0.40, \Delta = 3.00$		
20	32.04	86.46	292.48	676.17	1540.14
50	16.22	40.77	154.63	391.68	974.61
100	10.63	21.72	77.25	210.08	539.31
500	5.67	9.76	16.01	31.68	76.06

Table 666

Out of Control ARL_0 for ssMEWMC of Dimension 10 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	48.51	122.04	378.86	843.21	1792.88
50	32.42	80.82	258.32	609.16	1368.22
100	27.69	58.90	185.24	457.77	1054.16
500	26.83	40.15	93.11	222.06	520.13
			$\lambda = 0.50, \Delta = 0.50$		
20	52.96	130.78	394.01	871.44	1867.08
50	38.85	95.06	297.77	689.41	1531.20
100	33.10	74.38	230.07	555.84	1276.37
500	31.26	53.05	146.06	338.58	766.84
			$\lambda = 0.50, \Delta = 1.00$		
20	79.54	182.28	476.22	993.92	2016.95
50	80.21	182.24	475.64	997.69	2023.12
100	80.86	181.65	475.25	998.13	2019.34
500	66.48	174.38	488.71	998.62	2019.63
			$\lambda = 0.50, \Delta = 2.00$		
20	46.63	121.28	363.55	818.95	1746.53
50	32.00	81.19	259.66	617.53	1393.71
100	24.67	57.23	180.16	453.23	1055.35
500	12.20	29.21	63.33	148.30	365.24
			$\lambda = 0.50, \Delta = 3.00$		
20	33.40	89.10	301.12	700.41	1559.60
50	17.13	44.07	162.01	416.31	1018.83
100	11.78	23.47	85.38	225.02	601.59
500	5.50	10.35	17.30	36.33	93.14

Table 667

Out of Control ARL_0 for ssMEWMC of Dimension 10 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	49.79	127.01	379.10	857.66	1836.18
50	34.69	83.52	264.68	630.35	1443.23
100	28.50	61.00	189.66	485.45	1099.94
500	41.86	41.47	100.78	247.56	564.32
			λ = 0.60, Δ = 0.50		
20	54.92	136.08	398.00	887.62	1908.14
50	41.20	100.72	307.73	710.16	1614.37
100	35.84	82.42	242.71	590.37	1369.12
500	52.17	64.02	157.96	360.98	817.35
			λ = 0.60, Δ = 1.00		
20	80.13	181.28	475.94	988.78	2039.33
50	80.60	180.46	476.21	989.55	2035.64
100	80.78	180.15	471.78	986.52	2030.45
500	91.54	180.85	490.77	992.64	2036.44
			λ = 0.60, Δ = 2.00		
20	47.77	122.07	358.82	820.51	1773.68
50	33.20	83.21	259.50	625.53	1426.96
100	25.64	57.67	184.57	461.84	1096.78
500	12.46	30.33	65.77	149.69	389.83
			λ = 0.60, Δ = 3.00		
20	34.87	92.71	297.82	711.90	1586.51
50	17.50	46.64	163.64	431.48	1070.35
100	12.11	25.62	87.72	235.98	639.58
500	9.57	11.65	19.81	39.14	101.26

Table 668

Out of Control ARL_0 for ssMEWMC of Dimension 10 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			λ = 0.80, Δ = 0.25		
20	52.85	133.59	400.90	874.93	1851.22
50	37.08	90.20	289.00	668.66	1471.96
100	30.90	68.65	217.12	508.66	1149.19
500	17.53	45.71	123.71	275.47	619.64
			λ = 0.80, Δ = 0.50		
20	58.35	141.59	419.57	916.16	1937.88
50	44.52	107.84	338.91	753.02	1653.70
100	38.08	89.52	273.16	630.77	1414.07
500	26.80	67.66	183.82	406.63	889.46
			λ = 0.80, Δ = 1.00		
20	79.56	181.78	479.68	998.74	2027.77
50	80.55	181.06	479.48	996.57	2028.18
100	81.79	180.83	482.69	995.48	2025.50
500	90.60	184.57	491.76	1009.43	2002.10
			λ = 0.80, Δ = 2.00		
20	48.83	121.96	371.33	844.38	1777.65
50	34.12	85.33	271.82	652.52	1449.77
100	25.43	60.27	194.11	484.59	1111.88
500	11.60	32.14	73.45	158.98	400.38
			λ = 0.80, Δ = 3.00		
20	35.74	96.22	310.10	739.12	1617.29
50	18.28	48.79	181.83	457.96	1084.36
100	13.22	28.11	95.26	251.10	674.01
500	10.50	11.59	22.44	43.76	106.75

Table 669

Out of Control ARL_0 for ssMEWMC of Dimension 15 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
	λ = 0.05, Δ = 0.25				
20	23.80	57.79	195.85	486.58	1190.10
50	10.93	21.43	60.71	162.96	442.12
100	9.19	14.36	31.46	63.22	187.98
500	1.00	11.33	14.98	20.42	36.71
	λ = 0.05, Δ = 0.50				
20	24.09	51.26	164.26	403.23	989.71
50	12.47	23.53	59.24	146.24	365.65
100	10.73	17.49	32.76	71.22	163.98
500	1.00	14.02	20.04	32.18	48.15
	λ = 0.05, Δ = 1.00				
20	64.99	168.06	471.91	977.61	1996.72
50	52.94	149.82	453.62	942.17	1950.28
100	51.04	148.07	447.16	929.29	1952.32
500	51.00	149.64	455.90	945.65	1954.05
	λ = 0.05, Δ = 2.00				
20	27.81	82.89	280.56	665.79	1481.62
50	12.05	30.86	119.11	307.53	759.79
100	9.29	18.21	54.16	144.24	400.19
500	2.00	10.07	16.55	26.93	53.59
	λ = 0.05, Δ = 3.00				
20	17.55	52.54	200.77	515.16	1203.36
50	6.71	12.85	44.11	133.11	373.39
100	5.23	7.56	15.41	39.16	106.98
500	2.00	5.38	6.70	8.36	9.24

Table 670

Out of Control ARL_0 for ssMEWMC of Dimension 15 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			λ = 0.10, Δ = 0.25		
20	24.22	69.06	235.25	582.30	1305.74
50	12.69	28.59	102.89	266.79	666.89
100	9.90	19.10	50.30	129.91	342.83
500	16.00	11.63	19.62	34.73	69.65
			λ = 0.10, Δ = 0.50		
20	23.81	60.62	202.44	515.19	1200.26
50	14.54	29.91	95.71	248.73	634.65
100	11.74	21.31	56.62	136.51	348.70
500	15.13	14.33	27.60	52.21	109.12
			λ = 0.10, Δ = 1.00		
20	65.44	170.94	468.54	988.48	1993.85
50	60.95	164.74	462.43	973.38	1970.92
100	61.05	164.61	460.68	965.77	1965.10
500	41.00	149.75	461.96	973.42	1943.83
			λ = 0.10, Δ = 2.00		
20	27.59	85.75	281.66	662.49	1470.76
50	15.27	42.48	154.94	396.75	933.79
100	10.92	25.20	87.64	220.65	582.42
500	11.57	11.38	22.20	45.01	111.83
			λ = 0.10, Δ = 3.00		
20	17.32	55.11	209.21	512.81	1191.69
50	7.47	18.77	74.68	205.54	536.36
100	5.38	9.64	26.61	73.69	211.42
500	5.86	5.34	7.26	9.10	17.46

Table 671

Out of Control ARL_0 for ssMEWMC of Dimension 15 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	29.42	83.04	290.61	656.34	1437.61
50	16.40	43.76	158.22	381.61	887.91
100	12.51	27.45	95.32	229.66	582.84
500	1.50	13.58	34.10	69.33	155.02
			$\lambda = 0.20, \Delta = 0.50$		
20	28.69	76.79	271.97	618.83	1392.83
50	18.82	44.57	150.83	361.42	896.08
100	14.70	30.17	95.38	230.10	600.21
500	2.00	18.69	45.82	93.74	202.73
			$\lambda = 0.20, \Delta = 1.00$		
20	68.52	170.81	481.08	972.70	1987.62
50	68.00	170.22	479.35	960.40	1985.88
100	70.06	169.76	476.78	964.38	1983.64
500	80.20	167.78	476.34	946.59	1942.50
			$\lambda = 0.20, \Delta = 2.00$		
20	32.50	94.22	310.59	678.60	1484.52
50	19.35	57.66	199.81	455.19	1072.65
100	14.30	37.19	127.55	305.02	758.28
500	2.00	14.91	36.44	82.15	201.77
			$\lambda = 0.20, \Delta = 3.00$		
20	21.14	65.40	237.06	556.06	1264.53
50	9.81	28.05	113.98	283.28	713.78
100	6.81	13.86	51.73	130.49	368.11
500	1.00	6.17	8.95	15.74	39.94

Table 672

Out of Control ARL_0 for ssMEWMC of Dimension 15 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
	λ = 0.30, Δ = 0.25				
20	32.93	93.35	311.37	686.67	1489.91
50	19.75	52.13	181.09	433.81	994.01
100	14.23	34.11	116.90	284.34	680.73
500	11.50	18.22	46.78	95.01	216.21
	λ = 0.30, Δ = 0.50				
20	32.82	89.62	302.09	670.00	1482.44
50	22.00	55.28	184.54	448.96	1029.94
100	17.25	39.16	125.72	295.07	731.76
500	6.13	23.87	56.99	122.17	294.29
	λ = 0.30, Δ = 1.00				
20	70.35	173.52	486.63	973.33	1957.99
50	71.31	174.61	479.52	979.97	1959.06
100	71.64	172.69	485.51	974.64	1959.64
500	61.55	163.93	483.82	980.54	1940.99
	λ = 0.30, Δ = 2.00				
20	35.83	99.12	321.15	710.09	1509.39
50	22.74	63.71	218.44	509.11	1143.65
100	16.26	41.58	149.91	347.47	839.64
500	6.67	18.49	46.11	100.47	256.15
	λ = 0.30, Δ = 3.00				
20	24.28	72.38	258.39	598.16	1308.34
50	11.12	33.23	130.77	334.59	806.83
100	7.48	17.26	65.90	170.51	440.15
500	10.33	7.32	11.44	22.37	60.84

Table 673

Out of Control ARL_0 for ssMEWMC of Dimension 15 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.40, \Delta = 0.25$		
20	35.00	99.69	317.15	724.59	1534.57
50	21.20	56.24	194.37	481.85	1051.60
100	16.01	37.90	126.79	329.15	752.89
500	5.29	20.39	48.46	108.14	271.51
			$\lambda = 0.40, \Delta = 0.50$		
20	35.50	96.58	312.43	716.79	1531.89
50	23.44	61.40	202.83	497.42	1107.41
100	18.88	44.04	135.24	342.91	805.75
500	3.50	29.75	66.34	152.05	348.81
			$\lambda = 0.40, \Delta = 1.00$		
20	71.14	173.82	472.69	983.31	1932.83
50	71.73	172.77	468.55	987.36	1953.22
100	72.66	173.68	471.14	986.61	1951.61
500	58.25	170.03	467.14	996.87	1945.65
			$\lambda = 0.40, \Delta = 2.00$		
20	37.78	101.03	324.02	733.21	1536.57
50	24.18	65.74	223.30	544.98	1173.53
100	17.57	44.17	151.28	377.34	868.37
500	6.83	19.80	50.86	109.77	271.11
			$\lambda = 0.40, \Delta = 3.00$		
20	25.83	74.09	258.87	627.04	1342.02
50	12.21	34.37	138.76	369.71	848.92
100	8.37	18.88	68.85	194.17	480.30
500	6.00	7.33	13.49	28.62	73.75

Table 674

Out of Control ARL_0 for ssMEWMC of Dimension 15 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	35.56	103.43	322.46	739.89	1579.41
50	22.71	59.63	203.05	501.10	1101.20
100	16.53	40.25	134.73	343.77	791.45
500	7.29	23.38	54.82	128.87	309.51
			λ = 0.50, Δ = 0.50		
20	37.23	101.45	323.80	740.46	1557.74
50	25.73	64.71	216.39	543.01	1140.53
100	19.99	47.37	148.40	379.64	853.22
500	4.89	30.12	71.39	171.91	387.97
			λ = 0.50, Δ = 1.00		
20	71.00	171.17	472.27	977.52	1952.39
50	71.78	172.46	471.33	981.32	1970.14
100	72.49	175.68	466.15	991.28	1965.14
500	71.91	170.99	462.29	972.46	1953.11
			λ = 0.50, Δ = 2.00		
20	38.88	101.00	328.12	745.82	1546.33
50	25.07	66.94	232.08	557.79	1208.84
100	17.38	46.23	156.52	393.21	903.53
500	8.17	22.24	57.33	121.54	297.82
			λ = 0.50, Δ = 3.00		
20	26.83	75.04	267.09	636.52	1364.48
50	13.43	35.25	144.41	379.82	874.91
100	8.70	20.52	72.40	203.00	499.51
500	7.00	7.45	15.53	28.10	78.72

Table 675

Out of Control ARL_0 for ssMEWMC of Dimension 15 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			λ = 0.60, Δ = 0.25		
20	37.83	103.93	331.99	758.27	1600.49
50	24.14	59.63	206.95	517.70	1141.69
100	18.29	40.59	143.19	354.68	816.05
500	6.13	23.06	56.47	141.13	339.56
			λ = 0.60, Δ = 0.50		
20	38.79	104.24	333.96	754.65	1587.82
50	26.82	67.60	226.64	546.59	1182.73
100	21.55	49.06	159.41	399.68	891.29
500	10.13	29.57	77.96	186.94	428.77
			λ = 0.60, Δ = 1.00		
20	72.13	171.70	478.44	979.27	1957.85
50	73.24	172.80	471.90	983.38	1974.44
100	72.95	174.66	465.24	991.63	1972.42
500	74.27	176.41	461.35	985.99	1963.25
			λ = 0.60, Δ = 2.00		
20	40.37	102.53	331.61	748.82	1559.27
50	25.88	67.09	236.94	564.35	1220.51
100	17.82	47.67	155.60	417.24	917.66
500	10.14	21.45	54.88	129.62	316.34
			λ = 0.60, Δ = 3.00		
20	28.03	77.70	269.83	641.99	1391.22
50	13.86	37.49	148.73	388.22	901.60
100	9.27	20.63	73.79	214.50	534.41
500	8.40	7.68	16.41	31.30	77.43

Table 676

Out of Control ARL_0 for ssMEWMC of Dimension 15 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	38.70	106.96	350.66	778.75	1661.16
50	25.27	63.76	226.91	531.82	1202.87
100	18.34	44.50	153.09	369.22	891.53
500	1.50	29.05	65.06	154.04	364.21
			$\lambda = 0.80, \Delta = 0.50$		
20	40.48	108.78	347.05	772.01	1675.06
50	28.57	74.22	243.35	561.04	1256.60
100	23.80	52.11	177.53	405.13	965.78
500	2.00	34.98	92.76	204.98	486.99
			$\lambda = 0.80, \Delta = 1.00$		
20	72.49	173.82	479.77	980.10	1985.37
50	72.37	175.62	476.61	978.59	1989.99
100	73.49	172.41	469.16	979.08	1997.46
500	60.80	168.27	469.73	979.77	2004.92
			$\lambda = 0.80, \Delta = 2.00$		
20	40.13	107.43	335.73	751.57	1619.65
50	26.65	70.89	244.08	559.62	1269.63
100	18.72	48.34	165.82	410.87	975.27
500	2.50	21.44	54.35	128.66	335.53
			$\lambda = 0.80, \Delta = 3.00$		
20	29.14	80.01	281.88	651.77	1443.66
50	14.52	42.44	157.14	399.14	976.01
100	9.49	22.43	77.26	217.36	580.65
500	2.00	10.93	18.77	35.82	87.53

Table 677

Out of Control ARL_0 for ssMEWMC of Dimension 20 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05$, $\Delta = 0.25$		
20	23.68	63.23	218.60	571.48	1338.76
50	9.09	19.36	64.60	179.76	490.21
100	6.74	12.29	26.72	66.59	187.84
500	0.00	9.33	12.63	18.03	32.87
			$\lambda = 0.05$, $\Delta = 0.50$		
20	23.84	56.12	183.18	468.64	1116.19
50	9.80	19.92	54.24	141.84	375.78
100	7.80	13.60	26.89	58.15	149.55
500	0.00	10.92	15.90	20.18	30.98
			$\lambda = 0.05$, $\Delta = 1.00$		
20	59.84	159.58	455.57	968.62	1984.97
50	43.18	138.76	431.10	949.92	1952.69
100	40.55	133.15	426.56	944.87	1954.76
500	0.00	122.97	439.19	949.81	1962.54
			$\lambda = 0.05$, $\Delta = 2.00$		
20	25.56	78.59	273.71	674.46	1468.30
50	9.73	26.31	105.68	289.18	740.34
100	7.44	15.79	47.96	132.51	364.10
500	0.00	7.86	14.00	22.81	45.88
			$\lambda = 0.05$, $\Delta = 3.00$		
20	17.72	53.54	207.73	530.51	1229.27
50	5.65	12.13	40.89	137.97	389.84
100	4.44	7.09	15.17	35.99	109.18
500	0.00	4.74	6.34	7.52	11.03

Table 678

Out of Control ARL_0 for ssMEWMC of Dimension 20 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.10, \Delta = 0.25$		
20	23.03	66.78	245.25	588.14	1367.70
50	10.74	26.26	98.57	279.81	718.28
100	8.15	15.50	47.02	138.45	370.04
500	0.00	8.33	17.77	28.24	63.22
			$\lambda = 0.10, \Delta = 0.50$		
20	22.35	62.36	219.91	539.61	1260.77
50	11.30	25.87	91.67	243.01	631.79
100	8.65	16.90	45.75	118.51	313.37
500	0.00	10.33	18.59	28.10	61.83
			$\lambda = 0.10, \Delta = 1.00$		
20	59.37	161.78	459.89	970.65	1981.85
50	51.51	151.22	451.75	962.30	1970.06
100	50.83	149.01	447.16	963.60	1979.63
500	32.00	155.15	464.75	970.93	1984.97
			$\lambda = 0.10, \Delta = 2.00$		
20	24.74	77.10	270.10	644.89	1429.20
50	12.36	37.16	138.85	366.12	868.56
100	9.38	21.54	80.56	204.91	556.24
500	0.00	8.57	20.27	37.69	103.78
			$\lambda = 0.10, \Delta = 3.00$		
20	15.53	51.61	204.89	509.26	1194.17
50	6.67	16.80	73.00	201.94	551.77
100	5.23	9.20	27.45	74.81	222.47
500	0.00	5.35	6.38	8.95	14.23

Table 679

Out of Control ARL_0 for ssMEWMC of Dimension 20 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	26.11	76.06	273.72	646.58	1430.07
50	14.19	37.02	147.33	387.66	888.15
100	9.10	20.59	77.97	223.32	531.23
500	3.00	9.94	22.63	52.91	135.18
			$\lambda = 0.20, \Delta = 0.50$		
20	25.59	74.19	260.48	636.81	1426.72
50	14.29	36.62	139.74	373.25	870.63
100	10.07	23.88	78.44	212.53	540.29
500	0.00	12.99	28.70	66.88	151.77
			$\lambda = 0.20, \Delta = 1.00$		
20	61.48	160.05	463.91	1001.19	1985.83
50	59.06	156.90	459.47	985.95	1992.74
100	56.95	155.98	454.12	992.61	1986.96
500	31.33	159.41	466.54	987.87	1997.80
			$\lambda = 0.20, \Delta = 2.00$		
20	27.09	81.06	283.66	676.17	1472.09
50	15.50	47.45	177.42	452.24	1031.19
100	11.26	28.59	112.50	303.94	721.36
500	0.00	11.75	31.54	71.40	194.32
			$\lambda = 0.20, \Delta = 3.00$		
20	17.53	57.09	221.92	547.84	1245.18
50	8.27	24.23	102.81	287.00	712.28
100	5.86	11.69	48.44	138.11	378.24
500	1.00	6.24	8.16	14.63	37.86

Table 680

Out of Control ARL_0 for ssMEWMC of Dimension 20 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	27.45	81.02	288.42	674.68	1473.36
50	14.88	44.31	167.00	436.33	991.67
100	10.08	25.28	95.98	263.49	635.03
500	5.00	11.86	32.36	69.38	183.33
			$\lambda = 0.30, \Delta = 0.50$		
20	27.18	82.37	284.71	683.42	1474.63
50	16.00	45.17	165.65	434.99	974.25
100	11.71	29.93	99.91	275.03	651.46
500	9.00	17.76	38.17	79.97	191.10
			$\lambda = 0.30, \Delta = 1.00$		
20	61.00	161.70	467.70	991.89	1988.31
50	59.85	158.59	462.26	1000.45	2000.07
100	58.11	157.29	463.53	990.07	1996.88
500	36.00	161.48	470.31	993.00	1991.55
			$\lambda = 0.30, \Delta = 2.00$		
20	28.54	86.33	293.69	685.77	1465.81
50	16.42	53.01	191.22	482.77	1086.44
100	11.48	34.71	127.59	337.94	785.38
500	5.67	10.90	38.71	86.05	239.15
			$\lambda = 0.30, \Delta = 3.00$		
20	18.43	62.96	232.88	570.65	1263.28
50	9.02	28.48	112.98	330.29	777.79
100	5.84	14.53	57.24	163.36	454.57
500	3.00	5.90	10.77	21.95	51.56

Table 681

Out of Control ARL_0 for ssMEWMC of Dimension 20 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	29.46	85.77	298.95	687.58	1462.64
50	16.27	46.34	180.48	453.40	1007.79
100	10.31	27.30	109.52	286.07	683.02
500	0.00	13.73	35.55	82.99	197.87
			λ = 0.40, Δ = 0.50		
20	29.29	86.78	302.75	698.48	1510.37
50	16.96	48.85	183.00	459.15	1027.17
100	12.70	32.85	111.41	299.69	720.43
500	1.00	20.69	45.96	92.57	233.71
			λ = 0.40, Δ = 1.00		
20	62.03	160.65	477.22	997.22	1984.55
50	60.48	157.38	471.11	993.50	1983.94
100	59.33	158.32	476.00	998.90	1995.78
500	39.00	163.67	470.30	1002.11	1976.12
			λ = 0.40, Δ = 2.00		
20	29.91	87.74	304.30	696.16	1472.67
50	17.60	54.13	205.77	504.42	1115.72
100	12.37	36.69	139.90	354.26	814.62
500	2.00	14.26	42.97	98.96	261.35
			λ = 0.40, Δ = 3.00		
20	19.51	65.99	240.77	577.78	1265.60
50	9.91	28.83	124.00	339.02	814.83
100	6.33	15.32	62.50	182.52	460.20
500	1.00	6.88	11.23	24.84	51.68

Table 682

Out of Control ARL_0 for ssMEWMC of Dimension 20 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	30.06	89.07	306.17	691.73	1474.81
50	17.09	50.96	188.71	454.34	1047.16
100	11.15	28.94	111.58	293.73	701.84
500	0.00	14.50	39.01	93.02	214.86
			$\lambda = 0.50, \Delta = 0.50$		
20	29.84	90.64	308.81	701.77	1547.67
50	17.87	54.05	191.12	469.14	1082.39
100	14.11	34.27	122.38	313.91	761.54
500	0.00	26.95	48.06	103.18	268.55
			$\lambda = 0.50, \Delta = 1.00$		
20	61.06	163.66	471.81	984.98	1997.85
50	60.66	158.79	468.28	986.53	1990.98
100	58.89	160.17	476.66	991.61	2013.37
500	35.00	173.71	472.68	1001.39	2005.47
			$\lambda = 0.50, \Delta = 2.00$		
20	29.57	90.31	306.18	699.49	1486.50
50	18.15	56.28	209.88	507.13	1141.11
100	12.61	35.89	142.21	357.49	822.29
500	0.00	16.95	42.74	99.66	271.15
			$\lambda = 0.50, \Delta = 3.00$		
20	19.80	67.20	245.82	584.47	1293.48
50	10.32	31.55	129.66	348.98	853.33
100	6.47	15.77	64.03	185.74	493.48
500	0.00	6.86	11.54	24.58	57.83

Table 683

Out of Control ARL_0 for ssMEWMC of Dimension 20 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	30.39	90.71	310.83	694.74	1522.20
50	18.15	52.41	191.39	460.84	1058.50
100	11.94	30.23	114.57	309.42	711.67
500	1.00	19.74	40.40	89.85	230.46
			$\lambda = 0.60, \Delta = 0.50$		
20	30.59	92.91	308.71	730.41	1570.36
50	18.47	55.16	192.87	491.91	1104.32
100	14.08	35.08	129.61	327.04	772.81
500	2.00	25.56	51.83	109.81	280.89
			$\lambda = 0.60, \Delta = 1.00$		
20	61.21	163.56	466.14	992.12	1979.81
50	61.13	158.55	465.98	987.45	1987.73
100	59.65	157.84	475.94	990.36	2003.71
500	39.67	168.09	469.42	986.28	2010.02
			$\lambda = 0.60, \Delta = 2.00$		
20	30.07	91.77	304.07	708.15	1509.75
50	18.08	57.70	211.54	520.86	1150.28
100	13.16	36.49	139.83	360.68	855.44
500	1.00	17.73	43.55	103.07	258.91
			$\lambda = 0.60, \Delta = 3.00$		
20	19.78	67.84	245.66	595.97	1324.28
50	10.98	32.33	137.64	359.23	876.07
100	6.87	15.44	68.74	192.44	512.27
500	1.00	6.38	11.48	28.43	67.45

Table 684

Out of Control ARL_0 for ssMEWMC of Dimension 20 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.80, \Delta = 0.25$		
20	31.68	94.51	323.69	713.59	1510.01
50	18.99	58.21	201.87	484.73	1075.95
100	12.87	34.41	123.71	315.66	729.49
500	1.00	19.93	45.82	88.10	225.51
			$\lambda = 0.80, \Delta = 0.50$		
20	32.17	95.42	324.78	726.18	1558.79
50	19.60	60.51	207.56	492.02	1127.34
100	14.90	38.63	137.07	330.77	795.28
500	2.00	23.63	55.93	117.35	311.06
			$\lambda = 0.80, \Delta = 1.00$		
20	61.34	164.13	470.80	985.32	1973.28
50	61.22	162.11	475.02	976.31	1960.69
100	60.87	158.59	477.88	988.71	1978.34
500	53.33	160.40	464.15	980.36	1978.57
			$\lambda = 0.80, \Delta = 2.00$		
20	30.46	92.53	318.53	720.07	1512.08
50	18.32	59.68	218.20	521.42	1166.00
100	13.78	39.06	144.86	357.71	849.74
500	2.00	20.86	42.00	101.07	246.26
			$\lambda = 0.80, \Delta = 3.00$		
20	20.96	70.33	258.81	611.11	1349.44
50	10.86	33.92	147.21	362.44	883.52
100	7.50	17.01	73.95	202.31	520.47
500	0.00	8.00	13.47	27.74	67.49

Table 685

Out of Control ARL$_0$ for ssMEWMC of Dimension 25 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.05, \Delta = 0.25$		
20	24.07	71.98	257.86	628.14	1432.91
50	7.38	18.67	68.36	195.39	494.24
100	5.86	11.10	26.95	72.01	200.50
500	0.00	5.87	11.15	14.66	24.82
			$\lambda = 0.05, \Delta = 0.50$		
20	24.79	67.16	235.84	576.17	1302.17
50	8.20	19.09	62.51	165.90	435.85
100	6.79	12.09	25.97	67.18	175.59
500	0.00	8.04	11.97	16.69	26.42
			$\lambda = 0.05, \Delta = 1.00$		
20	54.98	153.92	463.48	970.35	1964.93
50	34.20	129.18	435.41	953.88	1943.79
100	31.85	122.90	432.04	934.84	1936.84
500	0.00	117.01	428.56	943.93	1945.67
			$\lambda = 0.05, \Delta = 2.00$		
20	24.75	81.76	299.04	700.60	1516.99
50	8.18	24.56	103.58	282.50	702.80
100	5.39	13.28	45.44	136.10	354.43
500	0.00	8.09	12.42	17.61	41.34
			$\lambda = 0.05, \Delta = 3.00$		
20	18.31	60.30	238.39	599.77	1358.86
50	4.89	10.88	43.64	143.55	384.94
100	3.60	5.90	14.01	39.87	116.97
500	0.00	4.53	5.74	6.27	8.49

Table 686

Out of Control ARL_0 for ssMEWMC of Dimension 25 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	22.99	75.74	268.27	632.96	1421.99
50	8.85	25.59	106.52	277.27	669.09
100	6.52	14.11	47.52	131.21	342.16
500	0.00	9.90	15.14	26.98	51.94
	λ = 0.10, Δ = 0.50				
20	23.39	70.47	249.29	607.24	1358.43
50	9.96	26.85	97.38	259.73	658.47
100	7.18	16.09	49.35	113.36	309.49
500	0.00	10.98	14.56	27.03	60.30
	λ = 0.10, Δ = 1.00				
20	54.28	155.85	459.85	953.40	1960.26
50	42.47	141.87	442.77	929.51	1931.48
100	39.75	138.34	447.46	937.28	1932.70
500	0.00	148.49	445.32	930.92	1917.73
	λ = 0.10, Δ = 2.00				
20	23.31	80.08	281.73	661.50	1466.30
50	10.04	32.77	135.77	341.53	854.52
100	6.49	18.34	72.56	198.35	525.94
500	0.00	11.67	17.35	31.39	94.04
	λ = 0.10, Δ = 3.00				
20	16.20	58.40	225.45	554.38	1268.22
50	5.58	14.56	67.34	188.40	526.23
100	3.88	7.37	23.75	65.81	214.40
500	0.00	5.34	5.84	7.20	16.22

Table 687

Out of Control ARL_0 for ssMEWMC of Dimension 25 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.20, \Delta = 0.25$		
20	24.51	80.33	283.83	640.69	1435.97
50	10.78	36.34	140.54	348.96	821.29
100	7.54	20.70	73.89	184.66	483.47
500	0.00	7.48	18.84	42.00	99.59
			$\lambda = 0.20, \Delta = 0.50$		
20	24.81	77.90	281.03	650.75	1411.57
50	12.54	36.26	141.41	350.73	826.24
100	8.54	23.25	76.61	197.87	496.34
500	0.00	11.72	22.90	50.43	109.30
			$\lambda = 0.20, \Delta = 1.00$		
20	54.22	155.67	465.53	949.81	1944.89
50	47.83	148.28	451.88	944.10	1934.27
100	46.97	146.52	451.84	943.55	1933.82
500	0.00	136.57	461.49	944.17	1942.83
			$\lambda = 0.20, \Delta = 2.00$		
20	24.35	82.49	292.86	657.03	1454.31
50	12.32	43.12	165.11	408.46	946.02
100	7.83	24.48	101.25	266.93	649.54
500	0.00	11.21	24.17	58.85	152.73
			$\lambda = 0.20, \Delta = 3.00$		
20	16.56	61.84	239.11	549.65	1254.59
50	6.48	22.14	101.22	261.53	651.49
100	4.39	10.19	37.27	110.32	324.52
500	0.00	5.04	7.07	13.09	29.73

Table 688

Out of Control ARL_0 for ssMEWMC of Dimension 25 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.30, \Delta = 0.25$		
20	26.22	84.43	294.20	667.88	1464.40
50	12.72	38.82	159.89	386.25	884.77
100	7.82	24.85	89.63	223.79	550.10
500	3.00	8.39	21.76	50.60	135.32
			$\lambda = 0.30, \Delta = 0.50$		
20	26.68	81.12	291.73	672.86	1454.63
50	14.23	41.53	157.02	393.11	910.50
100	9.32	26.69	90.94	232.98	570.25
500	2.00	9.65	28.03	66.75	157.60
			$\lambda = 0.30, \Delta = 1.00$		
20	53.81	150.91	459.40	969.92	1953.93
50	49.51	147.67	446.59	955.16	1940.23
100	47.74	146.78	443.96	954.62	1949.93
500	54.00	139.83	447.30	959.40	1928.12
			$\lambda = 0.30, \Delta = 2.00$		
20	26.00	83.50	295.07	671.75	1472.02
50	13.96	47.11	178.48	430.75	1000.08
100	8.76	28.86	111.89	294.59	700.61
500	7.00	11.59	30.05	72.70	190.67
			$\lambda = 0.30, \Delta = 3.00$		
20	17.69	63.43	240.69	568.63	1283.85
50	7.13	24.55	111.98	283.53	714.93
100	4.62	10.64	45.19	142.23	350.98
500	2.00	3.76	8.05	14.93	36.58

Table 689

Out of Control ARL_0 for ssMEWMC of Dimension 25 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	27.11	87.11	297.67	702.71	1488.06
50	13.93	42.03	165.31	401.58	929.45
100	8.90	26.28	95.46	233.17	604.93
500	3.00	9.35	25.88	56.67	150.66
			λ = 0.40, Δ = 0.50		
20	27.20	84.89	296.59	691.02	1522.49
50	15.82	44.80	168.18	426.64	991.04
100	10.58	28.67	101.23	266.65	636.16
500	2.00	11.78	33.57	74.86	184.82
			λ = 0.40, Δ = 1.00		
20	53.80	151.70	454.13	979.45	1972.59
50	50.66	150.20	447.01	964.99	1943.86
100	48.58	150.70	440.21	954.34	1946.56
500	76.50	150.97	442.04	942.24	1927.58
			λ = 0.40, Δ = 2.00		
20	26.52	88.22	297.54	686.23	1494.02
50	14.80	51.12	184.61	445.07	1039.46
100	9.29	30.20	118.29	292.36	742.56
500	7.00	13.50	30.90	75.66	209.48
			λ = 0.40, Δ = 3.00		
20	18.93	66.49	245.83	591.12	1329.37
50	7.95	26.97	111.80	299.65	761.77
100	5.38	11.11	52.73	143.53	404.92
500	2.00	5.32	8.90	15.16	44.56

Table 690

Out of Control ARL_0 for ssMEWMC of Dimension 25 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.50, \Delta = 0.25$		
20	27.80	90.22	303.72	724.18	1544.84
50	14.40	43.81	169.01	410.53	971.27
100	9.33	26.74	96.20	245.23	646.45
500	2.33	9.26	26.26	67.54	159.55
			$\lambda = 0.50, \Delta = 0.50$		
20	28.04	88.97	306.30	712.24	1546.74
50	16.15	45.55	176.20	443.91	990.13
100	11.13	29.36	105.90	272.79	677.52
500	1.50	11.83	35.76	84.75	200.85
			$\lambda = 0.50, \Delta = 1.00$		
20	53.76	152.11	458.14	989.08	1984.52
50	50.74	149.27	450.48	966.38	1963.90
100	50.11	148.69	446.57	961.11	1971.63
500	43.67	143.55	449.66	956.47	1941.52
			$\lambda = 0.50, \Delta = 2.00$		
20	26.82	90.08	302.42	700.76	1523.93
50	14.85	53.34	180.98	458.97	1068.50
100	9.87	30.45	122.51	311.56	756.42
500	7.00	12.27	37.64	89.58	225.62
			$\lambda = 0.50, \Delta = 3.00$		
20	19.43	68.64	249.94	609.33	1347.74
50	8.23	28.02	114.07	305.29	792.34
100	5.34	12.90	56.46	150.47	425.88
500	2.00	5.70	10.18	19.64	44.71

Table 691

Out of Control ARL_0 for ssMEWMC of Dimension 25 and λ of 0.60

t	ARL				
	100	200	500	1000	2000
			$\lambda = 0.60, \Delta = 0.25$		
20	28.96	92.75	316.32	728.06	1573.66
50	14.61	45.35	167.30	423.27	995.48
100	10.17	27.09	95.97	252.16	671.81
500	2.00	8.59	27.16	68.11	175.05
			$\lambda = 0.60, \Delta = 0.50$		
20	29.32	92.89	320.07	717.61	1580.28
50	16.28	50.17	179.09	447.26	1034.29
100	11.51	30.86	110.62	278.50	706.43
500	2.00	11.69	38.76	86.92	208.98
			$\lambda = 0.60, \Delta = 1.00$		
20	54.09	154.04	454.00	967.62	1981.72
50	51.02	150.14	449.09	953.30	1970.30
100	50.37	150.57	445.89	955.27	1976.96
500	28.00	151.94	446.32	939.95	1959.94
			$\lambda = 0.60, \Delta = 2.00$		
20	27.99	92.11	302.53	705.18	1567.66
50	15.68	54.13	182.94	463.27	1085.20
100	9.91	31.62	118.49	316.25	776.20
500	1.00	11.62	37.51	92.36	231.84
			$\lambda = 0.60, \Delta = 3.00$		
20	20.62	71.68	257.38	614.42	1408.88
50	8.67	29.07	117.88	311.90	814.64
100	5.26	13.61	53.23	154.23	443.00
500	2.00	5.56	11.12	21.99	40.57

Table 692

Out of Control ARL_0 for ssMEWMC of Dimension 25 and λ of 0.80

t	ARL				
	100	200	500	1000	2000
	λ = 0.80, Δ = 0.25				
20	32.44	101.07	341.92	755.21	1621.50
50	18.71	59.69	208.95	507.34	1114.25
100	12.39	35.09	126.70	313.68	749.02
500	0.00	13.71	31.71	61.55	171.55
	λ = 0.80, Δ = 0.50				
20	33.14	101.35	337.81	742.79	1594.53
50	19.83	60.38	221.21	514.17	1146.85
100	14.09	37.52	136.14	338.96	779.67
500	1.00	15.41	35.13	83.25	209.15
	λ = 0.80, Δ = 1.00				
20	56.52	155.07	455.68	958.80	1973.70
50	54.22	151.23	455.45	950.96	1970.06
100	54.59	152.97	461.38	945.97	1957.94
500	113.00	151.81	452.32	952.59	1968.34
	λ = 0.80, Δ = 2.00				
20	31.09	97.70	324.02	729.86	1573.62
50	19.98	64.35	229.55	518.52	1177.34
100	15.31	41.32	155.10	373.44	854.63
500	1.00	19.84	37.71	98.35	261.88
	λ = 0.80, Δ = 3.00				
20	25.25	82.33	288.88	651.23	1410.38
50	15.94	49.28	181.35	439.94	1017.97
100	9.98	27.65	98.54	252.33	631.95
500	0.00	8.32	16.39	33.27	97.08

Table 693

Out of Control ARL_0 for ssMEWMC of Dimension 50 and λ of 0.05

t	ARL				
	100	200	500	1000	2000
			λ = 0.05, Δ = 0.25		
20	19.54	115.20	394.82	868.29	1845.24
50	2.15	21.07	106.87	304.38	754.21
100	0.00	7.63	28.75	85.54	276.21
500	0.00	5.27	5.67	9.75	14.58
			λ = 0.05, Δ = 0.50		
20	20.14	117.00	387.06	852.25	1823.43
50	2.27	23.85	108.43	298.81	773.75
100	0.00	9.10	33.93	106.49	322.08
500	0.00	5.27	8.39	10.24	17.73
			λ = 0.05, Δ = 1.00		
20	29.98	132.65	434.31	937.10	1931.01
50	4.32	101.31	402.75	903.42	1896.72
100	0.00	83.14	375.12	869.26	1868.16
500	0.00	89.41	369.24	891.36	1897.84
			λ = 0.05, Δ = 2.00		
20	18.94	116.78	404.18	885.38	1859.27
50	2.23	23.64	117.94	337.83	835.27
100	0.00	9.39	45.70	142.66	409.40
500	0.00	6.58	8.60	11.14	28.27
			λ = 0.05, Δ = 3.00		
20	17.19	107.49	390.18	854.08	1824.85
50	1.91	13.10	75.27	218.05	592.33
100	0.00	4.75	12.39	39.00	153.45
500	0.00	3.60	4.12	4.69	10.69

Table 694

Out of Control ARL_0 for ssMEWMC of Dimension 50 and λ of 0.10

t	ARL				
	100	200	500	1000	2000
	λ = 0.10, Δ = 0.25				
20	25.49	129.70	412.57	906.69	1909.48
50	2.46	21.65	117.42	319.43	804.97
100	0.00	9.91	45.64	142.99	440.92
500	0.00	5.00	7.07	13.00	26.29
	λ = 0.10, Δ = 0.50				
20	26.01	129.21	407.11	902.04	1879.92
50	2.72	23.68	125.95	352.04	860.44
100	0.00	12.70	59.46	171.21	462.67
500	0.00	5.88	9.33	15.70	59.22
	λ = 0.10, Δ = 1.00				
20	30.07	131.99	434.28	935.08	1966.56
50	6.13	102.55	398.69	907.07	1935.22
100	0.00	95.86	391.38	906.20	1926.17
500	0.00	98.22	397.71	919.35	1919.75
	λ = 0.10, Δ = 2.00				
20	24.41	131.49	423.45	908.86	1902.69
50	2.55	24.20	132.30	356.84	887.15
100	0.00	11.40	70.83	206.22	547.48
500	0.00	7.67	10.94	21.88	75.92
	λ = 0.10, Δ = 3.00				
20	22.81	127.53	413.89	901.98	1880.44
50	2.07	12.41	77.69	234.36	604.79
100	0.00	5.13	22.62	86.38	243.94
500	0.00	3.19	4.10	4.75	11.54

Table 695

Out of Control ARL_0 for ssMEWMC of Dimension 50 and λ of 0.20

t	ARL				
	100	200	500	1000	2000
			λ = 0.20, Δ = 0.25		
20	30.71	132.98	426.34	905.94	1921.47
50	2.37	23.58	132.13	355.53	884.24
100	0.00	11.80	59.54	175.77	506.76
500	0.00	8.00	8.61	14.54	41.17
			λ = 0.20, Δ = 0.50		
20	30.86	132.02	420.67	896.86	1924.77
50	2.68	28.39	147.57	383.66	941.19
100	0.00	14.81	70.98	216.42	563.32
500	0.00	9.83	10.59	27.48	88.06
			λ = 0.20, Δ = 1.00		
20	29.97	129.47	429.96	922.57	1963.14
50	6.31	101.37	403.06	898.62	1932.98
100	0.00	101.21	402.03	903.62	1931.79
500	0.00	96.62	402.45	894.76	1960.49
			λ = 0.20, Δ = 2.00		
20	30.05	133.87	433.83	914.87	1934.88
50	2.54	27.08	146.76	383.99	936.32
100	0.00	13.87	86.32	240.11	628.65
500	0.00	7.96	12.22	29.75	126.10
			λ = 0.20, Δ = 3.00		
20	29.63	131.68	422.83	908.65	1931.53
50	2.00	14.25	89.83	252.88	661.15
100	0.00	5.59	32.94	97.99	295.21
500	0.00	2.80	4.33	5.94	15.06

Table 696

Out of Control ARL_0 for ssMEWMC of Dimension 50 and λ of 0.30

t	ARL				
	100	200	500	1000	2000
			λ = 0.30, Δ = 0.25		
20	30.94	132.86	425.30	917.75	1920.37
50	2.14	25.37	133.47	376.38	896.66
100	0.00	12.58	66.10	194.13	527.55
500	0.00	3.62	11.00	16.72	60.06
			λ = 0.30, Δ = 0.50		
20	31.02	131.97	421.91	917.53	1906.84
50	2.48	30.02	153.54	419.01	958.49
100	0.00	15.76	80.91	232.27	596.86
500	0.00	6.93	14.99	32.66	104.15
			λ = 0.30, Δ = 1.00		
20	29.90	130.28	432.83	933.76	1945.50
50	5.56	101.06	406.46	902.98	1916.39
100	0.00	102.58	407.76	909.09	1893.01
500	0.00	89.92	396.53	914.05	1915.52
			λ = 0.30, Δ = 2.00		
20	30.53	133.09	426.00	925.40	1922.75
50	2.34	27.72	155.66	402.20	957.40
100	0.00	14.61	90.81	270.42	665.15
500	0.00	8.04	15.23	31.70	148.14
			λ = 0.30, Δ = 3.00		
20	30.27	130.46	418.20	918.15	1912.80
50	1.86	14.65	92.48	272.32	667.95
100	0.00	5.21	37.77	120.10	330.29
500	0.00	1.95	4.42	5.77	19.64

Table 697

Out of Control ARL$_0$ for ssMEWMC of Dimension 50 and λ of 0.40

t	ARL				
	100	200	500	1000	2000
			λ = 0.40, Δ = 0.25		
20	30.70	132.74	420.73	919.54	1918.61
50	2.02	25.66	140.39	370.40	910.33
100	0.00	13.24	71.01	198.57	514.92
500	0.00	3.75	9.80	22.81	66.01
			λ = 0.40, Δ = 0.50		
20	30.78	131.64	422.17	917.29	1923.91
50	2.32	31.57	161.54	427.30	979.37
100	0.00	16.88	85.36	234.65	647.10
500	0.00	8.50	17.41	33.25	118.48
			λ = 0.40, Δ = 1.00		
20	29.90	131.31	432.87	935.17	1933.28
50	4.87	101.80	401.80	915.61	1894.10
100	0.00	102.92	404.56	903.66	1902.22
500	0.00	93.10	399.06	921.30	1905.58
			λ = 0.40, Δ = 2.00		
20	30.43	130.96	418.56	918.98	1932.98
50	2.21	27.37	160.11	408.27	971.32
100	0.00	14.80	84.41	275.58	700.88
500	0.00	17.24	14.23	41.54	160.49
			λ = 0.40, Δ = 3.00		
20	30.30	129.18	412.89	916.05	1930.35
50	1.74	15.71	99.44	265.76	686.65
100	0.00	6.11	35.70	120.47	347.19
500	0.00	2.69	4.61	6.27	18.32

Table 698

Out of Control ARL_0 for ssMEWMC of Dimension 50 and λ of 0.50

t	ARL				
	100	200	500	1000	2000
			λ = 0.50, Δ = 0.25		
20	30.53	134.99	450.61	450.61	450.61
50	1.89	26.93	164.65	164.65	164.65
100	0.00	12.13	82.67	82.67	82.67
500	0.00	3.44	14.36	14.36	14.36
			λ = 0.50, Δ = 0.50		
20	30.58	134.12	436.00	436.00	436.00
50	2.03	33.24	177.72	177.72	177.72
100	0.00	14.99	93.29	93.29	93.29
500	0.00	4.94	20.37	20.37	20.37
			λ = 0.50, Δ = 1.00		
20	29.90	132.46	433.58	433.58	433.58
50	4.29	103.41	406.71	406.71	406.71
100	0.00	102.85	403.44	403.44	403.44
500	0.00	88.66	398.09	398.09	398.09
			λ = 0.50, Δ = 2.00		
20	30.30	135.00	477.04	477.04	477.04
50	2.04	30.57	202.88	202.88	202.88
100	0.00	14.28	127.09	127.09	127.09
500	0.00	4.15	21.94	21.94	21.94
			λ = 0.50, Δ = 3.00		
20	30.22	133.09	475.85	475.85	475.85
50	1.67	17.25	138.11	138.11	138.11
100	0.00	6.01	51.26	51.26	51.26
500	0.00	2.71	5.19	5.19	5.19