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Robustness And Power Comparison Of The Mood-Westenberg And Siegel-Tukey Tests

Linda Candy Lowenstein
Wayne State University,

ROBUSTNESS AND POWER COMPARISON OF THE MOOD-WESTENBERG AND SIEGEL-TUKEY TESTS

by

LINDA C. LOWENSTEIN

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DEDICATION

B”H

To the memory of my parents, Julian (Bud) and Helen,

the honor of my husband, Doug,

and the inspiration of

The Rebbe, Rabbi Menachem Mendel Schneerson and his wife, Rebbetzin Chaya Mushka,

of blessed memory

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CHAPTER I

INTRODUCTION

In the context of its application in experimental design, the Student t-test (Student, 1908a) for two independent samples assumes independence, equal variances and population normality. By extension, these assumptions are required also for the Analysis of Variance (ANOVA), or F-test (Fisher, 1918). These classical statistics were formulated by William S. Gosset (1876-1937) in 1908 (Student, 1908a; Mankiewicz, 2000) and Ronald A. Fisher (1890-1962) during the 1920's (Fisher, 1918; Lomax & Has-Vaughn, 2012) respectively. Traditionally researchers have turned to these classical tests in order to assess the probability of a treatment effect in experimental design.

However, problems arise for researchers when these statistical assumptions are violated by the experimental data. If the variances between experimental samples are not equal, then these groups do not share common scales and it becomes difficult to determine an appropriate standard error for use in the t and F statistics. If data sets are not normal, then the normal probability functions fundamental to classical statistics may not be valid for detecting treatment effects.

The literature is vast on how poorly the t and F tests perform for unequal variances, the condition known as heteroscedasticity. "Heteroscedasticity refers to situations where two or more of the variances are unequal" (Wilcox, 1996, p. 174). For instance, it has been demonstrated that small sample sizes, unequal sample sizes and one-tailed tests can be problematic for the t-test with respect to heteroscedasticity and non-normal data. Wilcox (1996) discussed some of the issues for violation of the equal variance assumption in relationship to the robustness of the t test:

> When distributions are normal and there are equal sample sizes, but the equal variance assumption is violated, Student's t-test provides fairly good control over the probability of Type I error if the sample sizes are not too small… However, when the sample sizes are unequal Student's-t can be unsatisfactory, even when sampling from a normal distribution… …The situation is worse when the distributions are nonnormal…

With respect to the F test, the problem is even worse. Wilcox (1996) stated that "our hope is that any problem associated with unequal variances might diminish when there are more than two groups, but the reverse seems to be true" (p. 180). Keppel & Wickens (2004) noted the problem:

> The conclusion we drew from the Monte Carlo experiments in Table 7.1 was that the actual significance level could appreciably exceed the nominal α level when the group variances were unequal. Under these circumstances, we need a way to adjust or modify our analysis (p. 152).

Keppel & Wickens (2004) mentioned four possible remedies for unequal variances, such as adopting more stringent significance levels, transforming the data, using alternative tests, or emphasizing single-df tests. However, they (Keppel & Wickens, 2004) noted of these remedies, "although none of them is universally effective, most problems can be solved (or ameliorated) by one of the four" (p. 156). Other authorities take exception with some of these methods. Wilcox (1996) stated many would disagree with Keppel & Wickens' (2004) suggestion to adjust significance levels (i.e., accepting a Type I error rate of .09 when $\alpha = .05$). With respect to principled experimental design theory, it would indeed appear improper to extend a selected α level unless α is bounded by certain predetermined limits (e.g. Bradley, 1978). Wilcox (1996), and Sawilowsky & Fahoome (2003) took exception with the Keppel & Wickens' (2004) suggestion of data transformation (e.g., transforming data to logarithms) which tends to make the data distribution more symmetrical, more normal looking, and brings the sample variances closer together. In terms of transforming data with respect to the Student's-t test, which can be extended to the F-test, Wilcox (1996) stated data transformation "does not necessarily eliminate low power due to heavy-tailed distributions or outliers" (p. 155), and more importantly "that by transforming data and applying Student's t-test or Welch's method, you are no longer comparing the means corresponding to the original observations" (p. 155). When discussing an ANOVA example, Sawilowsky & Fahoome (2003) agreed with Wilcox's (1996) concern about meaningless results after data transformation:

> Interactions can be made to apparently vanish with other types of well-known transformations, such as logarithmic, hyperbolic, sine or squaring the above mentioned inverse, but how frequently in social and behavioral sciences would anyone be interested in the resulting metric and therefore the meaning of such transformed scores? <u>And of course more importantly, in which of these cases is the meaning of the construct unchanged by taking the reciprocal </u>(p. 280)?

Wilcox (1996) mentioned some of the poor results of the F-test under conditions of unequal variances in the literature (Brown and Forsythe, 1974; Rogan and Keselman, 1977; Tomarken and Serlin, 1986). At first, with respect to the F test, it was assumed there was no impact with unequal variances. For instance Box (1954a) analyzed results of violating the equal variance assumption under normality and reported that the probability of a Type I error is not overly affected by unequal variances if R $\leq \sqrt{3}$ (R $=\sigma 1/\alpha 2$). R is defined as the ratio of the largest to the smallest standard deviation. No results were given for large ratios and according to Wilcox (1996), the prevailing opinion for the next twenty years was that the F test was relatively immune to violations of the equal variance assumption. However, Wilcox, Charlin and Thompson (1986), found if the null hypothesis of equal means is true the actual probability of a Type I error rate can be as high as .3 when R = 4 and α= .05. Wilcox (1996) encountered estimates of R as high as 11 and noted:

> Brown and Forsythe (1974) reported results for R = 3 and found that the probability of a Type I error was unacceptably high. No reason for limiting the results to $R \leq 3$ was given. Wilcox (1989), in a survey of educational studies, found that estimates of R are often higher than 4. If the null hypothesis of equal means is true, the actual probability of a Type I error can be as high as .3 when R = 4 and $\alpha = .05$ (Wilcox, Charlin, and Thompson, 1986) (p. 180).

The problem, of course, with an inflated Type I error rate in the context of experimental design is that nonsense treatment effects will be concluded more often. Wilcox (1996) noted that a possible counter argument to the problem of Type I error discrepancies as described here is that according to some authorities (e.g., Sawilowsky, 2002), having equal means with unequal variances is unrealistic. "That is, this situation will never arise in practice because if the variances are unequal surely the means are unequal, in which case a Type I error is not an issue (Wilcox, 1996)" (p. 180).

However, despite this objection from some authorities, Wilcox (1996) mentioned that "there is evidence that problems with Type I errors with unequal variances reflect undesirable power properties even under normality (Wilcox, Charlin, and Thompson, 1986; Wilcox 1994a)" (p. 180). For instance, Wilcox (1996) mentioned there are situations where the null hypothesis is false, yet the probability of rejecting the null hypothesis is less than α. Thus, in this case, important treatment effects may be missed. Wilcox (1996, p. 181) noted that "the power curve might be unusually flat in a regions near the null hypothesis (Wilcox, 1994a)" especially when the data is skewed. Therefore, despite the objections of many who claim that means will not stay the same (eliminating Type I error concerns) if the scales/variances change, the Type II error rate could inflate should there be a treatment effect indicated by a shift in means *around* the null region. Wilcox (1996) noted other inconsistencies with power results under conditions of heteroscedasticity and warned "although an optimal solution has not been derived, it seems fair to say that you should not assume that the F test is always best" (p. 181).

This insidious violation of equal variances is common in experimental design. For instance, it is not unusual for a treatment group to have a change in scale or variance after treatment causing unequal variances between groups (Wilcox, 1996). According to Sawilowsky and Fahoome (2003), a common outcome for psychological and educational data after treatment is that the treatment group becomes more homogeneous or more heterogeneous. When this happens, it often causes non-robust test results for the t and F statistic, as the difference in scale or variance surface between control group and treatment group. Additionally, these tests often lack comparative statistical power as the differences in scale/variances surface between control and treatment groups. As the variability of the treatment group become more and more different from the control group, the underlying assumptions of equal variances become more and more violated. This condition of unequal variances (nonhomogeneous variances) or heteroscedasticity between sample groups in research settings gives rise to what statisticians have come to know as the Behrens-Fisher problem.

Sawilowsky (2002) noted that the Behrens-Fisher problem was named after W.V. Behrens (1902-1962), (1929) and Ronald A. Fisher (1935) who developed the first expression and solution for the problem. It

> arises in testing the difference between two means with a t test when the ratio of variances of the two populations from which the data were sampled is not equal to one. This condition is known as heteroscedasticity, which is a violation of one of the underlying assumptions of the t test. The resulting statistic is not distributed as t, and therefore the associated p values based on the entries found in standard t tables are incorrect. Use of tabulated critical values may lead to increased false positives, which are known as Type I errors, or a conservative test that lacks statistical power to detect significant treatment effects (p.461).

Additionally, these concerns apply to the ANOVA F-test. Sawilowsky (2002) noted that the Behrens-Fisher problem generalized to more than the two sample case; it applied to many layouts.

The Behrens-Fisher problem has a long history of research attention over the last century as statisticians attempted to provide solutions to work around this particular assumption violation. It continues to be actively studied according to Sawilowsky (2002):

> Despite the many approximate solutions published to date, the Behrens-Fisher problem remains actively studied. In the past 35 years, there were 37 doctoral dissertations completed pertaining to some aspect of the Behrens-Fisher problem, including newly proposed approximate solutions (*Dissertation Abstracts Online*, 2000). There was one dissertation completed in the 1960's, six in the 1970's, 16 in the 1980's and 14 in the 1990's (p. 463).

Background

Parametric Testing

For most of the 20th century, the equal variance violation was considered of little consequences according to Sawilowsky and Fahoome (2003). This perspective has been shown to be incorrect particularly in light of Monte Carlo research methods. Sawilowsky and Fahoome (2003) noted that for the ANOVA, F-test similar to the Students-t test:

> the literature on the behavior of the ANOVA F in the presence of violations of these three underlying assumptions is amazingly vast, considerable controversial, and only recently conclusive. Most of what is known regarding the operating characteristics of the Anova F test parallels work on the robustness of the t test. Most of the work is based on Monte Carlo studies.
>
> The violation of independence is a recipe for disaster in terms of Type I errors. There is no statistic that can overcome a true lack of independence, either within or between scores. Heteroscedasticity, or heterogeneous variances within or between groups, can also be quite debilitating in terms of type I errors (e.g., Randolph & Barcikowsky, 1989). This is especially so in no particular order, when (a) sample sizes are unequal, (b) cells with the smaller n's have the larger variances (c) accompanied by other violations of assumptions and (d) the degree of nonhomogeneity increases (p. 292).

Nonparametric Testing

Sawilowsky and Fahoome (2003) noted that non-homogeneity or heteroscedasticity causes nonparametric tests to be ineffective as well and that even the Wilcoxon Rank Sum test (1945), an alternative to the t test, which is three to four times more powerful than the t-test under conditions of non-normality, is also not a good test when the treatment primarily impacts scale. Additionally, Sawilowsky (2002, p. 463) noted with the ANOVA F-test, "for the case of K > 2, Feir-Walsh and Toothaker (1974) and Keselman, Rogan, and Feir-Walsh (1977) found the Kruskal-Wallis test (Kruskal & Wallis, 1952) and expected normal scores test (McSweeney & Penfield, 1969) to be 'substantially affected by inhomogeneity of variance' (p.220)."

Experimental Design

In experimental design, a version of the Behrens-Fisher problem has been particularly vexing for researchers: how to determine the probability of a treatment effect (within the limits of Type I errors) when the post-test reveals a possible variance change/difference concurrent with the means of the two groups remaining the same (Sawilowsky, 2002, Young & Smith, 2005). This problem has prompted much of the research efforts attempting to develop solutions. Yet, until today, many suggestions have been put forth for adjustments to the classical statistics when heteroscedasticity arises but there are no ultimate solutions; they are satisfactory only under limited circumstances.

Detecting Change in Scale

In addition to the absence of full-proof Behrens-Fisher solutions, there were no statistical tests designed for the purpose of *detecting* scale or variance changes between sample groups with regard to the level of heteroscedasticity necessary to invoke the Behrens-Fisher problem. According to Neave and Worthington (1988), there were no satisfactory nonparametric tests that could determine the potential of unequal variances *irrespective* of whether there was a location shift. They noted that the Mood-Westenberg dispersion test (1948) determined differences in variances under the assumption that the means of two samples are equal. Likewise, they noted that the Siegel-Tukey test (1960) assumes roughly equal means/medians for detecting variance differences between groups.

Neave & Worthington (1988) apologetically bemoaned their inability to offer a robust nonparametric test with power for determining when two samples reflected shifts in location and concurrently a possible change in scale. It is important to determine possible scale changes after treatment in order that the researcher can select the appropriate statistical test. If scales do not change, the classical t and F tests can be applied. Otherwise, if scales change, as Wilcox (1996) noted, it might be best to select another alternative and the researcher should not assume that the F (or t-test) is best. Neave and Worthington (1988) noted:

> Although the Kolmogorov-Smirnov and Rosenbaum tests in Chapter 7 deal with situations where there may be differences in both location and dispersion, there is one particular kind of problem that in fact does not seem to have any good distribution-free solutions. This is the problem of detecting a dispersion difference irrespective of whether there is a location difference. In classical statistics, this problem is solved very neatly by the F-test since the F-statistic remains completely unchanged if either or both samples have constants added or subtracted from them (representing change in location). Frustratingly, there is, as yet, no such neat equivalent distribution-free method. Several attempts have been made to solve the problem, but all resulting tests suffer from being rather un-powerful or not truly distribution-free or both….It is particularly unfortunate that there appears to be no good distribution-free solution to this problem since several researchers have shown that non-normality can upset the behavior of the F-statistic to a very considerable extent. The best attempt at such a distribution-free method appears to be Moses rank-like tests (p.135).

Purpose of Study

If, as Neave and Worthington (1988) noted, there are no testing procedures which can *detect* the occurrence of different variances *irrespective* of means, then how does the researcher even know *if* a Behrens-Fisher problem arises so as to subsequently apply any of the approximate solutions? The primary focus of this study will be to determine if there is a particular statistical method, for example, the Mood-Westenberg test (1948) that could detect the Behrens-Fisher problem for variance changes/differences if its assumption of equal means is violated. How far do the means have to differ before the test becomes non-robust (no longer able to maintain Type I and Type II error rates in light of violating the assumption of equal means)?

In this study, it is postulated that if the Mood-Westenberg test (1948) could remain robust with respect to Type I errors and Type II error properties under violations of the equal means assumption, then the Mood-Westenberg test (1948) might indeed alert a condition of the famous and classical Behrens-Fisher problem of heteroscedasticity so that a researcher could apply one of the approximate solutions. Sawilowsky (2013, personal communications) agreed “if the Mood-Westenberg test (1948) is robust with respect to departure from equal means, it would be useful as a precursor to employing classical solutions, such as, for example, Yuen’s procedure (Yuen, 1974).”

The purpose of the study, then, is to research and explicate under what conditions, if any, the Mood-Westenberg dispersion test (1948), a nonparametric ordinal test based on position within quartiles, is robust with respect to Type I errors and Type II error properties and maintains power for detecting heteroscedasticity (changes/differences in scale) when its equal means assumption is violated (means becoming more and more different) in small increasing increments. The interest in performing this study is to determine when heteroscedasticity or scale changes, (not location shifts) becomes detectable for experimental data drawn from real data sets and mathematical distributions.

Because the Siegel-Tukey test (1960), another ordinal test based upon rankings and an assumption of equal means/medians, has also been proposed for the purpose of determining variance/spread differences between two samples, it will be invoked as the primary competitor to the Mood-Westenberg test (1948). In the second phase of this study, which assumes the Mood-Westenberg test (1948) is robust, will be a comparative power study between the Mood-Westenberg (1948) and the Siegel-Tukey (1960) tests.

Statement of Problem

This problem under investigation is the following: How does a researcher become aware of the Behrens-Fisher problem (heteroscedasticity) in order to apply an approximate solution? Would a researcher even know if the Behrens-Fisher problem surfaced in experimental design? Under what conditions would the non-parametric Mood-Westenberg dispersion test (1948) detect the Behrens-Fisher problem when potential treatment effects (means become different) arise? The questions will be repeated for the Siegel-Tukey test (1960). Then, given that the Mood-Westenberg (1948) and Siegel Tukey (1960) tests are robust, a comparative power study will be performed for these two tests. The expectation is that both the Mood-Westenberg (1948) and the Siegel-Tukey (1960) tests will be robust with respect to Type I and Type II errors for variance change hypothesis testing when their assumption of equal means are violated. Secondly, it is expected that the Mood-Westenberg test (1948) will be slightly more powerful than the Siegel-Tukey test (1960) because “the power of Siegel-Tukey test is a little less than that of Mood’s test” (Neave and Worthington, 1988, p. 134).

Significance of Study/Impact on Literature

There are several possibilities for advancing the literature. If the Mood-Westenberg dispersion test (1948) is found to be robust and/or powerful in light of violation of the equal means assumption, then it could be utilized in experimental research as a testing procedure that could detect variance changes irrespective of mean/location shifts, a test that would be a palliative for the Neave and Worthington (1988) concern that there is no method for detecting variance changes irrespective of location shifts. Therefore it would be useful for the identification of the Behrens-Fisher problem. And because of the ability to identify the Behrens-Fisher problem, it would ultimately assist in identifying potential treatment effects around the null region, a concern surfaced by Wilcox (1996). Additionally, the outcomes will explicate the exact conditions under which the test statistic would be robust and powerful for this purpose.

If the test is found to be non-robust and/or not powerful and therefore yet another procedure that is ineffective for detecting the Behrens-Fisher problem, a decision must be made if it is worthwhile to continue devoting attention to developing solutions when there are no methods for detecting the Behrens-Fisher problem in research design. Unless there is a robust and powerful test for detecting heteroscedasticity after treatment when the occurrence of a treatment effect is unknown, (i.e., irrespective of location shifts), then continuing research efforts to find a Behrens-Fisher solution for this version of the problem would be a waste of resources and research efforts because the problem would be undetectable. It would be especially deemed wasted effort in developing additional solutions for the statisticians who believed "the situation will never arise in practice because if the variances are unequal surely the means are unequal, in which case a Type I error is not an issue (Wilcox, 1996, p. 180)." Negative outcome results would lend additional support to Sawilowsky (2002) who strongly opined that "sufficient journal space has been given to this problem in comparison with the frequency with which it occurs" (p. 468).

Limitations

The limitations will be related to the input parameters including various alpha levels, theoretical distributions and real data sets, small/medium equal and non-equal sample sizes and various magnitudes of shifts in location and changes in scale.

Definition of Terms

Alpha (Significance Level): Alpha is the probability criteria of incorrectly rejecting the null hypothesis (incorrectly finding in favor of a treatment effect) when in fact there is no treatment effect. For a hypothesis test, it is the probability that the test will lead to a Type I error. In this study it concerns the probability that the interested nonparametric tests, Mood-Westenberg (1948)/ Siegel-Tukey test (1960) will incorrectly reject the null hypothesis of equal variances for two experimental samples when in fact the variances are equal.

Assumption: A statistical test requirement necessary to maintain specified Type I error rates (e.g., p=.05).

Beta: Beta is the probability of incorrectly accepting the null hypothesis (incorrectly assessing no treatment effect) when there is in fact a treatment effect. For a hypothesis test, it is the probability that the test will lead to a Type II error. In this study it concerns the probability that the interested nonparametric tests, Mood-Westenberg (1948)/ Siegel-Tukey test (1960), will incorrectly accept the null hypothesis of equal variances for two experimental samples when in fact the variances are not equal.

Behrens-Fisher Problem: The Behrens-Fisher problem arises in testing the difference between two means with a t test when the ratio of variances of the two populations from which the data were sampled is not equal to one. This condition is known as heteroscedasticity, which is a violation of one of the underlying assumptions of the t test. It applies to many layouts with K > 2 (Sawilowsky, 2002).

Bradley Proposed Limits: According to Bradley's (1978) proposed limits, robustness can be defined liberally as when Type I error falls within plus or minus .5 of the nominal alpha level, and defined stringently when Type I error falls within plus or minus .1 of the nominal alpha level.

Conservative: When a test does not reject the null hypothesis as much as it should for a given Type I error rate.

Critical Value: A selected probability limit used to determine if the results of a statistical procedure are significant.

Distribution: A probability frequency for a given variable. According to Sawilowsky and Fahoome (2003): "In many areas of physical and mathematical science the uniform curve is the best first guess but in modern times variables are known to be distributed according to other distributions such as exponential and normal curve." Sawilowsky and Fahoome (2003) noted that Micceri (1989) found less than 3% of all educational and psychological data sets are symmetric with light tails, such as the bell curve and therefore for the past quarter of a century, many other mathematical curves other than the Gaussian distributions were suggested as models of the distribution properties of important variables. Also, Micceri (1989) found real world data sets often differ from mathematical models.

Effect Size: A measure of the absolute magnitude of a treatment effect that is independent of the sample size being used. It is the difference in means between samples divided by the standard deviation. The interest concerning simulated effect size in the context of this study is to explicate its impact upon the Mood-Westenberg (1948) and the Siegel-Tukey test (1960) capabilities to detect spread/variance ratios not equal to 1.

External Validity: Concerns the inferences about the extent to which a causal relationship holds over variations in persons, settings, treatment, and outcomes (Shadish, Cook & Campbell, 2002).

F-Test/ANOVA: A hypothesis test known as Analysis of Variance that is designed to evaluate the results from research studies producing two or more mean differences. In general terms, it is the ratio of variances/differences between sample means over variance/differences expected with no treatment effect. The analysis divides the total variability into two basic components: between-treatment variance and within-treatment variance (Gravatter and Wallnau, 2009).

*Fisher exact-tes*t: A method of analyzing 2x2 contingency tables which may be carried out even when the sample size is too small for the chi-squared approximation to be valid. It is called an 'exact' test because probability solutions are based on exact computations rather than chi-squared approximations (Neave & Worthington, 1988).

FORTRAN: A computer programming language that is used to carry out Monte Carlo Simulations. There are other ways to accomplish this task, but it has been found that FORTRAN is the shortest path to obtaining successful and useful results (Sawilowsky and Fahoome, 2003).

Heterogeneous: The variability of a group becomes more and more different.

Heteroscedasticity: When the ratio of variances of two populations from which the data were sampled is not equal to one. It can occur when the variability of the treatment group becomes more and more different from the control group and causes the underlying assumptions of equal variances to become more and more violated (Sawilowsky, 2002).

Homogeneous: The variability of a group becomes more and more the same.

Internal Validity: Ensures a causal relationship (co-variation reflects a causal relationship) between input and outputs in experimental design.

Liberal (1): When a test rejects the null hypothesis more than it should for a given Type I error rate.

Liberal (2): According to Bradley's proposed limits (1978), when Type I error falls within plus or minus half of the nominal alpha level.

Lower Tail: The lower set of values in a distribution.

Monte Carlo Methods: Repeated sampling from a population distribution, to determine the long-run average of some parameter or characteristic. Sampling is usually done with replacement, meaning that a subset of scores is obtained, they are analyzed, the results are recorded, and the scores are returned to the reservoir of data values. On the next iteration, the values just examined have the same probability of being selected as values not yet examined (Sawilowsky and Fahoome, 2003).

Monte Carlo Simulations: The use of a computer program to simulate some aspect of reality to make determinations of the nature of reality or change in reality through the repeated sampling via Monte Carlo methods (Sawilowsky and Fahoome, 2003).

Mood Westenberg Test (1948): A nonparametric ordinal test for detecting changes in spread (i.e. dispersion or variability) relying on the assumptions that two populations from which the samples are drawn have at least roughly equal means (Neave and Worthington, 1988, p.344). It is similar to the Siegel-Tukey test (1960) in these aspects. However, unlike the Siegel-Tukey test (1960), the Mood-Westenberg test (1948) does not involve ranking procedures and is somewhat quicker to perform (Neave and Worthington, 1988, p. 344). It is a test based on differences in the number of individuals from each group found in upper and lower quartiles and assesses the critical values from Fisher's exact tables.

Non-Parametric test: Any statistical test that does not make assumptions about the shape of the population distribution or about other population parameters (e.g. an assumption for the t-test is that the data distribution parameter must be from a normal distribution). A technique used for hypothesis testing which provides an alternative to classical parametric tests such as the t-test and F-test when some of their assumptions are violated.

Normality: A state of data distribution which fits the normal or Gaussian curve. It is a parameter assumed for the t and F tests.

Power: Power is the probability that a test will correctly reject a false null hypothesis and thus correctly identify a treatment effect between data sets. Power is a function primarily dependent upon sample size, alpha levels, and effect size. It is the probability that a test will identify a treatment effect if one exists and is known as the inverse of Type II (β) error or 1-β. In the context of this study it is the probability that the Mood-Westenberg test (1948)/the Siegel-Tukey (1960) tests will correctly reject the null hypothesis of equal variances for two experimental samples when the variances are in fact different.

Random Selection/Assignment: Any procedure that assigns units to conditions based only on chance, in which each unit has a non-zero probability of being assigned to a condition. A well-known random assignment procedure is a coin toss (50% probability of coming up heads). (Shadish, Cook, & Campbell, 2002).

Robustness: The degree to which a statistical test maintains Types I and II error rates in light of assumption violations.

Robust Test: A statistical test that maintains Type I error rates in light of assumption violations.

Robust Methods: A statistical method that is resilient to outliers. It is invoked in order to refine central tendency and variability of a group of scores or variables, thereby increasing power to detect treatment effects. For instance, one robust method is the Yuen (1974) statistic. There are literally an infinite number of modern robust measures. (Sawilowsky & Fahoome, 2003).

Siegel-Tukey Test (1960): A nonparametric ordinal test for detecting changes in spread (i.e. dispersion or variability) relying on the assumptions that two populations from which the samples are drawn have at least roughly equal medians. It involves ranking the data with higher values given for the values at the extremes. It follows a similar method to that of the Wilcoxon rank-version of the Mann-Whitney test (Neave and Worthington, 1988, p. 131) and assesses results with the Mann-Whitney tables of critical values.

Skewed Distribution: A distribution with extremely high or low scores that pulls the distribution to one side or the other.

Statistical Conclusion Validity: Concerns the conclusions about the co-variation (correlation) component of causal inference: Do the inputs and outputs of the experiment co-vary and how much do they co-vary.

Stringent: According to Bradley's proposed limits (1978), when Type I error falls within plus or minus one-tenth of the nominal alpha level.

T-Statistic (Student's-t): The t statistic is used to test hypothesis about an unknown population mean when the value of the standard deviation is unknown. The formula for the t statistic has the same structure as the z-score formula, except that t statistic uses the estimated standard error in the denominator (Gravetter and Wallnau, 2009).

Type I Error: Also known as α. It is the experimental probability error of rejecting the Null hypothesis when it is true; that is incorrectly rejecting the Null when there is in fact no treatment effect.

Type II Error: Also known as β. It is the experimental probability error of accepting the Null hypothesis when it is false; that is incorrectly accepting the Null hypothesis when there is in fact a treatment effect (it is the inverse of power known as 1-β).

Upper Tail: The upper set of values in a distribution.

Wilcoxon-Rank Sum Test (1945): A version of the Mann-Whitney (1947) test computed by adding together certain ranks. The ranks of the observations in the two samples are obtained simply numbering the letters in the letter sequence (A and B for two groups) from 1 to N where N is the total number of observations (Neave & Worthington, 1988).

Yuen Statistic (1974): A robust statistic used to increase power by increasing measures of location with standard errors that are relatively unaffected by heavy tails and outliers (Wilcox, 1996). It provides a solution based on trimmed means and matching sample variances.

CHAPTER II

LITERATURE REVIEW

Necessity of Addressing the Behrens Fisher Problem?

Soon after developing the t-test, William Gosset (Student, 1908a) was concerned about its effectiveness under conditions of unequal sample variances. However Gosset's friend, Karl Pearson (1857-1936), convinced Gosset that heteroscedasticity would not diminish the generality of the test (Sawilowsky, 2013, personal communications). Initially, Ronald Fisher was also unconcerned with the problem with respect to the F-test. Subsequently, the work of W. V. Behrens (1929) convinced Fisher to address this problem. Dr. Behrens worked as a scientific assistant at the Institute for Agriculture and Plant Breeding of the University of Koenigsberg from 1927 to 1931 and was appointed in 1932 as scientific chief assistant at the Institute of Agricultural Chemistry and Bacteriology of the Agricultural Academy (Heinisch, 1962). According to Sawilowsky (2002), Fisher and Behrens together developed the first expression and solution to what is now known as the Behrens-Fisher problem (Behrens, 1929, Fisher, 1935). According to Yao, (1965, p. 139), "the univariate problem was first studied by Behrens (1929) and the solution was presented by Fisher (1935) in terms of the fiducial theory. Sawilowsky (2002) described their initial solution as a modification of the t statistic, which weighted a group's variance according to sample size. It was expressed as:

$$t' = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{s_1^2}{2n_1 + 1} + \dfrac{s_2^2}{2n_2 + 1}}}$$

where S_1 and S_2 are fixed and σ_1 and σ_2 have fiducial distributions. Sawilowsky (2002) mentioned the historical support from the Fisherian perspective but also noted that Bartlett (1936) challenged the solution based "on the principle of inverse probability from a Bayesian perspective" (p. 462).

According to Yao (1965, p. 139.) "Welch studied it in the confidence theory framework and provided an 'approximate degrees of freedom' solution as well as an asymptotic series solution (1936, 1947)." It is known as Welch-Aspin t test (Welch, 1937, 1949a, 1949b; Satterthwaite, 1941, 1946; Aspin 1948, 1949), wherein the degrees of freedom were modified. Welch (1947) also provided a solution for the K > 2 generalized problem. Sawilowsky (2002) and Gravetter and Wallnau (2009, p. 329) noted the formula for this modification:

$$\nu = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}}$$

Sawilowsky (2002) stated this solution remains an approximate solution and is not robust with respect to departures from normality. However, according to Wilcox (1996) and Sawilowsky (2013, personal communications), this solution was untenable because after the statistician modified the degrees of freedom and then looked up the probabilities within the Student- t distribution, this statistic was no longer valid because the statistician had changed the degrees of freedom and therefore the adjustment would no longer map to the t distribution's modeled probabilities.

Historically, many others offered solutions to the Behrens-Fisher problem but often they were unsatisfactory. These solutions first met with a concern about robustness with respect to Type I errors for unequal sample sizes for instance in the cases where $k \geq 2$ (e.g. Kohr, 1970; Mehta & Srinivasa, 1970; Kohr & Games 1974; Tomarkin & Serlin, 1986). Later, they met with concerns of robustness with respect to Type I errors for departures from the population normality. Sawilowsky (2002) mentioned that "the Monte Carlo studies showed that the Behrens-Fisher, Bartlett, and Welch Aspin/Satterthwaite approximate solutions were not robust to departures from normality (e.g. James, 1959; Yuen, 1974)" (p.463).

Among solutions, Yao (1965) offered "an approximate degrees of freedom solution to the multivariate Behrens-Fisher problem" and mentioned others who offered solutions before:

> Many others have investigated this topic and various methods of approach were also suggested by Jeffreys (1940), Scheffé (1943), McCullough, Gurland & Rosenberg (1960), Banerjee (1961) and Savage (1961). In the multivariate extension of the Behrens-Fisher problem, Bennett (1951) has extended the Scheffé solution, and James (1954) the Welch series solution. (p.139)

The following are only a few of the other many perspectives found in the literature which claims to solve some version of the problem.

- Chapman (1950)
- Wald (1955)
- Banerjee(1960)
- Pagurova (1968)
- Brown and Forsythe (1974)
- Prokof'yev and Shishkin(1974)
- Clinch & Kesselman (1982)
- Wilcox (1990a)

- Dudewicz and Ahmed in (1998, 1999)

Sawilowsky (2002) mentioned that some solutions based on nonparametric or nonparametric-like procedures were unsuccessful but believed that a robust approximate solution, the Yuen's Procedure (1974), based on trimmed means and matching sample variances, effectively addressed this Behrens-Fisher problem even though it too remained an adjustment and not a solution. However, after the long historical search for solutions found in the literature, Sawilowsky (2002) also put forth a novel and perhaps shocking suggestion: namely, that more research dedicated to finding Behrens-Fisher solutions was a waste of valuable time and resources and that this line of investigation should be abandoned. Sawilowsky (2002) acknowledged the theoretical dilemma within experimental research of not knowing the probable likelihood of a treatment effect if the treatment should possibly cause a change in scale, but believed that was is an entirely impractical issue because it had no real life applications for educational and psychological research. Sawilowsky's (2002) reasoning was simple: no experimental data sets were known to exist where a treatment simultaneously changed the variance while at the same time the means remained unchanged.

This Behrens-Fisher problem (variance changed but means stayed the same) was irrelevant from an application standpoint because Sawilowsky (2002) couldn't imagine how this treatment outcome would ever arise and, furthermore, during 30 years of statistical research, found no such data sets in the literature where the means stayed the same concurrent with scale changes after treatment. Sawilowsky (2002) contended it was irrelevant when Howell and Games (1974) suggested that "educational and psychological researchers often deal with groups that tend to be heterogeneous in variability" (p.72). According to Sawilowsky (2002), this Howell and Games (1974) observation was:

> mitigated by the fact, "We have spent many years examining large data sets but have never encountered a treatment or other naturally occurring condition that produces heterogeneous variances while leaving population means exactly equal. While the impact of some treatments may be seen primarily in measure of scale, they always (in our experience) impact location as well (Sawilowsky & Blair, 1992, p.358)." (p.466)

Additionally, Sawilowsky (2002) mentioned that:

> none of Micceri's (1989) 440 real psychology and education data sets reflected this condition, nor have I seen an example in literature. Thus the issue of heterogeneous variance and their impact on type I errors is moot (p. 466).

In other words, according to Sawilowsky (2013 personal communications), "come on folks, how many resources should be expended to solve a potential experimental outcome that has not surface in the last 100 years?" Sawilowsky (2002) asserted that "even if examples can be found, the question remains if the Behrens-Fisher problem surfaces with such frequency that merits the journal space it has been given" (p. 466).

Thus, Sawilowsky believed the unlikely treatment outcome (the Behrens-Fisher problem concerning its impact on Type I errors) of equal means concurrent with unequal variances, although of theoretical interest, should not be the focus of continued on-going research. Rather educational and psychological research should be focused on the prevalent outcome conditions such as shifts in means while the variance remains constant or the more prevalent condition of when there is a concurrent shift in both means and variance.

According to Sawilowsky (2002),

> The importance of the Behrens-Fisher problem from a theoretical perspective is acknowledged, but it is concluded that this problem is irrelevant for applied research in psychology, education, and related disciplines. The focus is better placed on the "shift in location" and more importantly, "a shift in location and change in scale treatment alternatives" (p.461).

Sawilowsky (2002) stated the most prevalent treatment outcome for applied studies is known:

> It is where a change in scale is concomitant with a shift in means. As an intervention is implemented, the means increase or decrease according to the context. Simultaneously, the treatment group may become more homogeneous on the outcome variable due to sharing the same intervention method, conditions, etc. Alternatively, the group may become more heterogeneous as some respond to the treatment while others do not respond, or even regress (p.466).

With respect to these two prevalent scenarios, Sawilowsky (2002) mentioned that there were already very good tests available for determining treatment effect. With respect to robust tests for shifts in location (change in means where variances are assumed to be equal) Sawilowsky says of the t test:

> Although no test can survive violations of independence of observations, under certain commonly occurring conditions (i.e., sample sizes are equal or nearly so and are at least 25 to 30 and tests are two-tailed rather than one-tailed), the t test is remarkably robust with respect to both type I and II errors for departures from normality…the nonparametric Wilcoxon Rank Sum test can be three to four times more powerful in detecting differences in location parameters when the normality assumption was violated (p. 464).

With respect to robust tests involving concurrent general shifts in location (means) and scale (variance), these generalized nonparametric tests and corrections are suggested by the literature (Neave & Worthington, 1988; Wilcox, 1996):

- Rosenbaum's test (1965): Tests for change in variance and means
- The Kolmogorov-Smirnov tests (1933): Tests for change in variance and means
- Yuen's adjustment (1974): Adjusts for a change in variance and means.

Sawilowsky (2002) believed that the Behrens-Fisher problem was important only from two standpoints. First because it was a classic and many prestigious mathematical statisticians have addressed this problem: "the Behrens-Fisher problem has as much mystique and has received as much fanfare in its discipline as other classical problems that remain unsolved or unfinished in their disciplines" (Sawilowsky, 2002, p.465). Second, the Behrens-Fisher problem was important "due to the byproducts that have been developed in the course of creating approximate solutions" (Sawilowsky, 2002, p.465). Sawilowsky (2002) mentioned for instance that Bartlett's (1937) study of heteroscedasticity culminated in a well- known Chi-Squared test on variances, which is useful for testing the underlying assumption of homoscedasticity.

Sawilowsky (2002) concluded:

> The Behrens-Fisher problem is a classic, but its many and continuing solutions are perhaps better housed in journals catering to theoretical developments. Sufficient journal space has been given to this problem in comparison with the frequency with which it occurs. Instead, applied researchers should focus on more practical treatment outcomes such as naturally occurring conditions that bring about a shift in location and a change in scale. This is the most realistic treatment outcome in applied psychology and education research. It presents an exciting area in which considerable additional research is warranted (468).

The regret expressed by Neave and Worthington (1988) that there were no testing procedure for determining potential changes in scale/variance irrespective of location/means shifts perhaps adds support to Sawilowsky's position.

The question remains as to what extent heteroscedasticity must be present in the Mood-Westenberg test (1948) to invoke the Behrens-Fisher problem. If neither the Mood-Westenberg (1948) nor the Siegel-Tukey (1960) tests could powerfully detect variance changes when the means of two samples differ slightly, then this findings could lend additional support to Sawilowsky's (2002) suggestion that any more time investigating the Behrens-Fisher issue of treatment outcomes yielding approximately equal means concurrent with differences in variances, is a waste of resources that could be better devoted to the prevalent outcomes. There apparently would be no method available to discover the Behrens-Fisher condition. If the nonparametric tests such as the Mood-Westenberg (1948) and Siegel-Tukey (1960) are not powerful with respect to small shifts in means, why continue to worry about the apparently non-existent Behrens-Fisher variant issue of determining a treatment effect when there is a potential change in variance concurrent with constant means? If there were no procedures capable of detecting the Behrens-Fisher problem, then additional Behrens-Fisher research to yield solutions indeed would be quite irrelevant from a practical standpoint: there would be no known method to determine ***when*** the problem surfaced after treatment. On the other hand, if there were a test such as the Mood-Westenberg (1948) that could detect variance changes when the means have shifted, then this could be a precursor to other adjustment solutions such as the Yuen Procedure (1974).

Selection of the Mood-Westenberg Test (1948) and Siegel-Tukey (1960) Test for Study

In this study, the nonparametric Mood-Westenberg test (1948) will be the primary contender as a robust statistic for variance change detection. It was chosen due to its minimum assumption requirements, potentially making it a most forgiving (i.e., robust) test, and for its support in the literature for having power (Neave & Worthington, 1988, p.134). Also mentioned in literature (Neave & Worthington, 1988), the Siegel-Tukey test (1960) serves to detect variance spread hypothesis and will be invoked as a primary competitor to Mood-Westenberg (1948). These tests were chosen for their comparable testing characteristics, such as their measurements made on an ordinal scale involving ranking procedures and their assumptions of equal or nearly equal means/medians.

In general, the Mood-Westenberg test for dispersion (1948) combines two samples, orders the scores from high to low and then divides this ordered group into quartiles. If the null hypothesis is true, that is there is no difference in spread or variance between the groups (the ratio of the two variances approach one), then it would be expected within the quartiles that the upper (quartile four) and lower (quartile one) would have equal number of observations from each sample and the second and third quartiles would also have equal number of observations between the two sample groups. Proportional probabilities are matched against the Fisher exact-test statistic. It is called the exact-test because unlike the analysis of many proportional distributions based on Chi-Squared approximations, the Fisher exact test is based upon exact probability calculations and is helpful for smaller data sets. The Fisher exact test works well for within a Mood-Westenberg (1948) two-by-two contingency table format.

In general, the Siegel-Tukey test (1960) is similar to Mood-Westenberg (1948) in that it also begins with ordering the combined sample groups. However here, in place of quartiles, the scores are ranked by a procedure that gives the higher scores to the extremes of the group. The scores are added up for each group and the resulting numerical scores can be compared to the probabilities found in the Mann-Whitney (1947)/Wilcoxon (1945) critical values table.

In addition to their similarities in assumptions and procedures, these tests have been given attention in the literature and are worth further investigation. The related Mood-Westenberg *median test* (1950) which shares similarities to the Mood-Westenberg *dispersion test* (1948) (the concern of this study) was invoked by Rahman & Pearson, (2009) when they compared two medians for location shifts in two independent populations using nonparametric testing. Ferraro, Rondeau, & Poe, (2003) invoked the Mood-Westenberg test (1948) in their psychological study observing cooperative and rational self-interest behaviors. Once again, their interest was primarily in the location shift variation of Mood's *two-sample median test* and not the test for *dispersion.* Yet, these observations are relevant to this study in terms of highlighting the importance of this statistic for typical educational and psychological data sets. According to Ferraro, et al., (2003):

> We included the non-parametric tests (Mood, 1950; Westenberg, 1948; Flinger and Policello, 1981) because of the highly irregular, skewed sample distributions generated by the experiments tests lead to a rejection of the normality hypothesis. Given such poorly-behaved distributions, we believe the Mood-Westenberg test, a non-parametric test with few assumptions, is the most appropriate test (p. 105).

Ferraro, et al., (2003) chose the Mood-Westenberg (1948) test over the Mann-Whitney test (e.g., Siegel-Tukey) and another competitor, the Fligner and Policello (1981) procedure because of minimum assumptions:

> Unlike the Mann-Whitney test, which assumes that the underlying population have the same general shape and dispersion and are symmetric about the population median, and the Flingner-Policello test which requires symmetry about the population medians, the Mood-Westenberg test assumes only that the data are from two independent random samples, the measurement scale is ordinal, the variable of interest is continuous, and if, the two populations have the same median, the probability is the same that an observed value will exceed the grand median of the two samples combined (p. 105).

Additional support for the Siegel-Tukey(1960) test might be found with Sawilowsky (2002) and Sawilowsky and Blair (1992) when they concluded that the Student-t test was not as powerful under non-normal conditions as the Wilcoxon Rank Sum test (1945), a version of the Mann-Whitney U test (1947), which turned out to be three to four times more powerful in detecting differences in location parameters than Student's-t. Because of this power advantage under non-normal conditions, the Wilcoxon Rank-Sum (1945) /Mann-Whitney U (1947), the underlying statistic (basis of probability) for Siegel-Tukey test (1960), was determined to be a good contender for this study.

Katzenbeisser (1989) also observed power aspects of these two tests with respect to location shifts for the exponential distribution. Walter Katzenbeisser (1989) first derived the exact power of two-sample t test with three mathematical distributions: exponential, logistic and rectangular distributions. In the second part of the study, (Katzenbeisser, 1989) focused on comparing three nonparametric and distribution free tests for the two-sample Student-t test location problem on the basis of their respective power for the exponential distribution. The three nonparametric tests chosen were the Mood-Westenberg test (1948), the Mann-Whitney (1947)/Wilcoxon (1945) and the Mathisen test (1943). Again, in this study, like Rahman & Poe

(2009) and Ferraro, et al., (2003), Katzenbeisser also invoked the particular Mood-Westenberg test for determining location shifts (i.e., the two sample *median* test). Each of these studies focused on the shift in location as opposed to the Mood-Westenberg dispersion test (1948) (test for change in scale), the focus of this study.

Katzenbeisser (1989) described the three tests invoked as follows:

The Mann-Whitney form of the Wilcoxon Rank Sum:

$$W = \sum_{i=1}^{n} [number\ of\ X's \leq Y_i]$$

The Mood-Westenberg two sample median test:

$$MW = \begin{bmatrix} number\ of\ X's\ less\ than\ or\ equal\ to\ the\ median \\ of\ the\ combined\ X - and\ Y - sample \end{bmatrix}$$

The Mathisen Test:

$$M = [number\ of\ X's\ less\ than\ or\ equal\ to\ the\ median\ of\ the\ Y's]$$

The following Table 1, reprinted with permission, displays the results noted by Katzenbeisser (1989) where it was observed that the "Mathisen test is vastly less powerful compared with the Mann-Whitney-Wilcoxon, and the Mood-Westenberg tests for shifts in exponential distribution" (p. 53).

Table 1:

Power Comparison of Mood-Westenberg, Mann-Whitney/Wilcoxon, and Mathisen Tests

Acknowledgement

The author is indebted to WALTER BOEHM for his very useful help.

Table

The exact power of the MANN-WHITNEY-WILCOXON, the MOOD-WESTENBERG, and the MATHISEN-Test against shifts in the exponential distribution

H_1: $F(x) = 1 - e^{-x}$, $x > 0$ $\qquad$ $G(x) = 1 - e^{-(x-\Delta)}$, $x > \Delta$, $\Delta > 0$.

N	m	t_α	$\Delta = 0$	$\Delta = 0.1$	$\Delta = 0.5$	$\Delta = 1$	$\Delta = 2$	$\Delta = 3$
15	8	6	0.0317	0.0513	0.2385	0.6101	0.9577	0.9577[1]
		12	0.0361	0.0648	0.3043	0.6649	0.9564	0.9952[2]
		8	0.0256	0.0341	0.0926	0.2291	0.5803	0.8190[3]
	10	7	0.0186	0.0307	0.1932	0.6251	0.9786	0.9994
		8	0.0200	0.0328	0.1681	0.4945	0.9095	0.9882
		10	0.0220	0.0281	0.0703	0.1772	0.5132	0.7804
21	10	8	0.0073	0.0143	0.1183	0.4538	0.9244	0.9946
		20	0.0064	0.0158	0.1693	0.5476	0.9416	0.9946
		10	0.0085	0.0126	0.0479	0.1551	0.5054	0.7789

[1] First row: MOOD-WESTENBERG test
[2] Second row: MANN-WHITNEY-WILCOXON test
[3] Third row: MATHISEN test

Note: Reprinted from "The Exact Power of Two Sample Location Tests Based on Exceedance Statistics against Shift Alternatives," by Walter Katzenbeisser, 1989, Statistics: A Journal of the Original and Applied Statistics Volume 20(1) p. 53. Copyright 1989 Statistics: A Journal of Theoretical and Applied Statistics

Because Mood-Westenberg (1948) and Mann-Whitney/Wilcoxon (1947/1945) tests were determined by Katzenbeisser (1989) to be more powerful than the Mathisen (1943) test with respect to location shifts, this also lent impressive support to the selection of Mood-Westenberg (1948) and Siegel Tukey (1960) test statistics as potential test statistics that might indeed be able to detect variance changes with incremental shifts in location/means.

Katzenbeisser (1989) compared the three tests to determine the most powerful with respect to detection of location shifts and it was restricted to three mathematical distributions. To expand upon the initial research of Katzenbeisser (1989), in this study Type I and Type II errors (power) will be considered when heteroscedasticity or scale change (not location as with Katzenbeisser, 1986 and Ferraro, et al., 2003) becomes detectable. Additionally, unlike

Katzenbeisser (1986), real data sets will be the primary focus. Three theoretical/mathematical distributions, including the normal curve, will be observed for comparison purposes.

Advancing the Research of Walter Katzenbeisser (1989) with Real Data Set Samples

Katzenbeisser (1989) invoked the Mood-Westenberg (1950) median test with data sampled from theoretical distributions, including exponential, logistic and rectangular. In that study, as noted above, Katzenbeisser (1989) focused on the exponential distribution when observing power comparisons for the detection of location shifts under three nonparametric scale change tests: the Mood-Westenberg (1948), the Mann-Whitney/Wilcoxon (1947/1945), and the Mathisen (1943), finding in favor of the Mood-Westenberg (1948) and the Mann-Whitney-Wilcoxon (1947/1945) tests over the Mathisen test (1943).

Historically, many researchers conducted statistical studies with convenient theoretical or mathematical models much like Katzenbeisser (1989). Bradley (1968, 1977, 1982) objected to many of these studies believing that distributions encountered “in real research context may be much more radically nonnormal than the relatively tame population shapes typically used in robustness studies” (Sawilowsky & Blair, 1992, p. 352). Wilcox (1996) noted that in some cases light-tailed distributions appear to be common (Micceri 1989, Pearson and & Please, 1975) but it is unclear when it is safe to assume that this is the case when analyzing data.

In the same year of Katzenbeisser (1989) , Micceri’s (1989) benchmark research on real data sets was published highlighting the criticality of testing real world data sets along with theoretical models for robustness of Type I errors, dramatically supporting the position of Bradley (1968,1977,1978, 1982). Having mentioned the Micceri (1989) study, Sawilowsky & Blair (1992) believed that it was “one of the most comprehensive studies of its kind to appear in the social and behavioral science literature” (p. 352). Micceri (1989) collected 440 real world data sets from journals, test publishers, school districts, the Florida Department of Education, and the University of South Florida's institutional research department. In that study, four measures were tested separately: general achievement/ability tests, criterion/mastery tests, psychometric measures, and gain scores (difference between pre and post measures).

Statisticians who have studied robustness properties of statistics have long since known that real data sets seldom approximate the asymptotic conditions of the Gaussian/ normal curve and Type I and Type II error rates are often not maintained under these real life conditions. When speaking of the normal curve, Wilcox (1996) mentioned "that it is convenient probability model that has been assumed that is only an approximation of reality. A basic concern is whether this approximation is good enough to control Type I error, achieve reasonable accurate confidence intervals, and provide good results in terms of power" (p.131). Micceri's (1989) research supported Wilcox's assertion because 96% of the empirical distributions for the given psychology and education data had longer tails than the normal distribution and none of these distributions fit the exact criteria of the Gaussian curve. Micceri (1989) advanced research by having observed that in addition to the scarcity of normal data sets, the convenient theoretical models are often not found in educational and psychological research. However, in some disciplines, such as industrial settings, data have been shown to appear relatively more normal (Pearson & Please, 1975) as reproduced in Figure 9.

Micceri (1989) noted "prior robustness studies have generally limited themselves either to computational evaluations of asymptotic theory or to Monte Carlo investigations of interesting mathematical functions" (Micceri, 1989, p.163). Micceri, (1989) concluded that previous studies of the robustness of the t test (as well as other statistics) failed to consider typical distributions found in education and psychological research. For instance, Micceri (1989) mentioned the often cited study of Boneau (1960) included comparisons of two smooth symmetric distributions (normal, uniform) and one smooth asymmetric distribution (exponential), but had almost no comparisons with most real world educational and psychological data. Micceri (1989) determined from the 440 available data sets that "half of these real world data sets were lumpy and all were discrete, only 38 (8.6%) exhibited both exponential-level tail weight and asymmetry… none exhibited symmetric, uniform (rectangular) tail weights, and only 19 (4.3%) can be considered even reasonable approximations to the Gaussian (normal)" (Micceri, 1989, p. 164). Micceri (1989) stated that the findings did not invalidate Boneau's research "but does suggest that almost none of these comparisons occur in real life. The most obvious differences between Boneau's data and that of the real world are lumpiness and discreteness." (p.164).

Micceri (1989) observed that the convenient mathematical/theoretical models seldom approximate educational and psychological data sets. Sawilowsky & Blair (1992, p. 352) stated "that the findings of previous researchers who modeled population shapes with convenient mathematical functions cannot, necessarily, be applied in educational and psychological research settings" and they (Sawilowsky & Blair, 1992) conducted Monte Carlo studies on the independent samples t-test for departures from normality using eight real sets identified by Micceri (1989). Sawilowsky & Blair (1992) found that consistent with the prevailing literature is the fact that a dominant factor bringing about non-robustness to Type I errors was extreme skew and kurtosis when combined with skew in some of these data sets (Micceri, 1989). These findings together illustrate a researcher's obligation to test statistics, for instance Mood-Westenberg (1948), with real data in order to obtain accurate conclusions with respect to Type I and Type II (power) results.

Sawilowsky (2002) once again emphasized the requirement to investigate real world data sets when discussing the beneficial by-products of investigating the Behrens-Fisher problem, mentioning the importance of conducting robustness and comparative power studies relative to small samples:

> Statistics were developed throughout the 20th century based on asymptotic or large sample theory. Many were published based on elegant mathematical statistical theory, but turned out to be invalid for use in applied work. The Behrens-Fisher problem highlighted the importance of conducting robustness and comparative power studies relative to small samples (p. 466).

Regarding this suggestion, Sawilowsky (2002), recommended that authors of new statistics or procedures "publish their work after they have conducted studies on the properties of the statistics when underlying assumptions are violated" (p. 465). Sawilowsky (2002) noted that further study is moot if the mathematical distributions produce poor results. However, if the obtained results are good, verification was still required with real data sets. Additionally, Sawilowsky and Blair (1992) noted:

> With researchers relying more on power analyses and sample size determinations than in the past (Cohen, 1988), it has become increasingly important that these test characteristics also be evaluated in more realistic contexts. Treatments often produce changes in means, as well as variance, skew, tail weight, and other population parameters (p.353).

Following in the footsteps of others in the literature such as Micceri (1989), Sawilowsky and Blair (1992), Sawilowsky (2002), and Lance (2011) eight real world data sets (detailed below) will be reviewed, in addition to three mathematical models (normal, uniform, exponential). One of the assumptions of the Mood-Westenberg test (1948) is that the data be continuous. Because Micceri (1989) observed that half of the real world data sets (out of 440 reviewed) were lumpy and discrete it is understood that these common discreet data sets may have an adverse effect upon robustness properties of the Mood-Westenberg test (1948).

However, a few of these real discrete data sets will be tested to determine their outcomes. A description of these data sets, characterized from Micceri (1989), was detailed in Sawilowsky & Blair (1992) and is reproduced in this section. The work of Walter Katzenbeisser (1989) will be advanced by investigating these empirical data sets known to exist in educational and psychological research settings and by determining robustness of the Type I errors and Type II error properties with respect to hypothesis testing for heteroscedasticity or shifts in variance/scale.

The primary purpose of this study, then, is to investigate the robustness properties of the Mood-Westenberg (1948) and the Siegel-Tukey (1960) tests when sampling from distributions of the types identified by Micceri (1986). First Type I errors will be investigated. Then the robustness of the Mood-Westenberg (1948) test and the Siegel-Tukey test (1960) with respect to Type II error properties will be investigated for each of eight prevalent data sets and three mathematical distributions. In the second part of the study, provided that these tests prove robust, a power comparison of the Mood-Westenberg test (1948) and Siegel-Tukey test (1960) will be examined.

Table 2

Descriptive Information Pertaining to Eight Real-World Distributions

Distribution	Type of measure	µ	Median	σ	Skew	Kurtosis
Discrete mass at zero with gap	Psychometric	1.85	0	3.8	1.65	3.98
Mass at zero	Achievement	12.92	13	4.42	-0.03	3.31
Extreme asymmetry	Psychometric	13.67	11	5.75	1.64	4.52
Extreme asymmetry	Achievement	24.5	27	5.79	-1.33	4.11
Extreme bimodality	Psychometric	2.97	4	1.69	-0.08	1.3
Multimodality and lumpy	Achievement	21.15	18	11.9	0.19	1.8
Digit preference	Achievement	536.95	535	37.64	-0.07	2.76
Smooth symmetric	Achievement	13.19	13	4.91	0.01	2.66

Note: Adapted from Sawilowsky & Blair (1992)

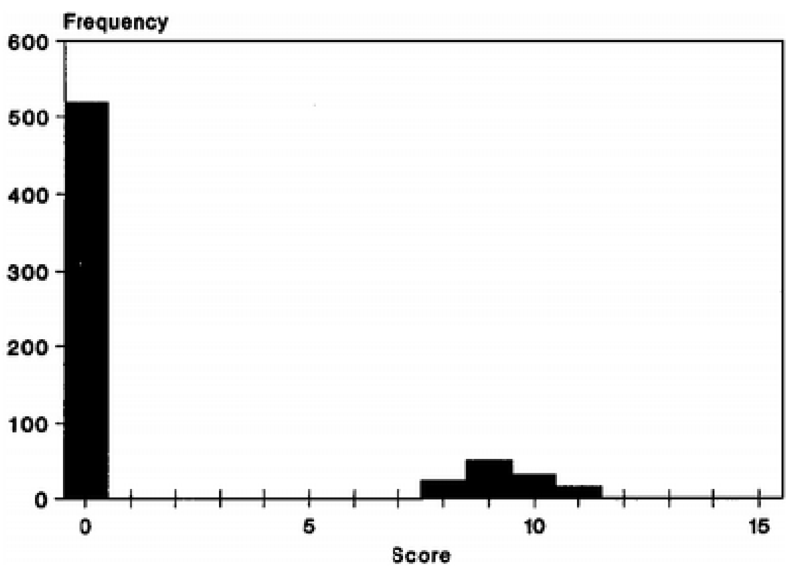

Figure 1. Discrete mass at zero with gap, psychometric measure. From “A More Realistic Look at the Robustness and Type II Error Properties of the t test to departures From Population Normality,” by Shlomo S. Sawilowsky and R. Clifford Blair, 1992, Psychological Bulletin, Vol. 111, No. 2, p. 354. Copyright © 1992 by the American Psychological Association. Reproduced with permission.

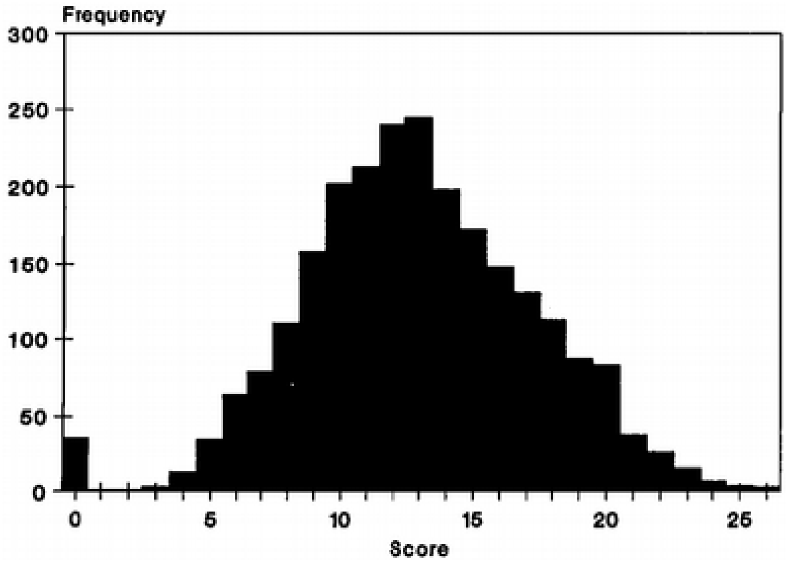

Figure 2. Mass at zero, achievement measure. . From “A More Realistic Look at the Robustness and Type II Error Properties of the t test to departures From Population Normality,” by Shlomo S. Sawilowsky and R. Clifford Blair, 1992, Psychological Bulletin, Vol. 111, No. 2, p. 354. Copyright © 1992 by the American Psychological Association. Reproduced with permission.

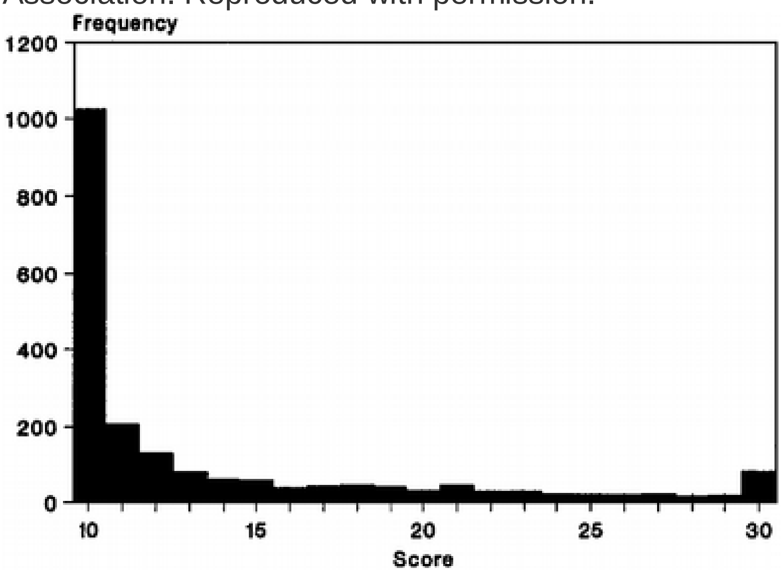

Figure 3. Extreme asymmetry, psychometric measure. From “A More Realistic Look at the Robustness and Type II Error Properties of the t test to departures From Population Normality,” by Shlomo S. Sawilowsky and R. Clifford Blair, 1992, Psychological Bulletin, Vol. 111, No. 2, p. 354. Copyright © 1992 by the American Psychological Association. Reproduced with permission.

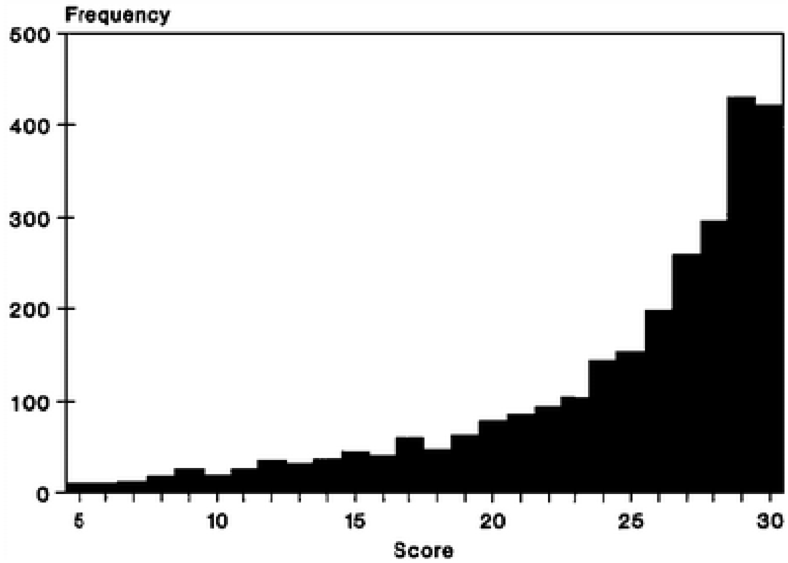

Figure 4. Extreme Asymmetry, achievement measure. From “A More Realistic Look at the Robustness and Type II Error Properties of the t test to departures From Population Normality,” by Shlomo S. Sawilowsky and R. Clifford Blair, 1992, Psychological Bulletin, Vol. 111, No. 2, p. 354. Copyright © 1992 by the American Psychological Association. Reproduced with permission.

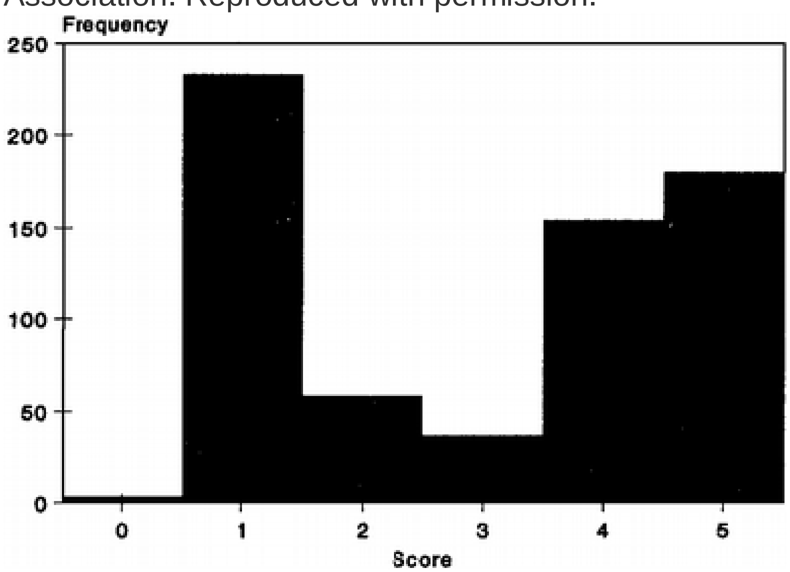

*Figure 5.*Extreme bimodality, psychometric measure. From “A More Realistic Look at the Robustness and Type II Error Properties of the t test to departures From Population Normality,” by Shlomo S. Sawilowsky and R. Clifford Blair, 1992, Psychological Bulletin, Vol. 111, No. 2, p. 355. Copyright © 1992 by the American Psychological Association. Reproduced with permission.

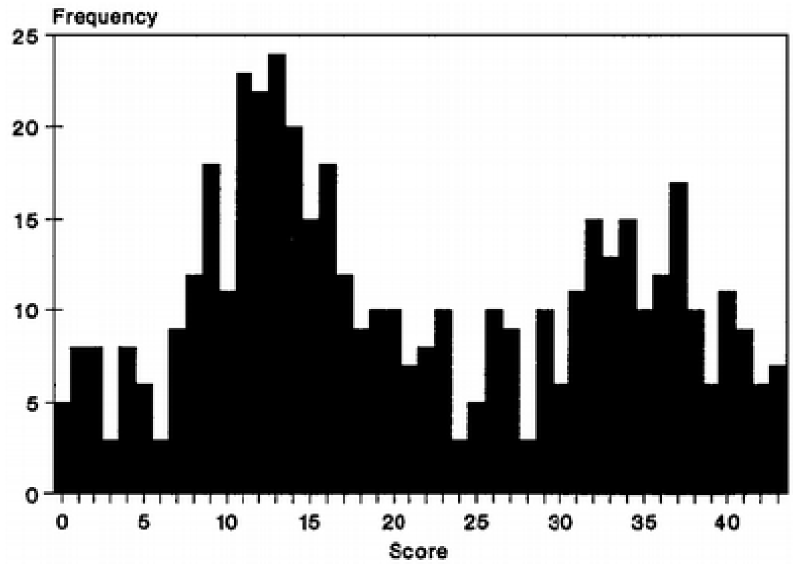

Figure 6. Multimodality and lumpiness, achievement measure. From "A More Realistic Look at the Robustness and Type II Error Properties of the t test to departures From Population Normality," by Shlomo S. Sawilowsky and R. Clifford Blair, 1992, Psychological Bulletin, Vol. 111, No. 2, p. 355. Copyright © 1992 by the American Psychological Association. Reproduced with permission.

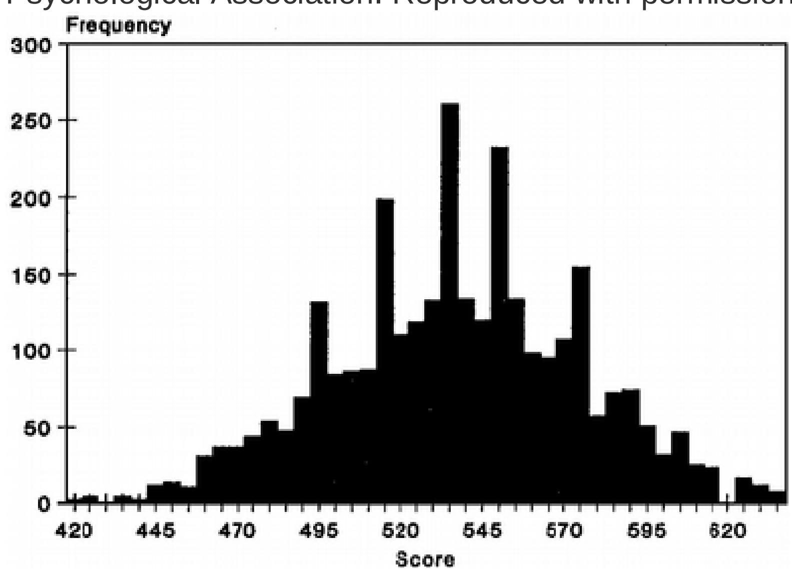

Figure 7. Digit preference, achievement measure. From "A More Realistic Look at the Robustness and Type II Error Properties of the t test to departures From Population Normality," by Shlomo S. Sawilowsky and R. Clifford Blair, 1992, Psychological Bulletin, Vol. 111, No. 2, p. 355. Copyright © 1992 by the American Psychological Association. Reproduced with permission.

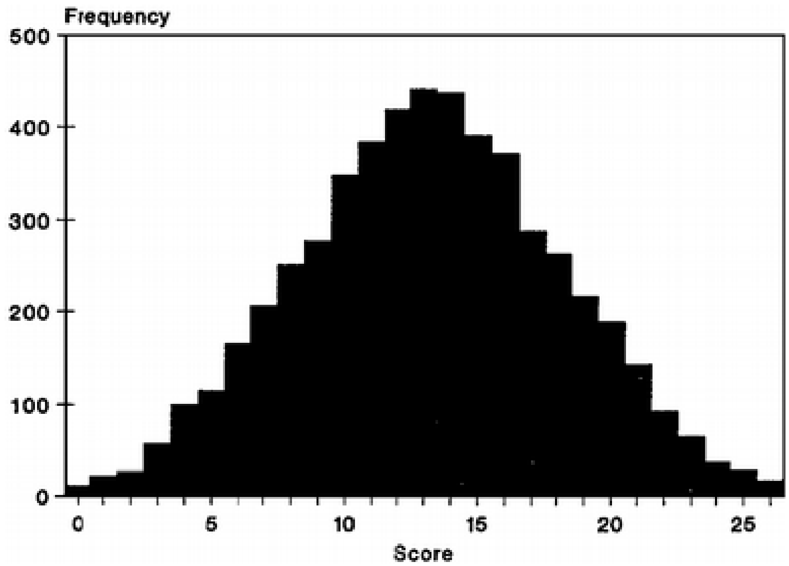

Figure 8. Smooth symmetric, achievement measure. From “A More Realistic Look at the Robustness and Type II Error Properties of the t test to departures From Population Normality,” by Shlomo S. Sawilowsky and R. Clifford Blair, 1992, Psychological Bulletin, Vol. 111, No. 2, p. 355. Copyright © 1992 by the American Psychological Association. Reproduced with permission.

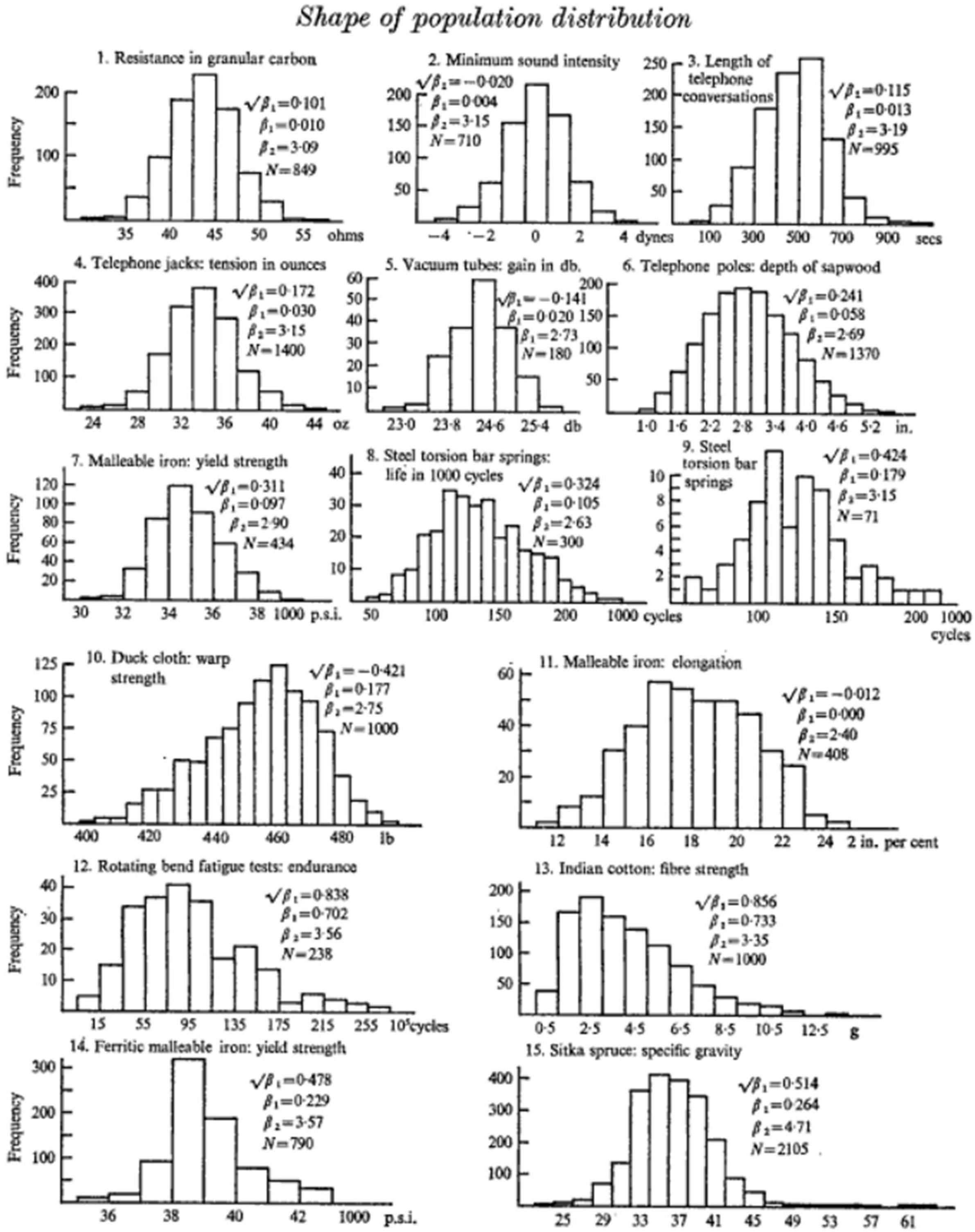

Figure 9. Histogram distributions of some industrial data. Reprinted from “Relation between the shape of population distribution and the robustness of four simple test statistics,” by E. S. Pearson and N.W. Please, 1975, Biometrika, 62, p.225.

The Yuen's Statistic (1974) and Application for the Behrens-Fisher Problem

The Yuen's Statistic

General Application of Yuen's Statistic

Wilcox (1996) noted, "to simplify technical and mathematical problems, Student's t-test assumes both normality and equal variances. That is, a convenient probability model that has been assumed that is only an approximation of reality" (p. 131). Without these assumptions under various circumstances, the Student's-t (1908a) becomes unable to maintain Type I errors and Type II error properties because it does not approach a standard normal distribution; that is, it cannot be mapped to the Gaussian curve probabilities.

As discussed above (Bradley, 1978, Micceri, 1989, Sawilowsky & Blair, 1992), these assumptions of normality and equal variances are often not met with real life data sets. Wilcox (1996) noted that "outliers and heavy-tailed distributions are common in applied work, which can reduce the power of any method designed to compare means" (p.136). Wilcox (1996) stated that very slight departures from normality toward heavier tails can have a tremendous effect on the variance in each group thereby impacting power (e.g., in the t test). It is known that a single outlier could eclipse an important difference between groups because power is affected by variances in the data (i.e., the standard error of measurement). The higher the variance, the more noise within the data and the less likely the researcher will find in favor of a treatment effect. In effect, real life data sets are heteroscedastic in their relation to the assumed and modeled normal curve because the real data sets have different variances as compared to the normal curve. Additionally, as the variance in one of two experimental groups increases or becomes more different from the other group, the pooled standard error of the mean increases and the t statistic, for instance, could become smaller.

Wilcox (1996) warned not to trust in the Central Limit Theorem as a guaranteed theorem for all experimental conditions: “Everyone believes in the normal law of errors, the experimenters because they think it is a mathematical theorem, the mathematicians because they think it is an experimental fact” (p. 132). Researchers are unable to rely upon the Central Limit Theorem’s guarantee of normality for the distribution of sampling means for any distribution. The Theorem has postulated for any population the distribution of the sampling means is a normal distribution as the population sample sizes approach infinity (large sample sizes). Sawilowsky (2014, personal communications) expounded upon the inadequacy of the Central Limit Theorem for small data sets and therefore the need for reviewing long run averages with Monte Carlo testing for any test statistic when assumptions are violated:

> Indeed, under asymptotic conditions (i.e., infinite sample sizes), the distribution of sample means approaches normality regardless of the shape of the population. However, as William Sealy Gosset (as in Student's t test) showed in 1908 in *Biometrika* in his article "The probable error of the mean", with small samples there are no guarantees from the Central Limit Theorem. The purpose for Monte Carlo studies is to explicate what happens when samples are small, both in terms of robustness to Type I and II error, and comparative statistical power in relation to nonparametric alternatives.

Wilcox (1996) put forth the belief that when these prevalent heavy-tailed conditions surfaced, one should not abandon the idea of comparing the means but instead increase power by using robust measures of location along with standard errors that are relatively unaffected by heavy tails and outliers. Robust measures are methods which are resilient to outliers and therefore better able to represent central tendency as the methods revise the data to include scores that are more representative of the true population and less variable. Wilcox (1996, pp. 136-138) mentioned a robust method suggested by Yuen (1974) for comparing the trimmed means corresponding to the independent groups and computing the Winsorized sum of squared deviations for each group. The Yuen statistic (1974) was also suggested by Sawilowsky (2002) as a robust procedure (i.e., resilient to outliers) which adjusted the Student's-t statistic (Student, 1908a) based on trimmed means and matching sample variances and useful as an adjustment for the Behrens-Fisher problem.

The literature discussed situations where it would be beneficial to apply the Yuen's statistic (1974). For instance it has been demonstrated that small sample sizes, unequal sample sizes and one-tailed tests can be problematic for the t-test with respect to heteroscedasticity and non-normal data. Wilcox (1996) discussed some of problems with violation of the equal variance assumption (heteroscedasticity) in relationship to the robustness of the t test when sample sizes are unequal, even when sampling from normal distributions and the even worse results when data sets are unequal and distributions are non-normal. Wilcox (1996) mentioned:

> If the sample sizes are unequal, Cressie and Whitford (1986) describe general circumstances where Student's t-test is based on the wrong standard error even with very large sample sizes. More precisely, if the variances are not equal, the distribution of Student's test statistic, T, does not approach a standard normal distribution as the sample sizes get large, contrary to what is typically assumed. The problem is that the variance of T does not approach one. With *n* large enough, perhaps this problem has no practical importance, but this has not been determined (p.131).

In their observations of long-run averages for the t-test with real data sets (Micceri, 1989), Sawilowsky and Blair (1992) noted similar outcomes to Wilcox (1996) with the prevailing view on non-Gaussian mathematical distributions (robust properties were observed with equal and large sample sizes). They included the importance of performing two-tailed tests to the Wilcox (1996) observations:

> These real distributions highlight situations in which the t test was, by any definition, non-robust to Type I error. The degree of non-robustness seen in these instances was at times more severe than has been previously reported. Having said this, however, we must note that the results obtained from these distributions do not change, in any fundamental fashion, the conclusions reached on the basis of studies that focused on populations modeled by well-known mathematical functions. That is to say, this study showed the t test to be reasonably robust under the conditions outlined in the introduction to this article: when sample sizes are equal or nearly so, sample sizes are fairly large (25,30),

> and tests are two-tailed rather than one-tailed. This study also showed that departures from nominal values were almost always of a conservative rather than a liberal nature for two-tailed tests. Also consistent with the prevailing literature is the fact that a dominant factor bringing about non-robustness to type I error was extreme skew (p. 359).

Wilcox (1996) discussed a more serious concern with heteroscedasticity in relation to power or Type II errors:

> However in terms of power, or Type II errors, or length of confidence intervals, student's t-test can be unsatisfactory, even with equal sample sizes. There are two facets to the problem. First, experience indicates that distributions can have very heavy tails-in fact much heavier than normal distributions (e.g., Hampel, 1973; Micceri, 1989; Stigler, 1977; Wilcox, 1990a). In some cases light-tailed distributions appear to be common (Micceri 1989, Pearson and & Please, 1975) but it is unclear when it is safe to assume that this is the case when analyzing data. Second, as illustrated in Chapter 5, very slight departures from normality toward a heavier-tailed distribution can have a tremendous effect on the variances in each group and this is why the power of Student's t-test can be unsatisfactory. In fact, for departures from normality that are difficult to detect, power can drop from .9 to .1 (pp.131, 132).

Likewise, Sawilowsky (2002) and Sawilowsky and Blair (1992) pointed out that the t-test was not as powerful under non-normal conditions as the Wilcoxon Rank Sum test (1945), a version of the Mann-Whitney U test (1947), which turned out to be three to four times more powerful in detecting differences in location parameters. Scheffé (1959) reminded an apathetic audience that "the question of whether the F tests (like the t tests) preserve against non-normal alternatives the power calculated under normal theory should not be confused with their efficiency against such alternatives relative to other kind of tests" (p. 351). Scheffé (1959) was remarking that power levels can be many times more powerful under alternative tests once the data departs from normality. The inadequate power levels in the absence of normality, discussed throughout literature, points to the utility of the Yuen's statistic (1974).

Behrens-Fisher Application

The Yuen statistic (1974) was suggested by Sawilowsky (2002) as a robust procedure (i.e., resilient to outliers) and useful as an adjustment for the Behrens-Fisher problem. Sawilowsky (2002) explained the Behrens-Fisher problem might arise because:

> The ratio of population variance is different from one, although neither constituent value is known. The second and more common example…indicates that no information is available on the population from which the samples were drawn and it cannot be safely assumed that the ratio of the population variances is equal to one. It is known that samples were drawn from two different populations but the population parameters are unknown (p. 464-465).

Also, as previously noted, heteroscedasticity becomes an issue in many experimental designs because the samples often start out (pre-test) or end up (post-test) with unequal variances (Micceri, 1989) and are not based upon the convenient mathematical models (Bradley, 1968, 1977, 1978, 1982). Data sets have been shown to be radically non-normal than relatively tame population shapes typically used in robust studies (Sawilowsky & Blair, 1992). Treatment groups tend to grow more homogeneous or more heterogeneous (Sawilowsky, 2002) and therefore bring about herteroscedastic outcomes (i.e., potential for the Behrens-Fisher problem).

Both Wilcox (1996) and Sawilowsky (2002) suggested that the Yuen statistic has a direct application as an adjustment method for the t-statistic under the conditions of heteroscedasticity. It follows that it would also have a direct impact on the discovery of the particular Behrens-Fisher problem for potential differences in variances after treatment irrespective of means changes. Thus, the Yuen's statistic (1974) could adjust solutions where the Behrens-Fisher problem surfaced. If the variances change after treatment, moving away from normality either by being distributed with heavier tails or in some other non-normal distribution this could cause unequal variances, a violation of testing assumptions, and thus a loss of Type I and II error properties and power. In these cases, the Yuen statistic (1974) would be a good alternative to the classical Student-t test (1908).

Implications for this Study

Wilcox (1996) noted that some researchers have suggested that before comparing means, equal variances should be tested. If the equal variance assumption was accepted, then go on to use the Student's-t test (Student, 1908a). While this appears to be a reasonable suggestion, published results do not support this approach (Markowski and Markowski, 1990; Moser, Stevens, and Watts, 1989; Wilcox, Charlin and Thompson, 1986). Wilcox (1996) noted:

> There are at least two problems. First, methods for comparing variances often do not have enough power to detect unequal variances in situations where the equal variance assumption needs to be abandoned, even when sampling from normal distributions. Second, dozens of procedures have been proposed for comparing variances, and nearly all of them have been found to be unsatisfactory in terms of Type I errors or probability coverage when sampling from non-normal distributions (Wilcox, 1990b).

According to Sawilowsky (2002), there is an additional and serious problem with this approach that is universally overlooked. "The sequential nature of testing for homogeneity of variance as a condition of conducting the independent samples t test leads to an inflation of experiment-wise Type I errors" (p. 466).

The literature is replete with the observation of inadequate procedures for detecting variance changes (e.g., Wilcox, 1996, Neave & Worthington, 1988), which is a central issue for detecting the Behrens-Fisher problem. Neave & Worthington (1988) noted that non-normality can greatly impact the F-Statistic for determining dispersion (variance) difference. Indeed, this lack of adequate procedures for the detection of variance differences underlies this proposed research which prepares to explicate the robustness of Type I errors and Type II error properties for the Mood-Westenberg test (1948). It is believed that the Mood-Westenberg test (1948), along with the Siegel-Tukey test (1960), might prove powerful for identifying heteroscedasticity under multiple real world scenarios and therefore a potential precursor to the selection of the Yuen statistic (1974) should the Behrens-Fisher problem arise after treatment.

In deference to Sawilowsky (2002) and Sawilowsky & Blair (1992), when they assessed the importance of examining small and unequal data sets for the Student's t-test (1908), small/medium sample sizes along with unequal sample sizes, typical of educational and psychological data sets, will be invoked in order to determine robustness to Type I and Type II errors for scale (variance) shifts with respect to simulated prevalent treatment conditions. The simulated treatment conditions include: multiple small shifts in location, multiple changes in scale and various combinations of the two to determine the impact for detecting changes in scale by the Mood-Westenberg test (1948) and Siegel-Tukey test (1960). If these tests are robust, then the second part of the study will examine power comparisons between the Mood-Westenberg (1948) and the Siegel-Tukey (1960) tests to determine the most powerful tests for detecting variance changes, tests that were noted as lacking by Wilcox above.

Conclusion

Wilcox (1996) concluded the discussion with a strong recommendation for the Yuen statistic (1974) as one of the best alternatives for heteroscedasticity:

> Confidence intervals based on Welch's procedure can be unsatisfactory when distributions have unequal skewness and unequal sample sizes and the sample sizes are not too large. An interesting feature of the Yuen test is that it maintains good control over the probability of a Type I error and probability coverage when computing confidence intervals in situations when the Welch's method is unsatisfactory (Wilcox 1994f). In fact, in terms of Type I errors and probability coverage Yuen's procedure seems to be the best among all procedures described in this chapter (p.139).

Sawilowsky (personal communications, 2014) also believed that the Yuen statistic (1974) was the best solution available, yet noted that it was still only an approximate solution.

Additionally, Sawilowsky (2002) mentioned some of the other nonparametric approximate solutions that met with some success for the Behrens-Fisher problem:

> Yuen (1974) provided a robust solution based on trimmed means and matching sample variances. Tiku and Singh's (1981) solution was based on modified maximum likelihood estimators. Tann and Tabatabai (1985) combined the Tiku and Singh procedure with the Brown-Forsythe test to produce a more powerful procedure than those based only on Huber's M estimator (Huber, 1981; Schrader & Hettmansperger, 1980)…
>
> The development of procedures involving the Behrens-Fisher problem is not restricted to the usual $K \geq 2$ independent sample cases. Games and Howel (1976) examined pairwise multiple comparison solutions. Bozdogan and Rameriz (1986) proposed a likelihood ratio for situations where only subsets respond to a treatment. Johnson and Weerahandi (1988) provided a Baysian solution the multivariate problem. Koschat and Weerahandi (1992) developed a class of tests for the problem of inference for structural parameters common to several regressions. (p. 463).

Whichever of these approximate solutions might be chosen by a researcher, the question still remains as to how they will first determine the existence of the Behrens-Fisher problem in order to apply one of these solutions. It is essential to find a robust test such as the Mood-Westenberg test (1948) to detect the possibility of a Behrens-Fisher problem, if the researchers hope to continue their search for Behrens-Fisher solutions or to apply other solutions. Thus, the focus of this study will be to explicate under what conditions it might be possible to detect the Behrens-Fisher problem with the Mood-Westenberg (1948) or the Siegel-Tukey (1960) tests and which of these test might offer the researcher the most power towards that end.

Monte Carlo Methods Simulation

Determination of Long Run Averages

According to Sawilowsky & Fahoome (2003, p. 46), "Monte Carlo refers to the repeated sampling from a probability distribution to determine the long run average of some parameter or characteristic." They noted that Monte Carlo methods are akin to a gambler throwing dice many times to practice (probability frequencies) before they went to the casinos of Monte Carlo. By observing long-run averages, they hoped to learn something about their betting habits from their experiences with the tossing of the dice. Sawilowsky & Fahoome (2003) noted:

> Monte Carlo refers to repeated sampling usually with replacement from a probability distribution and computing the long run averages of some property over all the samples. First, the idea of continuously repeating a process is akin to gamblers who threw dice many times to practice before visiting the casinos of Monte Carlo. They hoped to learn something about their betting habits from their experiences with the systematic tossing of dice, recording the results, and analyzing the outcomes.
>
> Second, the term method was used in the singular form because initially the statistical distribution considered was limited to only one shape, which was the uniform. In many areas of mathematics and the physical sciences, the uniform distribution is the best first guess of sampling properties of a variable. As mentioned above, however, in modern times many variables are known to be distributed according to other distributions, such as the normal curve or the exponential curve. Therefore, we now refer to these techniques in the plural as Monte Carlo methods (pp. 115-116).

Jerzy Neyman (1894-1981) is often credited with the development of the Monte Carlo methods philosophy with respect to long-run frequencies. Lehmann (1993) stated "in his discussion of Fisher's 1935 paper (Neyman, 1935, pp. 74-75) he expressed the thought that it should be possible 'to construct a theory of mathematical statistics…based solely upon the theory of probability,' and went on to suggest that the basis for such a theory can be provided by 'the conception of frequency of errors in judgment'" (p.1243). Lehmann (1993) went on to say:

> For Neyman, the idea of probability is fairly straightforward: It represents an idealization of long-run frequency in a long sequence of repetitions under constant conditions (see, for example, Neyman 1952, p. 27; 1957 p. 9). Later (Neyman, 1977) he pointed out that by the law of large numbers, this idea permits an extension: If a sequence of independent events is observed, each with probability p of success, then the long-run success frequency will be approximately p even if the events are not identical. This property adds greatly to the appeal and applicability of a frequentist probability (p. 1245).

One important benefit of the Monte Carlo methods is that it enables a researcher to evaluate testing procedures and sampling effects for long-run averages in line with the Neyman (1935) Frequentist philosophy, and in modern times, with the ease of computer programs. It efficiently calculates long-run averages after repeating any process such as a statistic or testing procedure and tabulates frequency of error in judgments (i.e. Type I & Type II errors). Thus, the long run averages for Type I error rates and Type II error properties along with power averages for any procedure such as the Mood-Westenberg test (1948) can be observed.

Sawilowsky & Fahoome (2003) added their opinion concerning the Monte Carlo beginnings:

> Monte Carlo methods based on sampling from a probability distribution began many years ago. Credit is usually given to Jerzy Neyman, certainly for good reason for developing the method in reference to the discipline of statistics. However in our opinion, it goes back to 1907/1908 in the work of “Student”, William Sealy Gosset, (student, 1907, 1908a, 1908b). (There are some references to Monte Carlo techniques being used a few years earlier in work done in chemistry and physics regarding the Boltzmann equation.) Gosset (Student, 1908b) studied the probable error of the correlation coefficient. Although he did not use computers, the process he describes is a Monte Carlo simulation (pp. 46-47).

Lance (2011) mentioned that the Monte Carlo had "its modern roots in particle physics, where it was first used by scientists at the Los Alamos Laboratory to detect the location (or distance traveled) of neutrons (Metropolis, 1987) and was instrumental in research leading up to the development of the atomic bomb” (p.28). Metropolis & Ulam (1949) believed it was a technique made possible with the help of modern computers.

Concept in Research Design

Sawilowsky & Fahoome (2003) mentioned another significant benefit to the Monte Carlo methods was that it offered an important concept in research design. They said that drawing samples from a distribution function simulated random selection. A familiar randomization procedure is a fair dice throw where there is a 50% chance of throwing either a head or a tail. In experimental design, this could be simulated for instance by drawing from the uniform distribution where if a unit draws a 0-.5 value it is assigned to a treatment group and if it draws a value of .6-1 it is assigned to a control group. Sawilowsky & Fahoome (2003) described drawing from the uniform distribution: "Drawing the uniform random numbers is akin to random selection, and placing ½ of them in one array and the other ½ in the second array simulates random assignment. These are important concepts in research design" (p. 119). Random numbers can be drawn from any distribution function to simulate variables that conform to specified population parameters.

Randomization assigns units to conditions based solely on chance. The Monte Carlo methods allows a researcher to draw independent and random values from data distributions and assign them randomly to a treatment and control group, real or simulated. With randomization, the researcher is able to rule out other plausible explanations for the relationship between input and output variables by neutralizing all other potential causes, thus reducing threats to internal validity, a primary concern with any experiment. The results of an experiment are deemed plausible because randomization equates groups on expectations of every variable before treatment, whether observed or not. Shadish, Cook & Campbell (2002) summarized the benefits of randomization:

- It ensures that alternative causes are not confounded with a unit's treatment condition.
- It reduces the plausibility of threats to validity by distributing them randomly over conditions.
- It equates groups on the expected value of all variables at pretest, measured or not.
- It allows the researcher to know and model the selection process correctly.
- It allows computation of a valid estimate of error variance that is also orthogonal to treatment (P. 248).

Sawilowsky (2006) disparaged the non-random or quasi-experimental design and stated that independence and random selection/assignment are necessary for sound experimental design and believed "there is no substitute for random assignment" (p.214). Sawilowsky (2006) stated "the insidiousness of bias is that in the absence of randomization, the degree of bias which is present is essentially unknowable; it can never be known in terms of confounding variables the researcher is aware of, or in terms of confounding variables the research is not aware of ” (p.232). Randomization works for sample sizes as small as n = 2 (Sawilowsky, 2004).

Simulation

According to Sawilowsky and Fahoome (2003), simulation is the representation of reality with a model that can be manipulated. Sawilowsky and Fahoome (2003) noted that the quality of the simulation increases as the model increases its ability to mimic reality. In this study, simulation will occur through a computer model of a control and treatment group and various permutations of input conditions. There will be randomly assigned values for simulated control and treatment groups through repeated drawing, with replacement, from various real world data sets and theoretical/mathematical distributions,

Additionally, efforts are made to improve the quality of the results by observing thousands of different scenario permutations for a wide range of typical educational and psychological sample groups, including variations in sample sizes, data distributions/data sets, alpha levels, treatment effects, and variance differences. Care will be given to include all permutations of these input variables. In this way, a wide range of input conditions will be tested to explicate long-run averages under a wide universe of conditions and interplay of these conditions. Through the simulation testing of thousands of potential input variations, each run a 100,000 times to determine long-run averages, the utility of a statistical procedure such as the Mood-Westenberg test (1948) can be determined. The advantage of using a simulation of this type in experimental research is, of course, the great reduction in time and expense as compared to performing actual experimental studies. Understandably, from the cost benefit perspective, this depth and breadth of analysis is generally not possible with live experimental research.

The Monte Carlo methods simulation results from putting together the two concepts of (1) the Monte Carlo methods of long run averages to explicate variance changes detection and (2) the simulated or modeled reality of randomly selected control and treatment groups to mimic real life experimental design. Following in the footsteps of many in the literature such as Student (1907,1908a, 1908b), Jerzy Neyman (1935), Sawilowsky & Blair (1992), Sawilowsky & Fahoome (2003), and Lance (2011), long-run averages of data set scenarios will be studied to explicate robustness of the Mood-Westenberg test (1948) and the Siegel-Tukey test (1960). The Monte Carlo methods simulations will determine long run averages of these tests under multiple data set scenarios, drawn with replacement from many distributions and data sets, to explicate the effects of violating the equal means assumption with respect to determining changes in scale. Afterwards, comparison of power between the two tests will be observed. It is hoped that a robust statistic can be found to identify the Behrens-Fisher problem.

Robustness to Type I Errors: Statistical Conclusion Validity

Robustness is the degree to which a statistical test maintains Type I and Type II error rates in light of testing assumption violations. A robust statistic is critical in experimental design for the determination of covariance (i.e., correlation) between cause (inputs) and effect (outputs). This covariance concept was referred to as statistical conclusion validity by Shadish, Cook & Campbell (2002) when they noted "inferences about covariation may be inaccurate if the assumptions of a statistical test are violated" (p.48). They (Shadish, Cook, & Campbell, 2002) remarked:

> Statistical conclusion validity concerns two related statistical inferences that affect the covariation component of causal inferences: (1) whether the presumed cause and effect covary and (2) how strongly they covary. For the first of these inferences we can incorrectly conclude that cause and effect covary when they do not (a Type I error) or incorrectly conclude that they do not covary when they do (a Type II error). For the

> second inference, we can overestimate or underestimate the magnitude of covariation, as well as the degree of confidence that magnitude estimate warrants (p.42).

Central to this study is determining covariance between thousands of unique input conditions and the output of error rates. These error rates will be observed to determine the dependability of the Mood-Westenberg (1948) and Siegel-Tukey (1960) statistics for maintaining Type I and Type II error rates with respect to change in scale as assumptions are violated. But what exactly constitutes dependability or robustness for Type I and Type II error rates? Given the importance of the robustness construct in explicating cause and effect conclusions in the context of experimental design, it would be wise to define its boundaries. However this has often not been the case in the literature. Appealing to fellow psychologists, Bradley (1978) opined that the literature which they had often relied upon alleged robustness with respect to departures from testing assumptions such as normality and homogeneity of variance; yet, unfortunately, the researchers offered no solid definition or quantitative standards for what constitutes robustness (i.e., in tests such as z, t, F tests). Bradley (1978) cited Young and Veldman (1965) when they concluded that it is better not to violate assumptions but “leave us with the distinct impression that little harm will come of it if we do” (p. 144). Bradley (1978) criticized the Young and Veldman (1965) study because:

> We are given no quantitative indication of how much distortion may occur, nor under what conditions. Instead we are assured on the basis of Authority that ‘relatively little’ distortion will ‘probably’ occur for ‘even considerable departures’ (p. 144).

According to Bradley (1978), robustness is a complicated concept because it is a function of many factors which may combine and produce unique interactive effects, all of which must be considered within the experiment. The interplay and interaction of many conditions were very important to Bradley (1978) who stated that the “interdependencies among the various influencing factors are often quite strong, requiring elaborate qualifications for an accurate and meaningful statement about the test violations (Bradley, 1968, pp. 26-28)" (p. 146) :

> When the population assumptions are violated, the departures for *p* from α depend upon a complex interaction involving many factors: the size of α, the location of the rejection region, for the smallest sample, the absolute size of the sample and the absolute shape of the population form which it was drawn; and for each of the other samples, considered separately, the absolute and relative size of the sample, and the absolute shape, relative slope or relative variance of the population from which it was drawn (p. 146).

Bradley (1964) determined that typically no one of the input conditions determines robustness:

> Here we have dramatic evidence of the importance of qualifying conditions. The complexity of the combinations required is suggested by the fact that with one unimpressive exception, there was no single condition , no alpha value, no rejection region, no absolute or relative sample size, no absolute or relative shape and no relative variance for which the liberal criteria was always met by any of the 5 tests investigations (p. 147).

Bradley (1978) discussed concerns that researchers performed their analysis with mathematical distributions and not real life data sets (Micceri, 1989), that there was an absence of a robustness definition and about study bias:

> Although the literature on robustness is quite extensive, psychologists appear to have been influenced primarily by the mainly mathematical treatment of the subject by Box (1954), Box & Andersen (1955) and Scheffé (1959) and the empirical sampling studies reported by Lindquist (1953) and Boneau (1960). None of these authors uses a quantitative definition of robustness. Furthermore, in every case some sort of selective bias appears to be operating and that bias always seems to favour robustness. The bias then tends to be overlooked or depreciated in summarizing the actual findings and drawing generalized conclusions. And the author's overgeneralization, underqualification or use of overly exuberant language in proclaiming robustness further tends to convey the impression that robustness is a highly general phenomenon (p.147).

Additionally, Bradley (1978) clarified that these mathematical models were highly amenable to robust findings, unlike real data sets. Therefore, test statistics found robust with mathematical distributions may not in fact be robust in real experimental settings:

> The empirical sampling studies reported by both Lindquist and Boneau were sampled from artificial populations some of which (e.g. the rectangular, the normal) are highly conducive to robustness and most of which seem rather tame (p. 148).

Besides the contention with these expert researchers, Bradley (1978) lamented the absence of clear guidelines for what constituted robustness from a high percentage of elementary statistical text book authors whom were the shapers of opinions. Bradley (1978) found only a small number of these authors dealt directly or indirectly with the subject and none of those authors mentioned all of the factors influencing robustness (advanced text book authors were slightly less culpable according to Bradley, 1978). Bradley (1978) suggested that the experts themselves most likely contributed considerably to these shortcomings. However, in light of the lack of guidelines, Bradley (1978) provided some proposed definitions.

The proposed robustness magnitude limits defined by Bradley (1978) were between .5(α) and 1.5(α) for liberal limits and between .9(α) and 1.1 (α) for stringent limits. These proposed limits have been accepted by many in literature and a few are noted below. The Bradley limits are valid in the opinion of this author who agrees with Bradley's (1978) proposal that "if the alpha level has been properly chosen, i.e., if alpha = .01 or .001 has been picked because protection is truly needed at that level, then there should be no objection to a definition of robustness that makes the robustness criterion proportional to alpha (p. 146)." Bradley described the liberal criterion for robustness as when the Type I error falls within plus or minus half of nominal alpha levels and the stringent criterion for robustness as when the Type I error falls within plus or minus 1/10 of the nominal alpha level. Table 3 summarizes the proposed liberal and stringent magnitude limits proposed by Bradley (1978).

Table 3

Definitions of Robustness to Type I error resulting from Monte Carlo Simulations

Definitions of Robustness	Alpha=.05 range	Alpha = .01 range
Liberal (within 0.5 * alpha)	.025-.075	.005-.015
Stringent (within 0.1*alpha)	.045-.055	.009-.011

Note: Adapted from Lance (2011)

The proposed Bradley Limits were applied by Lance (2011) in a study of robustness for the Winsorized t. In this study, Lance (2011) found:

> The need for a study like this to apply Bradley's definitions of robustness for the Winsorized t exists as those for the regular t have existed (and continues so for tests conducted with real data distributions not examined by Micceri,1989) (pp.12, 13).

Putting together the research of Lance (2011) and Bradley (1978) in terms of ***direction*** of non-robustness, Figure 10 determines the following. If the tests are non-robust from a conservative direction, then this means that the test will not reject the null hypothesis as much as the alpha level allows (under-rejecting H_0). If the tests are non-robust from a liberal direction, this means that the test will reject the null hypothesis more than allowed by the alpha level (over-rejecting H_0).

Definitions (see Bradley, 1978)

		Stringent Robust	Liberal Robust	Non-Robust Stringent	Non-Robust Liberal
Directions	Conservative (under-rejecting H_0)	$(0.9\alpha \leq p \leq \alpha)$	$(0.5\alpha \leq p \leq \alpha)$	$(p < 0.9\alpha)$	$(p < 0.5\alpha)$
	Liberal(over-rejecting H_0)	$(1.1\alpha \geq p \geq \alpha)$	$(1.5\alpha \geq p \geq \alpha)$	$(p > 1.1\alpha)$	$(p > 1.5\alpha)$

Note: Adapted from Lance (2011)

*Figure 10***.** Directions and definitions for Type I error ranges

Additionally, the Bradley limits were the choice of robust measurement constructs in other Type I error studies such as Maxwell (1980) and P. H. Ramsey, and Ramsey and K. Barrera, (2010). Wilcox (1996) mentioned the importance of considering the Bradley (1978) limits in relationship to determining the acceptability of Type I error rates lamenting the problem of unequal variances and the effect on producing poor F- test results:

> Using equal sample sizes reduces the problem, but with J = 4 groups and sample sizes of 50 for each group, the probability of a Type I error can be as high as .09 when α=.05 and R = 4, even under normality. One might try to salvage the F test by arguing that a Type I error can be as high as .09 but others would disagree. For example Bradley (1978) argues that ideally, when testing at the .05 level, the actual probability should not exceed .055 and at worst it should not exceed .075 (p. 180).

Sawilowsky and Blair (1992) considered these limits in their research investigating robustness for Type I errors and properties of Type II errors of the t test with departures from normality

In light of Bradley's (1978) conclusions with respect to the criticality of considering multiple input interactions in the determination of robust characteristics, thousands of permutations of input variations will be used to explicate the precise conditions for robustness with respect to Type I and Type II errors when violating the equal means assumptions for the Mood-Westenberg test (1978) and the Siegel-Tukey test (1960). Typical educational and psychological sample groups (i.e., the real world data sets) along with mathematical distributions will be simulated to include variations in sample sizes, alpha levels, and treatment effects of location shifts (means shifts) and variance differences (scale changes). The Bradley's (1978) proposed liberal and conservative definitions of robustness will be adopted here to test the hypothesis that the Mood-Westenberg (1948) test and the Siegel-Tukey (1960) test are robust with respect to Type I and Type II error rates. The Mood-Westenberg (1948) and Siegel-Tukey (1960) statistics will be considered liberally non-robust from a conservative direction if $p < (.5)\ \alpha$ and from a liberal direction if $p > (1.5)\ \alpha$. The test will be considered stringently non-robust from a conservative direction if $p < (.9)\ \alpha$ and from a liberal direction if $p > (1.1)\ \alpha$. Figure 10 illustrates these directional interactions and how they will be used in this study. The liberal non-robust limits will be the major focus of this study (see Methodology) in order to give both tests the maximum leeway.

CHAPTER III

METHODOLOGY

Overview of the Research Design

The purpose of this study is to determine whether the Mood-Westenberg (1948) dispersion test utilized to detect difference in scale, is robust with slight shifts in location. If it is robust, then it may be useful in determining the presence of a potential Behrens-Fisher problem of scale changes (heteroscedasticity) concurrent with location shifts. As Sawilowsky (2002) noted, if robust properties are found with respect to Type I and Type II errors it would be useful as a precursor to employing classical solutions, such as, for example, Yuen's procedure (Yuen, 1974, Reed, 2003). Hence, the purpose of the study is to determine if the Mood-Westenberg (1948) test is robust under violations of its equal means assumption.

Mood-Westenberg (1948) tests the probability hypothesis that two independent groups have the same variance or spread. It tests for the condition of heteroscedasticity and rejects the null hypothesis if it is improbable that the two groups have equal variances. According to Neave and Worthington (1988), it was proposed by Westenberg (1948) as "a simple procedure for testing whether or not two populations have the same spread. Because the test can be presented in a form similar to Mood's two-sample test, we shall refer to it as the Mood-Westenberg test (p. 344)". It assumes roughly equal averages for the groups. The test is conducted by ordering all values from high to low for the combined observations of the two groups, designating upper and lower quartiles, and expecting equal number of observations from both groups within and between these areas if there are no spread differences. This statistic uses the Fisher exact distribution tables to provide the critical values. An alternative probability distribution that can be used is the asymptotic Chi-Squared distribution. Both distributions will be analyzed.

Because the Siegel-Tukey test (1960) also has been proposed for the purpose of determining variance/spread differences between two samples, it will also be invoked as the primary competitor to the Mood-Westenberg (1948) test. It also assumes equal averages between groups. Neave and Worthington (1988) explained the Siegel-Tukey (1960) test as follows:

> What we now need for detecting differences in spread is some alternative ranking or scoring system which will assign, say, large values at both extremes of the letter sequence and small values towards the center (or vice versa). Then if any one of the two letters, say B, does predominate in both extremes, thus indicating a wider spread, the sum of the scores for the sample will be particularly large. Such a sum can therefore form the basis of a useful test for the difference in spread (p, 131).

The Siegel-Tukey (1960) test uses the Mann-Whitney distribution tables to provide the critical value for the test statistic. An alternative probability distribution which can be used is the asymptotic Z-Score distribution. Both distributions will be reviewed. In the second phase of this study, which assumes the Mood-Westenberg is robust, will be a comparative power study between the Mood-Westenberg (1948) and the Siegel-Tukey (1960) tests.

The construct of robustness is defined as the ability to maintain Type I and Type II error rates in light of assumption violations, within the conservative and liberal definitions proposed by Bradley (1978) for Type I errors. The output statistic that will be measured against the Bradley limits is the *p* value and the β rejection rates. These limits will be applied to the study's selected alpha levels of .05, .025, .01 and .005.

Post-test randomized experimental designs are simulated which compare a treatment and a control group. Monte Carlo simulations will be conducted in order to explicate the effect upon Type I and II errors for the Mood-Westenberg (1948) and Siegel-Tukey (1960) change in scale hypothesis after the assumption of equal means are violated in small increments. First, testing will be performed with the equal means assumption in place to establish baseline results. Then, treatment effects of location shifts will be gradually increased in small magnitudes, thus violating the assumption more and more. Type I and Type II error rates under the violations will be compared to the counterfactual conditions of equal means. Normal distribution results will be considered as another counterfactual to be compared with other distributions. The expectation is that both the Mood-Westenberg (1948) and the Siegel-Tukey (1960) tests will remain robust with respect to Type I and Type II errors for detecting variance change for several theoretical distributions and real world data sets.

Following in the footsteps of many in the literature including Sawilowsky and Fahoome (2003), the Mood-Westenberg (1948) test will be observed for robustness by determining long run averages through the Monte Carlo methods simulation. The design includes random selection and assignment for various sample sizes drawing from the classical normal distribution and 10 other theoretical distributions and real world data sets. Multiple distributions and data sets will be tested besides the normal distribution because, as mentioned by Sawilowsky and Fahoome (2003),

> Micceri (1989), Tan (1982) and Pearson and Please (1975), among many others, found that less than 3% of variables in education and psychology are symmetric with light tails, such as the bell curve. Therefore, for the past quarter of a century, many other mathematical curves other than the Gaussian distribution were suggested as models of the distribution properties of important variables (p. 129).

Wilcox (1996) reminded us that “outliers and heavy-tailed distributions are common in applied works, which can reduce the power of any method designed to compare means” (p. 136). Additionally, Micceri (1989) demonstrated the importance of testing real world data sets which are much less tame than the mathematical models; hence, the need to test many real world distributions along with the theoretical models.

After sample sizes are randomly drawn (with replacement) from the various distributions and data sets, they will be assigned to a simulated control and experimental group. Next, thousands of typical research experiments will be simulated whereby the means are shifted (indicating levels of treatment effect) under numerous scenarios or permutations of variable conditions, including variations in sample sizes, alpha levels, distributions/data sets, small location shifts/treatment effect sizes, and variance differences/changes. Long-run average rejection rates will be calculated after running 100,000 iterations for each of these permutation scenarios to determine the robustness measures with respect to Type I and Type II errors and power levels. Indeed, if robust results are found for these rejection rates under various permutation conditions, then it might be confidently concluded that these statistics detect the Behrens-Fischer problem and indicate a resolution such as the Yuen (1974) adjustment.

Hypothesis Testing

The general hypothesis tested is whether the Mood-Westenberg test (1948) and/or the Siegel-Tukey test (1960) will remain robust with respect to Type I and Type II errors (and associated power levels) after the equal means testing assumption is violated. The means will be increased in small increments to explicate the conditions under which the statistics remain robust. Determination of robustness for Type I errors and Type II error properties will be defined by the liberal limits of Type I errors proposed by Bradley (1978).

The specific hypothesis test defined for Mood-Westenberg test (1948) is:

- Assuming μ_1=μ_2, where μ_1 is the mean from sample 1 and μ_2 is the mean from sample 2.
- H_0=Null= Variances are Equal

- H_1= Variances are Different

The specific hypothesis test defined for the Siegel-Tukey test (1960) is:

- Assuming $\mu_1 = \mu_2$, where μ_1 is the mean from sample 1 and μ_2 is the mean from sample 2.
- H_0=Null= Variances are Equal
- H_1= Variances are Different

The second phase of the study which assumes that the Mood-Westenberg test (1948) is robust, will determine the relative power between the Mood-Westenberg (1948) and the Siegel-Tukey (1960) statistics. The hypothesis is that Mood-Westenberg would be more powerful as compared to the Siegel Tukey (1960) test because it has the least amount of assumptions (Ferraro, et al, 2003).

Research Design

The methodology satisfies the critical research design elements of independence and random selection. Monte Carlo design methods are invoked to generate non-biased computer generated pseudo random numbers which are drawn (with replacement) from various theoretical distributions and real world data sets, assigning the variates randomly to either of two groups, thus simulating an experimental random design for two independent samples (a control and a treatment group). Monte Carlo methods will also be invoked to run thousands of input scenarios 100,000 times each in order to determine long-run averages and robustness properties of the Mood-Westenberg (1948) and Siegel Tukey (1960) test statistics under each permutation. The permutations will include all combinations of various sample sizes, alpha levels, distributions/data sets, and magnitudes of location shifts and variance changes.

First, samples will be drawn without modifying the variates to simulate the equal means assumption (random assignment equates groups on expectation at pretest). In the next phase, the samples variates will be drawn and then the treatment group variates will be increasingly modified in small increments to simulate treatment effects. As the treatment effects increase and the means become more and more unequal, the equal means assumptions is violated also by slightly increasing magnitudes. Each of the two test statistics under observation, Mood-Westenberg (1948) and Siegel-Tukey (1960), will be invoked 100,000 times for each scenario permutation so as to evaluate the long-run average probabilities for detecting variance changes.

The construct for each test statistic is robustness which will be measured by the liberal limits of Type I errors proposed by Bradley (1978). The output results that will be measured against the Bradley limits are: the p value rejection rate (Type I) and the β rejection rate (Type II). The robustness measures proposed by Bradley (1978) will be the construct measure for all permutations scenarios for five (X) input variables described below.

If it is found that the long run averages for the p rejection rate, $\beta,$ rejection rate and power (1-β) are robust with respect to detecting various magnitudes of variance change after violation of the equal means assumption, then these outcomes could indicate useful robust test statistics for identifying the Behrens-Fisher problem and thus robust indicators for selecting alternative statistics to the more prevalent classical choices (i.e., the t-test). A general overview of the study's input and output variables follow and details are noted in the assumption section.

Input: Independent Variables (X):

- various small equal and unequal sample sizes for N_1 (population number for group 1), N_2 (population number for group 2)
- four alpha levels

- random numbers drawn from three theoretical/mathematical models and eight real data sets.
- equal means/medium assumption in place between the two groups
- equal means/medium assumption violations, with unequal means between the two groups determined by small incremental location shifts based upon Cohen's *d* (1988).
- scale changes based on ranges found in Brown and Forsythe (1974) and the Wilcox (1989) educational study.

Output: Dependent Variables (Y):

The purpose is to test for robustness of Type I and Type II errors with respect to detection of difference in variances, not location shifts, between the two groups. Determinations will be made, for each permutation, as to when the Mood-Westenberg test (1948) and the Siegel-Tukey test (1960) might break down in light of increasing location shifts (i.e. become non-robust) as measured by the Bradley's (1978) proposed liberal limits of Type I errors. A review of the output (Y) variables for each permutation scenario, for each test statistic, will be observed. For each of the statistical tests, Mood-Westenberg (1948) and Siegel-Tukey (1960), the reports will be produced for:

- robustness for Type I errors (error rate for finding in favor of a variance change when none occurred) where $\mu_1 = \mu_2$
- robustness for Type II errors (error rate for not finding in favor for a variance change when the variances are different) where $\mu_1 = \mu_2$
- robustness for Type II errors after violating the test assumption of equal means where $\mu_1 \neq \mu_2$
- power analysis between the Mood-Westenberg (1948) and Siegel-Tukey (1960) tests.

Assumptions

Independence, Random Selection/Random Assignment

Independence and random selection/assignment requirements for sound experimental design and the basic requirements for the Mood-Westenberg (1948) and the Siegel-Tukey (1960) tests will be satisfied in this Monte Carlo methods study. Non-biased computer generated pseudo random numbers will be drawn from theoretical distributions and real data sets, enabling independent and random selection and assignment for the test samples. Anyone could replicate this study by obtaining the initial seed number and entering the input parameters.

Settings and Participants

Post-test designs are simulated with one control group and one treatment group, testing under various permutation scenarios of central tendency (location shifts and/or scale changes) for a variety of samples sizes that represent typical educational and psychological studies: $n_1 = n_2 =$ 5,5; 5,15; 10,10; 10,30; 15,45; 20,20; 30,30; 30,90; 45,45; 65,65; 90,90.

Nominal alpha selected

Robustness properties as defined by Bradley (1978) for the Mood-Westenberg (1948) and the Siegel-Tukey (1960) statistics will be evaluated by observing long-run averages and comparing them to the alpha levels of .05, .025, .001, and .005. These alpha levels and were selected to represent those most selected in applied research and experimental design.

Distributions and Data Sets

Scenarios will be simulated by drawing samples from 11 distributions and data sets including the classical counterfactual normal/Gaussian distribution and two other theoretical data sets: the uniform and exponential models (Katzenbeisser, 1989). These distributions are chosen along with eight real data sets identified by Micceri (1986): smooth symmetric, extreme asymmetric (growth), extreme asymmetric (decline), extreme bimodality, multimodality and lumpy, discrete mass at zero, discrete mass at zero with gap, and digit preference. These data sets identified by Micceri (1986) are available in a subroutine library (Sawilowsky, Blair, and Micceri, 1990) and are described in Chapter II.

Statistical Power for Variance (Scale) Changes:

A change in scale/variance with no means shift is the primary indicator of the Behrens-Fisher problem of heteroscedasticity and it is hypothesized that the Mood-Westenberg (1948) and Siegel-Tukey (1960) tests will be able to detect changes in scale even under small incremental violation of the equal means assumption that indicate small treatment effects. These scale change magnitudes indicate the condition in which the ratio, R, of variance between the treatment group and the control group is not equal to 1. When this occurs, the alternative hypothesis (H_1) is expected to be true for the Mood-Westenberg (1948) and the Siegel Tukey (1960) tests. Brown and Forsythe (1974) reported results for R = 3 (in their study, R was a measure of standard deviation differences: R =$\sigma 1/\alpha 2$) and found that the probability of a Type I error was unacceptable high and, as Wilcox (1996) noted, there was no stated reason for limiting the results to R ≤ 3. Wilcox (1989), in a survey of educational studies, found that estimates of R (R =$\sigma 1/\alpha 2$) are often higher than 4.

In this study, variance change magnitudes of K equal to 1 (no difference) to K equal to 3.5 will be reviewed. K squared is the simulated new variance of the treatment group and also the simulated ratio difference, R, between the control and treatment group after treatment (subtracting the means from the variates which centers them around zero causes the standard deviation of the control group to approach a normal curve having a variance of 1). Ratio variance differences, of R, from 1.56 (K=1.25) to 12.25 (K=3.5) will be tested. Acceptance of the alternative hypotheses is expected after simulating a change in variance when K = 1.25-3.5 (.25). The condition of equal variances, indicating the null hypothesis (H_0) should be accepted, will occur when the ratio of the variances between the treatment and control groups is equal to 1 (K=1). In total, the variance ratios tested will be K=1-3.5 (.25). The Type II error rate, β, will be projected at .20 with an expected power probability (1- β) of .80; these Type II error and power rate expectations are often the literature standards.

Treatment Effect: Means (Location) Shifts:

Statistical power for detecting variance differences will be addressed by observing their long-run averages after simulating treatment effects (location shifts and/or scale changes) with the location shifts modeled after small effect sizes as indicated by Cohen's *d* (1988). It will be determined which small treatment effect sizes (assumption violations), if any, would cause the Mood-Westenberg (1948) and the Siegel-Tukey (1960) tests to become non-robust with respect to Type I errors, Type II errors and power levels for detecting variance differences. For location shifts, Cohen (1988) suggested .2(σ) represents a small treatment effect, .5(σ) a moderate treatment effect, and .8(σ), a large treatment effect. Only small levels (*d* less than or equal to .2(σ).01) will be tested in the study. Sawilowsky and Fahoome (2003) mentioned the applicability of Cohen's (1988) *d* treatment levels along with an additional level of 1.2 (σ) and stated "in many Monte Carlo Studies we have used 1.2 (σ) to represent a very large treatment effect" (p. 220). However, means shifts that approach these larger levels will not be the focus of this study because those are beyond the boundaries of Behrens-Fisher problem. Before these means shift treatment effects (.01σ -.12σ (.01)) will be simulated in violation of the equal mean assumption, the assumption of equal means (i.e., adding 0(σ) effect size to the variates) will be tested in order to observe the null or Type I, (*p)* and Type II, (β) rejection rate averages following all scale changes with the testing assumptions in place.

Robustness

The primary construct will be robustness. The definition of a robust test is a test that maintains Type I and Type II error rates in light of assumption violations. The instrument that will measure and define the construct of robustness for the Mood-Westenberg (1948) and Siegel-Tukey (1960) statistics, is the Bradley (1978) proposed conservative and liberal limits for Type I errors. This measurement was chosen as a reliable and valid measurement instrument after reading Bradley's (1978) justification and observing its usefulness in the other literature.

The robustness magnitude limits defined by Bradley (1978) are between .5(α) and 1.5(α) for liberal limits and between .9(α) and 1.1 (α) for stringent limits. Figure 10, in Chapter II illustrates these directional interactions and how they will be used in this study. The Mood-Westenberg (1948) and Siegel-Tukey (1960) statistics will be considered liberally non-robust from a conservative direction if $p < (.5)\ \alpha$ and from a liberal direction if $p > (1.5)\ \alpha$. The test will be considered stringently non-robust from a conservative direction if $p < (.9)\ \alpha$ and from a liberal direction if $p > (1.1)\ \alpha$; however these stringent limits are not the focus of this study and only the liberal limits will emphasized. If the tests are non-robust from a conservative direction, then this means that the test will not reject the null hypothesis as much as the alpha level allows (under-rejecting (H_0). If the tests are non-robust from a liberal direction, this means that the test will reject the null hypothesis more than allowed by the alpha level (over-rejecting H_0).

Table 4, is an example of the use of these limits in another Monte Carlo test, carried out by the author, to explicate robust characteristics of Student's-t (Student, 1908a). The results are shown here *only* to demonstrate the measurement approach that will be invoked when examining long run averages for detecting variance differences between samples with the use of the Mood-Westenberg (1948) and Siegel-Tukey (1960) statistics (the t-test is not reviewed in this study and is demonstrated here only as an example of robustness). The Bradley (1978) proposed measurements will be used as standards for assessing robustness for the p rejection rate, and β rejection rate.

Scales of Measurement

The Mood-Westenberg (1948) test and the Siegel-Tukey (1960) test measure outcomes on an ordinal scale. All other measures in this study conform to a ratio scale because the measurements have an absolute zero and no negative numbers. For instance, the Bradley (1978) proposed limits are defined by percentages of alpha. The simulated location shifts and scale changes are determined with ratio scales. Additionally, the outcome observation variables are measured for robustness on a ratio scale because the rejection rates for Type I and Type II errors will be found after analyzing the number of rejections over iterations for each permutation. When testing for Type I error rates, when the variance of the two groups are equal ($K = 1$), a percentage will be calculated for the total number of times the null hypothesis of equal variances is rejected (e.g., after 100,000 iterations) over the number of iterations. Finally, the ratio scale is necessary as a measure for detecting the Behrens-Fisher problem noted when the population variance ratios are not equal to 1.

Procedures

Data Input

Random sample variates will be drawn (with replacement) from each mathematical distribution and real world data set and randomly assigned to one of the two sample group arrays dimensioned for the noted sample sizes. Only the treatment group's array variates will be modified for location shifts (no modification initially) by adding a constant (shift level times standard deviation of the distribution/data set) to the drawn values to simulate location/treatment effects. In order to simulate group scale/variances changes, a constant (K=1-3.5(.25)) will be multiplied by the variates in the treatment group, after centering the values on zero by subtracting the means of the distribution/data set from the random variate. Also, to simulate the variance differences, the random values in the control group will be centered on zero by subtracting the distribution/data set mean. No other changes will be made to the control group. Each set of permutations with unique combinations of sample sizes, distributions/data sets, and location and scale changes will be tested at alpha levels of .05, .025, .01, and .005 to explicate which scenarios are robust for Type I and Type II errors and then to determine comparative power levels for the Mood-Westenberg (1948) and the Siegel-Tukey (1960) tests. Significant findings will be reported.

The formula that will be used to modify the randomly assigned values to simulate location/mean shifts and variance changes is detailed in Figure 11. The effect size is the standardized difference between the treatment and control group: $(\mu_1\text{-}\mu_2)/\sigma$ where σ is the pooled standard deviation of the treatment and control group. A treatment will be modeled as a shift in location, by multiplying a constant C = (.01-.12).1 by the distribution's σ. For example, because the standard deviation of the smooth symmetric data set is 4.91, a treatment effect size of .1σ or .491 is added to the treatment variates.

A treatment will be modeled as a change in scale, by multiplying a constant scale shift of k=1-3.5 (.25) by the random variates of the treatment group only, after the random variates will be centered around zero, for both groups, by subtracting the distribution mean from the variates.

Treatment Group

Centering the mean for scale shift scenarios:

$$X_1^* = (X_1 - \mu)$$

k= (1-3.5).25 is the change in scale and c= (.01-.012).1 is the shift in location:

$$X_1' = k(X_1^*) + c\sigma$$

Control Group

Centering the mean for scale shift scenarios:

$$X_2' = (X_2 - \mu)$$

Figure 11 – Modeling Shift in Location and Change in Scale

Each of the input variables (i.e., sample size, distribution/data set model, alpha level, location shift and scale change) will be assigned with program loops that assign the values of interest. For example, the location/means shift or effect size loop will run through all values: 0, .01, .02, .03, .04, 05…....12. From each of the possible combinations of the values in the 5 input loops, the input data set characteristics and permutation will be built for testing. Thousands of sample scenarios (one for each permutation) will be input into the Mood-Westenberg (1948) and the Siegel-Tukey tests (1960) test modules. Each permutation will be tested 100,000 times (i.e., the program will select 100,000 random variates from the distribution/data set to set up the control and treatment groups and then make modifications noted in Figure 11) for both tests to determine their long-run averages. Following each of the iterations for each of the tests, a counter will be incremented only for the statistically significant rejection rates, running totals will be maintained, and, after 100,000 iterations, these counter totals will be reported as rejection percentages (counter total/100,000). Thus, the long-run averages for the p rejection rate, β rejection rate, and power levels (1-β) will be calculated for each permutation.

Data Processing Flows

Absoft Pro Fortran 14.0.4 programing and IMSL Fortran Numerical Library 7.0 will be used to run and evaluate all simulations. The Rangen 2.0 subroutine (Fahoome, 2002), which is a 90/95 update to the Fortran 77 version (Blair, 1987), will be used to generate all random numbers from the normal and theoretical model distributions. The Realpops subroutine 2.0 (Sawilowsky, Blair, Micceri, 1990) will be used to generate all random numbers from real populations. These routines will be used in conjunction with the Mood-Westenberg (1948) and Siegel-Tukey (1960) tests coded by the author to produce the sample data sets and all output values for the study. For the Mood-Westenberg (1948) code, duplicates found in the control (A) and treatment groups (B) are coded to layout the groups as ABABABAB until all duplicates are accounted for; this method was selected as reasonable because this pattern appears to be unbiased for both groups (the pattern could favor either A or B in the extreme quarters depending upon the random variates sampled).

Algorithm AS 62 (Dinneen & Blakesley, 1973) will be used to calculate the Mann-Whitney exact probabilities for the Siegel-Tukey (1960) test. The Recursive Fortran 95 quicksort routine which sorts real numbers into ascending numerical order (Rew, 2003, based on algorithm from Corment et. al., Introduction to Algorithms, 1997) will be used to run all sorting algorithms.

The program routines will compare the test output statistic to the appropriate critical value or probability based on nominal alpha. For example, when observing the *p* rejection rate for the Mood-Westenberg test (1948) null hypothesis (variances are equal), when the test results are beyond the critical value areas (or the probabilities are less than or equal to nominal alpha) it will show a rejection to the null hypotheses of equal variances and count this as a rejection with a counter increase. If the null hypothesis of equal variances is not rejected, it is not counted. For a one-tailed test, after 100,000 iterations, the number of counted rejections in the one tail would be calculated and a percentage of rejections over iterations (100,000) will be output. When testing Type I error rates with no variance change, if the alpha level is .05, then a rejection rate of .05 will be expected for one of the tails; if the alpha level is .01, then a rejection rate of .01 will be expected for one tail.

In this study, only a one-tailed directional test will be invoked because only the treatment group is expected to have an increase in variance as simulated by the code. When alpha is equal to .05, then robustness (between .5α and 1.5α) is expected to be detected when the rejection rate is between .025 and .075 in one of the tails (for alpha=.01, between .005 and .015). If the percentage of rejection values differ from the expected percentages, then the robustness construct defined by the Bradley (1978) proposed liberal limits for Type I errors will be applied to determine robustness. Similar procedures will be conducted for the analysis of Type II errors when variance changes are simulated including the β (false negative) rejection rates and associated power level analysis of the two tests. Power of .40 will be the expected lower limit: (.5) (.80). For a general flowchart of the programing process, see Figure 12.

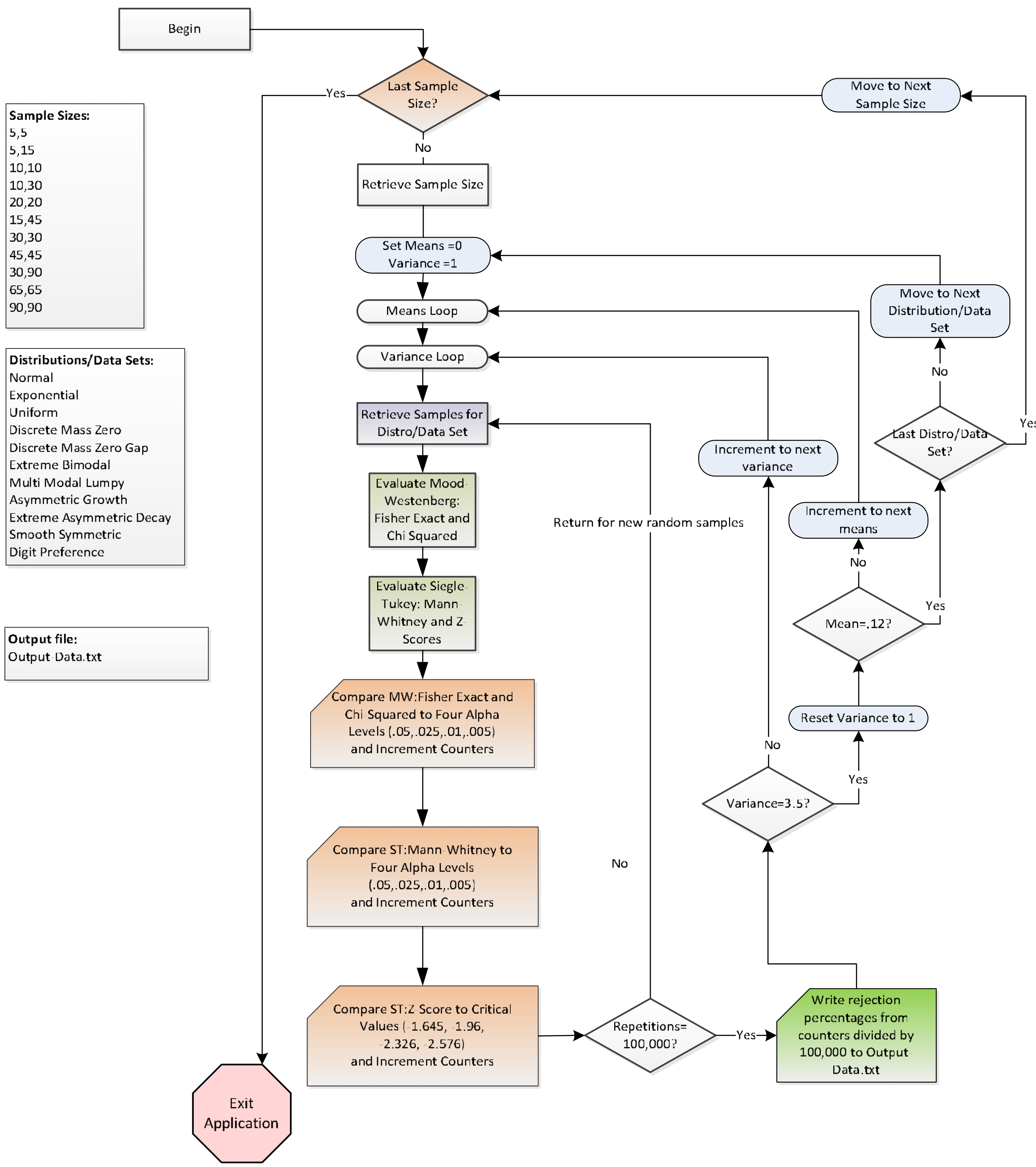

Figure 12. Application flow for determining Type I & Type II error values.

Data Output and Analysis:

There will be four primary reporting elements for the study's output:

- Reports detailing all the scenario outcomes for robustness of Type I errors when the means and variances are equal.
- Reports detailing all the scenario outcomes for Type II error properties when means are equal with multiple variance level shifts.
- Reports detailing all the scenario outcomes for the tests for Type II errors properties when the assumption of equal means is violated at all magnitudes, along with multiple magnitudes of variance/scale changes.
- Reports detailing the results for the power analysis between the Mood-Westenberg (1948) and Siegel-Tukey (1960) tests.

For an example of a model of the output report where the Bradley Limits (1978) are invoked, see Table 4, (the Mood-Westenberg (1948) and the Siegel-Tukey (1960) statistic will be substituted for Student's-t (1908a)). For the program flows that produce the raw data output file, the source for all reports, refer to Figure 12.

Table 4

Type I Error Rates for Independent-Samples T test for Various Sample Sizes and Alpha Levels When Sampling Is From Various Distributions, 10,000 Repetitions, Effect Size=0, Variances are Equal.

		a = 0.05			a = 0.01		
Sample Size	Distribution	U025	L025	Total	U005	L005	Total
10,10	Normal	0.024	0.024	0.049	0.006	0.004	0.010
10,10	UNI	0.027	0.028	0.055	0.006	0.006	0.013
10,10	Exponential	0.022	0.022	0.043	0.003	0.004	0.007
10,10	T	0.019	0.022	0.041	0.003	0.004	0.007
10,10	ChiSquared	0.025	0.022	0.047	0.003	0.004	0.008
10,10	SMOOTH SYMMETRIC	0.027	0.025	0.052	0.006	0.005	0.011
10,10	EXTREME ASYMETRIC	0.025	0.022	0.047	0.005	0.003	0.008
10,10	DISCRETE MASS ZERO	0.025	0.025	0.050	0.004	0.006	0.010
30,30	Normal	0.024	0.027	0.051	0.005	0.005	0.009
30,30	UNI	0.025	0.027	0.052	0.006	0.005	0.011
30,30	Exponential	0.026	0.026	0.051	0.005	0.005	0.010
30,30	T	0.021	0.027	0.048	0.004	0.004	0.009
30,30	ChiSquared	0.022	0.023	0.045	0.005	0.004	0.009
30,30	SMOOTH SYMMETRIC	0.025	0.023	0.048	0.007	0.006	0.013
30,30	EXTREME ASYMETRIC	0.028	0.024	0.051	0.004	0.006	0.010
30,30	DISCRETE MASS ZERO	0.024	0.025	0.050	0.007	0.005	0.012

Note: Type I error rates from another Monte Carlo methods study, conducted by the author.

Non-Robust Conservative Direction	P < 0.025	P < 0.005
Non-Robust Liberal Direction	P > 0.075	P > 0.015
Stringent Limits		
Non-Robust Conservative Direction	P < 0.045	P < 0.009
Non-Robust Liberal Direction	P > 0.055	P > 0.011

CHAPTER IV

RESULTS

Introduction

All measures of robustness will be defined within Bradley's (1978) liberal magnitudes, where alpha is between .5α and 1.5α. Only these liberal boundaries are invoked in order to give the greatest leeway for the results. When the rejection rates are outside of these liberal boundaries, the direction of non-robustness (conservative or liberal) will be noted according to Bradley's (1978) definitional ranges. To describe non-robust results that fall outside of Bradley's liberal range, the phrase conservative direction will be used to indicate when the rejection rates are less than the alpha levels, and the liberal direction will be used to indicate when the rejection rates are more than the alpha levels. In order to provide clarity for every report, orange (liberal) and green (conservative) shadings highlight the direction of non-robustness when it occurs. The grey shading, in all reports, indicates a rejection of 100%. A legend for these shadings appears at the beginning of the report section (i.e., Table 5) and applies to all reports.

Determining robustness, primarily the concern of limiting the boundaries for Type I errors, with all testing assumptions in place, was the first step before performing power studies to determine treatment effect (in this study, variance change detection). Without a robust Type I error rate, power is not typically meaningful, especially if the Type I error rates turn out to be in the liberal direction. Under conditions of liberally non-robust Type I rejection rates, the Mood-Westenberg (1948) and/or the Siegel-Tukey (1960) statistic are unable to be relied upon because rejection of the null hypothesis (null is no variance change) occurs for random samples at higher than expected rates, liberally finding for variance changes when in fact none have occurred and yielding nonsense treatment effects. Under non-robust conditions, particularly in the liberal direction, it will be uncertain as to when one of the statistics rejects for true treatment effects (i.e., detecting true variance changes).

Under investigation first, then, is testing with the assumptions of equal means in place for the two test statistics, Mood-Westenberg (1948) and Siegel-Tukey (1960). The long-run averages for Type I robustness measures, for a one-tailed test, is determined for 100,000 random samples from the normal distribution for all sample sizes. A one-tail test is selected as the criterion because a treatment effect was expected for only one group, the treatment group where the variance increases were simulated each time. If robustness is found for the normal distribution under both test statistics, then similar testing is performed for all other mathematical distributions and real world data sets in order to determine whether these two statistics remain robust under conditions of more typical population data sets. After other more prevalent mathematical distributions and real world data sets are investigated for robustness, with the testing assumptions in place, only those that pass this test are the focus of the remainder of the investigations. Next, with the assumption of equal means still in place, distributions and data sets demonstrating robust Type I rejection rates are investigated for power levels as the variances are changed from 1-3.5(.25).

After robustness and power levels are determined with equal means assumption in place, then the two test statistics are investigated to determine stability of rejection rates when variances are equal and the assumption of equal means is violated by slightly increasing means shifts from .01-.12(σ).01. Then, the effect of slight assumption violations on the expected (alpha levels) rejection rates are observed. Finding for a robust statistic under conditions of these slight assumption violations when there are no treatment effects (no variance change) is further reason to continue the main focus of this study: Can the Behrens-Fisher condition (i.e., means are equal, or differences are approximately zero, shifting in small amounts, simultaneously with variance changes) be identified when means are equal or nearly equal and variances have changed?

Only after these above preliminary tests are reviewed and are found to be robust for at least some conditions can the main focus of this study be addressed: What happens to the statistics, within the context of particular distributions and data sets, sample sizes and alpha levels, when the means shift slightly around zero and the variance in the treatment group increases in small to large degrees? What are the effects of the interaction of slight means shifts and small to large variance changes for Mood-Westenberg (1948) or Siegel-Tukey (1960) upon the ability of a researcher to powerfully identify changes in variance after treatment with either of these statistics? If these statistics prove robust and powerful under these interactive conditions, then, as Sawilowsky (2013, personal communications) noted, it would indicate an important precursor for identifying the Behrens-Fisher problem so that a researcher could by-pass the Student-t statistic, for instance, and choose another appropriate classical statistic which would be robust in the light of variance shifts, in order to assess the likelihood of a treatment effect.

Finally, in the second phase of the study, assuming robustness, a comparative power study between Mood-Westenberg (1948) and Siegel-Tukey (1960) is analyzed when the means differences slightly depart from zero and interact with the changing variance levels.

Type I Error: Normal Distribution, Means are Equal, Variances are Equal

This data found in Table 5 detail the Type I error results for the normal distribution, all sample sizes, at 4 alpha levels (.05, 025, .01, .001) for both the Mood-Westenberg (1948) and Siegel-Tukey (1960) test. Two probability distributions were invoked for each statistic: Mood-Westenberg (1978) utilized the Fisher Exact probability and the Chi-Squared probability. Siegel-

Tukey (1960) utilized the asymptotic Z-Score probability and the Mann-Whitney-U Exact probability. For each statistic, the exact and asymptotic distributions are found to track close to each other and did not seem to make significant difference in the outcomes, generally. However, some of the results reveal that the asymptotic rates for Mood-Westenberg (1948) were slightly more reliable than the Fisher Exact rates as noted in Figures 13-16.

With the exception of some unbalanced and smaller sample sizes, Mood-Westenberg (1948) demonstrated robust Type I errors at the larger sample sizes (45, 45; 65, 65; 90, 90) for all probabilities and all alpha levels. Some of the smaller and unequal sample sizes were robust (or conservatively non-robust) at some alpha levels; this was particularly the case when alpha levels were above .025. In comparison, Siegel-Tukey (1960), demonstrated a higher degree of robustness than Mood-Westenberg (1948) at all sample sizes where virtually all sample size cases (except a slightly conservative asymptotic rate for sample size 5, 5, at the .01 and .005 alpha levels), even smaller and unequal sample sizes, yielded robust alpha levels.

On investigating initial output for sample size data, it was noted for Mood-Westenberg (1948) that the Normal Type I error rates appeared to be greatly impacted by sample size. At this discovery, another extra report was developed to determine whether or not sample size indeed impacted the Type I error rates for either Mood-Westenberg (1948) and/or Siegel-Tukey (1960). This additional output, found in Table 6 and 7 and Figure 13-20, was produced in order to demonstrate the average Type I error rates by sample size for every equal sample size from 5, 5 to 200,200 at 10,000 repetitions. The data were produced for both Mood-Westenberg (1948) and Siegel-Tukey (1960) and revealed, as initially suspected, that Mood-Westenberg (1948) Type I error rates appeared to be greatly affected by sample sizes for both the asymptotic and exact probabilities, particularly the exact probability of the Fisher Exact test. The Mood-

Westenberg (1948) average Type I error rates for all sample sizes, when alpha was .05, for Chi Squared (asymptotic) and Fisher Exact (exact) distributions were .048 and .067 respectively. The same averages for Siegel-Tukey for Z-Scores (asymptotic) and the Mann-Whitney (exact) distribution were .049 and .049 respectively. The data, for all alpha levels of .05, .025, .01, .005, indicated a repeating saw-tooth pattern of Type I rates for Mood-Westenberg (1948) as the equal sample sizes increased, evening out a bit with the larger sample sizes. In other words, increasing sample size did not necessarily stabilize the Type I rejection rates at their expected levels for Mood-Westenberg (1948). However, for Siegel-Tukey (1960), sample size had little if any impact on the Siegel-Tukey (1960) asymptotic or exact probabilities and both of these Siegel-Tukey (1960) probability distributions more closely tracked their associated alpha levels at all sample sizes. The saw-tooth repeating pattern found with Mood-Westenberg (1948) was not noticed with the Siegel-Tukey output. These tests serve as a control for the remainder of the study and are important to consider when evaluating the remaining results.

Type I Error: All Distributions and Data Sets, Means are Equal, Variances are Equal

In Table 8-18, an examination of the Type I error rates for each of the eleven mathematical distributions and real world data sets when the assumption of equal means was met for Mood-Westenberg (1948) demonstrates robust rates for all distributions and data sets except three, at some alpha levels: Discrete Mass Zero with Gap, Extreme Asymmetric Decay, and Extreme Bimodal when the sample sizes were large and equal at 45, 45 and above. These three non-robust data sets were non-robust in the conservative direction for each non-robust alpha level. For the equal and unequal sample sizes below sample size 45, 45, Mood-Westenberg (1948) reports a mixture of conservative and liberal non-robust results for every distribution and data set at many of the alpha levels. In contrast, Siegel-Tukey (1960), for all sample sizes and all alpha levels, shows non-robust rates only in the conservative direction.

An examination of the Type I error rates for each of the eleven distributions and data sets when the assumption of equal means was met for Siegel-Tukey (1960) reports robust rates for all except the same three data sets mentioned above: Discrete Mass Zero with Gap, Extreme Asymmetric Decay, and Extreme Bimodal for all alpha levels and all sample sizes including equal, non-equal and small ones (with the exception of the 5, 5 sample size which shows at least one conservative error rate for each distribution/data set and sample size, 10,10 for Asymmetric Growth/alpha=.005). These three data sets were non-robust for all alpha levels in the conservative direction, the same results as Mood-Westenberg (1948). No particular differences were noted for Siegel-Tukey (1960) between the asymptotic and exact probabilities. For Mood-Westenberg (1948), the asymptotic and exact probabilities track closely when alpha is below 5%; however, at the 5% level for some sample sizes, the exact rate is sometimes higher than the asymptotic rate (e.g., sample size 45, 45 and 65, 65). Additionally, as noted above, the Mood-Westenberg (1948) rates, unlike Siegel-Tukey (1960), were found to fluctuate to a greater extent with different sample sizes.

For the next two reports, the sample size 90, 90 was selected as a focal point because both Mood-Westenberg (1948) and Siegel-Tukey (1960) were robust for all distributions and data sets, except the three data sets mentioned above, at the higher and equal sample size levels. And for these three non-robust data sets (Discrete Mass Zero with Gap, Extreme Asymmetric Decay, and Extreme Bimodal), they were all non-robust for all alpha levels in the conservative direction; these non-robust data sets, also permit the continuation of power investigations because robustness in the conservative direction indicates little likelihood that a treatment would be found (a variance change) if there were indeed no treatment effect. Additional investigations of power levels are performed next to determine what levels of variance changes will indicate high power and if power levels can overcome these conservative Type I errors for these three non-robust data sets.

Type II Error: Means are Equal, Variance Change (1.25-3.5).25

The constant K, as described in Figure 11, is multiplied by the random variates for each distribution and data set to control the variance change and it simulates a change as follows. When the constant K is equal to 1 and it is multiplied by the treatment variates, the variance of the treatment group does not change. To simulate an increase in variance in the treatment group, the constant K, greater than 1, will be multiplied by the variates and the new variance for the treatment group becomes K squared. For instance, after selecting variates from the Normal distribution (the variance is 1; it is already centered around zero as explained in Figure 11) and then multiplying the variates of the treatment group by a constant, K, the variance will change from one to the square of K. Over the long run, the average variance for the treatment group will be K squared.

A review of Tables 19-28 indicates the variance changes of K=1.25-3.5 (.25) for sample size 90, 90, when the assumption of equal means between the groups is met (the Behrens-Fisher problem). The output demonstrates that both statistics have power to determine variance changes at the levels starting with the smallest increment of K=1.25.

For Mood-Westenberg (1948), as K increases in increments of .25, the power increases dramatically and quickly at the lower levels, more than doubling or tripling in many cases from K=1.25 to K=1.5; for instance observe Asymmetric Growth, Digit Preference, Discrete Mass

Zero, Exponential, Multi-Modal Lumpy, Normal, Smooth Symmetric, and Uni. The other data sets start out with higher power levels at K=1.25 and do not go up as quickly.

For Siegel-Tukey (1960), the power also increases quickly, for the lower variance shifts, but not so much as Mood-Westenberg (1948) because the Siegel-Tukey (1960) power rates start off higher. For instance, at the smallest change of K=1.25, Siegel-Tukey's (1960) power for Smooth Symmetric asymptotic is .550 compared to Mood-Westenberg's (1948) at .165 when alpha is equal to .05. When alpha equals .01 for Smooth Symmetric, Siegel-Tukey's (1960) power is .288 as compared to .061 for Mood-Westenberg (1948). By the time the variance change level is K=1.5, most alpha levels have reached power of at least 40% and above.

The three conservative non-robust data sets, Discrete Mass Zero with Gap, Extreme Asymmetric Decay, and Extreme Bimodal, for both statistics and all alpha levels show around 80% -100% power for detecting variance change immediately with the first shift of K=1.25 and maintain these levels and higher for each increasing variance change. In Table 16, it is demonstrated that for equal sample sizes, at 45, 45 and above, these three data sets were non-robust in the conservative direction and now the results in Tables 19-28 demonstrates that these same data sets immediately detect the variance change at these high power levels. This power level of 80- 100%, for both Mood-Westenberg (1948) and Siegel-Tukey (1960) for all alpha levels, is a positive result for these data sets that display conservative Type I rates. This is because from the lowest level of variance change tested, these conservatively non-robust Type I data sets show high power levels of detection despite conservative Type I errors when the variance change treatment effect is present. We might have been concerned that conservative Type I errors would cause variance changes to be missed, but this does not appear to be the case.

Normal-type distributions (e.g., Normal, Smooth Symmetric, Uni, Digit Preference, Discrete Mass Zero) show lower power than these other three non-normal-type distributions at lower levels of variance change (i.e., K=1.25-1.5), but most of the normal-type distributions along with Exponential and Multi-Modal Lumpy have power levels above 40%, somewhere between K=1.25 and K=1.5, and the power levels continue to rise for each increased level of variance change until all alpha levels and distributions/data sets show near and above 80- 90% for all distributions/data sets, at least for alpha = .05 and .025, at K=1.75. These represent strong power levels at the lower levels of variance changes.

At variance shift levels from K=1.75-2.25 and above, in general, at each alpha level tested, each of the two Siegel-Tukey (1960) probability measurements (A and E) shows a higher power level than the Mood-Westenberg (1948) probability measurements and both of the Siegel-Tukey (1960) measurements arrive at power levels of around or at 100% for each alpha level and each distribution and data set. Siegel-Tukey (1960) reaches power of nearly 90% or higher at a variance change of K=1.75, while Mood-Westenberg (1960) does not reach the same levels until K=2.25. As the variance change approaches K= 2.5, the power to detect variance changes for Siegel-Tukey (1960) reaches 100% for all distributions/data sets and all alpha levels and continues to stay at this level for all larger changes to the maximum tested variance level of K=3.5. At K=2.5 and above, Mood-Westenberg (1948) also shows large detection rates at 95% and above but is never more powerful than Siegel-Tukey (1960).

Rejection Rate Errors: Means Shift (.01-.12).01, Variances are Equal

Early on it became necessary to determine the range of the small incremental means shifts that would be best to test. If the means shift and increment were too small, then no effect would be observed for assumption violations. On the other hand, if the shifts were too large, immediately rendering the statistic non-robust, then it would be unclear where the boundaries existed for the assumption violations; that is, it would be unclear how far the assumptions violations could be stretched for increased means shifts before the tests became non-robust. In order to determine the optimal range that could apply to all distributions and data sets, a supplemental program was written to test all means shifts from .00001 to .1 (.00001) for all distributions and data sets using sample size 30,30, with no variance change (K=1). The test was based only on the Mood-Westenberg (1948) Chi Squared statistic. The liberal robust limits were modified to .102 based upon Normal 30, 30 having a Type I error rate of .068 at alpha equal to .05 (.068 * 1.5=.102).

The results of running the 10,000 means shifts for each distribution and data set are summarized in Table 29. It was found that most non-normal-type and non-mathematical data sets (Asymmetric Growth, Discrete Mass Zero with Gap, Extreme Asymmetric Decay, Extreme Bimodal) were highly sensitive at the lowest means shift of .00001, whereas the others including Multi-Modal Lumpy and Exponential, were less sensitive to means shifts at any of these levels. Because these highly sensitive data sets were non-robust for virtually all 10,000 tested means shifts, even the smallest levels of .00001, the highly sensitive data sets were not considered in determining the range of means shifts used for the primary study. That is, any shift in means adversely affected these highly sensitive data sets. Instead, an average was drawn from the first mean shift that impacted each of the seven less sensitive distributions and data sets (Discrete Mass Zero, Smooth Symmetric, Normal, Multi-Modal Lumpy, Digit Preference, Uni, Exponential). This average of .0186 led to the selection of the means shift range of .01-.12(.01).

In Tables 30-41, the resulting rejection rates were noted for sample size 90, 90, when the variances were equal and the means shifts were from .01(σ) to .12(σ) in .01 increments. These were the initial test cases for assumption violations (these tests were reviewed against the standards of the Type I error rate for the given alpha level). With the Mood-Westenberg (1948) statistic, for both asymptotic and exact probability measures, many of the rejection rates were larger than their corresponding alpha levels, even at the smallest incremental level of .01, particularly for the non-normal-type distributions (Asymmetric Growth, Discrete Mass Zero with Gap, Extreme Asymmetric Decay, Extreme Bimodal). Additionally, Discrete Mass Zero, a normal-type distribution, showed tendency towards liberal, non-robust rates (robust measures were noted for smaller means shifts at alpha equal to 5%). Multi-Modal Lumpy became non-robust in the liberal direction with means shift at .09 and higher. The Exponential distribution held to robust rates up to means shifts of .06. At this point, alpha levels below 2.5% started to trend slightly above alpha levels in the liberal direction; at the next increment of .07 the Exponential distribution was from this point forward non-robust for Mood-Westenberg (1948) at all alpha levels. It was observed that for Mood-Westenberg (1948), most normal-type distributions (e.g., Digit Preference, Normal, Smooth Symmetric, Uni) maintained robust rejection rates at all of the tested means shifts with the exception of slightly liberal rates for Smooth Symmetric at a 1% alpha level when the means shift was at least .08. All of the non-robust Mood-Westenberg (1948) results were in the liberal direction and the non-robust distributions became more non-robust as the means shifts increased.

For Siegel-Tukey (1960), for both asymptotic and exact probability measures, all of the normal- type distributions (Digit Preference, Discrete Mass Zero, Normal, Smooth Symmetric, and Uni) were robust for all means shifts. Like Mood-Westenberg (1948), as the means shift progressed, non-robust results were detected for non-normal-type distributions including Asymmetric Growth, Discrete Mass Zero with Gap, Exponential, Extreme Asymmetric Decay;

however, unlike Mood-Westenberg (1948), all indicators of these non-robustness measures were in the conservative direction except for Asymmetric Growth which was in the liberal direction. The Multi-Modal Lumpy distribution was robust at lower means shifts but began to show conservative non-robust measures at means shift levels at and above .09. The Exponential distribution becomes conservatively non-robust at means shift of .03. Unlike Mood-Westenberg (1948), Siegel-Tukey (1960) showed robust measures at virtually all means shifts for the non-normal-type Extreme Bimodal (one slight liberal exception was noted at .5% alpha level when means shift was at .02, .03 and .1).

Type I and Type II Errors

Interaction of Equal Means, Means Shift (.01-.12).1 and Variance Change (1-3.5).25

Tables 42-283 detail the primary results of this study. These reports show long-run average rejection rates (also power) for 34,606 permutations at 100,000 repetitions. These include one-tailed directional tests for Mood-Westenberg (1948) Chi-Squared, and Siegel-Tukey (1960) Z-Scores at alpha levels of .05 and .01, for each of the 11 distributions and data sets, for each means shift (0 and .01-.12 (.01)) and variance change (1-3.5 (.25)). The Bradley Limits (Bradley, 1978) are noted on the Tables with shading indicating liberal (orange) and conservative (green) directions. Power levels were reviewed and a minimum of 40% power was selected as the cut-off point for when the tests began to attain higher power levels; the level was chosen as a liberal limit at 80% (.5).

Each distribution and data set should be examined individually to determine conclusions concerning robustness characteristics. However, for the purpose of this study, similar general findings were found to fit into two general categories: Normal-type distributions and non-normal-type distributions. Normal-type distributions are defined here as those distributions and data sets that approach uni-modal shapes with asymptotic or light tails and tend towards symmetry about the means. The distributions and data sets that fit into the normal-type distributions and whose conclusions can be generalized together will be discussed as a group and include: Normal, Digit Preference, Discrete Mass Zero, Smooth Symmetric, and Uni. Non-normal-type distributions that have similar conclusions which allow discussion as a group here include Extreme Asymmetric Growth, Extreme Asymmetric Decay, Extreme Bimodal and Discrete Mass Zero with Gap. Results for the Exponential distribution and Multi-Modal Lumpy data set did not fit into either of these two general categories, having unique results, and will each be discussed separately.

General findings for the Normal distribution discussed in this paragraph can be applied to the other distributions and data sets found under for the normal-type groupings. For the Normal distribution and the Mood-Westenberg (1948) statistic, rejection rates when variances were equal (K=1) and at all means shift levels found that at small sample sizes, such as 5,5 they generated slightly liberal rejection rates; alpha levels of .01were the most problematic for these liberal rates. As the sample size increased, the non-robust measurements decreased in frequency and became more robust. At 10,10 and above, only slight non-robust measures were noted from time to time and starting at sample size 30,90 and above for all sample size tested, all measurements were robust for Mood-Westenberg (1948). Uni, and Digit Preference followed this pattern when K=1; Discrete Mass at Zero and Smooth Symmetric followed this pattern in general, however, at some of the larger sample sizes became slightly liberally non-robust at some of the means shift levels, yet not grossly non-robust. As is presented here, these conclusions show some instability with Mood-Westenberg. Additionally and importantly, it should be noted that due to the instability in Type I rejection rates that was noted earlier, with respect to sample size changes for

Mood-Westenberg (1948), changes in sample size will make it difficult to state conclusions for all sample sizes that were not tested. When variances began to change with the Mood-Westenberg (1948) for the Normal distribution, power rates above nominal alpha were detected at all variance changes for all means shifts. Power rates were evident for all levels of means shifts when the variance changed; however, the power rates generally increased as would be expected as sample size increased. Power was below 40% at the 5, 5 sample size and began to improve above these levels when variances were high. At sample size 30, 90, and above, when robust rejection rates were noted for no variance change (i.e., K=1), power reached 40% at about K=1.5-1.75 for alpha =.05 and K=2 for alpha =.01. These power rates approached 80% quickly as sample size increased and the variance levels increased and approached 100% at the larger sample sizes and high variance changes.

For the Normal distribution under the Siegel-Tukey statistic (1960), rejection rates when variances were equal (K=1) and at all means shift levels were found to be robust at all sample sizes and for both alpha levels (only one exception of slightly conservative rates with sample size 5,5 and alpha=.01). All other of the normal-type distributions (Digit Preference, Smooth Symmetric, Discrete Mass Zero, and Uni) showed similar results for K=1 and all means shifts. Like Mood-Westenberg (1948), power levels reached 40% only at the highest variance changes for smaller sample sizes (i.e., for alpha =.01, power of 40% did not occur until K=3.25 when sample size was 10, 10). Uni reached power levels of 40% at smaller variance changes than the other normal-type distributions. However, in all cases, power rates above 40% were noted for smaller and smaller variance changes as sample size increased and they approached 100% at all points of comparison more quickly than Mood-Westenberg (1948). At every variance change and at every means shift level, Siegel-Tukey (1960) demonstrated more power, often at around twice as much, as Mood Westenberg (1948); additionally Siegel-Tukey demonstrated more robust rejection rates when variances were equal (K=1) and means began to shift. These generalized conclusions can apply to the other normal-type distributions. For instance, this condition of more power for Siegel-Tukey can be demonstrated by the Uni distribution. For Uni, when K=1.25, Siegel-Tukey (1960) demonstrated a power level of .49 at sample size is 45, 45 and .62 at sample size is 65, 65 for all tested means shifts when alpha equals .05. Mood-Westenberg (1948), on the other hand, demonstrated power levels of .17 and .23 respectively for the same conditions. In general, as with Normal and Uni, for all of the other normal-type distributions, Siegel-Tukey (1960) has greater or equal power levels as compared to Mood-Westenberg (1948) at every point of comparison.

When reviewing the results for the non-normal-type distributions (Extreme Asymmetric Growth, Extreme Asymmetric Decay, and Extreme Bimodal and Discrete Mass Zero with Gap) with the Mood-Westenberg (1948) statistic, rejection rates when variances were equal (K=1) and the means shifted were unusually highly liberal at all means shift levels for various sample sizes and for all alpha levels. These finding are supported by the extra report found in Table 29 which found for even the smallest of means change (i.e., .00001) these data sets show liberal rejection rates. Although the associated power levels are also generally high almost immediately, at K=1.25, from the point of the first means shifts upward and starting with this small variance changes (and then progressing with increasing power for increased sample size and variance change levels), the unusually high rejection rates when K=1 (and the means shift at any level) for these data sets renders their higher power virtually meaningless because the rejection rate is high for random samples yielding nonsense treatment effects (i.e., when there is no variance change). Additionally, for the Discrete Mass Zero with Gap data set, for most unequal sample sizes, for Mood-Westenberg (1948), power rates actually declined dramatically with increasing variance change increases (from the point when there was no variance change at K=1 to all increasing variances change levels); for instance, at 10, 30, (see also 30, 90) alpha =.05, when K=1 the rejection rate was close to 100% and with the highest variance change of 2.5, the power attained only 27%. This result is exactly opposite to what is expected to happen to a robust statistic which should be more powerful as variance changes increase.

This effect of yielding meaningless power applies also to the Siegel-Tukey (1960) statistic for the Asymmetric Growth data set which demonstrated high liberal rejection rates for most means shifts, particularly for larger sample sizes, when the variance did not change (K=1). However, unlike Mood-Westenberg (1948), with Siegel-Tukey (1960) at equal and large sample sizes, these other non-normal-type distributions (Discrete Mass Zero with Gap, Extreme Bimodal particularly for equal sample sizes, and Extreme Asymmetric Decay) generally are non-robust in the conservative direction under conditions of no variance change (K=1). This indicates that the increasing high power levels demonstrated under all conditions of increasing variances changes, when the means incrementally shifts, renders the statistic quite robust for these particular data sets when slight shifts in means occur concurrently with variance changes (i.e., the Behrens-Fisher problem). Another interesting advantage that Siegel-Tukey (1960) demonstrated over Mood-Westenberg (1948) with Extreme Bimodal is that it has mostly robust rejection rates with respect to alpha levels when the means begin to shift and for all means shift levels in the case of no variance change (K=1). For Extreme Bimodal, Siegel-Tukey (1960) looks to be extremely robust for identifying Behrens-Fisher in a majority of test cases, particularly when the sample sizes are equal.

For each of these three non-normal-type distributions, power quickly approaches 90% at one of the levels of variance changes starting with sample size 20, 20 and above for alpha =.05 (a little slower to reach 90% power when alpha equals to .01). As with Mood-Westenberg (1948), generally, with all means shifts and variance changes, the power increases more and more for smaller and smaller variance changes as sample size increases. In general, as with the normal-type distributions for Mood-Westenberg (1948), for these three powerful non-normal- type distributions, Siegel-Tukey (1960) demonstrated equal or greater power levels as compared to Mood-Westenberg (1948) at most points of comparison, (only in the case of equal sample sizes for Discrete Mass Zero with Gap) even though the Mood-Westenberg (1948) power levels were unreliable due to high liberal rejection rates for the treatment condition when variances were equal (K=1). For Siegel-Tukey (1960), there is high power for variance change detection at all means shift levels, even at the smallest level of variance change tested, at K=1.25. This was generally demonstrated for each of these three conservatively non-robust non-normal-type distributions, starting at sample size 30, 30 and then for all those sample sizes above, particularly when the sample sizes were equal and large and alpha was .05; here the power levels are greater than 90% starting with the very first variance shift (K=1.25) and continuing to rise above 90% to 100% at some level of variance change.

The Exponential distribution and Multi-Modal Lumpy data set require separate discussion. For Exponential, Mood-Westenberg (1948), the lower alpha of .01 has a mixture of liberal and conservative error rates when K=1. With this distribution, once again, Mood-Westenberg (1948) appears to be unstable, varying with different sample sizes when variances are equal (K=1). For example, when looking at alpha at .01 comparing sample sizes 20, 20 with sample sizes 30, 30, sample size 20, 20 has either conservative or robust rejection rates for some of the means shifts, whereas sample size 30, 30 rejection rates are in the liberal direction for all means shifts. On the other hand, Siegel-Tukey (1960) shows only robust or conservative non-robust rejection rates when there is no variance change (K=1) for all sample sizes and alpha levels (conservative non-robust with the higher means shifts) and thus appears more stable and reliable. Generally, for Siegel-Tukey (1960) there is very good power detection starting at sample size of 30, 30, alpha equal .05, and K=1.5. Power here is shown at 65-77% (approaching greater than 90% as sample size increases), with the smaller power levels at the higher means shifts. Power rates are a little lower in most cases when alpha =.01.

For Mood-Westenberg (1948), the Multi-Modal Lumpy data set also shows a mixture of conservative and liberal non-robust measurements for smaller sample sizes when variances are equal (K=1). However, starting with sample size 30, 90 and those tested above, both even and uneven sample sizes are robust and powerful. However, Siegel-Tukey (1960) once again is more powerful than Mood-Westenberg (1948) at every comparison. Additionally, like many of the other distributions and data sets discussed in this chapter, there are only a few conservative non-robust rejection rates for the Siegel-Tukey (1960) statistic when variances are equal (K=1) and the means shift above .09 (most of the measurements are robust at all alpha levels and all sample sizes); however, there are liberal non-robust rejection rates for some of the smaller sample sizes for Mood-Westenberg (1948) tests. Once again, this generally robust (and in only a few instances, non-robust conservative) characteristic of Siegel-Tukey (1960), at all sample sizes and for all alpha levels, renders it a broader test for power measurements as compared to Mood-Westenberg (1948) which demonstrated non-robust liberal directions for some smaller sample sizes.

CHAPTER V

DISCUSSION

The purpose of this study was to compare two statistics that are useful for detecting variance differences between groups, Mood-Westenberg (1948) and Siegel-Tukey (1960), under conditions of small, incremental assumption violation of homoscedasticity. The rejection rates of these two statistics were reported under 34,606 unique conditions with the aid of Monte Carlo derived data for all permutations for mean shift levels of 0-.12(.01), variance change levels of 1-3.5(.25), 11 sample sizes, two alpha levels and 11 mathematical distributions and real data sets.

Rejection rates were tabulated with respect to two probability distributions (exact and asymptotic) for each statistic. Each of the 34,606 permutations were replicated 100,000 times to tabulate and observe long run averages for the robustness (with respect to Type I errors) and power properties (with respect to inverse Type II errors). Robustness for Type I errors was measured within the boundaries of the liberal magnitudes of the Bradley Limits (Bradley, 1978), defined as between $.5\alpha$ and 1.5α.

The results and conclusions are important for research scientists who must select the appropriate statistic to determine treatment effects. Often preferred are the familiar classical statistics such as Student-t (Student, 1908) and ANOVA/ F statistic (Fisher, 1918). Unfortunately, the data analysis is frequently uncertain as to when these parametric statistics may be safely employed because the treatment may have produced a change in variance (heteroscedasticity) between the treatment group vs. the comparison group, or from the pretest to the posttest stage in repeated measures designs. The literature (e.g., Wilcox, 1996) is vast on how poorly the classical parametric t-test and F statistics (and well-known, non-parametric tests like Wilcoxon Rank Sum) perform under conditions of unequal variances.

As noted by Sawilowsky and Blair (1992), heteroscedasticity could result after treatment; "Treatments often produce changes in means, as well as variance, skew, tail weight, and other population parameters" (p. 353). With respect to a statistical selection for treatment determination, when the means shift is big or noticeable and the treatment group variance changes, there are many tests that function well in detecting treatment effects for general (larger) means shifts and variance changes (e.g., Rosenbaum,1965; Kolmogorov Smirnov, 1933).

However, if the means shift or difference is small, slightly around zero, these general tests are not appropriate. This condition of a change in variance with means differences of near zero is known as the Behrens-Fisher problem. The general concern with the Behrens-Fisher problem, noted in the literature (Wilcox, 1996), is that the t-test and F statistic produce high Type I errors and have the potential to cause highly inflated findings for nonsense treatments. Wilcox (1994a) noted that power levels might, in some cases, be unusually flat around the null region, especially when the data are skewed, thereby increasing Type II errors and missed treatment effects.

Complicating this matter of heterogeneous variances, Wilcox (1990b) mentioned that dozens of procedures, like the F test on variances, have been proposed for comparing variances, but all have been found to be unsatisfactory in terms of Type I errors or probability coverage when sampling from non-normal distributions. Sawilowsky (2002) also noted the sequential nature of testing, part and parcel of the F test for variance change detection, increases the Type I error rates.

Although Sawilowsky (2002) opined that the Behrens-Fisher problem is much to do about nothing because there are no or few practical examples, there remained a lingering question which was addressed in this study: How is it possible to become aware of an arising Behrens-Fisher problem in order to apply the appropriate statistical solution? If a robust test for variance detection existed when there were slight shifts in means around zero, then it could be applied in these circumstances to determine if variances had changed for the treatment group. This robust statistic could then serve as a precursor to indicate whether the t-test could be invoked (if variances are equal) or whether another procedure (if variances are different) should be used, such as the Yuen's (1974) solution in order to determine whether or not there is a treatment effect.

Walter Katzenbeisser (1989) suggested that the Mood-Westenberg *Median* (1948) test and the Mann-Whitney (1947) test were powerful with respect to detection of location shifts in the Exponential distribution. These findings are advanced now to investigate whether two related statistical tests, the Mood-Westenberg *Dispersion* test (1948) and the Siegel-Tukey test (1960), (which uses the Mann-Whitney probabilities) would remain robust with small means shifts around zero, and, concurrent with these assumption violations, maintain high power levels for detecting variance changes.

Eight real-data sets, along with three mathematical distributions including the Exponential studied by Katzenbeisser (1989), were reviewed. The results determined whether or not the Mood-Westenberg *Dispersion* statistic (1948) and/or Siegel-Tukey (1960) statistic remain robust with respect to Type I errors and with respect to rejection rates when there are small treatment effects (i.e. small assumption violations). Both of these tests were reviewed to determine under what conditions they remain powerful for detecting Behrens-Fisher.

The primary hypothesis was that the Mood-Westenberg (1948) test would be the better statistic, of the two studied, to determine variance differences between treatment groups when the means shift might be close to zero (the Behrens-Fisher problem). As compared with Siegel-Tukey (1960), Mood-Westenberg (1948) was selected, a priori, as the favored statistic because it is known for fewer assumptions (Ferraro et al., 2003), slightly higher power (Neave and Worthington, 1988, p.134), and generally favorable results (Katzenbeisser, 1989). Mood-Westenberg (1948) was expected to be useful as a precursor to selecting the appropriate statistic for determining treatment effects in research environments when Behrens-Fisher might arise.

Major Findings

In order to determine for the statistical properties for each statistics when sampled from various populations, a review of the output in Tables 42-283 is necessary, particularly with respect to the smaller and unequal sample sizes. For instance, general conclusions are made for both statistics with respect to whether the mathematical distributions and real world data sets could be characterized as a normal-type distribution (e.g., uni-modal shape, asymptotic light tails, symmetric about the means) or not. Conclusions for normal-type distributions are discussed as a group and they include: Normal, Digit Preference, Discrete Mass Zero, Smooth Symmetric and Uni. The non-normal-type distributions, discussed as a group, include: Extreme Asymmetric Growth, Extreme Asymmetric Decay, Extreme Bimodal and Discrete Mass Zero with Gap. Results for Exponential and Multi-Modal Lumpy demonstrated unique results and are discussed separately.

General conclusions drawn for most distributions and data sets (with the exceptions of the Exponential distribution and Multi-Modal Lumpy data set) were not greatly affected by the range of the tested means shift levels (.01-.12) .01; therefore, conclusions for particular distributions and data sets will generally hold under all of the tested means shift levels, especially for larger sample sizes and with alpha levels of .05. As expected, larger alpha levels (.05), larger and equal sample sizes and larger variance change levels render testing measurements more robust and powerful with each distribution and data set.

The conclusion reached from this Monte Carlo study is that Siegel-Tukey (1960) statistic is robust and powerful under a broad range of conditions for detecting variance changes even under small testing assumption violations (slight shift in means around zero). Therefore, it could be utilized in many scientific, educational and psychological research environments to note that the Behrens-Fisher problem has arisen. The Siegel-Tukey (1960) statistic would be an effective precursor which could make known the need to replace testing statistics dependent on the equal variance assumptions, such as Student’s-t (Student, 1908), with an alternative statistic, such as the Yuen’s solution (Yuen, 1974).

The Siegel-Tukey (1960) statistic measured quite robust and powerful in a majority of situations and for all distributions and data sets (particularly with large and equal sample sizes, and alpha equal to .05) with the exception of Extreme Asymmetric Growth. Mood-Westenberg (1948) on the other hand, proved only robust and powerful with normal-type distributions and was somewhat robust and powerful under limited conditions for the Exponential distribution and Multi-Modal Lumpy data set.

Although Mood-Westenberg (1948) proved robust and powerful under certain limited conditions discussed below (e.g., with normal-type and Multi-Modal Lumpy), right from the start, Siegel-Tukey (1960) had a major advantage over Mood-Westenberg (1948) in that it continually demonstrated a much higher degree of reliability, both in terms of robustness and power for a broader range of conditions. It continued to demonstrate primarily robust or non-robust conservative rejection rates when variances were equal and means began to shift, rendering its demonstrated high power properties (when the variances began to change) quite meaningful. Mood-Westenberg (1948) on the other hand, demonstrated many liberal non-robust rejection rates when variances were equal, rendering power properties meaningless under many conditions.

In general, Siegel-Tukey (1960) proved to be as or more robust and powerful than Mood-Westenberg (1948) at virtually every point of comparison and under a much wider range of conditions. Therefore, it must be concluded that Siegel-Tukey (1960) demonstrated a much broader applicability for detecting variance changes when its assumptions of equal means was slightly violated (i.e., detecting Behrens-Fisher) and would necessarily be the statistic of choice when testing for Behrens-Fisher. This advantage was not predicted by the original hypotheses. Details supporting these conclusions are discussed in the remainder of this chapter.

Preliminary Testing Conclusions

Robustness for Type I Errors with Testing Assumptions in Place

When examining each statistic for robustness with respect to Type I errors with the testing assumptions in place (i.e., means and variances were equal) for all mathematical distributions and real world data sets, for each combination of sample sizes and for all four alpha levels under both asymptotic and exact probabilities, both the Mood-Westenberg (1948) and Siegel-Tukey (1960) statistics were robust with large and equal samples sizes (45,45; 65,65; 90,90) except for the same three data sets under both statistics: Discrete Mass Zero with Gap, Extreme Asymmetric Decay, and Extreme Bimodal.

However, each of these three data sets produced non-robust results in the conservative direction for each statistic. This conservative nature of the Type I errors for both statistics, when their assumptions were met, indicated possibilities that either of these might be able to identify Behrens-Fisher for all tested distributions and data sets, if power levels proved strong for these distributions and data sets, as the means began to change by small amounts. If these rejection rates would continue to remain robust or conservatively non-robust as the means began to shift, then it would be unlikely that either statistic would find in favor of variance change (Behrens-Fisher) that was a nonsense conclusion; in other words, conservative non-robustness for Type I errors and rejection rates when the means would shift, would indicate little likelihood of finding for nonsense research treatments (a variance change) if there were indeed none. Therefore, the Mood-Westenberg (1948) and Siegel-Tukey (1960) statistics, at this early stage, both demonstrated promise for their ability to identify Behrens-Fisher problems with all of the distributions and data sets at large and equal sample sizes.

However, Siegel-Tukey (1960) demonstrated an advantage over Mood-Westenberg (1948) with the Type I error rates for smaller and unequal sample sizes. Although Mood-Westenberg (1948) produced a mixture of robust, liberal and conservative non-robust rates at the lower and unequal sample sizes, Siegel-Tukey (1960) was robust and *only* conservative non-robust rates at these lower and unequal sample sizes. Therefore, with the benefits mentioned above for conservative Type I errors, this consistent robust and only conservative non-robust nature demonstrated by Siegel-Tukey (1960) at small and unequal sample sizes, renders it a broader and more robust test for all distributions/data sets, sample sizes, and alpha levels, as compared to Mood-Westenberg (1948). Unlike Mood-Westenberg (1948), smaller and unequal sample sizes could be easily tested with Siegel-Tukey (1960).

For Mood-Westenberg (1948), both the Chi-Squared and Fisher Exact probability rejection rates tracked close to each other, for all four alpha levels, with the exception that the Fisher Exact was sometimes larger than the Chi-Squared which typically tracked closer, to nominal alpha. Siegel-Tukey's (1960) rejection rates for Z-scores and Mann-Whitney tracked closer to nominal alpha and closer to each other, mirroring each other more consistently than Mood-Westenberg's (1948) Chi-Squared and Fisher Exact, for all sample sizes and alpha levels. In general, then, because the Siegel-Tukey (1960) rates tracked more closely to each other and to nominal alpha rates (i.e., the rates were less erratic), it appeared slightly more robust at this early stage as compared to Mood-Westenberg (1948).

A significant concern with respect to the Type I error rates for Mood-Westenberg (1948) surfaced during preliminary testing. When testing for Mood-Westenberg's (1948) robustness characteristics (under the normal distribution, when means and variance were equal), it appeared that the Type I error rates were highly dependent upon the sample size and that they tracked in an unusual and repeating saw-tooth-like pattern as equal sample sizes were increased (Figures 13-20 - supplemental test, from 5, 5 to 200, 200). The Type I error rates sometimes approached as high as 9% ,when nominal alpha was 5%, or 2.5% when nominal alpha was 1%. There was no apparent pattern for these fluctuating rates , although it seemed dependent on sample size; Mood-Westenberg (1948) did not fit the usual pattern for statistics, whereby as the sample size increases, the Type I rejection rates approach the nominal alpha level and remain at nominal levels for larger sample sizes. Here, for Mood-Westenberg (1948), the rejection rates continued to move up and down as sample sizes increased.

A possible explanation for the observed instability of Type I error rates for Mood-Westenberg (1948) is that the statistic is demonstrating the unstable characteristics of many statistics that are based upon median measurements. Sawilowsky (2012-2014, personal communications) mentioned that the sampling distribution of the median is known to be undetermined and erratic. It could be that Mood-Westenberg (which is at its core a test of medians) is displaying this feature spoken of by Sawilowsky.

It can be concluded that Mood-Westenberg (1948), for some sample sizes, demonstrates liberal non-robust Type I rates, and therefore would be ineffective for detecting true variance changes (i.e., it would yield inflated Type I rates) under some sample sizes. The characteristics of robust sample sizes under Mood-Westenberg (1948) could not be determined in this study. This finding, by itself, would render the Mood-Westenberg (1960) test highly suspect for instability in detecting Type I errors in any research setting, without first performing testing to determine Type I rates for a particular sample size.

Therefore, with respect to this study, no overall conclusions will be made for Mood-Westenberg (1948) concerning sample sizes that have not been tested. All other conclusions in this study as they relate to Mood-Westenberg (1948) are particular to the sample sizes tested. Siegel-Tukey (1960) at this point appeared, in general, more robust as it's Type I error rates were more stable and typical as the sample sizes increased. The testing proceeded for both statistics because they both demonstrated robust characteristics for Type I errors at the large and equal sample sizes tested. This troublesome fluctuation of Type I rates for Mood-Westenberg (1948) was most likely a primary reason for its poor standing in comparison to Siegel-Tukey (1960) throughout the remainder of the study.

Power Properties (Inverse Type II Errors) with Testing Assumptions in Place

The results compiled in Tables 19-28 demonstrate basic power levels for both statistics when the assumptions were in place. As power levels were investigated for the large sample size 90, 90, for all distributions and data sets, with the simulated variances changes 1.25-3.5(.25), and the assumptions of equal means in place (the classical Behrens-Fisher problem), it was demonstrated that both statistics, generally, have the power defined at minimum levels of 40%

for most distributions and data sets (normal-type started off a little lower than 40% for Mood-Westenberg) to identify Behrens-Fisher starting at the smallest difference tested at 1.25.

Both statistics demonstrated particularly large power for smaller variance changes with non-normal-type distributions (Discrete Mass Zero with Gap, Extreme Asymmetric Decay, Extreme Bimodal, and Asymmetric Growth), Exponential, and Multi-Modal Lumpy; however, at these lower variance differences, the Siegel-Tukey (1960) power rates were always equal to or greater than Mood-Westenberg (1948) with particularly high power close to 80-100 % at even the smallest variance increment of 1.25. For both statistics, at the lower variance changes, for the normal-type distributions, the power rates were typically below those of the non-normal distributions, although for Siegel-Tukey (1960) they always maintained levels over 40%, particularly at the larger alpha levels of .05 and .025. However, for the small variance change at 1.25 and normal-type distributions, Mood-Westenberg's (1948) power is quite a bit lower than Siegel-Tukey's at the 40% level.

Siegel-Tukey(1960) always produced significantly more comparative statistical power at these lower variance changes (often more than double that of Mood-Westenberg (1948)) and then continued to maintain its advantage (or equality) for larger changes at every comparison point (i.e., alpha level and exact and asymptotic probability measure). Siegel-Tukey (1960) reached 100% power at 2.5 and after for all alpha levels and probability measures, while Mood-Westenberg (1948) never reached that 100% level, although coming close to it at percentages in the high 90s at about change level 2 and above.

Support can be observed by first reviewing the small variance change of 1.25 in Table 19. Here, Mood-Westenberg (1948), like Siegel-Tukey (1960), shows many distributions and data sets at or above the 40% level, particularly for the non-normal-type distributions (also the

Exponential distribution and the Multi-Modal Lumpy data set); however, many of the normal-type distributions under Mood-Westenberg (1948) show much lower power levels (below 40%) as compared to the non-normal-type. On the other hand, for Siegel-Tukey (1960), even the normal-type distributions (particularly with nominal alpha at 5% and 2.5%) generally demonstrated power levels at or above 40% right from the start of the lowest level of variance change of 1.25. Additionally, at 1.25, Siegel-Tukey (1960) has significantly more power to identify variance changes at all alpha levels, often double or more power, when compared to Mood-Westenberg (1948).

When the variance change level is 1.5 for both of the statistics (Table 20), most nominal alpha levels have reached power of 40% and above and many of the rates are approaching 90% and above. When the variance change reached 2.25, and for all changes above 2.25, both statistics were extremely powerful, each showing consistent levels above 90% and above for their exact and asymptotic probabilities. Therefore, at the higher levels of variance changes, both test statistics perform well with all distributions and data sets in the detection of variance change (Behrens-Fisher).

At this preliminary phase, both statistics appeared robust and powerful when their testing assumptions of equal means were met. These findings are significant because they demonstrate that for real world data sets that are often not normal, these statistics, under either of their probability functions, show strong power properties at small variance level changes, particularly for the non-normal-type, Exponential distribution, and Multi-Modal data set; power continues upward, approaching 100% as the variance differences increase. Therefore, for a pure Behrens-Fisher problem, when the testing assumptions are met at precisely equal means, and variances change, both statistics are powerful to detect variance differences for all distributions and data sets. These findings lent additional support for these statistics being viable candidates for the detection of a pure Behrens-Fisher problem, especially if they could maintain these power levels concurrent with the next testing stage which would simulate conditions of means shifting slightly when a data set variance changed.

When observing power levels with the equal means assumption in place, Siegel-Tukey (1960) generally demonstrated equal or higher power levels than Mood-Westenberg (1948) for all distributions and data sets, alpha levels, and variance changes. When observing the effect of increasing the variance levels, both statistics quickly increased power as to be expected as the variance difference between control and treatment group became more pronounced. Yet, once again, it was the Siegel-Tukey (1960) statistic that reached higher power levels sooner, as compared to Mood-Westenberg (1948), for all variance change levels. The final phase of the study, discussed in the remainder of this chapter, moved forward to test the possibilities that these statistics would continue to remain robust and powerful once their testing assumptions were slightly violated by simulating small differences in means between the control and the treatment groups. If they could remain robust and powerful in the detection of variance changes with small assumption violations, then they might be advanced as statistics useful for identifying Behrens-Fisher under a multitude of conditions.

Major and Final Testing Conclusions: Interaction of Assumption Violations (Means Shifts) and Variance Changes

Long-run averages of rejection rates were observed for both statistics. Each of 34,606 permutations were replicated 100,000 times to tabulate and observe long run averages for the robustness (with respect to Type I errors) and power properties (with respect to inverse Type II errors); random sample variates with replacement were drawn from each distribution and data set for each sample size and then modified to simulate the means shifts and variance changes. The results, summarized in Tables 42-283, include output for all combinations of variance differences of 1-3.5 (.25), means shifts of 0-.12 (01), at two alpha levels (.05, .01), for the 11 distributions and data sets, and for 11 sample sizes. Only the asymptotic probabilities were reported for comparison, for this final stage, (Chi-Squared for Mood-Westenberg, 1948, & Z-Scores for Siegel-Tukey, 1960).

Robustness (Variances are Equal and Means Shift)

For Mood-Westenberg (1948), for all means shifts tested, all five of the normal-type distributions (Digit Preference, Discrete Mass Zero, Normal, Smooth Symmetric, Uni,) remained generally robust, (particularly for the large sample sizes at 30, 30 and above; slightly conservative non-robust rates at 20, 20) and all alpha levels (most robust at alpha=.05). Some liberally non-robust rejection rates were observed at the lower sample sizes and intermittently for the larger sizes. Results for data sampled from the Discrete Mass Zero data set sporadically demonstrated slightly liberal rejection rates as means began to shift for some larger sample sizes and alpha levels.

Under Mood-Westenberg (1948), the non-normal-type distributions (Asymmetric Growth, Discrete Mass Zero with Gap, Extreme Asymmetric Decay, and Extreme Bimodal) were unable to handle any of the tested means shift levels (or even the much smaller shifts starting with the supplemental test mean shift of .00001, as demonstrated in Table 29), at any alpha level or sample size, and remain robust. Therefore, these non-normal-type distributions were shown to be non-robust as they typically demonstrated high to extremely high liberal rejection rates. For example, the rejection error rate when the variances were equal for Discrete Mass Zero with Gap, at sample sizes at and above 30, 30 (Table 120), demonstrated extreme rates of 70-100 % for all tested means shifts and generally over 95% for large and equal sample sizes starting with 45, 45.

These non-normal-type distributions produced high to extremely high liberal non-robust rejection rates for most alpha levels and sample sizes at all means shifts. Some permutations were robust, such as those found under sample size 20, 20 for Asymmetric Growth for both alpha levels (Table 74 and 75), but no pattern for this fluctuating level of robustness could be established; again the factor of sample size appeared to have a major destabilizing impact on the Mood-Westenberg (1948) findings as these unpredictable results surfaced from time to time.

For Mood-Westenberg (1948) for the larger sample sizes (30, 30, Table 164, and above), the Exponential distribution became liberally non-robust, generally around means shift of .06 and above, at both alpha levels, but was robust below this means shift level, particularly for larger sample sizes. The smaller sample sizes were unstable with a mixture of robust and non-robust measurements. Mood-Westenberg (1948) fared a little better with respect to the Multi-Modal Lumpy data set, for most larger sample sizes starting with (30, 30), Table 230, demonstrating robustness with slightly liberal non-robust rates (mean shift level of .09 and above) for both alpha levels (particularly for alpha equal to .05). However, the mixture of these robustness patterns (e.g., robust, conservatively non-robust, liberally non-robust) demonstrated for different sample size were found to parallel each other with respect to the Exponential distribution and Multi-Modal Lumpy data set.

Siegel-Tukey (1960), like Mood-Westenberg (1948), demonstrated robust rates for all normal-type distributions for large sample sizes and alpha levels as means began to shift; however, it demonstrated a more consistent robustness as compared to Mood-Westenberg (1948) with generally all robust rates at *every* sample size (except a few conservatively non-robust rates at the small sample size 5, 5, alpha=.01).

As with the Mood-Westenberg (1948), the Siegel Tukey (1960) test also produced non-robust rates for three of the non-normal-type distributions: Asymmetric Growth, Discrete Mass Zero with Gap, Extreme Asymmetric Decay. However, unlike Mood-Westenberg (1948), all non-robust rejection rates were in the conservative direction except for Asymmetric Growth which was in the liberal direction. The Exponential distribution and Multi-Modal Lumpy data set were generally robust and began to show conservative non-robust rejection rates at means shift levels at .03 and .09 respectively; again, here the non-robustness was directed conservatively whereas with Mood-Westenberg (1948) it was often directed liberally for the same distribution and data set. Another advantage for Siegel-Tukey (1960) over Mood-Westenberg (1948), which was highly liberally non-robust with respect to the Extreme Bimodal data set, was that Siegel-Tukey (1960) demonstrated robust rejection rates at most means shifts for this data set, particularly when the sample sizes were equal and when sample sizes were unequal with alpha at .05.

To summarize, the robustness characteristics (rejection rates tracking to the nominal alpha levels, within the Bradley (1978) liberal limits, when variances were equal), as testing assumptions were violated by slight means shifts, Siegel-Tukey (1960) remained robust or conservatively non-robust for all distributions and data sets except for its liberal measurements with Extreme Asymmetric Growth and therefore could be especially advanced for consideration as a robust statistic useful for detecting the Behrens-Fisher problem under all but one of the 11 tested distributions and data sets. This would particularly be the case if power levels were demonstrated to be high (see power conclusions to follow) for robust normal-type and conservatively non-robust non-normal-type, as well as for the Exponential distribution and the Multi-Modal Lumpy data set. Mood-Westenberg (1948), while not as stable as Siegel-Tukey (1960), was generally robust under conditions of means shifts for normal-type distributions at the higher sample sizes; it was also generally robust for the Exponential distribution and the Multi-Modal Lumpy data set for larger sample sizes and lower means shift levels. Consequently, for these distributions and data sets and, under the particular conditions presented here, Mood-Westenberg (1948) might be advanced as a method for detecting Behrens-Fisher.

However the Mood-Westenberg (1948) fared much worse overall than Siegel-Tukey (1960) with every distribution and data set (except Asymmetric Growth where they were the same) due to the nature of Mood-Westenberg's (1948) erratic mixture of liberal and conservative non-robustness patterns as opposed to Siegel-Tukey's (1960) steady robust or conservatively non-robust measurements. Also, Mood-Westenberg (1948) performed poorly in particular with respect to the non-normal-type distributions, as it demonstrated extremely high liberal rejection rates when variances were equal and means began to shift, while Siegel-Tukey demonstrated only robust or conservative non-robust measurements under the same conditions. As means began to shift, the Extreme Bimodal data set became even more robust under Siegel-Tukey as compared to when the means were equal; whereas this data set continued to be highly non-robust for Mood-Westenberg (1948).

From these findings it can be concluded that in research settings, with normal-type data, both tests would be generally robust. However, with non-normal-type distribution samples, Mood-Westenberg (1948) would tend to yield unusually high false positives (i.e., pronouncements that variance have changed when in fact they had not) for these non-normal-type distributions and would therefore not be a good candidate as a robust statistic useful for detection of the Behrens-Fisher problem under these particular data sets.

Siegel-Tukey (1960), however, does not tend to yield high rejection rates as the means began to shift around zero with respect to non-normal-type as well as normal-type data distributions (with the exception of Asymmetric Growth). For the Exponential distribution and the Multi-Modal Lumpy data set, Siegel-Tukey (1960) again proved generally more robust or conservatively non-robust (particularly for higher means shift levels), at all sample sizes and alpha levels. Finally, unlike Mood-Westenberg (1948), Siegel-Tukey (1960) performed robustly with respect to the Extreme Bimodal data set when the sample sizes were equal and for the unequal sample sizes when alpha was .05. Therefore, as it remained robust or conservatively non-robust when assumptions were violated, under a much broader range of conditions, Siegel-Tukey (1960) continued to demonstrate the most promise as a candidate for the detection of Behrens-Fisher.

Power Properties (Variances Changes and Means Shifts)

Normal-Type Distributions

For Mood-Westenberg (1948) the normal-type distributions demonstrated general robustness (some exceptions for Discrete Mass Zero) under conditions of increasing means shift when variances were equal. When the variance began to change, it demonstrated power rates above nominal alpha for all means shifts for these distributions. The power levels were small, below 40%, when sample sizes were small and unequal. However, the power rates generally increased, as would be expected, as sample sizes and variance change levels increased. At sample size 30, 30, alpha =.05, .01, (Table 54 and 55), for the Normal distribution, power reached levels above 40% at about variance change of 1.75-2 and continued to increase for larger variance changes, and generally for each variance level as sample size increased, eventually attaining power levels at or above 90% with variance change of 2, and alpha at .05, at larger sample sizes (65, 65 and above).

For Siegel-Tukey (1960), the normal-type distributions demonstrated a more stable robustness, as compared to Mood-Westenberg (1948), with its consistently robust and conservatively non-robust rates under conditions of increasing means shifts when variances were equal; when the variance began to change, it also demonstrated power rates above nominal alpha for all means shifts and higher power levels than Mood-Westenberg (1948) at almost all points of comparison. Like Mood-Westenberg (1948) power levels reached 40% only at the higher variance changes for smaller sample sizes, but reached them sooner (at smaller variance change levels) for Siegel-Tukey (1960) as compared to Mood-Westenberg (1948). For Siegel-Tukey (1960), at sample size 30, 30, for the Normal distribution (Table 54 and 55), power reached levels of at or above 40% at about 1.5-1.75, one variance level sooner than Mood-Westenberg (1948) which reached 40% at 1.75-2. For Siegel-Tukey (1960) power levels continued to increase for each increasing variance change level, and generally for each increasing sample size, eventually attaining power levels above 90% at the larger sample size (65, 65 and above) at alpha =.05 when the variance change was 1.75-2.0 (Table 60 and 61). Attaining this 90% power level was, once again, about one variance level lower than Mood-Westenberg (1948) which reached a power level above 90% for the same sample size 65, 65 at 2-2.25. These findings indicate that Siegel-Tukey (1960) detects smaller levels of variance changes, sooner, as compared to Mood-Westenberg (1948).

These Normal power measurements can be generalized across the board for the normal-type distributions for the two statistics: At every variance change and at every means shift level, Siegel-Tukey demonstrated more power, often at near twice as much as Mood-Westenberg (1948), at the lower variance changes, even though both tests demonstrated robust and good power properties for normal-type distributions. As an example, with respect to the Uni distribution, when the variance change was 1.25, for alpha=.05, Siegel-Tukey (1960) demonstrated power levels of .49 at sample size 45, 45 (Table 278) and .62 at sample size 65, 65 (Table 280) for all tested means shifts. Mood-Westenberg (1948) produced much lower power levels of .17 and .23 respectively for the same conditions.

Non-Normal-Type Distributions

For Mood-Westenberg (1948), non-normal-type distributions led to high power rates when variances began to change and the means shifted. However, these high power rates are not meaningful for these non-normal-type distributions because these same distributions demonstrated unusually high rejection rates when the variances were equal; therefore, these large liberal rejection rates when variances were equal would yield inflated treatment effects (i.e. inflated detection of variance changes) even when the variances changes had not occurred. As an example, at sample size 30, 30, the Extreme Bimodal data set measured long run rejection rates of around 32% (Table 208) when the variances were equal (at the factor of 1) and nominal alpha was .05. Instead of the accepted and expected error rejection rate of 5 out of 100, the actual rejection rate was inflated to 32 out of 100.

Therefore, with Mood-Westenberg (1948), under these non-normal-type distributions, the corresponding observed high power levels, when the variances change and the means begin to shift, are meaningless; in research settings it would not be clear whether the rejection of equal variances was due to a highly likely rejection by random chance or by an actual treatment effect. In other words, the Mood-Westenberg (1948) statistic under these non-normal-type distributions would be unable to distinguish a true Behrens-Fisher problem from a chance occurrence and many nonsense treatment effects would be pronounced (i.e., stating that the variance changed when it did not). Another problem was noted for Mood-Westenberg (1948) under the Discrete Mass Zero with Gap and some of the other non-normal-type distributions where power rates for many sample sizes could slightly decrease as the variance differences increased. This is the opposite of what should happen under a robust statistic which should demonstrate increasing power levels as variance levels increase. This also occurred in some instances for Siegel-Tukey but generally the decrease was less pronounced (the power levels remained more steady around prior levels) and occurred less often.

For the Siegel-Tukey (1960) test, only the Asymmetric Growth data set demonstrated unusually high rejection rates (i.e., liberally non-robust rates) when the variances were equal and therefore its associated high power levels when the variances began to change for this data set are meaningless for Siegel-Tukey (1960); this was particularly the case for sample sizes over 5, 5. As with Mood-Westenberg (1948), with liberal rejection rates when the variances are equal, power levels are meaningless because it can't be determined (within statistical probability) whether or not a variance change is a random error or true change in variance. Therefore, Siegel-Tukey (1960) must be ruled out as a robust/powerful statistic for detecting Behrens-Fisher under the Asymmetric Growth data set.

However, for all other non-normal-type distributions (Discrete Mass Zero with Gap, Extreme Bimodal and Extreme Asymmetric Decay), Siegel-Tukey (1960) delivered measures of robustness and power levels, well ahead of Mood-Westenberg (1948). At virtually every sample size tested (when variances were equal and the means shifted at all tested levels) Siegel-Tukey (1960) demonstrated either robust or non-robust measures only in the conservative direction for these data sets. The robust and conservative non-robust nature of these outcomes renders its associated high power levels very meaningful. Therefore, the corresponding higher power levels demonstrated by Siegel-Tukey (1960) for these non-normal-type distributions (with the exception of Asymmetric Growth) when the means began to shift slightly around zero and variances began to change (i.e., Behrens-Fisher problem) are important and meaningful for detecting Behrens-Fisher.

Another advantage that Siegel-Tukey (1960) demonstrated was its ability to remain robust and powerful for many sample sizes (particularly for equal sample sizes and unequal sample sizes with alpha of .05) for the Extreme Bi-Modal data set, with its consistent robust measurements and high power levels as the variance changed and the means began to shift (i.e., in Table 200, with alpha=.05, sample size 10, 10 and variance change was 1.25, and for all mean shifts, power was around 55% and it moved higher as sample size and variance levels increased). Another significant finding was that even though Siegel-Tukey's (1960) Type I rate (i.e., for means shift and variance changes equal to zero) were shown to be conservatively non-robust in earlier testing for the Extreme Bi-Modal data set, as the means began to shift at the smallest .01 level and then above, the rejection rates under conditions of equal variances became truly robust, particularly for all equal sample sizes and when alpha was .05 for unequal sample sizes. Because all of the rejection rates were robust for these conditions as the means began to shift and variances were equal, it renders the corresponding high power levels (when variances were changing) demonstrated for Siegel-Tukey (1960) under the Extreme Bi-Modal data set, very meaningful.

For instance, with Siegel-Tukey (1960) under Extreme Bi-Modal, the power levels for sample size 45, 45 reached 96- 99% at the smallest shift of variance change of 1.25 when alpha was .05 and .01 (Table 212 and 213). This extremely high power level, for both alphas, associated with the robust measurements for the Extreme Bi-Modal data set, when the means shift around zero, indicates that in research settings with Extreme Bimodal data sets, that Siegel-Tukey (1960) would be robust and powerful; it could be a strong and particularly useful statistic as a way to detect Behrens-Fisher for many educational research settings where the student population might have two modes (e.g.,, class settings with both English and non-English speaking students producing test scores which are highly correlated with mastery of the English language; here, there may very well be two resulting modes).

The power results for the Siegel-Tukey (1960) test for each of these three non-normal-type distributions, at alpha equal to .05, quickly approached 90% and above at small levels of variance change beginning with sample size 20, 20 and above (a little slower to reach 90% power when alpha was equal to .01). As with Mood-Westenberg (1948), with all means shifts and variance changes, the power rates increased more and more for smaller and smaller variance changes as the sample sizes increased generally; here, high power was demonstrated at all means shift levels, even at the smallest level of variance change of 1.25. Starting with sample sizes 30, 30 and above, particularly for large and equal sample sizes and alpha of .05, power levels climbed above 90% and quickly towards 100% starting with the very first variance shift of 1.25. For Siegel-Tukey (1960), these findings render the statistic not only as powerful as Mood-Westenberg (1948) was for normal-type data distributions but also powerful for these particular non-normal-type distributions, at all sample sizes, for all alpha levels when slight shifts in means occur concurrently with variance changes.

These strong power measurements enable Siegel-Tukey (1960) to detect Behrens-Fisher conditions for virtually all distribution and data sets tested (except Asymmetric Growth), including the Exponential distribution and Multi-Modal Lumpy data set discussed below. These non-normal-type distributions, under Siegel-Tukey (1960), reached higher power levels with smaller variance changes as compared to the normal-type distributions. Additionally, under the non-normal-type distributions, Siegel-Tukey (1960) demonstrated equal or greater power levels at most points of comparison with Mood-Westenberg (1948), even though the Mood-Westenberg (1948) power levels were boosted up unreliably high for these data sets due to high liberal rejection rates when variances were equal. In conclusion, it became evident once again that compared to Mood-Westenberg (1948), Siegel-Tukey (1960) was by far the stronger of the two statistics with respect to measurements of robustness and power properties.

The Exponential Distribution and the Multi-Modal Lumpy Data Set

When observing the Exponential distribution and Multi-Modal Lumpy data set, it was noted that while both statistics are robust for these under certain situations, these distributions and data sets again fared better overall with the Siegel-Tukey (1960) statistic than Mood-Westenberg (1948). For Exponential, Mood-Westenberg (1948) showed a mixture of robust, liberal non-robust and conservative non-robust rejection rates when the variance did not change for various sample sizes and alpha levels, while Siegel-Tukey (1960) demonstrated only robust or conservative non-robust rejection rates for all sample sizes and alpha levels.

The non-robust conservative measurements for Siegel-Tukey (1960) were found primarily at means shift levels of .06 and above, while there was no ascertainable pattern for non-robust liberal/conservative rates for Mood-Westenberg (1948). Once again, erratic power measurements appeared to be tied to sample size variations. Thus, for the Exponential distribution, Siegel-Tukey (1960) was more stable, and, due to its highly conservative nature for the non-robust measurements, was able to demonstrate high and reliable power levels at 65-77%

starting with sample size 30, 30 when alpha was .05 and the variance change was 1.5. For the same conditions, Mood-Westenberg (1948) power levels were powerful but at smaller levels at 41-55%; however, these power levels are a little less meaningful in light of some liberal rejection rates for conditions of equal variances. Both statistics approached power levels at 90-100% quickly as sample sizes and variance changes increased but, as with the other distributions and data sets, Siegel-Tukey (1960) approached these levels more quickly than Mood-Westenberg (1948). At every point of power comparison, Siegel-Tukey (1960) rates were equal to or greater than Mood-Westenberg (1948). For both statistics, the power levels were lower for alpha. 01 as compared to .05 and for smaller sample sizes. Therefore, in summary, for the Exponential distribution, the Siegel-Tukey (1960) power rates were more powerful and more reliable and meaningful due to its stable robust measures at all sample sizes and its conservative nature in the non-robust measurements found at higher mean shift levels.

The Multi-Modal Lumpy data set under Mood-Westenberg (1948) also led to a mixture of liberal and conservative non-robust measurements for smaller sample sizes when the variances were equal; however, starting with sample size 30, 90 and above, equal and unequal sample sizes were robust and powerful (except some slightly liberal non-robust rates at higher means shifts at and above .09). Likewise, Siegel-Tukey (1960) demonstrated only robust measurements for both equal and unequal sample sizes, at alpha equals .05, starting with sample size 30, 30 with a few conservatively non-robust rates (when variances were equal and means shift was at or above .09 for larger sample sizes). As mentioned above, these few non-robust conservative rates turned out to be a positive outcome in the light of the high power levels demonstrated with the means shifts and variance changes, for Siegel-Tukey (1960). For the Multi-Modal Lumpy data set, Siegel-Tukey (1960) demonstrated high power levels at 47-60% right from the start with variance change at the small level of 1.25 for sample size 30, 90 and alpha=.05; in contrast, while Mood-Westenberg (1948) also showed high power levels, it demonstrated lower levels than Siegel-Tukey (1960) at or around 30-40 % for the same parameters. For both statistics the power levels continued to increase as sample size, alpha levels and variance changes increased. Once again, for the Multi-Modal Lumpy data set, Siegel-Tukey (1948) is more robust and powerful at most comparison points, often showing power rates of at least 20 % higher than those of Mood-Westenberg (1948) particularly at the lower variance change level. For instance, this is the case when sample sizes are at least 20, 20 for both alpha levels.

Conclusion

Siegel-Tukey (1960) has a greater advantage due to its broadness of applicability for the normal-type distributions, the non-normal-type distributions, the Exponential distribution, and the Multi-Modal Lumpy data set; Siegel-Tukey (1960) could be applied to all but one (Extreme Asymmetric Growth) of the tested distributions and data sets and not limited in use to normal-type distributions (also the Multi-Modal Lumpy data set) as Mood-Westenberg (1948) was when the testing assumptions of equal means is violated. These properties enable Siegel-Tukey (1960) to be broadly used in research for the detection of the conditions known as the Behrens-Fisher problem.

There is an important implication of this study that must be put forth: If the Mood-Westenberg (1948) statistic is invoked for use under the particular robust conditions demonstrated by this study, then sample size implications should always be considered before making use of the statistic. While Mood-Westenberg (1948) might be useful in detecting the Behrens-Fisher problem, for instance, within the context of normal-type distribution samples or the Multi-Modal Lumpy data set, no use of the statistic for determination of variance shifts should occur before taking into account a review of Type I errors, perhaps in an independent Monte Carlo study, with respect to the particular samples size. It would be important to understand whether the Type I error rate for a sample size is much higher than nominal alpha before relying on the statistic to determine a change in variance. The findings of the study make it imperative that sample size always be taken into account before testing with the Mood-Westenberg (1948) statistic.

Recommendations and Next Steps

Topics that might require closer examination and generate new questions for the field of study are suggested now. First, it becomes obvious that, due to the sample size's pervasive impact on all test results for Mood-Westenberg (1948), attempts to determine more details concerning this phenomenon would be in order. More research concerning the erratic Type I rates found as the sample size increases could be useful not only for the Mood-Westenberg (1948) statistic but for other median based statistics as well. This investigation could add knowledge and refinement to the findings of this study. Determining the nature of the repeating fluctuating (saw-tooth) pattern of Type I error rates with increasing equal sample sizes might have implications not only for Mood-Westenberg (1948) but also for other median based statistics and for other non-parametric tests. How significant is sample size for other non-parametric tests? It could simply be that the instability of Type I errors is an anomaly for Mood-Westenberg (1948) but further research into this finding would be helpful in order to determine what other parameters might interact with sample size for other statistics.

It might be useful to continue to refine the boundaries of robustness and power properties for each of the distributions and data sets and test each of these found to be robust and powerful against other real world data, perhaps found in the literature. For instance, the strong robust characteristics and power properties demonstrated by Siegel-Tukey (1960) for the Extreme Bi-Modal data set could be investigated further with real life data in order to determine more precise boundaries of its applicability.

More research might also be performed to determine the reason for some of the differences in Type I errors between the different distributions and data sets under these non-parametric tests. For instance, why are the Type I error rates for Discrete Mass Zero with Gap so low for Siegel-Tukey (1960) and Mood-Westenberg (1948)? It might be beneficial to perform more research into the reasons for the differences exhibited in this study, for instance, with respect to the suggested grouping of normal-type distribution and non-normal-type distribution patterns for Mood-Westenberg (1948) and Siegel-Tukey (1960). It would be helpful to understand whether or not this classification of normal-type and non-normal-type groupings, yielding similar outcome patterns in this study, could be useful as a paradigm for other findings for other non-parametric statistics. A final suggestion would be to perform power comparisons between the Siegel-Tukey (1960) test and other tests such as the F test for variance differences with respect to all of the normal-type distributions or the Moses ‘rank-like’ test (Neave & Worthington, 1988, p. 134). These suggestions for future research might allow more information to emerge about these two non-parametric tests, and particularly, more information about median-based statistics.

APPENDIX

Table 5

Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Sample Sizes and Alpha Levels when Sampling is from the Normal distribution, 100,000 Repetitions, Variances are equal and Means are equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Sample Size	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
5,5	.080	.016	.016	.016	.016	.000	.016	.000	.047	.047	.016	.016	.004	.008	.000	.004
5,15	.033	.033	.033	.033	.033	.000	.000	.000	.058	.048	.025	.021	.010	.010	.004	.004
10,10	.022	.022	.022	.022	.022	.001	.001	.001	.044	.044	.021	.021	.007	.009	.003	.004
10,30	.066	.066	.008	.008	.008	.008	.008	.008	.051	.047	.024	.024	.010	.010	.004	.004
15,45	.072	.072	.016	.016	.016	.016	.002	.002	.051	.050	.027	.025	.010	.010	.005	.005
20,20	.026	.026	.026	.026	.004	.004	.004	.004	.048	.048	.025	.025	.010	.010	.004	.005
30,30	.068	.068	.019	.019	.019	.019	.004	.004	.050	.050	.023	.024	.009	.010	.005	.005
30,90	.056	.056	.020	.020	.006	.020	.006	.006	.050	.049	.025	.024	.009	.010	.005	.005
45,45	.043	.070	.025	.025	.007	.014	.004	.004	.049	.049	.024	.024	.010	.010	.005	.005
65,65	.041	.063	.026	.026	.010	.010	.006	.006	.049	.049	.024	.024	.010	.010	.005	.005
90,90	.052	.052	.025	.025	.011	.011	.004	.004	.050	.050	.025	.025	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 6

Mood-Westenberg Type I Error Rate Averages for all Sample Sizes (5, 5 to 200,200) for 10,000 Repetitions, Normal Distribution.

	.050		.025		.010		.005	
	Chi Squared	Fisher Exact	Chi Squared	Fisher Exact	Chi Squared	Fisher Exact	Chi Squared	Fisher Exact
Average	.048	.067	.024	.031	.009	.012	.005	.005

Table 7

Siegel-Tukey Type I Error Rate Averages for all Sample Sizes (5, 5 to 200,200) for 10,000 Repetitions, Normal Distribution.

	.050		.025		.010		.005	
	Z Scores	Mann Whitney	Z Scores	Mann Whitney	Z Scores	Mann Whitney	Z Scores	Mann Whitney
Average	.049	.049	.024	.025	.010	.010	.005	.005

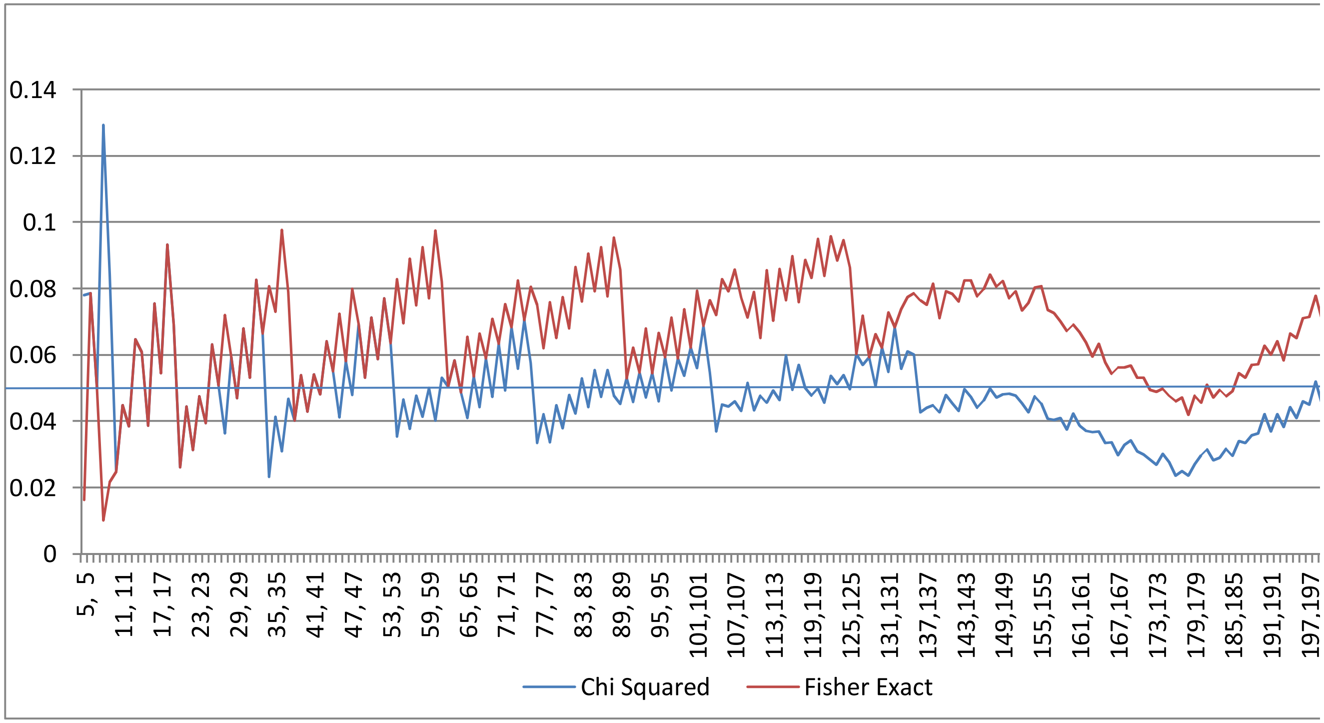

Figure 13. Mood-Westenberg Type I Error Rate, Comparisons between Chi Squared (blue line) and Fisher Exact (red line) for All Equal Sample Sizes from 5, 5 to 200, 200, for Normal Distribution, .05 Alpha, 10,000 Repetitions.

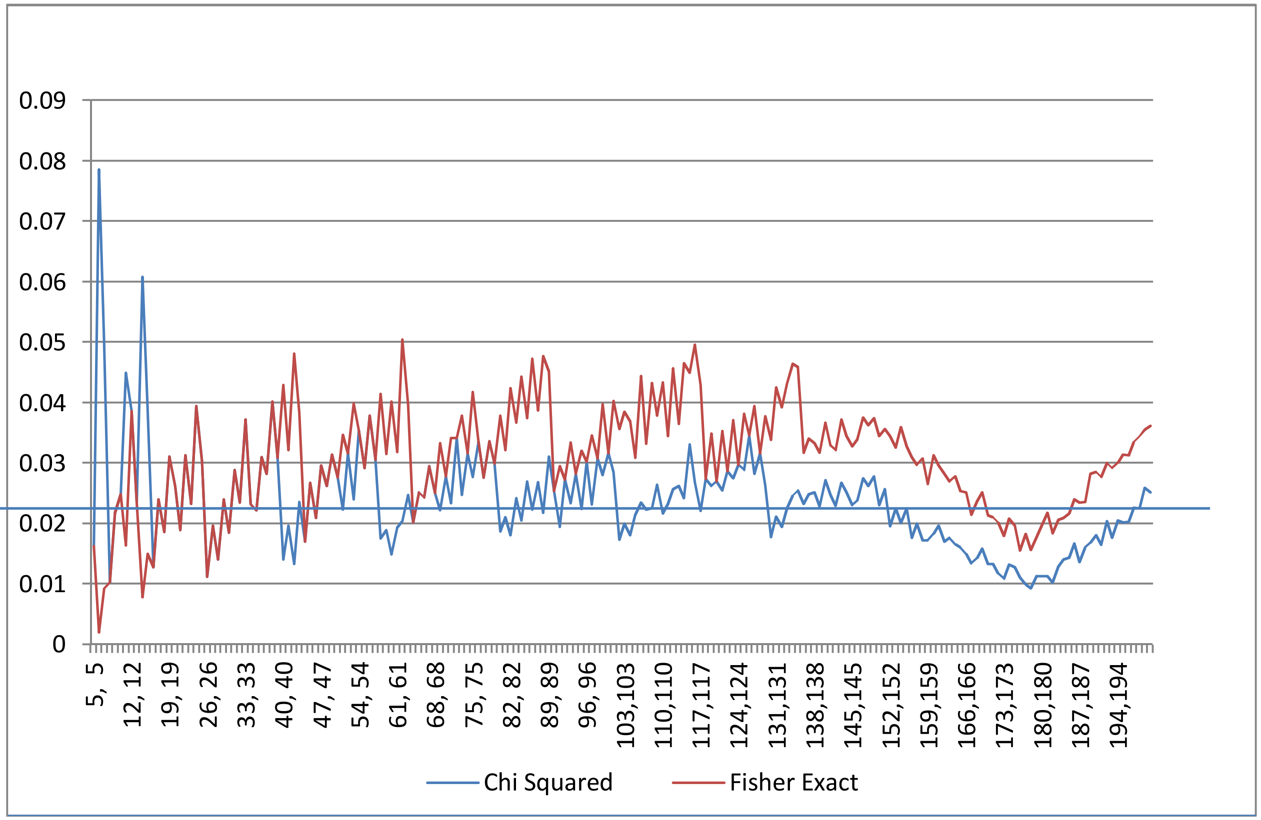

Figure 14. Mood-Westenberg Type I Error Rate, Comparisons between Chi Squared (blue line) and Fisher Exact (red line) for All Equal Sample Sizes from 5, 5 to 200, 200, for Normal Distribution, .025 Alpha, 10,000 Repetitions.

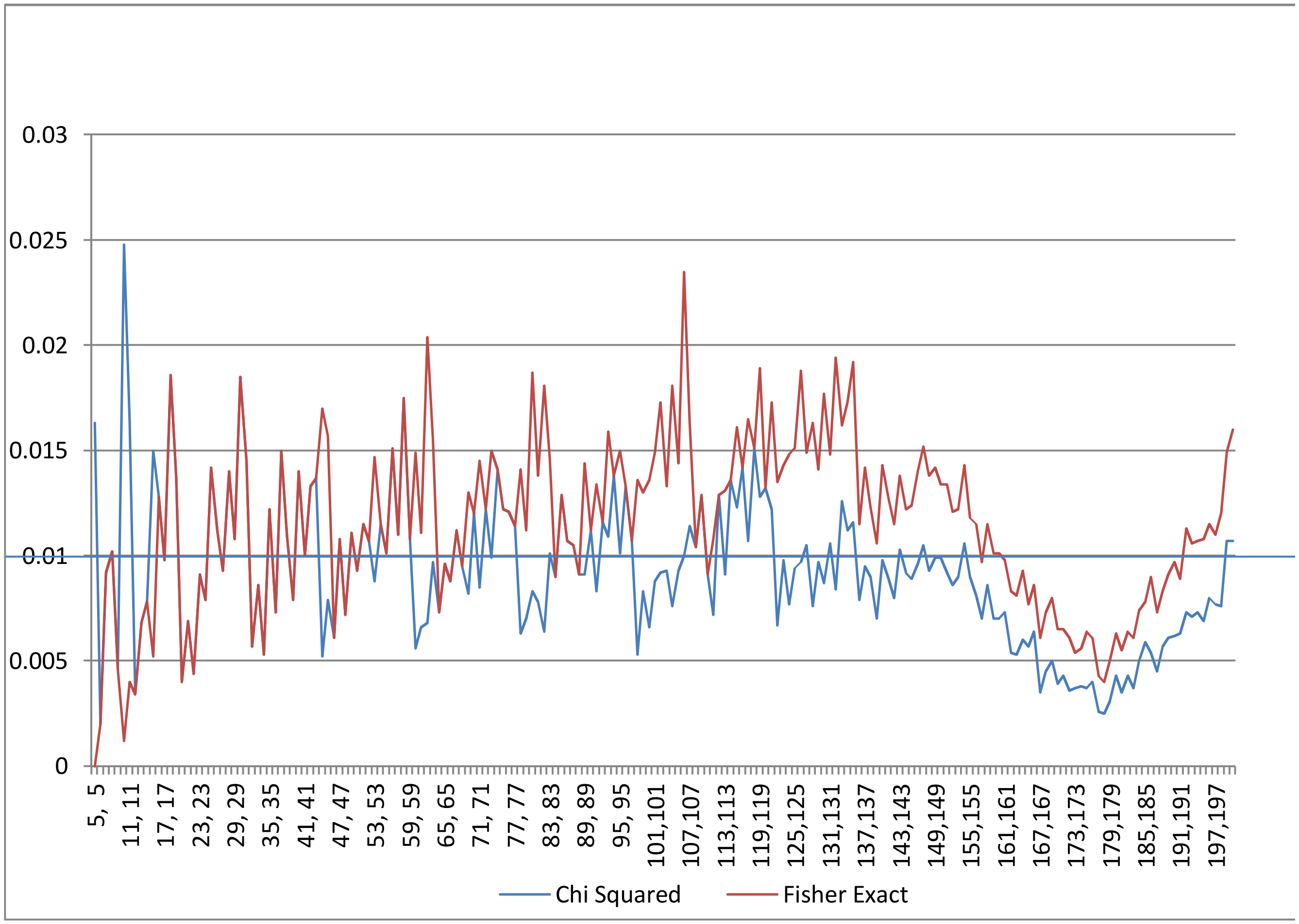

Figure 15. Mood-Westenberg Type I Error Rate, Comparisons between Chi Squared (blue line) and Fisher Exact (red line) for All Equal Sample Sizes from 5, 5 to 200, 200, for Normal Distribution, .01 Alpha, 10,000 Repetitions.

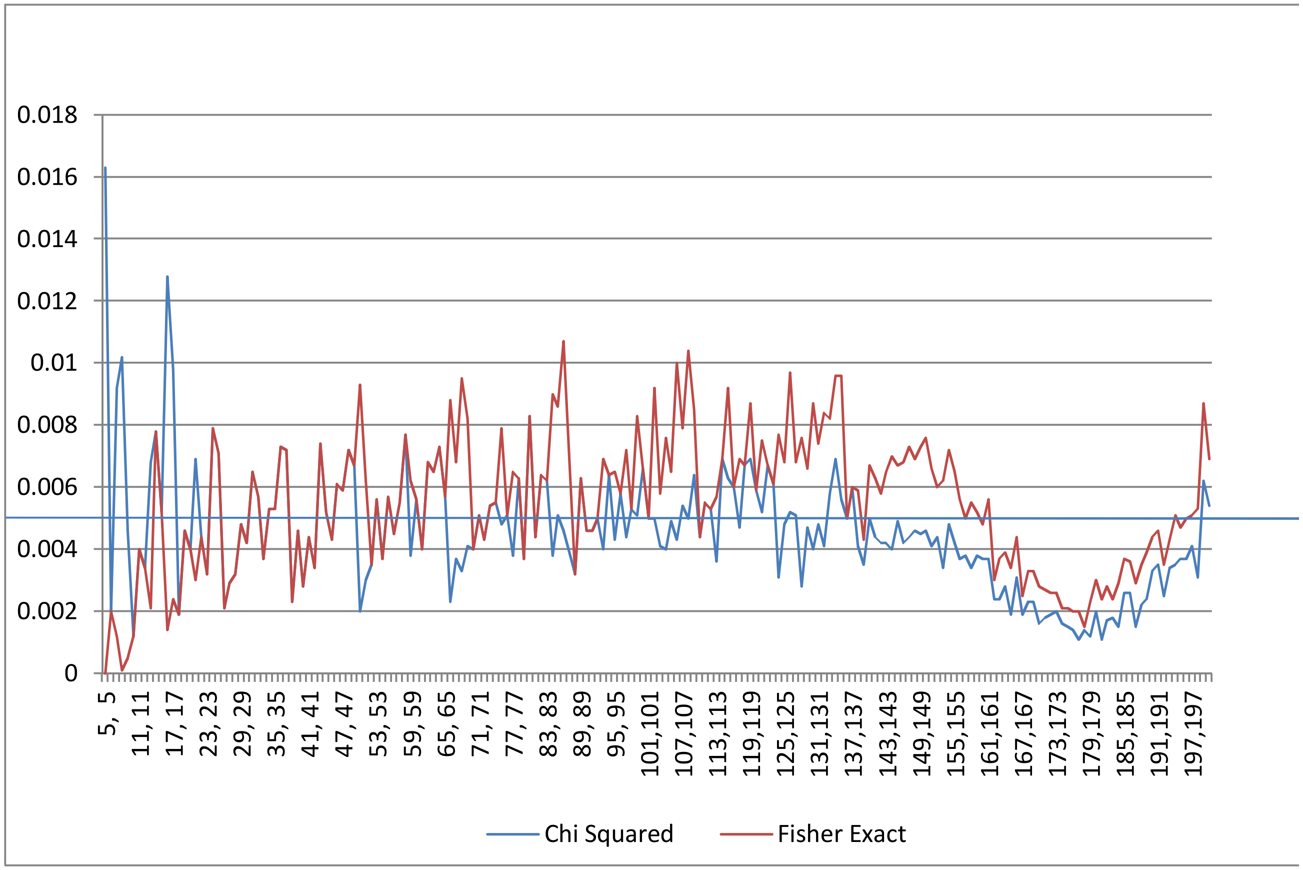

Figure 16. Mood-Westenberg Type I Error Rate, Comparisons between Chi Squared (blue line) and Fisher Exact (red line) for All Equal Sample Sizes from 5, 5 to 200, 200, for Normal Distribution, .005 Alpha, 10,000 Repetitions.

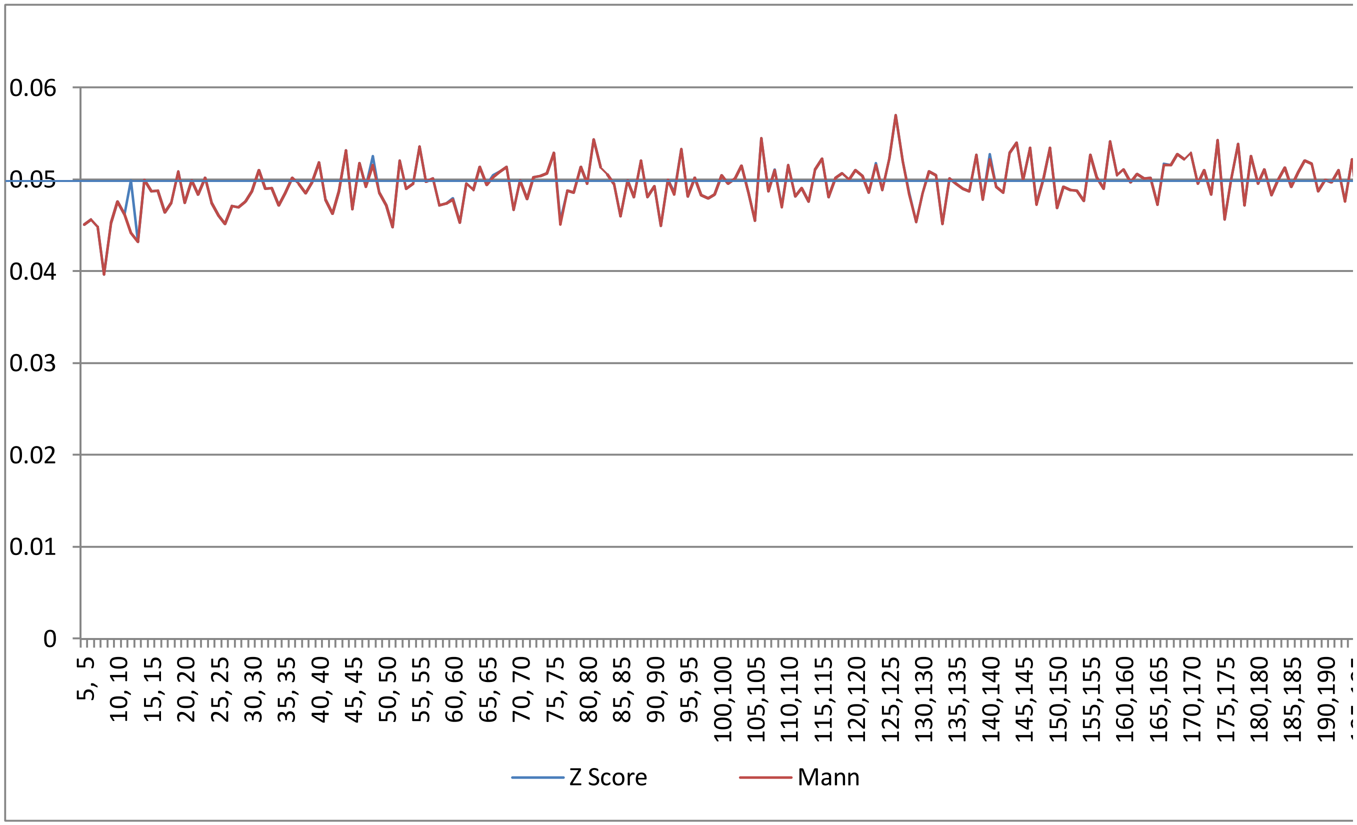

Figure 17. Siegel-Tukey Type I Error Rate, Comparisons between Z Scores (blue line) and Mann-Whitney (red line) for All Equal Sample Sizes from 5, 5 to 200, 200, for Normal Distribution, .05 Alpha, 10,000 Repetitions.

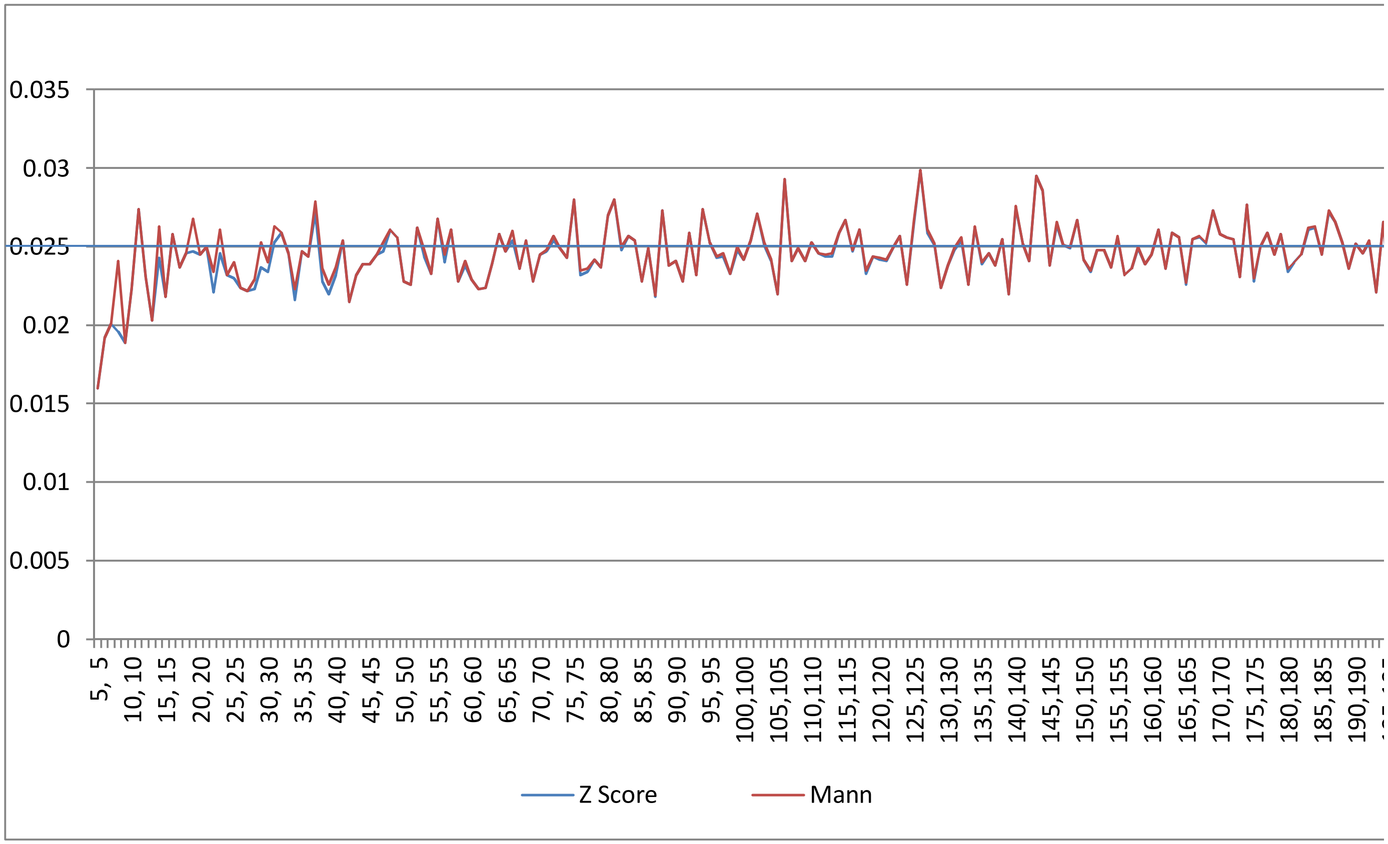

Figure 18. Siegel-Tukey Type I Error Rate, Comparisons between Z Scores (blue line) and Mann-Whitney (red line) for All Equal Sample Sizes from 5, 5 to 200, 200, for Normal Distribution, .025 Alpha, 10,000 Repetitions.

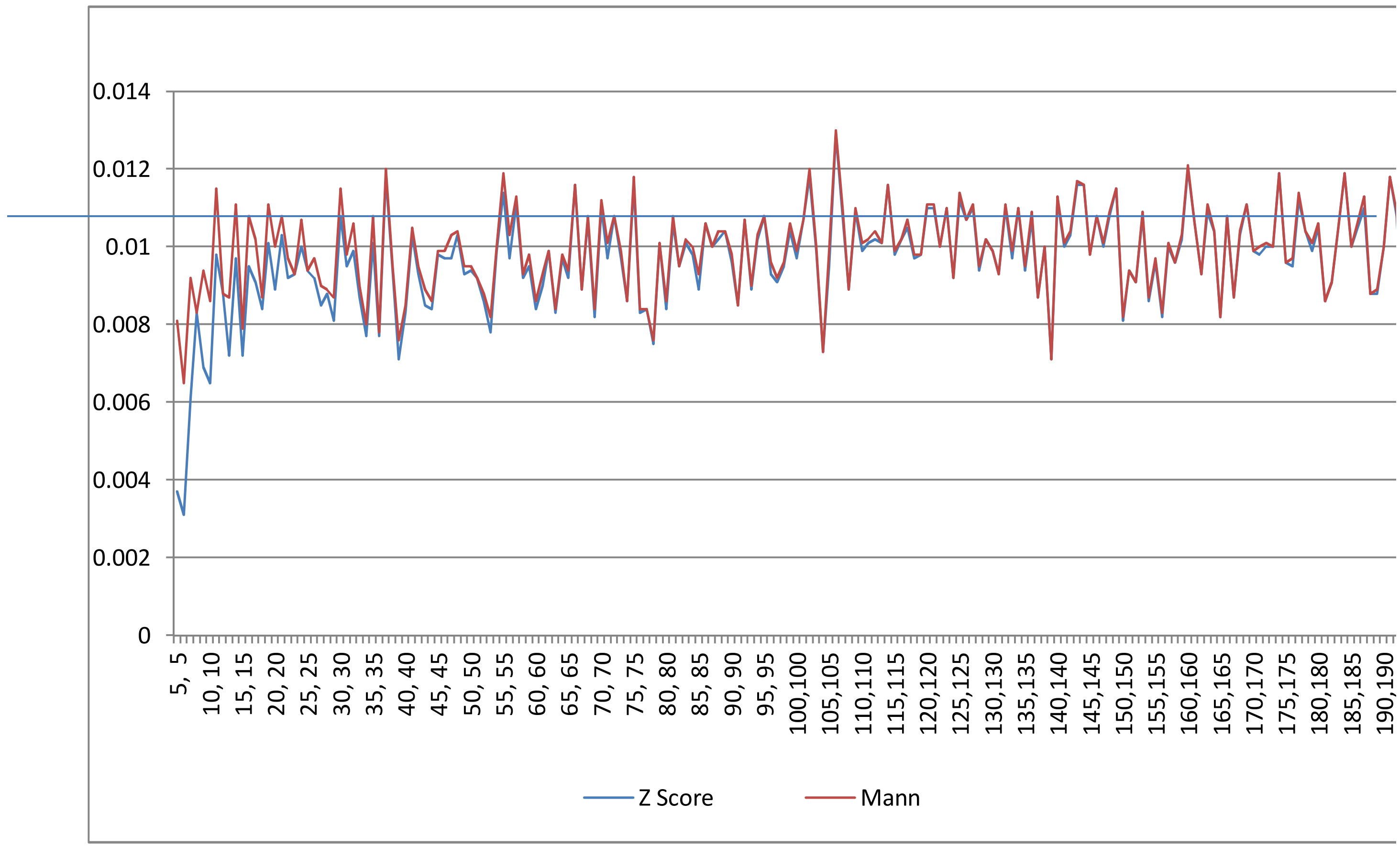

Figure 19. Siegel-Tukey Type I Error Rate, Comparisons between Z Scores (blue line) and Mann-Whitney (red line) for All Equal Sample Sizes from 5, 5 to 200, 200, for Normal Distribution, .01 Alpha, 10,000 Repetitions.

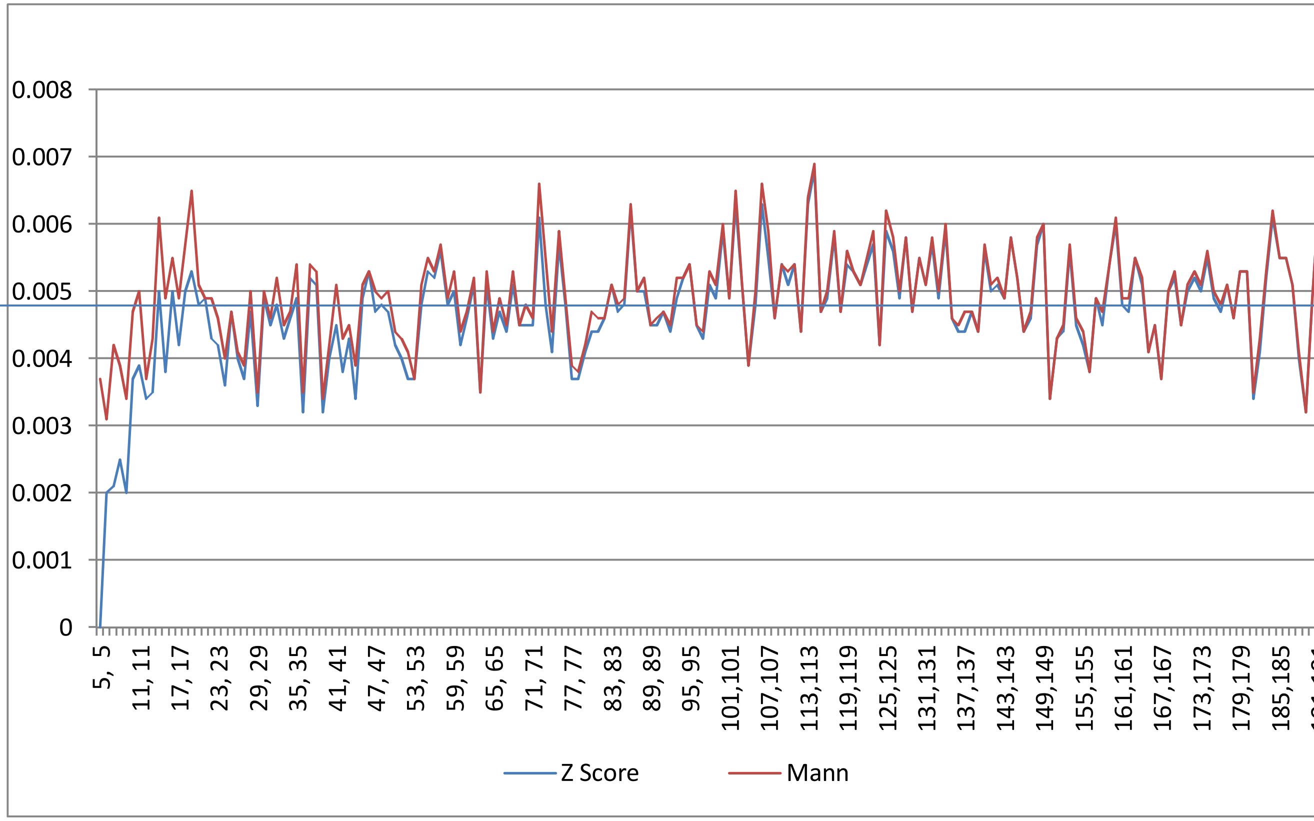

Figure 20. Siegel-Tukey Type I Error Rate, Comparisons between Z Scores (blue line) and Mann-Whitney (red line) for All Equal Sample Sizes from 5, 5 to 200, 200, for Normal Distribution, .005 Alpha, 10,000 Repetitions.

Table 8
Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 5, 5 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.074	.014	.014	.014	.014	.000	.014	.000	.034	.041	.012	.014	.002	.007	.000	.002
DIGIT PREF	.078	.016	.016	.016	.016	.000	.016	.000	.041	.049	.015	.016	.003	.009	.000	.003
DISC MASS ZERO	.073	.014	.014	.014	.014	.000	.014	.000	.036	.044	.013	.014	.002	.008	.000	.002
DISC MASS ZERO GAP	.020	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.081	.015	.015	.015	.015	.000	.015	.000	.048	.048	.017	.017	.004	.008	.000	.004
EXTRM ASYM DECAY	.041	.002	.002	.002	.002	.000	.002	.000	.008	.009	.001	.002	.001	.001	.000	.001
EXTRM BIMODAL	.036	.004	.004	.004	.004	.000	.004	.000	.011	.014	.003	.004	.000	.001	.000	.001
MULTI-MODAL LUMPY	.079	.016	.016	.016	.016	.000	.016	.000	.041	.048	.015	.015	.003	.009	.000	.003
NORMAL	.080	.016	.016	.016	.016	.000	.016	.000	.047	.047	.016	.016	.004	.008	.000	.004
SMOOTH SYM	.074	.014	.014	.014	.014	.000	.014	.000	.038	.046	.015	.016	.002	.009	.000	.002
UNI	.081	.017	.017	.017	.017	.000	.017	.000	.048	.048	.016	.016	.004	.008	.000	.004

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.
See Bradley, 1978
Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 9

Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 5, 15 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.032	.032	.032	.032	.032	.000	.000	.000	.049	.047	.022	.018	.007	.008	.003	.003
DIGIT PREF	.032	.032	.032	.032	.032	.000	.000	.000	.052	.049	.025	.020	.007	.009	.003	.003
DISC MASS ZERO	.030	.030	.030	.030	.030	.000	.000	.000	.050	.048	.024	.020	.007	.009	.003	.003
DISC MASS ZERO GAP	.186	.186	.186	.186	.186	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.033	.033	.033	.033	.033	.000	.000	.000	.059	.049	.026	.021	.010	.010	.004	.004
EXTRM ASYM DECAY	.109	.109	.109	.109	.109	.000	.000	.000	.014	.013	.005	.004	.002	.002	.001	.001
EXTRM BIMODAL	.035	.035	.035	.035	.035	.000	.000	.000	.023	.022	.009	.007	.002	.003	.001	.001
MULTI-MODAL LUMPY	.032	.032	.032	.032	.032	.000	.000	.000	.054	.050	.025	.021	.008	.010	.003	.004
NORMAL	.033	.033	.033	.033	.033	.000	.000	.000	.058	.048	.025	.021	.010	.010	.004	.004
SMOOTH SYM	.030	.030	.030	.030	.030	.000	.000	.000	.050	.048	.023	.019	.007	.009	.003	.003
UNI	.032	.032	.032	.032	.032	.000	.000	.000	.059	.049	.026	.020	.009	.009	.004	.004

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 10

Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 10, 10 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.020	.020	.020	.020	.020	.001	.001	.001	.038	.039	.017	.018	.005	.007	.002	.003
DIGIT PREF	.022	.022	.022	.022	.022	.001	.001	.001	.043	.044	.020	.021	.007	.009	.003	.004
DISC MASS ZERO	.021	.021	.021	.021	.021	.001	.001	.001	.042	.043	.019	.021	.006	.008	.003	.004
DISC MASS ZERO GAP	.005	.005	.005	.005	.005	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.023	.023	.023	.023	.023	.001	.001	.001	.045	.045	.022	.022	.008	.010	.004	.005
EXTRM ASYM DECAY	.011	.011	.011	.011	.011	.000	.000	.000	.010	.010	.004	.004	.001	.001	.000	.000
EXTRM BIMODAL	.010	.010	.010	.010	.010	.000	.000	.000	.016	.017	.005	.006	.001	.002	.000	.001
MULTI-MODAL LUMPY	.021	.021	.021	.021	.021	.001	.001	.001	.044	.045	.021	.021	.007	.009	.003	.004
NORMAL	.022	.022	.022	.022	.022	.001	.001	.001	.044	.044	.021	.021	.007	.009	.003	.004
SMOOTH SYM	.020	.020	.020	.020	.020	.001	.001	.001	.044	.045	.020	.021	.007	.009	.003	.004
UNI	.024	.024	.024	.024	.024	.001	.001	.001	.045	.045	.022	.022	.008	.010	.003	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 11

Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 10, 30 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.068	.068	.009	.009	.009	.009	.009	.009	.047	.045	.022	.022	.008	.008	.003	.004
DIGIT PREF	.063	.063	.008	.008	.008	.008	.008	.008	.050	.047	.024	.025	.009	.010	.004	.005
DISC MASS ZERO	.059	.059	.007	.007	.007	.007	.007	.007	.048	.046	.022	.023	.008	.009	.003	.004
DISC MASS ZERO GAP	.284	.284	.088	.088	.088	.088	.088	.088	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.063	.063	.008	.008	.008	.008	.008	.008	.049	.046	.024	.024	.009	.009	.004	.004
EXTRM ASYM DECAY	.274	.274	.064	.064	.064	.064	.064	.064	.012	.011	.004	.004	.001	.001	.000	.001
EXTRM BIMODAL	.085	.085	.013	.013	.013	.013	.013	.013	.024	.022	.009	.009	.003	.003	.001	.001
MULTI-MODAL LUMPY	.062	.062	.008	.008	.008	.008	.008	.008	.051	.048	.024	.024	.009	.010	.004	.004
NORMAL	.066	.066	.008	.008	.008	.008	.008	.008	.051	.047	.024	.024	.010	.010	.004	.004
SMOOTH SYM	.060	.060	.007	.007	.007	.007	.007	.007	.049	.046	.023	.023	.008	.009	.004	.004
UNI	.064	.064	.008	.008	.008	.008	.008	.008	.051	.048	.025	.025	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 12

Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 15, 45 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.081	.081	.018	.018	.018	.018	.003	.003	.046	.045	.021	.021	.008	.008	.004	.004
DIGIT PREF	.068	.068	.015	.015	.015	.015	.002	.002	.049	.048	.024	.024	.009	.009	.005	.005
DISC MASS ZERO	.067	.067	.014	.014	.014	.014	.002	.002	.049	.048	.024	.024	.009	.009	.004	.005
DISC MASS ZERO GAP	.582	.582	.322	.322	.322	.322	.137	.137	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.072	.072	.015	.015	.015	.015	.002	.002	.052	.050	.026	.025	.010	.010	.005	.005
EXTRM ASYM DECAY	.540	.540	.269	.269	.269	.269	.086	.086	.011	.011	.004	.004	.001	.001	.000	.000
EXTRM BIMODAL	.134	.134	.039	.039	.039	.039	.007	.007	.025	.024	.009	.009	.003	.003	.001	.001
MULTI-MODAL LUMPY	.069	.069	.015	.015	.015	.015	.002	.002	.052	.050	.025	.025	.010	.010	.005	.005
NORMAL	.072	.072	.016	.016	.016	.016	.002	.002	.051	.050	.027	.025	.010	.010	.005	.005
SMOOTH SYM	.068	.068	.014	.014	.014	.014	.002	.002	.049	.048	.023	.023	.009	.009	.004	.004
UNI	.072	.072	.015	.015	.015	.015	.002	.002	.051	.049	.025	.024	.009	.009	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 13

Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 20, 20 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.021	.021	.021	.021	.003	.003	.003	.003	.043	.044	.020	.021	.007	.008	.003	.004
DIGIT PREF	.024	.024	.024	.024	.003	.003	.003	.003	.048	.049	.023	.024	.008	.009	.004	.004
DISC MASS ZERO	.023	.023	.023	.023	.003	.003	.003	.003	.046	.047	.022	.024	.008	.009	.004	.004
DISC MASS ZERO GAP	.002	.002	.002	.002	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.026	.026	.026	.026	.004	.004	.004	.004	.049	.049	.025	.025	.009	.010	.005	.005
EXTRM ASYM DECAY	.008	.008	.008	.008	.000	.000	.000	.000	.011	.011	.004	.004	.001	.001	.000	.000
EXTRM BIMODAL	.012	.012	.012	.012	.001	.001	.001	.001	.020	.021	.007	.008	.002	.002	.001	.001
MULTI-MODAL LUMPY	.024	.024	.024	.024	.003	.003	.003	.003	.047	.048	.023	.024	.009	.010	.004	.005
NORMAL	.026	.026	.026	.026	.004	.004	.004	.004	.048	.048	.025	.025	.010	.010	.004	.005
SMOOTH SYM	.024	.024	.024	.024	.003	.003	.003	.003	.047	.048	.023	.024	.009	.010	.004	.005
UNI	.026	.026	.026	.026	.004	.004	.004	.004	.048	.048	.024	.024	.009	.010	.004	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 14
Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 30, 30 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.062	.062	.017	.017	.017	.017	.003	.003	.044	.045	.021	.022	.008	.008	.004	.004
DIGIT PREF	.065	.065	.018	.018	.018	.018	.004	.004	.047	.048	.023	.024	.009	.010	.004	.005
DISC MASS ZERO	.063	.063	.017	.017	.017	.017	.004	.004	.046	.047	.022	.023	.008	.009	.003	.004
DISC MASS ZERO GAP	.011	.011	.002	.002	.002	.002	.000	.000	.001	.001	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.069	.069	.020	.020	.020	.020	.004	.004	.049	.049	.023	.024	.009	.010	.004	.005
EXTRM ASYM DECAY	.039	.039	.007	.007	.007	.007	.001	.001	.011	.012	.004	.004	.001	.001	.000	.000
EXTRM BIMODAL	.040	.040	.008	.008	.008	.008	.001	.001	.022	.023	.008	.009	.002	.002	.001	.001
MULTI-MODAL LUMPY	.068	.068	.019	.019	.019	.019	.004	.004	.049	.050	.024	.025	.010	.010	.005	.005
NORMAL	.068	.068	.019	.019	.019	.019	.004	.004	.050	.050	.023	.024	.009	.010	.005	.005
SMOOTH SYM	.065	.065	.017	.017	.017	.017	.003	.003	.048	.049	.023	.024	.009	.010	.004	.005
UNI	.070	.070	.019	.019	.019	.019	.004	.004	.050	.050	.024	.025	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.
See Bradley, 1978
Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 15

Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 30, 90 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.085	.085	.033	.033	.011	.033	.011	.011	.047	.046	.023	.023	.009	.009	.004	.004
DIGIT PREF	.055	.055	.019	.019	.005	.019	.005	.005	.049	.049	.024	.024	.010	.010	.005	.005
DISC MASS ZERO	.055	.055	.020	.020	.006	.020	.006	.006	.048	.047	.023	.023	.009	.009	.004	.005
DISC MASS ZERO GAP	.738	.738	.561	.561	.379	.561	.379	.379	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.057	.057	.019	.019	.006	.019	.006	.006	.051	.049	.025	.025	.010	.010	.005	.005
EXTRM ASYM DECAY	.809	.809	.650	.650	.452	.650	.452	.452	.011	.011	.003	.003	.001	.001	.000	.000
EXTRM BIMODAL	.194	.194	.102	.102	.046	.102	.046	.046	.024	.024	.010	.010	.003	.003	.001	.001
MULTI-MODAL LUMPY	.056	.056	.019	.019	.006	.019	.006	.006	.049	.049	.024	.024	.009	.009	.004	.004
NORMAL	.056	.056	.020	.020	.006	.020	.006	.006	.050	.049	.025	.024	.009	.010	.005	.005
SMOOTH SYM	.055	.055	.019	.019	.005	.019	.005	.005	.050	.049	.025	.025	.009	.009	.004	.005
UNI	.055	.055	.019	.019	.005	.019	.005	.005	.052	.050	.025	.024	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 16

Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 45, 45 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.040	.067	.024	.024	.007	.013	.003	.003	.046	.047	.022	.022	.008	.009	.004	.004
DIGIT PREF	.042	.069	.024	.024	.007	.014	.004	.004	.049	.050	.024	.025	.009	.010	.005	.005
DISC MASS ZERO	.040	.066	.023	.023	.007	.012	.003	.003	.047	.048	.023	.024	.009	.009	.004	.005
DISC MASS ZERO GAP	.004	.008	.002	.002	.000	.001	.000	.000	.001	.001	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.043	.071	.025	.025	.007	.014	.004	.004	.050	.050	.026	.026	.010	.010	.005	.005
EXTRM ASYM DECAY	.021	.039	.011	.011	.002	.005	.001	.001	.011	.011	.003	.003	.001	.001	.000	.000
EXTRM BIMODAL	.022	.041	.011	.011	.002	.005	.001	.001	.023	.024	.009	.009	.003	.003	.001	.001
MULTI-MODAL LUMPY	.042	.069	.024	.024	.007	.014	.004	.004	.049	.050	.024	.025	.009	.010	.005	.005
NORMAL	.043	.070	.025	.025	.007	.014	.004	.004	.049	.049	.024	.024	.010	.010	.005	.005
SMOOTH SYM	.040	.066	.023	.023	.007	.013	.003	.003	.048	.048	.023	.024	.009	.009	.004	.004
UNI	.043	.070	.025	.025	.008	.015	.004	.004	.049	.049	.025	.025	.009	.009	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 17

Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 65, 65 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.039	.059	.024	.024	.009	.009	.005	.005	.045	.046	.022	.022	.008	.008	.004	.004
DIGIT PREF	.040	.061	.026	.026	.010	.010	.006	.006	.049	.049	.024	.024	.010	.010	.005	.005
DISC MASS ZERO	.040	.060	.025	.025	.009	.009	.006	.006	.048	.049	.024	.024	.009	.010	.004	.005
DISC MASS ZERO GAP	.003	.005	.001	.001	.000	.000	.000	.000	.001	.001	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.042	.064	.027	.027	.010	.010	.006	.006	.049	.049	.025	.025	.010	.010	.005	.005
EXTRM ASYM DECAY	.020	.033	.011	.011	.003	.003	.002	.002	.011	.011	.003	.003	.001	.001	.000	.000
EXTRM BIMODAL	.023	.038	.013	.013	.004	.004	.002	.002	.023	.023	.008	.008	.003	.003	.001	.001
MULTI-MODAL LUMPY	.041	.062	.026	.026	.010	.010	.006	.006	.050	.050	.025	.025	.010	.010	.005	.005
NORMAL	.041	.063	.026	.026	.010	.010	.006	.006	.049	.049	.024	.024	.010	.010	.005	.005
SMOOTH SYM	.039	.060	.025	.025	.009	.009	.005	.005	.049	.049	.024	.025	.009	.010	.005	.005
UNI	.043	.064	.028	.028	.010	.010	.006	.006	.050	.050	.025	.025	.009	.009	.004	.004

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 18
Type I Error Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Sample Size 90, 90 and Alpha Levels when Sampling is from all Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means are Equal.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.049	.049	.023	.023	.010	.010	.004	.004	.046	.046	.022	.022	.008	.009	.004	.004
DIGIT PREF	.050	.050	.023	.023	.010	.010	.004	.004	.048	.048	.023	.024	.009	.009	.005	.005
DISC MASS ZERO	.048	.048	.023	.023	.009	.009	.004	.004	.047	.047	.023	.023	.009	.009	.005	.005
DISC MASS ZERO GAP	.003	.003	.001	.001	.000	.000	.000	.000	.001	.001	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.052	.052	.025	.025	.011	.011	.005	.005	.050	.050	.025	.025	.010	.010	.005	.005
EXTRM ASYM DECAY	.027	.027	.010	.010	.003	.003	.001	.001	.011	.011	.003	.003	.001	.001	.000	.000
EXTRM BIMODAL	.029	.029	.012	.012	.004	.004	.001	.001	.023	.024	.009	.009	.002	.003	.001	.001
MULTI-MODAL LUMPY	.049	.049	.023	.023	.010	.010	.004	.004	.049	.049	.024	.024	.010	.010	.005	.005
NORMAL	.052	.052	.025	.025	.011	.011	.004	.004	.050	.050	.025	.025	.010	.010	.005	.005
SMOOTH SYM	.049	.049	.023	.023	.010	.010	.004	.004	.048	.048	.023	.023	.009	.009	.004	.004
UNI	.053	.053	.025	.025	.011	.011	.004	.004	.050	.050	.024	.024	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.
See Bradley, 1978
Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 19

Type II Errors/Power Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90,90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Means are Equal and Variance Change is 1.25.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	0.05		0.025		0.01		0.005		0.05		0.025		0.01		0.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.457	.457	.369	.369	.289	.289	.219	.219	.886	.886	.815	.816	.703	.706	.614	.616
DIGIT PREF	.265	.265	.179	.179	.114	.114	.068	.068	.512	.513	.389	.389	.258	.261	.184	.186
DISC MASS ZERO	.197	.197	.128	.128	.078	.078	.044	.044	.568	.569	.446	.447	.308	.310	.225	.227
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991								
EXPONENTIAL	.478	.478	.360	.360	.256	.256	.170	.170	.830	.830	.735	.735	.603	.605	.502	.504
EXTRM ASYM DECAY					.999	.999	.999	.999					.999	.999	.999	.999
EXTRM BIMODAL	.897	.897	.852	.852	.795	.795	.726	.726							.999	.999
MULTI-MODAL LUMPY	.668	.668	.559	.559	.446	.446	.334	.334	.846	.846	.758	.758	.630	.632	.531	.533
NORMAL	.257	.257	.169	.169	.102	.102	.058	.058	.495	.495	.370	.370	.240	.242	.169	.170
SMOOTH SYM	.165	.165	.104	.104	.061	.061	.034	.034	.550	.550	.425	.426	.288	.290	.210	.212
UNI	.330	.330	.230	.230	.150	.150	.090	.090	.750	.750	.639	.639	.494	.496	.394	.397

Note: For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

Table 20

Type II Errors/Power Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90,90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Means are Equal and Variance Change is 1.5.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	0.05		0.025		0.01		0.005		0.05		0.025		0.01		0.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.888	.888	.827	.827	.746	.746	.651	.651	.997	.997	.994	.994	.983	.983	.969	.970
DIGIT PREF	.570	.570	.458	.458	.349	.349	.250	.250	.896	.896	.829	.830	.720	.722	.630	.633
DISC MASS ZERO	.615	.615	.515	.515	.416	.416	.322	.322	.894	.894	.826	.826	.715	.717	.625	.628
DISC MASS ZERO GAP			.999	.999	.997	.997	.991	.991								
EXPONENTIAL	.916	.916	.861	.861	.787	.787	.692	.692	.995	.995	.988	.988	.970	.970	.948	.949
EXTRM ASYM DECAY																
EXTRM BIMODAL	.897	.897	.851	.851	.794	.794	.726	.726							.999	.999
MULTI-MODAL LUMPY	.971	.971	.946	.946	.906	.906	.849	.849	.998	.998	.996	.996	.987	.988	.977	.978
NORMAL	.643	.643	.527	.527	.407	.407	.293	.293	.899	.899	.831	.831	.721	.722	.629	.631
SMOOTH SYM	.651	.651	.543	.543	.433	.433	.328	.328	.902	.902	.835	.836	.729	.732	.641	.644
UNI	.776	.776	.678	.678	.567	.567	.449	.449	.988	.988	.974	.974	.942	.943	.907	.908

Note: For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

Table 21

Type II Errors/Power Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90,90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Means are Equal and Variance Change is 1.75.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	0.05		0.025		0.01		0.005		0.05		0.025		0.01		0.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.991	.991	.984	.984	.973	.973	.956	.956					.999	.999	.999	.999
DIGIT PREF	.803	.803	.715	.715	.613	.613	.503	.503	.988	.988	.974	.974	.941	.942	.905	.906
DISC MASS ZERO	.833	.833	.758	.758	.666	.666	.564	.564	.985	.985	.969	.969	.934	.935	.897	.898
DISC MASS ZERO GAP	.999	.999	.999	.999	.996	.996	.991	.991								
EXPONENTIAL	.993	.993	.985	.985	.971	.971	.946	.946					.999	.999	.997	.998
EXTRM ASYM DECAY																
EXTRM BIMODAL	.894	.894	.849	.849	.791	.791	.726	.726							.999	.999
MULTI-MODAL LUMPY	.998	.998	.996	.996	.991	.991	.982	.982								
NORMAL	.890	.890	.822	.822	.733	.733	.625	.625	.991	.991	.979	.979	.951	.952	.918	.919
SMOOTH SYM	.870	.870	.804	.804	.723	.723	.625	.625	.988	.988	.975	.975	.943	.944	.909	.910
UNI	.958	.958	.924	.924	.874	.874	.801	.801			.999	.999	.997	.997	.994	.994

Note: For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

Table 22

Type II Errors/Power Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90,90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Means are Equal and Variance Change is 2.00.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	0.05		0.025		0.01		0.005		0.05		0.025		0.01		0.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.999	.999	.997	.997	.994	.994	.987	.987								
DIGIT PREF	.942	.942	.901	.901	.841	.841	.762	.762	.999	.999	.997	.997	.992	.992	.984	.985
DISC MASS ZERO	.939	.939	.900	.900	.846	.846	.774	.774	.999	.999	.996	.996	.990	.990	.981	.982
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991								
EXPONENTIAL			.999	.999	.997	.997	.993	.993								
EXTRM ASYM DECAY																
EXTRM BIMODAL																
MULTI-MODAL LUMPY					.999	.999	.998	.998								
NORMAL	.974	.974	.951	.951	.911	.911	.853	.853	.999	.999	.998	.998	.994	.994	.989	.989
SMOOTH SYM	.952	.952	.919	.919	.870	.870	.803	.803	.999	.999	.998	.998	.993	.993	.987	.987
UNI	.994	.994	.988	.988	.975	.975	.952	.952								

Note: For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

Table 23

Type II Errors/Power Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90,90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Means are Equal and Variance Change is 2.25.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	0.05		0.025		0.01		0.005		0.05		0.025		0.01		0.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH																
DIGIT PREF	.985	.985	.971	.971	.948	.948	.913	.913					.999	.999	.997	.997
DISC MASS ZERO	.990	.990	.981	.981	.965	.965	.940	.940					.999	.999	.999	.999
DISC MASS ZERO GAP			.999	.999	.996	.996	.990	.990								
EXPONENTIAL							.999	.999								
EXTRM ASYM DECAY																
EXTRM BIMODAL																
MULTI-MODAL LUMPY																
NORMAL	.995	.995	.988	.988	.976	.976	.953	.953					.999	.999	.999	.999
SMOOTH SYM	.985	.985	.970	.970	.946	.946	.909	.909							.999	.999
UNI	.999	.999	.998	.998	.996	.996	.990	.990								

Note: For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

Table 24

Type II Errors/Power Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90,90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Means are Equal and Variance Change is 2.50.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	0.05		0.025		0.01		0.005		0.05		0.025		0.01		0.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH																
DIGIT PREF	.994	.994	.987	.987	.975	.975	.954	.954								
DISC MASS ZERO	.994	.994	.988	.988	.977	.977	.960	.960								
DISC MASS ZERO GAP	.999	.999	.998	.998	.995	.995	.989	.989								
EXPONENTIAL																
EXTRM ASYM DECAY																
EXTRM BIMODAL																
MULTI-MODAL LUMPY																
NORMAL	.999	.999	.998	.998	.994	.994	.987	.987								
SMOOTH SYM	.996	.996	.991	.991	.982	.982	.967	.967								
UNI					.999	.999	.998	.998								

Note: For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

Table 25

Type II Errors/Power Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90,90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Means are Equal and Variance Change is 2.75.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	0.05		0.025		0.01		0.005		0.05		0.025		0.01		0.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH																
DIGIT PREF	.999	.999	.996	.996	.992	.992	.983	.983								
DISC MASS ZERO	.998	.998	.997	.997	.993	.993	.986	.986								
DISC MASS ZERO GAP	.999	.999	.998	.998	.995	.995	.989	.989								
EXPONENTIAL																
EXTRM ASYM DECAY																
EXTRM BIMODAL																
MULTI-MODAL LUMPY																
NORMAL					.999	.999	.996	.996								
SMOOTH SYM			.999	.999	.997	.997	.993	.993								
UNI																

Note: For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

Table 26

Type II Errors/Power Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90,90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Means are Equal and Variance Change is 3.0.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	0.05		0.025		0.01		0.005		0.05		0.025		0.01		0.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH																
DIGIT PREF					.999	.999	.997	.997								
DISC MASS ZERO	.999	.999	.999	.999	.997	.997	.994	.994								
DISC MASS ZERO GAP	.999	.999	.998	.998	.995	.995	.989	.989								
EXPONENTIAL																
EXTRM ASYM DECAY																
EXTRM BIMODAL																
MULTI-MODAL LUMPY																
NORMAL							.999	.999								
SMOOTH SYM			.999	.999	.998	.998	.996	.996								
UNI																

Note: For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

Table 27

Type II Errors/Power Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90,90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Means are Equal and Variance Change is 3.25.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	0.05		0.025		0.01		0.005		0.05		0.025		0.01		0.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH																
DIGIT PREF					.999	.999	.999	.999								
DISC MASS ZERO			.999	.999	.999	.999	.997	.997								
DISC MASS ZERO GAP	.999	.999	.998	.998	.995	.995	.989	.989								
EXPONENTIAL																
EXTRM ASYM DECAY																
EXTRM BIMODAL																
MULTI-MODAL LUMPY																
NORMAL																
SMOOTH SYM							.999	.999								
UNI																

Note: For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

Table 28

Type II Errors/Power Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90,90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Means are Equal and Variance Change is 3.50.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	0.05		0.025		0.01		0.005		0.05		0.025		0.01		0.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH																
DIGIT PREF							.999	.999								
DISC MASS ZERO			.999	.999	.999	.999	.997	.997								
DISC MASS ZERO GAP			.999	.999	.996	.996	.989	.989								
EXPONENTIAL																
EXTRM ASYM DECAY																
EXTRM BIMODAL																
MULTI-MODAL LUMPY																
NORMAL																
SMOOTH SYM							.999	.999								
UNI																

Note: For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

Table 29

*Location Of First Mean That Causes Mood-Westenberg To Exceed .102 At 30, 30 Sample Size For Various Distributions/Data Sets, Means Changed 10,000 Levels From .00001 To .1. Based On Normal Type I Error Rate Of .068 When K=1 And C=0 For Sample Size 30, 30, When Modified Liberal Robust Equals .068 * 1.5 = .102.*

Distribution	First Mean	MW0.05A	Counts	Percentage Exceed 10.2%	C=0 - MW0.05A
ASYM GROWTH	0.00001	0.138	9797	97.97%	0.062
DISC MASS ZERO GAP	0.00001	0.863	10000	100.00%	0.011
EXTRM ASYM DECAY	0.00001	0.913	10000	100.00%	0.039
EXTRM BIMODAL	0.00001	0.319	10000	100.00%	0.040
DISC MASS ZERO	0.00181	0.104	14	0.14%	0.063
SMOOTH SYM	0.00227	0.103	14	0.14%	0.065
NORMAL	0.00531	0.103	2	0.02%	0.068
MULTI-MODAL LUMPY	0.01355	0.104	13	0.13%	0.068
DIGIT PREF	0.01615	0.104	1	0.01%	0.065
UNI	0.03116	0.103	1	0.01%	0.070
EXPONENTIAL	0.06021	0.104	134	1.34%	0.069
Average first Mean for Non-Highly Sensitive Means (Normal-Like, Multi-Modal Lumpy and Mathematical Distributions/Data Sets)		**0.0186**			

Note. Distributions/Data Sets highly sensitive to means shifts highlighted in yellow.

Table 30

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .01.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.241	.241	.164	.164	.105	.105	.064	.064	.297	.298	.199	.199	.112	.113	.071	.072
DIGIT PREF	.062	.062	.031	.031	.015	.015	.006	.006	.050	.050	.025	.025	.010	.011	.005	.005
DISC MASS ZERO	.074	.074	.039	.039	.020	.020	.009	.009	.042	.042	.021	.021	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.053	.053	.025	.025	.012	.012	.004	.004	.039	.039	.018	.018	.007	.007	.003	.003
EXTRM ASYM DECAY			.999	.999	.998	.998	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.539	.539	.459	.459	.383	.383	.311	.311	.057	.057	.030	.030	.013	.013	.007	.007
MULTI-MODAL LUMPY	.059	.059	.030	.030	.014	.014	.006	.006	.037	.037	.018	.018	.007	.007	.003	.003
NORMAL	.053	.053	.025	.025	.011	.011	.004	.004	.050	.050	.024	.024	.010	.010	.005	.005
SMOOTH SYM	.066	.066	.034	.034	.016	.016	.007	.007	.051	.051	.025	.025	.010	.011	.005	.005
UNI	.053	.053	.026	.026	.011	.011	.004	.004	.051	.051	.026	.026	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 31

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .02.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.240	.240	.164	.164	.107	.107	.065	.065	.298	.298	.199	.200	.113	.114	.072	.073
DIGIT PREF	.061	.061	.031	.031	.015	.015	.006	.006	.051	.051	.025	.025	.011	.011	.005	.005
DISC MASS ZERO	.073	.073	.038	.038	.019	.019	.008	.008	.041	.041	.019	.019	.007	.007	.003	.004
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.056	.056	.027	.027	.012	.012	.005	.005	.031	.031	.015	.015	.005	.005	.003	.003
EXTRM ASYM DECAY			.999	.999	.999	.999	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.538	.538	.459	.459	.384	.384	.312	.312	.056	.056	.030	.030	.014	.014	.008	.008
MULTI-MODAL LUMPY	.059	.059	.029	.029	.014	.014	.006	.006	.038	.038	.019	.019	.007	.007	.003	.004
NORMAL	.052	.052	.025	.025	.011	.011	.004	.004	.050	.050	.025	.025	.010	.010	.005	.005
SMOOTH SYM	.066	.066	.034	.034	.016	.016	.007	.007	.051	.051	.025	.025	.010	.010	.005	.005
UNI	.053	.053	.025	.025	.011	.011	.005	.005	.050	.050	.025	.025	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 32

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .03.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.239	.239	.164	.164	.105	.105	.063	.063	.299	.299	.197	.198	.111	.112	.070	.071
DIGIT PREF	.062	.062	.030	.030	.014	.014	.006	.006	.051	.051	.026	.026	.011	.011	.005	.005
DISC MASS ZERO	.075	.075	.040	.040	.019	.019	.009	.009	.041	.041	.020	.020	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.058	.058	.029	.029	.013	.013	.006	.006	.023	.023	.011	.011	.004	.004	.002	.002
EXTRM ASYM DECAY			.999	.999	.998	.998	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.535	.535	.457	.457	.380	.380	.309	.309	.055	.056	.030	.030	.014	.014	.008	.008
MULTI-MODAL LUMPY	.059	.059	.029	.029	.014	.014	.006	.006	.038	.038	.019	.019	.007	.007	.003	.003
NORMAL	.053	.053	.025	.025	.011	.011	.004	.004	.049	.049	.025	.025	.009	.010	.005	.005
SMOOTH SYM	.066	.066	.033	.033	.016	.016	.007	.007	.050	.050	.025	.025	.010	.010	.005	.005
UNI	.052	.052	.025	.025	.011	.011	.004	.004	.050	.050	.025	.025	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 33

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .04.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.240	.240	.164	.164	.105	.105	.063	.063	.297	.298	.198	.198	.113	.114	.072	.073
DIGIT PREF	.061	.061	.031	.031	.014	.014	.006	.006	.049	.049	.025	.025	.010	.010	.005	.005
DISC MASS ZERO	.076	.076	.040	.040	.020	.020	.009	.009	.042	.042	.020	.020	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.997	.997	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.061	.061	.030	.030	.014	.014	.006	.006	.019	.019	.008	.008	.003	.003	.001	.001
EXTRM ASYM DECAY			.999	.999	.998	.998	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.539	.539	.459	.459	.383	.383	.311	.311	.055	.055	.030	.030	.013	.013	.007	.007
MULTI-MODAL LUMPY	.059	.059	.029	.029	.014	.014	.006	.006	.037	.037	.018	.018	.007	.007	.003	.003
NORMAL	.052	.052	.025	.025	.011	.011	.005	.005	.049	.049	.025	.025	.010	.010	.005	.005
SMOOTH SYM	.067	.067	.034	.034	.016	.016	.007	.007	.050	.050	.025	.025	.010	.010	.005	.005
UNI	.052	.052	.024	.024	.011	.011	.004	.004	.049	.049	.024	.024	.010	.010	.004	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 34

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .05.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.240	.240	.164	.164	.105	.105	.063	.063	.296	.297	.197	.197	.110	.111	.070	.071
DIGIT PREF	.062	.062	.031	.031	.014	.014	.006	.006	.050	.050	.025	.025	.010	.010	.005	.005
DISC MASS ZERO	.073	.073	.038	.038	.018	.018	.008	.008	.042	.042	.021	.021	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.065	.065	.033	.033	.015	.015	.006	.006	.014	.014	.006	.006	.002	.002	.001	.001
EXTRM ASYM DECAY			.999	.999	.998	.998	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.537	.537	.459	.459	.383	.383	.310	.310	.056	.056	.030	.030	.013	.013	.007	.007
MULTI-MODAL LUMPY	.060	.060	.030	.030	.014	.014	.006	.006	.039	.039	.018	.019	.007	.007	.004	.004
NORMAL	.053	.053	.025	.025	.011	.011	.004	.004	.049	.049	.024	.024	.009	.009	.005	.005
SMOOTH SYM	.066	.066	.034	.034	.016	.016	.007	.007	.051	.051	.026	.026	.010	.010	.005	.005
UNI	.052	.052	.024	.024	.011	.011	.004	.004	.050	.050	.025	.025	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 35

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .06.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.240	.240	.163	.163	.105	.105	.063	.063	.298	.298	.198	.198	.111	.112	.071	.072
DIGIT PREF	.063	.063	.031	.031	.014	.014	.006	.006	.050	.050	.025	.026	.010	.011	.005	.005
DISC MASS ZERO	.073	.073	.039	.039	.019	.019	.009	.009	.040	.040	.020	.020	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.071	.071	.037	.037	.018	.018	.008	.008	.011	.011	.005	.005	.001	.001	.001	.001
EXTRM ASYM DECAY			.999	.999	.998	.998	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.537	.537	.459	.459	.383	.383	.310	.310	.056	.056	.031	.031	.014	.014	.007	.007
MULTI-MODAL LUMPY	.060	.060	.030	.030	.014	.014	.006	.006	.038	.038	.018	.018	.007	.007	.003	.003
NORMAL	.053	.053	.025	.025	.011	.011	.005	.005	.050	.050	.025	.025	.010	.010	.005	.005
SMOOTH SYM	.065	.065	.033	.033	.015	.015	.007	.007	.050	.050	.025	.025	.010	.010	.005	.005
UNI	.052	.052	.025	.025	.010	.010	.004	.004	.048	.048	.024	.024	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 36

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .07.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.239	.239	.164	.164	.106	.106	.062	.062	.297	.297	.198	.199	.112	.113	.070	.071
DIGIT PREF	.061	.061	.031	.031	.015	.015	.007	.007	.050	.050	.025	.025	.010	.010	.005	.005
DISC MASS ZERO	.075	.075	.040	.040	.020	.020	.009	.009	.041	.041	.020	.020	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.079	.079	.042	.042	.021	.021	.010	.010	.009	.009	.004	.004	.001	.001	.001	.001
EXTRM ASYM DECAY			.999	.999	.998	.998	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.539	.539	.461	.461	.385	.385	.312	.312	.056	.056	.031	.031	.013	.014	.007	.007
MULTI-MODAL LUMPY	.058	.058	.029	.029	.014	.014	.005	.005	.038	.038	.018	.019	.007	.007	.003	.003
NORMAL	.050	.050	.024	.024	.010	.010	.004	.004	.049	.049	.024	.024	.009	.009	.004	.005
SMOOTH SYM	.066	.066	.033	.033	.015	.015	.007	.007	.051	.051	.026	.026	.010	.010	.005	.005
UNI	.051	.051	.024	.024	.011	.011	.004	.004	.048	.048	.023	.023	.009	.009	.004	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 37

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .08.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.238	.238	.162	.162	.104	.104	.062	.062	.296	.296	.196	.197	.110	.112	.070	.071
DIGIT PREF	.061	.061	.030	.030	.014	.014	.006	.006	.051	.051	.025	.025	.010	.010	.005	.005
DISC MASS ZERO	.076	.076	.040	.040	.019	.019	.009	.009	.041	.041	.019	.020	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.087	.087	.047	.047	.024	.024	.011	.011	.006	.006	.003	.003	.001	.001	.000	.000
EXTRM ASYM DECAY			.999	.999	.998	.998	.996	.996	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.538	.538	.458	.458	.383	.383	.312	.312	.056	.056	.030	.030	.013	.014	.007	.007
MULTI-MODAL LUMPY	.060	.060	.030	.030	.013	.013	.006	.006	.038	.038	.018	.018	.007	.007	.003	.003
NORMAL	.053	.053	.025	.025	.011	.011	.004	.004	.049	.049	.024	.024	.010	.010	.005	.005
SMOOTH SYM	.067	.067	.034	.034	.016	.016	.007	.007	.051	.051	.026	.026	.010	.010	.005	.005
UNI	.053	.053	.025	.025	.011	.011	.004	.004	.050	.050	.025	.025	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 38

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .09.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.238	.238	.163	.163	.105	.105	.062	.062	.298	.298	.198	.198	.111	.112	.070	.070
DIGIT PREF	.060	.060	.030	.030	.014	.014	.006	.006	.049	.050	.025	.025	.010	.010	.005	.005
DISC MASS ZERO	.076	.076	.040	.040	.020	.020	.009	.009	.042	.042	.020	.020	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.096	.096	.054	.054	.027	.027	.013	.013	.005	.005	.002	.002	.000	.000	.000	.000
EXTRM ASYM DECAY			.999	.999	.998	.998	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.538	.538	.459	.459	.384	.384	.311	.311	.055	.055	.029	.029	.013	.013	.007	.007
MULTI-MODAL LUMPY	.075	.075	.039	.039	.019	.019	.009	.009	.022	.022	.009	.009	.004	.004	.002	.002
NORMAL	.052	.052	.025	.025	.011	.011	.005	.005	.049	.049	.026	.026	.010	.010	.005	.005
SMOOTH SYM	.066	.066	.034	.034	.016	.016	.007	.007	.051	.051	.025	.025	.010	.010	.005	.005
UNI	.053	.053	.025	.025	.011	.011	.005	.005	.050	.050	.025	.025	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 39

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .10

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.238	.238	.162	.162	.104	.104	.062	.062	.299	.300	.200	.200	.112	.113	.071	.072
DIGIT PREF	.062	.062	.031	.031	.015	.015	.006	.006	.050	.050	.025	.025	.010	.010	.005	.006
DISC MASS ZERO	.074	.074	.039	.039	.020	.020	.009	.009	.041	.041	.020	.020	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.997	.997	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.106	.106	.060	.060	.032	.032	.016	.016	.004	.004	.002	.002	.001	.001	.000	.000
EXTRM ASYM DECAY			.999	.999	.998	.998	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.535	.535	.458	.458	.381	.381	.310	.310	.056	.056	.030	.030	.014	.014	.007	.008
MULTI-MODAL LUMPY	.076	.076	.041	.041	.020	.020	.009	.009	.022	.022	.010	.010	.004	.004	.002	.002
NORMAL	.052	.052	.026	.026	.011	.011	.005	.005	.049	.049	.025	.025	.010	.010	.005	.005
SMOOTH SYM	.065	.065	.034	.034	.016	.016	.007	.007	.050	.050	.025	.025	.010	.010	.005	.005
UNI	.052	.052	.025	.025	.011	.011	.005	.005	.049	.049	.025	.025	.009	.009	.004	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 40

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .11.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.240	.240	.164	.164	.105	.105	.063	.063	.296	.296	.198	.198	.112	.113	.071	.072
DIGIT PREF	.062	.062	.032	.032	.015	.015	.006	.006	.051	.051	.026	.026	.010	.011	.005	.005
DISC MASS ZERO	.075	.075	.039	.039	.019	.019	.009	.009	.042	.042	.020	.020	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.119	.119	.068	.068	.036	.036	.018	.018	.003	.003	.001	.001	.000	.000	.000	.000
EXTRM ASYM DECAY			.999	.999	.998	.998	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.537	.537	.459	.459	.381	.381	.309	.309	.056	.056	.030	.030	.013	.013	.007	.007
MULTI-MODAL LUMPY	.076	.076	.040	.040	.019	.019	.009	.009	.021	.022	.010	.010	.004	.004	.002	.002
NORMAL	.051	.051	.025	.025	.011	.011	.004	.004	.049	.049	.024	.024	.009	.009	.005	.005
SMOOTH SYM	.068	.068	.036	.036	.017	.017	.007	.007	.050	.050	.025	.025	.010	.010	.005	.005
UNI	.051	.051	.025	.025	.011	.011	.004	.004	.048	.048	.024	.024	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 41

Rejection Rates for Mood-Westenberg and Siegel-Tukey, One-Tailed Directional Test, for Various Alpha Levels and Sample Size of 90, 90 when Sampling is from All Distributions/Data Sets, 100,000 Repetitions, Variances are Equal and Means Shift is .12.

	Mood-Westenberg								Siegel-Tukey							
	Alpha								Alpha							
	.05		.025		.01		.005		.05		.025		.01		.005	
Distribution	A	E	A	E	A	E	A	E	A	E	A	E	A	E	A	E
ASYM GROWTH	.240	.240	.164	.164	.106	.106	.064	.064	.297	.297	.198	.198	.112	.113	.071	.072
DIGIT PREF	.061	.061	.031	.031	.014	.014	.006	.006	.050	.050	.026	.026	.010	.011	.005	.005
DISC MASS ZERO	.074	.074	.039	.039	.019	.019	.008	.008	.041	.041	.020	.020	.008	.008	.004	.004
DISC MASS ZERO GAP			.999	.999	.996	.996	.991	.991	.000	.000	.000	.000	.000	.000	.000	.000
EXPONENTIAL	.133	.133	.079	.079	.043	.043	.022	.022	.002	.002	.001	.001	.000	.000	.000	.000
EXTRM ASYM DECAY	.999	.999	.999	.999	.998	.998	.997	.997	.000	.000	.000	.000	.000	.000	.000	.000
EXTRM BIMODAL	.536	.536	.458	.458	.381	.381	.310	.310	.055	.056	.030	.030	.013	.013	.007	.007
MULTI-MODAL LUMPY	.075	.075	.039	.039	.019	.019	.009	.009	.023	.023	.010	.010	.004	.004	.001	.001
NORMAL	.052	.052	.026	.026	.011	.011	.005	.005	.051	.051	.025	.025	.010	.010	.005	.005
SMOOTH SYM	.067	.067	.035	.035	.017	.017	.007	.007	.051	.052	.026	.026	.010	.010	.005	.005
UNI	.052	.052	.025	.025	.011	.011	.005	.005	.050	.050	.025	.025	.010	.010	.005	.005

Note. For Mood-Westenberg, A=Asymptotic Chi Squared probability, E =Fisher Exact probability; for Siegel-Tukey, A=Asymptotic Z-Score probability, E=Mann-Whitney-U Exact probability.

See Bradley, 1978

Liberal Limits

Non-Robust Conservative Direction		Non-Robust Liberal Direction	
Alpha = .05	P < .025	Alpha = .05	P > .075
Alpha = .025	P < .0125	Alpha = .025	P > .0375
Alpha = .01	P < .005	Alpha = .01	P > .015
Alpha = .005	P < .0025	Alpha = .005	P > .0075
			P = 1.000

Table 42

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.080	.092	.119	.150	.186	.217	.250	.275	.306	.330	.350
.01	.080	.092	.119	.151	.185	.218	.251	.276	.304	.329	.350
.02	.080	.091	.118	.150	.184	.220	.250	.276	.306	.328	.350
.03	.079	.092	.118	.149	.185	.217	.251	.279	.304	.331	.347
.04	.080	.090	.117	.152	.185	.219	.250	.279	.304	.326	.350
.05	.080	.091	.117	.149	.183	.217	.250	.280	.306	.328	.350
.06	.080	.090	.118	.151	.187	.220	.252	.277	.305	.327	.352
.07	.080	.091	.118	.149	.184	.220	.249	.278	.303	.327	.349
.08	.080	.091	.118	.149	.183	.219	.251	.279	.303	.328	.346
.09	.080	.091	.117	.151	.186	.217	.249	.279	.303	.328	.349
.10	.078	.090	.118	.149	.185	.216	.248	.276	.305	.328	.350
.11	.078	.092	.117	.152	.185	.219	.249	.278	.302	.329	.347
.12	.077	.088	.118	.152	.182	.217	.250	.278	.304	.326	.352

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.047	.086	.129	.170	.213	.251	.289	.316	.351	.377	.401
.01	.048	.085	.128	.169	.212	.249	.289	.321	.350	.378	.401
.02	.047	.085	.126	.169	.211	.254	.288	.319	.353	.377	.402
.03	.047	.084	.127	.170	.213	.250	.288	.322	.349	.380	.400
.04	.047	.084	.126	.171	.213	.252	.288	.320	.350	.376	.402
.05	.048	.084	.126	.170	.211	.249	.288	.321	.352	.379	.402
.06	.048	.083	.126	.171	.212	.254	.291	.320	.351	.378	.402
.07	.048	.085	.127	.169	.213	.251	.289	.322	.351	.375	.400
.08	.048	.085	.129	.169	.210	.252	.290	.323	.347	.378	.399
.09	.048	.086	.127	.171	.214	.252	.288	.323	.350	.379	.403
.10	.046	.086	.128	.169	.212	.251	.286	.320	.352	.378	.405
.11	.047	.085	.126	.172	.212	.251	.288	.323	.349	.379	.402
.12	.047	.082	.129	.172	.209	.251	.289	.323	.352	.378	.405

Table 43

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.016	.020	.031	.043	.059	.074	.092	.107	.126	.144	.158
.01	.016	.020	.029	.042	.059	.074	.092	.108	.124	.140	.157
.02	.016	.020	.029	.043	.058	.076	.092	.107	.126	.142	.157
.03	.016	.020	.030	.042	.058	.073	.091	.109	.124	.144	.158
.04	.015	.019	.029	.043	.059	.076	.091	.109	.126	.140	.157
.05	.016	.020	.030	.044	.058	.073	.092	.108	.127	.142	.157
.06	.016	.020	.030	.043	.060	.075	.093	.107	.125	.141	.159
.07	.016	.020	.031	.042	.058	.075	.092	.109	.125	.142	.157
.08	.016	.020	.030	.043	.057	.074	.093	.111	.123	.142	.156
.09	.016	.019	.029	.043	.059	.075	.091	.109	.123	.139	.159
.10	.016	.020	.030	.043	.058	.074	.090	.108	.126	.142	.158
.11	.015	.020	.029	.043	.058	.076	.091	.108	.123	.141	.157
.12	.015	.019	.031	.043	.058	.075	.093	.108	.125	.140	.157

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.004	.008	.015	.021	.029	.037	.045	.053	.062	.072	.080
.01	.004	.008	.014	.021	.029	.036	.046	.054	.062	.070	.080
.02	.004	.008	.014	.021	.028	.038	.046	.054	.063	.072	.079
.03	.004	.008	.014	.021	.028	.035	.045	.054	.061	.071	.078
.04	.004	.008	.013	.021	.029	.037	.045	.054	.062	.069	.078
.05	.004	.008	.013	.020	.029	.035	.045	.053	.062	.070	.077
.06	.004	.008	.013	.021	.029	.036	.045	.053	.061	.068	.080
.07	.004	.008	.014	.020	.028	.036	.045	.053	.060	.070	.078
.08	.004	.008	.013	.021	.027	.035	.045	.053	.059	.069	.076
.09	.004	.007	.013	.020	.028	.037	.044	.054	.060	.068	.078
.10	.004	.008	.013	.020	.027	.035	.043	.053	.061	.068	.077
.11	.003	.008	.013	.020	.027	.035	.044	.052	.059	.067	.076
.12	.003	.007	.013	.020	.027	.036	.045	.053	.060	.068	.076

Table 44

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.033	.044	.071	.108	.151	.200	.248	.293	.336	.375	.416
.01	.032	.043	.072	.108	.154	.201	.247	.293	.335	.379	.415
.02	.033	.043	.071	.108	.153	.199	.247	.291	.337	.377	.417
.03	.033	.044	.070	.107	.152	.199	.248	.290	.336	.376	.417
.04	.032	.045	.071	.108	.153	.200	.247	.293	.337	.377	.415
.05	.033	.042	.072	.110	.152	.201	.244	.292	.337	.379	.415
.06	.032	.043	.071	.109	.151	.198	.248	.294	.338	.378	.418
.07	.032	.043	.069	.109	.150	.201	.245	.292	.336	.379	.415
.08	.033	.042	.071	.108	.151	.198	.246	.295	.338	.378	.414
.09	.032	.042	.070	.108	.150	.197	.247	.293	.335	.379	.414
.10	.033	.043	.072	.106	.151	.199	.246	.292	.336	.377	.417
.11	.033	.043	.069	.108	.151	.200	.246	.292	.337	.378	.414
.12	.032	.043	.071	.107	.149	.198	.244	.290	.334	.378	.411

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.058	.120	.194	.275	.356	.432	.500	.558	.608	.647	.685
.01	.060	.118	.194	.273	.357	.433	.500	.556	.604	.652	.684
.02	.059	.117	.195	.274	.357	.434	.497	.555	.606	.650	.686
.03	.059	.119	.193	.274	.352	.431	.499	.556	.606	.648	.685
.04	.059	.122	.197	.274	.355	.433	.498	.555	.608	.650	.685
.05	.058	.118	.195	.276	.356	.432	.493	.557	.605	.650	.686
.06	.059	.120	.194	.274	.355	.428	.498	.557	.606	.650	.686
.07	.060	.116	.191	.275	.358	.432	.497	.554	.607	.650	.684
.08	.060	.116	.194	.275	.354	.430	.495	.558	.607	.647	.684
.09	.059	.116	.194	.275	.352	.429	.498	.557	.605	.648	.683
.10	.059	.119	.193	.271	.355	.431	.495	.555	.605	.650	.688
.11	.060	.116	.192	.272	.354	.427	.495	.555	.605	.649	.683
.12	.059	.117	.192	.272	.353	.429	.498	.553	.604	.648	.681

Table 45

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.033	.044	.071	.108	.151	.200	.248	.293	.336	.375	.416
.01	.032	.043	.072	.108	.154	.201	.247	.293	.335	.379	.415
.02	.033	.043	.071	.108	.153	.199	.247	.291	.337	.377	.417
.03	.033	.044	.070	.107	.152	.199	.248	.290	.336	.376	.417
.04	.032	.045	.071	.108	.153	.200	.247	.293	.337	.377	.415
.05	.033	.042	.072	.110	.152	.201	.244	.292	.337	.379	.415
.06	.032	.043	.071	.109	.151	.198	.248	.294	.338	.378	.418
.07	.032	.043	.069	.109	.150	.201	.245	.292	.336	.379	.415
.08	.033	.042	.071	.108	.151	.198	.246	.295	.338	.378	.414
.09	.032	.042	.070	.108	.150	.197	.247	.293	.335	.379	.414
.10	.033	.043	.072	.106	.151	.199	.246	.292	.336	.377	.417
.11	.033	.043	.069	.108	.151	.200	.246	.292	.337	.378	.414
.12	.032	.043	.071	.107	.149	.198	.244	.290	.334	.378	.411

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.023	.042	.068	.099	.136	.172	.209	.244	.278	.311
.01	.010	.023	.044	.070	.101	.136	.172	.208	.243	.281	.313
.02	.009	.022	.043	.068	.101	.135	.170	.206	.245	.277	.313
.03	.010	.023	.043	.067	.100	.135	.171	.208	.242	.278	.312
.04	.009	.023	.044	.069	.101	.135	.171	.208	.242	.281	.312
.05	.009	.023	.044	.069	.100	.134	.169	.207	.243	.281	.312
.06	.009	.023	.043	.069	.100	.132	.171	.209	.246	.279	.314
.07	.009	.022	.041	.068	.099	.137	.169	.208	.244	.279	.310
.08	.010	.023	.043	.069	.099	.133	.172	.209	.244	.278	.310
.09	.009	.022	.042	.069	.099	.133	.172	.207	.243	.280	.310
.10	.009	.022	.043	.069	.100	.134	.170	.205	.242	.277	.314
.11	.009	.022	.042	.069	.100	.134	.168	.207	.243	.281	.313
.12	.010	.022	.042	.067	.100	.133	.169	.205	.242	.278	.310

Table 46

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.022	.035	.062	.102	.149	.203	.248	.299	.346	.387	.430
.01	.023	.034	.063	.104	.150	.201	.247	.299	.344	.389	.432
.02	.024	.035	.064	.103	.150	.199	.251	.300	.346	.388	.432
.03	.023	.035	.065	.103	.148	.200	.250	.298	.348	.388	.430
.04	.023	.035	.064	.104	.149	.199	.251	.297	.342	.387	.430
.05	.023	.033	.061	.103	.151	.197	.250	.299	.344	.387	.429
.06	.023	.035	.064	.102	.149	.200	.249	.300	.344	.387	.432
.07	.023	.036	.061	.104	.149	.199	.250	.298	.342	.391	.429
.08	.022	.034	.062	.102	.150	.198	.246	.299	.346	.390	.431
.09	.023	.034	.062	.102	.147	.198	.250	.299	.344	.389	.430
.10	.024	.033	.063	.101	.150	.197	.249	.296	.347	.390	.429
.11	.023	.035	.063	.102	.148	.198	.249	.298	.345	.389	.428
.12	.022	.034	.063	.100	.149	.200	.247	.297	.343	.387	.430

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.044	.111	.203	.304	.400	.490	.563	.624	.683	.723	.760
.01	.044	.113	.203	.304	.399	.488	.562	.624	.681	.724	.760
.02	.045	.112	.204	.303	.400	.490	.565	.627	.679	.721	.761
.03	.045	.112	.204	.302	.399	.489	.562	.627	.679	.724	.761
.04	.045	.112	.202	.303	.400	.485	.566	.626	.678	.722	.762
.05	.046	.110	.202	.305	.401	.485	.562	.626	.680	.726	.759
.06	.045	.110	.202	.304	.403	.487	.564	.628	.678	.723	.762
.07	.045	.114	.198	.305	.401	.488	.564	.626	.681	.724	.761
.08	.044	.113	.202	.303	.402	.486	.561	.627	.679	.723	.761
.09	.045	.111	.203	.302	.397	.485	.561	.628	.681	.722	.760
.10	.044	.110	.202	.303	.398	.488	.564	.627	.681	.723	.760
.11	.044	.111	.202	.301	.399	.488	.563	.626	.682	.724	.760
.12	.044	.110	.203	.300	.399	.488	.563	.626	.681	.721	.761

Table 47

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.022	.035	.062	.102	.149	.203	.248	.299	.346	.387	.430
.01	.023	.034	.063	.104	.150	.201	.247	.299	.344	.389	.432
.02	.024	.035	.064	.103	.150	.199	.251	.300	.346	.388	.432
.03	.023	.035	.065	.103	.148	.200	.250	.298	.348	.388	.430
.04	.023	.035	.064	.104	.149	.199	.251	.297	.342	.387	.430
.05	.023	.033	.061	.103	.151	.197	.250	.299	.344	.387	.429
.06	.023	.035	.064	.102	.149	.200	.249	.300	.344	.387	.432
.07	.023	.036	.061	.104	.149	.199	.250	.298	.342	.391	.429
.08	.022	.034	.062	.102	.150	.198	.246	.299	.346	.390	.431
.09	.023	.034	.062	.102	.147	.198	.250	.299	.344	.389	.430
.10	.024	.033	.063	.101	.150	.197	.249	.296	.347	.390	.429
.11	.023	.035	.063	.102	.148	.198	.249	.298	.345	.389	.428
.12	.022	.034	.063	.100	.149	.200	.247	.297	.343	.387	.430

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.024	.054	.097	.150	.207	.259	.317	.368	.413	.457
.01	.007	.024	.055	.097	.148	.205	.259	.316	.366	.416	.461
.02	.007	.023	.055	.097	.150	.205	.263	.319	.368	.410	.460
.03	.007	.024	.055	.098	.149	.203	.262	.313	.368	.415	.458
.04	.008	.025	.055	.098	.148	.203	.261	.314	.364	.414	.458
.05	.008	.023	.053	.097	.150	.202	.261	.315	.368	.413	.459
.06	.008	.024	.054	.097	.149	.204	.260	.318	.367	.414	.460
.07	.007	.025	.053	.097	.149	.205	.262	.314	.366	.417	.459
.08	.007	.024	.054	.096	.150	.204	.257	.315	.367	.416	.456
.09	.007	.024	.054	.098	.147	.204	.262	.317	.365	.414	.458
.10	.007	.024	.055	.095	.148	.204	.263	.314	.368	.415	.458
.11	.007	.025	.054	.096	.148	.205	.260	.315	.368	.416	.457
.12	.007	.024	.054	.096	.148	.206	.260	.313	.367	.414	.458

Table 48

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.066	.101	.193	.310	.434	.547	.648	.726	.790	.836	.872
.01	.065	.103	.192	.309	.434	.548	.647	.728	.790	.837	.875
.02	.065	.101	.190	.311	.434	.552	.648	.727	.789	.837	.873
.03	.064	.102	.192	.306	.434	.545	.649	.726	.788	.836	.870
.04	.065	.103	.192	.309	.431	.546	.648	.730	.788	.834	.872
.05	.065	.102	.191	.310	.434	.550	.646	.727	.791	.836	.873
.06	.066	.101	.192	.310	.433	.547	.646	.727	.788	.837	.872
.07	.065	.101	.191	.307	.432	.548	.645	.726	.788	.835	.871
.08	.064	.101	.190	.310	.430	.547	.647	.727	.789	.834	.872
.09	.064	.100	.191	.306	.432	.546	.646	.728	.790	.836	.871
.10	.065	.100	.190	.309	.431	.548	.647	.724	.786	.834	.871
.11	.066	.100	.191	.307	.428	.547	.644	.723	.785	.835	.871
.12	.065	.101	.190	.303	.429	.547	.641	.725	.788	.834	.869

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.051	.150	.295	.458	.605	.718	.807	.865	.908	.934	.953
.01	.051	.149	.296	.455	.602	.721	.806	.867	.907	.934	.954
.02	.050	.148	.293	.457	.603	.723	.806	.867	.905	.934	.954
.03	.050	.148	.293	.456	.604	.719	.806	.866	.907	.934	.952
.04	.051	.149	.296	.455	.602	.718	.805	.866	.907	.932	.953
.05	.050	.150	.294	.457	.602	.719	.804	.865	.906	.935	.953
.06	.050	.149	.294	.457	.602	.719	.804	.867	.906	.934	.953
.07	.050	.147	.293	.453	.602	.719	.803	.865	.907	.934	.952
.08	.051	.148	.296	.457	.601	.718	.805	.865	.907	.932	.953
.09	.050	.147	.294	.452	.602	.718	.805	.866	.906	.934	.952
.10	.050	.147	.293	.457	.601	.720	.805	.864	.906	.934	.951
.11	.051	.145	.292	.455	.598	.718	.803	.864	.905	.935	.953
.12	.050	.147	.292	.451	.600	.718	.804	.864	.905	.934	.951

Table 49

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.017	.045	.094	.161	.238	.323	.407	.485	.557	.619
.01	.008	.018	.046	.094	.163	.238	.325	.407	.485	.558	.619
.02	.009	.018	.045	.095	.161	.242	.325	.409	.484	.556	.621
.03	.008	.018	.045	.092	.161	.238	.325	.408	.485	.557	.616
.04	.009	.018	.047	.093	.160	.237	.323	.410	.486	.556	.618
.05	.008	.018	.047	.094	.161	.241	.324	.405	.486	.554	.619
.06	.008	.017	.046	.094	.161	.237	.320	.405	.485	.558	.617
.07	.009	.018	.045	.093	.158	.240	.321	.405	.486	.553	.616
.08	.009	.017	.045	.094	.157	.239	.321	.407	.488	.553	.617
.09	.008	.017	.045	.091	.161	.237	.321	.406	.486	.553	.616
.10	.008	.017	.045	.094	.159	.240	.323	.405	.482	.556	.617
.11	.008	.018	.045	.092	.157	.238	.322	.404	.482	.554	.616
.12	.008	.018	.045	.092	.157	.236	.320	.403	.486	.552	.617

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.037	.098	.187	.298	.408	.518	.609	.689	.752	.800
.01	.010	.039	.099	.188	.299	.411	.517	.611	.687	.752	.804
.02	.010	.040	.098	.189	.295	.412	.520	.610	.684	.753	.801
.03	.010	.038	.099	.187	.298	.409	.519	.609	.688	.752	.800
.04	.010	.039	.100	.187	.296	.408	.518	.612	.687	.749	.802
.05	.010	.039	.098	.187	.298	.413	.516	.610	.686	.749	.801
.06	.010	.039	.098	.189	.296	.409	.514	.611	.687	.751	.801
.07	.010	.038	.096	.186	.295	.411	.515	.607	.688	.750	.800
.08	.010	.038	.098	.187	.295	.409	.515	.610	.690	.748	.799
.09	.010	.037	.097	.184	.296	.408	.516	.611	.691	.750	.797
.10	.009	.038	.096	.187	.295	.410	.516	.609	.686	.750	.799
.11	.010	.038	.097	.186	.291	.410	.514	.607	.684	.750	.798
.12	.010	.038	.097	.184	.294	.407	.512	.607	.687	.748	.800

Table 50

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.072	.131	.276	.451	.611	.744	.838	.898	.938	.960	.974
.01	.070	.131	.274	.449	.615	.743	.837	.898	.937	.961	.975
.02	.072	.133	.274	.449	.614	.743	.838	.898	.936	.960	.975
.03	.073	.131	.272	.449	.612	.743	.837	.898	.938	.960	.975
.04	.071	.132	.275	.450	.615	.743	.838	.900	.938	.962	.975
.05	.072	.131	.272	.448	.611	.743	.836	.896	.935	.960	.973
.06	.072	.131	.273	.447	.610	.745	.837	.898	.938	.961	.974
.07	.071	.130	.271	.448	.614	.744	.835	.898	.937	.960	.975
.08	.070	.130	.273	.447	.612	.740	.835	.898	.936	.959	.974
.09	.071	.131	.273	.450	.609	.742	.834	.897	.935	.959	.974
.10	.072	.129	.273	.449	.613	.741	.834	.898	.935	.959	.973
.11	.070	.129	.272	.448	.611	.742	.836	.897	.934	.959	.973
.12	.072	.129	.273	.448	.611	.742	.833	.895	.936	.958	.973

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.051	.189	.409	.625	.783	.887	.942	.971	.986	.992	.996
.01	.050	.189	.407	.624	.784	.886	.942	.970	.985	.992	.995
.02	.051	.191	.405	.627	.787	.887	.943	.971	.985	.992	.996
.03	.051	.190	.406	.623	.787	.885	.942	.971	.986	.992	.995
.04	.050	.190	.406	.627	.788	.886	.942	.971	.985	.992	.995
.05	.050	.189	.405	.624	.785	.887	.942	.969	.985	.992	.995
.06	.051	.190	.406	.624	.786	.888	.942	.970	.986	.992	.995
.07	.050	.188	.404	.623	.784	.887	.942	.971	.985	.992	.996
.08	.050	.187	.406	.622	.786	.886	.941	.971	.984	.992	.995
.09	.051	.189	.404	.622	.784	.886	.941	.970	.984	.992	.996
.10	.050	.185	.406	.622	.788	.886	.941	.970	.984	.992	.995
.11	.049	.185	.402	.621	.783	.884	.941	.970	.984	.992	.995
.12	.048	.187	.404	.619	.784	.883	.940	.970	.984	.991	.995

Table 51

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.016	.038	.110	.221	.362	.509	.633	.735	.812	.867	.906
.01	.015	.038	.109	.223	.362	.501	.632	.734	.811	.867	.906
.02	.016	.038	.108	.223	.363	.503	.631	.734	.810	.867	.905
.03	.015	.037	.107	.221	.364	.506	.632	.733	.812	.866	.906
.04	.015	.038	.109	.220	.361	.504	.632	.735	.811	.868	.906
.05	.015	.039	.106	.219	.360	.504	.631	.733	.810	.867	.904
.06	.015	.038	.108	.220	.360	.507	.631	.732	.812	.868	.905
.07	.016	.038	.106	.221	.360	.504	.631	.734	.810	.864	.906
.08	.015	.038	.108	.219	.361	.501	.629	.733	.810	.865	.903
.09	.015	.038	.106	.222	.357	.503	.630	.731	.810	.864	.904
.10	.015	.037	.107	.222	.362	.502	.627	.732	.808	.864	.904
.11	.014	.037	.107	.222	.359	.501	.633	.731	.807	.864	.902
.12	.015	.037	.105	.222	.358	.503	.627	.730	.809	.864	.903

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.053	.159	.318	.496	.652	.772	.855	.909	.942	.963
.01	.009	.052	.157	.319	.494	.652	.771	.855	.909	.943	.963
.02	.010	.054	.159	.319	.496	.651	.771	.854	.908	.942	.963
.03	.009	.052	.157	.318	.496	.653	.772	.855	.909	.943	.964
.04	.009	.052	.160	.319	.496	.650	.771	.856	.910	.943	.963
.05	.009	.053	.155	.316	.494	.652	.771	.852	.906	.942	.962
.06	.010	.052	.157	.315	.491	.652	.771	.855	.909	.942	.962
.07	.009	.052	.156	.318	.492	.652	.771	.854	.909	.941	.964
.08	.009	.052	.157	.316	.494	.649	.771	.854	.908	.941	.962
.09	.009	.052	.157	.317	.492	.650	.770	.852	.908	.940	.963
.10	.009	.050	.158	.318	.493	.648	.769	.852	.905	.941	.962
.11	.009	.051	.156	.316	.490	.648	.771	.852	.905	.941	.962
.12	.009	.051	.154	.316	.489	.648	.767	.850	.907	.941	.961

Table 52

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.026	.053	.124	.222	.334	.444	.544	.630	.704	.762	.811
.01	.025	.052	.122	.218	.333	.445	.545	.631	.702	.762	.809
.02	.026	.052	.123	.222	.331	.443	.542	.630	.704	.764	.809
.03	.025	.052	.120	.221	.331	.444	.546	.631	.703	.760	.809
.04	.026	.052	.123	.221	.332	.443	.547	.632	.704	.760	.809
.05	.026	.052	.121	.220	.334	.443	.544	.632	.703	.762	.810
.06	.025	.052	.123	.222	.336	.440	.543	.632	.704	.761	.808
.07	.025	.053	.124	.220	.332	.444	.545	.631	.704	.760	.810
.08	.025	.053	.121	.220	.334	.444	.542	.632	.705	.761	.808
.09	.026	.053	.121	.220	.336	.441	.545	.631	.703	.762	.810
.10	.025	.052	.122	.221	.332	.445	.542	.630	.703	.761	.808
.11	.024	.053	.121	.222	.332	.444	.542	.629	.702	.763	.809
.12	.024	.053	.122	.219	.331	.445	.543	.632	.702	.762	.808

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.175	.367	.551	.704	.808	.877	.922	.949	.967	.979
.01	.048	.175	.363	.550	.705	.809	.878	.922	.949	.966	.978
.02	.048	.177	.364	.555	.703	.809	.879	.921	.949	.967	.977
.03	.047	.175	.364	.553	.701	.808	.877	.922	.949	.966	.978
.04	.049	.175	.362	.552	.701	.808	.879	.922	.949	.968	.978
.05	.048	.174	.363	.551	.704	.808	.877	.922	.949	.966	.978
.06	.047	.175	.364	.554	.703	.805	.877	.922	.949	.967	.977
.07	.048	.177	.363	.552	.703	.808	.878	.922	.949	.966	.978
.08	.048	.174	.363	.550	.704	.809	.877	.922	.950	.966	.978
.09	.048	.175	.361	.552	.704	.808	.878	.922	.949	.967	.978
.10	.048	.175	.364	.551	.702	.808	.877	.922	.948	.966	.978
.11	.047	.176	.361	.553	.703	.808	.876	.922	.948	.966	.978
.12	.048	.175	.363	.551	.703	.809	.879	.921	.950	.966	.978

Table 53

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.004	.010	.034	.076	.137	.210	.289	.369	.445	.513	.578
.01	.004	.011	.033	.075	.136	.208	.291	.364	.445	.513	.578
.02	.004	.011	.033	.076	.135	.208	.286	.366	.445	.515	.578
.03	.004	.012	.033	.076	.135	.207	.289	.368	.445	.514	.577
.04	.004	.011	.033	.076	.134	.208	.289	.368	.444	.514	.576
.05	.004	.011	.033	.075	.136	.209	.289	.367	.445	.515	.579
.06	.004	.010	.035	.076	.136	.208	.286	.367	.443	.513	.578
.07	.004	.012	.034	.075	.134	.208	.289	.368	.442	.511	.579
.08	.004	.010	.032	.075	.136	.206	.287	.369	.444	.513	.577
.09	.004	.011	.033	.075	.138	.207	.288	.367	.442	.515	.575
.10	.004	.010	.034	.076	.135	.208	.287	.367	.444	.513	.577
.11	.004	.011	.033	.076	.136	.209	.286	.370	.442	.515	.578
.12	.004	.011	.033	.076	.135	.209	.287	.368	.443	.513	.578

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.050	.144	.275	.423	.555	.667	.751	.817	.865	.900
.01	.009	.050	.143	.276	.422	.556	.666	.752	.815	.863	.897
.02	.009	.050	.144	.278	.421	.556	.664	.751	.816	.866	.897
.03	.009	.049	.142	.275	.421	.553	.667	.751	.816	.863	.898
.04	.009	.050	.144	.275	.420	.555	.668	.752	.818	.862	.898
.05	.009	.050	.141	.274	.423	.556	.663	.755	.816	.863	.898
.06	.009	.050	.143	.278	.422	.552	.665	.753	.817	.862	.896
.07	.009	.050	.144	.276	.422	.555	.667	.752	.816	.861	.899
.08	.009	.050	.140	.275	.420	.555	.666	.752	.817	.864	.897
.09	.009	.050	.141	.277	.424	.551	.666	.751	.815	.864	.898
.10	.009	.050	.143	.276	.420	.555	.664	.751	.815	.863	.897
.11	.008	.050	.141	.276	.423	.556	.663	.751	.813	.863	.898
.12	.009	.050	.142	.274	.422	.554	.664	.752	.815	.862	.897

Table 54

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.068	.144	.312	.497	.659	.780	.860	.913	.947	.967	.979
.01	.071	.146	.313	.498	.660	.781	.860	.913	.945	.967	.980
.02	.069	.147	.311	.499	.660	.781	.863	.914	.946	.967	.979
.03	.070	.144	.312	.499	.660	.780	.861	.913	.945	.967	.980
.04	.071	.145	.313	.498	.659	.780	.861	.913	.947	.967	.980
.05	.070	.147	.314	.499	.659	.780	.863	.914	.946	.967	.980
.06	.071	.145	.308	.498	.659	.776	.863	.914	.946	.967	.979
.07	.069	.145	.311	.500	.659	.779	.862	.913	.947	.967	.980
.08	.070	.144	.311	.500	.661	.778	.862	.914	.947	.967	.979
.09	.070	.145	.314	.498	.660	.781	.859	.914	.946	.967	.979
.10	.068	.146	.311	.501	.662	.781	.860	.912	.946	.966	.979
.11	.071	.144	.313	.501	.661	.781	.862	.913	.945	.967	.978
.12	.069	.146	.310	.498	.660	.780	.859	.915	.946	.966	.980

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.231	.499	.722	.864	.936	.971	.987	.994	.997	.998
.01	.050	.233	.500	.725	.865	.936	.970	.986	.993	.997	.999
.02	.049	.233	.499	.725	.865	.936	.972	.987	.993	.997	.998
.03	.051	.232	.499	.724	.864	.936	.970	.986	.993	.997	.999
.04	.050	.231	.498	.723	.863	.937	.970	.987	.994	.997	.998
.05	.049	.234	.498	.724	.863	.935	.971	.987	.994	.997	.998
.06	.049	.231	.499	.726	.863	.934	.971	.986	.993	.997	.999
.07	.050	.230	.499	.726	.863	.936	.971	.987	.994	.997	.999
.08	.049	.229	.497	.723	.863	.936	.970	.987	.993	.997	.998
.09	.048	.232	.501	.722	.862	.936	.970	.986	.994	.997	.998
.10	.049	.233	.499	.726	.864	.936	.970	.986	.994	.997	.998
.11	.049	.230	.498	.725	.863	.936	.970	.986	.993	.997	.998
.12	.049	.231	.497	.723	.863	.937	.970	.987	.993	.996	.999

Table 55

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.019	.055	.152	.296	.455	.597	.709	.796	.860	.903	.935
.01	.019	.055	.154	.296	.453	.597	.710	.797	.859	.904	.936
.02	.019	.056	.154	.299	.455	.595	.712	.799	.860	.903	.935
.03	.021	.055	.153	.297	.454	.596	.711	.797	.859	.903	.934
.04	.020	.055	.155	.298	.451	.599	.713	.798	.862	.902	.935
.05	.019	.055	.155	.297	.451	.594	.713	.798	.860	.904	.934
.06	.020	.054	.152	.298	.452	.595	.712	.799	.860	.903	.934
.07	.020	.055	.156	.298	.453	.596	.711	.798	.860	.904	.934
.08	.020	.053	.153	.298	.454	.596	.710	.799	.859	.904	.932
.09	.019	.054	.152	.297	.454	.594	.708	.797	.861	.904	.933
.10	.019	.056	.153	.298	.455	.594	.710	.796	.859	.904	.932
.11	.020	.055	.153	.299	.454	.597	.712	.796	.860	.904	.934
.12	.020	.055	.152	.297	.454	.595	.707	.798	.859	.902	.933

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.075	.236	.452	.649	.790	.879	.931	.961	.978	.988
.01	.010	.076	.239	.453	.650	.791	.878	.931	.961	.979	.987
.02	.009	.076	.238	.454	.648	.790	.881	.932	.961	.978	.987
.03	.010	.076	.239	.454	.649	.789	.880	.931	.960	.979	.988
.04	.010	.075	.238	.453	.646	.791	.880	.931	.962	.978	.987
.05	.009	.075	.238	.452	.647	.789	.880	.932	.962	.978	.988
.06	.010	.074	.237	.452	.647	.788	.879	.930	.960	.978	.987
.07	.010	.075	.238	.453	.647	.787	.880	.930	.962	.978	.987
.08	.009	.074	.236	.456	.648	.788	.878	.932	.961	.977	.987
.09	.010	.074	.237	.450	.646	.789	.877	.932	.961	.978	.987
.10	.009	.076	.234	.455	.649	.789	.878	.930	.961	.978	.987
.11	.009	.075	.235	.452	.649	.790	.880	.932	.961	.978	.986
.12	.009	.074	.235	.452	.648	.791	.877	.932	.961	.977	.987

Table 56

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.056	.167	.426	.691	.863	.949	.982	.994	.998	.999	
.01	.056	.165	.427	.689	.863	.949	.982	.994	.998		
.02	.055	.163	.422	.691	.863	.948	.982	.995	.998		
.03	.056	.164	.422	.689	.864	.948	.983	.994	.998	.999	
.04	.056	.163	.424	.688	.864	.948	.982	.994	.998		
.05	.057	.167	.421	.688	.864	.947	.983	.995	.998	.999	
.06	.057	.164	.419	.688	.862	.947	.982	.994	.998	.999	
.07	.057	.165	.419	.686	.862	.949	.982	.994	.998		
.08	.057	.166	.425	.688	.863	.948	.983	.994	.998	.999	
.09	.057	.163	.422	.687	.860	.946	.982	.994	.998	.999	
.10	.056	.162	.421	.684	.863	.948	.982	.994	.998	.999	
.11	.057	.164	.419	.682	.862	.947	.982	.994	.998	.999	
.12	.056	.159	.419	.684	.860	.947	.982	.994	.998	.999	

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.303	.669	.896	.976	.995	.999				
.01	.051	.301	.674	.895	.976	.995	.999				
.02	.051	.300	.668	.896	.976	.995	.999				
.03	.050	.299	.669	.895	.976	.995	.999				
.04	.050	.302	.669	.895	.976	.995	.999				
.05	.050	.304	.665	.895	.976	.995	.999				
.06	.051	.303	.666	.896	.975	.995	.999				
.07	.050	.302	.663	.892	.975	.995	.999				
.08	.050	.302	.667	.895	.976	.995	.999				
.09	.049	.298	.666	.893	.975	.995	.999				
.10	.049	.296	.665	.893	.974	.995	.999				
.11	.049	.297	.662	.893	.975	.995	.999				
.12	.048	.293	.662	.895	.974	.995	.999				

Table 57

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.006	.032	.142	.350	.584	.771	.889	.950	.979	.992	.996
.01	.005	.031	.143	.349	.584	.774	.888	.951	.978	.992	.997
.02	.006	.031	.140	.349	.581	.770	.889	.951	.979	.991	.997
.03	.006	.031	.141	.350	.581	.772	.891	.949	.979	.991	.996
.04	.006	.031	.142	.350	.586	.770	.887	.950	.979	.992	.996
.05	.006	.032	.141	.348	.582	.769	.889	.951	.978	.991	.996
.06	.006	.031	.141	.348	.582	.771	.887	.949	.979	.991	.996
.07	.005	.032	.140	.348	.580	.772	.889	.949	.978	.991	.996
.08	.006	.032	.142	.348	.584	.769	.889	.949	.978	.991	.996
.09	.006	.032	.141	.347	.580	.768	.887	.951	.979	.991	.997
.10	.005	.031	.141	.343	.580	.767	.887	.950	.978	.991	.996
.11	.005	.031	.141	.341	.578	.768	.887	.949	.978	.991	.996
.12	.006	.031	.139	.343	.576	.766	.884	.948	.977	.991	.996

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.109	.378	.688	.883	.964	.990	.997	.999		
.01	.010	.105	.379	.688	.882	.964	.990	.998	.999		
.02	.010	.106	.374	.687	.882	.964	.990	.998	.999		
.03	.010	.104	.376	.687	.882	.963	.991	.997	.999		
.04	.009	.107	.376	.686	.882	.963	.990	.998	.999		
.05	.009	.107	.373	.686	.882	.963	.990	.998	.999		
.06	.009	.105	.373	.684	.881	.963	.990	.998	.999		
.07	.009	.107	.370	.683	.880	.964	.991	.997	.999		
.08	.010	.107	.377	.686	.882	.963	.990	.997	.999		
.09	.009	.105	.371	.685	.879	.962	.990	.997	.999		
.10	.009	.103	.372	.683	.880	.963	.990	.997	.999		
.11	.010	.104	.369	.681	.878	.962	.990	.997	.999		
.12	.009	.102	.370	.683	.879	.963	.990	.997	.999		

Table 58

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.043	.134	.347	.584	.767	.881	.943	.972	.986	.994	.997
.01	.044	.135	.347	.585	.765	.882	.940	.971	.986	.993	.997
.02	.043	.136	.348	.588	.767	.880	.943	.972	.986	.993	.997
.03	.044	.133	.351	.587	.767	.879	.940	.971	.986	.994	.997
.04	.043	.132	.349	.584	.767	.880	.940	.972	.987	.993	.997
.05	.043	.134	.348	.587	.765	.878	.941	.972	.986	.993	.997
.06	.044	.135	.349	.586	.768	.880	.941	.972	.986	.993	.997
.07	.044	.135	.347	.585	.770	.881	.940	.972	.986	.994	.997
.08	.043	.133	.350	.584	.767	.880	.941	.971	.986	.993	.997
.09	.044	.135	.347	.585	.767	.879	.939	.972	.986	.994	.997
.10	.043	.134	.349	.586	.768	.879	.941	.971	.986	.994	.997
.11	.043	.133	.347	.585	.766	.878	.940	.971	.987	.993	.997
.12	.044	.133	.346	.589	.769	.879	.940	.971	.987	.993	.997

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.304	.654	.872	.961	.989	.997	.999			
.01	.049	.305	.654	.873	.961	.990	.997	.999			
.02	.049	.305	.653	.873	.961	.989	.997	.999			
.03	.050	.303	.656	.873	.960	.989	.997	.999			
.04	.049	.303	.653	.872	.961	.989	.997	.999			
.05	.049	.306	.655	.873	.961	.989	.997	.999			
.06	.050	.302	.655	.871	.961	.989	.997	.999			
.07	.050	.305	.654	.871	.961	.989	.997	.999			
.08	.049	.301	.655	.873	.961	.989	.997	.999			
.09	.050	.304	.652	.872	.960	.989	.997	.999			
.10	.050	.303	.652	.872	.960	.989	.997	.999			
.11	.050	.301	.653	.871	.960	.989	.997	.999			
.12	.050	.304	.652	.873	.960	.989	.997	.999			

Table 59

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.040	.149	.331	.534	.703	.822	.896	.942	.967	.982
.01	.008	.040	.148	.332	.535	.706	.821	.897	.942	.967	.983
.02	.008	.039	.149	.335	.534	.702	.823	.899	.940	.967	.982
.03	.008	.039	.152	.335	.533	.702	.820	.895	.941	.967	.982
.04	.007	.038	.148	.335	.535	.703	.822	.898	.943	.967	.982
.05	.007	.040	.148	.334	.534	.701	.822	.899	.942	.967	.982
.06	.008	.040	.150	.331	.535	.703	.824	.898	.942	.968	.982
.07	.008	.039	.151	.330	.536	.702	.820	.898	.942	.968	.982
.08	.008	.039	.149	.331	.533	.705	.823	.896	.942	.968	.982
.09	.008	.038	.150	.335	.535	.703	.819	.897	.942	.968	.982
.10	.008	.039	.149	.333	.536	.701	.822	.896	.942	.968	.983
.11	.007	.040	.149	.333	.532	.703	.821	.897	.942	.967	.982
.12	.008	.039	.149	.335	.536	.701	.819	.896	.942	.967	.983

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.113	.375	.665	.854	.945	.980	.993	.998	.999	
.01	.009	.113	.376	.667	.854	.943	.979	.993	.997	.999	
.02	.010	.113	.376	.668	.854	.943	.980	.993	.997	.999	
.03	.010	.112	.378	.666	.852	.942	.979	.992	.997	.999	
.04	.009	.111	.380	.667	.854	.942	.978	.992	.997	.999	
.05	.009	.113	.375	.668	.853	.942	.979	.992	.997	.999	
.06	.009	.111	.377	.667	.853	.943	.980	.993	.997	.999	
.07	.010	.112	.377	.663	.854	.943	.979	.992	.997	.999	
.08	.009	.111	.377	.661	.853	.943	.979	.992	.997	.999	
.09	.009	.111	.376	.666	.853	.943	.978	.992	.997	.999	
.10	.010	.111	.376	.664	.854	.942	.979	.993	.997	.999	
.11	.009	.111	.374	.665	.850	.943	.979	.992	.997	.999	
.12	.010	.111	.374	.667	.854	.943	.979	.992	.997	.999	

Table 60

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.041	.173	.474	.748	.899	.965	.989	.997	.999		
.01	.042	.172	.471	.746	.900	.964	.988	.997	.999		
.02	.042	.175	.472	.746	.900	.965	.988	.996	.999		
.03	.042	.174	.472	.751	.900	.965	.989	.996	.999		
.04	.043	.172	.475	.748	.901	.965	.988	.997	.999		
.05	.041	.173	.474	.743	.899	.966	.989	.997	.999		
.06	.042	.173	.473	.746	.899	.964	.989	.996	.999		
.07	.041	.173	.475	.745	.901	.965	.988	.996	.999		
.08	.043	.172	.474	.746	.899	.965	.989	.997	.999		
.09	.041	.172	.472	.745	.899	.965	.988	.996	.999		
.10	.042	.174	.473	.745	.901	.965	.988	.997	.999		
.11	.042	.173	.474	.749	.900	.965	.988	.996	.999		
.12	.042	.171	.475	.746	.899	.965	.988	.997	.999		

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.391	.799	.959	.994	.999					
.01	.049	.390	.794	.957	.994	.999					
.02	.049	.390	.795	.958	.993	.999					
.03	.050	.392	.794	.958	.993	.999					
.04	.051	.391	.796	.960	.994	.999					
.05	.049	.392	.795	.958	.993	.999					
.06	.051	.391	.793	.958	.993	.999					
.07	.050	.389	.796	.957	.994	.999					
.08	.048	.390	.797	.958	.993	.999					
.09	.050	.389	.792	.958	.993	.999					
.10	.049	.391	.795	.958	.994	.999					
.11	.049	.391	.795	.958	.994	.999					
.12	.050	.388	.794	.957	.993	.999					

Table 61

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.069	.274	.554	.775	.901	.961	.984	.995	.998	.999
.01	.011	.069	.275	.552	.776	.899	.961	.986	.994	.998	.999
.02	.010	.072	.273	.553	.774	.901	.959	.985	.995	.998	.999
.03	.010	.069	.272	.557	.774	.899	.961	.985	.994	.998	.999
.04	.010	.069	.275	.553	.773	.901	.960	.985	.994	.998	.999
.05	.010	.071	.275	.552	.772	.901	.961	.985	.994	.998	.999
.06	.010	.070	.273	.550	.771	.900	.960	.985	.994	.998	.999
.07	.011	.070	.274	.553	.774	.901	.960	.985	.994	.998	.999
.08	.010	.069	.274	.552	.772	.900	.959	.986	.994	.998	.999
.09	.010	.069	.273	.550	.771	.901	.961	.985	.995	.998	.999
.10	.011	.070	.275	.550	.776	.900	.959	.986	.994	.998	.999
.11	.010	.069	.275	.552	.775	.899	.960	.984	.995	.998	.999
.12	.010	.068	.273	.552	.773	.901	.959	.986	.994	.998	.999

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.164	.553	.849	.963	.992	.998				
.01	.010	.166	.551	.847	.962	.992	.999				
.02	.009	.167	.550	.848	.963	.992	.998				
.03	.010	.167	.552	.851	.963	.992	.999				
.04	.010	.164	.551	.851	.964	.992	.999				
.05	.010	.167	.550	.848	.962	.993	.999				
.06	.010	.166	.551	.849	.962	.992	.999				
.07	.010	.168	.553	.848	.963	.992	.999				
.08	.009	.165	.553	.850	.964	.992	.999				
.09	.010	.164	.548	.848	.963	.992	.998				
.10	.009	.168	.550	.849	.964	.993	.999				
.11	.010	.166	.552	.850	.963	.992	.998				
.12	.009	.163	.551	.849	.962	.992	.999				

Table 62

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.052	.257	.643	.890	.974	.995	.999				
.01	.053	.253	.644	.889	.974	.995	.999				
.02	.052	.254	.643	.889	.975	.995	.999				
.03	.053	.254	.640	.888	.974	.995	.999				
.04	.052	.254	.644	.889	.975	.995	.999				
.05	.053	.251	.642	.890	.974	.995	.999				
.06	.053	.254	.643	.888	.974	.995	.999				
.07	.050	.254	.644	.889	.974	.995	.999				
.08	.053	.254	.641	.886	.973	.995	.999				
.09	.052	.255	.644	.889	.975	.995	.999				
.10	.052	.253	.643	.889	.974	.995	.999				
.11	.051	.252	.642	.889	.975	.995	.999				
.12	.052	.254	.637	.887	.975	.995	.999				

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.495	.899	.991	.999						
.01	.050	.489	.900	.991	.999						
.02	.050	.492	.900	.991	.999						
.03	.049	.492	.900	.990	.999						
.04	.049	.493	.900	.990	.999						
.05	.049	.489	.899	.991	.999						
.06	.050	.489	.899	.991	.999						
.07	.049	.490	.898	.991	.999						
.08	.049	.492	.900	.991	.999						
.09	.049	.490	.901	.990							
.10	.049	.489	.900	.991	.999						
.11	.049	.491	.900	.990	.999						
.12	.051	.489	.898	.990	.999						

Table 63

Power Rates For One-Tailed Directional Test For Normal Distribution, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.102	.407	.733	.911	.976	.994	.999			
.01	.011	.102	.408	.734	.910	.975	.994	.998			
.02	.011	.103	.410	.732	.910	.976	.994	.999			
.03	.011	.104	.408	.731	.911	.976	.994	.999			
.04	.011	.102	.408	.730	.912	.976	.994	.999			
.05	.011	.102	.409	.735	.911	.976	.994	.999			
.06	.011	.104	.408	.733	.911	.976	.994	.999			
.07	.010	.103	.406	.731	.910	.975	.994	.999			
.08	.011	.103	.406	.729	.909	.977	.994	.999			
.09	.011	.104	.406	.732	.911	.976	.994	.999			
.10	.011	.103	.404	.732	.911	.975	.994	.998			
.11	.011	.102	.406	.731	.910	.976	.994	.999			
.12	.011	.103	.402	.732	.910	.976	.994	.999			

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.240	.721	.951	.994	.999					
.01	.010	.238	.724	.951	.995						
.02	.010	.239	.721	.951	.995						
.03	.009	.239	.720	.951	.995						
.04	.010	.236	.722	.950	.995						
.05	.009	.237	.721	.951	.994						
.06	.010	.239	.720	.951	.994						
.07	.009	.237	.721	.951	.995						
.08	.010	.239	.720	.950	.994						
.09	.010	.238	.721	.950	.995						
.10	.010	.235	.721	.951	.994	.999					
.11	.009	.237	.720	.951	.994						
.12	.010	.237	.717	.950	.995						

Table 64

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.074	.137	.168	.224	.256	.314	.328	.339	.346	.372	.376
.01	.089	.138	.168	.224	.257	.318	.328	.337	.353	.370	.377
.02	.087	.136	.169	.225	.257	.318	.333	.339	.352	.370	.378
.03	.088	.149	.168	.241	.257	.315	.331	.330	.349	.362	.376
.04	.089	.149	.168	.241	.255	.316	.330	.327	.353	.365	.377
.05	.088	.148	.199	.239	.257	.316	.315	.332	.348	.364	.402
.06	.088	.148	.197	.238	.260	.315	.316	.330	.353	.363	.401
.07	.090	.146	.197	.234	.256	.305	.315	.346	.350	.360	.402
.08	.089	.146	.200	.232	.258	.304	.315	.343	.353	.358	.401
.09	.088	.145	.201	.232	.277	.303	.313	.344	.354	.357	.401
.10	.088	.146	.202	.233	.278	.306	.313	.345	.352	.360	.402
.11	.088	.140	.197	.224	.281	.295	.317	.339	.352	.389	.402
.12	.087	.141	.198	.225	.279	.299	.315	.338	.351	.394	.401

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.034	.141	.192	.262	.314	.394	.415	.430	.446	.489	.494
.01	.071	.141	.192	.262	.315	.396	.417	.429	.464	.489	.496
.02	.071	.138	.195	.263	.314	.397	.419	.430	.463	.487	.497
.03	.073	.159	.193	.291	.314	.400	.420	.417	.462	.478	.497
.04	.071	.161	.191	.293	.313	.400	.419	.418	.462	.481	.499
.05	.071	.161	.230	.289	.314	.400	.401	.420	.461	.481	.549
.06	.072	.161	.228	.292	.316	.399	.402	.421	.464	.479	.549
.07	.073	.164	.230	.284	.315	.387	.400	.454	.464	.475	.549
.08	.073	.162	.230	.282	.314	.384	.403	.451	.465	.474	.549
.09	.071	.159	.232	.281	.354	.386	.399	.452	.468	.471	.549
.10	.071	.161	.230	.283	.352	.390	.398	.455	.464	.475	.553
.11	.072	.155	.231	.274	.351	.377	.406	.447	.468	.534	.549
.12	.070	.155	.230	.271	.352	.374	.402	.446	.462	.538	.549

Table 65

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.014	.038	.052	.080	.099	.142	.152	.161	.167	.193	.196
.01	.019	.038	.052	.081	.099	.142	.152	.158	.177	.190	.198
.02	.019	.036	.051	.081	.098	.142	.154	.161	.174	.191	.197
.03	.019	.042	.051	.090	.099	.140	.155	.155	.174	.185	.196
.04	.018	.043	.050	.088	.098	.144	.153	.154	.173	.186	.197
.05	.019	.042	.067	.089	.099	.142	.143	.156	.172	.185	.231
.06	.018	.043	.066	.088	.100	.142	.143	.153	.174	.185	.228
.07	.020	.042	.068	.086	.099	.135	.142	.167	.172	.183	.229
.08	.019	.041	.067	.085	.101	.136	.144	.165	.177	.180	.228
.09	.018	.040	.067	.085	.118	.135	.144	.168	.178	.179	.229
.10	.019	.042	.069	.085	.117	.137	.142	.169	.173	.182	.230
.11	.019	.038	.068	.080	.118	.129	.146	.163	.175	.216	.230
.12	.018	.040	.067	.080	.118	.129	.143	.162	.174	.219	.228

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.017	.022	.033	.039	.053	.055	.058	.058	.069	.070
.01	.007	.018	.023	.034	.039	.052	.055	.058	.062	.068	.071
.02	.007	.017	.022	.033	.038	.053	.057	.058	.061	.069	.070
.03	.007	.019	.022	.035	.038	.051	.056	.055	.061	.066	.071
.04	.007	.019	.022	.034	.038	.052	.057	.056	.060	.065	.070
.05	.007	.019	.027	.034	.040	.052	.050	.057	.060	.066	.079
.06	.007	.019	.027	.035	.039	.052	.050	.056	.061	.066	.076
.07	.007	.017	.027	.033	.039	.047	.051	.058	.061	.065	.078
.08	.007	.018	.027	.033	.039	.048	.051	.058	.061	.064	.078
.09	.006	.018	.028	.033	.041	.048	.051	.059	.060	.063	.079
.10	.007	.018	.028	.032	.040	.048	.051	.059	.061	.064	.078
.11	.007	.016	.027	.030	.041	.046	.052	.057	.062	.073	.077
.12	.007	.016	.027	.030	.042	.047	.051	.056	.062	.075	.077

Table 66

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.032	.096	.127	.194	.226	.282	.303	.318	.325	.364	.375
.01	.039	.094	.126	.195	.226	.280	.303	.320	.325	.361	.373
.02	.040	.095	.127	.195	.227	.281	.303	.318	.326	.360	.373
.03	.040	.102	.127	.204	.227	.277	.304	.311	.328	.351	.373
.04	.041	.106	.127	.201	.225	.275	.302	.310	.324	.351	.375
.05	.040	.104	.161	.203	.226	.275	.287	.309	.326	.352	.371
.06	.039	.104	.160	.203	.228	.273	.287	.310	.327	.348	.374
.07	.039	.100	.160	.194	.229	.264	.286	.309	.324	.343	.375
.08	.039	.102	.161	.189	.226	.264	.285	.307	.327	.340	.374
.09	.039	.101	.160	.189	.225	.266	.286	.309	.325	.344	.370
.10	.040	.101	.161	.192	.228	.268	.283	.312	.327	.341	.374
.11	.040	.096	.160	.180	.225	.253	.287	.299	.324	.350	.371
.12	.040	.094	.159	.181	.224	.253	.283	.302	.327	.351	.373

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.197	.306	.411	.490	.577	.599	.608	.628	.646	.653
.01	.092	.199	.305	.410	.489	.575	.599	.614	.615	.644	.651
.02	.094	.199	.308	.412	.490	.575	.598	.611	.618	.643	.650
.03	.096	.245	.305	.457	.489	.571	.597	.595	.616	.630	.653
.04	.095	.248	.305	.457	.488	.571	.596	.598	.616	.634	.654
.05	.097	.246	.357	.455	.489	.576	.576	.597	.613	.636	.658
.06	.095	.247	.356	.454	.490	.571	.577	.598	.619	.631	.662
.07	.093	.254	.358	.439	.491	.554	.575	.603	.614	.627	.665
.08	.095	.256	.359	.435	.491	.556	.573	.601	.616	.627	.661
.09	.095	.254	.358	.436	.505	.555	.575	.602	.613	.627	.660
.10	.095	.255	.355	.436	.505	.556	.574	.603	.616	.627	.663
.11	.095	.241	.357	.417	.504	.538	.575	.593	.615	.647	.661
.12	.095	.238	.354	.416	.503	.536	.573	.597	.619	.647	.662

Table 67

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.032	.096	.127	.194	.226	.282	.303	.318	.325	.364	.375
.01	.039	.094	.126	.195	.226	.280	.303	.320	.325	.361	.373
.02	.040	.095	.127	.195	.227	.281	.303	.318	.326	.360	.373
.03	.040	.102	.127	.204	.227	.277	.304	.311	.328	.351	.373
.04	.041	.106	.127	.201	.225	.275	.302	.310	.324	.351	.375
.05	.040	.104	.161	.203	.226	.275	.287	.309	.326	.352	.371
.06	.039	.104	.160	.203	.228	.273	.287	.310	.327	.348	.374
.07	.039	.100	.160	.194	.229	.264	.286	.309	.324	.343	.375
.08	.039	.102	.161	.189	.226	.264	.285	.307	.327	.340	.374
.09	.039	.101	.160	.189	.225	.266	.286	.309	.325	.344	.370
.10	.040	.101	.161	.192	.228	.268	.283	.312	.327	.341	.374
.11	.040	.096	.160	.180	.225	.253	.287	.299	.324	.350	.371
.12	.040	.094	.159	.181	.224	.253	.283	.302	.327	.351	.373

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.046	.085	.133	.179	.246	.266	.274	.291	.321	.329
.01	.017	.047	.084	.132	.178	.246	.263	.276	.291	.321	.329
.02	.017	.046	.084	.132	.180	.248	.264	.274	.292	.318	.329
.03	.017	.064	.085	.164	.179	.245	.265	.260	.295	.308	.328
.04	.017	.066	.084	.162	.176	.246	.265	.259	.289	.310	.329
.05	.018	.065	.108	.162	.180	.246	.245	.259	.292	.311	.348
.06	.018	.066	.110	.162	.179	.244	.245	.261	.292	.307	.352
.07	.017	.067	.108	.154	.182	.230	.243	.280	.292	.300	.352
.08	.017	.066	.109	.150	.178	.231	.243	.279	.292	.301	.349
.09	.017	.068	.109	.149	.197	.230	.244	.280	.290	.303	.349
.10	.017	.067	.109	.152	.198	.231	.242	.278	.293	.302	.350
.11	.017	.061	.109	.136	.197	.214	.244	.274	.291	.333	.350
.12	.017	.060	.108	.138	.194	.218	.242	.274	.292	.334	.352

Table 68

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.020	.087	.129	.242	.294	.421	.442	.454	.470	.511	.517
.01	.030	.087	.130	.238	.294	.419	.440	.453	.479	.512	.522
.02	.030	.088	.133	.240	.294	.423	.444	.450	.476	.511	.521
.03	.030	.107	.131	.269	.294	.420	.442	.444	.477	.499	.520
.04	.030	.107	.130	.265	.294	.418	.441	.439	.475	.499	.519
.05	.031	.107	.204	.267	.291	.416	.422	.444	.475	.504	.575
.06	.031	.105	.204	.267	.290	.417	.421	.445	.479	.499	.573
.07	.030	.104	.204	.252	.292	.406	.418	.465	.475	.488	.574
.08	.031	.105	.204	.251	.293	.407	.422	.466	.477	.490	.572
.09	.030	.106	.203	.254	.358	.403	.421	.468	.478	.485	.573
.10	.031	.105	.204	.255	.359	.404	.420	.467	.477	.483	.572
.11	.030	.098	.205	.242	.361	.389	.421	.453	.476	.553	.573
.12	.031	.099	.205	.243	.357	.389	.419	.451	.479	.552	.572

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.038	.218	.351	.493	.599	.716	.750	.762	.804	.825	.831
.01	.086	.217	.351	.491	.601	.715	.749	.760	.800	.824	.832
.02	.087	.217	.354	.494	.599	.717	.751	.760	.800	.826	.832
.03	.086	.276	.352	.560	.602	.727	.751	.747	.799	.814	.830
.04	.087	.274	.354	.561	.602	.726	.749	.745	.799	.816	.830
.05	.088	.275	.429	.562	.600	.725	.725	.747	.799	.816	.867
.06	.086	.273	.426	.563	.599	.727	.725	.747	.801	.814	.865
.07	.086	.284	.427	.538	.600	.709	.726	.788	.799	.809	.865
.08	.086	.287	.426	.540	.600	.709	.725	.789	.799	.808	.864
.09	.084	.286	.425	.541	.656	.708	.724	.789	.799	.806	.865
.10	.087	.288	.426	.542	.656	.707	.726	.788	.799	.806	.865
.11	.086	.273	.428	.520	.655	.689	.726	.779	.799	.855	.865
.12	.087	.272	.429	.520	.653	.689	.722	.780	.800	.853	.865

Table 69

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.020	.087	.129	.242	.294	.421	.442	.454	.470	.511	.517
.01	.030	.087	.130	.238	.294	.419	.440	.453	.479	.512	.522
.02	.030	.088	.133	.240	.294	.423	.444	.450	.476	.511	.521
.03	.030	.107	.131	.269	.294	.420	.442	.444	.477	.499	.520
.04	.030	.107	.130	.265	.294	.418	.441	.439	.475	.499	.519
.05	.031	.107	.204	.267	.291	.416	.422	.444	.475	.504	.575
.06	.031	.105	.204	.267	.290	.417	.421	.445	.479	.499	.573
.07	.030	.104	.204	.252	.292	.406	.418	.465	.475	.488	.574
.08	.031	.105	.204	.251	.293	.407	.422	.466	.477	.490	.572
.09	.030	.106	.203	.254	.358	.403	.421	.468	.478	.485	.573
.10	.031	.105	.204	.255	.359	.404	.420	.467	.477	.483	.572
.11	.030	.098	.205	.242	.361	.389	.421	.453	.476	.553	.573
.12	.031	.099	.205	.243	.357	.389	.419	.451	.479	.552	.572

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.005	.064	.122	.210	.288	.406	.445	.461	.515	.549	.561
.01	.016	.063	.122	.208	.289	.404	.440	.458	.514	.550	.562
.02	.017	.065	.125	.209	.290	.408	.445	.456	.512	.552	.562
.03	.018	.088	.122	.259	.289	.416	.444	.440	.511	.535	.560
.04	.017	.087	.122	.256	.290	.415	.443	.436	.510	.536	.562
.05	.018	.087	.165	.256	.288	.411	.412	.442	.510	.537	.626
.06	.017	.086	.166	.258	.287	.412	.413	.440	.512	.534	.625
.07	.017	.090	.165	.239	.287	.392	.412	.494	.509	.526	.626
.08	.018	.091	.166	.240	.289	.394	.415	.497	.511	.527	.625
.09	.017	.091	.165	.241	.336	.391	.414	.497	.514	.524	.625
.10	.017	.089	.165	.241	.339	.393	.414	.495	.510	.520	.625
.11	.017	.084	.167	.224	.338	.373	.414	.483	.510	.604	.626
.12	.017	.082	.166	.225	.335	.373	.412	.482	.514	.602	.625

Table 70

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.068	.283	.372	.576	.623	.690	.713	.729	.729	.764	.773
.01	.088	.281	.371	.578	.624	.689	.715	.727	.725	.767	.774
.02	.087	.281	.371	.578	.626	.692	.715	.727	.724	.766	.776
.03	.087	.314	.374	.579	.623	.680	.711	.716	.725	.752	.776
.04	.087	.314	.375	.578	.625	.679	.714	.718	.727	.751	.775
.05	.087	.318	.499	.574	.625	.680	.688	.716	.725	.753	.756
.06	.086	.317	.498	.574	.625	.678	.690	.718	.726	.755	.753
.07	.086	.303	.498	.553	.622	.667	.687	.709	.724	.740	.756
.08	.086	.302	.502	.553	.625	.664	.688	.712	.724	.739	.755
.09	.087	.302	.503	.551	.599	.668	.687	.713	.725	.736	.755
.10	.088	.302	.499	.556	.601	.667	.689	.711	.723	.737	.756
.11	.088	.288	.499	.536	.602	.647	.689	.700	.725	.733	.757
.12	.088	.288	.502	.535	.601	.645	.686	.697	.725	.733	.756

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.047	.295	.515	.684	.791	.873	.886	.895	.904	.899	.903
.01	.106	.293	.513	.685	.794	.873	.886	.894	.882	.900	.902
.02	.105	.293	.513	.686	.793	.873	.885	.894	.881	.899	.904
.03	.104	.387	.515	.750	.790	.868	.886	.880	.881	.892	.904
.04	.105	.386	.515	.751	.793	.866	.887	.879	.882	.892	.904
.05	.107	.389	.598	.751	.793	.868	.865	.878	.883	.894	.894
.06	.105	.389	.597	.749	.793	.866	.866	.880	.882	.894	.894
.07	.106	.416	.594	.725	.790	.849	.864	.874	.882	.890	.895
.08	.105	.416	.599	.726	.793	.849	.865	.875	.882	.889	.893
.09	.107	.415	.596	.726	.802	.851	.865	.877	.883	.887	.895
.10	.105	.415	.595	.728	.802	.850	.865	.874	.880	.890	.893
.11	.107	.388	.597	.693	.804	.835	.864	.872	.881	.889	.894
.12	.106	.389	.596	.693	.802	.833	.865	.871	.883	.886	.895

Table 71

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.093	.130	.257	.295	.374	.401	.425	.428	.480	.497
.01	.014	.092	.127	.261	.297	.371	.401	.423	.428	.480	.494
.02	.014	.091	.126	.259	.299	.373	.402	.423	.426	.479	.500
.03	.014	.098	.129	.256	.297	.362	.400	.411	.428	.468	.500
.04	.014	.098	.128	.254	.298	.357	.401	.414	.429	.467	.497
.05	.014	.099	.199	.252	.299	.359	.375	.414	.428	.467	.479
.06	.014	.099	.201	.253	.296	.362	.376	.414	.427	.468	.480
.07	.014	.092	.197	.239	.299	.344	.375	.405	.428	.454	.481
.08	.014	.092	.201	.239	.301	.345	.374	.404	.427	.453	.478
.09	.014	.090	.201	.237	.281	.348	.374	.407	.427	.450	.480
.10	.014	.092	.200	.240	.282	.347	.374	.404	.429	.448	.482
.11	.014	.083	.199	.226	.283	.329	.377	.390	.427	.444	.479
.12	.015	.085	.200	.226	.284	.328	.373	.390	.428	.442	.483

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.099	.233	.381	.518	.664	.693	.710	.732	.745	.754
.01	.025	.098	.230	.385	.518	.663	.693	.709	.711	.748	.756
.02	.025	.097	.229	.384	.520	.665	.694	.710	.709	.748	.758
.03	.024	.155	.233	.467	.517	.659	.691	.679	.711	.734	.756
.04	.025	.154	.234	.467	.519	.657	.693	.681	.713	.734	.756
.05	.025	.156	.302	.465	.520	.657	.650	.680	.712	.734	.769
.06	.025	.155	.302	.466	.518	.656	.654	.683	.711	.735	.767
.07	.025	.170	.299	.438	.520	.625	.653	.693	.711	.726	.769
.08	.025	.171	.305	.438	.520	.623	.654	.697	.711	.726	.767
.09	.025	.169	.305	.437	.550	.628	.652	.700	.711	.723	.770
.10	.025	.171	.303	.440	.553	.628	.652	.696	.709	.725	.769
.11	.025	.152	.304	.398	.552	.600	.651	.688	.710	.756	.769
.12	.025	.151	.302	.400	.551	.598	.652	.687	.712	.752	.772

Table 72

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.081	.404	.530	.787	.822	.861	.879	.885	.887	.912	.913
.01	.110	.406	.535	.785	.823	.862	.879	.886	.882	.911	.914
.02	.110	.403	.532	.788	.825	.861	.878	.885	.883	.913	.913
.03	.111	.462	.532	.779	.825	.852	.878	.881	.883	.900	.913
.04	.111	.460	.532	.783	.822	.853	.879	.882	.883	.897	.914
.05	.111	.461	.713	.783	.823	.855	.859	.880	.883	.898	.899
.06	.111	.460	.716	.781	.824	.854	.858	.880	.884	.899	.898
.07	.111	.445	.716	.762	.822	.846	.858	.875	.884	.886	.899
.08	.110	.443	.714	.760	.823	.847	.859	.876	.883	.889	.898
.09	.111	.440	.714	.761	.791	.846	.859	.877	.883	.887	.898
.10	.111	.437	.714	.761	.788	.846	.858	.878	.883	.887	.901
.11	.110	.422	.714	.749	.788	.829	.859	.860	.884	.883	.899
.12	.112	.413	.712	.748	.792	.828	.859	.861	.882	.886	.900

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.046	.398	.692	.856	.931	.970	.974	.975	.977	.974	.975
.01	.125	.402	.696	.856	.932	.970	.974	.976	.968	.973	.975
.02	.126	.400	.693	.855	.933	.971	.973	.977	.967	.974	.974
.03	.128	.528	.692	.905	.933	.966	.974	.972	.967	.971	.975
.04	.127	.529	.694	.908	.932	.968	.974	.971	.968	.971	.975
.05	.127	.527	.775	.906	.932	.968	.964	.971	.967	.970	.967
.06	.126	.527	.776	.906	.932	.966	.965	.970	.968	.971	.968
.07	.125	.576	.778	.890	.931	.959	.964	.965	.967	.969	.968
.08	.127	.572	.778	.889	.932	.958	.965	.965	.968	.970	.968
.09	.126	.571	.777	.891	.937	.958	.964	.965	.968	.969	.968
.10	.127	.572	.775	.890	.935	.958	.963	.965	.968	.969	.970
.11	.126	.541	.776	.867	.935	.951	.965	.962	.967	.965	.968
.12	.127	.534	.775	.866	.936	.951	.964	.963	.968	.967	.968

Table 73

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.018	.218	.298	.558	.608	.675	.705	.723	.726	.774	.782
.01	.030	.220	.300	.556	.608	.677	.705	.721	.721	.772	.782
.02	.030	.216	.298	.558	.609	.673	.706	.720	.722	.775	.782
.03	.030	.241	.298	.542	.608	.659	.707	.718	.720	.758	.780
.04	.030	.240	.299	.547	.605	.660	.705	.716	.721	.755	.782
.05	.031	.239	.464	.547	.606	.659	.677	.714	.719	.756	.758
.06	.030	.240	.467	.545	.608	.657	.673	.717	.723	.756	.758
.07	.030	.225	.467	.522	.607	.646	.674	.704	.722	.732	.756
.08	.029	.224	.465	.520	.607	.645	.673	.705	.720	.736	.757
.09	.031	.221	.464	.520	.567	.644	.676	.708	.721	.735	.757
.10	.031	.222	.465	.520	.564	.646	.673	.705	.720	.734	.760
.11	.030	.209	.464	.505	.563	.627	.674	.680	.721	.722	.757
.12	.031	.205	.464	.505	.567	.624	.673	.683	.719	.725	.759

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.156	.391	.603	.762	.878	.895	.904	.915	.911	.917
.01	.030	.156	.394	.602	.763	.880	.894	.906	.892	.911	.915
.02	.031	.153	.394	.603	.765	.879	.894	.904	.893	.912	.915
.03	.031	.249	.390	.708	.765	.870	.895	.888	.892	.905	.916
.04	.030	.248	.393	.712	.763	.873	.895	.887	.892	.902	.917
.05	.031	.247	.489	.711	.762	.873	.866	.885	.893	.904	.913
.06	.031	.249	.491	.709	.764	.872	.865	.886	.894	.903	.913
.07	.030	.286	.493	.676	.761	.848	.865	.882	.893	.898	.915
.08	.030	.283	.489	.675	.764	.848	.867	.884	.892	.900	.914
.09	.031	.285	.491	.674	.788	.847	.868	.885	.892	.899	.914
.10	.030	.281	.492	.676	.785	.849	.866	.886	.892	.898	.916
.11	.031	.254	.489	.631	.785	.827	.866	.876	.893	.907	.914
.12	.031	.247	.491	.630	.787	.826	.867	.879	.892	.908	.915

Table 74

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.021	.155	.274	.538	.637	.836	.854	.862	.877	.904	.907
.01	.043	.159	.273	.539	.638	.837	.855	.860	.881	.905	.907
.02	.044	.158	.274	.535	.636	.837	.853	.861	.880	.903	.906
.03	.043	.223	.273	.596	.636	.832	.855	.855	.878	.894	.906
.04	.044	.221	.271	.593	.635	.830	.854	.858	.880	.895	.907
.05	.043	.224	.474	.595	.637	.832	.836	.855	.880	.893	.929
.06	.044	.220	.474	.596	.639	.831	.839	.857	.880	.893	.931
.07	.042	.212	.473	.571	.638	.824	.837	.873	.879	.885	.929
.08	.043	.211	.472	.573	.639	.823	.839	.873	.879	.885	.931
.09	.044	.212	.469	.571	.779	.823	.834	.873	.880	.885	.930
.10	.043	.209	.473	.572	.777	.823	.838	.873	.878	.884	.932
.11	.043	.198	.472	.560	.778	.809	.838	.862	.880	.923	.930
.12	.044	.200	.473	.561	.778	.809	.837	.861	.878	.925	.931

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.043	.371	.638	.804	.907	.959	.976	.978	.988	.991	.991
.01	.123	.374	.636	.804	.907	.960	.977	.978	.988	.991	.991
.02	.125	.373	.639	.803	.905	.960	.976	.979	.987	.991	.991
.03	.121	.483	.637	.882	.906	.969	.976	.973	.987	.989	.991
.04	.124	.482	.637	.880	.906	.968	.976	.973	.987	.989	.991
.05	.121	.485	.729	.881	.907	.968	.968	.973	.987	.990	.996
.06	.123	.479	.729	.881	.905	.969	.967	.973	.987	.989	.996
.07	.123	.531	.729	.861	.906	.962	.968	.986	.988	.988	.995
.08	.124	.531	.729	.862	.907	.961	.968	.986	.988	.989	.995
.09	.125	.532	.728	.861	.941	.962	.967	.986	.987	.988	.995
.10	.121	.526	.729	.863	.939	.962	.967	.986	.988	.989	.996
.11	.123	.511	.728	.843	.940	.954	.968	.984	.987	.994	.995
.12	.124	.513	.729	.842	.940	.954	.967	.984	.987	.995	.995

Table 75

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.060	.108	.307	.378	.620	.648	.658	.677	.727	.733
.01	.009	.060	.107	.308	.377	.621	.648	.656	.684	.727	.733
.02	.009	.060	.108	.304	.376	.620	.645	.658	.679	.728	.732
.03	.009	.083	.107	.340	.377	.611	.650	.649	.680	.711	.732
.04	.008	.082	.106	.335	.378	.611	.646	.653	.681	.707	.734
.05	.009	.081	.252	.337	.376	.609	.618	.648	.680	.706	.790
.06	.009	.081	.251	.336	.380	.611	.621	.651	.681	.707	.792
.07	.008	.076	.250	.315	.378	.598	.621	.669	.684	.690	.791
.08	.008	.075	.252	.317	.379	.595	.622	.669	.682	.689	.792
.09	.009	.076	.248	.314	.532	.597	.618	.667	.680	.693	.789
.10	.008	.074	.249	.314	.532	.599	.623	.669	.679	.690	.791
.11	.009	.068	.250	.302	.531	.577	.620	.649	.679	.771	.792
.12	.009	.069	.251	.306	.533	.577	.617	.650	.680	.774	.791

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.154	.354	.551	.718	.847	.892	.898	.932	.950	.953
.01	.032	.156	.351	.553	.719	.848	.891	.898	.934	.950	.952
.02	.032	.155	.355	.550	.717	.847	.889	.899	.932	.949	.952
.03	.030	.231	.354	.672	.718	.867	.891	.881	.932	.941	.951
.04	.031	.230	.352	.668	.718	.868	.890	.884	.933	.943	.953
.05	.030	.232	.457	.671	.720	.868	.863	.881	.934	.943	.972
.06	.031	.229	.458	.673	.722	.868	.864	.882	.934	.942	.971
.07	.031	.260	.455	.637	.721	.846	.864	.926	.934	.939	.972
.08	.031	.257	.455	.639	.722	.845	.865	.927	.933	.939	.971
.09	.032	.259	.454	.637	.787	.845	.863	.927	.933	.938	.971
.10	.031	.255	.455	.639	.788	.847	.866	.927	.933	.938	.971
.11	.031	.239	.455	.603	.789	.824	.864	.921	.933	.966	.972
.12	.031	.241	.457	.604	.788	.825	.864	.920	.933	.967	.971

Table 76

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.062	.305	.545	.814	.903	.984	.988	.989	.993	.995	.996
.01	.123	.303	.550	.813	.904	.984	.988	.989	.993	.995	.996
.02	.125	.303	.545	.816	.903	.985	.987	.989	.993	.996	.996
.03	.122	.472	.547	.876	.904	.984	.988	.988	.994	.995	.996
.04	.122	.469	.545	.875	.903	.984	.988	.989	.994	.995	.996
.05	.123	.468	.759	.877	.904	.984	.986	.988	.993	.995	.998
.06	.124	.473	.759	.875	.904	.984	.985	.988	.993	.995	.998
.07	.122	.453	.761	.866	.903	.982	.985	.992	.993	.994	.998
.08	.124	.453	.762	.864	.902	.982	.985	.992	.993	.994	.997
.09	.122	.452	.761	.867	.972	.982	.985	.992	.993	.994	.998
.10	.124	.451	.761	.867	.972	.981	.986	.993	.993	.994	.998
.11	.125	.429	.762	.859	.972	.981	.985	.991	.993	.997	.997
.12	.123	.429	.760	.857	.972	.980	.985	.991	.993	.997	.998

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.044	.499	.809	.932	.982	.995	.998	.999	.999		
.01	.154	.499	.808	.933	.982	.995	.998	.999			
.02	.156	.502	.807	.934	.981	.995	.998	.998	.999		
.03	.152	.635	.808	.972	.982	.997	.998	.998			
.04	.153	.634	.808	.972	.981	.997	.998	.998	.999		
.05	.155	.632	.881	.973	.982	.997	.997	.998	.999		
.06	.153	.635	.882	.971	.982	.997	.997	.998	.999	.999	
.07	.153	.704	.884	.965	.981	.996	.997	.999	.999		
.08	.153	.701	.882	.963	.982	.996	.997	.999	.999		
.09	.152	.700	.881	.964	.992	.996	.997	.999	.999		
.10	.156	.699	.884	.964	.991	.996	.997	.999			
.11	.157	.686	.885	.953	.992	.995	.997	.999	.999		
.12	.154	.684	.883	.953	.992	.995	.997	.999			

Table 77

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.017	.176	.348	.683	.790	.954	.961	.965	.973	.982	.982
.01	.046	.176	.354	.682	.791	.954	.961	.966	.973	.982	.982
.02	.045	.176	.348	.684	.790	.955	.961	.964	.973	.981	.982
.03	.045	.283	.351	.747	.791	.952	.962	.963	.973	.978	.982
.04	.045	.283	.351	.745	.789	.951	.962	.964	.974	.978	.982
.05	.045	.283	.614	.748	.791	.951	.955	.962	.973	.978	.989
.06	.045	.284	.613	.743	.788	.950	.954	.964	.973	.978	.988
.07	.045	.267	.615	.730	.791	.947	.954	.970	.973	.975	.988
.08	.045	.267	.615	.728	.790	.948	.955	.970	.973	.975	.988
.09	.044	.268	.614	.729	.924	.948	.954	.971	.973	.974	.989
.10	.046	.268	.617	.731	.925	.946	.956	.971	.974	.975	.988
.11	.046	.251	.616	.720	.924	.943	.956	.966	.973	.987	.989
.12	.045	.248	.614	.717	.924	.942	.955	.966	.972	.987	.988

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.246	.563	.782	.914	.970	.986	.988	.994	.996	.997
.01	.042	.247	.566	.782	.914	.969	.985	.988	.995	.997	.997
.02	.043	.247	.562	.784	.913	.970	.986	.988	.994	.996	.997
.03	.042	.366	.565	.884	.914	.981	.986	.983	.994	.996	.997
.04	.042	.367	.564	.883	.915	.980	.985	.983	.995	.996	.997
.05	.043	.365	.682	.885	.916	.980	.979	.983	.994	.996	.999
.06	.042	.368	.684	.882	.914	.980	.978	.983	.994	.996	.999
.07	.041	.429	.686	.860	.914	.973	.978	.993	.994	.995	.999
.08	.042	.430	.684	.859	.915	.973	.979	.993	.994	.995	.999
.09	.042	.429	.683	.861	.951	.972	.978	.994	.995	.995	.998
.10	.043	.428	.685	.860	.951	.973	.979	.994	.995	.995	.999
.11	.044	.407	.684	.829	.951	.966	.978	.992	.994	.998	.998
.12	.043	.402	.685	.829	.951	.965	.978	.993	.995	.998	.999

Table 78

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.085	.584	.745	.973	.980	.985	.988	.989	.991	.994	.994
.01	.145	.583	.746	.972	.980	.985	.988	.989	.988	.994	.994
.02	.145	.582	.747	.974	.980	.984	.989	.988	.989	.994	.994
.03	.146	.672	.747	.966	.980	.983	.989	.989	.989	.991	.994
.04	.146	.676	.745	.966	.980	.983	.988	.989	.989	.991	.994
.05	.146	.674	.947	.965	.980	.982	.984	.988	.989	.991	.991
.06	.145	.672	.944	.967	.981	.983	.984	.989	.989	.991	.990
.07	.145	.651	.944	.960	.980	.981	.985	.988	.988	.989	.991
.08	.145	.650	.944	.961	.981	.982	.983	.988	.989	.989	.991
.09	.145	.650	.945	.961	.963	.982	.984	.988	.989	.989	.991
.10	.144	.648	.944	.961	.964	.982	.983	.988	.989	.989	.991
.11	.145	.612	.944	.957	.964	.977	.984	.984	.989	.989	.991
.12	.145	.615	.944	.958	.964	.977	.983	.985	.988	.989	.991

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.047	.658	.938	.991	.999						
.01	.179	.654	.940	.991	.999				.999	.999	
.02	.182	.654	.939	.991	.999				.999		
.03	.184	.803	.939	.997	.998				.999	.999	
.04	.183	.804	.938	.997	.998				.999		
.05	.182	.804	.972	.997	.999		.999		.999		.999
.06	.184	.803	.971	.997	.999				.999		.999
.07	.182	.856	.971	.995	.999	.999	.999	.999	.999	.999	.999
.08	.181	.858	.971	.996	.999	.999		.999	.999	.999	.999
.09	.181	.855	.972	.995	.998	.999		.999	.999	.999	.999
.10	.182	.857	.971	.996	.998	.999	.999	.999	.999	.999	.999
.11	.183	.823	.971	.993	.998	.999		.999	.999	.999	.999
.12	.182	.825	.971	.993	.999	.999		.999	.999	.999	.999

Table 79

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.349	.464	.847	.879	.901	.921	.927	.934	.954	.955
.01	.028	.351	.464	.846	.879	.902	.922	.929	.927	.954	.955
.02	.028	.349	.463	.848	.878	.900	.922	.927	.928	.954	.955
.03	.028	.382	.465	.821	.877	.890	.924	.927	.927	.945	.955
.04	.028	.385	.460	.821	.877	.889	.923	.927	.927	.944	.956
.05	.028	.382	.757	.822	.879	.889	.900	.927	.928	.944	.944
.06	.027	.380	.758	.822	.879	.892	.902	.927	.927	.944	.944
.07	.028	.352	.757	.807	.880	.887	.902	.922	.926	.930	.943
.08	.028	.356	.756	.809	.878	.888	.900	.922	.928	.931	.943
.09	.027	.355	.757	.807	.820	.887	.901	.921	.927	.930	.944
.10	.027	.352	.759	.808	.820	.885	.899	.921	.927	.930	.945
.11	.028	.318	.756	.799	.820	.875	.899	.900	.927	.927	.944
.12	.028	.319	.755	.796	.821	.874	.900	.902	.927	.928	.943

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.363	.782	.942	.987	.998	.998	.998	.998	.997	.998
.01	.052	.362	.782	.939	.988	.998	.998	.998	.996	.997	.998
.02	.052	.359	.784	.942	.987	.997	.998	.998	.996	.997	.998
.03	.052	.543	.783	.976	.987	.997	.998	.998	.996	.997	.998
.04	.052	.543	.781	.977	.987	.997	.998	.997	.996	.997	.997
.05	.052	.544	.872	.976	.988	.997	.996	.997	.996	.997	.996
.06	.052	.540	.873	.977	.988	.997	.996	.997	.996	.997	.996
.07	.052	.626	.870	.967	.988	.995	.996	.995	.996	.997	.996
.08	.052	.625	.869	.968	.987	.995	.996	.995	.996	.996	.996
.09	.051	.626	.871	.967	.988	.995	.996	.996	.996	.996	.997
.10	.051	.626	.870	.968	.988	.995	.996	.995	.997	.997	.996
.11	.052	.565	.871	.953	.988	.993	.996	.995	.996	.995	.997
.12	.052	.567	.869	.952	.989	.993	.996	.995	.996	.995	.996

Table 80

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.040	.307	.625	.890	.957	.998	.998	.999	.999		
.01	.115	.306	.629	.889	.958	.998	.999	.999	.999		
.02	.118	.303	.628	.889	.956	.998	.998	.999	.999		
.03	.116	.542	.629	.935	.957	.997	.998	.999	.999		
.04	.116	.543	.629	.935	.955	.997	.998	.999			
.05	.116	.546	.843	.937	.956	.997	.998	.998	.999		
.06	.116	.542	.843	.935	.956	.998	.998	.999			
.07	.116	.518	.842	.930	.957	.997	.998	.999	.999		
.08	.115	.518	.843	.932	.957	.997	.998	.999	.999	.999	
.09	.116	.516	.843	.931	.995	.997	.998	.999	.999	.999	
.10	.114	.516	.844	.931	.995	.997	.998	.999	.999		
.11	.117	.480	.845	.927	.995	.997	.998	.999	.999		
.12	.116	.479	.845	.927	.995	.997	.998	.999	.999		

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.046	.646	.929	.987	.999						
.01	.192	.644	.931	.987	.999						
.02	.195	.644	.929	.988	.999						
.03	.194	.787	.929	.997	.998						
.04	.192	.787	.931	.997	.999						
.05	.194	.788	.970	.997	.999						
.06	.194	.788	.969	.997	.999						
.07	.192	.854	.969	.996	.999						
.08	.192	.854	.969	.996	.999						
.09	.192	.854	.969	.996							
.10	.193	.854	.969	.996							
.11	.192	.844	.971	.993							
.12	.191	.845	.970	.993							

Table 81

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.160	.381	.775	.875	.990	.992	.994	.995	.997	.998
.01	.034	.160	.388	.776	.873	.990	.993	.993	.995	.997	.997
.02	.034	.159	.388	.774	.871	.990	.992	.994	.995	.997	.997
.03	.034	.308	.387	.829	.873	.989	.992	.994	.995	.997	.998
.04	.034	.309	.387	.829	.872	.989	.992	.993	.996	.997	.998
.05	.034	.312	.710	.829	.872	.989	.990	.993	.995	.997	.998
.06	.035	.306	.708	.829	.872	.989	.991	.993	.995	.997	.999
.07	.034	.285	.709	.819	.872	.988	.990	.995	.995	.996	.998
.08	.033	.285	.708	.821	.872	.988	.990	.995	.995	.996	.999
.09	.034	.283	.706	.821	.979	.987	.991	.995	.996	.996	.998
.10	.034	.285	.708	.822	.979	.987	.990	.995	.995	.996	.998
.11	.034	.255	.707	.810	.979	.986	.990	.993	.995	.999	.999
.12	.034	.256	.708	.811	.979	.986	.990	.993	.996	.998	.999

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.377	.779	.938	.989	.998					
.01	.058	.380	.782	.938	.989	.998					
.02	.060	.377	.781	.938	.989	.998	.999				
.03	.059	.545	.781	.980	.988	.999	.999	.999			
.04	.059	.545	.783	.980	.989	.999		.999			
.05	.060	.546	.879	.981	.988	.999	.999	.999			
.06	.059	.544	.879	.980	.989	.999	.999	.999			
.07	.058	.639	.878	.972	.989	.999	.999				
.08	.057	.641	.879	.972	.989	.999	.999				
.09	.059	.640	.878	.972	.996	.999	.999				
.10	.058	.639	.880	.973	.996	.999	.999				
.11	.058	.613	.881	.961	.997	.998	.999				
.12	.059	.614	.879	.959	.996	.998	.999				

Table 82

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.039	.363	.767	.960	.990						
.01	.159	.366	.766	.961	.990						
.02	.159	.365	.769	.959	.991						
.03	.158	.691	.770	.981	.989						
.04	.158	.689	.769	.981	.990						
.05	.157	.693	.932	.980	.990						
.06	.158	.690	.933	.981	.990						
.07	.161	.660	.934	.980	.990						
.08	.158	.661	.933	.980	.990						
.09	.158	.663	.932	.980							
.10	.158	.661	.933	.981							
.11	.158	.611	.933	.978							
.12	.157	.611	.934	.978							

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.045	.783	.983	.999							
.01	.240	.781	.982	.999							
.02	.240	.782	.983	.999							
.03	.241	.901	.984								
.04	.239	.901	.983								
.05	.241	.900	.996								
.06	.241	.900	.996								
.07	.243	.945	.996								
.08	.238	.946	.996								
.09	.241	.946	.995								
.10	.239	.946	.995								
.11	.240	.944	.995								
.12	.240	.942	.995								

Table 83

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.227	.589	.914	.969						
.01	.066	.230	.589	.914	.968						
.02	.067	.227	.592	.913	.968						
.03	.066	.496	.593	.946	.967	.999					
.04	.066	.497	.590	.945	.968	.999					
.05	.067	.502	.867	.945	.969	.999					
.06	.066	.498	.869	.945	.968	.999					
.07	.068	.464	.870	.945	.968	.999					
.08	.066	.466	.868	.944	.968	.999					
.09	.067	.466	.868	.944	.999	.999					
.10	.066	.464	.869	.944	.999	.999					
.11	.068	.413	.870	.941	.999	.999					
.12	.066	.413	.869	.939	.999	.999					

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.543	.924	.991	.999						
.01	.081	.541	.924	.991							
.02	.082	.542	.924	.991	.999						
.03	.082	.729	.926	.999	.999						
.04	.081	.732	.925	.999	.999						
.05	.083	.733	.972	.999							
.06	.082	.731	.974	.999	.999						
.07	.084	.824	.973	.998	.999						
.08	.081	.824	.973	.998	.999						
.09	.082	.825	.971	.998							
.10	.081	.825	.972	.998							
.11	.082	.810	.972	.995							
.12	.081	.809	.973	.996							

Table 84

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.457	.888	.991	.999						
.01	.241	.460	.890	.991	.999						
.02	.240	.460	.888	.991	.999						
.03	.239	.835	.890	.997	.999						
.04	.240	.836	.890	.997	.999						
.05	.240	.835	.981	.997	.999						
.06	.240	.837	.982	.997	.999						
.07	.239	.809	.981	.997	.999						
.08	.238	.809	.981	.997	.999						
.09	.238	.809	.981	.997							
.10	.238	.810	.981	.997							
.11	.240	.758	.981	.996							
.12	.240	.757	.981	.996							

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.046	.886	.997								
.01	.297	.885	.998								
.02	.298	.885	.997								
.03	.299	.965	.997								
.04	.297	.962	.997								
.05	.296	.964									
.06	.298	.964									
.07	.297	.985									
.08	.296	.985									
.09	.298	.986									
.10	.299	.986									
.11	.296	.985									
.12	.297	.985									

Table 85

Power Rates For One-Tailed Directional Test For Asymmetric Growth Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.289	.746	.973	.994						
.01	.105	.292	.750	.972	.993						
.02	.107	.290	.749	.974	.993						
.03	.105	.660	.750	.986	.993						
.04	.105	.660	.749	.986	.994						
.05	.105	.661	.949	.985	.993						
.06	.105	.662	.950	.986	.994						
.07	.106	.625	.950	.986	.993						
.08	.104	.626	.948	.986	.993						
.09	.105	.626	.949	.986							
.10	.104	.628	.948	.985							
.11	.105	.555	.950	.984							
.12	.106	.558	.950	.984							

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.703	.983	.999							
.01	.112	.705	.983	.999							
.02	.113	.706	.983	.999							
.03	.111	.872	.983								
.04	.113	.870	.982								
.05	.110	.872	.997								
.06	.111	.872	.997								
.07	.112	.935	.996								
.08	.110	.934	.996								
.09	.111	.936	.997								
.10	.112	.935	.997								
.11	.112	.931	.997								
.12	.112	.929	.996								

Table 86

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.078	.092	.119	.150	.183	.214	.239	.267	.297	.318	.338
.01	.079	.095	.119	.151	.183	.215	.243	.263	.296	.317	.337
.02	.081	.091	.120	.151	.182	.214	.243	.267	.296	.317	.338
.03	.080	.092	.118	.150	.186	.215	.244	.267	.299	.313	.333
.04	.080	.093	.117	.150	.182	.214	.246	.265	.296	.315	.334
.05	.079	.094	.120	.148	.183	.216	.244	.266	.297	.316	.334
.06	.079	.093	.117	.147	.180	.218	.241	.276	.297	.318	.336
.07	.080	.093	.117	.149	.180	.212	.241	.275	.298	.316	.337
.08	.079	.095	.119	.149	.182	.211	.239	.275	.296	.313	.336
.09	.080	.093	.117	.147	.181	.211	.241	.273	.294	.318	.338
.10	.080	.094	.120	.149	.179	.215	.240	.272	.297	.317	.336
.11	.079	.092	.116	.149	.179	.216	.241	.271	.296	.321	.336
.12	.079	.093	.119	.150	.180	.214	.239	.270	.296	.314	.337

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.041	.085	.128	.168	.209	.247	.277	.307	.341	.364	.388
.01	.048	.088	.128	.170	.209	.247	.278	.305	.341	.364	.386
.02	.048	.084	.129	.169	.208	.247	.282	.308	.342	.364	.386
.03	.048	.084	.126	.169	.212	.247	.281	.307	.343	.362	.383
.04	.048	.084	.127	.167	.207	.247	.282	.306	.340	.362	.384
.05	.048	.086	.128	.167	.208	.251	.282	.306	.342	.364	.384
.06	.048	.086	.126	.167	.208	.249	.277	.318	.341	.367	.384
.07	.049	.086	.126	.167	.208	.242	.280	.317	.343	.362	.389
.08	.049	.089	.127	.167	.208	.245	.277	.319	.341	.363	.387
.09	.048	.088	.125	.166	.209	.244	.278	.316	.340	.367	.390
.10	.048	.089	.128	.168	.207	.248	.276	.314	.341	.367	.390
.11	.047	.087	.127	.170	.206	.249	.278	.314	.342	.369	.388
.12	.048	.088	.127	.170	.208	.248	.276	.314	.344	.366	.389

Table 87

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.016	.020	.030	.044	.057	.072	.086	.103	.120	.134	.149
.01	.016	.021	.031	.043	.056	.072	.087	.101	.120	.136	.147
.02	.016	.020	.031	.042	.056	.072	.089	.102	.122	.135	.150
.03	.016	.020	.030	.042	.059	.074	.089	.101	.121	.133	.146
.04	.016	.020	.030	.042	.056	.074	.089	.101	.120	.131	.147
.05	.016	.021	.030	.042	.057	.074	.089	.101	.122	.133	.148
.06	.016	.021	.029	.042	.056	.074	.086	.106	.122	.135	.148
.07	.016	.021	.029	.042	.056	.072	.086	.107	.121	.133	.150
.08	.016	.022	.030	.042	.056	.071	.087	.107	.121	.132	.149
.09	.016	.021	.030	.041	.057	.071	.086	.106	.119	.134	.149
.10	.016	.021	.030	.042	.057	.073	.087	.106	.120	.134	.151
.11	.016	.020	.029	.042	.055	.073	.087	.105	.120	.137	.149
.12	.016	.020	.031	.042	.057	.073	.087	.104	.121	.134	.149

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.008	.015	.021	.028	.035	.043	.051	.059	.066	.073
.01	.004	.009	.014	.021	.028	.035	.044	.049	.059	.067	.073
.02	.004	.008	.015	.020	.027	.035	.044	.050	.059	.065	.073
.03	.004	.008	.014	.020	.030	.037	.043	.050	.059	.066	.071
.04	.004	.008	.014	.020	.027	.036	.044	.050	.059	.063	.072
.05	.004	.008	.013	.019	.028	.036	.043	.050	.059	.065	.074
.06	.004	.008	.013	.019	.026	.036	.042	.051	.060	.066	.074
.07	.004	.008	.013	.020	.026	.034	.042	.052	.059	.065	.071
.08	.004	.009	.014	.019	.026	.034	.041	.052	.059	.064	.073
.09	.004	.008	.013	.019	.026	.033	.041	.051	.058	.065	.072
.10	.004	.008	.013	.020	.026	.035	.041	.050	.059	.065	.071
.11	.004	.008	.012	.019	.025	.035	.042	.050	.056	.066	.071
.12	.004	.008	.013	.019	.027	.034	.040	.049	.057	.063	.071

Table 88

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.032	.043	.071	.104	.147	.195	.235	.277	.320	.359	.394
.01	.033	.043	.071	.107	.146	.192	.232	.275	.326	.360	.393
.02	.033	.042	.070	.104	.146	.191	.234	.276	.325	.357	.395
.03	.033	.044	.069	.106	.146	.194	.235	.274	.327	.360	.391
.04	.033	.043	.069	.104	.148	.193	.235	.272	.321	.360	.394
.05	.034	.044	.069	.104	.146	.192	.233	.275	.324	.364	.390
.06	.033	.045	.068	.104	.145	.195	.232	.288	.325	.358	.395
.07	.033	.045	.069	.103	.144	.189	.234	.288	.322	.362	.397
.08	.034	.046	.069	.101	.143	.190	.232	.287	.324	.356	.394
.09	.033	.045	.067	.103	.145	.188	.230	.286	.327	.363	.396
.10	.033	.045	.071	.102	.145	.193	.230	.281	.325	.363	.396
.11	.034	.046	.069	.103	.144	.192	.230	.284	.322	.361	.396
.12	.032	.045	.071	.102	.143	.192	.232	.284	.321	.356	.394

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.052	.120	.191	.267	.345	.416	.474	.527	.579	.624	.655
.01	.059	.118	.193	.270	.343	.419	.469	.527	.585	.621	.655
.02	.059	.113	.191	.268	.344	.415	.474	.527	.582	.616	.654
.03	.060	.114	.187	.267	.344	.417	.475	.526	.584	.615	.650
.04	.060	.114	.189	.261	.345	.417	.475	.525	.581	.616	.653
.05	.061	.120	.189	.260	.343	.417	.474	.526	.582	.617	.649
.06	.062	.118	.189	.263	.336	.418	.476	.541	.579	.615	.653
.07	.060	.120	.189	.261	.333	.405	.476	.538	.580	.618	.652
.08	.060	.124	.186	.260	.336	.409	.466	.540	.584	.614	.654
.09	.061	.122	.187	.262	.335	.406	.466	.538	.582	.624	.653
.10	.060	.123	.191	.259	.333	.412	.467	.529	.583	.624	.657
.11	.060	.122	.187	.262	.333	.412	.466	.530	.577	.625	.656
.12	.060	.122	.189	.262	.335	.411	.469	.529	.577	.613	.654

Table 89

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.032	.043	.071	.104	.147	.195	.235	.277	.320	.359	.394
.01	.033	.043	.071	.107	.146	.192	.232	.275	.326	.360	.393
.02	.033	.042	.070	.104	.146	.191	.234	.276	.325	.357	.395
.03	.033	.044	.069	.106	.146	.194	.235	.274	.327	.360	.391
.04	.033	.043	.069	.104	.148	.193	.235	.272	.321	.360	.394
.05	.034	.044	.069	.104	.146	.192	.233	.275	.324	.364	.390
.06	.033	.045	.068	.104	.145	.195	.232	.288	.325	.358	.395
.07	.033	.045	.069	.103	.144	.189	.234	.288	.322	.362	.397
.08	.034	.046	.069	.101	.143	.190	.232	.287	.324	.356	.394
.09	.033	.045	.067	.103	.145	.188	.230	.286	.327	.363	.396
.10	.033	.045	.071	.102	.145	.193	.230	.281	.325	.363	.396
.11	.034	.046	.069	.103	.144	.192	.230	.284	.322	.361	.396
.12	.032	.045	.071	.102	.143	.192	.232	.284	.321	.356	.394

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.023	.042	.066	.094	.129	.157	.188	.224	.257	.284
.01	.010	.024	.043	.068	.095	.127	.155	.185	.229	.256	.284
.02	.010	.021	.043	.067	.094	.127	.157	.186	.229	.251	.284
.03	.010	.022	.042	.067	.096	.128	.160	.189	.228	.253	.281
.04	.010	.022	.040	.065	.098	.129	.157	.187	.224	.251	.282
.05	.010	.022	.041	.064	.095	.129	.157	.189	.225	.255	.282
.06	.010	.024	.040	.064	.091	.131	.155	.199	.226	.252	.283
.07	.009	.023	.041	.064	.091	.123	.158	.201	.225	.253	.285
.08	.011	.025	.042	.062	.090	.122	.153	.199	.228	.253	.285
.09	.010	.024	.039	.064	.089	.123	.151	.199	.229	.260	.284
.10	.009	.024	.040	.063	.090	.126	.154	.191	.228	.261	.288
.11	.010	.024	.040	.064	.090	.126	.154	.192	.227	.259	.285
.12	.010	.024	.042	.064	.090	.126	.154	.192	.223	.251	.286

Table 90

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.022	.035	.061	.096	.142	.189	.230	.276	.327	.364	.402
.01	.023	.035	.062	.100	.141	.188	.230	.272	.327	.364	.402
.02	.024	.035	.064	.100	.142	.188	.233	.276	.329	.367	.398
.03	.024	.035	.062	.099	.143	.190	.235	.272	.332	.365	.397
.04	.024	.034	.060	.097	.142	.189	.231	.274	.330	.366	.401
.05	.024	.037	.061	.098	.141	.190	.231	.274	.328	.367	.400
.06	.023	.036	.061	.098	.138	.190	.231	.292	.329	.364	.403
.07	.024	.036	.061	.099	.138	.184	.231	.291	.327	.363	.403
.08	.024	.037	.061	.096	.140	.184	.229	.295	.328	.367	.407
.09	.023	.037	.061	.097	.137	.184	.229	.295	.327	.366	.407
.10	.023	.038	.062	.096	.139	.189	.227	.289	.329	.367	.404
.11	.023	.037	.062	.098	.142	.192	.229	.290	.330	.366	.405
.12	.023	.037	.063	.099	.137	.189	.228	.288	.328	.363	.403

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.043	.113	.200	.296	.391	.476	.537	.598	.656	.696	.727
.01	.045	.112	.202	.298	.391	.476	.532	.591	.653	.695	.731
.02	.046	.110	.204	.299	.393	.472	.543	.594	.656	.688	.724
.03	.046	.110	.202	.300	.391	.476	.542	.597	.656	.690	.726
.04	.045	.109	.200	.290	.391	.477	.541	.594	.658	.689	.725
.05	.046	.112	.200	.291	.391	.476	.540	.597	.655	.689	.725
.06	.046	.113	.200	.295	.381	.476	.540	.611	.657	.691	.730
.07	.045	.115	.199	.292	.383	.464	.541	.611	.655	.690	.731
.08	.045	.119	.198	.293	.383	.463	.534	.615	.658	.692	.732
.09	.045	.120	.200	.292	.382	.461	.531	.615	.655	.699	.732
.10	.045	.118	.201	.291	.382	.472	.529	.602	.656	.700	.727
.11	.046	.117	.201	.292	.384	.471	.532	.600	.654	.700	.732
.12	.045	.117	.204	.296	.381	.470	.530	.599	.652	.689	.731

Table 91

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.022	.035	.061	.096	.142	.189	.230	.276	.327	.364	.402
.01	.023	.035	.062	.100	.141	.188	.230	.272	.327	.364	.402
.02	.024	.035	.064	.100	.142	.188	.233	.276	.329	.367	.398
.03	.024	.035	.062	.099	.143	.190	.235	.272	.332	.365	.397
.04	.024	.034	.060	.097	.142	.189	.231	.274	.330	.366	.401
.05	.024	.037	.061	.098	.141	.190	.231	.274	.328	.367	.400
.06	.023	.036	.061	.098	.138	.190	.231	.292	.329	.364	.403
.07	.024	.036	.061	.099	.138	.184	.231	.291	.327	.363	.403
.08	.024	.037	.061	.096	.140	.184	.229	.295	.328	.367	.407
.09	.023	.037	.061	.097	.137	.184	.229	.295	.327	.366	.407
.10	.023	.038	.062	.096	.139	.189	.227	.289	.329	.367	.404
.11	.023	.037	.062	.098	.142	.192	.229	.290	.330	.366	.405
.12	.023	.037	.063	.099	.137	.189	.228	.288	.328	.363	.403

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.025	.054	.093	.143	.196	.244	.293	.347	.386	.425
.01	.007	.025	.055	.097	.144	.197	.242	.289	.345	.386	.423
.02	.007	.023	.055	.096	.144	.195	.247	.289	.345	.383	.419
.03	.008	.024	.053	.096	.145	.197	.249	.291	.348	.381	.420
.04	.008	.023	.053	.093	.145	.199	.243	.292	.348	.382	.424
.05	.008	.025	.054	.093	.143	.199	.246	.290	.346	.382	.423
.06	.007	.025	.053	.093	.138	.198	.245	.306	.346	.384	.424
.07	.007	.025	.053	.093	.138	.189	.246	.304	.346	.382	.427
.08	.007	.026	.053	.093	.141	.189	.241	.308	.348	.384	.429
.09	.008	.026	.053	.092	.139	.192	.239	.308	.345	.395	.430
.10	.008	.027	.053	.092	.139	.195	.237	.299	.345	.395	.424
.11	.008	.026	.054	.093	.142	.195	.239	.295	.345	.393	.427
.12	.007	.025	.054	.093	.138	.195	.239	.295	.343	.380	.426

Table 92

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.063	.100	.185	.287	.406	.524	.612	.687	.766	.813	.846
.01	.066	.102	.185	.292	.409	.521	.608	.684	.768	.811	.846
.02	.066	.099	.183	.293	.409	.526	.614	.688	.769	.812	.845
.03	.066	.098	.178	.292	.406	.521	.614	.684	.766	.812	.846
.04	.068	.098	.181	.287	.406	.523	.613	.682	.767	.811	.845
.05	.067	.103	.180	.289	.410	.522	.609	.685	.767	.811	.844
.06	.066	.104	.179	.287	.400	.526	.611	.709	.768	.807	.845
.07	.066	.102	.179	.287	.400	.510	.610	.708	.767	.806	.844
.08	.066	.106	.178	.284	.402	.513	.608	.708	.766	.810	.845
.09	.066	.108	.179	.284	.403	.512	.607	.707	.766	.806	.846
.10	.066	.107	.187	.284	.402	.524	.607	.705	.767	.807	.847
.11	.066	.107	.186	.287	.402	.523	.609	.705	.761	.807	.846
.12	.065	.105	.186	.289	.403	.525	.607	.708	.761	.800	.844

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.149	.290	.439	.582	.698	.775	.834	.886	.917	.936
.01	.052	.150	.291	.442	.586	.696	.774	.834	.887	.916	.935
.02	.052	.138	.289	.443	.586	.699	.779	.836	.888	.913	.934
.03	.051	.137	.281	.444	.584	.695	.779	.836	.886	.911	.935
.04	.052	.138	.283	.427	.584	.700	.778	.835	.887	.910	.935
.05	.052	.147	.280	.428	.584	.699	.777	.835	.887	.911	.934
.06	.051	.147	.283	.429	.567	.701	.777	.849	.889	.912	.936
.07	.051	.146	.280	.430	.568	.680	.779	.847	.887	.911	.935
.08	.051	.155	.280	.427	.568	.681	.763	.847	.887	.911	.935
.09	.051	.155	.281	.428	.568	.678	.763	.847	.886	.915	.936
.10	.051	.155	.288	.428	.568	.687	.761	.836	.886	.917	.935
.11	.051	.156	.283	.430	.568	.687	.765	.834	.879	.916	.936
.12	.050	.152	.286	.432	.568	.692	.762	.836	.878	.906	.936

Table 93

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.017	.043	.086	.147	.224	.298	.369	.463	.525	.581
.01	.009	.018	.044	.088	.150	.222	.296	.369	.463	.524	.584
.02	.009	.017	.042	.088	.150	.223	.297	.371	.465	.531	.581
.03	.009	.017	.042	.087	.149	.222	.296	.370	.466	.531	.582
.04	.009	.017	.043	.085	.146	.226	.297	.366	.463	.527	.579
.05	.009	.018	.043	.085	.148	.223	.297	.368	.465	.529	.581
.06	.009	.018	.042	.085	.144	.227	.297	.393	.465	.526	.581
.07	.009	.018	.043	.086	.143	.215	.295	.393	.464	.524	.582
.08	.008	.019	.042	.084	.144	.217	.293	.393	.462	.523	.583
.09	.009	.019	.043	.083	.146	.215	.293	.394	.465	.522	.586
.10	.009	.019	.045	.084	.144	.222	.289	.391	.463	.522	.585
.11	.009	.019	.044	.085	.145	.223	.294	.388	.455	.521	.584
.12	.009	.019	.045	.086	.145	.226	.292	.390	.460	.513	.585

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.039	.098	.177	.278	.387	.475	.555	.648	.710	.754
.01	.010	.040	.097	.181	.283	.386	.472	.554	.649	.709	.754
.02	.010	.036	.096	.182	.281	.387	.481	.560	.651	.700	.754
.03	.010	.035	.091	.182	.281	.384	.481	.559	.648	.698	.756
.04	.010	.036	.093	.168	.281	.392	.481	.558	.648	.695	.751
.05	.011	.038	.091	.169	.282	.389	.479	.559	.650	.697	.754
.06	.010	.039	.091	.171	.264	.393	.480	.582	.648	.698	.755
.07	.010	.039	.093	.170	.265	.364	.480	.582	.648	.695	.753
.08	.011	.042	.092	.167	.267	.367	.459	.581	.647	.698	.754
.09	.010	.041	.092	.169	.267	.365	.460	.579	.650	.712	.755
.10	.010	.042	.095	.168	.265	.374	.458	.561	.647	.714	.757
.11	.010	.041	.092	.170	.268	.374	.464	.558	.636	.710	.756
.12	.010	.040	.093	.174	.266	.378	.459	.562	.636	.688	.756

Table 94

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.068	.133	.257	.413	.573	.711	.798	.862	.921	.944	.962
.01	.074	.130	.260	.417	.574	.711	.795	.862	.920	.944	.962
.02	.074	.126	.263	.418	.576	.707	.798	.863	.920	.948	.962
.03	.074	.126	.249	.420	.571	.710	.798	.860	.920	.947	.962
.04	.074	.125	.247	.407	.572	.710	.796	.862	.919	.948	.961
.05	.075	.129	.251	.408	.573	.710	.799	.858	.920	.946	.961
.06	.074	.125	.248	.405	.562	.712	.799	.882	.921	.943	.962
.07	.074	.129	.250	.407	.567	.695	.798	.880	.921	.945	.962
.08	.075	.138	.250	.404	.566	.700	.795	.880	.920	.943	.962
.09	.076	.138	.250	.406	.564	.696	.795	.881	.921	.943	.961
.10	.076	.136	.259	.406	.565	.714	.795	.879	.919	.943	.961
.11	.075	.136	.262	.412	.562	.713	.796	.883	.917	.942	.961
.12	.073	.139	.261	.410	.565	.712	.796	.882	.917	.941	.962

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.194	.401	.601	.768	.868	.925	.956	.978	.987	.992
.01	.051	.192	.403	.610	.769	.869	.923	.957	.978	.987	.992
.02	.051	.176	.405	.610	.771	.868	.925	.957	.978	.986	.992
.03	.051	.176	.387	.609	.764	.868	.926	.957	.977	.986	.992
.04	.052	.176	.385	.587	.767	.873	.925	.957	.978	.986	.992
.05	.053	.185	.388	.588	.767	.870	.926	.956	.978	.986	.992
.06	.051	.185	.384	.584	.750	.874	.925	.963	.978	.986	.992
.07	.052	.185	.387	.584	.752	.854	.926	.962	.978	.985	.992
.08	.052	.199	.388	.587	.751	.856	.914	.962	.978	.986	.992
.09	.052	.198	.387	.588	.749	.853	.916	.963	.978	.988	.992
.10	.053	.200	.392	.587	.750	.860	.915	.955	.977	.987	.992
.11	.051	.196	.391	.592	.747	.862	.915	.956	.976	.988	.992
.12	.051	.197	.392	.593	.749	.860	.918	.956	.975	.984	.993

Table 95

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.015	.039	.101	.198	.329	.473	.581	.679	.783	.834	.874
.01	.016	.038	.101	.201	.331	.470	.582	.681	.782	.831	.875
.02	.017	.036	.104	.203	.332	.468	.583	.681	.783	.843	.873
.03	.016	.036	.097	.202	.328	.469	.583	.678	.782	.838	.874
.04	.017	.036	.094	.193	.330	.474	.582	.678	.781	.842	.874
.05	.017	.038	.097	.196	.328	.472	.584	.675	.782	.841	.873
.06	.016	.037	.095	.194	.320	.473	.583	.711	.782	.836	.875
.07	.016	.038	.097	.193	.323	.455	.583	.708	.784	.834	.877
.08	.016	.042	.097	.193	.320	.458	.578	.707	.782	.833	.877
.09	.016	.042	.097	.193	.320	.457	.580	.709	.784	.831	.876
.10	.017	.041	.102	.193	.323	.469	.576	.707	.781	.832	.877
.11	.016	.040	.103	.198	.320	.471	.578	.708	.778	.830	.876
.12	.016	.042	.103	.198	.320	.470	.579	.707	.777	.827	.877

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.054	.156	.299	.471	.621	.728	.809	.880	.919	.942
.01	.010	.055	.155	.306	.472	.617	.727	.808	.881	.918	.943
.02	.010	.046	.158	.308	.472	.618	.731	.809	.879	.914	.941
.03	.010	.047	.147	.306	.468	.617	.731	.809	.880	.912	.942
.04	.010	.047	.144	.283	.469	.627	.731	.810	.879	.912	.942
.05	.010	.051	.146	.284	.469	.626	.733	.811	.880	.912	.941
.06	.010	.050	.146	.282	.445	.626	.732	.829	.879	.912	.942
.07	.010	.051	.146	.283	.449	.592	.730	.828	.881	.911	.943
.08	.010	.057	.149	.283	.445	.596	.710	.827	.880	.912	.944
.09	.010	.056	.147	.285	.446	.592	.710	.827	.882	.920	.943
.10	.010	.056	.148	.283	.447	.606	.706	.806	.878	.921	.943
.11	.009	.055	.148	.289	.444	.605	.706	.809	.872	.919	.943
.12	.010	.056	.148	.291	.444	.605	.710	.806	.869	.908	.943

Table 96

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.024	.053	.119	.195	.307	.416	.495	.578	.676	.728	.768
.01	.028	.054	.117	.205	.307	.414	.495	.579	.675	.727	.766
.02	.027	.049	.119	.203	.305	.413	.499	.578	.676	.731	.766
.03	.027	.051	.113	.205	.307	.415	.501	.570	.675	.732	.768
.04	.026	.051	.114	.202	.307	.408	.504	.569	.676	.727	.769
.05	.027	.055	.112	.201	.306	.408	.505	.568	.675	.728	.769
.06	.027	.055	.112	.199	.302	.409	.503	.620	.676	.722	.766
.07	.026	.055	.112	.200	.301	.402	.501	.620	.674	.726	.773
.08	.027	.057	.113	.196	.302	.401	.499	.620	.674	.724	.773
.09	.027	.057	.115	.197	.301	.404	.499	.621	.674	.720	.771
.10	.027	.057	.117	.198	.301	.427	.500	.622	.675	.723	.771
.11	.027	.058	.119	.200	.302	.429	.498	.623	.678	.721	.774
.12	.026	.057	.119	.199	.303	.429	.498	.622	.679	.717	.773

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.177	.366	.535	.687	.789	.849	.897	.933	.954	.963
.01	.050	.179	.362	.543	.687	.788	.849	.897	.932	.953	.963
.02	.050	.168	.363	.540	.686	.788	.853	.896	.933	.948	.963
.03	.050	.168	.354	.543	.688	.789	.853	.897	.933	.949	.964
.04	.049	.169	.355	.524	.690	.794	.853	.897	.934	.947	.964
.05	.049	.179	.352	.527	.685	.792	.855	.897	.932	.947	.964
.06	.049	.177	.352	.525	.673	.793	.855	.906	.933	.947	.964
.07	.049	.178	.351	.521	.671	.774	.855	.904	.932	.949	.966
.08	.050	.185	.354	.525	.669	.774	.843	.907	.932	.948	.965
.09	.050	.186	.356	.526	.672	.773	.842	.906	.931	.954	.965
.10	.050	.185	.357	.528	.670	.779	.843	.895	.933	.954	.964
.11	.050	.186	.361	.535	.671	.780	.844	.893	.929	.954	.965
.12	.050	.184	.362	.534	.670	.782	.841	.896	.931	.948	.965

Table 97

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.011	.033	.065	.122	.192	.251	.322	.421	.478	.531
.01	.004	.012	.032	.070	.122	.190	.251	.323	.419	.477	.527
.02	.004	.010	.033	.070	.120	.190	.254	.321	.421	.484	.528
.03	.004	.011	.032	.069	.122	.191	.257	.318	.421	.486	.528
.04	.004	.010	.031	.069	.122	.187	.257	.316	.419	.481	.531
.05	.004	.012	.032	.067	.121	.188	.259	.318	.422	.484	.532
.06	.004	.012	.030	.065	.118	.187	.259	.364	.422	.477	.531
.07	.004	.012	.031	.067	.120	.181	.256	.363	.420	.477	.537
.08	.004	.013	.031	.064	.119	.183	.255	.364	.420	.480	.538
.09	.004	.012	.031	.065	.118	.184	.255	.365	.419	.471	.536
.10	.004	.012	.033	.065	.119	.199	.256	.364	.420	.474	.536
.11	.004	.013	.033	.068	.120	.201	.255	.364	.422	.472	.541
.12	.004	.012	.033	.066	.120	.201	.253	.366	.422	.467	.538

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.052	.145	.262	.406	.532	.621	.703	.781	.829	.861
.01	.010	.052	.142	.271	.405	.529	.625	.707	.778	.829	.858
.02	.009	.046	.143	.271	.406	.530	.627	.704	.781	.817	.859
.03	.009	.049	.138	.272	.408	.531	.627	.707	.779	.819	.860
.04	.009	.047	.138	.258	.407	.535	.632	.707	.781	.816	.861
.05	.009	.052	.137	.256	.408	.535	.632	.706	.780	.816	.862
.06	.009	.051	.137	.255	.389	.536	.631	.725	.782	.818	.859
.07	.009	.051	.137	.256	.389	.514	.629	.725	.778	.821	.865
.08	.009	.056	.137	.255	.388	.512	.612	.727	.781	.819	.865
.09	.009	.054	.139	.257	.389	.513	.610	.725	.780	.832	.864
.10	.009	.054	.139	.257	.391	.519	.612	.707	.781	.836	.862
.11	.009	.054	.141	.265	.391	.523	.612	.705	.775	.833	.864
.12	.010	.054	.140	.260	.392	.524	.611	.705	.776	.815	.863

Table 98

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.065	.145	.292	.441	.613	.743	.817	.874	.930	.951	.965
.01	.073	.142	.291	.457	.611	.744	.813	.873	.930	.951	.965
.02	.073	.135	.291	.458	.615	.742	.821	.875	.930	.952	.964
.03	.073	.134	.279	.456	.612	.743	.820	.867	.931	.953	.965
.04	.072	.133	.281	.454	.612	.730	.821	.866	.929	.953	.965
.05	.072	.141	.276	.452	.614	.730	.820	.866	.927	.954	.965
.06	.073	.143	.278	.451	.611	.730	.821	.904	.931	.949	.964
.07	.073	.142	.278	.454	.607	.727	.819	.905	.930	.950	.966
.08	.073	.151	.281	.445	.611	.727	.818	.902	.930	.949	.967
.09	.075	.150	.280	.444	.613	.727	.819	.903	.931	.948	.967
.10	.074	.150	.292	.443	.610	.761	.819	.908	.930	.948	.967
.11	.073	.148	.292	.447	.611	.760	.818	.907	.933	.948	.967
.12	.073	.153	.292	.443	.610	.762	.818	.908	.932	.948	.967

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.047	.237	.498	.706	.849	.922	.957	.977	.989	.994	.996
.01	.051	.234	.498	.711	.849	.922	.957	.978	.989	.994	.996
.02	.051	.219	.498	.714	.849	.922	.958	.976	.988	.992	.996
.03	.053	.217	.482	.710	.849	.922	.960	.978	.989	.993	.996
.04	.051	.218	.482	.690	.849	.926	.959	.976	.989	.992	.996
.05	.051	.230	.479	.690	.849	.925	.958	.977	.988	.993	.996
.06	.050	.229	.482	.692	.835	.926	.959	.980	.989	.993	.996
.07	.052	.232	.479	.691	.832	.913	.959	.980	.988	.992	.997
.08	.052	.247	.483	.694	.834	.912	.952	.980	.988	.992	.996
.09	.051	.244	.481	.695	.835	.912	.952	.980	.988	.994	.997
.10	.052	.246	.489	.691	.835	.915	.951	.975	.989	.994	.996
.11	.053	.245	.488	.703	.834	.915	.951	.975	.989	.994	.997
.12	.051	.242	.490	.699	.833	.915	.951	.976	.988	.992	.996

Table 99

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.018	.056	.144	.255	.408	.557	.652	.739	.832	.875	.902
.01	.021	.054	.142	.267	.411	.556	.648	.740	.834	.873	.903
.02	.021	.051	.143	.268	.413	.554	.656	.737	.834	.878	.903
.03	.021	.049	.135	.268	.409	.555	.656	.725	.835	.881	.902
.04	.021	.050	.136	.262	.410	.541	.658	.728	.833	.879	.905
.05	.021	.054	.134	.263	.410	.540	.658	.726	.830	.880	.903
.06	.021	.054	.135	.261	.408	.542	.659	.788	.835	.871	.903
.07	.021	.054	.133	.261	.403	.536	.655	.788	.835	.874	.908
.08	.021	.059	.138	.255	.407	.536	.655	.788	.835	.873	.909
.09	.022	.059	.137	.256	.409	.535	.655	.787	.834	.869	.908
.10	.021	.059	.144	.255	.406	.577	.656	.793	.834	.868	.910
.11	.020	.058	.144	.259	.406	.576	.655	.791	.838	.868	.907
.12	.020	.060	.144	.256	.406	.578	.654	.795	.838	.870	.908

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.079	.237	.435	.628	.763	.847	.900	.942	.964	.975
.01	.011	.077	.238	.440	.628	.764	.844	.902	.943	.964	.976
.02	.010	.070	.236	.444	.628	.762	.849	.900	.942	.958	.974
.03	.010	.070	.227	.442	.626	.763	.851	.903	.943	.959	.975
.04	.010	.070	.226	.418	.627	.770	.850	.903	.943	.958	.975
.05	.010	.075	.225	.419	.628	.769	.848	.901	.941	.959	.974
.06	.010	.075	.226	.415	.606	.772	.849	.913	.943	.959	.974
.07	.010	.075	.225	.418	.600	.741	.848	.913	.943	.959	.976
.08	.010	.084	.228	.422	.603	.742	.831	.912	.942	.960	.976
.09	.010	.082	.228	.422	.603	.741	.833	.910	.942	.964	.976
.10	.010	.083	.231	.420	.604	.749	.831	.898	.943	.966	.977
.11	.010	.081	.231	.429	.603	.748	.830	.896	.941	.965	.976
.12	.010	.080	.233	.426	.601	.749	.831	.899	.940	.957	.976

Table 100

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.055	.166	.376	.622	.814	.924	.965	.986	.996	.998	.999
.01	.061	.165	.377	.620	.811	.926	.964	.985	.996	.998	.999
.02	.063	.147	.375	.620	.814	.923	.965	.986	.996	.999	.999
.03	.062	.146	.353	.622	.813	.923	.964	.985	.996	.999	.999
.04	.063	.146	.352	.601	.814	.920	.965	.984	.996	.999	.999
.05	.061	.143	.351	.599	.814	.921	.964	.985	.996	.999	.999
.06	.062	.140	.355	.602	.806	.922	.964	.990	.996	.998	.999
.07	.061	.141	.351	.601	.803	.915	.965	.990	.996	.998	.999
.08	.062	.164	.356	.607	.803	.913	.965	.990	.996	.998	.999
.09	.061	.166	.354	.609	.802	.916	.964	.989	.996	.998	.999
.10	.061	.164	.382	.604	.801	.925	.964	.991	.996	.998	.999
.11	.063	.164	.381	.614	.802	.923	.964	.991	.996	.998	.999
.12	.062	.178	.384	.613	.803	.924	.965	.991	.996	.998	.999

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.309	.660	.878	.970	.993	.998				
.01	.049	.309	.659	.884	.969	.993	.998				
.02	.051	.273	.660	.885	.970	.993	.998	.999			
.03	.050	.271	.637	.885	.969	.993	.998				
.04	.050	.270	.634	.863	.970	.994	.998				
.05	.050	.286	.635	.863	.970	.993	.998				
.06	.049	.285	.635	.864	.963	.993	.998				
.07	.049	.285	.634	.863	.961	.991	.998				
.08	.048	.314	.639	.865	.963	.991	.998				
.09	.050	.313	.638	.866	.962	.990	.998				
.10	.050	.311	.643	.865	.961	.992	.997				
.11	.051	.314	.643	.871	.962	.991	.998				
.12	.050	.313	.647	.871	.962	.992	.998	.999			

Table 101

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.005	.034	.124	.299	.519	.721	.837	.912	.966	.981	.990
.01	.006	.033	.122	.297	.518	.721	.837	.912	.965	.982	.990
.02	.007	.028	.124	.296	.521	.722	.834	.913	.965	.984	.990
.03	.007	.026	.113	.302	.517	.719	.831	.908	.966	.984	.990
.04	.006	.027	.110	.278	.520	.719	.833	.909	.965	.984	.990
.05	.006	.026	.110	.275	.516	.720	.831	.909	.965	.985	.990
.06	.007	.026	.112	.276	.504	.722	.832	.930	.965	.981	.990
.07	.007	.026	.111	.276	.500	.702	.831	.929	.966	.982	.990
.08	.006	.035	.113	.284	.502	.703	.834	.929	.965	.981	.990
.09	.007	.034	.112	.282	.502	.703	.831	.930	.965	.980	.991
.10	.006	.034	.126	.281	.499	.718	.830	.933	.965	.979	.991
.11	.007	.034	.128	.292	.501	.714	.832	.933	.964	.979	.991
.12	.007	.038	.130	.291	.500	.717	.833	.933	.963	.979	.990

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.113	.368	.655	.864	.950	.982	.994	.998	.999	
.01	.010	.111	.368	.667	.861	.952	.981	.995	.999		
.02	.010	.090	.368	.667	.862	.950	.984	.994	.998	.999	
.03	.010	.091	.345	.669	.859	.950	.983	.994	.999	.999	
.04	.009	.091	.339	.625	.861	.954	.983	.994	.999	.999	
.05	.010	.098	.340	.625	.862	.954	.983	.995	.998	.999	
.06	.009	.096	.343	.625	.840	.954	.983	.996	.999	.999	
.07	.010	.097	.339	.625	.838	.939	.984	.996	.999	.999	
.08	.010	.113	.347	.631	.838	.938	.978	.996	.999	.999	
.09	.009	.113	.344	.631	.837	.940	.977	.996	.999		
.10	.009	.111	.349	.629	.836	.944	.977	.994	.998		
.11	.010	.114	.351	.639	.837	.942	.977	.994	.998		
.12	.010	.113	.353	.639	.837	.945	.978	.994	.998	.999	

Table 102

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.042	.135	.314	.504	.709	.842	.898	.944	.979	.988	.991
.01	.048	.134	.317	.528	.707	.841	.897	.944	.978	.986	.992
.02	.047	.119	.314	.524	.706	.840	.907	.944	.977	.988	.992
.03	.047	.117	.296	.526	.707	.840	.905	.936	.977	.988	.992
.04	.048	.121	.295	.519	.707	.822	.907	.937	.977	.988	.992
.05	.046	.122	.296	.522	.707	.821	.907	.937	.978	.988	.992
.06	.047	.122	.297	.522	.708	.823	.909	.965	.977	.986	.992
.07	.047	.122	.297	.521	.706	.823	.906	.965	.978	.986	.993
.08	.048	.133	.299	.508	.707	.822	.904	.965	.978	.986	.993
.09	.047	.135	.297	.506	.709	.825	.903	.965	.978	.986	.993
.10	.048	.135	.311	.507	.706	.863	.905	.969	.979	.986	.993
.11	.047	.133	.315	.508	.709	.866	.904	.967	.980	.985	.993
.12	.048	.143	.312	.510	.706	.863	.905	.968	.979	.986	.993

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.315	.650	.858	.953	.984	.994	.998	.999		
.01	.052	.313	.650	.866	.953	.983	.994	.998	.999		
.02	.050	.281	.650	.863	.953	.984	.995	.998	.999		
.03	.050	.281	.628	.862	.952	.984	.994	.998	.999		
.04	.053	.281	.629	.841	.952	.986	.994	.998	.999		
.05	.051	.297	.629	.839	.953	.986	.994	.998	.999		
.06	.051	.298	.630	.841	.943	.986	.995	.998	.999		
.07	.051	.297	.626	.840	.944	.980	.994	.998	.999		
.08	.050	.323	.631	.845	.943	.980	.992	.998	.999		
.09	.051	.323	.629	.845	.944	.980	.993	.998	.999		
.10	.053	.326	.636	.845	.945	.981	.992	.997	.999		
.11	.051	.322	.641	.850	.943	.982	.992	.997	.999		
.12	.051	.319	.641	.851	.944	.981	.993	.998	.999		

Table 103

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.040	.133	.272	.471	.652	.751	.838	.923	.947	.963
.01	.009	.040	.136	.292	.471	.653	.750	.837	.920	.946	.965
.02	.009	.034	.135	.289	.470	.650	.759	.838	.921	.952	.964
.03	.009	.033	.122	.292	.470	.651	.757	.822	.920	.952	.964
.04	.009	.034	.122	.282	.469	.625	.760	.824	.920	.952	.964
.05	.008	.035	.123	.282	.472	.623	.760	.824	.920	.952	.964
.06	.009	.035	.122	.283	.471	.623	.761	.886	.920	.945	.964
.07	.009	.035	.122	.280	.469	.626	.759	.885	.920	.945	.969
.08	.009	.041	.124	.272	.469	.625	.758	.887	.921	.946	.969
.09	.009	.041	.123	.272	.470	.626	.756	.885	.921	.944	.969
.10	.009	.041	.134	.271	.470	.677	.757	.894	.921	.943	.969
.11	.009	.040	.135	.273	.471	.682	.757	.892	.925	.944	.969
.12	.009	.044	.134	.275	.471	.681	.758	.894	.926	.945	.969

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.118	.378	.644	.834	.926	.966	.985	.994	.998	.999
.01	.010	.118	.377	.657	.834	.925	.965	.984	.994	.997	.999
.02	.010	.101	.377	.653	.833	.927	.967	.984	.993	.996	.999
.03	.010	.099	.354	.655	.833	.926	.967	.985	.994	.996	.998
.04	.010	.103	.353	.617	.835	.931	.968	.985	.993	.996	.999
.05	.009	.109	.354	.615	.834	.932	.968	.985	.994	.996	.999
.06	.010	.110	.356	.616	.810	.932	.967	.987	.994	.996	.999
.07	.009	.110	.356	.614	.812	.913	.967	.987	.994	.997	.999
.08	.010	.123	.358	.624	.811	.912	.958	.987	.994	.997	.999
.09	.010	.124	.356	.623	.814	.913	.959	.987	.994	.997	.999
.10	.010	.125	.363	.622	.812	.916	.959	.983	.994	.998	.999
.11	.010	.122	.366	.633	.813	.918	.959	.982	.993	.998	.999
.12	.010	.121	.364	.633	.812	.916	.959	.982	.994	.997	.999

Table 104

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.040	.176	.420	.647	.843	.941	.967	.987	.997	.999	.999
.01	.049	.179	.416	.672	.843	.939	.966	.987	.997	.998	.999
.02	.048	.147	.419	.668	.847	.939	.973	.987	.997	.999	.999
.03	.048	.149	.391	.667	.844	.939	.974	.983	.997	.999	.999
.04	.048	.148	.392	.668	.843	.925	.973	.982	.997	.999	.999
.05	.049	.144	.390	.668	.846	.924	.973	.982	.997	.999	.999
.06	.048	.145	.391	.670	.849	.925	.973	.995	.997	.999	.999
.07	.047	.143	.391	.668	.846	.926	.973	.995	.997	.999	
.08	.049	.161	.392	.650	.847	.927	.972	.994	.997	.999	
.09	.048	.161	.391	.648	.848	.926	.971	.994	.997	.998	
.10	.049	.159	.412	.647	.847	.954	.971	.995	.997	.998	
.11	.049	.159	.409	.651	.849	.953	.971	.995	.997	.998	
.12	.048	.184	.413	.647	.848	.952	.971	.995	.997	.998	

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.406	.792	.949	.991	.999					
.01	.051	.407	.793	.951	.991	.998					
.02	.051	.356	.791	.950	.991	.998					
.03	.052	.361	.765	.952	.991	.998					
.04	.051	.356	.768	.936	.991	.999					
.05	.051	.380	.766	.935	.990	.998					
.06	.050	.377	.769	.936	.988	.999					
.07	.051	.377	.768	.934	.987	.997					
.08	.052	.414	.768	.942	.987	.998					
.09	.050	.413	.767	.941	.987	.998	.999				
.10	.052	.410	.779	.940	.987	.998					
.11	.051	.410	.778	.945	.988	.998	.999				
.12	.051	.410	.777	.945	.988	.998					

Table 105

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.074	.237	.450	.693	.856	.914	.960	.989	.993	.996
.01	.013	.075	.234	.475	.694	.854	.914	.960	.988	.993	.997
.02	.013	.056	.237	.474	.697	.853	.922	.959	.988	.995	.997
.03	.013	.058	.214	.476	.694	.854	.924	.950	.989	.995	.997
.04	.013	.059	.215	.468	.694	.829	.922	.949	.989	.995	.997
.05	.013	.056	.212	.470	.696	.826	.921	.949	.988	.995	.997
.06	.013	.058	.214	.468	.702	.830	.921	.980	.988	.994	.997
.07	.012	.057	.215	.470	.697	.831	.923	.979	.989	.994	.998
.08	.012	.067	.216	.451	.699	.831	.920	.979	.988	.993	.998
.09	.013	.067	.215	.446	.700	.832	.919	.979	.988	.993	.998
.10	.012	.066	.235	.448	.697	.879	.919	.981	.988	.993	.997
.11	.013	.066	.232	.449	.702	.877	.921	.981	.989	.993	.998
.12	.013	.080	.236	.450	.700	.877	.919	.981	.989	.993	.998

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.176	.552	.829	.953	.988	.996	.999			
.01	.010	.179	.550	.838	.955	.988	.996	.999			
.02	.010	.146	.552	.834	.953	.988	.997	.999			
.03	.011	.148	.517	.836	.952	.988	.997	.999			
.04	.010	.146	.518	.799	.954	.989	.996	.999			
.05	.010	.159	.515	.800	.954	.989	.997	.999			
.06	.010	.160	.519	.799	.941	.990	.997	.999			
.07	.010	.157	.519	.797	.939	.983	.997	.999			
.08	.011	.183	.518	.810	.938	.983	.995	.999			
.09	.010	.183	.518	.809	.940	.983	.995	.999			
.10	.010	.180	.534	.807	.940	.984	.995	.999			
.11	.010	.180	.529	.817	.940	.984	.995	.999			
.12	.010	.179	.532	.816	.941	.984	.995	.999			

Table 106

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.265	.570	.803	.942	.985	.994	.999			
.01	.062	.265	.568	.817	.943	.986	.994	.999			
.02	.061	.211	.567	.819	.942	.986	.995	.998			
.03	.062	.209	.529	.816	.942	.985	.996	.997			
.04	.061	.213	.526	.820	.942	.979	.996	.997			
.05	.062	.194	.528	.819	.942	.979	.996	.997			
.06	.063	.195	.528	.821	.946	.979	.996				
.07	.061	.194	.528	.820	.945	.980	.996				
.08	.061	.216	.528	.801	.945	.979	.995				
.09	.060	.215	.529	.799	.943	.980	.995				
.10	.062	.214	.548	.799	.946	.990	.995				
.11	.062	.214	.552	.798	.947	.991	.995				
.12	.061	.264	.552	.797	.946	.990	.995				

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.512	.896	.988	.999						
.01	.050	.512	.897	.988	.999						
.02	.051	.446	.896	.988	.999						
.03	.051	.443	.875	.987	.999						
.04	.049	.447	.872	.981	.999						
.05	.050	.466	.875	.980	.999						
.06	.050	.467	.871	.981	.998						
.07	.050	.467	.873	.981	.998						
.08	.051	.511	.873	.983	.998						
.09	.049	.510	.875	.983	.998						
.10	.050	.508	.883	.983	.998						
.11	.051	.508	.885	.985	.999						
.12	.050	.511	.885	.986	.998						

Table 107

Power Rates For One-Tailed Directional Test For Digit Preference Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.114	.349	.613	.841	.948	.975	.992	.999	.999	
.01	.015	.115	.347	.635	.845	.949	.975	.992	.999	.999	
.02	.015	.083	.347	.635	.843	.949	.980	.992	.999		
.03	.014	.081	.307	.635	.842	.949	.980	.988	.999		
.04	.014	.083	.306	.633	.841	.930	.980	.988	.999		
.05	.014	.074	.307	.636	.843	.930	.980	.988	.999		
.06	.014	.077	.310	.638	.852	.930	.981	.997	.999		
.07	.015	.075	.309	.636	.852	.933	.980	.997	.999	.999	
.08	.014	.090	.309	.607	.852	.932	.977	.997	.999		
.09	.014	.088	.309	.606	.850	.933	.978	.997	.999		
.10	.015	.088	.334	.607	.852	.962	.978	.998	.999	.999	
.11	.015	.088	.335	.606	.853	.962	.978	.998	.999	.999	
.12	.014	.116	.336	.605	.850	.962	.977	.998	.999		

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.258	.720	.941	.992	.999					
.01	.010	.257	.719	.944	.992	.999					
.02	.011	.207	.716	.943	.993	.999					
.03	.011	.206	.679	.943	.992	.999					
.04	.010	.207	.678	.919	.991	.999					
.05	.010	.222	.678	.918	.992	.999					
.06	.010	.224	.679	.919	.988	.999					
.07	.010	.222	.681	.920	.988	.998					
.08	.010	.255	.677	.925	.988	.998					
.09	.010	.255	.681	.925	.988	.998					
.10	.010	.252	.693	.926	.988	.998					
.11	.010	.253	.697	.931	.989	.998					
.12	.010	.257	.696	.931	.987	.998					

Table 108

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.020	.241	.251	.251	.251	.248	.248	.248	.244	.250	.247
.01	.190	.239	.253	.251	.251	.246	.249	.248	.250	.250	.250
.02	.193	.244	.249	.248	.251	.251	.247	.247	.246	.248	.248
.03	.191	.241	.252	.251	.252	.252	.246	.244	.247	.246	.250
.04	.188	.243	.253	.249	.251	.251	.246	.248	.248	.248	.246
.05	.192	.240	.251	.253	.252	.251	.249	.248	.247	.248	.247
.06	.192	.244	.252	.249	.251	.256	.248	.248	.245	.246	.248
.07	.191	.245	.250	.249	.253	.250	.247	.247	.249	.248	.246
.08	.192	.246	.253	.251	.252	.250	.253	.250	.249	.248	.248
.09	.192	.245	.251	.254	.252	.252	.253	.245	.249	.250	.248
.10	.190	.247	.249	.248	.251	.251	.252	.245	.247	.248	.245
.11	.193	.247	.250	.249	.252	.251	.253	.249	.248	.248	.248
.12	.192	.245	.251	.252	.252	.252	.253	.247	.246	.246	.249

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.248	.258	.258	.257	.254	.254	.254	.250	.256	.252
.01	.000	.246	.259	.258	.258	.253	.254	.254	.257	.256	.256
.02	.000	.252	.256	.254	.258	.258	.254	.253	.252	.254	.254
.03	.000	.249	.259	.258	.259	.259	.252	.251	.253	.253	.256
.04	.000	.251	.260	.256	.259	.258	.252	.255	.254	.254	.252
.05	.000	.247	.258	.260	.259	.258	.255	.255	.254	.254	.254
.06	.000	.251	.259	.256	.258	.263	.253	.255	.251	.251	.254
.07	.000	.252	.257	.256	.260	.258	.253	.253	.254	.254	.252
.08	.000	.254	.260	.258	.259	.257	.260	.256	.256	.254	.254
.09	.000	.252	.257	.261	.259	.259	.260	.251	.255	.256	.255
.10	.000	.254	.256	.255	.259	.259	.259	.252	.254	.254	.252
.11	.000	.254	.256	.255	.259	.258	.260	.256	.254	.254	.255
.12	.000	.253	.258	.260	.259	.260	.260	.254	.252	.252	.256

Table 109

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.198	.240	.242	.243	.244	.246	.245	.242	.248	.245
.01	.108	.198	.242	.242	.244	.243	.247	.246	.248	.248	.247
.02	.109	.202	.238	.239	.244	.244	.245	.245	.245	.246	.246
.03	.108	.200	.240	.242	.244	.246	.244	.242	.245	.244	.248
.04	.105	.201	.242	.241	.244	.244	.244	.246	.246	.246	.244
.05	.108	.198	.240	.244	.245	.244	.247	.246	.245	.246	.245
.06	.109	.211	.241	.240	.244	.248	.245	.246	.243	.244	.246
.07	.108	.212	.239	.239	.246	.243	.245	.245	.247	.246	.244
.08	.108	.213	.241	.242	.245	.243	.247	.248	.247	.246	.246
.09	.109	.213	.239	.244	.245	.246	.247	.243	.247	.248	.246
.10	.108	.213	.238	.240	.244	.245	.246	.243	.245	.246	.243
.11	.108	.213	.239	.239	.245	.245	.247	.247	.246	.246	.246
.12	.108	.213	.240	.243	.245	.246	.247	.245	.244	.244	.247

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.159	.193	.195	.195	.197	.199	.196	.196	.198	.197
.01	.000	.160	.194	.194	.196	.196	.199	.197	.200	.200	.199
.02	.000	.164	.192	.190	.197	.196	.198	.197	.197	.198	.198
.03	.000	.163	.194	.193	.197	.198	.198	.196	.197	.196	.199
.04	.000	.163	.194	.194	.195	.196	.197	.199	.197	.197	.197
.05	.000	.160	.191	.196	.196	.196	.198	.198	.198	.198	.198
.06	.000	.170	.193	.193	.196	.200	.197	.198	.195	.196	.197
.07	.000	.171	.193	.193	.198	.196	.198	.197	.200	.198	.197
.08	.000	.172	.193	.194	.196	.196	.197	.200	.199	.198	.197
.09	.000	.172	.192	.197	.197	.198	.199	.195	.198	.199	.198
.10	.000	.173	.191	.192	.196	.197	.199	.197	.197	.198	.197
.11	.000	.173	.192	.192	.198	.197	.198	.199	.198	.198	.198
.12	.000	.172	.194	.196	.196	.197	.198	.198	.197	.197	.198

Table 110

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.186	.153	.188	.187	.190	.186	.188	.187	.190	.190	.191
.01	.898	.155	.188	.189	.190	.191	.188	.189	.189	.191	.189
.02	.899	.154	.188	.187	.189	.188	.189	.187	.190	.189	.190
.03	.899	.156	.186	.189	.189	.189	.189	.188	.191	.188	.191
.04	.900	.155	.187	.187	.188	.187	.191	.190	.189	.187	.191
.05	.899	.156	.185	.187	.189	.188	.190	.189	.189	.190	.188
.06	.900	.165	.185	.188	.186	.189	.189	.191	.189	.190	.190
.07	.898	.163	.186	.189	.190	.187	.190	.190	.189	.189	.190
.08	.900	.161	.186	.188	.189	.187	.187	.190	.188	.189	.191
.09	.901	.163	.184	.187	.189	.190	.190	.193	.191	.189	.189
.10	.899	.160	.186	.187	.188	.191	.191	.189	.189	.188	.191
.11	.899	.165	.185	.186	.191	.189	.190	.188	.189	.189	.190
.12	.899	.162	.186	.185	.188	.190	.191	.189	.190	.190	.186

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.150	.161	.162	.162	.153	.154	.153	.154	.154	.155
.01	.000	.152	.161	.163	.162	.155	.153	.154	.154	.155	.154
.02	.000	.152	.161	.160	.162	.162	.154	.152	.155	.154	.155
.03	.000	.154	.161	.162	.161	.162	.153	.152	.156	.152	.155
.04	.000	.154	.161	.161	.160	.161	.155	.154	.153	.152	.155
.05	.000	.153	.159	.159	.162	.161	.155	.154	.154	.154	.152
.06	.000	.158	.159	.161	.159	.162	.154	.156	.153	.154	.155
.07	.000	.157	.160	.162	.163	.161	.155	.155	.153	.153	.155
.08	.000	.155	.161	.162	.160	.160	.160	.155	.153	.155	.156
.09	.000	.156	.158	.161	.161	.163	.162	.156	.155	.153	.154
.10	.000	.154	.160	.162	.160	.161	.162	.153	.154	.152	.155
.11	.000	.159	.159	.161	.163	.161	.161	.152	.154	.155	.154
.12	.000	.158	.159	.160	.162	.162	.164	.153	.154	.154	.153

Table 111

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.186	.153	.188	.187	.190	.186	.188	.187	.190	.190	.191
.01	.898	.155	.188	.189	.190	.191	.188	.189	.189	.191	.189
.02	.899	.154	.188	.187	.189	.188	.189	.187	.190	.189	.190
.03	.899	.156	.186	.189	.189	.189	.189	.188	.191	.188	.191
.04	.900	.155	.187	.187	.188	.187	.191	.190	.189	.187	.191
.05	.899	.156	.185	.187	.189	.188	.190	.189	.189	.190	.188
.06	.900	.165	.185	.188	.186	.189	.189	.191	.189	.190	.190
.07	.898	.163	.186	.189	.190	.187	.190	.190	.189	.189	.190
.08	.900	.161	.186	.188	.189	.187	.187	.190	.188	.189	.191
.09	.901	.163	.184	.187	.189	.190	.190	.193	.191	.189	.189
.10	.899	.160	.186	.187	.188	.191	.191	.189	.189	.188	.191
.11	.899	.165	.185	.186	.191	.189	.190	.188	.189	.189	.190
.12	.899	.162	.186	.185	.188	.190	.191	.189	.190	.190	.186

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.054	.058	.060	.059	.055	.055	.056	.056	.056	.057
.01	.000	.054	.060	.060	.060	.057	.055	.056	.056	.057	.056
.02	.000	.053	.060	.058	.058	.059	.057	.055	.057	.057	.055
.03	.000	.054	.059	.060	.059	.060	.056	.055	.057	.055	.056
.04	.000	.054	.060	.058	.059	.059	.057	.055	.055	.055	.056
.05	.000	.054	.059	.059	.059	.059	.056	.057	.056	.055	.055
.06	.000	.057	.058	.059	.059	.060	.057	.056	.056	.057	.056
.07	.000	.056	.059	.059	.061	.059	.057	.056	.056	.056	.057
.08	.000	.056	.059	.059	.060	.059	.059	.056	.055	.055	.056
.09	.000	.057	.058	.059	.060	.061	.059	.056	.057	.055	.056
.10	.000	.056	.059	.059	.060	.059	.059	.056	.056	.055	.057
.11	.000	.059	.058	.060	.060	.059	.060	.055	.056	.055	.056
.12	.000	.058	.059	.060	.061	.060	.060	.056	.055	.055	.055

Table 112

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.005	.310	.316	.314	.315	.308	.307	.309	.308	.307	.308
.01	.248	.308	.314	.315	.314	.310	.309	.308	.308	.310	.305
.02	.247	.310	.316	.318	.314	.313	.307	.308	.308	.308	.309
.03	.249	.309	.313	.315	.316	.315	.309	.311	.311	.311	.310
.04	.246	.310	.316	.316	.315	.316	.309	.309	.309	.311	.310
.05	.246	.310	.317	.312	.314	.315	.308	.310	.308	.309	.307
.06	.248	.311	.315	.317	.312	.316	.310	.308	.306	.306	.309
.07	.246	.313	.316	.317	.315	.313	.308	.309	.305	.309	.309
.08	.245	.311	.314	.314	.317	.314	.315	.309	.306	.306	.308
.09	.249	.312	.315	.314	.315	.312	.315	.308	.309	.309	.311
.10	.244	.313	.316	.315	.316	.315	.315	.310	.308	.311	.309
.11	.247	.311	.315	.314	.314	.317	.313	.307	.311	.310	.311
.12	.247	.308	.314	.315	.314	.315	.314	.310	.312	.310	.308

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.619	.620	.619	.619	.612	.610	.611	.612	.610	.611
.01	.000	.617	.620	.624	.621	.614	.612	.613	.611	.612	.609
.02	.000	.617	.623	.622	.621	.623	.612	.610	.611	.610	.611
.03	.000	.619	.621	.624	.623	.620	.612	.613	.613	.615	.615
.04	.000	.619	.623	.621	.620	.622	.613	.613	.611	.611	.610
.05	.000	.619	.623	.621	.619	.620	.610	.612	.612	.613	.612
.06	.000	.621	.622	.623	.621	.624	.613	.611	.612	.610	.611
.07	.000	.622	.622	.623	.620	.620	.613	.612	.609	.610	.612
.08	.000	.619	.623	.622	.622	.620	.620	.613	.612	.610	.609
.09	.000	.620	.620	.622	.619	.621	.623	.612	.615	.613	.614
.10	.000	.623	.621	.621	.622	.624	.623	.612	.613	.614	.612
.11	.000	.621	.622	.621	.622	.621	.618	.608	.614	.615	.613
.12	.000	.618	.622	.620	.621	.621	.622	.613	.614	.614	.613

Table 113

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.005	.310	.316	.314	.315	.308	.307	.309	.308	.307	.308
.01	.248	.308	.314	.315	.314	.310	.309	.308	.308	.310	.305
.02	.247	.310	.316	.318	.314	.313	.307	.308	.308	.308	.309
.03	.249	.309	.313	.315	.316	.315	.309	.311	.311	.311	.310
.04	.246	.310	.316	.316	.315	.316	.309	.309	.309	.311	.310
.05	.246	.310	.317	.312	.314	.315	.308	.310	.308	.309	.307
.06	.248	.311	.315	.317	.312	.316	.310	.308	.306	.306	.309
.07	.246	.313	.316	.317	.315	.313	.308	.309	.305	.309	.309
.08	.245	.311	.314	.314	.317	.314	.315	.309	.306	.306	.308
.09	.249	.312	.315	.314	.315	.312	.315	.308	.309	.309	.311
.10	.244	.313	.316	.315	.316	.315	.315	.310	.308	.311	.309
.11	.247	.311	.315	.314	.314	.317	.313	.307	.311	.310	.311
.12	.247	.308	.314	.315	.314	.315	.314	.310	.312	.310	.308

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.509	.595	.598	.603	.605	.606	.607	.608	.606	.607
.01	.000	.510	.594	.603	.606	.606	.607	.609	.607	.608	.605
.02	.000	.512	.596	.601	.606	.608	.607	.606	.607	.606	.607
.03	.000	.512	.595	.603	.608	.606	.608	.609	.609	.610	.611
.04	.000	.512	.597	.601	.605	.606	.609	.609	.607	.607	.606
.05	.000	.513	.597	.599	.604	.605	.606	.608	.608	.609	.608
.06	.000	.541	.595	.602	.605	.610	.609	.607	.607	.606	.606
.07	.000	.545	.596	.603	.605	.604	.609	.607	.605	.606	.608
.08	.000	.542	.597	.601	.607	.605	.608	.609	.608	.606	.605
.09	.000	.543	.594	.601	.604	.609	.610	.608	.611	.608	.610
.10	.000	.545	.596	.600	.607	.611	.611	.608	.609	.609	.608
.11	.000	.545	.596	.600	.607	.609	.607	.604	.610	.611	.609
.12	.000	.541	.595	.599	.606	.609	.609	.609	.610	.610	.609

Table 114

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.284	.271	.275	.276	.274	.269	.264	.269	.271	.266	.269
.01	.994	.269	.274	.275	.275	.269	.270	.270	.270	.267	.267
.02	.995	.270	.275	.276	.272	.272	.269	.269	.270	.268	.268
.03	.994	.268	.273	.274	.273	.274	.269	.270	.271	.268	.269
.04	.995	.272	.273	.277	.274	.272	.267	.266	.271	.270	.267
.05	.994	.270	.275	.272	.274	.274	.271	.267	.269	.270	.269
.06	.995	.269	.274	.276	.276	.274	.270	.266	.268	.266	.268
.07	.994	.269	.277	.272	.275	.272	.267	.269	.269	.270	.269
.08	.995	.270	.273	.271	.273	.275	.273	.270	.271	.270	.269
.09	.995	.271	.275	.273	.275	.274	.276	.268	.268	.268	.271
.10	.994	.272	.273	.274	.275	.273	.274	.267	.268	.269	.271
.11	.995	.268	.273	.275	.274	.275	.275	.267	.268	.269	.270
.12	.994	.269	.272	.273	.273	.275	.275	.272	.269	.271	.269

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.203	.227	.230	.232	.221	.218	.222	.223	.220	.221
.01	.000	.200	.227	.230	.233	.219	.222	.222	.221	.218	.219
.02	.000	.202	.229	.231	.230	.230	.221	.220	.223	.221	.219
.03	.000	.200	.227	.230	.231	.232	.222	.221	.223	.220	.222
.04	.000	.203	.227	.231	.233	.230	.219	.219	.223	.222	.219
.05	.000	.203	.228	.229	.231	.231	.222	.220	.222	.224	.222
.06	.000	.215	.228	.230	.234	.233	.222	.218	.221	.219	.219
.07	.000	.215	.229	.228	.233	.230	.219	.221	.220	.222	.222
.08	.000	.214	.226	.228	.231	.232	.231	.222	.223	.221	.221
.09	.000	.215	.230	.228	.231	.231	.233	.219	.221	.220	.222
.10	.000	.218	.226	.230	.234	.232	.232	.219	.220	.221	.222
.11	.000	.214	.227	.231	.231	.233	.234	.219	.221	.223	.221
.12	.000	.214	.226	.229	.231	.233	.231	.223	.222	.222	.222

Table 115

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.088	.115	.129	.128	.129	.125	.124	.127	.128	.124	.126
.01	.974	.114	.130	.128	.128	.125	.128	.127	.126	.125	.124
.02	.974	.115	.127	.128	.127	.128	.126	.127	.127	.126	.126
.03	.974	.113	.128	.130	.129	.129	.127	.126	.127	.126	.126
.04	.974	.114	.128	.129	.128	.126	.125	.125	.128	.127	.126
.05	.975	.115	.129	.127	.127	.128	.127	.125	.128	.128	.126
.06	.974	.115	.128	.129	.130	.128	.126	.123	.126	.124	.125
.07	.973	.116	.129	.127	.128	.127	.125	.126	.127	.127	.127
.08	.974	.115	.127	.128	.128	.129	.128	.126	.128	.126	.126
.09	.974	.115	.130	.129	.127	.128	.127	.126	.126	.124	.126
.10	.974	.116	.127	.128	.128	.129	.129	.125	.127	.127	.127
.11	.975	.113	.129	.128	.128	.128	.129	.125	.126	.127	.127
.12	.973	.115	.127	.127	.128	.129	.128	.127	.127	.129	.126

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.103	.120	.122	.124	.115	.115	.117	.118	.115	.116
.01	.000	.103	.122	.122	.122	.114	.118	.117	.116	.115	.114
.02	.000	.104	.120	.122	.121	.123	.117	.116	.118	.117	.115
.03	.000	.102	.121	.123	.124	.124	.117	.117	.117	.116	.116
.04	.000	.103	.121	.123	.124	.121	.115	.115	.118	.117	.116
.05	.000	.104	.121	.122	.122	.123	.117	.115	.118	.119	.117
.06	.000	.111	.121	.122	.126	.124	.116	.114	.116	.115	.115
.07	.000	.112	.122	.121	.124	.122	.115	.116	.117	.116	.117
.08	.000	.111	.120	.122	.123	.124	.124	.117	.118	.116	.116
.09	.000	.111	.123	.122	.122	.124	.123	.116	.116	.115	.117
.10	.000	.113	.119	.122	.124	.125	.124	.115	.117	.117	.117
.11	.000	.110	.121	.122	.122	.124	.125	.115	.116	.117	.117
.12	.000	.111	.120	.121	.123	.124	.123	.117	.117	.118	.117

Table 116

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.582	.308	.309	.309	.310	.298	.300	.301	.302	.299	.300
.01		.310	.309	.310	.309	.300	.298	.300	.300	.299	.299
.02		.310	.309	.309	.309	.310	.299	.299	.298	.300	.299
.03		.309	.308	.311	.309	.311	.298	.300	.300	.301	.301
.04		.310	.309	.308	.309	.310	.301	.298	.299	.297	.301
.05		.308	.309	.308	.309	.309	.299	.299	.300	.299	.299
.06		.311	.311	.308	.311	.312	.299	.299	.301	.299	.299
.07		.307	.307	.309	.311	.311	.298	.299	.300	.301	.301
.08		.309	.310	.311	.309	.307	.312	.300	.299	.300	.300
.09		.309	.309	.308	.311	.310	.312	.300	.300	.300	.300
.10		.311	.309	.307	.309	.312	.310	.298	.302	.299	.298
.11		.311	.308	.307	.311	.309	.311	.298	.301	.301	.299
.12		.308	.310	.309	.309	.310	.307	.301	.298	.299	.301

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.226	.263	.265	.269	.255	.256	.257	.257	.255	.256
.01	.000	.226	.264	.266	.268	.256	.254	.257	.256	.256	.255
.02	.000	.227	.264	.266	.268	.269	.256	.255	.254	.256	.257
.03	.000	.226	.261	.266	.269	.271	.255	.256	.255	.257	.257
.04	.000	.227	.262	.264	.267	.269	.257	.255	.255	.254	.257
.05	.000	.225	.263	.264	.267	.269	.256	.255	.255	.255	.256
.06	.000	.245	.264	.264	.271	.271	.254	.255	.258	.254	.255
.07	.000	.243	.261	.264	.271	.270	.254	.255	.256	.257	.258
.08	.000	.244	.263	.267	.268	.266	.271	.257	.256	.257	.257
.09	.000	.244	.263	.263	.270	.269	.271	.256	.256	.257	.257
.10	.000	.244	.263	.264	.269	.271	.270	.255	.258	.255	.255
.11	.000	.245	.261	.263	.270	.269	.270	.254	.256	.258	.255
.12	.000	.242	.263	.265	.267	.269	.266	.257	.253	.254	.257

Table 117

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.322	.173	.178	.175	.177	.169	.170	.171	.171	.169	.171
.01	.998	.175	.178	.177	.175	.169	.169	.170	.171	.170	.171
.02	.998	.175	.177	.176	.176	.177	.170	.168	.166	.169	.169
.03	.998	.174	.175	.178	.175	.178	.170	.169	.170	.171	.170
.04	.998	.176	.177	.175	.175	.176	.171	.168	.169	.168	.170
.05	.998	.174	.176	.176	.175	.176	.169	.169	.170	.169	.171
.06	.998	.176	.177	.177	.178	.178	.169	.171	.170	.169	.170
.07	.998	.174	.176	.177	.179	.178	.170	.169	.170	.170	.170
.08	.998	.173	.176	.178	.176	.174	.177	.170	.169	.171	.171
.09	.998	.173	.176	.175	.177	.176	.178	.171	.171	.171	.170
.10	.998	.174	.176	.177	.175	.178	.177	.167	.171	.170	.168
.11	.998	.176	.176	.176	.178	.175	.178	.168	.170	.171	.170
.12	.998	.174	.177	.177	.177	.175	.176	.172	.168	.170	.173

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.090	.097	.095	.096	.087	.089	.089	.089	.089	.090
.01	.000	.091	.096	.097	.096	.086	.087	.087	.088	.088	.089
.02	.000	.093	.096	.096	.096	.096	.089	.087	.086	.088	.087
.03	.000	.092	.095	.097	.095	.097	.088	.087	.088	.088	.088
.04	.000	.091	.096	.096	.096	.097	.088	.088	.087	.086	.087
.05	.000	.090	.095	.097	.096	.097	.089	.087	.087	.088	.089
.06	.000	.095	.096	.096	.097	.097	.088	.088	.089	.087	.087
.07	.000	.092	.096	.098	.097	.097	.088	.087	.087	.088	.088
.08	.000	.093	.095	.097	.096	.096	.097	.088	.087	.087	.089
.09	.000	.094	.095	.096	.096	.096	.097	.088	.089	.089	.089
.10	.000	.093	.096	.096	.095	.097	.097	.086	.087	.088	.087
.11	.000	.095	.097	.097	.097	.096	.098	.087	.087	.089	.088
.12	.000	.094	.095	.097	.096	.096	.095	.089	.086	.088	.090

Table 118

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.584	.584	.584	.581	.571	.567	.572	.569	.572	.571
.01	.561	.584	.582	.582	.583	.569	.569	.573	.572	.573	.571
.02	.560	.586	.583	.580	.579	.583	.572	.570	.570	.571	.568
.03	.562	.583	.582	.581	.583	.582	.574	.571	.570	.571	.571
.04	.562	.581	.584	.584	.583	.582	.571	.571	.572	.569	.570
.05	.559	.584	.583	.582	.583	.585	.567	.572	.571	.569	.572
.06	.560	.583	.580	.584	.583	.583	.569	.571	.572	.569	.571
.07	.560	.581	.580	.581	.581	.582	.570	.571	.571	.570	.570
.08	.563	.580	.581	.585	.583	.585	.581	.570	.569	.566	.571
.09	.563	.582	.583	.585	.581	.583	.580	.571	.568	.570	.572
.10	.562	.582	.580	.585	.581	.583	.582	.570	.572	.569	.569
.11	.560	.584	.583	.585	.583	.586	.583	.570	.570	.572	.572
.12	.562	.583	.583	.582	.584	.581	.582	.572	.570	.572	.571

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.924	.927	.929	.926	.924	.924	.925	.925	.926	.925
.01	.000	.925	.926	.927	.927	.925	.924	.926	.925	.925	.924
.02	.000	.923	.926	.927	.926	.929	.925	.925	.925	.924	.925
.03	.000	.922	.927	.927	.928	.928	.924	.925	.924	.924	.925
.04	.000	.924	.928	.927	.928	.927	.924	.924	.925	.924	.925
.05	.000	.924	.928	.927	.927	.926	.924	.926	.925	.924	.924
.06	.000	.926	.928	.926	.927	.926	.924	.923	.925	.924	.925
.07	.000	.925	.926	.926	.927	.927	.924	.925	.926	.926	.924
.08	.000	.925	.925	.928	.927	.929	.927	.925	.923	.924	.923
.09	.000	.925	.928	.927	.927	.928	.927	.925	.924	.924	.925
.10	.000	.925	.926	.927	.925	.925	.927	.925	.927	.924	.923
.11	.000	.925	.927	.928	.928	.927	.928	.925	.924	.925	.926
.12	.000	.925	.927	.927	.927	.927	.927	.925	.924	.925	.924

Table 119

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.363	.362	.363	.361	.353	.352	.352	.351	.353	.352
.01	.320	.363	.363	.364	.362	.349	.352	.355	.352	.352	.351
.02	.321	.363	.365	.363	.362	.363	.355	.353	.351	.352	.351
.03	.320	.361	.362	.361	.363	.361	.355	.351	.351	.351	.352
.04	.322	.362	.364	.361	.363	.362	.353	.352	.352	.351	.351
.05	.321	.363	.362	.363	.363	.364	.349	.352	.355	.351	.355
.06	.321	.360	.362	.363	.362	.363	.352	.352	.353	.350	.351
.07	.320	.364	.360	.360	.362	.362	.349	.351	.354	.351	.353
.08	.321	.360	.362	.366	.363	.366	.360	.351	.353	.349	.354
.09	.324	.363	.365	.365	.362	.361	.361	.350	.352	.352	.353
.10	.322	.363	.361	.364	.362	.360	.362	.350	.354	.351	.351
.11	.320	.363	.363	.365	.363	.367	.363	.351	.352	.353	.353
.12	.322	.362	.365	.363	.361	.362	.363	.353	.349	.354	.352

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.787	.792	.793	.789	.782	.779	.781	.780	.783	.782
.01	.000	.786	.788	.790	.790	.782	.780	.783	.783	.782	.780
.02	.000	.787	.789	.788	.788	.793	.784	.781	.782	.781	.780
.03	.000	.784	.791	.789	.790	.791	.782	.780	.781	.781	.782
.04	.000	.785	.791	.791	.791	.790	.781	.782	.783	.781	.781
.05	.000	.786	.791	.789	.790	.790	.778	.783	.783	.780	.780
.06	.000	.790	.791	.790	.790	.790	.783	.781	.783	.780	.783
.07	.000	.789	.790	.789	.791	.789	.781	.783	.782	.783	.781
.08	.000	.785	.786	.792	.789	.791	.789	.781	.780	.779	.781
.09	.000	.785	.792	.791	.788	.791	.790	.780	.779	.782	.782
.10	.000	.786	.788	.791	.789	.788	.790	.780	.784	.780	.782
.11	.000	.788	.790	.791	.788	.793	.791	.780	.782	.782	.782
.12	.000	.787	.789	.791	.792	.791	.789	.782	.781	.782	.781

Table 120

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.875	.875	.874	.875	.867	.868	.868	.866	.867	.863
.01	.873	.873	.876	.874	.877	.865	.866	.868	.865	.866	.865
.02	.874	.877	.872	.874	.876	.874	.868	.865	.868	.864	.866
.03	.874	.875	.875	.875	.877	.876	.866	.867	.867	.867	.865
.04	.875	.874	.874	.874	.876	.872	.866	.867	.866	.866	.866
.05	.873	.874	.875	.874	.874	.872	.866	.866	.866	.867	.864
.06	.872	.873	.875	.875	.873	.873	.866	.865	.867	.865	.866
.07	.873	.876	.876	.873	.873	.876	.865	.868	.864	.865	.866
.08	.873	.875	.875	.874	.873	.873	.875	.866	.867	.868	.865
.09	.873	.875	.873	.875	.873	.874	.875	.865	.867	.866	.866
.10	.874	.875	.874	.874	.873	.872	.873	.866	.864	.868	.866
.11	.874	.873	.874	.875	.875	.875	.875	.865	.865	.866	.864
.12	.874	.875	.874	.874	.875	.875	.876	.866	.865	.866	.865

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.967	.984	.985	.986	.986	.987	.987	.987	.987	.987
.01	.000	.967	.984	.985	.987	.987	.988	.987	.988	.987	.988
.02	.000	.968	.983	.984	.987	.987	.987	.988	.988	.988	.987
.03	.000	.968	.983	.985	.987	.987	.988	.987	.987	.988	.987
.04	.000	.966	.983	.984	.987	.986	.987	.987	.988	.987	.988
.05	.000	.967	.984	.985	.987	.987	.987	.987	.987	.987	.987
.06	.000	.973	.983	.984	.986	.986	.988	.988	.987	.988	.988
.07	.000	.974	.983	.984	.987	.987	.987	.987	.988	.988	.987
.08	.000	.974	.983	.985	.986	.986	.988	.987	.988	.987	.988
.09	.000	.974	.983	.984	.986	.987	.988	.987	.987	.988	.988
.10	.000	.974	.983	.985	.987	.987	.988	.987	.988	.987	.988
.11	.000	.974	.983	.985	.987	.987	.988	.987	.988	.988	.987
.12	.000	.975	.984	.984	.986	.988	.988	.988	.987	.987	.987

Table 121

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.741	.742	.738	.742	.728	.729	.730	.728	.728	.724
.01	.733	.739	.742	.741	.739	.727	.726	.727	.725	.729	.726
.02	.735	.743	.737	.740	.741	.739	.726	.726	.729	.725	.727
.03	.735	.741	.743	.739	.742	.740	.728	.727	.730	.726	.726
.04	.735	.740	.739	.739	.741	.736	.728	.728	.725	.728	.727
.05	.733	.739	.741	.740	.739	.740	.725	.728	.728	.728	.724
.06	.734	.739	.738	.741	.739	.739	.728	.728	.729	.726	.728
.07	.734	.740	.741	.738	.739	.742	.726	.728	.726	.725	.726
.08	.734	.741	.741	.739	.740	.739	.740	.725	.726	.729	.727
.09	.734	.740	.737	.740	.739	.741	.742	.723	.727	.727	.725
.10	.734	.741	.739	.739	.739	.739	.738	.728	.724	.728	.728
.11	.734	.740	.739	.741	.742	.742	.741	.726	.725	.725	.726
.12	.737	.741	.739	.739	.740	.740	.742	.727	.726	.726	.726

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.918	.943	.948	.951	.950	.948	.950	.949	.949	.946
.01	.000	.917	.943	.948	.950	.948	.949	.949	.949	.949	.948
.02	.000	.920	.941	.948	.950	.950	.949	.950	.949	.949	.950
.03	.000	.919	.942	.948	.950	.950	.950	.949	.950	.949	.949
.04	.000	.918	.942	.947	.950	.948	.949	.951	.949	.949	.948
.05	.000	.918	.944	.949	.948	.948	.948	.949	.949	.949	.947
.06	.000	.926	.943	.949	.948	.948	.948	.949	.949	.949	.949
.07	.000	.928	.944	.947	.949	.950	.947	.949	.948	.948	.949
.08	.000	.927	.944	.948	.948	.949	.950	.949	.950	.949	.950
.09	.000	.927	.943	.947	.948	.949	.950	.949	.950	.949	.949
.10	.000	.926	.943	.948	.950	.948	.950	.948	.949	.949	.949
.11	.000	.927	.942	.948	.949	.949	.949	.949	.949	.950	.949
.12	.000	.927	.944	.948	.950	.950	.950	.949	.948	.948	.949

Table 122

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.738	.350	.348	.347	.350	.328	.326	.327	.327	.323	.327
.01		.349	.349	.350	.351	.328	.328	.329	.328	.324	.327
.02		.348	.352	.345	.349	.349	.325	.327	.324	.328	.326
.03		.348	.347	.351	.350	.347	.324	.324	.327	.326	.328
.04		.350	.348	.348	.348	.349	.327	.329	.325	.331	.327
.05		.350	.347	.349	.350	.347	.326	.325	.325	.325	.324
.06		.352	.349	.351	.351	.350	.327	.325	.327	.329	.326
.07		.349	.352	.349	.350	.350	.329	.325	.329	.327	.327
.08		.352	.349	.350	.351	.351	.350	.324	.326	.328	.326
.09		.349	.351	.349	.349	.349	.348	.327	.328	.329	.329
.10		.349	.352	.350	.352	.350	.349	.328	.327	.325	.327
.11		.350	.350	.351	.347	.350	.348	.328	.329	.327	.329
.12		.351	.349	.347	.351	.346	.350	.325	.328	.327	.328

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.277	.318	.322	.329	.305	.303	.304	.303	.300	.303
.01	.000	.276	.319	.325	.329	.304	.304	.305	.305	.301	.304
.02	.000	.275	.322	.321	.329	.328	.302	.303	.300	.305	.303
.03	.000	.274	.317	.326	.329	.326	.301	.300	.303	.303	.304
.04	.000	.277	.317	.324	.326	.327	.305	.305	.302	.307	.304
.05	.000	.276	.317	.325	.329	.326	.303	.301	.302	.301	.301
.06	.000	.298	.319	.327	.330	.328	.303	.302	.303	.305	.302
.07	.000	.295	.321	.324	.329	.328	.305	.300	.306	.303	.304
.08	.000	.299	.320	.326	.329	.329	.328	.300	.303	.304	.302
.09	.000	.295	.320	.325	.328	.327	.327	.302	.304	.305	.306
.10	.000	.295	.322	.325	.330	.329	.328	.304	.304	.303	.303
.11	.000	.295	.320	.326	.326	.328	.326	.305	.304	.304	.305
.12	.000	.297	.319	.323	.329	.326	.329	.302	.305	.303	.304

Table 123

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.379	.172	.170	.172	.173	.156	.155	.158	.156	.155	.156
.01		.171	.172	.172	.173	.157	.157	.158	.157	.155	.156
.02		.170	.173	.169	.170	.171	.155	.157	.153	.158	.157
.03		.172	.170	.173	.172	.171	.154	.154	.157	.156	.155
.04		.172	.171	.171	.170	.170	.157	.156	.156	.159	.157
.05		.172	.171	.170	.172	.171	.155	.155	.155	.154	.155
.06		.172	.171	.174	.173	.172	.156	.154	.156	.158	.156
.07		.171	.172	.170	.172	.172	.158	.154	.158	.157	.157
.08		.173	.171	.173	.171	.173	.170	.156	.157	.158	.155
.09		.170	.173	.172	.171	.171	.171	.154	.156	.156	.156
.10		.171	.173	.172	.172	.173	.172	.157	.155	.156	.155
.11		.172	.172	.173	.170	.169	.171	.157	.157	.157	.159
.12		.172	.170	.169	.173	.172	.172	.156	.157	.156	.156

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.140	.164	.169	.172	.153	.152	.154	.153	.152	.152
.01	.000	.139	.166	.170	.171	.153	.153	.154	.154	.152	.152
.02	.000	.138	.168	.167	.169	.170	.152	.153	.149	.154	.153
.03	.000	.139	.163	.170	.170	.170	.150	.151	.154	.152	.152
.04	.000	.140	.165	.168	.170	.169	.153	.152	.152	.155	.153
.05	.000	.140	.164	.168	.171	.170	.151	.151	.151	.151	.151
.06	.000	.154	.164	.171	.172	.170	.152	.151	.152	.154	.152
.07	.000	.154	.165	.168	.171	.170	.154	.151	.154	.153	.153
.08	.000	.154	.164	.171	.170	.172	.169	.152	.153	.154	.152
.09	.000	.151	.166	.170	.170	.170	.171	.150	.152	.152	.153
.10	.000	.152	.166	.170	.171	.172	.171	.153	.152	.152	.152
.11	.000	.153	.166	.170	.169	.168	.170	.153	.153	.154	.155
.12	.000	.153	.165	.167	.172	.171	.171	.152	.154	.152	.152

Table 124

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.004	.959	.960	.960	.961	.957	.957	.956	.955	.955	.957
.01	.960	.960	.961	.960	.961	.956	.956	.957	.956	.956	.957
.02	.961	.960	.961	.959	.961	.961	.956	.956	.957	.957	.955
.03	.961	.961	.960	.961	.960	.960	.957	.956	.957	.957	.956
.04	.960	.961	.960	.960	.959	.960	.957	.955	.955	.956	.957
.05	.961	.960	.960	.961	.960	.959	.956	.957	.956	.956	.957
.06	.960	.960	.961	.961	.961	.960	.956	.956	.957	.955	.956
.07	.960	.960	.960	.961	.961	.960	.956	.956	.956	.956	.956
.08	.961	.961	.960	.960	.961	.959	.961	.955	.957	.955	.956
.09	.960	.961	.960	.959	.960	.961	.961	.956	.955	.957	.956
.10	.961	.960	.960	.961	.961	.961	.960	.956	.955	.956	.956
.11	.960	.961	.960	.960	.960	.960	.961	.955	.957	.957	.956
.12	.961	.961	.961	.960	.961	.960	.960	.957	.957	.957	.956

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.997	.996	.996	.997	.996	.996	.996	.996	.996	.996
.01	.000	.997	.997	.997	.997	.996	.996	.996	.996	.996	.996
.02	.000	.997	.996	.996	.997	.997	.996	.996	.996	.996	.996
.03	.000	.997	.996	.997	.996	.996	.996	.996	.996	.996	.996
.04	.000	.997	.997	.997	.997	.996	.996	.996	.996	.996	.996
.05	.000	.997	.997	.997	.997	.996	.996	.996	.996	.996	.996
.06	.000	.997	.997	.997	.997	.997	.996	.996	.997	.996	.996
.07	.000	.996	.997	.997	.997	.997	.996	.996	.996	.996	.996
.08	.000	.997	.997	.997	.997	.997	.996	.996	.996	.996	.996
.09	.000	.996	.997	.996	.997	.997	.997	.996	.996	.996	.996
.10	.000	.996	.997	.997	.997	.996	.997	.996	.996	.996	.996
.11	.000	.997	.996	.997	.997	.996	.997	.996	.996	.996	.996
.12	.000	.997	.997	.997	.997	.996	.996	.996	.996	.996	.996

Table 125

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.819	.818	.818	.819	.807	.806	.805	.807	.805	.808
.01	.819	.819	.817	.820	.820	.806	.805	.808	.805	.808	.806
.02	.819	.820	.819	.819	.819	.820	.805	.806	.806	.805	.807
.03	.819	.818	.821	.818	.819	.817	.805	.805	.807	.806	.807
.04	.818	.821	.818	.820	.817	.820	.805	.804	.804	.807	.806
.05	.818	.820	.818	.821	.817	.817	.805	.806	.807	.805	.806
.06	.819	.819	.822	.822	.819	.818	.805	.805	.804	.806	.805
.07	.815	.820	.819	.821	.819	.817	.805	.806	.805	.806	.805
.08	.821	.819	.818	.818	.818	.820	.820	.805	.806	.804	.806
.09	.818	.819	.819	.817	.820	.819	.820	.808	.805	.805	.804
.10	.819	.820	.821	.819	.819	.818	.819	.804	.804	.806	.805
.11	.818	.820	.818	.818	.818	.821	.821	.804	.805	.805	.805
.12	.819	.820	.820	.818	.820	.818	.820	.808	.808	.805	.804

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.986	.986	.986	.987	.985	.985	.985	.984	.984	.985
.01	.000	.986	.986	.986	.987	.984	.985	.985	.985	.985	.985
.02	.000	.986	.987	.986	.987	.987	.984	.985	.986	.985	.985
.03	.000	.987	.986	.987	.986	.986	.985	.984	.986	.985	.985
.04	.000	.986	.986	.986	.986	.986	.985	.985	.985	.985	.985
.05	.000	.986	.987	.987	.986	.986	.985	.985	.985	.985	.985
.06	.000	.987	.987	.987	.987	.987	.985	.985	.985	.985	.984
.07	.000	.986	.987	.987	.987	.987	.985	.985	.985	.985	.985
.08	.000	.987	.987	.986	.987	.986	.987	.984	.985	.985	.985
.09	.000	.986	.987	.986	.987	.986	.986	.984	.985	.985	.984
.10	.000	.986	.986	.987	.987	.987	.986	.985	.984	.984	.985
.11	.000	.986	.986	.987	.987	.986	.987	.985	.985	.985	.985
.12	.000	.987	.987	.986	.987	.986	.986	.985	.985	.985	.985

Table 126

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.994	.994	.994	.994	.992	.993	.993	.993	.993	.993
.01	.994	.994	.994	.994	.994	.993	.993	.993	.993	.992	.993
.02	.994	.994	.994	.994	.994	.994	.993	.993	.993	.993	.993
.03	.994	.993	.994	.994	.994	.994	.993	.993	.993	.993	.993
.04	.993	.994	.994	.995	.994	.994	.993	.993	.993	.993	.993
.05	.994	.994	.994	.994	.994	.994	.993	.993	.993	.993	.993
.06	.994	.994	.994	.994	.994	.994	.993	.993	.993	.993	.993
.07	.994	.993	.994	.994	.994	.994	.993	.993	.993	.993	.993
.08	.994	.994	.994	.994	.994	.994	.994	.993	.993	.993	.993
.09	.994	.994	.994	.994	.994	.994	.994	.993	.993	.993	.993
.10	.994	.994	.994	.994	.994	.994	.994	.993	.993	.993	.993
.11	.994	.994	.994	.994	.994	.994	.994	.993	.993	.993	.993
.12	.994	.994	.994	.994	.993	.994	.994	.993	.993	.993	.993

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001										
.01	.000										
.02	.000										
.03	.000										
.04	.000										
.05	.000										
.06	.000										
.07	.000										
.08	.000										
.09	.000										
.10	.000										
.11	.000										
.12	.000										

Table 127

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.960	.961	.961	.961	.956	.956	.957	.956	.955	.956
.01	.961	.961	.961	.963	.961	.957	.956	.956	.955	.956	.955
.02	.961	.960	.961	.961	.961	.961	.956	.957	.956	.956	.956
.03	.961	.961	.961	.961	.961	.960	.956	.956	.956	.956	.957
.04	.961	.962	.961	.962	.960	.961	.957	.956	.956	.955	.957
.05	.962	.961	.961	.961	.961	.961	.956	.956	.956	.956	.956
.06	.962	.961	.961	.962	.961	.961	.956	.956	.956	.957	.957
.07	.963	.960	.962	.961	.961	.961	.956	.957	.956	.956	.956
.08	.962	.962	.961	.962	.962	.961	.961	.955	.956	.956	.956
.09	.961	.961	.960	.961	.962	.961	.961	.956	.957	.956	.956
.10	.961	.961	.962	.962	.961	.961	.961	.956	.956	.957	.955
.11	.962	.962	.961	.961	.961	.961	.962	.957	.956	.956	.957
.12	.960	.960	.960	.961	.960	.962	.961	.955	.956	.955	.956

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.998	.998	.998	.998	.997	.998	.998	.998	.998	.998
.01	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.02	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.03	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.04	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.05	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.06	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.07	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.08	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.09	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.10	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.11	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998
.12	.000	.998	.998	.998	.998	.998	.998	.998	.998	.998	.998

Table 128

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003			.999			.999	.999	.999	.999	
.01							.999	.999	.999	.999	
.02							.999	.999			.999
.03							.999	.999	.999	.999	.999
.04							.999	.999		.999	.999
.05				.999			.999		.999		
.06							.999	.999	.999	.999	.999
.07							.999	.999	.999		
.08				.999					.999		
.09									.999	.999	.999
.10					.999			.999	.999	.999	
.11							.999	.999	.999	.999	.999
.12					.999						

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001										
.01	.000										
.02	.000										
.03	.000										
.04	.000										
.05	.000										
.06	.000										
.07	.000										
.08	.000										
.09	.000										
.10	.000										
.11	.000										
.12	.000										

Table 129

Power Rates For One-Tailed Directional Test For Discrete Mass Zero with Gap Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.996	.997	.996	.996	.996	.995	.995	.995	.995	.996
.01	.996	.996	.996	.996	.996	.996	.995	.995	.996	.995	.996
.02	.996	.997	.996	.997	.996	.996	.996	.995	.996	.996	.996
.03	.996	.997	.996	.996	.996	.996	.995	.996	.996	.996	.996
.04	.997	.996	.996	.996	.996	.996	.995	.995	.995	.996	.995
.05	.996	.996	.996	.996	.997	.996	.996	.996	.995	.996	.995
.06	.996	.996	.996	.996	.996	.996	.995	.995	.996	.996	.996
.07	.996	.996	.996	.996	.996	.996	.995	.995	.996	.996	.995
.08	.996	.996	.996	.996	.996	.996	.996	.996	.995	.996	.995
.09	.996	.996	.996	.997	.996	.996	.996	.996	.996	.996	.995
.10	.997	.996	.996	.996	.996	.996	.996	.995	.995	.995	.995
.11	.996	.996	.996	.996	.996	.996	.996	.996	.995	.996	.995
.12	.996	.996	.996	.996	.996	.996	.996	.995	.996	.996	.996

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000										
.01	.000										
.02	.000										
.03	.000										
.04	.000										
.05	.000										
.06	.000										
.07	.000										
.08	.000										
.09	.000										
.10	.000										
.11	.000										
.12	.000										

Table 130

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.073	.095	.118	.151	.183	.219	.247	.268	.289	.326	.345
.01	.081	.095	.120	.153	.182	.219	.248	.270	.292	.326	.342
.02	.082	.094	.120	.151	.180	.218	.242	.269	.294	.310	.341
.03	.079	.093	.118	.152	.181	.218	.248	.276	.292	.308	.341
.04	.079	.093	.118	.152	.181	.215	.248	.275	.291	.310	.343
.05	.080	.096	.120	.152	.182	.215	.245	.278	.295	.307	.342
.06	.082	.094	.119	.152	.182	.217	.245	.276	.293	.307	.342
.07	.081	.092	.120	.152	.182	.214	.244	.277	.292	.309	.338
.08	.081	.093	.118	.152	.179	.216	.248	.277	.295	.307	.337
.09	.079	.094	.119	.151	.177	.217	.240	.273	.296	.303	.334
.10	.079	.093	.119	.147	.181	.209	.239	.270	.294	.307	.338
.11	.080	.091	.115	.149	.180	.208	.242	.274	.292	.305	.336
.12	.079	.094	.116	.147	.183	.208	.240	.270	.292	.308	.335

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.036	.086	.127	.167	.206	.252	.280	.307	.333	.372	.391
.01	.048	.087	.127	.170	.207	.253	.282	.307	.333	.374	.391
.02	.047	.088	.126	.169	.206	.251	.277	.306	.337	.352	.391
.03	.046	.087	.126	.168	.206	.251	.281	.316	.334	.350	.391
.04	.046	.086	.125	.169	.205	.244	.283	.317	.334	.350	.392
.05	.046	.089	.126	.169	.205	.244	.279	.319	.337	.352	.393
.06	.047	.085	.125	.171	.205	.244	.280	.318	.335	.348	.393
.07	.047	.084	.127	.171	.208	.244	.279	.316	.336	.350	.385
.08	.046	.085	.124	.169	.204	.246	.282	.319	.340	.351	.385
.09	.045	.087	.126	.169	.201	.246	.275	.314	.336	.347	.382
.10	.046	.084	.125	.163	.204	.237	.273	.312	.338	.350	.388
.11	.046	.082	.122	.166	.205	.236	.276	.315	.335	.348	.383
.12	.047	.083	.122	.164	.207	.237	.275	.310	.336	.351	.384

Table 131

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.014	.021	.030	.045	.057	.078	.091	.103	.118	.142	.154
.01	.016	.021	.031	.044	.056	.077	.091	.104	.119	.144	.154
.02	.017	.021	.031	.044	.056	.076	.090	.104	.119	.131	.153
.03	.016	.020	.031	.044	.057	.077	.090	.108	.120	.130	.153
.04	.016	.021	.031	.044	.056	.074	.091	.108	.120	.130	.154
.05	.017	.021	.030	.043	.057	.074	.090	.110	.120	.130	.155
.06	.017	.020	.030	.044	.056	.074	.089	.109	.120	.129	.154
.07	.016	.021	.031	.044	.057	.073	.088	.111	.119	.130	.150
.08	.017	.020	.031	.044	.057	.076	.091	.110	.119	.129	.150
.09	.017	.021	.030	.043	.055	.074	.087	.107	.122	.127	.149
.10	.016	.021	.029	.042	.057	.071	.087	.105	.119	.128	.151
.11	.017	.020	.030	.042	.057	.071	.087	.107	.119	.127	.147
.12	.016	.021	.030	.042	.057	.069	.087	.105	.120	.131	.151

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.008	.014	.022	.028	.040	.046	.053	.060	.075	.080
.01	.004	.008	.014	.022	.028	.039	.046	.054	.060	.075	.081
.02	.003	.009	.014	.022	.028	.039	.046	.053	.060	.068	.081
.03	.004	.009	.014	.022	.027	.039	.046	.055	.061	.066	.080
.04	.004	.009	.015	.022	.027	.036	.047	.055	.061	.066	.081
.05	.004	.009	.014	.021	.028	.037	.046	.057	.060	.067	.080
.06	.004	.008	.014	.022	.028	.038	.046	.056	.060	.065	.080
.07	.003	.008	.014	.022	.028	.037	.045	.058	.061	.066	.075
.08	.004	.008	.014	.022	.028	.038	.047	.057	.060	.064	.074
.09	.004	.008	.014	.021	.027	.037	.043	.054	.061	.063	.075
.10	.003	.008	.014	.020	.027	.034	.043	.053	.060	.066	.077
.11	.004	.008	.013	.020	.027	.035	.043	.053	.061	.065	.073
.12	.004	.008	.013	.020	.027	.034	.043	.052	.060	.065	.075

Table 132

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.030	.043	.070	.110	.145	.195	.239	.275	.319	.359	.394
.01	.034	.044	.070	.110	.147	.193	.240	.278	.318	.363	.395
.02	.035	.043	.071	.110	.146	.193	.240	.277	.317	.343	.393
.03	.033	.044	.071	.111	.147	.192	.238	.288	.316	.345	.396
.04	.033	.044	.070	.112	.147	.196	.237	.283	.316	.347	.394
.05	.034	.046	.071	.106	.147	.196	.240	.283	.316	.346	.392
.06	.034	.046	.070	.106	.146	.196	.237	.285	.318	.345	.393
.07	.033	.045	.071	.105	.144	.195	.239	.283	.318	.348	.392
.08	.033	.044	.069	.107	.146	.194	.241	.284	.318	.345	.393
.09	.034	.044	.071	.105	.146	.195	.231	.275	.321	.345	.393
.10	.034	.045	.071	.100	.148	.186	.233	.276	.320	.350	.394
.11	.033	.045	.067	.101	.146	.188	.233	.277	.318	.346	.393
.12	.033	.044	.067	.102	.146	.189	.235	.276	.316	.344	.393

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.123	.188	.267	.336	.428	.478	.521	.573	.627	.655
.01	.055	.124	.188	.266	.338	.426	.475	.523	.573	.628	.656
.02	.056	.123	.186	.266	.336	.427	.478	.520	.570	.595	.656
.03	.056	.125	.189	.266	.336	.427	.476	.542	.570	.597	.654
.04	.055	.124	.186	.267	.337	.403	.477	.542	.570	.596	.656
.05	.055	.125	.189	.271	.337	.409	.479	.539	.570	.596	.654
.06	.057	.116	.188	.272	.337	.407	.478	.541	.572	.596	.654
.07	.054	.116	.190	.272	.335	.406	.475	.540	.572	.598	.644
.08	.055	.115	.186	.272	.336	.403	.478	.544	.573	.594	.649
.09	.055	.114	.188	.271	.337	.404	.459	.528	.575	.594	.645
.10	.056	.115	.188	.258	.337	.390	.461	.533	.570	.598	.647
.11	.055	.108	.176	.256	.333	.391	.463	.532	.572	.595	.644
.12	.055	.104	.176	.257	.337	.390	.464	.530	.569	.594	.646

Table 133

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.030	.043	.070	.110	.145	.195	.239	.275	.319	.359	.394
.01	.034	.044	.070	.110	.147	.193	.240	.278	.318	.363	.395
.02	.035	.043	.071	.110	.146	.193	.240	.277	.317	.343	.393
.03	.033	.044	.071	.111	.147	.192	.238	.288	.316	.345	.396
.04	.033	.044	.070	.112	.147	.196	.237	.283	.316	.347	.394
.05	.034	.046	.071	.106	.147	.196	.240	.283	.316	.346	.392
.06	.034	.046	.070	.106	.146	.196	.237	.285	.318	.345	.393
.07	.033	.045	.071	.105	.144	.195	.239	.283	.318	.348	.392
.08	.033	.044	.069	.107	.146	.194	.241	.284	.318	.345	.393
.09	.034	.044	.071	.105	.146	.195	.231	.275	.321	.345	.393
.10	.034	.045	.071	.100	.148	.186	.233	.276	.320	.350	.394
.11	.033	.045	.067	.101	.146	.188	.233	.277	.318	.346	.393
.12	.033	.044	.067	.102	.146	.189	.235	.276	.316	.344	.393

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.026	.042	.068	.094	.140	.165	.189	.227	.276	.297
.01	.009	.026	.043	.068	.095	.140	.163	.189	.228	.276	.294
.02	.010	.025	.043	.068	.094	.140	.165	.191	.227	.240	.296
.03	.009	.026	.043	.067	.095	.139	.166	.210	.223	.245	.297
.04	.009	.026	.042	.068	.093	.124	.166	.207	.225	.243	.297
.05	.009	.027	.042	.072	.095	.126	.168	.208	.225	.243	.294
.06	.009	.023	.041	.071	.094	.126	.164	.208	.226	.243	.298
.07	.009	.023	.043	.071	.093	.124	.165	.207	.224	.244	.280
.08	.009	.022	.042	.071	.093	.123	.168	.204	.227	.239	.283
.09	.008	.022	.042	.071	.095	.124	.157	.198	.227	.241	.283
.10	.009	.024	.042	.064	.096	.115	.156	.198	.225	.245	.284
.11	.009	.020	.039	.064	.095	.117	.157	.199	.225	.241	.282
.12	.009	.020	.039	.066	.095	.118	.157	.198	.223	.241	.283

Table 134

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.021	.035	.064	.106	.141	.200	.240	.278	.323	.387	.412
.01	.024	.036	.064	.105	.141	.199	.241	.279	.327	.385	.410
.02	.024	.036	.062	.106	.143	.199	.239	.278	.324	.352	.408
.03	.024	.037	.063	.105	.142	.198	.242	.296	.326	.353	.410
.04	.024	.037	.062	.105	.144	.194	.240	.295	.325	.351	.411
.05	.024	.037	.063	.103	.142	.193	.241	.295	.325	.354	.411
.06	.024	.036	.062	.104	.145	.194	.240	.296	.327	.353	.409
.07	.024	.037	.064	.100	.145	.195	.240	.298	.324	.355	.402
.08	.024	.038	.064	.102	.143	.193	.240	.296	.324	.345	.402
.09	.025	.037	.064	.101	.144	.195	.237	.290	.322	.349	.401
.10	.023	.037	.064	.093	.142	.183	.237	.284	.325	.349	.401
.11	.024	.036	.060	.094	.143	.181	.239	.284	.322	.349	.401
.12	.024	.036	.058	.096	.143	.182	.238	.286	.323	.347	.404

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.042	.117	.200	.294	.379	.490	.545	.595	.646	.716	.741
.01	.042	.118	.200	.296	.379	.491	.547	.595	.650	.716	.741
.02	.042	.118	.199	.297	.380	.490	.545	.592	.646	.673	.741
.03	.041	.120	.199	.294	.379	.490	.549	.619	.646	.672	.742
.04	.042	.118	.197	.295	.378	.461	.550	.621	.649	.672	.742
.05	.041	.119	.198	.305	.381	.462	.546	.621	.651	.673	.740
.06	.042	.111	.198	.303	.382	.464	.546	.617	.650	.671	.738
.07	.042	.110	.198	.299	.382	.461	.549	.619	.646	.675	.724
.08	.043	.111	.198	.303	.380	.461	.545	.618	.647	.670	.723
.09	.043	.110	.200	.301	.383	.463	.528	.610	.646	.669	.720
.10	.042	.109	.199	.283	.381	.441	.526	.607	.650	.670	.721
.11	.042	.103	.186	.283	.381	.443	.528	.605	.647	.672	.721
.12	.043	.101	.185	.285	.380	.444	.527	.608	.648	.671	.724

Table 135

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.021	.035	.064	.106	.141	.200	.240	.278	.323	.387	.412
.01	.024	.036	.064	.105	.141	.199	.241	.279	.327	.385	.410
.02	.024	.036	.062	.106	.143	.199	.239	.278	.324	.352	.408
.03	.024	.037	.063	.105	.142	.198	.242	.296	.326	.353	.410
.04	.024	.037	.062	.105	.144	.194	.240	.295	.325	.351	.411
.05	.024	.037	.063	.103	.142	.193	.241	.295	.325	.354	.411
.06	.024	.036	.062	.104	.145	.194	.240	.296	.327	.353	.409
.07	.024	.037	.064	.100	.145	.195	.240	.298	.324	.355	.402
.08	.024	.038	.064	.102	.143	.193	.240	.296	.324	.345	.402
.09	.025	.037	.064	.101	.144	.195	.237	.290	.322	.349	.401
.10	.023	.037	.064	.093	.142	.183	.237	.284	.325	.349	.401
.11	.024	.036	.060	.094	.143	.181	.239	.284	.322	.349	.401
.12	.024	.036	.058	.096	.143	.182	.238	.286	.323	.347	.404

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.006	.025	.053	.096	.138	.209	.251	.294	.342	.417	.447
.01	.007	.026	.055	.096	.139	.211	.253	.294	.344	.414	.446
.02	.007	.026	.053	.097	.140	.209	.251	.294	.342	.368	.446
.03	.007	.027	.054	.096	.139	.209	.253	.313	.343	.370	.445
.04	.007	.026	.053	.095	.140	.193	.253	.312	.344	.366	.445
.05	.007	.027	.053	.100	.139	.192	.253	.313	.345	.369	.444
.06	.007	.024	.051	.099	.141	.192	.251	.312	.345	.371	.442
.07	.007	.024	.055	.096	.140	.191	.252	.315	.343	.370	.423
.08	.007	.025	.054	.097	.140	.191	.250	.313	.343	.361	.424
.09	.007	.025	.054	.098	.140	.192	.237	.306	.340	.366	.422
.10	.007	.025	.054	.088	.140	.178	.238	.304	.344	.363	.421
.11	.007	.022	.049	.089	.141	.178	.237	.302	.341	.365	.420
.12	.007	.021	.048	.090	.139	.178	.238	.303	.340	.366	.423

Table 136

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.059	.098	.189	.314	.411	.523	.620	.691	.754	.804	.833
.01	.068	.098	.191	.315	.412	.524	.619	.691	.753	.805	.836
.02	.069	.097	.191	.316	.411	.523	.620	.692	.755	.787	.836
.03	.071	.097	.193	.316	.412	.523	.617	.701	.751	.788	.835
.04	.069	.098	.191	.317	.409	.533	.621	.703	.753	.788	.836
.05	.068	.098	.191	.291	.411	.533	.620	.702	.751	.789	.834
.06	.070	.111	.189	.289	.412	.535	.618	.702	.752	.788	.835
.07	.069	.110	.193	.290	.413	.535	.622	.700	.751	.788	.840
.08	.070	.109	.190	.292	.411	.534	.620	.702	.755	.787	.841
.09	.068	.111	.189	.289	.410	.535	.616	.690	.753	.784	.841
.10	.069	.109	.192	.277	.414	.517	.617	.691	.753	.787	.841
.11	.068	.111	.175	.279	.409	.521	.615	.689	.754	.786	.838
.12	.066	.109	.173	.275	.410	.517	.618	.690	.753	.787	.840

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.162	.283	.429	.567	.707	.775	.827	.876	.916	.934
.01	.046	.161	.283	.433	.565	.711	.777	.828	.872	.917	.936
.02	.046	.160	.282	.433	.564	.709	.777	.827	.876	.893	.933
.03	.047	.161	.287	.433	.568	.711	.774	.846	.876	.894	.935
.04	.047	.162	.284	.434	.565	.676	.778	.847	.874	.896	.935
.05	.046	.161	.287	.451	.566	.676	.775	.846	.875	.895	.933
.06	.046	.140	.282	.450	.566	.675	.774	.847	.875	.894	.934
.07	.046	.139	.285	.448	.565	.678	.776	.847	.872	.894	.927
.08	.045	.138	.283	.453	.566	.677	.775	.845	.878	.895	.930
.09	.046	.142	.281	.449	.565	.680	.754	.838	.874	.893	.928
.10	.046	.139	.285	.420	.565	.653	.755	.841	.875	.894	.929
.11	.047	.123	.256	.421	.564	.655	.757	.838	.876	.893	.928
.12	.045	.120	.254	.421	.566	.652	.755	.839	.875	.894	.929

Table 137

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.017	.046	.101	.153	.223	.310	.380	.452	.519	.569
.01	.009	.016	.047	.101	.153	.227	.308	.382	.450	.519	.575
.02	.009	.017	.048	.101	.150	.226	.309	.384	.455	.504	.574
.03	.010	.016	.047	.101	.152	.225	.308	.390	.450	.504	.572
.04	.010	.018	.047	.101	.151	.242	.310	.390	.452	.505	.575
.05	.009	.017	.047	.087	.151	.239	.310	.387	.450	.505	.573
.06	.009	.020	.046	.088	.152	.237	.308	.388	.452	.507	.572
.07	.009	.020	.047	.087	.151	.242	.310	.389	.448	.505	.582
.08	.009	.021	.046	.088	.151	.240	.309	.388	.452	.506	.583
.09	.009	.021	.047	.088	.151	.238	.302	.376	.451	.502	.585
.10	.010	.021	.047	.081	.153	.226	.306	.381	.452	.506	.583
.11	.009	.020	.042	.083	.151	.229	.303	.378	.452	.505	.581
.12	.009	.021	.039	.083	.151	.229	.304	.376	.452	.504	.584

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.045	.095	.174	.272	.411	.486	.555	.636	.726	.759
.01	.009	.045	.095	.177	.271	.414	.488	.557	.631	.724	.761
.02	.009	.045	.096	.176	.268	.411	.486	.554	.637	.668	.761
.03	.009	.045	.096	.176	.273	.414	.486	.589	.632	.669	.762
.04	.009	.046	.097	.178	.269	.368	.487	.591	.634	.671	.762
.05	.009	.046	.097	.190	.270	.370	.486	.588	.633	.669	.760
.06	.009	.037	.094	.191	.271	.369	.485	.588	.633	.670	.763
.07	.009	.037	.097	.191	.271	.371	.485	.588	.631	.669	.742
.08	.009	.036	.096	.192	.270	.371	.487	.589	.634	.668	.742
.09	.009	.037	.096	.188	.272	.369	.456	.575	.633	.664	.743
.10	.009	.037	.096	.170	.271	.342	.457	.577	.635	.669	.744
.11	.009	.030	.082	.169	.269	.345	.457	.574	.633	.667	.742
.12	.008	.029	.080	.169	.269	.345	.459	.573	.634	.668	.743

Table 138

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.067	.122	.274	.461	.577	.706	.806	.864	.910	.938	.953
.01	.077	.120	.272	.456	.581	.705	.805	.863	.908	.939	.951
.02	.077	.119	.272	.456	.577	.705	.804	.863	.908	.931	.952
.03	.077	.119	.273	.454	.579	.706	.803	.873	.909	.932	.952
.04	.079	.121	.273	.458	.581	.721	.805	.874	.909	.931	.954
.05	.078	.120	.274	.407	.583	.721	.805	.873	.910	.930	.953
.06	.078	.147	.273	.410	.578	.720	.803	.874	.912	.932	.952
.07	.078	.147	.271	.408	.577	.723	.804	.874	.909	.930	.957
.08	.077	.146	.273	.409	.578	.721	.804	.873	.908	.928	.957
.09	.079	.145	.274	.405	.579	.722	.803	.863	.909	.928	.958
.10	.079	.147	.274	.402	.580	.704	.802	.863	.908	.929	.957
.11	.078	.153	.241	.402	.579	.706	.802	.863	.910	.929	.958
.12	.078	.154	.242	.399	.579	.705	.805	.862	.910	.928	.957

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.213	.392	.595	.746	.878	.923	.953	.974	.987	.992
.01	.043	.209	.391	.591	.750	.875	.923	.953	.973	.987	.992
.02	.044	.208	.389	.592	.745	.877	.923	.952	.973	.980	.991
.03	.045	.207	.392	.588	.749	.877	.924	.962	.973	.980	.991
.04	.046	.210	.389	.589	.749	.851	.924	.961	.973	.980	.992
.05	.044	.209	.392	.614	.750	.851	.924	.962	.974	.980	.992
.06	.045	.173	.391	.615	.747	.851	.923	.962	.974	.979	.992
.07	.045	.173	.390	.613	.747	.852	.923	.961	.973	.980	.990
.08	.045	.174	.391	.614	.747	.850	.924	.962	.974	.980	.991
.09	.046	.171	.390	.611	.746	.851	.908	.959	.973	.980	.991
.10	.045	.174	.394	.584	.748	.832	.910	.959	.974	.980	.990
.11	.044	.150	.345	.582	.747	.833	.910	.957	.974	.980	.991
.12	.044	.149	.345	.579	.748	.832	.912	.958	.974	.980	.990

Table 139

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.014	.035	.112	.239	.337	.466	.600	.692	.769	.824	.860
.01	.018	.034	.110	.234	.339	.465	.599	.689	.766	.826	.858
.02	.018	.034	.110	.236	.337	.466	.601	.689	.765	.814	.860
.03	.017	.034	.112	.235	.338	.468	.596	.698	.766	.813	.860
.04	.018	.035	.113	.238	.338	.492	.599	.700	.764	.814	.862
.05	.017	.034	.113	.198	.340	.489	.601	.699	.768	.810	.861
.06	.017	.047	.112	.198	.336	.491	.597	.698	.770	.814	.861
.07	.017	.046	.112	.198	.337	.494	.599	.698	.767	.814	.872
.08	.017	.046	.111	.201	.337	.490	.598	.697	.765	.809	.873
.09	.018	.045	.111	.196	.337	.491	.594	.684	.765	.811	.872
.10	.018	.047	.113	.194	.336	.477	.593	.686	.765	.812	.872
.11	.018	.050	.092	.194	.340	.478	.589	.685	.767	.809	.873
.12	.018	.049	.093	.194	.335	.477	.595	.685	.767	.807	.872

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.065	.154	.297	.449	.642	.736	.802	.869	.923	.944
.01	.008	.064	.150	.294	.452	.645	.732	.802	.867	.925	.942
.02	.008	.064	.153	.294	.450	.645	.734	.803	.867	.893	.944
.03	.008	.063	.154	.293	.449	.646	.734	.831	.868	.892	.944
.04	.008	.063	.154	.295	.452	.591	.735	.829	.866	.892	.945
.05	.008	.065	.154	.317	.451	.592	.737	.832	.867	.891	.945
.06	.009	.048	.153	.318	.448	.590	.733	.832	.869	.893	.945
.07	.008	.048	.152	.317	.450	.593	.734	.830	.868	.891	.935
.08	.008	.048	.153	.320	.449	.592	.735	.832	.867	.889	.936
.09	.009	.046	.150	.316	.450	.592	.699	.820	.867	.891	.936
.10	.008	.048	.153	.288	.450	.560	.699	.821	.866	.891	.934
.11	.008	.038	.125	.287	.452	.561	.700	.821	.868	.890	.936
.12	.008	.037	.125	.284	.450	.560	.702	.820	.868	.890	.936

Table 140

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.023	.051	.122	.224	.313	.436	.511	.579	.660	.748	.766
.01	.028	.050	.124	.224	.315	.437	.512	.578	.658	.745	.761
.02	.028	.051	.123	.225	.312	.438	.511	.583	.661	.695	.764
.03	.028	.050	.124	.225	.313	.434	.512	.623	.661	.699	.764
.04	.028	.051	.122	.224	.314	.428	.512	.620	.656	.696	.766
.05	.028	.050	.123	.217	.314	.426	.511	.619	.659	.694	.765
.06	.029	.060	.123	.217	.315	.426	.512	.621	.659	.695	.766
.07	.028	.060	.122	.216	.314	.426	.510	.622	.662	.697	.765
.08	.029	.060	.123	.214	.314	.430	.513	.619	.660	.685	.765
.09	.028	.060	.122	.217	.316	.429	.525	.595	.661	.683	.764
.10	.029	.060	.121	.198	.311	.395	.522	.593	.657	.684	.765
.11	.029	.061	.112	.199	.311	.393	.525	.595	.657	.683	.767
.12	.029	.064	.110	.199	.314	.393	.525	.594	.659	.686	.764

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.046	.192	.356	.530	.672	.808	.858	.893	.930	.961	.969
.01	.044	.191	.358	.529	.670	.810	.861	.893	.928	.961	.968
.02	.044	.192	.357	.527	.671	.809	.859	.897	.928	.940	.968
.03	.045	.191	.354	.530	.670	.807	.861	.912	.928	.941	.969
.04	.043	.191	.353	.529	.670	.769	.859	.911	.928	.940	.969
.05	.045	.192	.355	.552	.669	.769	.860	.913	.929	.940	.968
.06	.045	.169	.357	.551	.672	.769	.860	.913	.928	.940	.969
.07	.044	.171	.354	.549	.671	.769	.858	.914	.929	.941	.961
.08	.045	.170	.354	.549	.672	.771	.860	.911	.931	.940	.963
.09	.044	.168	.354	.551	.671	.771	.837	.905	.930	.939	.960
.10	.044	.169	.356	.520	.667	.749	.837	.907	.930	.939	.962
.11	.045	.150	.324	.522	.668	.747	.837	.907	.928	.939	.961
.12	.045	.149	.323	.525	.671	.748	.838	.907	.929	.940	.961

Table 141

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.011	.035	.081	.127	.207	.270	.333	.410	.507	.533
.01	.004	.010	.036	.079	.129	.207	.270	.331	.408	.503	.528
.02	.004	.010	.035	.081	.129	.209	.268	.332	.410	.450	.534
.03	.005	.010	.036	.081	.129	.206	.269	.368	.410	.454	.534
.04	.004	.011	.035	.080	.129	.205	.268	.367	.407	.453	.534
.05	.004	.011	.035	.075	.128	.205	.269	.368	.409	.452	.533
.06	.005	.013	.035	.074	.131	.205	.272	.369	.405	.455	.532
.07	.005	.013	.035	.076	.129	.205	.269	.370	.411	.454	.537
.08	.004	.013	.036	.076	.127	.206	.272	.366	.409	.440	.535
.09	.004	.013	.035	.076	.129	.207	.281	.342	.409	.439	.536
.10	.004	.013	.035	.067	.127	.183	.279	.342	.405	.437	.537
.11	.005	.014	.031	.068	.128	.182	.280	.342	.408	.440	.536
.12	.005	.014	.031	.067	.126	.182	.280	.343	.410	.441	.535

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.057	.139	.263	.392	.561	.644	.704	.773	.855	.877
.01	.008	.057	.141	.262	.392	.563	.642	.704	.774	.855	.874
.02	.008	.056	.141	.262	.391	.563	.642	.707	.776	.801	.876
.03	.008	.056	.139	.262	.390	.561	.644	.740	.775	.802	.877
.04	.008	.058	.138	.261	.391	.509	.643	.737	.773	.802	.878
.05	.008	.057	.138	.281	.392	.509	.643	.739	.774	.801	.876
.06	.008	.048	.139	.278	.393	.510	.643	.738	.773	.801	.876
.07	.008	.049	.139	.279	.391	.511	.643	.741	.776	.803	.854
.08	.008	.049	.139	.277	.391	.512	.645	.737	.777	.802	.856
.09	.008	.049	.137	.278	.394	.513	.607	.726	.776	.799	.854
.10	.008	.048	.139	.253	.390	.484	.603	.727	.773	.799	.855
.11	.008	.041	.122	.255	.387	.482	.608	.727	.772	.799	.858
.12	.008	.041	.122	.254	.393	.481	.605	.729	.774	.802	.855

Table 142

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.063	.132	.306	.493	.620	.764	.816	.867	.914	.953	.957
.01	.078	.133	.305	.494	.622	.763	.818	.869	.916	.952	.957
.02	.078	.131	.307	.493	.623	.763	.819	.869	.914	.928	.956
.03	.076	.132	.306	.490	.620	.763	.819	.897	.915	.928	.955
.04	.079	.129	.305	.492	.622	.748	.817	.898	.915	.930	.956
.05	.077	.131	.307	.477	.623	.747	.818	.896	.916	.930	.956
.06	.078	.164	.309	.476	.623	.751	.817	.896	.916	.930	.955
.07	.076	.164	.307	.480	.620	.750	.816	.897	.913	.930	.958
.08	.077	.164	.304	.479	.619	.751	.819	.897	.915	.921	.958
.09	.078	.165	.305	.479	.621	.750	.840	.879	.915	.923	.958
.10	.078	.163	.306	.450	.622	.702	.837	.876	.915	.921	.959
.11	.078	.181	.275	.448	.622	.702	.839	.878	.916	.922	.959
.12	.079	.182	.275	.448	.619	.703	.842	.878	.915	.922	.959

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.046	.257	.488	.699	.834	.936	.961	.975	.987	.995	.997
.01	.044	.258	.486	.697	.837	.936	.961	.976	.988	.995	.997
.02	.045	.259	.487	.699	.835	.936	.963	.976	.988	.990	.997
.03	.045	.260	.488	.697	.835	.936	.962	.982	.988	.991	.997
.04	.044	.258	.486	.697	.837	.909	.961	.983	.988	.991	.997
.05	.045	.259	.487	.722	.835	.908	.962	.983	.988	.991	.997
.06	.045	.217	.488	.723	.836	.909	.962	.982	.988	.990	.997
.07	.045	.218	.487	.725	.836	.908	.961	.983	.987	.991	.995
.08	.045	.218	.488	.724	.836	.908	.962	.982	.988	.990	.995
.09	.045	.217	.486	.723	.834	.909	.949	.981	.987	.990	.995
.10	.044	.217	.488	.689	.835	.896	.949	.981	.987	.991	.996
.11	.046	.191	.440	.688	.836	.895	.949	.980	.988	.990	.996
.12	.046	.191	.437	.691	.835	.896	.949	.981	.988	.991	.996

Table 143

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.017	.050	.155	.303	.423	.583	.658	.735	.811	.880	.889
.01	.023	.050	.156	.303	.423	.584	.662	.737	.813	.878	.888
.02	.023	.049	.156	.301	.423	.579	.662	.737	.812	.841	.888
.03	.022	.049	.155	.300	.422	.583	.662	.779	.812	.841	.888
.04	.023	.048	.158	.302	.423	.569	.659	.781	.812	.843	.889
.05	.023	.049	.156	.287	.423	.569	.659	.781	.813	.841	.888
.06	.023	.066	.158	.285	.425	.573	.658	.781	.814	.841	.888
.07	.023	.067	.158	.286	.422	.576	.660	.780	.809	.841	.895
.08	.022	.066	.155	.288	.422	.572	.660	.782	.811	.827	.897
.09	.023	.068	.157	.286	.423	.572	.693	.750	.811	.829	.895
.10	.023	.066	.157	.266	.424	.519	.691	.746	.812	.827	.896
.11	.023	.077	.134	.265	.422	.517	.690	.746	.812	.827	.896
.12	.024	.076	.133	.265	.422	.518	.694	.749	.813	.826	.896

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.089	.232	.431	.609	.797	.858	.899	.940	.972	.980
.01	.008	.089	.232	.430	.609	.796	.858	.902	.940	.972	.979
.02	.009	.089	.231	.430	.608	.794	.861	.902	.939	.952	.979
.03	.008	.091	.231	.427	.608	.794	.860	.921	.940	.952	.979
.04	.009	.088	.232	.428	.609	.739	.858	.921	.940	.953	.979
.05	.009	.089	.233	.455	.607	.736	.860	.920	.941	.953	.979
.06	.009	.071	.234	.454	.608	.738	.858	.920	.940	.952	.980
.07	.008	.070	.234	.457	.609	.741	.857	.921	.940	.952	.973
.08	.008	.071	.232	.457	.606	.739	.860	.922	.941	.950	.974
.09	.008	.071	.230	.454	.609	.737	.827	.915	.940	.952	.973
.10	.008	.070	.235	.419	.608	.710	.825	.914	.940	.952	.973
.11	.009	.059	.198	.419	.608	.712	.825	.914	.939	.951	.973
.12	.009	.059	.196	.417	.606	.713	.827	.916	.940	.951	.974

Table 144

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.055	.136	.429	.684	.813	.917	.965	.985	.993	.997	.998
.01	.070	.133	.431	.688	.811	.919	.964	.984	.994	.997	.998
.02	.069	.135	.433	.686	.816	.916	.963	.984	.993	.997	.998
.03	.069	.133	.433	.682	.815	.917	.963	.987	.993	.996	.998
.04	.069	.134	.430	.685	.814	.921	.965	.987	.994	.997	.998
.05	.067	.135	.432	.604	.815	.922	.965	.987	.994	.997	.998
.06	.068	.199	.431	.605	.815	.921	.965	.987	.994	.997	.998
.07	.069	.201	.432	.604	.816	.921	.963	.988	.994	.997	.999
.08	.068	.202	.433	.603	.815	.922	.964	.988	.994	.996	.999
.09	.068	.201	.431	.602	.815	.921	.966	.983	.993	.996	.999
.10	.069	.200	.433	.614	.815	.909	.965	.983	.994	.995	.999
.11	.067	.232	.346	.614	.815	.909	.966	.984	.993	.995	.999
.12	.068	.232	.346	.616	.814	.909	.966	.983	.994	.995	.999

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.340	.644	.868	.961	.994	.998	.999			
.01	.043	.340	.647	.870	.961	.994	.998				
.02	.042	.343	.646	.870	.961	.994	.998	.999			
.03	.041	.341	.648	.868	.962	.994	.998				
.04	.042	.341	.647	.868	.962	.989	.999				
.05	.042	.342	.648	.885	.961	.990	.998				
.06	.042	.263	.646	.886	.962	.990	.998				
.07	.041	.265	.648	.888	.961	.990	.998				
.08	.041	.265	.648	.888	.961	.990	.998				
.09	.042	.264	.649	.886	.961	.989	.997				
.10	.042	.264	.648	.859	.961	.986	.997				
.11	.040	.224	.573	.859	.962	.986	.997				
.12	.042	.221	.573	.862	.962	.986	.997				

Table 145

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.006	.025	.160	.371	.529	.709	.842	.915	.955	.976	.983
.01	.008	.026	.162	.374	.528	.710	.841	.914	.953	.977	.983
.02	.008	.026	.164	.371	.532	.706	.840	.913	.954	.975	.982
.03	.008	.024	.164	.370	.532	.707	.842	.920	.956	.975	.983
.04	.008	.025	.161	.372	.531	.727	.843	.922	.956	.975	.983
.05	.007	.025	.162	.284	.531	.726	.843	.920	.956	.974	.982
.06	.008	.047	.163	.287	.534	.726	.842	.920	.956	.975	.983
.07	.008	.049	.164	.286	.531	.726	.841	.921	.955	.975	.989
.08	.008	.049	.166	.286	.533	.727	.842	.919	.955	.971	.989
.09	.008	.048	.163	.285	.530	.725	.841	.907	.956	.969	.989
.10	.008	.048	.165	.304	.532	.717	.838	.907	.956	.970	.989
.11	.008	.060	.111	.303	.534	.714	.839	.907	.953	.969	.989
.12	.008	.059	.112	.304	.529	.713	.840	.907	.955	.969	.989

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.136	.360	.641	.839	.959	.983	.993	.998		
.01	.009	.135	.361	.646	.838	.960	.984	.993	.998		
.02	.007	.134	.361	.643	.841	.958	.984	.993	.998	.999	
.03	.008	.133	.363	.640	.839	.958	.982	.996	.998	.999	
.04	.007	.135	.359	.641	.841	.937	.984	.996	.998	.999	
.05	.008	.135	.362	.678	.841	.938	.984	.996	.998	.999	
.06	.008	.088	.361	.677	.841	.937	.983	.995	.998	.999	
.07	.007	.089	.363	.677	.838	.937	.983	.995	.998	.999	
.08	.008	.089	.364	.678	.841	.938	.983	.996	.998	.999	
.09	.008	.089	.361	.675	.841	.936	.976	.995	.998	.999	
.10	.008	.088	.363	.629	.839	.922	.976	.995	.998	.999	
.11	.008	.068	.287	.628	.840	.921	.976	.995	.998	.999	
.12	.008	.067	.287	.630	.841	.921	.977	.995	.998	.999	

Table 146

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.040	.112	.347	.568	.716	.859	.900	.938	.968	.984	.984
.01	.053	.113	.347	.569	.714	.859	.901	.938	.967	.985	.985
.02	.052	.113	.346	.568	.716	.860	.900	.939	.967	.972	.985
.03	.053	.113	.348	.566	.713	.862	.901	.958	.966	.972	.984
.04	.053	.112	.346	.568	.714	.855	.901	.958	.966	.971	.984
.05	.053	.112	.347	.550	.716	.855	.901	.958	.966	.972	.985
.06	.053	.159	.348	.551	.716	.852	.900	.957	.965	.972	.985
.07	.054	.160	.347	.549	.713	.852	.900	.958	.967	.972	.986
.08	.051	.159	.349	.553	.717	.855	.899	.959	.966	.968	.987
.09	.051	.159	.348	.552	.717	.851	.926	.943	.966	.969	.987
.10	.053	.160	.347	.520	.716	.788	.924	.942	.966	.967	.987
.11	.053	.195	.287	.521	.715	.790	.926	.942	.966	.969	.986
.12	.051	.196	.287	.521	.721	.788	.925	.942	.966	.967	.988

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.047	.349	.640	.852	.946	.989	.995	.998	.999		
.01	.043	.349	.642	.851	.945	.988	.995	.998	.999		
.02	.044	.346	.642	.849	.945	.989	.995	.998	.999		
.03	.044	.347	.642	.848	.945	.989	.995	.999	.999		
.04	.043	.349	.643	.851	.946	.980	.995	.999	.999		
.05	.044	.345	.642	.871	.945	.980	.995	.999	.999	.999	
.06	.044	.281	.644	.872	.945	.979	.995	.999	.999		
.07	.044	.280	.643	.870	.945	.980	.995	.999	.999		
.08	.044	.279	.644	.871	.945	.979	.995	.999	.999	.999	
.09	.043	.280	.643	.871	.946	.979	.992	.998	.999	.999	
.10	.044	.282	.642	.844	.945	.973	.992	.998	.999		
.11	.044	.240	.578	.845	.946	.974	.992	.998	.999	.999	
.12	.043	.238	.576	.845	.946	.974	.992	.999	.999	.999	

Table 147

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.032	.161	.334	.488	.682	.760	.839	.901	.944	.946
.01	.011	.033	.160	.336	.488	.682	.761	.840	.902	.944	.947
.02	.010	.033	.161	.334	.488	.682	.761	.841	.902	.919	.948
.03	.011	.033	.162	.335	.488	.684	.759	.877	.901	.919	.947
.04	.011	.033	.161	.336	.487	.679	.761	.877	.900	.918	.947
.05	.010	.033	.161	.314	.490	.678	.761	.877	.901	.919	.947
.06	.011	.053	.162	.316	.490	.675	.760	.876	.901	.920	.948
.07	.011	.054	.161	.310	.486	.677	.760	.877	.902	.919	.955
.08	.010	.053	.162	.316	.490	.678	.758	.879	.900	.908	.956
.09	.010	.053	.161	.313	.487	.676	.802	.841	.900	.908	.955
.10	.010	.054	.162	.294	.488	.598	.801	.841	.900	.908	.955
.11	.010	.071	.120	.295	.488	.599	.802	.840	.902	.909	.955
.12	.010	.071	.120	.295	.491	.596	.803	.841	.901	.907	.956

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.138	.370	.635	.819	.944	.971	.984	.994	.998	.999
.01	.008	.139	.372	.637	.817	.943	.971	.984	.993	.998	.999
.02	.008	.137	.370	.636	.818	.944	.971	.984	.994	.996	.999
.03	.009	.139	.371	.635	.817	.945	.972	.990	.994	.996	.999
.04	.008	.138	.370	.638	.817	.913	.971	.989	.993	.996	.999
.05	.008	.137	.370	.668	.819	.914	.971	.989	.993	.995	.999
.06	.008	.102	.371	.670	.818	.911	.970	.989	.993	.995	.999
.07	.008	.102	.371	.667	.816	.912	.970	.989	.993	.995	.998
.08	.008	.102	.371	.670	.817	.911	.971	.990	.993	.995	.998
.09	.008	.102	.374	.668	.818	.912	.959	.988	.993	.995	.998
.10	.008	.103	.371	.624	.817	.894	.957	.988	.993	.996	.998
.11	.008	.081	.307	.623	.815	.896	.959	.987	.993	.995	.998
.12	.008	.081	.308	.626	.820	.894	.957	.988	.993	.995	.998

Table 148

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.040	.140	.465	.706	.846	.951	.968	.986	.994	.998	.997
.01	.056	.140	.468	.705	.845	.953	.968	.986	.994	.997	.997
.02	.056	.138	.469	.706	.847	.951	.969	.986	.994	.994	.997
.03	.057	.139	.467	.705	.847	.954	.969	.992	.994	.995	.998
.04	.056	.138	.467	.705	.847	.948	.968	.992	.993	.994	.997
.05	.055	.140	.470	.695	.846	.950	.969	.992	.994	.994	.997
.06	.057	.205	.467	.692	.847	.948	.968	.992	.993	.995	.997
.07	.056	.208	.467	.692	.847	.949	.968	.992	.993	.994	.998
.08	.056	.208	.467	.693	.846	.950	.968	.992	.993	.994	.998
.09	.056	.211	.467	.693	.845	.948	.982	.986	.993	.993	.998
.10	.058	.206	.468	.667	.846	.894	.982	.986	.994	.994	.998
.11	.057	.285	.370	.668	.848	.891	.982	.986	.994	.994	.998
.12	.056	.285	.370	.666	.846	.893	.982	.986	.994	.993	.998

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.453	.786	.945	.989	.999					
.01	.042	.453	.788	.945	.989	.999					
.02	.042	.454	.784	.944	.989	.999					
.03	.043	.456	.787	.945	.989	.999					
.04	.044	.451	.784	.944	.990	.997					
.05	.042	.452	.786	.957	.988	.998					
.06	.043	.355	.785	.957	.989	.998					
.07	.043	.356	.788	.957	.988	.997					
.08	.043	.355	.787	.958	.989	.998					
.09	.042	.357	.785	.958	.989	.997	.999				
.10	.042	.354	.785	.942	.989	.996					
.11	.043	.303	.710	.942	.989	.996					
.12	.043	.302	.712	.942	.989	.996	.999				

Table 149

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.055	.289	.524	.707	.879	.917	.961	.981	.991	.990
.01	.016	.055	.291	.525	.704	.880	.919	.962	.981	.990	.991
.02	.015	.054	.290	.523	.705	.880	.920	.963	.981	.984	.991
.03	.015	.055	.289	.523	.708	.883	.920	.974	.982	.985	.991
.04	.016	.055	.290	.523	.707	.877	.920	.975	.980	.985	.990
.05	.016	.054	.289	.503	.705	.877	.919	.975	.982	.984	.990
.06	.016	.094	.290	.499	.707	.875	.920	.975	.981	.984	.990
.07	.016	.096	.290	.501	.706	.875	.918	.975	.981	.984	.993
.08	.015	.096	.289	.501	.705	.877	.919	.975	.981	.982	.993
.09	.016	.098	.290	.501	.706	.876	.946	.958	.981	.982	.993
.10	.016	.094	.291	.485	.704	.790	.946	.957	.981	.982	.993
.11	.016	.143	.204	.487	.706	.788	.947	.957	.982	.982	.993
.12	.015	.144	.204	.486	.705	.788	.947	.958	.982	.981	.993

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.213	.543	.823	.946	.991	.997	.999			
.01	.008	.214	.545	.822	.946	.992	.997	.999			
.02	.008	.211	.544	.821	.947	.992	.997	.999			
.03	.008	.214	.547	.822	.945	.992	.997				
.04	.008	.209	.544	.823	.946	.983	.997	.999			
.05	.008	.211	.546	.851	.947	.984	.997				
.06	.008	.148	.544	.849	.946	.983	.997	.999			
.07	.008	.148	.546	.851	.947	.983	.997				
.08	.008	.147	.546	.850	.945	.983	.997	.999			
.09	.008	.150	.547	.851	.945	.982	.995	.999			
.10	.008	.145	.547	.815	.945	.978	.995	.999			
.11	.008	.115	.449	.815	.946	.977	.995	.999			
.12	.008	.115	.450	.814	.947	.977	.995	.999			

Table 150

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.197	.615	.833	.939	.990	.994	.998	.999		
.01	.074	.198	.616	.833	.940	.990	.994	.998			
.02	.073	.201	.617	.832	.938	.990	.994	.998	.999	.999	
.03	.075	.199	.615	.834	.938	.991	.994	.999	.999	.999	
.04	.076	.200	.617	.834	.939	.990	.994	.999	.999	.999	
.05	.073	.198	.615	.826	.940	.990	.994	.999			
.06	.073	.288	.616	.828	.939	.989	.994	.999	.999	.999	
.07	.075	.292	.615	.829	.939	.990	.994	.999	.999	.999	
.08	.076	.294	.614	.827	.938	.989	.994	.999	.999	.999	
.09	.076	.293	.613	.828	.939	.990	.998	.998	.999	.999	
.10	.074	.292	.616	.816	.939	.959	.998	.998	.999	.999	
.11	.075	.426	.495	.819	.941	.959	.998	.998	.999	.999	
.12	.074	.427	.498	.817	.939	.958	.997	.998	.999		

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.047	.568	.894	.985	.999						
.01	.042	.568	.894	.985	.999						
.02	.041	.573	.896	.985	.999						
.03	.041	.569	.893	.985	.999						
.04	.042	.569	.894	.986	.998						
.05	.042	.569	.894	.990	.999						
.06	.040	.440	.892	.990	.999						
.07	.041	.443	.893	.990	.998						
.08	.041	.446	.893	.989	.999						
.09	.042	.443	.893	.990	.999						
.10	.041	.445	.894	.986	.999						
.11	.042	.376	.831	.985	.999						
.12	.041	.379	.832	.985	.999						

Table 151

Power Rates For One-Tailed Directional Test For Discrete Mass Zero Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.078	.416	.666	.846	.965	.977	.993	.997	.999	.999
.01	.020	.079	.417	.667	.844	.964	.978	.993	.997	.999	.999
.02	.019	.079	.417	.666	.842	.964	.978	.993	.997	.997	.999
.03	.019	.079	.416	.668	.843	.966	.977	.996	.997	.998	.999
.04	.020	.078	.416	.665	.845	.965	.977	.996	.997	.997	.999
.05	.018	.079	.418	.653	.846	.964	.977	.996	.997	.997	.998
.06	.019	.138	.418	.651	.845	.963	.977	.996	.997	.997	.999
.07	.020	.142	.415	.655	.845	.964	.978	.996	.997	.997	.999
.08	.019	.140	.414	.654	.841	.964	.977	.996	.997	.997	.999
.09	.020	.141	.415	.651	.844	.964	.989	.990	.997	.997	.999
.10	.020	.140	.417	.653	.843	.896	.989	.991	.997	.997	.999
.11	.019	.234	.289	.654	.845	.896	.990	.990	.997	.997	.999
.12	.019	.237	.291	.653	.845	.894	.989	.991	.997	.997	.999

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.308	.715	.934	.990	.999					
.01	.008	.306	.715	.934	.990						
.02	.007	.310	.718	.934	.990	.999					
.03	.008	.306	.715	.935	.989	.999					
.04	.008	.310	.717	.935	.990	.998					
.05	.008	.309	.716	.951	.990	.998					
.06	.008	.205	.715	.952	.990	.998					
.07	.008	.207	.715	.951	.990	.998					
.08	.008	.207	.716	.951	.989	.998					
.09	.008	.207	.715	.951	.990	.998					
.10	.008	.207	.719	.934	.990	.998					
.11	.008	.160	.607	.933	.990	.997					
.12	.008	.161	.609	.932	.990	.997					

Table 152

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.081	.113	.162	.205	.246	.274	.299	.320	.341	.357	.368
.01	.078	.111	.161	.205	.243	.273	.303	.319	.341	.357	.370
.02	.079	.110	.162	.205	.243	.277	.300	.319	.341	.356	.370
.03	.078	.108	.157	.202	.244	.276	.299	.322	.337	.358	.373
.04	.080	.107	.158	.202	.241	.273	.299	.323	.342	.358	.372
.05	.080	.105	.156	.204	.239	.272	.299	.323	.342	.358	.368
.06	.081	.103	.155	.201	.241	.269	.299	.320	.342	.355	.370
.07	.082	.102	.153	.198	.240	.271	.299	.324	.341	.356	.371
.08	.083	.100	.149	.200	.239	.273	.298	.321	.343	.359	.372
.09	.082	.100	.149	.199	.239	.268	.298	.323	.341	.358	.373
.10	.083	.098	.149	.196	.233	.271	.301	.320	.342	.355	.372
.11	.085	.095	.148	.197	.237	.270	.300	.321	.343	.357	.375
.12	.086	.095	.144	.196	.235	.270	.301	.321	.341	.358	.373

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.117	.178	.228	.273	.303	.329	.353	.375	.392	.404
.01	.045	.114	.177	.229	.269	.304	.333	.353	.375	.393	.404
.02	.042	.112	.179	.227	.269	.306	.331	.352	.375	.392	.404
.03	.040	.112	.174	.225	.270	.305	.330	.353	.371	.392	.408
.04	.038	.109	.175	.226	.267	.301	.330	.357	.375	.393	.407
.05	.036	.107	.172	.228	.265	.300	.330	.355	.375	.393	.405
.06	.035	.104	.169	.222	.269	.299	.331	.351	.375	.389	.405
.07	.034	.102	.168	.221	.266	.300	.331	.356	.375	.392	.407
.08	.032	.099	.165	.222	.267	.302	.328	.353	.378	.395	.406
.09	.030	.097	.164	.221	.265	.299	.330	.356	.375	.394	.409
.10	.029	.096	.164	.218	.261	.300	.332	.353	.375	.391	.408
.11	.028	.091	.161	.219	.263	.300	.330	.355	.378	.391	.411
.12	.026	.090	.158	.218	.261	.298	.331	.355	.377	.392	.408

Table 153

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.015	.028	.049	.070	.093	.109	.127	.143	.161	.175	.188
.01	.016	.027	.048	.068	.091	.111	.130	.146	.160	.177	.189
.02	.016	.026	.047	.070	.090	.112	.127	.144	.163	.175	.189
.03	.016	.026	.046	.068	.090	.111	.129	.143	.160	.177	.190
.04	.017	.025	.046	.067	.089	.109	.128	.147	.162	.178	.189
.05	.016	.025	.045	.069	.088	.107	.128	.145	.162	.176	.190
.06	.016	.024	.046	.067	.090	.107	.128	.142	.161	.174	.190
.07	.017	.024	.044	.067	.088	.107	.126	.144	.161	.174	.189
.08	.017	.023	.043	.066	.088	.109	.124	.144	.160	.177	.188
.09	.017	.023	.042	.066	.087	.108	.127	.145	.160	.176	.191
.10	.018	.022	.043	.065	.084	.108	.126	.143	.160	.172	.189
.11	.018	.022	.041	.064	.087	.106	.125	.144	.161	.174	.191
.12	.018	.021	.040	.064	.085	.107	.127	.142	.160	.175	.188

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.004	.013	.026	.040	.054	.067	.079	.089	.102	.111	.120
.01	.004	.012	.025	.039	.053	.068	.081	.091	.101	.111	.121
.02	.004	.012	.025	.040	.054	.068	.078	.089	.103	.110	.119
.03	.003	.011	.024	.038	.053	.067	.080	.089	.100	.111	.120
.04	.003	.011	.024	.038	.052	.066	.078	.090	.101	.112	.120
.05	.003	.011	.023	.038	.051	.064	.077	.089	.100	.110	.118
.06	.003	.010	.024	.037	.052	.064	.077	.087	.100	.109	.119
.07	.003	.010	.022	.037	.050	.063	.076	.088	.100	.109	.119
.08	.003	.009	.021	.036	.050	.065	.074	.089	.099	.110	.117
.09	.002	.009	.021	.036	.049	.063	.076	.089	.099	.110	.117
.10	.003	.009	.021	.035	.048	.063	.076	.086	.098	.105	.118
.11	.002	.008	.020	.034	.049	.062	.074	.088	.099	.108	.120
.12	.002	.008	.019	.034	.048	.062	.075	.085	.099	.109	.117

Table 154

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.033	.064	.125	.175	.220	.254	.282	.305	.329	.350	.366
.01	.032	.062	.123	.177	.221	.252	.287	.308	.330	.348	.367
.02	.033	.063	.121	.176	.219	.254	.283	.310	.334	.347	.371
.03	.033	.060	.121	.174	.219	.254	.284	.310	.334	.352	.367
.04	.033	.058	.118	.177	.222	.256	.287	.310	.334	.353	.373
.05	.033	.056	.118	.175	.218	.258	.285	.312	.333	.353	.377
.06	.034	.056	.115	.175	.219	.258	.287	.316	.339	.356	.377
.07	.034	.052	.114	.173	.219	.260	.288	.314	.339	.359	.376
.08	.034	.051	.111	.171	.220	.257	.291	.317	.340	.360	.379
.09	.034	.049	.108	.171	.220	.260	.291	.321	.342	.360	.379
.10	.036	.048	.107	.169	.222	.259	.294	.320	.342	.366	.380
.11	.036	.047	.105	.170	.219	.261	.291	.322	.344	.367	.383
.12	.039	.044	.102	.170	.219	.259	.294	.325	.347	.366	.384

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.059	.172	.293	.391	.466	.522	.562	.592	.618	.641	.653
.01	.056	.166	.292	.390	.467	.520	.565	.595	.620	.638	.655
.02	.053	.165	.287	.388	.463	.521	.563	.597	.622	.637	.658
.03	.050	.160	.282	.383	.465	.520	.564	.598	.624	.641	.657
.04	.049	.156	.281	.386	.463	.521	.566	.596	.622	.645	.659
.05	.046	.151	.275	.384	.461	.521	.563	.598	.626	.645	.665
.06	.045	.149	.274	.381	.460	.523	.565	.605	.628	.644	.662
.07	.043	.142	.271	.377	.461	.523	.568	.603	.630	.648	.664
.08	.040	.139	.265	.374	.460	.522	.571	.601	.632	.650	.664
.09	.038	.133	.260	.376	.458	.523	.568	.608	.631	.653	.668
.10	.037	.130	.258	.369	.458	.523	.571	.604	.632	.653	.669
.11	.036	.127	.255	.368	.457	.522	.569	.605	.634	.654	.669
.12	.034	.121	.249	.369	.456	.524	.570	.611	.635	.654	.670

Table 155

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.033	.064	.125	.175	.220	.254	.282	.305	.329	.350	.366
.01	.032	.062	.123	.177	.221	.252	.287	.308	.330	.348	.367
.02	.033	.063	.121	.176	.219	.254	.283	.310	.334	.347	.371
.03	.033	.060	.121	.174	.219	.254	.284	.310	.334	.352	.367
.04	.033	.058	.118	.177	.222	.256	.287	.310	.334	.353	.373
.05	.033	.056	.118	.175	.218	.258	.285	.312	.333	.353	.377
.06	.034	.056	.115	.175	.219	.258	.287	.316	.339	.356	.377
.07	.034	.052	.114	.173	.219	.260	.288	.314	.339	.359	.376
.08	.034	.051	.111	.171	.220	.257	.291	.317	.340	.360	.379
.09	.034	.049	.108	.171	.220	.260	.291	.321	.342	.360	.379
.10	.036	.048	.107	.169	.222	.259	.294	.320	.342	.366	.380
.11	.036	.047	.105	.170	.219	.261	.291	.322	.344	.367	.383
.12	.039	.044	.102	.170	.219	.259	.294	.325	.347	.366	.384

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.036	.078	.123	.164	.204	.234	.261	.287	.311	.329
.01	.009	.034	.078	.122	.165	.201	.235	.262	.287	.309	.330
.02	.009	.034	.076	.121	.165	.201	.233	.264	.290	.306	.333
.03	.008	.031	.074	.117	.162	.200	.233	.263	.292	.309	.327
.04	.007	.031	.073	.120	.163	.201	.235	.262	.289	.311	.333
.05	.007	.030	.072	.117	.160	.199	.232	.265	.288	.312	.337
.06	.007	.029	.071	.117	.159	.201	.236	.267	.294	.312	.335
.07	.006	.028	.069	.115	.159	.201	.235	.262	.293	.316	.334
.08	.006	.027	.068	.112	.161	.199	.238	.265	.293	.313	.338
.09	.006	.025	.064	.112	.157	.200	.237	.267	.293	.316	.337
.10	.006	.024	.064	.112	.158	.199	.237	.268	.293	.318	.337
.11	.006	.024	.063	.110	.157	.200	.233	.268	.293	.320	.338
.12	.006	.023	.060	.110	.154	.197	.237	.268	.296	.319	.338

Table 156

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.023	.055	.127	.205	.276	.336	.386	.430	.465	.497	.520
.01	.023	.054	.123	.203	.272	.334	.387	.428	.465	.498	.525
.02	.023	.051	.120	.199	.271	.332	.386	.429	.463	.496	.523
.03	.024	.049	.118	.196	.268	.335	.387	.425	.466	.498	.522
.04	.023	.047	.116	.196	.267	.329	.382	.429	.465	.498	.523
.05	.024	.046	.114	.191	.267	.330	.381	.425	.464	.498	.523
.06	.024	.043	.113	.190	.263	.327	.382	.428	.465	.495	.525
.07	.025	.042	.107	.186	.261	.326	.379	.427	.463	.496	.526
.08	.025	.041	.103	.184	.258	.326	.379	.424	.465	.495	.523
.09	.027	.039	.101	.183	.256	.323	.379	.429	.466	.494	.524
.10	.027	.038	.100	.180	.257	.320	.379	.424	.461	.497	.522
.11	.028	.038	.097	.172	.253	.318	.378	.425	.462	.495	.525
.12	.029	.034	.094	.173	.248	.318	.376	.421	.461	.496	.523

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.045	.180	.331	.458	.560	.631	.691	.733	.770	.795	.816
.01	.040	.174	.326	.455	.553	.632	.691	.734	.768	.796	.819
.02	.038	.167	.320	.451	.554	.629	.688	.732	.769	.796	.815
.03	.035	.163	.314	.446	.551	.631	.688	.731	.767	.797	.817
.04	.033	.159	.311	.445	.549	.625	.685	.733	.765	.798	.816
.05	.031	.155	.309	.443	.545	.626	.683	.730	.766	.795	.817
.06	.028	.149	.303	.440	.543	.624	.685	.732	.769	.794	.818
.07	.025	.143	.300	.436	.541	.626	.681	.733	.769	.793	.816
.08	.024	.141	.294	.430	.536	.623	.681	.728	.765	.793	.815
.09	.022	.136	.288	.427	.536	.618	.684	.731	.766	.791	.817
.10	.021	.130	.282	.428	.532	.615	.680	.727	.763	.793	.815
.11	.020	.124	.281	.418	.529	.613	.677	.727	.762	.793	.815
.12	.019	.119	.274	.416	.527	.612	.677	.724	.765	.794	.816

Table 157

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.023	.055	.127	.205	.276	.336	.386	.430	.465	.497	.520
.01	.023	.054	.123	.203	.272	.334	.387	.428	.465	.498	.525
.02	.023	.051	.120	.199	.271	.332	.386	.429	.463	.496	.523
.03	.024	.049	.118	.196	.268	.335	.387	.425	.466	.498	.522
.04	.023	.047	.116	.196	.267	.329	.382	.429	.465	.498	.523
.05	.024	.046	.114	.191	.267	.330	.381	.425	.464	.498	.523
.06	.024	.043	.113	.190	.263	.327	.382	.428	.465	.495	.525
.07	.025	.042	.107	.186	.261	.326	.379	.427	.463	.496	.526
.08	.025	.041	.103	.184	.258	.326	.379	.424	.465	.495	.523
.09	.027	.039	.101	.183	.256	.323	.379	.429	.466	.494	.524
.10	.027	.038	.100	.180	.257	.320	.379	.424	.461	.497	.522
.11	.028	.038	.097	.172	.253	.318	.378	.425	.462	.495	.525
.12	.029	.034	.094	.173	.248	.318	.376	.421	.461	.496	.523

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.046	.113	.184	.255	.317	.378	.427	.471	.505	.537
.01	.006	.045	.110	.182	.251	.319	.377	.425	.468	.506	.544
.02	.006	.042	.106	.180	.251	.318	.375	.423	.467	.507	.537
.03	.006	.040	.104	.177	.248	.317	.374	.419	.468	.506	.542
.04	.005	.039	.103	.177	.247	.311	.371	.424	.467	.509	.541
.05	.005	.038	.102	.175	.247	.313	.370	.419	.468	.508	.539
.06	.004	.035	.099	.172	.244	.311	.371	.424	.468	.504	.542
.07	.004	.034	.097	.170	.243	.311	.368	.421	.467	.504	.542
.08	.003	.033	.094	.168	.239	.310	.367	.418	.466	.504	.539
.09	.004	.031	.090	.168	.238	.307	.368	.423	.466	.503	.539
.10	.003	.029	.090	.166	.239	.306	.367	.420	.464	.504	.539
.11	.003	.029	.088	.159	.235	.302	.365	.419	.464	.504	.540
.12	.003	.026	.085	.160	.233	.303	.365	.416	.463	.503	.538

Table 158

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.063	.168	.380	.534	.623	.676	.712	.735	.756	.772	.785
.01	.064	.161	.376	.533	.626	.682	.714	.740	.759	.772	.785
.02	.064	.154	.365	.531	.627	.682	.718	.741	.760	.776	.789
.03	.067	.148	.360	.528	.628	.680	.720	.747	.764	.780	.791
.04	.065	.143	.354	.527	.627	.685	.721	.747	.765	.782	.795
.05	.067	.136	.347	.523	.628	.688	.726	.753	.769	.785	.796
.06	.069	.130	.339	.519	.629	.690	.728	.753	.773	.789	.799
.07	.069	.125	.330	.519	.632	.695	.731	.755	.774	.788	.803
.08	.071	.119	.325	.512	.627	.691	.735	.760	.778	.793	.802
.09	.071	.113	.316	.510	.632	.696	.738	.760	.778	.795	.807
.10	.074	.109	.307	.503	.628	.691	.738	.762	.784	.794	.807
.11	.078	.104	.297	.501	.625	.695	.742	.768	.786	.797	.809
.12	.079	.100	.290	.496	.628	.698	.741	.769	.788	.805	.811

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.249	.487	.658	.761	.825	.865	.886	.899	.909	.914
.01	.048	.241	.482	.656	.763	.826	.866	.889	.901	.909	.915
.02	.044	.232	.475	.655	.761	.827	.866	.889	.902	.911	.917
.03	.042	.227	.470	.648	.762	.827	.867	.892	.905	.913	.918
.04	.035	.218	.462	.647	.759	.827	.869	.893	.905	.915	.920
.05	.034	.208	.456	.642	.757	.828	.868	.894	.908	.916	.920
.06	.032	.201	.448	.638	.759	.829	.871	.895	.909	.919	.922
.07	.029	.193	.441	.635	.758	.830	.870	.896	.910	.918	.924
.08	.028	.186	.434	.630	.752	.828	.873	.897	.912	.922	.924
.09	.025	.177	.426	.627	.756	.829	.873	.898	.911	.921	.927
.10	.023	.170	.421	.620	.751	.828	.873	.899	.915	.921	.928
.11	.022	.160	.411	.617	.750	.826	.874	.900	.915	.924	.928
.12	.021	.153	.403	.612	.747	.826	.874	.901	.916	.926	.931

Table 159

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.039	.127	.222	.294	.346	.390	.424	.454	.481	.504
.01	.008	.036	.127	.220	.295	.354	.394	.425	.454	.481	.503
.02	.009	.033	.124	.220	.297	.352	.397	.430	.459	.485	.507
.03	.009	.032	.118	.222	.299	.352	.398	.434	.465	.490	.508
.04	.009	.030	.117	.219	.298	.355	.402	.437	.464	.492	.513
.05	.009	.027	.114	.217	.297	.357	.404	.443	.467	.496	.516
.06	.009	.026	.109	.214	.300	.360	.408	.440	.475	.500	.519
.07	.009	.024	.106	.214	.302	.363	.408	.442	.474	.501	.526
.08	.010	.023	.102	.209	.298	.363	.412	.447	.478	.506	.526
.09	.010	.021	.098	.207	.302	.364	.418	.452	.480	.510	.529
.10	.011	.021	.095	.207	.301	.362	.417	.454	.486	.507	.530
.11	.012	.018	.091	.203	.300	.367	.420	.457	.488	.514	.534
.12	.012	.017	.087	.202	.298	.366	.420	.460	.489	.518	.536

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.077	.211	.354	.473	.566	.637	.684	.724	.747	.766
.01	.009	.073	.209	.349	.474	.571	.637	.687	.721	.747	.768
.02	.008	.069	.202	.349	.471	.566	.640	.688	.726	.749	.769
.03	.008	.068	.196	.345	.472	.565	.640	.691	.728	.754	.772
.04	.006	.063	.195	.342	.470	.567	.637	.692	.728	.758	.776
.05	.006	.060	.190	.338	.468	.564	.640	.695	.733	.759	.777
.06	.006	.057	.186	.334	.467	.568	.643	.694	.733	.762	.778
.07	.005	.054	.180	.333	.468	.566	.642	.694	.733	.760	.783
.08	.005	.051	.175	.327	.460	.565	.644	.698	.738	.765	.783
.09	.004	.047	.169	.323	.463	.566	.647	.700	.736	.766	.788
.10	.004	.045	.168	.319	.458	.561	.643	.699	.741	.767	.787
.11	.004	.042	.160	.315	.457	.561	.646	.701	.742	.769	.789
.12	.003	.040	.154	.311	.453	.560	.644	.701	.742	.772	.791

Table 160

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.072	.231	.553	.749	.829	.865	.884	.900	.908	.917	.923
.01	.072	.220	.546	.747	.833	.867	.888	.900	.911	.919	.924
.02	.073	.210	.532	.744	.832	.869	.889	.901	.913	.920	.925
.03	.073	.198	.523	.742	.832	.871	.890	.904	.914	.921	.928
.04	.073	.188	.509	.736	.833	.873	.894	.907	.915	.922	.927
.05	.077	.180	.500	.732	.834	.876	.896	.908	.918	.925	.931
.06	.077	.172	.488	.730	.834	.878	.898	.911	.921	.925	.931
.07	.080	.163	.481	.722	.835	.880	.901	.913	.921	.929	.933
.08	.081	.156	.467	.721	.837	.879	.903	.914	.922	.929	.934
.09	.084	.147	.452	.713	.834	.882	.904	.916	.926	.930	.935
.10	.087	.139	.438	.708	.834	.884	.906	.918	.925	.933	.937
.11	.091	.135	.427	.701	.834	.885	.908	.920	.928	.935	.940
.12	.094	.125	.414	.693	.832	.886	.908	.923	.929	.935	.940

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.052	.340	.660	.836	.915	.951	.967	.975	.978	.980	.981
.01	.046	.330	.651	.834	.916	.950	.968	.975	.978	.980	.980
.02	.042	.321	.644	.832	.915	.952	.968	.975	.979	.981	.981
.03	.037	.306	.638	.828	.913	.952	.968	.976	.980	.982	.982
.04	.033	.293	.628	.824	.912	.952	.970	.977	.981	.982	.983
.05	.031	.284	.621	.820	.913	.953	.968	.978	.981	.983	.983
.06	.028	.271	.612	.817	.911	.952	.970	.978	.982	.983	.983
.07	.025	.257	.607	.813	.911	.952	.971	.978	.982	.984	.985
.08	.022	.244	.596	.811	.911	.951	.971	.979	.983	.984	.985
.09	.020	.232	.585	.807	.909	.952	.971	.980	.984	.984	.986
.10	.018	.221	.577	.803	.908	.952	.972	.979	.984	.985	.986
.11	.017	.212	.567	.798	.908	.952	.971	.980	.983	.986	.986
.12	.015	.197	.553	.793	.906	.954	.972	.981	.984	.986	.987

Table 161

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.015	.088	.309	.502	.614	.674	.710	.740	.760	.779	.795
.01	.015	.081	.302	.505	.615	.676	.715	.741	.765	.782	.798
.02	.016	.076	.291	.498	.615	.680	.716	.746	.768	.785	.801
.03	.016	.070	.288	.496	.617	.685	.722	.750	.772	.789	.803
.04	.017	.065	.276	.489	.620	.684	.725	.753	.776	.793	.806
.05	.017	.061	.267	.489	.621	.688	.729	.757	.776	.794	.811
.06	.017	.056	.258	.484	.620	.692	.736	.762	.781	.796	.811
.07	.019	.052	.252	.481	.622	.695	.738	.767	.783	.803	.817
.08	.019	.050	.240	.477	.624	.697	.742	.768	.787	.804	.817
.09	.021	.045	.231	.470	.622	.700	.744	.770	.792	.807	.820
.10	.021	.042	.220	.466	.621	.703	.746	.772	.793	.810	.823
.11	.023	.040	.211	.459	.622	.703	.750	.778	.798	.814	.828
.12	.024	.036	.201	.447	.617	.708	.749	.781	.801	.816	.829

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.121	.354	.571	.719	.808	.860	.894	.910	.923	.929
.01	.008	.114	.347	.569	.721	.809	.864	.893	.913	.924	.929
.02	.007	.108	.339	.564	.716	.809	.864	.895	.914	.926	.932
.03	.006	.102	.336	.559	.713	.809	.863	.897	.915	.927	.934
.04	.006	.096	.325	.554	.714	.811	.866	.900	.918	.928	.934
.05	.005	.089	.318	.550	.712	.809	.867	.899	.919	.929	.937
.06	.005	.085	.310	.544	.710	.811	.868	.902	.920	.930	.938
.07	.004	.079	.304	.540	.711	.811	.870	.902	.922	.933	.939
.08	.004	.074	.295	.535	.710	.808	.870	.903	.921	.934	.941
.09	.003	.067	.284	.528	.703	.809	.870	.905	.924	.934	.942
.10	.003	.064	.279	.523	.699	.809	.871	.905	.925	.936	.943
.11	.003	.060	.268	.516	.698	.806	.872	.906	.926	.939	.945
.12	.002	.053	.259	.506	.695	.809	.870	.908	.927	.939	.945

Table 162

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.026	.094	.273	.464	.617	.725	.794	.845	.879	.899	.916
.01	.026	.092	.264	.458	.609	.721	.794	.844	.879	.899	.916
.02	.026	.085	.258	.448	.606	.716	.793	.843	.875	.901	.914
.03	.027	.081	.248	.439	.602	.713	.791	.841	.875	.902	.915
.04	.025	.077	.240	.435	.596	.710	.789	.840	.876	.899	.916
.05	.028	.072	.234	.426	.592	.707	.786	.842	.874	.901	.917
.06	.029	.069	.226	.421	.584	.704	.783	.839	.873	.899	.916
.07	.029	.066	.220	.411	.578	.698	.781	.835	.874	.900	.918
.08	.030	.063	.212	.404	.569	.693	.779	.835	.873	.899	.915
.09	.032	.059	.204	.400	.565	.693	.778	.835	.873	.897	.917
.10	.034	.055	.197	.392	.562	.685	.774	.831	.871	.899	.915
.11	.035	.053	.191	.382	.555	.683	.771	.830	.869	.897	.914
.12	.037	.051	.186	.375	.550	.677	.769	.828	.869	.900	.915

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.312	.601	.777	.875	.929	.956	.974	.983	.988	.991
.01	.042	.305	.591	.774	.872	.925	.957	.973	.983	.988	.991
.02	.040	.294	.581	.768	.872	.927	.955	.972	.982	.987	.991
.03	.035	.283	.573	.763	.871	.924	.957	.972	.981	.988	.991
.04	.030	.270	.568	.761	.866	.924	.956	.972	.982	.988	.991
.05	.029	.257	.559	.754	.868	.923	.955	.973	.982	.988	.991
.06	.025	.249	.549	.749	.863	.922	.953	.971	.981	.987	.991
.07	.022	.238	.542	.746	.860	.921	.953	.972	.983	.987	.991
.08	.020	.226	.531	.741	.855	.921	.953	.971	.981	.987	.991
.09	.018	.217	.520	.735	.853	.919	.952	.971	.980	.987	.991
.10	.016	.207	.512	.730	.853	.915	.951	.970	.982	.988	.991
.11	.014	.198	.504	.727	.847	.914	.950	.969	.981	.987	.991
.12	.013	.189	.494	.718	.847	.913	.949	.969	.981	.987	.991

Table 163

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.004	.024	.104	.229	.358	.467	.557	.625	.681	.720	.752
.01	.004	.024	.101	.224	.352	.463	.554	.625	.679	.719	.752
.02	.004	.021	.097	.218	.345	.459	.553	.623	.675	.721	.750
.03	.005	.020	.092	.211	.343	.458	.550	.622	.676	.722	.751
.04	.004	.018	.088	.209	.341	.454	.549	.621	.674	.719	.755
.05	.004	.016	.085	.203	.334	.452	.548	.621	.674	.720	.754
.06	.004	.016	.081	.200	.327	.446	.542	.619	.675	.718	.753
.07	.005	.014	.078	.193	.326	.441	.540	.616	.675	.720	.755
.08	.005	.014	.075	.189	.319	.439	.538	.616	.672	.718	.753
.09	.005	.013	.070	.183	.313	.441	.535	.614	.675	.718	.755
.10	.006	.012	.066	.179	.310	.432	.530	.609	.674	.717	.753
.11	.006	.011	.064	.172	.307	.427	.530	.609	.668	.718	.751
.12	.007	.011	.062	.169	.300	.422	.526	.606	.669	.719	.752

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.114	.317	.510	.658	.762	.831	.879	.910	.931	.946
.01	.008	.109	.308	.507	.652	.760	.831	.877	.910	.931	.945
.02	.007	.104	.303	.498	.650	.757	.830	.877	.908	.931	.945
.03	.006	.098	.293	.493	.650	.754	.829	.874	.908	.932	.946
.04	.005	.091	.288	.490	.646	.754	.827	.876	.908	.930	.946
.05	.005	.085	.280	.481	.645	.751	.826	.877	.908	.933	.946
.06	.004	.082	.273	.477	.636	.750	.824	.873	.907	.930	.946
.07	.004	.078	.269	.470	.635	.745	.822	.872	.908	.930	.946
.08	.003	.072	.260	.467	.625	.743	.821	.872	.906	.930	.946
.09	.003	.069	.253	.461	.623	.743	.822	.873	.906	.931	.946
.10	.002	.064	.246	.456	.623	.736	.817	.870	.906	.930	.946
.11	.002	.059	.241	.448	.616	.737	.817	.868	.904	.930	.946
.12	.002	.056	.234	.442	.613	.732	.816	.868	.905	.930	.944

Table 164

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.069	.241	.553	.782	.899	.951	.976	.988	.994	.996	.997
.01	.069	.232	.543	.772	.896	.951	.975	.988	.993	.996	.997
.02	.071	.222	.532	.765	.890	.949	.975	.987	.993	.996	.997
.03	.071	.212	.518	.760	.887	.947	.974	.987	.993	.996	.997
.04	.073	.204	.506	.752	.885	.944	.973	.986	.993	.996	.997
.05	.075	.195	.496	.745	.879	.944	.972	.986	.992	.996	.997
.06	.078	.183	.484	.736	.876	.941	.972	.986	.992	.996	.997
.07	.081	.176	.475	.729	.872	.938	.970	.985	.992	.996	.997
.08	.084	.166	.459	.720	.866	.938	.969	.984	.992	.996	.997
.09	.087	.158	.451	.713	.865	.935	.969	.984	.991	.995	.997
.10	.092	.150	.440	.705	.858	.932	.967	.985	.991	.995	.997
.11	.097	.143	.428	.697	.852	.933	.968	.983	.991	.995	.997
.12	.102	.137	.417	.687	.850	.929	.965	.983	.991	.995	.997

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.428	.768	.917	.970	.989	.995	.998	.999	.999	
.01	.043	.415	.761	.914	.970	.988	.995	.998	.999		
.02	.038	.398	.755	.910	.968	.988	.995	.998	.999		
.03	.032	.382	.743	.909	.968	.988	.995	.998	.999		
.04	.029	.369	.734	.904	.966	.987	.995	.998	.999	.999	
.05	.024	.356	.724	.902	.964	.988	.994	.998	.999		
.06	.021	.336	.720	.897	.963	.986	.995	.997	.999	.999	
.07	.018	.324	.710	.893	.963	.986	.995	.998	.999		
.08	.016	.306	.700	.891	.961	.986	.995	.998	.999		
.09	.014	.291	.690	.887	.961	.985	.994	.998	.999	.999	
.10	.012	.275	.678	.882	.958	.985	.994	.998	.999	.999	
.11	.011	.262	.667	.879	.956	.985	.994	.997	.999		
.12	.009	.249	.658	.875	.955	.984	.994	.998	.999	.999	

Table 165

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.020	.110	.359	.609	.780	.879	.930	.959	.975	.981	.986
.01	.020	.104	.343	.599	.778	.875	.929	.957	.973	.982	.987
.02	.020	.099	.337	.590	.769	.871	.927	.957	.972	.982	.987
.03	.020	.093	.324	.581	.763	.870	.925	.957	.973	.981	.987
.04	.021	.087	.312	.572	.757	.864	.924	.956	.973	.981	.987
.05	.021	.082	.303	.561	.751	.861	.923	.954	.972	.981	.987
.06	.023	.076	.292	.552	.746	.857	.921	.953	.971	.982	.987
.07	.025	.071	.284	.543	.740	.854	.917	.953	.971	.981	.986
.08	.025	.067	.271	.532	.732	.852	.917	.951	.970	.981	.987
.09	.027	.062	.262	.524	.726	.847	.915	.952	.971	.981	.986
.10	.029	.057	.254	.515	.718	.843	.911	.950	.969	.980	.986
.11	.032	.055	.244	.506	.711	.840	.910	.948	.969	.980	.987
.12	.033	.051	.236	.495	.704	.836	.908	.947	.969	.980	.986

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.187	.509	.747	.877	.938	.968	.984	.991	.994	.997
.01	.008	.177	.499	.739	.874	.937	.968	.983	.991	.994	.997
.02	.007	.167	.490	.734	.870	.936	.968	.983	.991	.994	.996
.03	.005	.158	.477	.730	.866	.936	.967	.983	.991	.994	.996
.04	.005	.149	.466	.723	.866	.932	.966	.982	.991	.995	.996
.05	.004	.141	.458	.716	.862	.933	.965	.982	.990	.995	.997
.06	.003	.131	.448	.710	.857	.930	.966	.982	.990	.994	.996
.07	.003	.124	.437	.704	.856	.928	.964	.982	.990	.994	.997
.08	.002	.113	.427	.696	.851	.928	.964	.981	.990	.994	.997
.09	.002	.105	.414	.690	.849	.926	.964	.981	.990	.994	.996
.10	.002	.098	.405	.684	.845	.924	.962	.981	.989	.994	.996
.11	.001	.090	.395	.678	.841	.923	.963	.980	.990	.994	.997
.12	.001	.083	.382	.669	.838	.921	.961	.980	.989	.994	.997

Table 166

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.057	.335	.808	.961	.983	.989	.992	.993	.994	.995	.996
.01	.058	.316	.799	.960	.984	.990	.992	.994	.995	.995	.996
.02	.058	.299	.781	.958	.985	.990	.992	.994	.995	.996	.996
.03	.059	.282	.769	.956	.984	.990	.993	.994	.995	.996	.996
.04	.063	.263	.756	.954	.985	.991	.993	.995	.995	.996	.997
.05	.065	.247	.739	.952	.985	.991	.993	.995	.995	.996	.997
.06	.067	.231	.726	.949	.986	.992	.994	.995	.996	.996	.997
.07	.070	.215	.708	.944	.986	.992	.994	.995	.996	.997	.997
.08	.075	.203	.690	.941	.986	.992	.995	.995	.996	.997	.997
.09	.079	.189	.673	.938	.986	.993	.995	.995	.997	.997	.998
.10	.084	.175	.654	.933	.986	.993	.995	.996	.996	.997	.997
.11	.089	.163	.637	.929	.986	.993	.995	.996	.997	.997	.997
.12	.096	.152	.617	.923	.984	.993	.996	.996	.997	.997	.998

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.051	.574	.917	.987	.997	.999					
.01	.044	.555	.916	.986	.998	.999					
.02	.037	.536	.909	.986	.998						
.03	.032	.516	.905	.986	.998	.999					
.04	.028	.495	.899	.985	.998	.999					
.05	.023	.473	.893	.985	.997	.999					
.06	.020	.452	.887	.983	.997	.999					
.07	.017	.429	.878	.983	.997	.999					
.08	.015	.408	.871	.981	.997	.999					
.09	.012	.388	.865	.981	.997	.999					
.10	.010	.360	.856	.980	.997	.999					
.11	.009	.339	.847	.978	.997						
.12	.008	.317	.837	.978	.997	.999					

Table 167

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.006	.099	.509	.804	.888	.918	.932	.945	.954	.959	.966
.01	.006	.090	.497	.802	.892	.921	.936	.947	.954	.961	.967
.02	.006	.081	.477	.797	.892	.922	.938	.949	.957	.962	.968
.03	.006	.075	.459	.795	.893	.925	.940	.951	.958	.964	.969
.04	.007	.067	.443	.789	.897	.928	.943	.952	.960	.966	.970
.05	.007	.060	.423	.786	.897	.930	.945	.954	.961	.967	.971
.06	.008	.054	.403	.774	.901	.932	.947	.956	.963	.968	.972
.07	.008	.049	.386	.769	.902	.936	.950	.957	.963	.969	.973
.08	.009	.045	.367	.764	.900	.935	.950	.959	.965	.970	.974
.09	.010	.039	.347	.756	.901	.938	.952	.960	.967	.971	.975
.10	.011	.034	.331	.744	.899	.940	.955	.962	.968	.973	.976
.11	.013	.032	.313	.734	.901	.941	.956	.963	.969	.973	.976
.12	.013	.028	.292	.722	.899	.943	.958	.965	.969	.975	.978

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.287	.732	.927	.979	.993	.997	.998	.999	.999	.999
.01	.008	.270	.727	.925	.979	.994	.997	.998	.999	.999	.999
.02	.007	.253	.711	.922	.979	.994	.997	.998	.999	.999	.999
.03	.006	.239	.705	.920	.979	.993	.997	.998	.999	.999	.999
.04	.005	.221	.694	.918	.979	.993	.997	.999	.999	.999	.999
.05	.004	.206	.683	.917	.978	.993	.997	.998	.999	.999	.999
.06	.003	.194	.672	.911	.979	.993	.997	.998	.999	.999	.999
.07	.003	.176	.657	.908	.977	.994	.997	.998	.999	.999	.999
.08	.002	.165	.645	.905	.977	.994	.998	.999	.999	.999	.999
.09	.002	.151	.629	.903	.976	.994	.998	.999	.999	.999	.999
.10	.001	.137	.617	.897	.976	.994	.998	.999	.999	.999	.999
.11	.001	.124	.603	.894	.974	.994	.998	.999	.999	.999	.999
.12	.001	.112	.586	.888	.974	.993	.998	.999	.999	.999	.999

Table 168

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.043	.253	.641	.872	.959	.988	.996	.999			
.01	.043	.242	.630	.866	.957	.986	.996	.999			
.02	.045	.225	.614	.859	.955	.986	.996	.999	.999		
.03	.045	.215	.600	.854	.953	.986	.995	.999	.999		
.04	.047	.203	.587	.848	.950	.984	.995	.998	.999		
.05	.050	.191	.576	.841	.948	.984	.995	.998	.999		
.06	.053	.182	.560	.835	.947	.983	.995	.998	.999		
.07	.056	.169	.545	.828	.944	.983	.994	.998	.999		
.08	.059	.155	.534	.821	.940	.981	.994	.998	.999		
.09	.063	.149	.518	.812	.938	.980	.993	.998	.999		
.10	.069	.139	.503	.804	.934	.979	.993	.998	.999		
.11	.075	.128	.490	.795	.930	.978	.993	.998	.999		
.12	.080	.122	.480	.785	.927	.977	.992	.997	.999		

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.569	.904	.983	.997	.999					
.01	.042	.552	.900	.981	.997	.999					
.02	.037	.529	.893	.980	.997	.999					
.03	.029	.510	.887	.980	.996	.999					
.04	.025	.495	.880	.978	.996	.999					
.05	.022	.469	.873	.977	.996	.999					
.06	.019	.452	.866	.975	.996	.999					
.07	.014	.431	.858	.974	.995	.999					
.08	.013	.406	.851	.972	.995	.999					
.09	.011	.388	.842	.971	.995	.999					
.10	.008	.365	.831	.968	.994	.999					
.11	.007	.342	.825	.967	.994	.999					
.12	.006	.326	.815	.965	.994	.999					

Table 169

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.097	.401	.705	.877	.951	.980	.992	.996	.998	.999
.01	.008	.090	.386	.696	.873	.949	.979	.991	.996	.998	.999
.02	.008	.082	.372	.686	.867	.948	.979	.991	.996	.998	.999
.03	.008	.077	.359	.675	.863	.944	.977	.991	.996	.998	.999
.04	.008	.071	.347	.666	.856	.942	.978	.990	.996	.998	.999
.05	.010	.065	.334	.652	.852	.942	.976	.990	.996	.998	.999
.06	.011	.061	.321	.646	.846	.939	.976	.990	.996	.998	.999
.07	.011	.054	.305	.634	.839	.937	.974	.989	.996	.998	.999
.08	.012	.048	.294	.622	.833	.934	.973	.989	.995	.998	.999
.09	.014	.046	.281	.612	.828	.931	.972	.988	.995	.998	.999
.10	.015	.041	.271	.598	.819	.927	.971	.987	.995	.998	.999
.11	.017	.037	.258	.587	.813	.924	.970	.987	.995	.997	.999
.12	.019	.034	.249	.573	.805	.920	.968	.986	.994	.997	.999

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.297	.724	.920	.978	.994	.998	.999			
.01	.007	.283	.716	.916	.977	.994	.998	.999			
.02	.006	.264	.703	.912	.975	.994	.998				
.03	.005	.250	.692	.908	.975	.993	.998				
.04	.004	.236	.680	.905	.975	.993	.998				
.05	.003	.218	.672	.901	.973	.993	.998				
.06	.003	.206	.658	.897	.972	.992	.998	.999			
.07	.002	.190	.642	.891	.971	.992	.998	.999			
.08	.002	.172	.631	.888	.969	.992	.998	.999			
.09	.001	.163	.617	.884	.968	.992	.997	.999			
.10	.001	.149	.603	.877	.967	.991	.998	.999			
.11	.001	.135	.591	.873	.964	.991	.997	.999			
.12	.001	.124	.579	.866	.964	.991	.997	.999			

Table 170

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.042	.338	.788	.957	.993	.999					
.01	.042	.322	.778	.955	.993	.999					
.02	.043	.304	.764	.953	.992	.999					
.03	.046	.285	.753	.948	.991	.999					
.04	.047	.268	.740	.945	.990	.998					
.05	.051	.255	.725	.942	.990	.998					
.06	.056	.234	.713	.938	.990	.998					
.07	.059	.222	.698	.933	.988	.998					
.08	.064	.207	.683	.928	.987	.998					
.09	.070	.191	.668	.922	.986	.998					
.10	.078	.181	.652	.917	.985	.997					
.11	.086	.168	.641	.911	.983	.997	.999				
.12	.095	.155	.619	.906	.983	.997	.999				

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.708	.972	.998							
.01	.041	.690	.970	.998							
.02	.033	.670	.967	.998							
.03	.027	.643	.964	.998							
.04	.022	.622	.961	.998							
.05	.018	.602	.957	.997							
.06	.014	.575	.955	.997							
.07	.012	.550	.949	.996							
.08	.009	.524	.945	.996							
.09	.007	.498	.939	.995							
.10	.006	.471	.934	.995							
.11	.005	.446	.928	.995							
.12	.004	.415	.921	.994							

Table 171

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.171	.616	.892	.977	.995	.999				
.01	.011	.161	.600	.885	.976	.994	.999				
.02	.011	.150	.584	.881	.973	.994	.999				
.03	.012	.135	.567	.871	.971	.994	.999				
.04	.012	.125	.551	.865	.967	.993	.999				
.05	.013	.115	.535	.858	.966	.992	.999				
.06	.015	.106	.521	.851	.965	.992	.998				
.07	.017	.097	.501	.840	.961	.992	.998				
.08	.019	.089	.485	.834	.959	.991	.998				
.09	.020	.080	.468	.823	.957	.991	.998				
.10	.025	.074	.452	.814	.954	.990	.998				
.11	.028	.068	.436	.802	.951	.989	.998	.999			
.12	.032	.060	.415	.793	.947	.989	.998	.999			

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.445	.890	.985	.998						
.01	.008	.423	.884	.985	.998						
.02	.006	.399	.875	.985	.998						
.03	.004	.375	.868	.983	.998						
.04	.004	.353	.858	.982	.998						
.05	.002	.331	.848	.981	.998						
.06	.002	.307	.840	.979	.998						
.07	.002	.286	.829	.977	.997						
.08	.001	.264	.817	.976	.997						
.09	.001	.241	.805	.973	.997						
.10	.001	.225	.794	.971	.997						
.11	.000	.204	.782	.969	.996						
.12	.000	.187	.766	.966	.996						

Table 172

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.052	.478	.916	.993							
.01	.053	.451	.907	.992	.999						
.02	.056	.432	.898	.992	.999						
.03	.058	.406	.889	.990	.999						
.04	.061	.383	.881	.989	.999						
.05	.065	.367	.869	.988	.999						
.06	.071	.340	.861	.986	.999						
.07	.079	.320	.851	.985	.999						
.08	.087	.299	.838	.983	.999						
.09	.096	.277	.824	.982	.999						
.10	.106	.261	.811	.980	.998						
.11	.119	.241	.797	.977	.998						
.12	.133	.222	.783	.975	.998						

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.830	.995								
.01	.039	.809	.994								
.02	.031	.791	.994								
.03	.023	.770	.993								
.04	.019	.746	.991								
.05	.014	.727	.990								
.06	.011	.699	.989								
.07	.009	.672	.987								
.08	.006	.645	.985								
.09	.005	.615	.984								
.10	.004	.584	.980	.999							
.11	.003	.555	.978	.999							
.12	.002	.520	.975	.999							

Table 173

Power Rates For One-Tailed Directional Test For Exponential Distribution, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.256	.787	.971	.997						
.01	.012	.238	.770	.968	.997						
.02	.012	.221	.756	.965	.996						
.03	.013	.202	.740	.961	.996						
.04	.014	.187	.725	.957	.995						
.05	.015	.174	.707	.954	.995						
.06	.018	.157	.691	.950	.994	.999					
.07	.021	.143	.675	.947	.994	.999					
.08	.024	.130	.656	.940	.993	.999					
.09	.027	.117	.636	.937	.993	.999					
.10	.032	.109	.617	.930	.991	.999					
.11	.036	.097	.598	.923	.991	.999					
.12	.043	.087	.580	.919	.990	.999					

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.603	.970	.999							
.01	.007	.574	.967	.999							
.02	.005	.549	.963	.999							
.03	.004	.519	.959	.998							
.04	.003	.490	.955	.998							
.05	.002	.467	.949	.998							
.06	.001	.436	.945	.998							
.07	.001	.405	.940	.997							
.08	.001	.377	.933	.997							
.09	.000	.344	.926	.997							
.10	.001	.318	.917	.996							
.11	.000	.291	.909	.996							
.12	.000	.262	.899	.995							

Table 174

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.041	.246	.318	.314	.325	.360	.358	.366	.368	.373	.382
.01	.224	.244	.316	.316	.328	.363	.369	.368	.369	.376	.378
.02	.221	.248	.317	.316	.325	.337	.368	.367	.369	.378	.378
.03	.222	.252	.317	.316	.326	.336	.370	.376	.369	.381	.381
.04	.224	.252	.319	.317	.324	.333	.372	.380	.367	.377	.382
.05	.224	.252	.316	.335	.326	.339	.370	.374	.367	.382	.385
.06	.221	.250	.266	.333	.324	.338	.365	.375	.388	.382	.387
.07	.224	.251	.265	.330	.327	.338	.369	.377	.387	.382	.386
.08	.225	.266	.266	.333	.324	.340	.370	.381	.390	.382	.382
.09	.223	.263	.267	.338	.325	.340	.348	.379	.388	.390	.387
.10	.224	.262	.265	.339	.323	.342	.350	.381	.390	.392	.383
.11	.223	.260	.266	.340	.328	.344	.350	.383	.391	.391	.387
.12	.224	.283	.267	.343	.358	.344	.351	.382	.392	.392	.397

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.273	.354	.347	.360	.394	.391	.400	.401	.406	.412
.01	.004	.272	.352	.351	.363	.397	.402	.402	.402	.409	.411
.02	.004	.276	.353	.351	.361	.372	.402	.400	.401	.410	.411
.03	.004	.280	.354	.351	.360	.371	.402	.401	.402	.413	.413
.04	.004	.280	.355	.351	.358	.372	.405	.414	.401	.410	.415
.05	.004	.280	.351	.371	.359	.374	.402	.409	.401	.417	.418
.06	.004	.278	.295	.371	.358	.374	.401	.408	.421	.415	.418
.07	.003	.277	.295	.366	.363	.375	.403	.410	.420	.415	.419
.08	.004	.295	.295	.370	.360	.376	.405	.414	.423	.414	.415
.09	.004	.292	.295	.374	.361	.376	.385	.412	.422	.422	.419
.10	.004	.291	.296	.376	.359	.378	.386	.414	.423	.424	.417
.11	.004	.290	.295	.378	.362	.381	.387	.415	.423	.424	.421
.12	.004	.315	.295	.379	.396	.380	.387	.416	.427	.427	.429

Table 175

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.093	.149	.150	.159	.211	.212	.223	.226	.236	.244
.01	.082	.094	.151	.153	.161	.214	.222	.226	.228	.239	.241
.02	.081	.095	.150	.152	.162	.170	.223	.224	.226	.240	.240
.03	.082	.100	.149	.152	.162	.171	.222	.230	.225	.242	.243
.04	.081	.097	.153	.154	.162	.168	.223	.234	.228	.241	.245
.05	.082	.098	.149	.164	.161	.173	.222	.230	.226	.245	.250
.06	.081	.096	.107	.163	.160	.173	.219	.230	.248	.244	.250
.07	.081	.097	.105	.161	.164	.173	.222	.232	.248	.245	.249
.08	.082	.108	.107	.164	.160	.174	.221	.236	.248	.245	.248
.09	.083	.106	.106	.166	.161	.174	.182	.235	.248	.250	.252
.10	.083	.104	.107	.170	.160	.177	.185	.235	.250	.253	.247
.11	.083	.105	.108	.168	.162	.178	.185	.236	.251	.250	.251
.12	.082	.120	.108	.170	.185	.181	.184	.237	.252	.252	.260

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.058	.102	.105	.111	.152	.154	.161	.165	.170	.176
.01	.001	.059	.103	.106	.112	.153	.159	.165	.164	.173	.172
.02	.001	.059	.102	.104	.114	.117	.161	.164	.163	.174	.174
.03	.001	.061	.102	.105	.112	.119	.160	.160	.163	.173	.174
.04	.001	.060	.105	.106	.113	.117	.160	.168	.164	.173	.176
.05	.001	.059	.101	.112	.111	.120	.159	.165	.162	.178	.180
.06	.001	.059	.067	.112	.110	.121	.158	.166	.177	.175	.180
.07	.001	.059	.065	.110	.114	.121	.159	.167	.177	.176	.179
.08	.001	.065	.066	.111	.111	.119	.159	.167	.178	.176	.177
.09	.001	.063	.066	.113	.112	.121	.127	.168	.179	.179	.181
.10	.001	.063	.067	.115	.111	.122	.128	.169	.179	.181	.178
.11	.001	.063	.067	.115	.113	.123	.128	.168	.180	.180	.181
.12	.001	.069	.067	.115	.125	.124	.127	.170	.181	.181	.185

Table 176

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.109	.175	.209	.209	.231	.246	.246	.264	.268	.283	.292
.01	.231	.177	.210	.219	.230	.245	.258	.260	.265	.287	.290
.02	.231	.179	.205	.216	.231	.246	.260	.261	.267	.286	.288
.03	.229	.189	.209	.215	.229	.247	.262	.268	.269	.288	.293
.04	.231	.185	.207	.218	.231	.249	.261	.271	.268	.286	.298
.05	.232	.188	.207	.226	.229	.249	.260	.271	.268	.294	.301
.06	.228	.186	.204	.226	.232	.251	.258	.272	.299	.293	.299
.07	.230	.188	.206	.227	.230	.253	.260	.272	.297	.292	.298
.08	.230	.197	.205	.229	.231	.250	.263	.275	.297	.293	.299
.09	.231	.197	.204	.238	.230	.252	.269	.276	.295	.300	.297
.10	.226	.198	.205	.235	.229	.253	.270	.277	.296	.302	.300
.11	.231	.198	.207	.239	.230	.259	.271	.276	.299	.300	.298
.12	.228	.210	.203	.237	.262	.260	.271	.281	.299	.299	.310

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.014	.428	.502	.494	.527	.487	.484	.496	.498	.506	.512
.01	.005	.432	.502	.509	.523	.486	.496	.492	.493	.507	.509
.02	.006	.433	.500	.509	.524	.539	.498	.495	.498	.507	.508
.03	.006	.444	.502	.507	.520	.541	.498	.497	.498	.509	.513
.04	.006	.443	.503	.508	.521	.542	.499	.504	.496	.508	.515
.05	.006	.441	.501	.529	.522	.539	.496	.504	.498	.515	.518
.06	.006	.442	.472	.527	.525	.540	.499	.505	.518	.513	.516
.07	.006	.441	.472	.530	.520	.543	.496	.503	.521	.513	.513
.08	.006	.464	.471	.530	.524	.542	.501	.507	.521	.516	.517
.09	.006	.463	.472	.539	.522	.542	.562	.509	.518	.523	.515
.10	.006	.463	.471	.538	.522	.542	.559	.509	.519	.522	.517
.11	.006	.462	.474	.541	.526	.548	.558	.508	.520	.525	.516
.12	.006	.488	.470	.539	.566	.549	.559	.511	.523	.519	.526

Table 177

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.109	.175	.209	.209	.231	.246	.246	.264	.268	.283	.292
.01	.231	.177	.210	.219	.230	.245	.258	.260	.265	.287	.290
.02	.231	.179	.205	.216	.231	.246	.260	.261	.267	.286	.288
.03	.229	.189	.209	.215	.229	.247	.262	.268	.269	.288	.293
.04	.231	.185	.207	.218	.231	.249	.261	.271	.268	.286	.298
.05	.232	.188	.207	.226	.229	.249	.260	.271	.268	.294	.301
.06	.228	.186	.204	.226	.232	.251	.258	.272	.299	.293	.299
.07	.230	.188	.206	.227	.230	.253	.260	.272	.297	.292	.298
.08	.230	.197	.205	.229	.231	.250	.263	.275	.297	.293	.299
.09	.231	.197	.204	.238	.230	.252	.269	.276	.295	.300	.297
.10	.226	.198	.205	.235	.229	.253	.270	.277	.296	.302	.300
.11	.231	.198	.207	.239	.230	.259	.271	.276	.299	.300	.298
.12	.228	.210	.203	.237	.262	.260	.271	.281	.299	.299	.310

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.166	.232	.220	.243	.246	.245	.255	.257	.265	.271
.01	.001	.167	.232	.230	.241	.245	.254	.253	.256	.268	.270
.02	.001	.170	.230	.230	.242	.254	.258	.254	.257	.267	.268
.03	.001	.177	.232	.228	.238	.253	.258	.257	.261	.269	.272
.04	.001	.177	.232	.230	.241	.255	.256	.263	.256	.268	.276
.05	.001	.175	.230	.250	.240	.253	.257	.265	.258	.275	.280
.06	.001	.175	.190	.250	.243	.255	.254	.264	.281	.273	.277
.07	.001	.175	.190	.250	.239	.257	.256	.263	.279	.273	.274
.08	.001	.189	.189	.251	.241	.256	.259	.266	.281	.274	.276
.09	.001	.189	.190	.260	.240	.257	.273	.267	.278	.281	.276
.10	.001	.189	.190	.258	.241	.257	.271	.271	.278	.282	.279
.11	.001	.191	.191	.261	.242	.262	.274	.268	.281	.284	.276
.12	.001	.217	.188	.259	.281	.263	.270	.270	.281	.281	.287

Table 178

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.298	.435	.429	.454	.500	.497	.510	.514	.519	.530
.01	.267	.297	.435	.438	.449	.502	.521	.510	.512	.526	.527
.02	.268	.300	.436	.438	.453	.460	.516	.513	.515	.526	.529
.03	.266	.313	.435	.437	.449	.463	.517	.520	.513	.528	.527
.04	.265	.312	.434	.438	.451	.465	.517	.527	.515	.525	.537
.05	.267	.312	.431	.456	.453	.463	.518	.522	.512	.532	.536
.06	.268	.312	.331	.456	.449	.467	.517	.527	.544	.534	.538
.07	.266	.316	.329	.459	.451	.468	.519	.523	.546	.533	.540
.08	.266	.331	.329	.458	.450	.471	.517	.532	.545	.534	.538
.09	.269	.329	.328	.468	.452	.467	.483	.537	.548	.549	.541
.10	.264	.331	.332	.472	.451	.470	.486	.532	.543	.549	.539
.11	.265	.332	.330	.470	.450	.479	.483	.533	.546	.543	.535
.12	.265	.349	.332	.469	.499	.476	.487	.541	.549	.547	.554

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.550	.759	.752	.774	.834	.830	.837	.840	.843	.846
.01	.001	.549	.762	.762	.774	.836	.845	.837	.839	.844	.848
.02	.001	.550	.763	.759	.778	.786	.844	.836	.839	.844	.846
.03	.001	.566	.760	.759	.777	.789	.841	.844	.839	.847	.845
.04	.001	.563	.762	.760	.774	.789	.842	.849	.838	.845	.849
.05	.001	.562	.760	.785	.778	.787	.842	.847	.837	.849	.850
.06	.001	.563	.596	.785	.774	.792	.841	.851	.857	.849	.851
.07	.001	.565	.595	.787	.774	.791	.843	.846	.856	.849	.850
.08	.001	.590	.593	.787	.773	.794	.843	.851	.857	.849	.851
.09	.001	.588	.592	.796	.776	.789	.804	.854	.859	.860	.850
.10	.001	.590	.596	.797	.775	.793	.805	.851	.858	.859	.850
.11	.001	.588	.596	.797	.776	.798	.805	.854	.856	.858	.849
.12	.001	.619	.598	.795	.819	.795	.804	.854	.858	.859	.859

Table 179

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.298	.435	.429	.454	.500	.497	.510	.514	.519	.530
.01	.267	.297	.435	.438	.449	.502	.521	.510	.512	.526	.527
.02	.268	.300	.436	.438	.453	.460	.516	.513	.515	.526	.529
.03	.266	.313	.435	.437	.449	.463	.517	.520	.513	.528	.527
.04	.265	.312	.434	.438	.451	.465	.517	.527	.515	.525	.537
.05	.267	.312	.431	.456	.453	.463	.518	.522	.512	.532	.536
.06	.268	.312	.331	.456	.449	.467	.517	.527	.544	.534	.538
.07	.266	.316	.329	.459	.451	.468	.519	.523	.546	.533	.540
.08	.266	.331	.329	.458	.450	.471	.517	.532	.545	.534	.538
.09	.269	.329	.328	.468	.452	.467	.483	.537	.548	.549	.541
.10	.264	.331	.332	.472	.451	.470	.486	.532	.543	.549	.539
.11	.265	.332	.330	.470	.450	.479	.483	.533	.546	.543	.535
.12	.265	.349	.332	.469	.499	.476	.487	.541	.549	.547	.554

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.269	.477	.461	.496	.623	.618	.637	.645	.659	.668
.01	.000	.267	.477	.476	.494	.624	.646	.638	.643	.665	.669
.02	.000	.271	.477	.473	.498	.519	.643	.639	.644	.664	.669
.03	.000	.283	.478	.475	.496	.521	.643	.649	.643	.667	.669
.04	.000	.282	.476	.474	.497	.521	.642	.659	.644	.664	.675
.05	.000	.282	.476	.512	.498	.520	.643	.656	.643	.670	.679
.06	.000	.282	.310	.513	.495	.524	.640	.660	.683	.672	.678
.07	.000	.283	.309	.512	.495	.523	.643	.656	.686	.672	.679
.08	.000	.303	.306	.514	.495	.527	.643	.666	.688	.672	.679
.09	.000	.304	.308	.528	.496	.525	.546	.670	.689	.694	.682
.10	.000	.302	.311	.531	.496	.526	.550	.665	.686	.692	.678
.11	.000	.304	.307	.528	.495	.533	.546	.666	.686	.688	.675
.12	.000	.347	.311	.527	.567	.533	.547	.672	.690	.693	.698

Table 180

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.274	.527	.551	.553	.573	.581	.571	.589	.593	.600	.610
.01	.495	.520	.553	.561	.578	.580	.597	.589	.591	.606	.609
.02	.495	.519	.549	.563	.575	.591	.601	.586	.591	.611	.608
.03	.491	.542	.553	.561	.577	.589	.600	.606	.592	.609	.607
.04	.495	.540	.551	.562	.576	.587	.602	.606	.594	.608	.624
.05	.492	.541	.553	.578	.577	.590	.596	.606	.590	.621	.626
.06	.495	.541	.569	.583	.576	.597	.597	.605	.634	.620	.624
.07	.496	.540	.571	.584	.576	.600	.599	.605	.634	.618	.622
.08	.496	.562	.570	.580	.577	.597	.599	.618	.637	.618	.623
.09	.491	.564	.572	.600	.577	.598	.620	.616	.633	.636	.625
.10	.495	.564	.573	.600	.574	.600	.620	.616	.635	.636	.622
.11	.492	.565	.571	.600	.576	.612	.618	.617	.634	.633	.622
.12	.495	.581	.573	.596	.637	.613	.617	.632	.636	.636	.649

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.012	.717	.780	.772	.791	.700	.691	.702	.706	.712	.717
.01	.001	.712	.781	.779	.791	.698	.706	.703	.703	.713	.716
.02	.001	.710	.779	.777	.791	.804	.708	.701	.703	.717	.714
.03	.001	.728	.782	.778	.791	.802	.708	.711	.705	.717	.714
.04	.001	.729	.780	.778	.791	.804	.711	.712	.709	.714	.722
.05	.001	.732	.780	.803	.791	.804	.705	.713	.705	.720	.724
.06	.001	.729	.768	.804	.792	.808	.706	.712	.727	.718	.722
.07	.001	.728	.765	.804	.791	.808	.706	.711	.727	.718	.719
.08	.001	.757	.766	.804	.791	.804	.704	.715	.730	.716	.721
.09	.001	.757	.767	.813	.793	.808	.817	.715	.726	.730	.724
.10	.001	.758	.766	.814	.790	.808	.820	.716	.729	.730	.722
.11	.001	.756	.766	.813	.791	.811	.819	.717	.726	.726	.720
.12	.001	.777	.768	.810	.833	.811	.817	.724	.728	.727	.734

Table 181

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.064	.212	.237	.242	.266	.278	.281	.299	.307	.322	.333
.01	.228	.212	.235	.253	.266	.279	.300	.299	.307	.328	.330
.02	.228	.208	.236	.250	.268	.285	.302	.298	.305	.329	.333
.03	.227	.226	.236	.249	.269	.286	.302	.311	.307	.329	.331
.04	.227	.225	.234	.253	.268	.284	.302	.313	.307	.328	.346
.05	.228	.227	.240	.262	.267	.284	.299	.310	.303	.340	.347
.06	.229	.225	.249	.263	.265	.294	.301	.312	.345	.339	.347
.07	.228	.222	.249	.264	.267	.292	.302	.311	.344	.338	.345
.08	.229	.241	.251	.263	.266	.292	.300	.323	.348	.336	.345
.09	.225	.241	.250	.278	.269	.297	.318	.323	.344	.348	.349
.10	.228	.241	.250	.280	.265	.294	.316	.320	.346	.351	.346
.11	.228	.242	.251	.278	.269	.308	.317	.323	.345	.348	.346
.12	.229	.255	.250	.277	.317	.304	.315	.336	.344	.348	.367

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.454	.580	.564	.596	.523	.516	.529	.535	.543	.550
.01	.000	.450	.580	.577	.598	.523	.534	.529	.532	.546	.548
.02	.000	.448	.577	.576	.596	.619	.537	.528	.533	.548	.546
.03	.000	.468	.582	.574	.598	.617	.536	.537	.533	.547	.548
.04	.000	.469	.580	.577	.595	.615	.539	.544	.536	.545	.557
.05	.000	.470	.581	.614	.595	.618	.533	.543	.532	.554	.559
.06	.000	.467	.510	.616	.600	.623	.536	.543	.563	.554	.555
.07	.000	.467	.509	.617	.597	.625	.537	.543	.562	.550	.553
.08	.000	.505	.509	.614	.596	.621	.535	.548	.565	.552	.555
.09	.000	.504	.507	.630	.598	.623	.641	.548	.561	.565	.559
.10	.000	.505	.510	.631	.593	.624	.644	.548	.563	.567	.554
.11	.000	.505	.508	.631	.596	.632	.642	.549	.563	.562	.554
.12	.000	.550	.511	.627	.664	.631	.642	.557	.563	.565	.571

Table 182

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.540	.720	.741	.743	.762	.764	.749	.761	.765	.770	.776
.01	.649	.720	.743	.751	.765	.763	.779	.763	.764	.776	.778
.02	.645	.721	.742	.750	.760	.771	.779	.761	.764	.774	.774
.03	.649	.742	.740	.753	.761	.770	.779	.779	.763	.778	.776
.04	.649	.739	.742	.752	.761	.770	.779	.781	.763	.775	.790
.05	.649	.740	.742	.767	.763	.768	.778	.783	.764	.787	.792
.06	.647	.742	.767	.767	.762	.777	.777	.782	.808	.786	.793
.07	.649	.740	.769	.767	.763	.780	.780	.783	.808	.787	.790
.08	.648	.760	.768	.766	.762	.780	.780	.794	.806	.790	.791
.09	.647	.760	.768	.786	.761	.779	.794	.795	.806	.805	.792
.10	.649	.760	.770	.785	.760	.779	.796	.796	.807	.806	.791
.11	.646	.757	.770	.782	.763	.793	.797	.794	.807	.807	.790
.12	.650	.770	.766	.780	.814	.793	.797	.804	.803	.808	.816

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.874	.907	.900	.912	.823	.818	.825	.829	.834	.836
.01	.000	.874	.908	.904	.913	.820	.832	.826	.829	.837	.839
.02	.000	.875	.906	.905	.911	.920	.831	.824	.830	.834	.835
.03	.000	.889	.905	.904	.911	.919	.832	.832	.828	.837	.837
.04	.000	.885	.906	.905	.912	.919	.831	.834	.827	.836	.841
.05	.000	.887	.908	.919	.911	.917	.831	.837	.828	.837	.843
.06	.000	.887	.913	.919	.913	.921	.830	.836	.848	.839	.844
.07	.000	.887	.915	.922	.913	.921	.831	.836	.848	.838	.842
.08	.000	.907	.915	.919	.911	.920	.830	.840	.846	.842	.840
.09	.000	.907	.912	.925	.912	.921	.927	.840	.845	.848	.844
.10	.000	.907	.913	.925	.912	.921	.926	.840	.848	.847	.842
.11	.000	.906	.915	.925	.913	.923	.928	.839	.846	.848	.841
.12	.000	.916	.913	.925	.934	.923	.926	.843	.842	.848	.853

Table 183

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.269	.461	.493	.502	.530	.537	.531	.550	.557	.566	.580
.01	.427	.467	.494	.511	.534	.537	.565	.555	.557	.579	.582
.02	.427	.466	.495	.513	.531	.548	.562	.551	.557	.576	.580
.03	.427	.492	.493	.513	.530	.547	.564	.569	.555	.581	.580
.04	.429	.489	.493	.513	.530	.546	.564	.571	.554	.578	.601
.05	.429	.490	.494	.531	.531	.544	.561	.571	.555	.593	.603
.06	.425	.492	.525	.532	.533	.560	.565	.573	.614	.596	.602
.07	.428	.487	.526	.530	.532	.560	.562	.571	.614	.595	.597
.08	.427	.510	.526	.526	.530	.561	.563	.589	.610	.596	.596
.09	.427	.511	.529	.553	.533	.560	.586	.588	.612	.613	.602
.10	.429	.513	.526	.551	.529	.560	.588	.591	.610	.609	.600
.11	.426	.509	.526	.550	.528	.577	.589	.590	.612	.614	.599
.12	.428	.525	.525	.547	.599	.578	.587	.602	.608	.614	.630

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.670	.784	.771	.795	.675	.667	.678	.686	.695	.697
.01	.000	.673	.785	.777	.796	.677	.689	.680	.684	.696	.699
.02	.000	.671	.783	.778	.793	.809	.688	.680	.685	.695	.697
.03	.000	.696	.782	.778	.792	.808	.689	.689	.685	.698	.697
.04	.000	.691	.782	.780	.793	.809	.688	.693	.683	.695	.704
.05	.000	.693	.783	.811	.794	.807	.687	.695	.682	.700	.707
.06	.000	.692	.740	.810	.794	.812	.688	.695	.713	.701	.707
.07	.000	.691	.741	.812	.795	.815	.687	.694	.714	.700	.705
.08	.000	.730	.740	.809	.792	.814	.685	.701	.714	.702	.704
.09	.000	.733	.740	.822	.794	.813	.825	.702	.712	.715	.707
.10	.000	.732	.740	.822	.794	.813	.826	.699	.712	.713	.704
.11	.000	.729	.741	.823	.796	.817	.828	.701	.711	.716	.703
.12	.000	.766	.739	.820	.844	.819	.825	.705	.709	.714	.724

Table 184

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.695	.856	.855	.866	.881	.869	.874	.875	.877	.878
.01	.644	.700	.855	.858	.867	.881	.884	.876	.876	.879	.878
.02	.643	.696	.858	.859	.865	.870	.886	.875	.877	.879	.879
.03	.645	.714	.858	.860	.866	.871	.887	.883	.876	.879	.879
.04	.643	.711	.857	.860	.865	.870	.886	.887	.875	.880	.885
.05	.647	.714	.857	.869	.866	.869	.886	.886	.877	.885	.885
.06	.646	.712	.737	.870	.864	.877	.886	.888	.896	.884	.885
.07	.645	.716	.736	.869	.866	.872	.885	.887	.897	.884	.886
.08	.646	.729	.737	.871	.864	.874	.885	.893	.895	.884	.885
.09	.647	.729	.738	.880	.867	.874	.884	.892	.896	.895	.885
.10	.643	.729	.738	.882	.865	.874	.882	.893	.898	.898	.885
.11	.645	.728	.737	.879	.866	.880	.884	.894	.897	.897	.886
.12	.642	.744	.738	.880	.896	.881	.883	.894	.897	.897	.899

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.841	.981	.980	.985	.990	.989	.990	.990	.991	.990
.01	.000	.843	.982	.982	.985	.990	.990	.990	.991	.991	.990
.02	.000	.842	.981	.982	.985	.987	.991	.990	.991	.991	.991
.03	.000	.859	.981	.982	.984	.987	.991	.990	.990	.991	.991
.04	.000	.853	.981	.982	.985	.987	.991	.991	.990	.991	.991
.05	.000	.856	.981	.986	.985	.987	.991	.991	.990	.992	.991
.06	.000	.854	.881	.985	.985	.988	.991	.991	.992	.991	.992
.07	.000	.858	.881	.985	.985	.988	.991	.991	.991	.991	.991
.08	.000	.876	.880	.986	.984	.988	.990	.991	.992	.991	.991
.09	.000	.879	.883	.987	.985	.988	.989	.991	.992	.992	.991
.10	.000	.876	.882	.988	.984	.987	.990	.991	.992	.992	.991
.11	.000	.877	.881	.987	.985	.988	.989	.991	.992	.991	.991
.12	.000	.885	.881	.987	.991	.988	.989	.992	.992	.992	.992

Table 185

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.436	.631	.631	.654	.692	.677	.688	.690	.695	.703
.01	.382	.438	.628	.640	.657	.690	.704	.690	.689	.703	.702
.02	.379	.435	.630	.643	.653	.662	.702	.688	.691	.702	.703
.03	.383	.459	.633	.643	.652	.664	.703	.701	.691	.705	.700
.04	.378	.457	.631	.640	.653	.664	.702	.709	.690	.699	.715
.05	.382	.458	.631	.659	.656	.663	.705	.704	.692	.714	.713
.06	.382	.458	.484	.658	.653	.675	.703	.707	.729	.711	.714
.07	.382	.460	.483	.657	.653	.671	.703	.704	.728	.713	.716
.08	.383	.482	.484	.660	.654	.674	.702	.719	.725	.711	.712
.09	.380	.480	.486	.676	.655	.673	.692	.718	.727	.729	.715
.10	.379	.480	.487	.677	.653	.675	.690	.717	.730	.728	.714
.11	.381	.480	.486	.673	.655	.685	.691	.722	.729	.731	.714
.12	.379	.498	.486	.677	.709	.684	.689	.724	.728	.729	.734

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.635	.912	.906	.921	.959	.954	.957	.959	.962	.961
.01	.000	.636	.914	.910	.922	.959	.961	.959	.960	.962	.962
.02	.000	.635	.913	.911	.922	.930	.962	.958	.960	.963	.962
.03	.000	.657	.914	.911	.921	.930	.962	.962	.959	.962	.962
.04	.000	.655	.915	.912	.922	.930	.962	.963	.959	.962	.964
.05	.000	.656	.913	.932	.921	.930	.962	.963	.959	.963	.964
.06	.000	.654	.696	.929	.921	.932	.961	.963	.967	.963	.964
.07	.000	.656	.698	.930	.923	.931	.961	.963	.967	.962	.964
.08	.000	.693	.695	.931	.920	.934	.960	.965	.967	.963	.965
.09	.000	.693	.699	.937	.922	.933	.941	.965	.968	.967	.964
.10	.000	.691	.697	.938	.921	.932	.941	.965	.967	.968	.964
.11	.000	.691	.698	.938	.921	.937	.941	.965	.967	.967	.964
.12	.000	.734	.697	.938	.952	.936	.940	.966	.967	.968	.969

Table 186

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.039	.942	.993	.992	.993	.994	.991	.991	.991	.992	.992
.01	.919	.942	.992	.992	.993	.993	.994	.992	.992	.992	.992
.02	.919	.943	.993	.992	.992	.993	.993	.991	.992	.991	.992
.03	.917	.945	.992	.992	.993	.993	.993	.992	.992	.992	.992
.04	.919	.946	.992	.992	.993	.993	.993	.993	.991	.992	.992
.05	.920	.946	.992	.993	.992	.993	.994	.993	.991	.993	.992
.06	.919	.947	.956	.993	.993	.994	.994	.994	.994	.992	.992
.07	.917	.947	.956	.994	.993	.993	.994	.993	.994	.993	.992
.08	.918	.952	.956	.993	.992	.994	.993	.994	.994	.992	.993
.09	.917	.950	.956	.995	.993	.993	.994	.994	.994	.994	.993
.10	.918	.950	.956	.995	.993	.994	.994	.994	.994	.995	.992
.11	.920	.951	.956	.995	.993	.994	.994	.995	.994	.994	.992
.12	.918	.953	.955	.994	.996	.994	.994	.994	.995	.994	.994

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.945	.999	.999	.999	.999	.999	.999		.999	
.01	.000	.945	.999	.999	.999	.999			.999	.999	.999
.02	.000	.946	.999	.999	.999	.999	.999	.999	.999	.999	.999
.03	.000	.951	.999	.999	.999	.999		.999		.999	.999
.04	.000	.953	.999	.999	.999	.999	.999		.999		
.05	.000	.953	.999	.999	.999			.999	.999	.999	
.06	.000	.953	.966	.999	.999		.999	.999	.999		.999
.07	.000	.952	.965	.999	.999	.999	.999	.999	.999		
.08	.000	.966	.966	.999	.999		.999		.999		
.09	.000	.965	.966	.999	.999			.999			.999
.10	.000	.964	.966	.999	.999	.999		.999			.999
.11	.000	.965	.966	.999	.999				.999		
.12	.000	.961	.966	.999							.999

Table 187

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.868	.966	.966	.969	.971	.965	.967	.967	.968	.967
.01	.827	.869	.965	.967	.969	.971	.974	.967	.967	.969	.968
.02	.827	.868	.967	.967	.969	.970	.973	.967	.968	.968	.968
.03	.824	.875	.966	.967	.968	.970	.972	.971	.967	.968	.968
.04	.825	.878	.966	.967	.968	.970	.972	.973	.967	.968	.970
.05	.827	.876	.966	.970	.968	.970	.972	.972	.967	.970	.971
.06	.828	.878	.895	.971	.969	.972	.974	.973	.976	.969	.971
.07	.825	.877	.893	.972	.969	.970	.973	.973	.977	.971	.970
.08	.824	.887	.895	.971	.968	.973	.973	.975	.976	.971	.970
.09	.825	.886	.896	.975	.969	.972	.975	.975	.976	.977	.971
.10	.827	.884	.896	.975	.970	.972	.975	.976	.976	.976	.971
.11	.827	.886	.896	.975	.969	.974	.975	.975	.977	.976	.970
.12	.825	.891	.895	.975	.980	.974	.975	.976	.976	.976	.977

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.831	.991	.990	.993	.996	.996	.996	.996	.996	.997
.01	.000	.833	.991	.991	.993	.996	.997	.996	.996	.997	.996
.02	.000	.832	.991	.991	.993	.994	.996	.996	.996	.996	.997
.03	.000	.846	.990	.991	.992	.994	.996	.996	.996	.996	.997
.04	.000	.850	.990	.991	.993	.994	.996	.997	.997	.996	.997
.05	.000	.847	.990	.994	.993	.994	.997	.996	.996	.997	.997
.06	.000	.848	.879	.993	.993	.995	.996	.997	.997	.997	.997
.07	.000	.848	.880	.994	.993	.994	.997	.996	.997	.997	.997
.08	.000	.878	.879	.994	.993	.995	.996	.997	.997	.997	.997
.09	.000	.878	.881	.995	.993	.995	.996	.997	.997	.997	.997
.10	.000	.876	.882	.995	.993	.995	.996	.997	.997	.997	.996
.11	.000	.878	.880	.995	.993	.995	.996	.997	.997	.997	.997
.12	.000	.891	.880	.995	.997	.995	.996	.997	.997	.997	.997

Table 188

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.809	.938	.944	.943	.954	.954	.944	.947	.948	.948	.952
.01	.861	.937	.944	.950	.952	.953	.957	.947	.948	.951	.949
.02	.861	.938	.944	.950	.952	.954	.958	.948	.948	.951	.950
.03	.860	.946	.944	.951	.952	.955	.957	.956	.949	.951	.951
.04	.860	.946	.944	.949	.952	.955	.958	.958	.947	.951	.958
.05	.862	.946	.943	.953	.954	.955	.958	.959	.948	.958	.957
.06	.861	.947	.958	.955	.953	.958	.958	.958	.967	.958	.959
.07	.863	.947	.957	.953	.952	.957	.957	.957	.968	.957	.958
.08	.862	.951	.956	.954	.953	.958	.959	.965	.968	.959	.958
.09	.861	.951	.959	.960	.954	.958	.965	.965	.968	.967	.958
.10	.861	.953	.958	.960	.953	.958	.965	.965	.966	.967	.958
.11	.861	.951	.957	.961	.953	.965	.965	.964	.968	.967	.957
.12	.861	.957	.957	.961	.972	.965	.965	.967	.968	.968	.970

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.992	.993	.991	.994	.966	.964	.967	.968	.971	.972
.01	.000	.992	.993	.992	.993	.966	.968	.966	.968	.971	.971
.02	.000	.992	.993	.992	.993	.994	.969	.967	.967	.971	.970
.03	.000	.994	.993	.992	.994	.994	.969	.969	.968	.970	.973
.04	.000	.994	.993	.992	.993	.994	.969	.970	.967	.971	.974
.05	.000	.994	.993	.995	.993	.995	.969	.971	.968	.973	.973
.06	.000	.994	.997	.995	.994	.994	.968	.971	.975	.972	.973
.07	.000	.994	.997	.994	.993	.994	.968	.970	.975	.972	.972
.08	.000	.996	.997	.995	.993	.995	.970	.973	.975	.973	.973
.09	.000	.996	.997	.995	.993	.995	.995	.971	.975	.974	.974
.10	.000	.997	.997	.995	.993	.995	.995	.972	.974	.976	.973
.11	.000	.996	.997	.995	.993	.995	.995	.972	.975	.975	.972
.12	.000	.996	.997	.995	.996	.995	.995	.972	.975	.975	.976

Table 189

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.452	.729	.752	.757	.784	.789	.778	.795	.797	.800	.813
.01	.622	.725	.749	.774	.786	.786	.810	.797	.797	.815	.811
.02	.623	.727	.750	.771	.785	.793	.808	.796	.797	.811	.812
.03	.621	.750	.750	.773	.785	.794	.809	.809	.796	.813	.814
.04	.620	.751	.749	.773	.786	.792	.808	.811	.796	.813	.836
.05	.624	.751	.747	.783	.787	.793	.809	.814	.796	.834	.834
.06	.621	.749	.786	.784	.786	.810	.809	.813	.850	.835	.836
.07	.625	.750	.786	.782	.784	.809	.809	.811	.850	.834	.835
.08	.623	.765	.784	.784	.786	.807	.811	.836	.849	.836	.835
.09	.625	.766	.787	.801	.788	.809	.832	.832	.850	.848	.835
.10	.626	.767	.788	.801	.785	.808	.835	.834	.848	.849	.835
.11	.624	.763	.785	.801	.785	.830	.834	.833	.849	.849	.834
.12	.624	.784	.785	.800	.845	.831	.835	.847	.849	.849	.859

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.957	.975	.970	.976	.911	.906	.911	.915	.920	.923
.01	.000	.957	.975	.973	.976	.910	.915	.912	.915	.923	.921
.02	.000	.957	.975	.973	.976	.979	.915	.912	.915	.922	.921
.03	.000	.966	.974	.973	.976	.979	.916	.916	.914	.922	.924
.04	.000	.965	.974	.972	.976	.979	.917	.921	.914	.921	.927
.05	.000	.965	.974	.980	.976	.980	.917	.923	.915	.924	.926
.06	.000	.965	.979	.981	.977	.979	.916	.921	.931	.926	.927
.07	.000	.965	.979	.980	.975	.979	.916	.922	.931	.925	.926
.08	.000	.976	.979	.980	.976	.979	.918	.925	.930	.925	.927
.09	.000	.976	.979	.981	.976	.979	.983	.924	.931	.930	.926
.10	.000	.977	.979	.981	.976	.979	.982	.925	.930	.932	.927
.11	.000	.975	.979	.982	.977	.980	.982	.924	.930	.931	.926
.12	.000	.979	.979	.982	.985	.981	.982	.926	.931	.931	.934

Table 190

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.021	.983						.999		.999	.999
.01	.971	.983	.999								.999
.02	.972	.983						.999	.999	.999	.999
.03	.972	.985							.999	.999	.999
.04	.972	.985								.999	.999
.05	.973	.985	.999						.999		.999
.06	.971	.984	.989								.999
.07	.971	.984	.989							.999	
.08	.972	.986	.989								
.09	.971	.986	.988								.999
.10	.971	.986	.989								
.11	.972	.986	.988								
.12	.972	.987	.988								

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.989									
.01	.000	.989									
.02	.000	.989									
.03	.000	.992									
.04	.000	.992									
.05	.000	.992									
.06	.000	.992	.995								
.07	.000	.992	.995								
.08	.000	.995	.995								
.09	.000	.995	.995								
.10	.000	.995	.995								
.11	.000	.995	.995								
.12	.000	.993	.995								

Table 191

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.947	.993	.994	.995	.994	.992	.992	.993	.993	.993
.01	.918	.946	.994	.994	.994	.995	.995	.992	.993	.992	.993
.02	.920	.947	.993	.994	.994	.994	.995	.993	.992	.992	.993
.03	.919	.951	.994	.994	.994	.994	.994	.994	.992	.993	.992
.04	.920	.952	.994	.994	.994	.995	.995	.994	.992	.992	.993
.05	.921	.953	.993	.995	.994	.994	.995	.995	.992	.993	.993
.06	.919	.953	.963	.995	.994	.995	.995	.995	.996	.993	.993
.07	.918	.952	.964	.995	.994	.995	.995	.994	.995	.993	.993
.08	.921	.956	.963	.995	.994	.995	.994	.995	.996	.993	.993
.09	.920	.955	.962	.996	.994	.995	.995	.995	.996	.995	.993
.10	.920	.956	.963	.996	.995	.995	.995	.995	.995	.995	.993
.11	.921	.954	.963	.996	.994	.995	.995	.995	.996	.996	.993
.12	.919	.960	.962	.996	.997	.995	.996	.995	.995	.996	.995

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.953									
.01	.000	.952									
.02	.000	.953									
.03	.000	.961									
.04	.000	.960									
.05	.000	.962									
.06	.000	.962	.974								
.07	.000	.960	.974								
.08	.000	.973	.974								
.09	.000	.973	.973								
.10	.000	.973	.974								
.11	.000	.973	.973								
.12	.000	.973	.973								

Table 192

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.020	.998									
.01	.995	.998									
.02	.995	.997									
.03	.995	.998									
.04	.995	.998									
.05	.995	.998									
.06	.995	.998	.999								
.07	.995	.998	.999								
.08	.995	.998	.999								
.09	.995	.998	.999								
.10	.995	.998	.999								
.11	.995	.998	.999								
.12	.995	.999	.999								

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.999									
.01	.000	.999									
.02	.000	.999									
.03	.000	.999									
.04	.000	.999									
.05	.000	.999									
.06	.000	.999									
.07	.000	.999									
.08	.000										
.09	.000										
.10	.000										
.11	.000										
.12	.000	.999									

Table 193

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.993									
.01	.986	.993									
.02	.986	.993									
.03	.986	.993									
.04	.986	.994									
.05	.986	.993									
.06	.986	.994	.996								
.07	.987	.994	.996								
.08	.986	.995	.996								
.09	.986	.994	.996								
.10	.986	.995	.996								
.11	.987	.995	.996								
.12	.986	.995	.996								

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.993									
.01	.000	.993									
.02	.000	.993									
.03	.000	.994									
.04	.000	.995									
.05	.000	.995									
.06	.000	.995	.997								
.07	.000	.995	.997								
.08	.000	.997	.997								
.09	.000	.997	.997								
.10	.000	.997	.997								
.11	.000	.997	.997								
.12	.000	.997	.997								

Table 194

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.027										
.01											
.02											
.03											
.04											
.05											
.06											
.07											
.08											
.09											
.10											
.11											
.12	.999										

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011										
.01	.000										
.02	.000										
.03	.000										
.04	.000										
.05	.000										
.06	.000										
.07	.000										
.08	.000										
.09	.000										
.10	.000										
.11	.000										
.12	.000										

Table 195

Power Rates For One-Tailed Directional Test For Extreme Asymmetric Decay Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.999									
.01	.998	.999									
.02	.999	.999									
.03	.998										
.04	.998	.999									
.05	.998	.999									
.06	.998	.999									
.07	.998										
.08	.998										
.09	.998	.999									
.10	.998										
.11	.998										
.12	.998										

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.999									
.01	.000	.999									
.02	.000	.999									
.03	.000										
.04	.000										
.05	.000										
.06	.000										
.07	.000										
.08	.000										
.09	.000										
.10	.000										
.11	.000										
.12	.000										

Table 196

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.036	.274	.275	.279	.477	.571	.568	.568	.571	.570	.570
.01	.121	.273	.274	.277	.472	.567	.570	.571	.568	.572	.567
.02	.121	.275	.272	.280	.476	.569	.569	.566	.568	.569	.569
.03	.123	.272	.273	.278	.477	.568	.572	.567	.569	.572	.573
.04	.122	.272	.275	.280	.471	.571	.569	.568	.571	.568	.572
.05	.121	.275	.273	.279	.473	.568	.571	.572	.571	.570	.571
.06	.121	.274	.275	.278	.472	.570	.570	.567	.567	.570	.572
.07	.120	.272	.274	.278	.473	.568	.570	.567	.569	.572	.572
.08	.122	.274	.274	.280	.469	.569	.569	.569	.568	.571	.569
.09	.122	.275	.273	.281	.469	.569	.569	.571	.570	.572	.568
.10	.122	.273	.275	.279	.473	.567	.570	.567	.573	.568	.572
.11	.122	.274	.272	.278	.472	.569	.569	.571	.565	.570	.571
.12	.121	.275	.273	.275	.473	.567	.569	.567	.569	.568	.570

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.300	.302	.307	.581	.702	.702	.702	.702	.704	.704
.01	.036	.300	.301	.308	.581	.702	.704	.706	.700	.705	.701
.02	.036	.303	.299	.308	.583	.703	.703	.702	.703	.703	.704
.03	.036	.300	.300	.308	.585	.702	.705	.701	.705	.705	.705
.04	.036	.299	.301	.308	.579	.706	.704	.702	.703	.703	.707
.05	.036	.301	.301	.309	.581	.702	.706	.705	.705	.703	.705
.06	.036	.300	.302	.309	.581	.704	.704	.702	.702	.705	.706
.07	.035	.301	.302	.308	.582	.704	.703	.701	.702	.705	.705
.08	.036	.299	.299	.309	.578	.704	.703	.704	.703	.705	.702
.09	.035	.302	.301	.310	.580	.702	.703	.704	.703	.704	.702
.10	.036	.300	.302	.308	.579	.704	.704	.704	.705	.703	.703
.11	.035	.300	.300	.307	.579	.704	.705	.704	.696	.703	.704
.12	.035	.301	.301	.307	.580	.702	.701	.702	.703	.703	.704

Table 197

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.004	.111	.112	.114	.304	.472	.470	.468	.470	.476	.474
.01	.034	.111	.112	.115	.302	.470	.471	.472	.470	.475	.472
.02	.033	.113	.110	.115	.307	.470	.472	.469	.470	.474	.473
.03	.034	.110	.111	.113	.304	.468	.472	.469	.472	.476	.478
.04	.033	.110	.112	.115	.302	.471	.470	.470	.473	.473	.476
.05	.033	.112	.112	.115	.301	.469	.472	.473	.471	.476	.474
.06	.033	.110	.111	.115	.302	.471	.471	.469	.467	.476	.476
.07	.033	.110	.112	.115	.304	.470	.472	.468	.470	.477	.474
.08	.033	.112	.112	.114	.299	.471	.469	.469	.469	.476	.473
.09	.033	.111	.111	.116	.301	.470	.471	.471	.472	.475	.473
.10	.034	.111	.112	.114	.303	.470	.472	.468	.472	.473	.478
.11	.033	.111	.111	.115	.302	.471	.470	.471	.466	.472	.475
.12	.033	.111	.112	.114	.302	.469	.470	.468	.471	.471	.475

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.000	.054	.055	.055	.128	.220	.220	.219	.219	.223	.223
.01	.008	.054	.055	.056	.127	.221	.220	.221	.221	.222	.223
.02	.007	.055	.054	.056	.131	.221	.221	.222	.219	.221	.222
.03	.008	.054	.055	.055	.130	.218	.220	.219	.221	.223	.225
.04	.007	.054	.055	.056	.127	.220	.218	.220	.221	.221	.223
.05	.008	.055	.054	.057	.128	.219	.221	.221	.221	.222	.223
.06	.008	.054	.054	.056	.129	.220	.218	.220	.219	.221	.224
.07	.007	.054	.054	.057	.129	.221	.222	.218	.221	.222	.224
.08	.007	.056	.055	.056	.127	.221	.220	.219	.221	.224	.220
.09	.007	.054	.053	.057	.126	.221	.221	.219	.220	.223	.222
.10	.007	.054	.054	.055	.128	.220	.223	.219	.222	.222	.225
.11	.007	.054	.054	.057	.129	.222	.220	.220	.220	.222	.223
.12	.007	.053	.055	.056	.128	.221	.219	.220	.220	.221	.222

Table 198

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.035	.283	.282	.288	.631	.808	.807	.808	.809	.814	.813
.01	.072	.278	.281	.288	.631	.809	.808	.807	.808	.815	.812
.02	.071	.282	.281	.290	.635	.809	.810	.808	.811	.811	.813
.03	.070	.280	.281	.288	.633	.804	.808	.808	.809	.812	.815
.04	.071	.285	.280	.287	.635	.807	.810	.810	.808	.814	.813
.05	.072	.281	.283	.285	.631	.807	.808	.810	.808	.812	.811
.06	.072	.282	.281	.287	.632	.809	.808	.809	.809	.813	.812
.07	.070	.281	.280	.288	.632	.808	.808	.810	.810	.814	.813
.08	.070	.282	.281	.287	.633	.809	.807	.808	.807	.813	.814
.09	.072	.282	.283	.289	.633	.809	.808	.808	.808	.812	.814
.10	.071	.278	.279	.288	.633	.809	.807	.809	.807	.816	.813
.11	.071	.280	.285	.289	.633	.808	.805	.810	.807	.808	.813
.12	.071	.281	.283	.289	.634	.806	.807	.806	.810	.810	.814

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.023	.479	.477	.488	.805	.882	.883	.884	.884	.885	.885
.01	.068	.477	.479	.488	.804	.884	.883	.881	.884	.885	.883
.02	.068	.478	.480	.488	.808	.884	.884	.883	.885	.883	.884
.03	.067	.477	.477	.487	.806	.881	.883	.883	.884	.883	.885
.04	.068	.480	.478	.486	.806	.883	.886	.885	.883	.884	.885
.05	.068	.479	.478	.485	.807	.882	.883	.884	.884	.883	.885
.06	.068	.476	.477	.488	.807	.884	.884	.883	.884	.884	.884
.07	.069	.479	.476	.486	.808	.883	.882	.884	.884	.885	.885
.08	.067	.475	.480	.488	.806	.884	.884	.883	.882	.884	.886
.09	.069	.476	.480	.487	.807	.885	.883	.884	.883	.884	.885
.10	.067	.478	.476	.487	.806	.883	.882	.884	.884	.886	.884
.11	.067	.476	.482	.488	.807	.883	.881	.884	.882	.884	.883
.12	.068	.475	.480	.488	.808	.883	.883	.882	.884	.885	.884

Table 199

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.035	.283	.282	.288	.631	.808	.807	.808	.809	.814	.813
.01	.072	.278	.281	.288	.631	.809	.808	.807	.808	.815	.812
.02	.071	.282	.281	.290	.635	.809	.810	.808	.811	.811	.813
.03	.070	.280	.281	.288	.633	.804	.808	.808	.809	.812	.815
.04	.071	.285	.280	.287	.635	.807	.810	.810	.808	.814	.813
.05	.072	.281	.283	.285	.631	.807	.808	.810	.808	.812	.811
.06	.072	.282	.281	.287	.632	.809	.808	.809	.809	.813	.812
.07	.070	.281	.280	.288	.632	.808	.808	.810	.810	.814	.813
.08	.070	.282	.281	.287	.633	.809	.807	.808	.807	.813	.814
.09	.072	.282	.283	.289	.633	.809	.808	.808	.808	.812	.814
.10	.071	.278	.279	.288	.633	.809	.807	.809	.807	.816	.813
.11	.071	.280	.285	.289	.633	.808	.805	.810	.807	.808	.813
.12	.071	.281	.283	.289	.634	.806	.807	.806	.810	.810	.814

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.174	.173	.179	.493	.674	.675	.676	.678	.679	.677
.01	.018	.172	.174	.178	.494	.674	.676	.674	.673	.680	.680
.02	.019	.175	.174	.179	.495	.677	.675	.674	.676	.675	.678
.03	.018	.173	.173	.180	.495	.671	.673	.677	.675	.673	.682
.04	.019	.176	.173	.177	.495	.674	.678	.676	.673	.678	.677
.05	.019	.175	.175	.177	.493	.673	.675	.675	.675	.677	.677
.06	.019	.174	.174	.176	.494	.676	.673	.676	.677	.677	.677
.07	.019	.174	.174	.178	.495	.675	.677	.675	.678	.677	.676
.08	.018	.174	.175	.177	.494	.676	.675	.675	.673	.677	.677
.09	.019	.174	.174	.177	.496	.676	.675	.675	.674	.678	.677
.10	.018	.173	.174	.178	.496	.675	.675	.674	.674	.680	.676
.11	.018	.175	.174	.178	.497	.673	.674	.676	.675	.676	.678
.12	.018	.172	.174	.179	.496	.676	.674	.674	.672	.676	.679

Table 200

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.266	.267	.270	.667	.833	.831	.834	.835	.834	.836
.01	.078	.264	.266	.271	.667	.834	.832	.835	.836	.835	.835
.02	.076	.264	.266	.269	.667	.833	.835	.833	.833	.837	.833
.03	.076	.267	.264	.268	.667	.834	.834	.832	.832	.835	.835
.04	.077	.264	.268	.269	.670	.833	.834	.833	.833	.834	.836
.05	.077	.266	.264	.273	.672	.834	.834	.835	.835	.833	.836
.06	.076	.266	.264	.270	.670	.834	.833	.832	.834	.837	.835
.07	.075	.264	.264	.270	.670	.833	.833	.834	.834	.836	.838
.08	.077	.264	.263	.269	.666	.835	.832	.834	.831	.835	.834
.09	.076	.265	.265	.269	.668	.834	.833	.833	.834	.833	.836
.10	.076	.266	.265	.271	.665	.834	.835	.832	.833	.835	.833
.11	.075	.267	.262	.268	.666	.831	.834	.833	.832	.835	.833
.12	.077	.267	.266	.272	.664	.833	.833	.834	.831	.834	.833

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.016	.554	.554	.565	.894	.963	.963	.965	.963	.965	.965
.01	.043	.555	.557	.565	.893	.964	.964	.964	.965	.964	.964
.02	.043	.552	.553	.567	.894	.964	.964	.963	.964	.965	.964
.03	.044	.555	.556	.565	.893	.964	.965	.964	.963	.965	.964
.04	.043	.551	.556	.565	.893	.964	.964	.963	.963	.964	.964
.05	.043	.553	.553	.567	.894	.964	.964	.965	.964	.964	.964
.06	.043	.555	.555	.564	.894	.964	.963	.964	.964	.964	.964
.07	.043	.552	.554	.564	.893	.964	.964	.963	.963	.963	.966
.08	.044	.554	.552	.566	.893	.964	.964	.964	.964	.964	.963
.09	.043	.553	.555	.564	.893	.963	.963	.964	.963	.964	.964
.10	.041	.554	.553	.567	.892	.963	.964	.964	.964	.963	.964
.11	.042	.554	.552	.566	.892	.964	.964	.963	.963	.964	.963
.12	.044	.555	.556	.566	.892	.963	.964	.965	.964	.964	.964

Table 201

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.266	.267	.270	.667	.833	.831	.834	.835	.834	.836
.01	.078	.264	.266	.271	.667	.834	.832	.835	.836	.835	.835
.02	.076	.264	.266	.269	.667	.833	.835	.833	.833	.837	.833
.03	.076	.267	.264	.268	.667	.834	.834	.832	.832	.835	.835
.04	.077	.264	.268	.269	.670	.833	.834	.833	.833	.834	.836
.05	.077	.266	.264	.273	.672	.834	.834	.835	.835	.833	.836
.06	.076	.266	.264	.270	.670	.834	.833	.832	.834	.837	.835
.07	.075	.264	.264	.270	.670	.833	.833	.834	.834	.836	.838
.08	.077	.264	.263	.269	.666	.835	.832	.834	.831	.835	.834
.09	.076	.265	.265	.269	.668	.834	.833	.833	.834	.833	.836
.10	.076	.266	.265	.271	.665	.834	.835	.832	.833	.835	.833
.11	.075	.267	.262	.268	.666	.831	.834	.833	.832	.835	.833
.12	.077	.267	.266	.272	.664	.833	.833	.834	.831	.834	.833

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.279	.279	.288	.696	.884	.883	.886	.882	.887	.887
.01	.008	.277	.278	.288	.693	.885	.884	.886	.885	.887	.886
.02	.008	.276	.278	.289	.695	.883	.885	.883	.884	.888	.886
.03	.008	.280	.277	.285	.693	.885	.885	.883	.884	.888	.885
.04	.008	.275	.281	.287	.695	.886	.885	.884	.885	.886	.888
.05	.009	.279	.275	.290	.698	.884	.885	.886	.884	.886	.886
.06	.008	.278	.277	.288	.696	.885	.884	.883	.885	.887	.886
.07	.008	.274	.277	.285	.696	.884	.884	.885	.884	.886	.889
.08	.009	.277	.275	.286	.692	.886	.883	.885	.882	.887	.886
.09	.008	.276	.278	.287	.693	.884	.883	.884	.884	.886	.888
.10	.008	.280	.276	.289	.692	.883	.884	.885	.884	.885	.886
.11	.008	.278	.276	.286	.694	.882	.882	.883	.883	.884	.885
.12	.008	.279	.279	.289	.692	.883	.883	.885	.883	.884	.886

Table 202

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.085	.619	.619	.627	.912	.983	.984	.984	.985	.983	.983
.01	.159	.622	.619	.627	.910	.984	.982	.984	.983	.983	.983
.02	.160	.619	.621	.627	.909	.983	.983	.982	.983	.983	.984
.03	.158	.619	.618	.632	.909	.983	.983	.983	.983	.983	.984
.04	.162	.617	.619	.626	.911	.984	.984	.983	.984	.983	.984
.05	.159	.618	.618	.627	.909	.983	.983	.984	.983	.983	.983
.06	.160	.621	.620	.625	.909	.983	.983	.983	.983	.984	.983
.07	.160	.621	.619	.629	.908	.983	.983	.984	.984	.983	.982
.08	.159	.620	.620	.628	.911	.983	.984	.984	.983	.983	.983
.09	.157	.619	.619	.630	.911	.984	.983	.984	.983	.983	.983
.10	.161	.617	.618	.628	.909	.983	.983	.983	.984	.983	.983
.11	.157	.620	.619	.625	.910	.983	.984	.983	.983	.984	.984
.12	.161	.621	.617	.626	.911	.983	.983	.983	.983	.983	.984

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.024	.754	.758	.769	.980	.991	.992	.991	.992	.992	.991
.01	.061	.757	.756	.769	.979	.991	.991	.991	.991	.991	.992
.02	.062	.758	.759	.771	.979	.991	.992	.991	.991	.992	.991
.03	.062	.758	.756	.772	.979	.991	.992	.992	.991	.991	.992
.04	.061	.756	.755	.770	.980	.992	.992	.991	.992	.992	.992
.05	.062	.757	.754	.770	.980	.991	.992	.992	.991	.991	.991
.06	.062	.761	.760	.769	.980	.992	.992	.991	.991	.992	.991
.07	.061	.757	.758	.771	.979	.992	.991	.992	.992	.991	.991
.08	.062	.757	.757	.769	.980	.991	.992	.992	.992	.991	.991
.09	.061	.755	.759	.770	.980	.992	.991	.991	.991	.991	.992
.10	.062	.755	.756	.770	.980	.991	.991	.991	.992	.991	.991
.11	.061	.755	.757	.768	.980	.991	.991	.991	.991	.991	.991
.12	.062	.758	.755	.769	.980	.991	.992	.991	.991	.991	.992

Table 203

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.013	.355	.353	.364	.800	.954	.956	.956	.956	.955	.954
.01	.040	.356	.354	.364	.800	.956	.954	.956	.955	.955	.954
.02	.038	.355	.355	.362	.800	.955	.955	.954	.955	.955	.955
.03	.039	.355	.353	.365	.797	.955	.954	.955	.955	.955	.956
.04	.039	.352	.354	.362	.798	.955	.956	.955	.956	.955	.956
.05	.040	.352	.353	.361	.796	.954	.954	.956	.954	.956	.956
.06	.038	.355	.358	.361	.800	.955	.955	.955	.954	.956	.954
.07	.038	.358	.357	.365	.795	.954	.956	.956	.956	.955	.954
.08	.038	.356	.353	.362	.797	.954	.957	.955	.955	.955	.955
.09	.038	.355	.356	.365	.799	.955	.955	.955	.954	.954	.955
.10	.040	.352	.355	.363	.798	.954	.955	.955	.955	.956	.954
.11	.038	.353	.355	.362	.799	.955	.956	.955	.954	.955	.956
.12	.039	.357	.353	.360	.799	.954	.955	.955	.956	.955	.955

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.484	.484	.498	.927	.973	.975	.975	.975	.974	.974
.01	.017	.487	.482	.500	.925	.974	.973	.974	.974	.974	.974
.02	.018	.487	.486	.500	.926	.974	.974	.973	.973	.974	.975
.03	.018	.487	.485	.502	.927	.973	.974	.975	.974	.974	.975
.04	.018	.483	.486	.500	.927	.974	.975	.974	.975	.974	.975
.05	.018	.484	.484	.499	.926	.974	.974	.975	.974	.975	.974
.06	.018	.489	.486	.498	.927	.974	.974	.974	.973	.975	.974
.07	.017	.489	.484	.499	.925	.974	.974	.975	.975	.974	.973
.08	.018	.487	.484	.499	.927	.973	.975	.973	.974	.974	.974
.09	.018	.486	.487	.500	.928	.974	.974	.975	.974	.974	.974
.10	.018	.484	.487	.499	.927	.973	.974	.974	.974	.974	.974
.11	.018	.485	.486	.499	.927	.973	.975	.974	.973	.974	.975
.12	.017	.487	.482	.497	.927	.973	.974	.974	.974	.973	.974

Table 204

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.134	.774	.776	.783	.972	.998	.998	.998	.998	.998	.998
.01	.202	.777	.775	.785	.972	.998	.998	.998	.998	.998	.998
.02	.202	.780	.776	.785	.973	.998	.998	.998	.998	.998	.998
.03	.204	.773	.776	.784	.973	.998	.998	.998	.998	.998	.998
.04	.202	.774	.777	.784	.972	.998	.998	.998	.998	.998	.998
.05	.205	.776	.777	.785	.972	.998	.998	.998	.998	.998	.998
.06	.205	.776	.777	.784	.971	.998	.998	.998	.998	.998	.998
.07	.203	.775	.775	.784	.972	.998	.998	.998	.998	.998	.998
.08	.203	.776	.779	.786	.973	.998	.998	.998	.998	.998	.998
.09	.203	.780	.778	.785	.973	.998	.998	.998	.998	.998	.998
.10	.202	.774	.776	.786	.973	.998	.998	.998	.998	.998	.998
.11	.203	.776	.777	.784	.971	.998	.998	.998	.998	.998	.998
.12	.204	.777	.778	.786	.973	.998	.998	.998	.998	.998	.998

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.025	.905	.905	.912	.998	.999		.999	.999	.999	.999
.01	.062	.906	.904	.915	.998	.999	.999		.999	.999	.999
.02	.062	.906	.904	.915	.998	.999	.999	.999		.999	.999
.03	.062	.904	.906	.913	.998	.999	.999	.999	.999	.999	.999
.04	.061	.905	.906	.913	.998	.999	.999	.999	.999	.999	
.05	.062	.904	.906	.914	.998		.999	.999		.999	.999
.06	.063	.906	.905	.914	.998	.999	.999	.999	.999		.999
.07	.061	.905	.905	.914	.998	.999	.999	.999	.999	.999	.999
.08	.063	.905	.905	.915	.998	.999	.999	.999	.999	.999	.999
.09	.062	.907	.906	.914	.998		.999	.999	.999	.999	.999
.10	.061	.904	.903	.913	.998	.999	.999	.999	.999		.999
.11	.061	.904	.905	.913	.998	.999	.999	.999	.999	.999	.999
.12	.063	.905	.906	.914	.998	.999	.999	.999	.999	.999	.999

Table 205

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.039	.593	.595	.602	.932	.995	.995	.995	.995	.995	.995
.01	.078	.595	.593	.607	.933	.995	.995	.995	.995	.995	.995
.02	.078	.597	.596	.606	.932	.995	.995	.995	.995	.995	.995
.03	.078	.593	.595	.603	.934	.994	.995	.995	.995	.995	.994
.04	.079	.593	.596	.605	.932	.995	.995	.995	.995	.994	.995
.05	.078	.595	.594	.606	.932	.995	.995	.995	.995	.995	.995
.06	.080	.593	.597	.607	.932	.994	.995	.995	.995	.995	.995
.07	.078	.594	.596	.605	.932	.995	.995	.995	.994	.995	.995
.08	.079	.596	.598	.607	.933	.995	.995	.994	.995	.995	.994
.09	.078	.597	.594	.607	.934	.995	.994	.995	.995	.995	.995
.10	.078	.591	.593	.604	.934	.995	.994	.995	.995	.995	.995
.11	.078	.594	.595	.606	.931	.995	.995	.995	.995	.995	.995
.12	.079	.596	.593	.607	.932	.995	.995	.995	.995	.995	.995

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.715	.718	.730	.991	.997	.997	.997	.997	.997	.998
.01	.018	.717	.716	.733	.991	.997	.997	.998	.997	.998	.997
.02	.017	.720	.716	.731	.991	.997	.997	.997	.998	.997	.997
.03	.018	.715	.716	.731	.991	.997	.997	.997	.997	.998	.997
.04	.017	.715	.716	.733	.991	.997	.997	.997	.997	.997	.998
.05	.017	.716	.717	.733	.991	.998	.998	.998	.998	.998	.998
.06	.018	.718	.716	.733	.991	.997	.997	.997	.997	.998	.997
.07	.017	.716	.718	.732	.990	.997	.998	.997	.997	.997	.997
.08	.017	.717	.717	.734	.991	.997	.998	.997	.997	.998	.997
.09	.017	.718	.718	.734	.991	.998	.997	.997	.997	.998	.997
.10	.017	.718	.714	.732	.991	.997	.997	.997	.997	.997	.997
.11	.017	.716	.717	.732	.991	.998	.997	.997	.997	.998	.997
.12	.018	.718	.716	.733	.991	.997	.997	.998	.998	.997	.998

Table 206

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.012	.451	.448	.450	.958	.993	.994	.993	.993	.993	.994
.01	.150	.448	.451	.453	.959	.993	.993	.993	.993	.993	.993
.02	.150	.452	.447	.453	.959	.993	.993	.993	.993	.993	.993
.03	.150	.448	.448	.454	.959	.993	.993	.993	.993	.993	.993
.04	.149	.450	.448	.453	.959	.993	.993	.993	.993	.993	.993
.05	.151	.451	.453	.455	.960	.994	.993	.993	.993	.993	.993
.06	.149	.447	.447	.452	.959	.993	.993	.993	.993	.993	.993
.07	.151	.451	.448	.451	.960	.993	.993	.993	.993	.994	.993
.08	.149	.446	.449	.452	.960	.993	.993	.993	.993	.993	.993
.09	.150	.450	.449	.452	.958	.993	.992	.993	.993	.994	.993
.10	.149	.449	.451	.450	.960	.993	.994	.993	.994	.993	.992
.11	.150	.451	.450	.454	.960	.993	.993	.993	.993	.993	.994
.12	.151	.447	.447	.450	.959	.993	.993	.993	.993	.993	.993

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.020	.846	.844	.852	.996						
.01	.048	.842	.841	.852	.996						
.02	.048	.844	.842	.852	.996						
.03	.047	.843	.842	.851	.996						
.04	.048	.842	.844	.853	.996						
.05	.048	.843	.843	.851	.996						
.06	.049	.842	.841	.852	.997						
.07	.049	.843	.843	.853	.996						
.08	.047	.842	.843	.853	.996						
.09	.048	.843	.843	.852	.996						
.10	.048	.844	.841	.851	.996						
.11	.048	.843	.842	.851	.996						
.12	.047	.844	.841	.849	.997						

Table 207

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.001	.262	.260	.263	.864	.972	.973	.972	.972	.972	.973
.01	.052	.263	.262	.266	.868	.972	.971	.972	.971	.972	.971
.02	.052	.263	.260	.264	.868	.972	.971	.972	.973	.971	.972
.03	.052	.261	.259	.265	.868	.971	.973	.971	.972	.972	.971
.04	.051	.263	.259	.264	.868	.973	.972	.972	.972	.971	.971
.05	.053	.261	.263	.268	.869	.973	.972	.972	.972	.972	.971
.06	.053	.262	.262	.265	.868	.972	.972	.972	.972	.972	.972
.07	.054	.261	.261	.266	.870	.972	.972	.972	.971	.973	.971
.08	.052	.259	.262	.265	.869	.972	.971	.972	.971	.971	.971
.09	.051	.260	.259	.266	.868	.972	.971	.973	.973	.973	.973
.10	.051	.262	.263	.264	.870	.971	.973	.973	.973	.973	.971
.11	.052	.263	.261	.265	.869	.971	.972	.972	.972	.971	.972
.12	.052	.259	.260	.264	.868	.972	.972	.971	.972	.972	.973

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.639	.640	.651	.977	.999	.998	.998	.998	.998	.999
.01	.010	.637	.638	.654	.977	.999	.998	.998	.998	.998	.999
.02	.010	.639	.636	.652	.977	.999	.998	.998	.999	.998	.998
.03	.010	.636	.636	.653	.978	.998	.999	.998	.999	.998	.999
.04	.010	.637	.639	.653	.978	.999	.999	.999	.998	.998	.999
.05	.010	.638	.641	.655	.978	.999	.998	.998	.998	.999	.998
.06	.011	.639	.636	.652	.978	.999	.998	.998	.998	.999	.998
.07	.011	.638	.636	.653	.978	.998	.998	.998	.998	.999	.998
.08	.011	.636	.636	.652	.978	.998	.998	.998	.998	.998	.998
.09	.010	.638	.637	.654	.977	.998	.998	.998	.999	.999	.999
.10	.010	.636	.638	.651	.978	.998	.998	.999	.999	.998	.998
.11	.011	.639	.637	.654	.978	.998	.998	.998	.998	.998	.999
.12	.010	.636	.637	.648	.978	.999	.999	.998	.998	.998	.998

Table 208

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.040	.663	.663	.663	.999						
.01	.321	.666	.663	.666	.999						
.02	.317	.665	.664	.663	.999						
.03	.319	.666	.665	.665	.999						
.04	.317	.660	.666	.661	.999						
.05	.320	.665	.663	.664	.999						
.06	.321	.662	.663	.666	.999						
.07	.318	.664	.661	.664	.999						
.08	.316	.664	.661	.663	.999						
.09	.320	.663	.664	.662	.999						
.10	.318	.664	.664	.665	.999						
.11	.319	.662	.664	.662	.999						
.12	.323	.662	.664	.666	.999						

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.022	.949	.947	.953							
.01	.052	.950	.948	.952							
.02	.052	.949	.949	.953							
.03	.052	.950	.948	.954							
.04	.052	.947	.948	.952							
.05	.051	.949	.949	.953							
.06	.052	.949	.949	.952							
.07	.051	.949	.948	.953							
.08	.051	.949	.948	.954							
.09	.053	.948	.949	.953							
.10	.051	.949	.949	.954							
.11	.053	.949	.949	.952							
.12	.052	.948	.948	.953							

Table 209

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.514	.513	.512	.994						
.01	.187	.517	.515	.516	.995						
.02	.186	.517	.516	.514	.995						
.03	.185	.516	.514	.516	.995						
.04	.185	.510	.515	.514	.995						
.05	.186	.517	.513	.518	.995						
.06	.188	.511	.517	.517	.995						
.07	.186	.515	.512	.517	.995						
.08	.184	.515	.513	.516	.995						
.09	.184	.514	.515	.512	.995						
.10	.186	.515	.513	.515	.995						
.11	.185	.512	.515	.517	.994						
.12	.188	.513	.514	.517	.995						

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.843	.841	.852	.999						
.01	.011	.844	.841	.853	.999						
.02	.011	.843	.842	.853	.999						
.03	.012	.845	.842	.854	.999						
.04	.011	.840	.844	.851	.999						
.05	.011	.845	.843	.854	.999						
.06	.011	.842	.843	.852	.999						
.07	.011	.843	.842	.853	.999						
.08	.011	.843	.842	.854	.999						
.09	.012	.843	.844	.853	.999						
.10	.011	.844	.843	.854	.999						
.11	.012	.843	.844	.853	.999						
.12	.012	.843	.842	.854	.999						

Table 210

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.194	.940	.941	.946	.999						
.01	.245	.940	.941	.943	.999						
.02	.243	.940	.939	.943	.999						
.03	.242	.941	.941	.945	.999						
.04	.244	.940	.941	.943	.999						
.05	.244	.939	.939	.945	.999						
.06	.243	.940	.940	.944	.999						
.07	.246	.940	.940	.943	.999						
.08	.244	.940	.941	.943	.999						
.09	.244	.940	.941	.944	.999						
.10	.244	.940	.942	.945	.999						
.11	.245	.941	.942	.943	.999						
.12	.245	.939	.940	.946	.999						

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.024	.996	.996	.997							
.01	.062	.996	.996	.997							
.02	.063	.996	.996	.997							
.03	.063	.996	.996	.997							
.04	.064	.996	.996	.997							
.05	.063	.996	.996	.997							
.06	.063	.996	.996	.997							
.07	.064	.996	.996	.997							
.08	.063	.996	.996	.997							
.09	.064	.996	.996	.997							
.10	.064	.996	.996	.997							
.11	.064	.996	.996	.997							
.12	.063	.996	.996	.997							

Table 211

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.046	.806	.809	.820	.993						
.01	.078	.809	.811	.817	.993						
.02	.074	.809	.805	.819	.993						
.03	.074	.809	.808	.820	.993						
.04	.076	.808	.809	.816	.993						
.05	.074	.807	.806	.819	.993						
.06	.076	.806	.808	.818	.993						
.07	.077	.808	.806	.817	.993						
.08	.076	.808	.808	.817	.993						
.09	.075	.807	.809	.819	.993						
.10	.075	.807	.811	.821	.993						
.11	.075	.809	.808	.818	.993						
.12	.076	.808	.808	.820	.993						

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.974	.973	.978							
.01	.018	.973	.974	.978							
.02	.018	.975	.974	.978							
.03	.018	.974	.974	.978							
.04	.018	.974	.975	.977							
.05	.018	.974	.974	.977							
.06	.018	.974	.974	.978							
.07	.019	.974	.973	.978							
.08	.018	.974	.974	.978							
.09	.018	.973	.974	.978							
.10	.018	.974	.974	.978							
.11	.018	.973	.974	.978							
.12	.018	.973	.974	.979							

Table 212

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.022	.701	.705	.700							
.01	.347	.699	.701	.701							
.02	.347	.699	.702	.701							
.03	.349	.703	.701	.704							
.04	.349	.701	.701	.699							
.05	.349	.700	.701	.701							
.06	.345	.700	.701	.702							
.07	.346	.701	.703	.703							
.08	.348	.700	.703	.701							
.09	.347	.702	.702	.700							
.10	.349	.699	.701	.702							
.11	.350	.702	.702	.702							
.12	.346	.702	.702	.702							

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.023	.991	.991	.992							
.01	.055	.991	.991	.992							
.02	.054	.991	.992	.992							
.03	.055	.991	.992	.992							
.04	.054	.991	.991	.992							
.05	.054	.991	.991	.992							
.06	.055	.991	.991	.992							
.07	.054	.991	.991	.992							
.08	.054	.991	.991	.992							
.09	.054	.992	.991	.992							
.10	.053	.992	.991	.992							
.11	.053	.991	.991	.992							
.12	.052	.992	.991	.992							

Table 213

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.547	.551	.546							
.01	.187	.548	.548	.547							
.02	.187	.545	.550	.549	.999						
.03	.189	.548	.550	.550							
.04	.189	.547	.548	.547							
.05	.189	.546	.547	.547	.999						
.06	.188	.546	.548	.550							
.07	.185	.549	.551	.549							
.08	.188	.547	.549	.547	.999						
.09	.188	.549	.549	.548							
.10	.188	.548	.546	.548							
.11	.188	.548	.549	.549	.999						
.12	.186	.549	.549	.550	.999						

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.961	.962	.964							
.01	.012	.960	.960	.965							
.02	.012	.960	.961	.964							
.03	.012	.962	.962	.964							
.04	.013	.961	.961	.964							
.05	.012	.960	.960	.964							
.06	.012	.961	.960	.964							
.07	.012	.961	.960	.964							
.08	.012	.961	.961	.964							
.09	.012	.961	.961	.965							
.10	.012	.960	.960	.965							
.11	.011	.960	.960	.965							
.12	.012	.961	.961	.965							

Table 214

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.023	.798	.797	.797							
.01	.432	.798	.796	.797							
.02	.432	.798	.797	.798							
.03	.435	.798	.801	.798							
.04	.432	.798	.796	.798							
.05	.434	.798	.797	.795							
.06	.433	.797	.797	.798							
.07	.431	.797	.797	.798							
.08	.433	.797	.798	.797							
.09	.434	.799	.799	.796							
.10	.432	.797	.795	.796							
.11	.433	.799	.798	.798							
.12	.433	.799	.798	.797							

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.023	.999	.999	.999							
.01	.054	.999	.999	.999							
.02	.055	.999	.999	.999							
.03	.055	.999	.999	.999							
.04	.055	.999	.999	.999							
.05	.056	.999	.999	.999							
.06	.056	.999	.999	.999							
.07	.055	.999	.999	.999							
.08	.055	.999	.999	.999							
.09	.055	.999	.999	.999							
.10	.055	.999	.999	.999							
.11	.055	.999	.999	.999							
.12	.055	.999	.999	.999							

Table 215

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.004	.694	.694	.691							
.01	.285	.694	.691	.694							
.02	.285	.693	.693	.693							
.03	.286	.694	.696	.693							
.04	.284	.693	.692	.694							
.05	.286	.693	.692	.693							
.06	.285	.694	.693	.693							
.07	.284	.693	.693	.695							
.08	.286	.694	.694	.692							
.09	.285	.694	.695	.692							
.10	.285	.693	.691	.690							
.11	.285	.693	.693	.694							
.12	.286	.694	.694	.691							

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.995	.995	.996							
.01	.013	.995	.995	.996							
.02	.013	.995	.996	.996							
.03	.012	.996	.995	.996							
.04	.013	.995	.995	.996							
.05	.013	.995	.995	.996							
.06	.013	.995	.995	.996							
.07	.013	.995	.995	.996							
.08	.013	.995	.995	.996							
.09	.013	.995	.995	.996							
.10	.013	.995	.995	.996							
.11	.013	.995	.995	.996							
.12	.013	.995	.995	.996							

Table 216

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.029	.897	.897	.894							
.01	.539	.896	.896	.895							
.02	.538	.896	.898	.896							
.03	.535	.897	.897	.895							
.04	.539	.896	.895	.896							
.05	.537	.897	.895	.896							
.06	.537	.895	.896	.897							
.07	.539	.896	.896	.895							
.08	.538	.895	.896	.895							
.09	.538	.895	.895	.895							
.10	.535	.896	.896	.897							
.11	.537	.897	.895	.896							
.12	.536	.895	.896	.896							

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.023										
.01	.057										
.02	.056										
.03	.055										
.04	.055										
.05	.056										
.06	.056										
.07	.056										
.08	.056										
.09	.055										
.10	.056										
.11	.056										
.12	.055										

Table 217

Power Rates For One-Tailed Directional Test For Extreme Bimodal Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.004	.795	.794	.791							
.01	.383	.797	.794	.792							
.02	.384	.794	.795	.792							
.03	.380	.796	.797	.795							
.04	.383	.793	.793	.793							
.05	.383	.793	.793	.792							
.06	.383	.793	.792	.793							
.07	.385	.795	.794	.790							
.08	.383	.793	.794	.791							
.09	.384	.793	.796	.794							
.10	.381	.794	.795	.795							
.11	.381	.794	.793	.794							
.12	.381	.793	.795	.794							

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002										
.01	.013										
.02	.014										
.03	.014										
.04	.013										
.05	.013										
.06	.014										
.07	.013										
.08	.013										
.09	.013										
.10	.014										
.11	.013										
.12	.013										

Table 218

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.079	.115	.179	.245	.306	.351	.388	.419	.444	.457	.475
.01	.080	.111	.172	.244	.305	.354	.387	.414	.439	.457	.475
.02	.081	.111	.174	.244	.297	.349	.387	.415	.441	.461	.476
.03	.080	.111	.174	.245	.299	.352	.386	.417	.438	.459	.476
.04	.080	.112	.173	.243	.297	.343	.388	.418	.435	.459	.475
.05	.080	.110	.172	.242	.299	.345	.385	.415	.437	.459	.474
.06	.081	.109	.172	.236	.297	.344	.388	.416	.439	.460	.474
.07	.078	.110	.171	.237	.299	.344	.381	.415	.436	.454	.473
.08	.080	.111	.171	.233	.296	.345	.382	.416	.439	.456	.473
.09	.080	.108	.172	.237	.298	.344	.381	.414	.444	.454	.473
.10	.080	.107	.168	.235	.288	.341	.381	.414	.436	.456	.472
.11	.079	.106	.168	.233	.289	.342	.379	.408	.436	.455	.472
.12	.079	.105	.167	.232	.287	.341	.378	.409	.435	.457	.469

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.041	.120	.202	.277	.347	.398	.434	.467	.495	.512	.534
.01	.045	.116	.194	.277	.347	.399	.433	.466	.491	.513	.531
.02	.047	.116	.197	.278	.337	.394	.434	.466	.491	.514	.533
.03	.045	.115	.196	.279	.339	.396	.432	.467	.491	.514	.533
.04	.046	.117	.196	.276	.336	.389	.433	.467	.488	.514	.532
.05	.046	.112	.193	.275	.339	.390	.434	.465	.490	.515	.531
.06	.047	.113	.192	.269	.337	.388	.436	.466	.492	.514	.530
.07	.045	.113	.192	.271	.338	.390	.428	.465	.490	.509	.528
.08	.047	.112	.192	.267	.336	.392	.430	.469	.491	.513	.531
.09	.042	.111	.192	.272	.338	.389	.428	.466	.497	.510	.529
.10	.041	.109	.188	.268	.328	.384	.429	.465	.490	.513	.529
.11	.042	.108	.189	.266	.331	.388	.427	.459	.492	.513	.531
.12	.042	.107	.186	.264	.329	.386	.427	.460	.488	.511	.528

Table 219

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.016	.028	.057	.091	.129	.163	.192	.224	.249	.269	.291
.01	.016	.028	.053	.089	.129	.163	.196	.220	.247	.268	.292
.02	.016	.027	.054	.091	.124	.159	.191	.222	.248	.271	.293
.03	.016	.027	.054	.092	.123	.164	.194	.222	.243	.268	.294
.04	.016	.028	.053	.088	.122	.158	.194	.223	.241	.268	.290
.05	.016	.027	.052	.087	.124	.158	.190	.220	.244	.268	.291
.06	.017	.028	.054	.086	.122	.155	.194	.220	.245	.268	.289
.07	.016	.027	.053	.086	.123	.158	.188	.219	.243	.268	.290
.08	.017	.028	.053	.084	.122	.156	.188	.219	.245	.265	.285
.09	.016	.026	.052	.086	.123	.155	.188	.218	.247	.266	.287
.10	.016	.025	.051	.084	.117	.154	.188	.218	.241	.266	.286
.11	.016	.026	.051	.083	.117	.156	.184	.211	.241	.266	.285
.12	.016	.025	.051	.083	.117	.156	.187	.213	.239	.266	.283

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.014	.031	.049	.072	.090	.105	.124	.137	.149	.161
.01	.004	.014	.029	.049	.070	.089	.107	.120	.136	.147	.159
.02	.004	.014	.029	.049	.066	.085	.104	.122	.137	.149	.161
.03	.004	.013	.028	.050	.064	.089	.105	.120	.134	.146	.161
.04	.004	.014	.029	.048	.066	.085	.104	.122	.132	.146	.159
.05	.004	.013	.027	.046	.066	.084	.103	.120	.133	.146	.161
.06	.004	.014	.027	.046	.065	.083	.105	.120	.134	.146	.158
.07	.004	.013	.027	.045	.065	.085	.101	.118	.132	.147	.158
.08	.004	.013	.027	.045	.066	.084	.101	.118	.134	.145	.156
.09	.003	.012	.027	.045	.066	.082	.101	.117	.135	.144	.157
.10	.004	.012	.026	.045	.061	.081	.101	.117	.131	.144	.155
.11	.003	.012	.026	.044	.062	.083	.098	.114	.129	.144	.156
.12	.003	.011	.026	.044	.061	.082	.100	.113	.127	.143	.154

Table 220

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.032	.065	.146	.243	.342	.426	.493	.547	.584	.615	.645
.01	.033	.065	.139	.239	.344	.426	.491	.545	.586	.621	.645
.02	.033	.064	.140	.241	.331	.424	.486	.543	.591	.621	.648
.03	.033	.063	.140	.243	.331	.425	.487	.550	.584	.619	.647
.04	.033	.065	.140	.236	.334	.416	.491	.550	.588	.616	.647
.05	.033	.061	.137	.233	.331	.413	.488	.544	.585	.614	.644
.06	.033	.061	.135	.231	.332	.413	.488	.546	.584	.617	.645
.07	.033	.062	.136	.229	.333	.411	.483	.545	.584	.618	.647
.08	.033	.061	.136	.232	.332	.415	.480	.548	.583	.617	.644
.09	.034	.060	.134	.232	.333	.414	.482	.541	.585	.618	.647
.10	.034	.060	.134	.227	.317	.411	.483	.544	.588	.620	.644
.11	.035	.056	.135	.226	.320	.411	.477	.534	.579	.621	.644
.12	.035	.058	.135	.224	.315	.411	.476	.534	.578	.620	.643

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.054	.175	.336	.479	.601	.676	.731	.771	.794	.811	.826
.01	.055	.175	.325	.474	.598	.675	.731	.769	.794	.815	.826
.02	.056	.172	.324	.474	.581	.674	.727	.768	.799	.816	.827
.03	.056	.169	.324	.476	.580	.677	.728	.772	.795	.814	.828
.04	.055	.172	.324	.468	.583	.667	.730	.769	.796	.813	.827
.05	.054	.165	.312	.467	.583	.665	.727	.770	.794	.812	.825
.06	.056	.165	.310	.459	.581	.667	.729	.769	.796	.813	.827
.07	.054	.163	.310	.459	.583	.664	.725	.769	.795	.816	.828
.08	.056	.159	.313	.457	.580	.667	.724	.771	.792	.812	.828
.09	.048	.159	.313	.459	.580	.668	.724	.766	.796	.814	.829
.10	.048	.158	.304	.451	.565	.664	.724	.766	.797	.814	.827
.11	.048	.151	.307	.451	.566	.663	.721	.763	.792	.814	.827
.12	.049	.153	.308	.447	.563	.662	.720	.763	.791	.815	.828

Table 221

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.032	.065	.146	.243	.342	.426	.493	.547	.584	.615	.645
.01	.033	.065	.139	.239	.344	.426	.491	.545	.586	.621	.645
.02	.033	.064	.140	.241	.331	.424	.486	.543	.591	.621	.648
.03	.033	.063	.140	.243	.331	.425	.487	.550	.584	.619	.647
.04	.033	.065	.140	.236	.334	.416	.491	.550	.588	.616	.647
.05	.033	.061	.137	.233	.331	.413	.488	.544	.585	.614	.644
.06	.033	.061	.135	.231	.332	.413	.488	.546	.584	.617	.645
.07	.033	.062	.136	.229	.333	.411	.483	.545	.584	.618	.647
.08	.033	.061	.136	.232	.332	.415	.480	.548	.583	.617	.644
.09	.034	.060	.134	.232	.333	.414	.482	.541	.585	.618	.647
.10	.034	.060	.134	.227	.317	.411	.483	.544	.588	.620	.644
.11	.035	.056	.135	.226	.320	.411	.477	.534	.579	.621	.644
.12	.035	.058	.135	.224	.315	.411	.476	.534	.578	.620	.643

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.038	.093	.162	.241	.308	.366	.422	.459	.491	.521
.01	.009	.038	.087	.160	.242	.307	.367	.419	.461	.495	.521
.02	.009	.037	.090	.160	.226	.304	.361	.415	.464	.497	.526
.03	.009	.036	.089	.159	.226	.307	.361	.419	.457	.494	.525
.04	.009	.038	.088	.157	.228	.299	.366	.418	.459	.491	.522
.05	.008	.034	.083	.155	.229	.295	.362	.414	.456	.489	.518
.06	.010	.034	.082	.150	.225	.294	.363	.414	.456	.493	.522
.07	.009	.034	.082	.150	.227	.294	.357	.416	.455	.492	.522
.08	.009	.032	.083	.150	.229	.298	.355	.418	.455	.489	.518
.09	.007	.033	.083	.148	.226	.296	.355	.411	.456	.490	.521
.10	.008	.032	.081	.146	.214	.293	.355	.412	.459	.490	.516
.11	.008	.031	.081	.145	.215	.294	.354	.403	.449	.490	.519
.12	.008	.031	.082	.143	.215	.293	.351	.402	.448	.485	.515

Table 222

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.021	.058	.142	.245	.346	.427	.505	.562	.608	.644	.679
.01	.024	.056	.138	.241	.349	.427	.505	.557	.611	.648	.679
.02	.024	.055	.136	.243	.332	.426	.497	.559	.610	.646	.679
.03	.023	.055	.136	.243	.333	.429	.500	.562	.603	.646	.677
.04	.024	.055	.135	.237	.333	.421	.499	.562	.602	.646	.675
.05	.023	.054	.130	.234	.335	.421	.500	.558	.603	.642	.678
.06	.024	.053	.130	.228	.330	.415	.500	.558	.605	.644	.680
.07	.023	.053	.130	.229	.332	.416	.488	.559	.602	.642	.678
.08	.024	.052	.129	.230	.335	.418	.490	.558	.603	.637	.669
.09	.024	.051	.127	.228	.334	.419	.487	.552	.604	.639	.672
.10	.023	.051	.129	.225	.321	.413	.486	.552	.605	.642	.671
.11	.024	.050	.127	.222	.316	.416	.485	.544	.595	.642	.671
.12	.025	.047	.129	.222	.320	.412	.481	.540	.597	.636	.667

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.044	.182	.376	.548	.672	.754	.812	.850	.875	.895	.910
.01	.041	.180	.366	.537	.675	.755	.813	.848	.876	.896	.911
.02	.042	.179	.363	.541	.657	.749	.806	.848	.877	.895	.909
.03	.041	.177	.365	.539	.654	.751	.808	.849	.873	.894	.910
.04	.043	.179	.365	.532	.655	.744	.807	.849	.872	.895	.907
.05	.041	.169	.351	.528	.654	.745	.807	.846	.872	.892	.909
.06	.041	.170	.352	.518	.651	.741	.807	.847	.874	.893	.911
.07	.041	.168	.350	.521	.655	.741	.801	.847	.872	.895	.908
.08	.041	.165	.348	.518	.655	.744	.798	.845	.873	.890	.905
.09	.036	.162	.347	.514	.655	.743	.798	.843	.872	.893	.905
.10	.036	.166	.341	.510	.634	.735	.800	.846	.873	.891	.905
.11	.034	.155	.339	.505	.632	.737	.795	.838	.868	.892	.906
.12	.036	.154	.341	.506	.634	.736	.793	.837	.867	.889	.904

Table 223

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.021	.058	.142	.245	.346	.427	.505	.562	.608	.644	.679
.01	.024	.056	.138	.241	.349	.427	.505	.557	.611	.648	.679
.02	.024	.055	.136	.243	.332	.426	.497	.559	.610	.646	.679
.03	.023	.055	.136	.243	.333	.429	.500	.562	.603	.646	.677
.04	.024	.055	.135	.237	.333	.421	.499	.562	.602	.646	.675
.05	.023	.054	.130	.234	.335	.421	.500	.558	.603	.642	.678
.06	.024	.053	.130	.228	.330	.415	.500	.558	.605	.644	.680
.07	.023	.053	.130	.229	.332	.416	.488	.559	.602	.642	.678
.08	.024	.052	.129	.230	.335	.418	.490	.558	.603	.637	.669
.09	.024	.051	.127	.228	.334	.419	.487	.552	.604	.639	.672
.10	.023	.051	.129	.225	.321	.413	.486	.552	.605	.642	.671
.11	.024	.050	.127	.222	.316	.416	.485	.544	.595	.642	.671
.12	.025	.047	.129	.222	.320	.412	.481	.540	.597	.636	.667

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.047	.137	.252	.365	.455	.537	.594	.641	.679	.714
.01	.007	.046	.132	.243	.366	.455	.535	.591	.644	.680	.712
.02	.007	.046	.130	.247	.346	.450	.526	.589	.644	.679	.710
.03	.007	.045	.130	.247	.345	.452	.529	.591	.633	.677	.712
.04	.007	.045	.131	.239	.347	.443	.528	.594	.633	.678	.708
.05	.006	.043	.122	.236	.345	.444	.529	.589	.633	.673	.710
.06	.007	.043	.123	.229	.344	.441	.528	.591	.635	.676	.711
.07	.007	.042	.122	.231	.345	.441	.517	.589	.636	.675	.710
.08	.006	.040	.123	.231	.346	.442	.515	.588	.634	.670	.701
.09	.005	.041	.120	.227	.347	.444	.513	.583	.634	.672	.703
.10	.005	.041	.120	.222	.327	.434	.513	.583	.638	.672	.702
.11	.005	.039	.117	.221	.326	.437	.511	.575	.623	.673	.703
.12	.006	.037	.118	.221	.325	.435	.506	.573	.624	.665	.698

Table 224

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.062	.180	.409	.626	.767	.851	.900	.926	.938	.945	.954
.01	.066	.169	.399	.620	.764	.853	.899	.925	.938	.947	.952
.02	.066	.169	.399	.620	.761	.855	.897	.925	.938	.949	.953
.03	.065	.169	.398	.618	.762	.852	.898	.926	.940	.949	.953
.04	.067	.168	.397	.611	.761	.847	.901	.925	.941	.949	.954
.05	.064	.162	.388	.613	.761	.847	.899	.926	.940	.950	.954
.06	.067	.162	.389	.608	.759	.847	.898	.926	.940	.949	.954
.07	.067	.162	.389	.605	.758	.849	.898	.927	.940	.950	.954
.08	.066	.161	.387	.610	.760	.851	.898	.928	.940	.949	.955
.09	.070	.159	.387	.611	.759	.851	.899	.928	.941	.949	.954
.10	.068	.158	.390	.605	.751	.847	.897	.927	.941	.950	.954
.11	.069	.149	.388	.603	.750	.846	.897	.926	.944	.950	.954
.12	.069	.146	.386	.600	.749	.845	.898	.925	.943	.952	.956

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.051	.260	.562	.780	.893	.943	.966	.976	.982	.984	.986
.01	.045	.252	.546	.772	.892	.944	.965	.977	.981	.984	.985
.02	.045	.251	.544	.772	.883	.943	.965	.977	.981	.985	.986
.03	.045	.249	.543	.772	.883	.944	.966	.977	.982	.985	.986
.04	.046	.248	.542	.762	.883	.939	.966	.976	.982	.985	.986
.05	.045	.238	.521	.764	.882	.939	.966	.977	.982	.985	.986
.06	.047	.236	.523	.755	.883	.939	.965	.976	.983	.985	.986
.07	.046	.230	.520	.753	.881	.939	.964	.978	.982	.985	.987
.08	.046	.230	.521	.748	.882	.941	.964	.977	.982	.985	.987
.09	.036	.223	.522	.750	.882	.940	.966	.977	.983	.984	.986
.10	.035	.222	.509	.741	.868	.939	.963	.976	.982	.985	.986
.11	.035	.212	.508	.740	.866	.937	.963	.976	.983	.985	.987
.12	.036	.210	.505	.737	.866	.938	.964	.976	.983	.985	.987

Table 225

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.042	.150	.321	.485	.618	.713	.774	.808	.833	.861
.01	.009	.039	.144	.314	.482	.617	.711	.773	.809	.840	.860
.02	.009	.039	.145	.317	.476	.618	.710	.774	.809	.841	.860
.03	.009	.039	.144	.317	.475	.619	.709	.774	.814	.843	.859
.04	.009	.038	.147	.307	.477	.607	.711	.775	.812	.843	.860
.05	.009	.036	.139	.307	.475	.607	.711	.773	.812	.841	.860
.06	.009	.036	.139	.303	.478	.605	.710	.770	.813	.840	.862
.07	.009	.037	.137	.299	.473	.606	.701	.777	.815	.841	.861
.08	.009	.035	.140	.307	.472	.611	.703	.775	.813	.842	.860
.09	.010	.034	.139	.307	.475	.613	.703	.775	.816	.839	.860
.10	.010	.034	.139	.301	.457	.604	.702	.772	.813	.844	.861
.11	.010	.031	.139	.299	.458	.603	.699	.765	.817	.845	.860
.12	.009	.031	.139	.296	.457	.602	.698	.765	.814	.846	.861

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.083	.265	.488	.670	.781	.856	.895	.918	.932	.944
.01	.009	.080	.250	.475	.667	.784	.852	.895	.919	.933	.942
.02	.009	.078	.249	.478	.644	.781	.852	.895	.919	.933	.943
.03	.009	.077	.248	.475	.645	.780	.850	.895	.919	.935	.942
.04	.009	.077	.250	.462	.646	.770	.854	.896	.919	.935	.942
.05	.009	.072	.233	.463	.645	.769	.852	.893	.919	.934	.944
.06	.009	.072	.234	.452	.642	.769	.852	.894	.919	.933	.945
.07	.009	.069	.231	.452	.642	.773	.843	.897	.919	.935	.944
.08	.009	.067	.232	.446	.641	.771	.842	.896	.918	.933	.943
.09	.006	.065	.231	.445	.644	.773	.845	.894	.921	.933	.942
.10	.006	.065	.223	.436	.616	.767	.843	.892	.920	.935	.943
.11	.006	.060	.223	.436	.617	.764	.841	.888	.919	.934	.943
.12	.006	.060	.222	.431	.616	.765	.840	.888	.918	.936	.944

Table 226

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.069	.257	.586	.808	.908	.960	.978	.986	.989	.991	.992
.01	.073	.242	.571	.800	.908	.959	.979	.987	.989	.991	.992
.02	.075	.240	.570	.800	.909	.958	.978	.986	.988	.991	.993
.03	.074	.241	.570	.798	.909	.959	.978	.987	.990	.991	.992
.04	.074	.236	.569	.795	.908	.956	.977	.986	.990	.991	.992
.05	.073	.227	.557	.798	.910	.955	.978	.987	.991	.992	.992
.06	.073	.226	.556	.795	.907	.956	.977	.987	.990	.992	.992
.07	.074	.228	.559	.793	.907	.957	.979	.987	.989	.992	.992
.08	.074	.227	.551	.796	.908	.959	.978	.987	.990	.992	.992
.09	.081	.226	.554	.797	.907	.958	.979	.987	.990	.992	.992
.10	.078	.225	.560	.792	.903	.955	.979	.987	.990	.992	.993
.11	.078	.205	.560	.789	.902	.957	.978	.987	.991	.992	.992
.12	.080	.206	.563	.788	.902	.955	.979	.987	.991	.992	.993

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.052	.357	.742	.926	.979	.993	.997	.998	.998	.999	.999
.01	.044	.346	.721	.921	.979	.993	.997	.998	.999	.999	.999
.02	.045	.345	.724	.920	.976	.993	.997	.998	.998	.999	.999
.03	.044	.337	.723	.918	.976	.993	.996	.998	.999	.999	.999
.04	.044	.335	.721	.915	.975	.992	.997	.998	.999	.999	.999
.05	.045	.320	.699	.915	.975	.992	.997	.998	.999	.999	.999
.06	.043	.319	.701	.909	.976	.992	.997	.998	.999	.999	.999
.07	.045	.311	.700	.909	.976	.992	.997	.998	.999	.999	.999
.08	.044	.308	.697	.904	.975	.992	.997	.998	.999	.999	.999
.09	.032	.301	.699	.906	.975	.993	.997	.998	.999	.999	.999
.10	.032	.300	.684	.899	.970	.992	.997	.998	.999	.999	.999
.11	.032	.281	.682	.898	.970	.993	.997	.998	.999	.999	.999
.12	.034	.282	.685	.897	.970	.992	.997	.998	.999	.999	.999

Table 227

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.015	.101	.347	.609	.777	.883	.930	.955	.964	.970	.975
.01	.016	.092	.330	.599	.776	.882	.930	.955	.964	.972	.975
.02	.016	.092	.329	.600	.777	.881	.928	.954	.963	.971	.975
.03	.016	.091	.332	.599	.777	.883	.929	.955	.967	.973	.975
.04	.016	.089	.328	.590	.775	.875	.928	.955	.967	.973	.975
.05	.017	.085	.317	.595	.781	.873	.929	.955	.967	.973	.975
.06	.017	.084	.316	.590	.776	.876	.930	.957	.966	.973	.976
.07	.017	.085	.321	.589	.776	.876	.930	.957	.966	.973	.976
.08	.016	.085	.314	.594	.778	.878	.928	.956	.966	.973	.976
.09	.019	.083	.316	.594	.778	.880	.929	.957	.966	.974	.976
.10	.018	.083	.320	.587	.767	.872	.930	.957	.966	.973	.976
.11	.018	.074	.320	.582	.767	.876	.929	.956	.970	.974	.976
.12	.018	.074	.323	.582	.768	.872	.930	.955	.970	.975	.978

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.131	.445	.736	.892	.955	.977	.987	.991	.993	.994
.01	.008	.123	.417	.724	.889	.954	.977	.987	.991	.993	.994
.02	.008	.122	.420	.721	.877	.952	.977	.987	.991	.993	.994
.03	.008	.118	.419	.722	.878	.954	.977	.987	.991	.993	.994
.04	.008	.118	.418	.709	.876	.947	.976	.987	.991	.993	.994
.05	.008	.110	.392	.711	.877	.947	.977	.987	.991	.992	.994
.06	.008	.109	.391	.699	.874	.948	.976	.987	.991	.993	.994
.07	.008	.105	.391	.698	.875	.947	.975	.987	.991	.993	.994
.08	.008	.104	.390	.688	.877	.948	.975	.987	.992	.993	.994
.09	.005	.099	.392	.689	.877	.948	.976	.987	.991	.993	.994
.10	.005	.098	.375	.678	.853	.946	.975	.987	.991	.993	.994
.11	.005	.088	.373	.675	.854	.947	.975	.986	.991	.993	.994
.12	.006	.089	.377	.672	.854	.945	.974	.986	.992	.993	.995

Table 228

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.024	.116	.323	.531	.692	.790	.865	.914	.940	.955	.968
.01	.026	.105	.309	.524	.696	.789	.864	.909	.940	.957	.969
.02	.027	.105	.305	.524	.668	.785	.862	.910	.938	.957	.969
.03	.026	.103	.307	.522	.663	.786	.862	.909	.938	.957	.968
.04	.027	.101	.308	.508	.665	.779	.860	.911	.938	.956	.968
.05	.028	.099	.286	.509	.666	.779	.862	.907	.937	.956	.967
.06	.026	.101	.286	.498	.664	.774	.861	.907	.938	.955	.968
.07	.027	.096	.287	.500	.665	.776	.848	.905	.938	.955	.967
.08	.027	.098	.284	.498	.666	.778	.850	.906	.938	.954	.965
.09	.029	.095	.282	.497	.667	.778	.850	.902	.937	.953	.965
.10	.029	.093	.287	.485	.647	.772	.852	.902	.936	.953	.966
.11	.029	.084	.286	.484	.647	.774	.846	.898	.931	.953	.965
.12	.029	.086	.286	.479	.648	.772	.844	.897	.932	.951	.963

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.047	.324	.664	.857	.943	.974	.988	.994	.996	.998	.999
.01	.043	.313	.644	.851	.944	.974	.988	.993	.996	.998	.998
.02	.044	.315	.644	.849	.932	.971	.987	.993	.996	.998	.999
.03	.043	.305	.644	.851	.932	.972	.986	.993	.996	.997	.998
.04	.044	.307	.647	.842	.932	.970	.987	.994	.996	.997	.998
.05	.044	.294	.621	.842	.932	.970	.986	.993	.996	.998	.998
.06	.043	.295	.621	.833	.931	.969	.987	.993	.996	.997	.998
.07	.043	.282	.619	.835	.932	.969	.985	.993	.996	.998	.998
.08	.042	.286	.619	.829	.931	.970	.985	.993	.996	.997	.998
.09	.034	.278	.618	.828	.933	.970	.984	.992	.996	.997	.998
.10	.034	.275	.605	.821	.918	.968	.985	.993	.996	.997	.998
.11	.035	.262	.603	.820	.920	.968	.984	.992	.995	.997	.998
.12	.034	.265	.606	.818	.918	.968	.983	.992	.995	.997	.998

Table 229

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.032	.133	.287	.441	.565	.672	.760	.814	.850	.884
.01	.004	.028	.125	.279	.444	.560	.672	.749	.812	.853	.887
.02	.004	.028	.123	.280	.419	.558	.669	.751	.810	.856	.887
.03	.004	.026	.124	.277	.415	.560	.668	.752	.809	.855	.884
.04	.004	.027	.125	.269	.417	.550	.667	.753	.807	.854	.884
.05	.004	.026	.112	.267	.417	.551	.668	.745	.806	.850	.881
.06	.004	.027	.112	.260	.417	.542	.668	.748	.807	.850	.882
.07	.004	.025	.113	.260	.416	.548	.650	.748	.808	.850	.881
.08	.004	.024	.112	.259	.419	.548	.650	.747	.807	.846	.878
.09	.005	.025	.110	.260	.417	.550	.648	.738	.809	.845	.878
.10	.005	.024	.113	.250	.400	.543	.652	.736	.807	.847	.877
.11	.005	.021	.114	.250	.400	.544	.647	.732	.797	.846	.878
.12	.005	.022	.112	.245	.401	.544	.643	.731	.797	.843	.873

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.119	.382	.634	.805	.888	.935	.962	.975	.982	.988
.01	.008	.115	.363	.623	.807	.888	.936	.959	.974	.982	.988
.02	.008	.115	.362	.625	.779	.882	.932	.959	.974	.982	.988
.03	.008	.111	.363	.622	.776	.883	.932	.961	.972	.982	.987
.04	.008	.111	.364	.611	.779	.874	.931	.961	.973	.981	.987
.05	.008	.104	.340	.612	.779	.876	.933	.958	.973	.982	.986
.06	.008	.105	.342	.597	.778	.874	.932	.958	.973	.981	.986
.07	.008	.099	.341	.602	.777	.875	.925	.957	.973	.981	.986
.08	.008	.100	.338	.591	.778	.876	.925	.958	.973	.981	.985
.09	.006	.097	.337	.589	.779	.876	.925	.956	.972	.981	.985
.10	.006	.095	.326	.577	.751	.871	.925	.956	.973	.979	.986
.11	.006	.089	.327	.578	.750	.871	.922	.953	.969	.980	.985
.12	.006	.090	.325	.573	.750	.869	.921	.953	.970	.979	.986

Table 230

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.068	.303	.652	.846	.936	.971	.988	.995	.998	.999	.999
.01	.074	.272	.624	.840	.935	.971	.988	.995	.998	.999	
.02	.072	.273	.623	.841	.924	.969	.988	.995	.998	.999	.999
.03	.072	.266	.623	.840	.923	.970	.988	.995	.998	.999	.999
.04	.073	.266	.625	.823	.922	.969	.988	.995	.998	.999	.999
.05	.073	.261	.590	.823	.925	.968	.988	.994	.998	.999	.999
.06	.074	.263	.591	.817	.923	.967	.987	.994	.998	.999	.999
.07	.071	.258	.590	.818	.925	.968	.985	.994	.997	.999	.999
.08	.074	.258	.590	.817	.924	.968	.985	.994	.997	.998	.999
.09	.080	.247	.592	.814	.923	.968	.985	.994	.998	.999	.999
.10	.078	.249	.587	.805	.914	.966	.985	.994	.998	.999	.999
.11	.079	.221	.589	.804	.915	.966	.984	.993	.997	.999	.999
.12	.077	.221	.586	.798	.914	.965	.984	.994	.997	.999	.999

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.444	.831	.961	.992	.998	.999				
.01	.043	.430	.812	.956	.992	.998					
.02	.043	.431	.811	.958	.989	.998	.999				
.03	.043	.418	.812	.957	.989	.998	.999				
.04	.043	.417	.814	.952	.989	.997	.999				
.05	.044	.399	.788	.953	.989	.997	.999				
.06	.043	.399	.790	.948	.989	.997	.999				
.07	.042	.388	.789	.949	.989	.997	.999				
.08	.044	.388	.788	.945	.989	.997	.999				
.09	.031	.376	.792	.943	.989	.997	.999				
.10	.032	.378	.773	.939	.985	.997	.999				
.11	.032	.357	.774	.940	.985	.997	.999				
.12	.032	.357	.772	.940	.985	.997	.999				

Table 231

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.019	.149	.451	.698	.845	.916	.960	.982	.990	.995	.997
.01	.021	.129	.423	.690	.845	.917	.960	.980	.990	.995	.997
.02	.021	.130	.422	.691	.824	.913	.960	.979	.990	.994	.997
.03	.020	.125	.421	.689	.824	.914	.960	.980	.990	.994	.997
.04	.021	.126	.423	.665	.821	.912	.958	.979	.989	.995	.997
.05	.021	.123	.390	.665	.825	.912	.960	.979	.990	.994	.997
.06	.021	.124	.391	.656	.822	.910	.959	.979	.989	.994	.997
.07	.020	.122	.390	.656	.826	.909	.954	.978	.989	.994	.997
.08	.021	.121	.390	.657	.824	.912	.953	.978	.989	.993	.996
.09	.024	.114	.388	.654	.823	.911	.953	.976	.989	.993	.996
.10	.023	.116	.389	.641	.806	.905	.953	.976	.989	.994	.996
.11	.024	.099	.392	.643	.806	.904	.952	.975	.988	.993	.996
.12	.023	.099	.391	.631	.808	.905	.951	.975	.987	.994	.996

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.199	.596	.854	.954	.984	.994	.998	.999		
.01	.008	.187	.570	.844	.954	.984	.994	.998	.999	.999	
.02	.007	.188	.568	.844	.943	.982	.994	.998	.999	.999	
.03	.008	.180	.568	.845	.943	.982	.994	.998	.999	.999	
.04	.008	.179	.571	.833	.941	.981	.993	.997	.999	.999	
.05	.008	.168	.538	.834	.943	.980	.994	.997	.999	.999	
.06	.009	.169	.539	.823	.943	.981	.994	.997	.999	.999	
.07	.008	.161	.539	.823	.943	.981	.992	.997	.999	.999	
.08	.008	.161	.538	.814	.943	.981	.992	.997	.999	.999	
.09	.005	.154	.538	.810	.942	.981	.993	.997	.999	.999	
.10	.005	.156	.517	.804	.927	.979	.993	.998	.999	.999	
.11	.005	.142	.519	.804	.928	.979	.992	.997	.999	.999	
.12	.005	.141	.517	.801	.928	.979	.992	.997	.999	.999	

Table 232

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.056	.401	.839	.965	.993	.999					
.01	.062	.375	.825	.964	.992	.999					
.02	.061	.373	.826	.963	.992	.999					
.03	.061	.362	.827	.962	.993	.999					
.04	.061	.360	.825	.964	.992	.998					
.05	.061	.349	.807	.964	.993	.999					
.06	.061	.349	.809	.964	.993	.999					
.07	.062	.354	.811	.964	.993	.998					
.08	.061	.353	.809	.963	.992	.999					
.09	.069	.351	.809	.964	.993	.999					
.10	.070	.350	.816	.961	.992	.998					
.11	.071	.304	.817	.962	.992	.999					
.12	.071	.306	.817	.962	.992	.998					

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.595	.960	.998							
.01	.042	.579	.952	.998							
.02	.042	.577	.951	.998							
.03	.041	.563	.951	.998							
.04	.041	.563	.952	.998							
.05	.041	.536	.939	.998							
.06	.040	.537	.940	.997							
.07	.041	.519	.941	.997							
.08	.042	.519	.940	.997							
.09	.026	.505	.941	.997							
.10	.027	.505	.930	.996							
.11	.026	.473	.929	.996							
.12	.025	.474	.931	.996							

Table 233

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.006	.133	.563	.853	.953	.988	.997	.998	.999	.999	
.01	.007	.120	.540	.845	.952	.988	.996	.998	.999	.999	.999
.02	.006	.118	.539	.843	.955	.987	.996	.998	.999	.999	.999
.03	.006	.113	.538	.843	.954	.988	.996	.998	.999	.999	.999
.04	.006	.112	.540	.847	.954	.985	.996	.999	.999	.999	.999
.05	.006	.106	.516	.846	.954	.986	.996	.999	.999	.999	.999
.06	.007	.108	.516	.849	.955	.987	.996	.999	.999	.999	.999
.07	.006	.109	.519	.848	.956	.987	.997	.999	.999	.999	.999
.08	.006	.109	.515	.847	.954	.988	.997	.999	.999	.999	.999
.09	.008	.109	.518	.848	.955	.988	.997	.999	.999	.999	.999
.10	.008	.109	.528	.835	.953	.986	.997	.999	.999	.999	
.11	.008	.088	.530	.838	.953	.986	.996	.999	.999	.999	.999
.12	.008	.088	.531	.839	.952	.985	.997	.998	.999	.999	.999

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.306	.833	.983	.999						
.01	.008	.290	.811	.981	.999						
.02	.008	.291	.810	.981	.998						
.03	.007	.280	.811	.980	.998						
.04	.007	.277	.810	.978	.998						
.05	.007	.254	.781	.978	.998						
.06	.008	.254	.781	.975	.998						
.07	.008	.240	.782	.975	.998						
.08	.007	.242	.780	.973	.998						
.09	.004	.231	.782	.973	.998						
.10	.004	.229	.757	.971	.997						
.11	.004	.207	.759	.970	.997						
.12	.004	.208	.759	.968	.997						

Table 234

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.042	.349	.762	.930	.982	.994	.998				
.01	.047	.301	.727	.928	.981	.994	.999				
.02	.047	.297	.729	.926	.975	.994	.999				
.03	.047	.289	.729	.927	.976	.994	.998				
.04	.047	.288	.728	.909	.976	.993	.998				
.05	.048	.293	.690	.908	.976	.994	.999				
.06	.047	.294	.692	.908	.976	.993	.998	.999			
.07	.047	.293	.690	.908	.975	.993	.998	.999			
.08	.048	.291	.692	.909	.975	.993	.998				
.09	.055	.270	.691	.907	.976	.993	.998	.999			
.10	.054	.268	.688	.898	.971	.993	.998	.999			
.11	.054	.229	.687	.900	.972	.993	.998	.999			
.12	.054	.229	.692	.891	.972	.993	.998	.999			

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.587	.942	.995							
.01	.042	.568	.932	.994							
.02	.041	.566	.931	.994	.999						
.03	.041	.553	.932	.994	.999						
.04	.042	.554	.931	.993	.999						
.05	.043	.528	.916	.993							
.06	.041	.531	.917	.992	.999						
.07	.041	.515	.917	.992	.999						
.08	.042	.516	.918	.991	.999						
.09	.029	.499	.916	.991	.999						
.10	.029	.499	.905	.990	.999						
.11	.028	.474	.905	.990	.999						
.12	.027	.474	.906	.989	.999						

Table 235

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.155	.536	.807	.929	.972	.990	.997	.999	.999	
.01	.009	.122	.495	.799	.929	.972	.991	.997	.999		
.02	.009	.123	.500	.796	.912	.971	.991	.997	.999		
.03	.009	.117	.495	.800	.913	.971	.991	.997	.999		
.04	.009	.117	.495	.771	.915	.970	.990	.997	.999		
.05	.009	.119	.455	.770	.914	.971	.991	.997	.999	.999	
.06	.008	.120	.455	.765	.913	.967	.991	.997	.999		
.07	.008	.119	.453	.766	.912	.967	.989	.996	.999		
.08	.009	.117	.456	.767	.912	.970	.988	.996	.999	.999	
.09	.011	.106	.452	.765	.913	.969	.988	.996	.999	.999	
.10	.011	.107	.455	.749	.903	.966	.989	.996	.999	.999	
.11	.011	.086	.453	.752	.904	.966	.988	.996	.999		
.12	.010	.087	.456	.737	.904	.965	.987	.996	.998		

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.313	.806	.969	.996	.999					
.01	.008	.297	.783	.966	.996	.999					
.02	.008	.297	.784	.965	.994	.999					
.03	.008	.285	.782	.966	.994	.999					
.04	.007	.285	.783	.961	.995	.999					
.05	.007	.263	.752	.960	.995	.999					
.06	.008	.264	.753	.957	.994	.999					
.07	.007	.253	.752	.958	.994	.999					
.08	.008	.253	.755	.952	.994	.999					
.09	.005	.242	.754	.952	.994	.999					
.10	.005	.240	.729	.947	.991	.999					
.11	.004	.221	.727	.948	.992	.999					
.12	.004	.221	.733	.946	.991	.999					

Table 236

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.041	.486	.894	.985	.998						
.01	.047	.408	.866	.985	.998						
.02	.047	.406	.866	.983	.997						
.03	.047	.389	.865	.983	.997						
.04	.047	.392	.868	.975	.997						
.05	.047	.404	.839	.975	.997						
.06	.047	.404	.838	.975	.997						
.07	.048	.409	.839	.975	.997	.999					
.08	.046	.413	.839	.976	.997						
.09	.058	.376	.836	.977	.997						
.10	.057	.375	.833	.971	.996						
.11	.057	.302	.833	.971	.996						
.12	.058	.302	.831	.966	.996						

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.727	.988								
.01	.039	.712	.984								
.02	.039	.711	.984								
.03	.039	.698	.984								
.04	.040	.695	.983								
.05	.040	.663	.979	.999							
.06	.040	.664	.978	.999							
.07	.040	.649	.978	.999							
.08	.038	.651	.978	.999							
.09	.024	.634	.978	.999							
.10	.024	.634	.973	.999							
.11	.025	.602	.974	.999							
.12	.024	.600	.973	.999							

Table 237

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.290	.771	.953	.991	.998					
.01	.012	.227	.728	.949	.991	.998					
.02	.012	.223	.725	.948	.987	.998					
.03	.012	.212	.725	.947	.988	.998					
.04	.013	.214	.729	.928	.987	.998					
.05	.012	.224	.689	.930	.987	.998					
.06	.012	.225	.685	.930	.987	.998					
.07	.013	.230	.687	.930	.988	.998					
.08	.012	.230	.688	.932	.987	.998					
.09	.017	.206	.685	.933	.987	.998					
.10	.016	.206	.682	.920	.985	.998					
.11	.016	.154	.682	.922	.984	.998	.999				
.12	.017	.152	.681	.911	.985	.998	.999				

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.464	.941	.997							
.01	.007	.446	.926	.996							
.02	.007	.444	.925	.996							
.03	.007	.429	.926	.996							
.04	.008	.431	.928	.996							
.05	.007	.396	.909	.996							
.06	.007	.395	.907	.995							
.07	.008	.381	.909	.995							
.08	.007	.380	.908	.994							
.09	.004	.362	.905	.994							
.10	.004	.365	.893	.993							
.11	.004	.332	.894	.993							
.12	.004	.332	.892	.993							

Table 238

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.668	.971	.998							
.01	.059	.560	.955	.998							
.02	.059	.561	.954	.998							
.03	.059	.536	.954	.998							
.04	.059	.537	.955	.996							
.05	.060	.572	.943	.996							
.06	.060	.566	.942	.997							
.07	.058	.579	.943	.997							
.08	.060	.581	.943	.997							
.09	.075	.537	.942	.997							
.10	.076	.535	.935	.995							
.11	.076	.421	.936	.995							
.12	.075	.423	.937	.994							

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.846	.998								
.01	.037	.829	.998								
.02	.038	.830	.998								
.03	.038	.816	.998								
.04	.037	.815	.998								
.05	.039	.791	.996								
.06	.038	.789	.997								
.07	.038	.774	.996								
.08	.038	.776	.996								
.09	.022	.758	.996								
.10	.022	.756	.995								
.11	.021	.723	.995								
.12	.023	.725	.995								

Table 239

Power Rates For One-Tailed Directional Test For Multi-Modal Lumpy Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.446	.906	.991	.999						
.01	.014	.333	.873	.991	.999						
.02	.014	.334	.872	.991	.999						
.03	.014	.316	.871	.991	.999						
.04	.014	.316	.871	.983	.999						
.05	.014	.348	.846	.983	.999						
.06	.014	.344	.844	.985	.999						
.07	.014	.358	.845	.985	.999						
.08	.013	.359	.846	.986	.999						
.09	.019	.317	.844	.985	.999						
.10	.020	.315	.834	.981	.998						
.11	.019	.221	.833	.981	.998						
.12	.019	.221	.836	.976	.999						

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.630	.987								
.01	.007	.606	.985								
.02	.007	.604	.984								
.03	.007	.582	.983								
.04	.007	.586	.984								
.05	.007	.550	.978								
.06	.007	.547	.977								
.07	.007	.527	.977								
.08	.007	.528	.978								
.09	.004	.505	.977								
.10	.004	.505	.971								
.11	.004	.463	.971								
.12	.004	.464	.970	.999							

Table 240

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.074	.093	.120	.152	.186	.221	.247	.280	.304	.325	.350
.01	.079	.095	.122	.153	.185	.220	.250	.281	.304	.324	.349
.02	.082	.094	.119	.154	.187	.220	.250	.274	.303	.321	.349
.03	.080	.092	.121	.155	.185	.219	.249	.276	.304	.322	.346
.04	.080	.093	.121	.152	.187	.219	.246	.275	.301	.330	.350
.05	.080	.093	.119	.153	.185	.218	.249	.277	.304	.331	.347
.06	.079	.092	.118	.153	.185	.219	.247	.276	.304	.330	.350
.07	.081	.093	.120	.152	.185	.220	.248	.273	.304	.331	.346
.08	.079	.094	.120	.154	.183	.216	.247	.273	.302	.332	.346
.09	.082	.093	.119	.151	.185	.217	.249	.276	.300	.333	.348
.10	.081	.093	.121	.154	.186	.218	.250	.274	.301	.330	.349
.11	.080	.093	.119	.153	.186	.216	.250	.275	.300	.332	.347
.12	.079	.093	.118	.152	.184	.216	.248	.279	.302	.332	.348

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.038	.085	.129	.170	.213	.255	.286	.323	.349	.373	.404
.01	.047	.087	.131	.171	.212	.255	.286	.324	.347	.373	.401
.02	.049	.087	.129	.173	.214	.254	.289	.315	.349	.370	.403
.03	.049	.084	.130	.174	.211	.253	.287	.319	.349	.369	.399
.04	.049	.088	.130	.171	.216	.254	.284	.316	.346	.384	.402
.05	.047	.086	.129	.172	.213	.255	.287	.318	.349	.385	.400
.06	.048	.086	.127	.172	.213	.253	.285	.316	.349	.384	.402
.07	.050	.086	.128	.172	.214	.255	.285	.314	.350	.383	.399
.08	.047	.086	.128	.174	.212	.252	.284	.315	.352	.385	.397
.09	.049	.086	.128	.171	.213	.253	.288	.317	.349	.384	.400
.10	.048	.086	.129	.175	.213	.250	.288	.315	.352	.382	.404
.11	.048	.085	.128	.173	.214	.249	.288	.317	.349	.384	.404
.12	.048	.086	.127	.174	.212	.250	.288	.326	.352	.384	.404

Table 241

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.014	.020	.030	.044	.060	.075	.091	.109	.125	.139	.157
.01	.015	.021	.031	.044	.059	.075	.092	.110	.125	.141	.158
.02	.017	.021	.030	.045	.059	.075	.093	.107	.127	.139	.158
.03	.016	.020	.030	.044	.058	.074	.091	.107	.126	.139	.155
.04	.016	.021	.031	.045	.060	.076	.090	.107	.124	.144	.160
.05	.016	.021	.030	.044	.059	.075	.091	.107	.128	.144	.156
.06	.016	.020	.031	.044	.058	.075	.090	.108	.128	.144	.157
.07	.016	.021	.030	.045	.059	.076	.090	.106	.126	.145	.157
.08	.016	.020	.031	.044	.058	.075	.092	.105	.125	.146	.157
.09	.016	.021	.030	.042	.057	.074	.091	.107	.121	.146	.158
.10	.016	.021	.030	.045	.059	.076	.090	.106	.124	.144	.157
.11	.016	.021	.030	.044	.058	.074	.092	.108	.122	.145	.158
.12	.016	.021	.030	.044	.057	.075	.090	.111	.124	.145	.158

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.002	.008	.014	.021	.031	.036	.044	.055	.063	.069	.077
.01	.004	.008	.014	.021	.030	.037	.046	.055	.063	.071	.078
.02	.004	.009	.013	.021	.030	.037	.047	.053	.064	.070	.079
.03	.004	.008	.013	.021	.030	.037	.045	.052	.064	.071	.077
.04	.004	.009	.014	.021	.028	.037	.044	.053	.062	.070	.078
.05	.004	.008	.013	.020	.027	.037	.045	.053	.063	.072	.076
.06	.004	.008	.013	.021	.028	.037	.043	.053	.064	.070	.077
.07	.004	.008	.014	.021	.028	.037	.043	.052	.063	.072	.078
.08	.003	.008	.013	.020	.027	.035	.044	.052	.059	.072	.078
.09	.004	.008	.013	.020	.026	.036	.043	.053	.058	.070	.078
.10	.004	.008	.013	.021	.026	.036	.043	.052	.058	.070	.075
.11	.004	.008	.013	.020	.027	.035	.044	.051	.058	.070	.076
.12	.004	.008	.013	.020	.027	.034	.044	.052	.059	.070	.077

Table 242

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.030	.045	.071	.110	.150	.195	.246	.287	.336	.374	.414
.01	.034	.044	.070	.108	.152	.193	.246	.285	.332	.373	.412
.02	.033	.044	.070	.108	.150	.193	.247	.290	.334	.372	.412
.03	.033	.044	.070	.109	.152	.191	.244	.290	.335	.371	.413
.04	.033	.045	.071	.109	.148	.196	.249	.293	.335	.377	.413
.05	.033	.044	.070	.110	.148	.193	.245	.290	.334	.375	.411
.06	.033	.045	.069	.110	.150	.193	.243	.289	.334	.379	.415
.07	.034	.045	.069	.109	.149	.190	.241	.288	.339	.376	.413
.08	.034	.045	.069	.104	.149	.192	.243	.290	.327	.376	.415
.09	.033	.045	.070	.105	.149	.190	.242	.290	.328	.376	.410
.10	.034	.045	.070	.105	.148	.197	.242	.289	.330	.377	.411
.11	.033	.044	.071	.107	.149	.197	.243	.289	.330	.373	.412
.12	.033	.043	.070	.107	.147	.198	.243	.290	.329	.377	.412

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.123	.193	.272	.350	.429	.491	.553	.597	.631	.675
.01	.059	.120	.194	.271	.352	.429	.490	.551	.595	.628	.673
.02	.058	.121	.191	.271	.349	.426	.491	.541	.598	.629	.675
.03	.058	.119	.192	.266	.354	.426	.490	.542	.597	.629	.674
.04	.059	.122	.194	.270	.346	.430	.493	.543	.596	.648	.672
.05	.060	.120	.191	.270	.348	.425	.491	.539	.595	.645	.675
.06	.059	.119	.191	.269	.347	.424	.488	.539	.596	.648	.675
.07	.060	.117	.191	.268	.352	.424	.484	.535	.598	.646	.672
.08	.061	.116	.191	.273	.347	.423	.486	.536	.592	.647	.677
.09	.059	.117	.192	.273	.348	.420	.485	.537	.590	.645	.672
.10	.059	.117	.191	.274	.348	.415	.484	.536	.591	.643	.673
.11	.060	.117	.193	.274	.348	.416	.488	.537	.591	.641	.671
.12	.058	.116	.192	.276	.347	.415	.490	.552	.590	.644	.671

Table 243

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.030	.045	.071	.110	.150	.195	.246	.287	.336	.374	.414
.01	.034	.044	.070	.108	.152	.193	.246	.285	.332	.373	.412
.02	.033	.044	.070	.108	.150	.193	.247	.290	.334	.372	.412
.03	.033	.044	.070	.109	.152	.191	.244	.290	.335	.371	.413
.04	.033	.045	.071	.109	.148	.196	.249	.293	.335	.377	.413
.05	.033	.044	.070	.110	.148	.193	.245	.290	.334	.375	.411
.06	.033	.045	.069	.110	.150	.193	.243	.289	.334	.379	.415
.07	.034	.045	.069	.109	.149	.190	.241	.288	.339	.376	.413
.08	.034	.045	.069	.104	.149	.192	.243	.290	.327	.376	.415
.09	.033	.045	.070	.105	.149	.190	.242	.290	.328	.376	.410
.10	.034	.045	.070	.105	.148	.197	.242	.289	.330	.377	.411
.11	.033	.044	.071	.107	.149	.197	.243	.289	.330	.373	.412
.12	.033	.043	.070	.107	.147	.198	.243	.290	.329	.377	.412

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.024	.043	.068	.099	.138	.169	.210	.239	.267	.308
.01	.010	.023	.043	.067	.100	.137	.169	.210	.237	.263	.308
.02	.010	.024	.042	.068	.099	.135	.170	.200	.237	.264	.306
.03	.010	.023	.042	.066	.100	.135	.166	.199	.239	.263	.308
.04	.010	.024	.043	.067	.096	.138	.170	.200	.240	.286	.306
.05	.010	.023	.043	.067	.097	.134	.168	.197	.238	.283	.307
.06	.010	.024	.041	.068	.099	.134	.166	.197	.239	.285	.310
.07	.010	.023	.042	.067	.097	.132	.166	.196	.241	.284	.307
.08	.010	.022	.041	.069	.098	.134	.166	.194	.237	.284	.308
.09	.010	.023	.042	.070	.096	.132	.166	.195	.235	.283	.308
.10	.010	.022	.042	.069	.097	.127	.166	.197	.236	.283	.304
.11	.010	.023	.043	.071	.099	.126	.167	.193	.234	.280	.307
.12	.010	.022	.043	.071	.097	.127	.167	.210	.236	.282	.304

Table 244

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.020	.036	.063	.102	.145	.195	.242	.298	.339	.376	.421
.01	.024	.035	.064	.103	.146	.195	.243	.296	.340	.376	.423
.02	.024	.035	.063	.102	.147	.193	.245	.287	.342	.379	.423
.03	.023	.036	.062	.105	.146	.192	.243	.292	.341	.374	.425
.04	.024	.035	.064	.105	.146	.193	.246	.289	.338	.392	.425
.05	.024	.037	.063	.103	.146	.191	.245	.290	.339	.391	.420
.06	.024	.035	.062	.105	.147	.194	.243	.288	.341	.393	.419
.07	.024	.036	.063	.103	.144	.194	.243	.289	.341	.392	.419
.08	.024	.036	.064	.101	.146	.193	.241	.290	.336	.392	.421
.09	.024	.036	.064	.101	.147	.193	.244	.289	.339	.391	.423
.10	.024	.037	.064	.099	.145	.197	.242	.286	.340	.396	.423
.11	.024	.037	.063	.102	.145	.195	.242	.290	.335	.392	.423
.12	.025	.036	.062	.100	.145	.194	.244	.299	.335	.389	.421

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.044	.115	.207	.302	.397	.492	.558	.630	.672	.706	.753
.01	.045	.115	.204	.301	.399	.492	.563	.628	.674	.705	.753
.02	.044	.114	.203	.302	.399	.496	.559	.613	.672	.707	.754
.03	.045	.116	.202	.300	.402	.491	.555	.614	.675	.702	.754
.04	.045	.116	.204	.302	.396	.493	.559	.614	.672	.729	.754
.05	.043	.116	.203	.302	.397	.485	.558	.613	.672	.728	.753
.06	.044	.115	.203	.302	.397	.491	.554	.612	.673	.730	.753
.07	.045	.112	.205	.299	.397	.488	.556	.608	.673	.729	.752
.08	.044	.112	.202	.307	.397	.487	.556	.612	.667	.731	.755
.09	.044	.112	.204	.309	.398	.489	.557	.606	.672	.727	.754
.10	.045	.112	.205	.307	.396	.475	.555	.607	.671	.729	.751
.11	.045	.113	.204	.308	.398	.473	.554	.611	.670	.727	.752
.12	.044	.110	.202	.307	.396	.473	.556	.629	.667	.727	.751

Table 245

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.020	.036	.063	.102	.145	.195	.242	.298	.339	.376	.421
.01	.024	.035	.064	.103	.146	.195	.243	.296	.340	.376	.423
.02	.024	.035	.063	.102	.147	.193	.245	.287	.342	.379	.423
.03	.023	.036	.062	.105	.146	.192	.243	.292	.341	.374	.425
.04	.024	.035	.064	.105	.146	.193	.246	.289	.338	.392	.425
.05	.024	.037	.063	.103	.146	.191	.245	.290	.339	.391	.420
.06	.024	.035	.062	.105	.147	.194	.243	.288	.341	.393	.419
.07	.024	.036	.063	.103	.144	.194	.243	.289	.341	.392	.419
.08	.024	.036	.064	.101	.146	.193	.241	.290	.336	.392	.421
.09	.024	.036	.064	.101	.147	.193	.244	.289	.339	.391	.423
.10	.024	.037	.064	.099	.145	.197	.242	.286	.340	.396	.423
.11	.024	.037	.063	.102	.145	.195	.242	.290	.335	.392	.423
.12	.025	.036	.062	.100	.145	.194	.244	.299	.335	.389	.421

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.025	.057	.097	.147	.209	.259	.320	.365	.400	.459
.01	.008	.025	.056	.097	.150	.209	.261	.320	.364	.399	.460
.02	.007	.025	.055	.097	.150	.209	.258	.305	.367	.402	.457
.03	.007	.025	.055	.098	.149	.208	.257	.310	.366	.398	.460
.04	.008	.025	.056	.097	.147	.208	.260	.306	.361	.427	.458
.05	.007	.025	.055	.096	.148	.205	.260	.306	.363	.426	.457
.06	.007	.025	.054	.097	.149	.207	.258	.307	.366	.427	.456
.07	.008	.024	.055	.096	.146	.207	.257	.304	.364	.428	.455
.08	.007	.024	.056	.100	.148	.206	.254	.306	.361	.425	.458
.09	.007	.024	.055	.102	.149	.206	.259	.303	.363	.425	.457
.10	.008	.024	.055	.101	.148	.200	.258	.302	.363	.428	.455
.11	.007	.026	.054	.101	.148	.198	.256	.306	.361	.427	.453
.12	.008	.023	.054	.099	.147	.198	.258	.322	.361	.420	.453

Table 246

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.060	.097	.190	.309	.417	.514	.629	.704	.772	.820	.858
.01	.068	.100	.189	.309	.414	.515	.633	.703	.774	.819	.855
.02	.066	.101	.186	.310	.417	.515	.632	.708	.775	.820	.856
.03	.067	.100	.185	.314	.415	.516	.629	.710	.775	.817	.855
.04	.067	.100	.185	.316	.415	.515	.631	.711	.773	.822	.855
.05	.069	.102	.185	.314	.416	.519	.632	.711	.774	.823	.854
.06	.069	.100	.188	.316	.415	.518	.624	.711	.774	.824	.856
.07	.068	.108	.187	.317	.417	.518	.623	.712	.775	.823	.857
.08	.067	.107	.186	.287	.415	.520	.626	.712	.765	.825	.856
.09	.066	.109	.189	.289	.419	.517	.628	.712	.766	.822	.857
.10	.068	.109	.184	.288	.415	.544	.624	.711	.768	.824	.856
.11	.067	.109	.185	.289	.414	.541	.625	.711	.767	.823	.858
.12	.067	.109	.186	.287	.415	.540	.626	.706	.764	.823	.856

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.157	.295	.445	.591	.717	.796	.862	.896	.921	.947
.01	.049	.152	.294	.445	.591	.718	.796	.862	.898	.921	.945
.02	.050	.155	.288	.447	.592	.717	.796	.849	.897	.921	.944
.03	.049	.153	.289	.438	.594	.716	.795	.849	.896	.921	.945
.04	.051	.153	.287	.440	.590	.717	.795	.851	.898	.932	.945
.05	.051	.155	.289	.441	.590	.711	.796	.850	.897	.932	.944
.06	.052	.153	.291	.440	.589	.709	.792	.849	.897	.933	.947
.07	.050	.141	.289	.441	.588	.712	.788	.844	.897	.932	.946
.08	.050	.139	.288	.456	.592	.711	.791	.844	.893	.932	.947
.09	.049	.141	.291	.457	.592	.709	.789	.845	.894	.928	.946
.10	.051	.141	.286	.455	.588	.695	.790	.845	.893	.928	.943
.11	.051	.142	.289	.457	.587	.693	.789	.844	.892	.927	.945
.12	.050	.140	.289	.455	.588	.692	.791	.858	.891	.928	.943

Table 247

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.017	.046	.096	.153	.219	.317	.387	.475	.545	.604
.01	.009	.018	.046	.095	.153	.221	.317	.386	.478	.545	.605
.02	.009	.018	.045	.097	.155	.218	.319	.400	.477	.544	.605
.03	.009	.017	.045	.098	.155	.222	.317	.402	.476	.544	.605
.04	.009	.018	.045	.097	.153	.220	.318	.400	.476	.543	.603
.05	.009	.018	.045	.100	.153	.223	.320	.400	.476	.544	.602
.06	.009	.018	.044	.100	.153	.220	.311	.402	.478	.544	.605
.07	.009	.019	.044	.100	.153	.219	.308	.402	.476	.542	.605
.08	.009	.020	.044	.087	.153	.221	.313	.402	.464	.545	.604
.09	.009	.020	.045	.086	.154	.218	.312	.404	.468	.543	.601
.10	.009	.020	.045	.086	.154	.245	.311	.404	.468	.545	.603
.11	.009	.020	.045	.086	.152	.242	.310	.404	.469	.543	.601
.12	.009	.020	.045	.086	.151	.240	.313	.392	.463	.544	.602

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.043	.098	.180	.289	.413	.505	.611	.671	.722	.788
.01	.010	.041	.100	.180	.287	.413	.506	.608	.672	.722	.785
.02	.010	.042	.096	.181	.288	.415	.506	.583	.673	.721	.784
.03	.010	.041	.097	.177	.287	.412	.503	.583	.671	.722	.785
.04	.010	.040	.097	.174	.287	.412	.506	.586	.671	.752	.785
.05	.010	.042	.096	.178	.285	.405	.506	.584	.672	.752	.784
.06	.010	.041	.097	.180	.286	.404	.499	.583	.674	.753	.786
.07	.010	.036	.097	.178	.288	.405	.498	.575	.671	.752	.787
.08	.010	.036	.097	.191	.287	.407	.498	.575	.665	.752	.787
.09	.010	.036	.097	.191	.288	.404	.499	.575	.665	.742	.786
.10	.010	.036	.095	.190	.286	.385	.499	.575	.665	.743	.780
.11	.010	.037	.096	.192	.286	.381	.497	.575	.664	.744	.782
.12	.010	.036	.095	.190	.285	.381	.500	.606	.661	.742	.781

Table 248

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.068	.120	.266	.448	.588	.698	.815	.871	.921	.947	.965
.01	.076	.126	.266	.449	.584	.691	.817	.873	.922	.946	.965
.02	.074	.124	.262	.449	.586	.698	.814	.881	.923	.947	.965
.03	.075	.126	.261	.457	.586	.696	.813	.879	.924	.947	.964
.04	.074	.125	.262	.459	.585	.696	.813	.880	.923	.949	.964
.05	.074	.125	.260	.458	.582	.698	.815	.879	.925	.950	.965
.06	.077	.125	.262	.461	.581	.698	.808	.882	.922	.951	.966
.07	.074	.144	.265	.459	.584	.699	.807	.882	.921	.949	.965
.08	.076	.146	.260	.405	.581	.697	.807	.883	.919	.949	.965
.09	.076	.145	.260	.403	.582	.698	.807	.881	.916	.948	.964
.10	.075	.146	.264	.408	.583	.733	.806	.882	.918	.950	.964
.11	.076	.146	.261	.408	.582	.731	.808	.882	.917	.949	.964
.12	.076	.144	.259	.407	.582	.734	.806	.876	.918	.949	.964

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.203	.408	.609	.779	.884	.937	.969	.981	.989	.994
.01	.050	.197	.405	.610	.776	.883	.937	.969	.982	.989	.995
.02	.049	.196	.402	.609	.777	.887	.935	.962	.982	.989	.994
.03	.049	.199	.397	.601	.778	.886	.935	.963	.982	.988	.994
.04	.051	.196	.398	.601	.775	.885	.936	.963	.983	.990	.994
.05	.050	.197	.399	.598	.772	.879	.935	.962	.982	.992	.995
.06	.050	.198	.399	.603	.772	.879	.932	.964	.982	.991	.994
.07	.050	.174	.400	.600	.773	.878	.932	.961	.982	.991	.994
.08	.051	.175	.398	.623	.770	.878	.933	.960	.980	.991	.995
.09	.051	.177	.398	.621	.772	.880	.933	.961	.980	.990	.994
.10	.050	.177	.401	.625	.772	.865	.932	.961	.981	.990	.993
.11	.050	.176	.397	.624	.771	.866	.931	.961	.980	.991	.993
.12	.051	.175	.395	.626	.772	.865	.931	.967	.980	.990	.993

Table 249

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.014	.034	.106	.225	.345	.456	.611	.693	.790	.845	.885
.01	.017	.037	.105	.227	.341	.452	.613	.695	.790	.843	.885
.02	.016	.036	.105	.227	.343	.456	.611	.714	.790	.844	.884
.03	.016	.037	.103	.234	.343	.455	.611	.714	.792	.846	.886
.04	.017	.036	.103	.237	.338	.454	.611	.715	.789	.843	.885
.05	.016	.037	.105	.234	.339	.460	.612	.713	.793	.847	.885
.06	.018	.036	.103	.237	.338	.460	.600	.713	.788	.847	.888
.07	.016	.045	.105	.235	.338	.460	.599	.716	.788	.847	.886
.08	.017	.045	.104	.195	.337	.456	.600	.718	.781	.846	.887
.09	.017	.046	.103	.193	.338	.460	.598	.716	.780	.843	.886
.10	.016	.046	.104	.196	.341	.502	.598	.715	.780	.845	.884
.11	.017	.045	.104	.196	.338	.500	.599	.716	.781	.848	.884
.12	.016	.046	.103	.195	.338	.504	.598	.700	.780	.846	.885

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.060	.159	.305	.486	.654	.758	.851	.895	.925	.957
.01	.010	.057	.159	.306	.482	.651	.759	.850	.897	.924	.956
.02	.009	.057	.154	.306	.484	.656	.755	.830	.895	.926	.955
.03	.009	.057	.153	.296	.484	.656	.756	.830	.898	.924	.956
.04	.010	.057	.153	.298	.478	.653	.758	.830	.897	.941	.956
.05	.009	.057	.154	.295	.479	.640	.755	.830	.898	.942	.956
.06	.010	.056	.154	.299	.477	.640	.750	.829	.896	.939	.956
.07	.009	.047	.155	.298	.478	.642	.749	.823	.896	.941	.956
.08	.010	.047	.152	.321	.476	.639	.749	.823	.891	.941	.956
.09	.010	.048	.153	.320	.476	.642	.749	.822	.890	.935	.956
.10	.010	.048	.155	.322	.478	.611	.749	.823	.890	.936	.952
.11	.010	.048	.155	.323	.478	.609	.749	.823	.891	.939	.952
.12	.010	.048	.153	.324	.478	.612	.747	.846	.891	.936	.952

Table 250

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.024	.049	.122	.227	.321	.418	.521	.621	.682	.731	.780
.01	.027	.052	.123	.226	.321	.414	.522	.618	.682	.731	.778
.02	.028	.051	.121	.226	.320	.420	.520	.601	.680	.730	.781
.03	.027	.052	.121	.229	.320	.417	.523	.600	.678	.729	.781
.04	.027	.051	.121	.228	.321	.418	.523	.602	.682	.753	.779
.05	.028	.052	.122	.231	.319	.422	.521	.601	.680	.754	.782
.06	.027	.052	.120	.229	.317	.418	.522	.602	.680	.753	.783
.07	.027	.061	.119	.226	.320	.422	.521	.603	.680	.750	.779
.08	.027	.060	.120	.207	.321	.421	.523	.600	.680	.749	.780
.09	.028	.060	.123	.207	.316	.421	.524	.602	.679	.751	.780
.10	.028	.061	.121	.207	.319	.431	.521	.602	.677	.751	.789
.11	.028	.060	.121	.208	.317	.430	.524	.599	.678	.754	.788
.12	.027	.060	.120	.206	.320	.428	.521	.618	.678	.754	.789

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.047	.188	.367	.547	.699	.814	.868	.921	.944	.956	.974
.01	.049	.184	.368	.545	.697	.813	.870	.921	.942	.956	.973
.02	.049	.183	.361	.546	.694	.812	.870	.907	.943	.956	.974
.03	.048	.182	.364	.538	.697	.813	.871	.908	.943	.956	.974
.04	.048	.183	.363	.538	.696	.813	.871	.908	.943	.967	.973
.05	.049	.185	.365	.539	.694	.806	.870	.908	.943	.967	.975
.06	.049	.186	.363	.538	.692	.805	.866	.906	.942	.966	.974
.07	.049	.173	.362	.536	.697	.808	.866	.904	.942	.967	.973
.08	.049	.172	.363	.561	.697	.808	.867	.904	.942	.967	.974
.09	.049	.170	.366	.562	.692	.806	.869	.904	.942	.964	.974
.10	.049	.173	.363	.562	.697	.787	.867	.903	.941	.966	.973
.11	.049	.172	.364	.561	.695	.785	.866	.903	.941	.966	.972
.12	.049	.168	.364	.562	.694	.785	.867	.922	.942	.965	.971

Table 251

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.003	.010	.035	.079	.132	.194	.275	.364	.429	.488	.549
.01	.004	.011	.035	.080	.132	.192	.277	.361	.428	.489	.548
.02	.004	.011	.034	.078	.131	.194	.274	.347	.430	.489	.552
.03	.004	.011	.034	.082	.131	.192	.279	.350	.426	.490	.552
.04	.004	.010	.035	.081	.131	.195	.277	.349	.428	.510	.550
.05	.004	.011	.033	.081	.130	.196	.276	.349	.428	.511	.553
.06	.004	.011	.035	.082	.131	.194	.276	.349	.426	.509	.553
.07	.004	.013	.034	.079	.130	.195	.273	.348	.429	.510	.549
.08	.004	.013	.033	.070	.129	.195	.276	.347	.425	.509	.549
.09	.005	.013	.034	.070	.130	.195	.276	.351	.427	.509	.550
.10	.004	.014	.034	.071	.129	.207	.275	.350	.426	.508	.560
.11	.004	.013	.034	.071	.130	.207	.275	.347	.425	.512	.560
.12	.005	.014	.034	.070	.131	.205	.274	.361	.425	.509	.561

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.054	.146	.273	.420	.566	.655	.758	.806	.839	.889
.01	.009	.054	.147	.273	.420	.565	.657	.757	.804	.840	.889
.02	.010	.054	.143	.273	.417	.567	.658	.730	.804	.839	.889
.03	.009	.054	.145	.268	.417	.566	.662	.728	.802	.838	.891
.04	.009	.053	.144	.268	.416	.566	.659	.729	.804	.869	.889
.05	.009	.053	.145	.270	.415	.558	.658	.728	.803	.871	.891
.06	.009	.054	.142	.267	.415	.555	.652	.730	.804	.870	.891
.07	.009	.050	.142	.264	.417	.558	.652	.720	.804	.866	.888
.08	.009	.050	.142	.285	.417	.558	.653	.721	.803	.867	.890
.09	.009	.049	.144	.286	.411	.558	.655	.720	.803	.862	.889
.10	.009	.050	.145	.287	.416	.528	.651	.721	.801	.863	.886
.11	.009	.049	.143	.287	.414	.528	.653	.719	.803	.864	.886
.12	.010	.048	.143	.286	.416	.528	.652	.755	.802	.863	.885

Table 252

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.065	.127	.308	.502	.630	.743	.832	.899	.928	.949	.963
.01	.075	.134	.308	.501	.633	.744	.830	.899	.928	.949	.962
.02	.075	.133	.298	.499	.629	.743	.830	.885	.928	.948	.962
.03	.075	.135	.300	.505	.634	.743	.831	.883	.927	.948	.965
.04	.075	.135	.301	.506	.631	.744	.829	.884	.927	.957	.964
.05	.075	.134	.300	.504	.633	.741	.832	.885	.928	.956	.964
.06	.075	.133	.300	.504	.631	.747	.833	.886	.928	.958	.964
.07	.075	.170	.297	.509	.631	.743	.832	.884	.929	.957	.963
.08	.075	.168	.300	.459	.631	.744	.830	.885	.928	.956	.963
.09	.076	.169	.301	.459	.630	.747	.832	.885	.926	.957	.964
.10	.076	.170	.298	.461	.631	.751	.833	.884	.926	.957	.968
.11	.075	.170	.303	.455	.631	.751	.831	.884	.928	.957	.967
.12	.076	.175	.300	.457	.631	.750	.831	.894	.927	.957	.966

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.250	.502	.713	.857	.939	.967	.986	.992	.995	.998
.01	.051	.243	.503	.713	.857	.939	.967	.985	.992	.995	.998
.02	.050	.242	.494	.712	.856	.939	.966	.982	.992	.995	.998
.03	.051	.245	.495	.705	.858	.939	.966	.981	.991	.995	.998
.04	.050	.243	.495	.702	.856	.937	.966	.981	.992	.997	.998
.05	.050	.245	.495	.703	.856	.932	.967	.982	.992	.997	.998
.06	.052	.245	.497	.701	.856	.934	.965	.981	.991	.997	.998
.07	.050	.220	.493	.705	.856	.933	.964	.980	.992	.997	.998
.08	.051	.218	.496	.734	.856	.934	.964	.979	.991	.997	.998
.09	.051	.221	.496	.734	.857	.934	.964	.979	.992	.996	.998
.10	.051	.222	.495	.737	.855	.919	.964	.979	.991	.996	.997
.11	.050	.221	.494	.733	.856	.920	.965	.979	.991	.996	.998
.12	.051	.217	.496	.731	.855	.917	.965	.986	.992	.996	.997

Table 253

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.017	.047	.153	.305	.431	.555	.679	.779	.833	.876	.904
.01	.022	.051	.155	.307	.434	.557	.677	.779	.831	.874	.902
.02	.021	.051	.148	.304	.430	.559	.676	.760	.832	.873	.904
.03	.021	.051	.150	.310	.432	.557	.678	.758	.832	.875	.905
.04	.022	.051	.151	.313	.430	.555	.676	.756	.832	.887	.904
.05	.022	.052	.150	.310	.433	.554	.677	.758	.832	.887	.906
.06	.021	.050	.150	.307	.430	.559	.679	.760	.830	.888	.904
.07	.021	.069	.148	.312	.429	.555	.678	.759	.834	.887	.903
.08	.021	.069	.151	.269	.429	.557	.676	.760	.831	.888	.902
.09	.022	.069	.150	.270	.427	.557	.679	.758	.830	.887	.905
.10	.022	.068	.150	.269	.429	.570	.676	.759	.829	.889	.912
.11	.022	.069	.151	.267	.429	.570	.678	.759	.832	.890	.912
.12	.022	.072	.150	.268	.430	.571	.678	.772	.830	.889	.912

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.085	.241	.443	.638	.798	.873	.932	.954	.968	.984
.01	.009	.082	.242	.446	.640	.798	.870	.931	.955	.968	.984
.02	.009	.082	.236	.444	.637	.798	.870	.916	.954	.967	.984
.03	.010	.081	.238	.434	.642	.798	.872	.914	.954	.968	.984
.04	.010	.082	.238	.432	.638	.798	.871	.915	.955	.978	.984
.05	.010	.083	.236	.432	.639	.784	.872	.916	.954	.978	.984
.06	.010	.081	.238	.430	.639	.790	.866	.917	.954	.978	.984
.07	.009	.072	.235	.435	.636	.786	.863	.909	.956	.979	.984
.08	.010	.070	.239	.467	.639	.787	.863	.909	.954	.978	.984
.09	.010	.071	.237	.465	.637	.788	.865	.910	.953	.975	.984
.10	.010	.072	.238	.470	.636	.756	.866	.910	.953	.976	.982
.11	.010	.073	.237	.465	.638	.757	.865	.909	.953	.976	.983
.12	.010	.070	.237	.467	.637	.756	.866	.932	.953	.976	.982

Table 254

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.055	.128	.399	.685	.821	.908	.971	.986	.996	.998	.999
.01	.064	.146	.401	.685	.823	.908	.971	.986	.995	.998	.999
.02	.065	.145	.392	.685	.825	.910	.970	.988	.995	.998	.999
.03	.064	.146	.391	.701	.827	.908	.970	.988	.995	.998	.999
.04	.063	.144	.392	.701	.823	.907	.971	.988	.995	.998	.999
.05	.063	.145	.392	.698	.820	.907	.970	.988	.996	.998	.999
.06	.064	.146	.394	.699	.822	.908	.964	.988	.996	.998	.999
.07	.064	.204	.391	.700	.823	.909	.964	.988	.995	.998	.999
.08	.064	.207	.389	.603	.823	.908	.966	.988	.994	.998	.999
.09	.065	.204	.394	.601	.820	.909	.965	.988	.995	.999	.999
.10	.063	.207	.392	.604	.823	.937	.964	.988	.995	.998	.999
.11	.063	.206	.394	.601	.823	.934	.964	.989	.995	.998	.999
.12	.063	.200	.390	.604	.821	.934	.962	.987	.995	.998	.999

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.331	.667	.884	.972	.995	.999				
.01	.049	.318	.667	.885	.972	.995	.999				
.02	.050	.315	.655	.884	.973	.995	.999				
.03	.050	.313	.657	.877	.974	.995	.999				
.04	.050	.314	.656	.877	.971	.995	.999				
.05	.049	.313	.655	.875	.971	.994	.999				
.06	.049	.315	.656	.876	.971	.994	.999				
.07	.050	.271	.653	.876	.970	.994	.999				
.08	.049	.272	.653	.895	.972	.994	.999				
.09	.050	.271	.655	.897	.970	.994	.999				
.10	.049	.275	.654	.897	.971	.992	.999				
.11	.049	.274	.656	.896	.971	.992	.999				
.12	.049	.268	.653	.898	.971	.992	.999				

Table 255

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.005	.024	.135	.364	.537	.688	.861	.912	.963	.983	.991
.01	.007	.029	.136	.361	.538	.686	.861	.911	.964	.982	.991
.02	.007	.028	.135	.362	.540	.690	.862	.930	.964	.983	.991
.03	.007	.028	.133	.377	.541	.687	.860	.930	.965	.982	.991
.04	.007	.029	.133	.381	.537	.687	.860	.928	.964	.983	.991
.05	.007	.028	.134	.378	.534	.693	.858	.928	.963	.982	.991
.06	.007	.029	.134	.379	.538	.688	.838	.930	.964	.982	.991
.07	.007	.047	.135	.380	.534	.693	.840	.930	.965	.983	.991
.08	.007	.048	.135	.285	.538	.688	.840	.928	.960	.982	.991
.09	.007	.046	.135	.285	.532	.691	.841	.929	.961	.982	.991
.10	.007	.046	.134	.283	.534	.764	.837	.930	.961	.982	.991
.11	.007	.047	.134	.281	.536	.763	.839	.929	.960	.983	.992
.12	.007	.045	.133	.283	.535	.758	.836	.920	.960	.982	.991

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.127	.378	.667	.871	.964	.988	.997	.999		
.01	.010	.116	.379	.668	.871	.964	.988	.997	.999		
.02	.010	.116	.364	.665	.871	.964	.988	.996	.999		
.03	.010	.117	.362	.648	.874	.965	.988	.996	.999		
.04	.010	.115	.362	.648	.867	.963	.988	.996	.999		
.05	.010	.116	.363	.648	.864	.958	.987	.996	.999		
.06	.009	.115	.365	.646	.866	.959	.986	.996	.999		
.07	.009	.091	.360	.649	.866	.959	.986	.995	.999		
.08	.010	.091	.361	.689	.866	.959	.986	.995	.999		
.09	.010	.091	.365	.690	.866	.959	.986	.995	.999		
.10	.010	.092	.361	.692	.868	.948	.986	.995	.999		
.11	.009	.093	.366	.690	.867	.947	.986	.995	.999		
.12	.009	.089	.363	.691	.865	.947	.985	.997	.999		

Table 256

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.040	.104	.353	.588	.734	.841	.910	.960	.974	.985	.990
.01	.049	.116	.350	.589	.734	.839	.913	.961	.975	.985	.990
.02	.050	.115	.332	.588	.734	.843	.910	.949	.974	.986	.990
.03	.051	.118	.333	.592	.733	.842	.909	.951	.975	.986	.990
.04	.049	.117	.332	.593	.732	.842	.909	.951	.975	.988	.990
.05	.049	.115	.334	.594	.731	.841	.911	.951	.975	.988	.990
.06	.050	.116	.331	.595	.730	.841	.915	.951	.975	.988	.990
.07	.051	.174	.333	.594	.728	.843	.913	.950	.973	.988	.990
.08	.049	.173	.329	.528	.729	.844	.914	.950	.975	.988	.990
.09	.049	.170	.330	.526	.731	.840	.914	.951	.975	.989	.990
.10	.050	.175	.334	.527	.728	.846	.915	.951	.975	.988	.992
.11	.050	.175	.328	.527	.729	.847	.915	.951	.974	.989	.992
.12	.050	.180	.332	.527	.732	.847	.915	.957	.975	.988	.992

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.335	.659	.860	.957	.989	.996	.999			
.01	.050	.321	.658	.862	.958	.990	.996	.999			
.02	.051	.321	.646	.862	.958	.990	.996	.999			
.03	.050	.322	.648	.853	.958	.990	.996	.999			
.04	.051	.322	.648	.853	.955	.989	.996	.998			
.05	.051	.324	.650	.854	.955	.988	.996	.998			
.06	.049	.322	.645	.853	.956	.988	.996	.998			
.07	.051	.285	.646	.853	.955	.988	.996	.998			
.08	.051	.286	.647	.878	.956	.988	.996	.998			
.09	.052	.284	.648	.877	.956	.988	.996	.998			
.10	.050	.286	.648	.879	.956	.982	.996	.998			
.11	.051	.288	.647	.878	.956	.983	.995	.998			
.12	.051	.281	.648	.878	.957	.983	.996	.999			

Table 257

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.007	.030	.157	.349	.503	.651	.779	.875	.914	.946	.961
.01	.009	.033	.156	.351	.503	.649	.783	.876	.915	.945	.961
.02	.010	.033	.147	.349	.506	.650	.777	.856	.914	.948	.961
.03	.010	.034	.148	.354	.502	.652	.778	.859	.914	.949	.960
.04	.010	.034	.146	.354	.503	.651	.779	.858	.915	.955	.961
.05	.009	.034	.149	.356	.500	.649	.780	.859	.915	.953	.962
.06	.010	.035	.146	.356	.501	.649	.781	.859	.915	.954	.960
.07	.010	.058	.147	.355	.498	.652	.779	.858	.913	.954	.961
.08	.009	.056	.145	.293	.500	.653	.778	.858	.914	.954	.961
.09	.010	.058	.145	.291	.500	.648	.779	.860	.915	.953	.962
.10	.010	.058	.147	.288	.501	.669	.781	.859	.916	.954	.967
.11	.009	.060	.144	.294	.500	.667	.780	.859	.914	.954	.967
.12	.009	.061	.148	.290	.503	.668	.780	.869	.915	.954	.967

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.129	.385	.651	.847	.947	.976	.992	.996	.998	.999
.01	.010	.123	.384	.652	.846	.947	.977	.992	.996	.998	.999
.02	.010	.122	.374	.653	.847	.947	.976	.988	.996	.998	.999
.03	.010	.123	.375	.638	.846	.946	.976	.988	.996	.998	.999
.04	.010	.125	.375	.638	.844	.946	.975	.988	.996	.999	.999
.05	.010	.122	.376	.639	.843	.940	.976	.988	.996	.999	.999
.06	.010	.124	.374	.638	.842	.940	.973	.988	.996	.999	.999
.07	.010	.103	.375	.638	.842	.940	.973	.987	.996	.999	.999
.08	.010	.103	.372	.680	.842	.942	.973	.986	.996	.999	.999
.09	.010	.101	.373	.679	.844	.939	.973	.986	.996	.998	.999
.10	.010	.102	.377	.679	.842	.922	.974	.986	.996	.999	.999
.11	.010	.106	.372	.678	.844	.923	.973	.986	.996	.999	.999
.12	.010	.101	.376	.679	.846	.924	.973	.992	.996	.999	.999

Table 258

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.039	.121	.482	.738	.863	.938	.974	.994	.996	.999	.999
.01	.052	.141	.479	.738	.865	.938	.973	.993	.996	.998	.999
.02	.050	.139	.441	.736	.864	.939	.974	.990	.996	.998	.999
.03	.052	.139	.440	.740	.866	.939	.973	.990	.996	.998	.999
.04	.051	.139	.441	.741	.860	.939	.973	.991	.996	.998	.999
.05	.050	.140	.444	.741	.860	.940	.974	.990	.996	.999	.999
.06	.052	.136	.443	.739	.860	.939	.977	.990	.996	.999	.999
.07	.051	.242	.442	.740	.860	.939	.976	.990	.996	.999	.999
.08	.052	.239	.442	.673	.860	.938	.977	.990	.997	.999	.999
.09	.050	.243	.439	.675	.859	.938	.977	.990	.997	.999	.999
.10	.052	.238	.442	.676	.859	.941	.976	.990	.997	.999	.999
.11	.052	.242	.443	.677	.858	.940	.976	.990	.996	.999	.999
.12	.051	.253	.440	.675	.859	.940	.977	.991	.997	.999	.999

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.439	.800	.951	.993	.999					
.01	.050	.416	.800	.951	.992	.999					
.02	.050	.414	.787	.951	.992	.999					
.03	.051	.416	.788	.946	.992	.999					
.04	.050	.413	.786	.944	.992	.999					
.05	.050	.416	.787	.945	.991	.999					
.06	.052	.414	.788	.946	.992	.999					
.07	.050	.363	.786	.945	.992	.999					
.08	.050	.361	.788	.961	.992	.999					
.09	.050	.365	.785	.961	.992	.999					
.10	.050	.361	.787	.961	.992	.998					
.11	.051	.365	.788	.961	.992	.998					
.12	.050	.361	.786	.960	.992	.998					

Table 259

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.046	.291	.560	.728	.851	.931	.976	.985	.994	.995
.01	.014	.057	.290	.557	.725	.852	.930	.976	.985	.994	.996
.02	.014	.056	.259	.558	.727	.854	.931	.969	.985	.994	.996
.03	.014	.055	.259	.563	.729	.851	.930	.968	.984	.994	.996
.04	.013	.055	.259	.563	.721	.852	.930	.969	.985	.994	.996
.05	.013	.055	.262	.563	.722	.853	.932	.968	.985	.995	.995
.06	.014	.054	.261	.562	.721	.854	.934	.968	.985	.995	.996
.07	.014	.114	.260	.564	.722	.853	.934	.969	.985	.995	.995
.08	.013	.112	.259	.481	.722	.852	.934	.968	.987	.994	.995
.09	.013	.113	.258	.480	.722	.851	.933	.969	.987	.995	.996
.10	.014	.110	.256	.482	.720	.861	.933	.968	.987	.995	.997
.11	.014	.113	.260	.481	.720	.860	.932	.969	.987	.995	.997
.12	.013	.119	.257	.483	.719	.860	.934	.971	.986	.995	.997

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.199	.562	.836	.959	.993	.998				
.01	.010	.186	.562	.836	.959	.993	.998				
.02	.010	.184	.543	.834	.959	.993	.998	.999			
.03	.009	.185	.545	.820	.960	.993	.998	.999			
.04	.010	.183	.543	.819	.957	.993	.998	.999			
.05	.010	.184	.545	.819	.956	.991	.998				
.06	.010	.183	.544	.820	.957	.991	.998	.999			
.07	.010	.150	.543	.820	.957	.990	.997	.999			
.08	.010	.150	.545	.858	.957	.991	.997	.999			
.09	.010	.153	.543	.857	.956	.991	.997	.999			
.10	.010	.149	.544	.859	.958	.987	.998	.999			
.11	.010	.151	.545	.858	.957	.987	.997	.999			
.12	.010	.148	.543	.858	.956	.987	.997				

Table 260

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.165	.651	.870	.952	.985	.996				
.01	.066	.189	.651	.869	.951	.985	.995	.999			
.02	.066	.191	.591	.871	.952	.984	.996	.999			
.03	.066	.190	.590	.869	.952	.985	.996	.999			
.04	.067	.189	.590	.870	.945	.985	.996	.999			
.05	.066	.190	.592	.869	.944	.985	.996	.999			
.06	.065	.190	.588	.870	.946	.984	.996	.999			
.07	.066	.356	.588	.872	.944	.984	.997	.999			
.08	.067	.359	.593	.821	.945	.984	.997	.999			
.09	.066	.357	.590	.821	.945	.984	.996	.999			
.10	.065	.358	.589	.820	.946	.985	.997	.999			
.11	.068	.358	.592	.820	.945	.984	.997	.999			
.12	.067	.369	.592	.820	.946	.984	.997	.999			

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.550	.902	.988	.999						
.01	.051	.517	.903	.988	.999						
.02	.051	.517	.892	.988	.999						
.03	.050	.518	.891	.984	.999						
.04	.050	.515	.892	.985	.999						
.05	.051	.517	.892	.985	.999						
.06	.050	.518	.891	.985	.999						
.07	.051	.450	.891	.985	.999						
.08	.051	.455	.891	.991	.999						
.09	.051	.452	.891	.991	.999						
.10	.050	.452	.890	.991	.999						
.11	.050	.452	.891	.991	.999						
.12	.051	.450	.891	.992	.999						

Table 261

Power Rates For One-Tailed Directional Test For Smooth Symmetric Data Set, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.061	.433	.723	.870	.946	.982	.997	.998		
.01	.016	.075	.432	.720	.869	.946	.982	.997	.998		
.02	.016	.077	.378	.724	.868	.945	.981	.995	.998		
.03	.016	.075	.379	.721	.869	.947	.981	.995	.998	.999	
.04	.016	.075	.378	.721	.852	.945	.982	.995	.998		
.05	.016	.076	.380	.723	.851	.947	.982	.995	.998		
.06	.015	.076	.377	.724	.855	.946	.984	.995	.998		
.07	.015	.178	.377	.725	.853	.946	.985	.995	.998		
.08	.016	.179	.380	.648	.853	.945	.984	.995	.999		
.09	.016	.177	.379	.646	.855	.944	.985	.995	.999		
.10	.016	.177	.378	.648	.855	.948	.986	.995	.999		
.11	.017	.177	.380	.648	.856	.946	.984	.995	.999		
.12	.017	.186	.380	.649	.855	.946	.985	.995	.998		

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.288	.729	.943	.993						
.01	.010	.264	.731	.943	.993						
.02	.010	.262	.711	.943	.993						
.03	.010	.264	.710	.930	.993						
.04	.010	.260	.708	.933	.992	.999					
.05	.010	.263	.709	.932	.993	.999					
.06	.010	.261	.708	.933	.993	.999					
.07	.010	.210	.709	.933	.993	.999					
.08	.010	.214	.712	.953	.993	.999					
.09	.010	.211	.708	.954	.992	.999					
.10	.010	.212	.707	.955	.993	.999					
.11	.010	.212	.711	.955	.993	.999					
.12	.010	.208	.710	.954	.993	.999					

Table 262

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.081	.108	.156	.206	.254	.294	.325	.356	.383	.405	.423
.01	.078	.106	.155	.208	.253	.293	.329	.359	.383	.403	.420
.02	.080	.105	.158	.205	.253	.293	.326	.359	.381	.405	.422
.03	.078	.107	.156	.208	.253	.296	.329	.356	.384	.402	.423
.04	.079	.106	.155	.207	.253	.293	.326	.355	.381	.406	.421
.05	.079	.108	.154	.206	.253	.293	.327	.357	.382	.406	.425
.06	.079	.104	.153	.205	.252	.296	.326	.358	.381	.404	.423
.07	.081	.106	.155	.207	.253	.290	.329	.358	.382	.402	.420
.08	.079	.105	.157	.205	.252	.292	.328	.356	.380	.403	.424
.09	.080	.106	.156	.205	.252	.295	.328	.358	.381	.401	.419
.10	.079	.104	.153	.206	.252	.291	.326	.358	.383	.405	.420
.11	.079	.105	.155	.205	.251	.294	.329	.358	.380	.402	.420
.12	.080	.104	.153	.204	.253	.292	.328	.357	.379	.403	.423

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.109	.175	.236	.286	.331	.367	.402	.434	.460	.480
.01	.048	.109	.172	.235	.286	.333	.372	.404	.433	.457	.479
.02	.048	.109	.176	.234	.286	.330	.368	.405	.432	.458	.478
.03	.047	.109	.174	.235	.286	.334	.372	.403	.436	.456	.480
.04	.048	.110	.174	.235	.287	.331	.368	.403	.431	.462	.479
.05	.047	.109	.171	.235	.288	.332	.369	.404	.434	.461	.481
.06	.047	.108	.174	.234	.285	.334	.368	.405	.432	.458	.481
.07	.048	.109	.175	.235	.288	.330	.371	.405	.435	.457	.479
.08	.046	.108	.177	.234	.285	.333	.372	.404	.432	.459	.481
.09	.046	.109	.175	.233	.288	.333	.371	.408	.436	.457	.479
.10	.046	.108	.173	.235	.286	.332	.371	.406	.434	.460	.480
.11	.046	.108	.175	.234	.286	.336	.373	.406	.434	.459	.481
.12	.045	.110	.173	.234	.289	.332	.372	.407	.432	.461	.481

Table 263

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 5-5, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.017	.025	.043	.067	.093	.117	.139	.162	.185	.207	.222
.01	.016	.024	.044	.069	.092	.117	.142	.165	.186	.203	.222
.02	.017	.024	.045	.067	.092	.116	.139	.164	.184	.206	.223
.03	.016	.025	.044	.068	.092	.119	.142	.163	.185	.204	.224
.04	.015	.024	.044	.067	.092	.114	.140	.164	.184	.206	.222
.05	.016	.024	.043	.067	.093	.117	.142	.164	.186	.206	.225
.06	.016	.024	.044	.066	.092	.117	.139	.163	.183	.206	.223
.07	.016	.025	.044	.067	.093	.116	.140	.164	.186	.205	.223
.08	.016	.024	.044	.068	.091	.116	.141	.164	.185	.204	.225
.09	.016	.024	.044	.066	.091	.118	.140	.164	.186	.205	.222
.10	.016	.025	.043	.067	.092	.116	.141	.164	.187	.205	.223
.11	.016	.024	.043	.067	.092	.117	.141	.164	.184	.204	.224
.12	.016	.024	.043	.066	.093	.117	.141	.163	.184	.207	.223

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.004	.012	.021	.033	.046	.058	.070	.081	.093	.104	.110
.01	.004	.011	.021	.034	.045	.058	.072	.083	.092	.102	.110
.02	.004	.011	.021	.033	.046	.058	.069	.082	.091	.103	.111
.03	.004	.011	.021	.033	.045	.059	.071	.082	.093	.101	.112
.04	.004	.011	.021	.034	.045	.056	.070	.081	.091	.103	.112
.05	.004	.011	.020	.033	.045	.056	.069	.081	.092	.101	.111
.06	.004	.010	.020	.032	.045	.058	.067	.080	.091	.101	.110
.07	.004	.011	.021	.033	.045	.057	.068	.081	.092	.101	.110
.08	.004	.010	.021	.033	.044	.057	.070	.081	.091	.100	.111
.09	.004	.010	.021	.031	.044	.058	.069	.079	.091	.100	.111
.10	.004	.010	.020	.031	.044	.056	.069	.079	.092	.102	.109
.11	.004	.011	.020	.032	.045	.057	.069	.080	.089	.101	.109
.12	.004	.010	.020	.031	.044	.056	.067	.079	.090	.100	.110

Table 264

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.032	.055	.109	.184	.262	.333	.397	.453	.499	.538	.572
.01	.033	.054	.109	.185	.259	.336	.395	.453	.498	.538	.572
.02	.033	.054	.109	.184	.259	.334	.397	.453	.503	.538	.572
.03	.032	.054	.108	.183	.259	.337	.398	.453	.500	.539	.571
.04	.032	.052	.108	.183	.262	.333	.396	.451	.500	.538	.572
.05	.033	.053	.110	.183	.261	.336	.396	.451	.500	.539	.575
.06	.033	.053	.108	.182	.260	.334	.397	.452	.498	.535	.571
.07	.032	.053	.108	.184	.258	.334	.396	.451	.499	.540	.569
.08	.032	.054	.109	.182	.260	.333	.399	.452	.495	.539	.569
.09	.032	.053	.109	.183	.258	.331	.396	.448	.495	.537	.570
.10	.033	.053	.109	.182	.258	.331	.394	.450	.499	.540	.568
.11	.032	.052	.107	.184	.260	.331	.396	.449	.495	.536	.568
.12	.031	.053	.108	.182	.258	.332	.393	.453	.498	.540	.571

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.059	.151	.271	.388	.491	.574	.641	.694	.733	.761	.786
.01	.061	.153	.270	.388	.490	.575	.636	.691	.732	.762	.786
.02	.059	.151	.271	.389	.490	.575	.640	.690	.734	.761	.788
.03	.058	.152	.270	.388	.492	.574	.639	.693	.733	.762	.784
.04	.059	.149	.270	.387	.492	.574	.637	.691	.733	.763	.788
.05	.059	.151	.270	.389	.490	.578	.638	.690	.733	.765	.788
.06	.059	.150	.267	.386	.491	.574	.642	.691	.732	.758	.785
.07	.059	.150	.267	.390	.487	.574	.641	.691	.732	.764	.786
.08	.058	.151	.269	.386	.492	.576	.642	.690	.730	.762	.787
.09	.059	.149	.270	.390	.489	.573	.640	.688	.728	.763	.784
.10	.059	.150	.269	.386	.489	.573	.641	.692	.733	.765	.784
.11	.058	.148	.267	.384	.490	.573	.637	.688	.732	.762	.788
.12	.058	.150	.267	.386	.491	.573	.639	.689	.730	.762	.786

Table 265

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 5-15, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.032	.055	.109	.184	.262	.333	.397	.453	.499	.538	.572
.01	.033	.054	.109	.185	.259	.336	.395	.453	.498	.538	.572
.02	.033	.054	.109	.184	.259	.334	.397	.453	.503	.538	.572
.03	.032	.054	.108	.183	.259	.337	.398	.453	.500	.539	.571
.04	.032	.052	.108	.183	.262	.333	.396	.451	.500	.538	.572
.05	.033	.053	.110	.183	.261	.336	.396	.451	.500	.539	.575
.06	.033	.053	.108	.182	.260	.334	.397	.452	.498	.535	.571
.07	.032	.053	.108	.184	.258	.334	.396	.451	.499	.540	.569
.08	.032	.054	.109	.182	.260	.333	.399	.452	.495	.539	.569
.09	.032	.053	.109	.183	.258	.331	.396	.448	.495	.537	.570
.10	.033	.053	.109	.182	.258	.331	.394	.450	.499	.540	.568
.11	.032	.052	.107	.184	.260	.331	.396	.449	.495	.536	.568
.12	.031	.053	.108	.182	.258	.332	.393	.453	.498	.540	.571

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.029	.061	.108	.157	.210	.263	.312	.355	.393	.429
.01	.011	.030	.063	.106	.157	.211	.258	.312	.352	.394	.427
.02	.010	.028	.062	.107	.157	.209	.263	.311	.356	.394	.429
.03	.009	.029	.061	.109	.157	.212	.262	.310	.355	.392	.425
.04	.010	.028	.061	.108	.159	.212	.261	.310	.354	.393	.429
.05	.010	.029	.062	.106	.157	.212	.262	.308	.355	.394	.429
.06	.010	.028	.060	.106	.159	.213	.263	.311	.351	.389	.427
.07	.009	.028	.061	.108	.157	.212	.259	.309	.354	.395	.425
.08	.010	.030	.062	.108	.158	.213	.265	.310	.351	.391	.426
.09	.010	.028	.063	.107	.158	.211	.261	.307	.352	.393	.428
.10	.009	.029	.061	.106	.157	.210	.260	.312	.355	.395	.422
.11	.010	.028	.061	.107	.156	.210	.258	.308	.353	.391	.426
.12	.009	.029	.061	.107	.157	.211	.259	.307	.351	.393	.427

Table 266

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.024	.043	.094	.165	.240	.311	.374	.434	.483	.532	.564
.01	.024	.043	.093	.164	.236	.309	.374	.436	.485	.530	.568
.02	.024	.044	.095	.162	.238	.307	.375	.435	.486	.528	.569
.03	.023	.044	.094	.163	.236	.311	.375	.435	.488	.528	.567
.04	.022	.044	.094	.163	.237	.312	.376	.431	.486	.529	.567
.05	.024	.043	.094	.164	.236	.309	.376	.433	.484	.531	.565
.06	.023	.042	.094	.164	.238	.312	.376	.434	.489	.530	.567
.07	.022	.043	.096	.164	.237	.308	.377	.432	.486	.529	.570
.08	.023	.043	.092	.164	.238	.307	.376	.435	.485	.530	.570
.09	.023	.044	.094	.163	.238	.306	.373	.431	.485	.528	.569
.10	.023	.042	.093	.162	.235	.310	.376	.435	.487	.530	.567
.11	.023	.044	.095	.161	.234	.308	.375	.432	.486	.529	.567
.12	.023	.043	.094	.161	.237	.309	.373	.435	.485	.528	.571

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.045	.159	.303	.443	.553	.635	.704	.754	.791	.828	.849
.01	.045	.160	.305	.441	.549	.637	.703	.754	.794	.824	.850
.02	.044	.160	.305	.439	.552	.636	.703	.757	.794	.826	.850
.03	.045	.159	.304	.441	.550	.638	.705	.754	.794	.824	.850
.04	.044	.162	.305	.440	.551	.638	.706	.756	.795	.826	.848
.05	.044	.160	.304	.442	.549	.638	.706	.754	.790	.826	.848
.06	.044	.156	.304	.443	.553	.638	.703	.754	.796	.825	.849
.07	.043	.160	.308	.440	.550	.637	.705	.754	.794	.825	.849
.08	.044	.159	.305	.440	.550	.636	.702	.755	.795	.827	.848
.09	.043	.161	.305	.439	.552	.634	.702	.754	.794	.825	.848
.10	.044	.156	.304	.438	.549	.637	.706	.756	.793	.826	.851
.11	.043	.159	.306	.438	.550	.634	.704	.755	.793	.826	.849
.12	.043	.157	.303	.439	.550	.635	.703	.756	.796	.825	.849

Table 267

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 10-10, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.024	.043	.094	.165	.240	.311	.374	.434	.483	.532	.564
.01	.024	.043	.093	.164	.236	.309	.374	.436	.485	.530	.568
.02	.024	.044	.095	.162	.238	.307	.375	.435	.486	.528	.569
.03	.023	.044	.094	.163	.236	.311	.375	.435	.488	.528	.567
.04	.022	.044	.094	.163	.237	.312	.376	.431	.486	.529	.567
.05	.024	.043	.094	.164	.236	.309	.376	.433	.484	.531	.565
.06	.023	.042	.094	.164	.238	.312	.376	.434	.489	.530	.567
.07	.022	.043	.096	.164	.237	.308	.377	.432	.486	.529	.570
.08	.023	.043	.092	.164	.238	.307	.376	.435	.485	.530	.570
.09	.023	.044	.094	.163	.238	.306	.373	.431	.485	.528	.569
.10	.023	.042	.093	.162	.235	.310	.376	.435	.487	.530	.567
.11	.023	.044	.095	.161	.234	.308	.375	.432	.486	.529	.567
.12	.023	.043	.094	.161	.237	.309	.373	.435	.485	.528	.571

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.039	.099	.176	.255	.330	.396	.457	.504	.553	.589
.01	.007	.039	.097	.175	.253	.329	.395	.456	.507	.551	.591
.02	.007	.039	.098	.172	.255	.326	.395	.458	.508	.551	.592
.03	.008	.039	.098	.173	.252	.329	.396	.456	.513	.550	.590
.04	.008	.039	.098	.174	.253	.330	.399	.455	.509	.551	.590
.05	.007	.039	.098	.174	.253	.330	.397	.454	.507	.554	.589
.06	.008	.038	.099	.175	.253	.330	.396	.454	.509	.552	.588
.07	.007	.039	.099	.175	.254	.328	.397	.454	.508	.551	.594
.08	.007	.039	.096	.174	.252	.328	.395	.458	.507	.553	.592
.09	.007	.039	.097	.175	.254	.325	.396	.456	.507	.551	.589
.10	.007	.037	.098	.174	.252	.330	.396	.457	.506	.552	.592
.11	.007	.038	.098	.173	.251	.326	.397	.453	.507	.553	.589
.12	.007	.037	.095	.173	.253	.328	.393	.455	.507	.552	.594

Table 268

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.064	.125	.286	.484	.649	.767	.839	.884	.917	.932	.946
.01	.066	.123	.287	.486	.652	.769	.841	.888	.916	.933	.946
.02	.064	.127	.286	.488	.651	.767	.843	.888	.916	.934	.945
.03	.065	.125	.288	.484	.649	.766	.840	.887	.915	.934	.946
.04	.065	.126	.285	.481	.651	.767	.842	.887	.915	.932	.946
.05	.065	.126	.285	.482	.650	.767	.841	.887	.914	.934	.945
.06	.063	.127	.288	.483	.649	.767	.841	.887	.915	.933	.947
.07	.065	.125	.288	.482	.648	.768	.843	.885	.915	.934	.945
.08	.065	.125	.288	.484	.651	.766	.841	.885	.916	.933	.945
.09	.064	.125	.286	.480	.645	.766	.840	.887	.915	.933	.945
.10	.065	.125	.290	.481	.645	.766	.841	.887	.912	.933	.945
.11	.064	.126	.284	.481	.648	.764	.837	.883	.915	.932	.945
.12	.065	.124	.285	.481	.648	.764	.838	.884	.914	.931	.945

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.051	.212	.450	.659	.796	.881	.926	.954	.971	.978	.985
.01	.052	.210	.452	.663	.798	.881	.928	.955	.969	.978	.985
.02	.052	.215	.451	.662	.797	.882	.928	.956	.970	.979	.985
.03	.051	.213	.452	.658	.796	.881	.927	.954	.970	.979	.984
.04	.050	.215	.451	.657	.797	.880	.928	.955	.969	.978	.984
.05	.050	.214	.449	.659	.797	.880	.928	.955	.970	.979	.984
.06	.050	.213	.451	.658	.798	.881	.929	.956	.970	.979	.985
.07	.050	.212	.451	.656	.795	.881	.928	.955	.970	.979	.984
.08	.051	.211	.451	.658	.797	.879	.929	.954	.970	.979	.984
.09	.051	.212	.449	.654	.795	.879	.927	.955	.970	.979	.985
.10	.051	.210	.451	.656	.793	.879	.926	.955	.969	.979	.984
.11	.050	.211	.445	.654	.795	.879	.927	.954	.971	.979	.984
.12	.050	.207	.446	.653	.795	.881	.927	.953	.969	.978	.984

Table 269

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 10-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.025	.085	.203	.342	.477	.586	.671	.734	.776	.810
.01	.009	.024	.085	.204	.346	.478	.588	.672	.733	.778	.811
.02	.009	.024	.086	.202	.340	.477	.590	.671	.731	.778	.814
.03	.008	.024	.085	.203	.344	.473	.587	.668	.730	.779	.814
.04	.008	.024	.087	.201	.344	.477	.587	.672	.730	.777	.812
.05	.008	.026	.087	.201	.342	.477	.587	.667	.730	.778	.812
.06	.008	.026	.086	.202	.343	.478	.587	.669	.731	.775	.812
.07	.008	.024	.087	.200	.341	.478	.586	.669	.731	.779	.810
.08	.008	.025	.087	.202	.341	.476	.585	.668	.731	.776	.812
.09	.008	.025	.086	.201	.341	.478	.585	.669	.732	.778	.810
.10	.008	.024	.087	.198	.337	.474	.584	.670	.728	.777	.812
.11	.008	.025	.085	.200	.342	.473	.582	.668	.731	.777	.808
.12	.009	.024	.086	.199	.340	.472	.583	.666	.730	.774	.809

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.058	.174	.335	.494	.628	.727	.800	.852	.887	.913
.01	.011	.058	.175	.336	.496	.628	.729	.802	.853	.886	.913
.02	.010	.060	.175	.336	.492	.628	.731	.802	.853	.889	.913
.03	.010	.059	.174	.334	.493	.626	.728	.800	.851	.888	.914
.04	.010	.058	.174	.334	.496	.629	.729	.801	.851	.886	.912
.05	.010	.059	.175	.334	.491	.628	.728	.800	.852	.889	.912
.06	.010	.060	.173	.333	.495	.628	.730	.801	.852	.887	.913
.07	.010	.058	.174	.335	.492	.628	.730	.798	.852	.889	.911
.08	.010	.059	.174	.334	.496	.626	.729	.799	.853	.887	.912
.09	.010	.059	.174	.333	.492	.627	.725	.801	.851	.889	.911
.10	.010	.058	.175	.331	.488	.625	.726	.801	.849	.889	.912
.11	.010	.058	.172	.332	.489	.624	.726	.799	.851	.888	.912
.12	.010	.057	.172	.331	.494	.623	.725	.798	.851	.884	.911

Table 270

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.072	.166	.401	.655	.827	.920	.960	.980	.987	.991	.994
.01	.073	.168	.400	.655	.831	.922	.963	.980	.987	.991	.994
.02	.071	.165	.404	.655	.828	.919	.961	.979	.988	.991	.994
.03	.073	.167	.402	.656	.829	.921	.961	.979	.987	.992	.994
.04	.073	.167	.399	.653	.827	.918	.961	.980	.988	.992	.994
.05	.071	.168	.402	.654	.830	.919	.960	.979	.987	.991	.994
.06	.071	.168	.401	.654	.829	.918	.962	.979	.987	.991	.993
.07	.072	.167	.402	.654	.831	.919	.960	.979	.987	.992	.994
.08	.072	.164	.400	.653	.829	.919	.962	.978	.987	.991	.994
.09	.071	.165	.402	.653	.826	.919	.960	.979	.987	.991	.993
.10	.072	.167	.402	.652	.829	.919	.960	.978	.987	.991	.993
.11	.071	.166	.396	.651	.826	.921	.960	.978	.987	.991	.993
.12	.072	.166	.404	.655	.827	.919	.959	.978	.986	.991	.993

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.051	.292	.624	.840	.938	.976	.990	.996	.998	.999	.999
.01	.051	.291	.622	.838	.937	.977	.991	.996	.998	.999	.999
.02	.050	.291	.623	.840	.937	.976	.991	.995	.998	.999	.999
.03	.051	.291	.621	.840	.938	.976	.991	.996	.998	.999	.999
.04	.051	.292	.621	.837	.937	.976	.990	.996	.998	.999	.999
.05	.050	.290	.620	.840	.938	.976	.990	.996	.998	.999	.999
.06	.049	.291	.619	.838	.938	.976	.990	.996	.998	.999	.999
.07	.050	.287	.621	.837	.939	.977	.990	.996	.998	.999	.999
.08	.051	.290	.618	.838	.938	.976	.991	.995	.998	.999	.999
.09	.050	.289	.620	.839	.938	.976	.990	.996	.998	.999	.999
.10	.050	.285	.618	.836	.938	.975	.990	.996	.998	.999	.999
.11	.050	.285	.616	.834	.936	.976	.990	.995	.998	.999	.999
.12	.050	.286	.618	.838	.936	.976	.990	.996	.998	.999	.999

Table 271

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 15-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.015	.053	.189	.416	.632	.789	.877	.926	.950	.966	.973
.01	.016	.054	.191	.415	.637	.790	.879	.925	.951	.964	.975
.02	.015	.054	.191	.417	.633	.787	.876	.925	.950	.965	.974
.03	.016	.053	.191	.419	.635	.787	.878	.925	.950	.967	.974
.04	.015	.054	.190	.412	.633	.786	.879	.925	.951	.965	.974
.05	.015	.054	.190	.415	.635	.785	.875	.924	.950	.964	.974
.06	.015	.055	.192	.415	.633	.785	.878	.925	.951	.964	.973
.07	.015	.053	.191	.415	.633	.786	.876	.924	.950	.965	.973
.08	.016	.054	.192	.415	.632	.784	.877	.922	.950	.963	.975
.09	.015	.054	.192	.414	.631	.786	.874	.926	.949	.964	.973
.10	.016	.053	.191	.412	.634	.785	.875	.923	.948	.964	.973
.11	.015	.053	.190	.412	.630	.786	.873	.922	.950	.964	.973
.12	.016	.054	.194	.413	.628	.784	.872	.923	.949	.964	.973

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.091	.304	.559	.749	.870	.932	.964	.980	.988	.993
.01	.010	.092	.303	.558	.754	.870	.933	.964	.979	.988	.993
.02	.009	.091	.304	.562	.751	.868	.932	.963	.980	.988	.992
.03	.010	.091	.304	.561	.754	.870	.932	.964	.980	.988	.993
.04	.010	.092	.302	.558	.750	.867	.932	.964	.980	.988	.993
.05	.010	.093	.303	.556	.753	.869	.931	.963	.979	.988	.992
.06	.009	.092	.303	.556	.750	.868	.932	.963	.980	.988	.992
.07	.009	.090	.301	.556	.752	.868	.930	.963	.979	.988	.992
.08	.009	.092	.303	.555	.750	.868	.932	.962	.980	.987	.992
.09	.009	.089	.301	.556	.749	.870	.932	.963	.979	.988	.992
.10	.010	.089	.302	.554	.752	.867	.932	.963	.978	.988	.992
.11	.010	.089	.299	.551	.748	.869	.931	.962	.979	.988	.992
.12	.010	.088	.303	.553	.746	.868	.929	.963	.979	.988	.992

Table 272

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.026	.067	.179	.331	.480	.610	.714	.791	.846	.885	.914
.01	.024	.068	.182	.330	.484	.610	.715	.790	.845	.887	.915
.02	.025	.069	.180	.333	.484	.610	.712	.789	.846	.884	.914
.03	.025	.067	.181	.330	.485	.613	.714	.790	.845	.884	.913
.04	.026	.068	.180	.331	.484	.612	.715	.791	.846	.885	.913
.05	.026	.068	.180	.331	.481	.609	.712	.791	.845	.885	.915
.06	.026	.067	.182	.330	.482	.613	.712	.791	.843	.886	.914
.07	.025	.069	.179	.331	.481	.612	.717	.791	.845	.885	.914
.08	.026	.068	.182	.330	.483	.611	.714	.790	.846	.886	.914
.09	.026	.069	.179	.329	.482	.611	.713	.790	.844	.883	.914
.10	.026	.069	.178	.332	.482	.612	.711	.789	.844	.885	.914
.11	.026	.068	.182	.332	.484	.613	.714	.789	.844	.887	.914
.12	.025	.068	.179	.332	.481	.611	.715	.788	.844	.884	.916

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.048	.272	.548	.745	.859	.922	.955	.973	.984	.989	.994
.01	.046	.272	.548	.744	.860	.922	.955	.973	.984	.990	.994
.02	.048	.273	.548	.746	.861	.921	.955	.974	.984	.989	.993
.03	.047	.269	.549	.745	.861	.922	.955	.974	.985	.990	.993
.04	.048	.272	.547	.746	.860	.921	.956	.974	.984	.990	.993
.05	.048	.272	.549	.745	.859	.922	.955	.973	.984	.990	.994
.06	.049	.270	.547	.743	.858	.922	.956	.974	.984	.990	.993
.07	.048	.269	.545	.745	.860	.923	.955	.974	.985	.990	.993
.08	.047	.273	.547	.745	.859	.920	.955	.974	.983	.990	.993
.09	.048	.271	.546	.743	.859	.921	.955	.973	.983	.990	.994
.10	.046	.269	.545	.745	.859	.922	.954	.973	.983	.990	.993
.11	.047	.266	.545	.743	.859	.922	.956	.974	.984	.990	.993
.12	.047	.267	.545	.744	.857	.923	.955	.973	.983	.990	.994

Table 273

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 20-20, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.004	.015	.058	.139	.242	.359	.469	.565	.645	.711	.762
.01	.003	.015	.058	.138	.245	.360	.469	.562	.644	.711	.761
.02	.004	.016	.059	.139	.246	.359	.466	.563	.644	.709	.761
.03	.004	.015	.058	.138	.244	.359	.466	.564	.644	.707	.759
.04	.004	.015	.058	.138	.245	.360	.472	.565	.644	.707	.761
.05	.004	.015	.059	.139	.245	.357	.467	.562	.644	.711	.762
.06	.004	.015	.058	.139	.244	.360	.468	.565	.640	.709	.761
.07	.004	.016	.058	.138	.244	.357	.470	.562	.644	.708	.762
.08	.004	.015	.060	.139	.245	.359	.468	.563	.643	.710	.762
.09	.004	.016	.057	.138	.244	.360	.467	.564	.642	.705	.763
.10	.004	.016	.057	.140	.244	.361	.468	.562	.639	.708	.760
.11	.004	.016	.057	.139	.246	.359	.467	.565	.641	.710	.762
.12	.004	.016	.058	.139	.246	.359	.467	.563	.641	.707	.764

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.092	.273	.474	.639	.754	.835	.887	.922	.944	.960
.01	.009	.093	.276	.474	.640	.756	.834	.886	.921	.945	.960
.02	.009	.094	.274	.476	.640	.755	.834	.887	.921	.944	.959
.03	.009	.091	.276	.475	.639	.755	.833	.887	.922	.942	.959
.04	.009	.092	.274	.474	.639	.755	.836	.887	.920	.944	.959
.05	.009	.093	.274	.474	.636	.755	.832	.887	.921	.945	.959
.06	.010	.090	.274	.472	.637	.754	.834	.888	.920	.945	.960
.07	.009	.092	.272	.474	.637	.755	.835	.888	.921	.945	.960
.08	.009	.092	.274	.474	.637	.755	.834	.887	.920	.944	.959
.09	.009	.092	.270	.471	.636	.754	.834	.886	.920	.943	.961
.10	.009	.090	.270	.474	.637	.756	.832	.887	.920	.944	.960
.11	.009	.091	.273	.475	.641	.753	.834	.887	.920	.945	.959
.12	.009	.090	.271	.472	.635	.755	.835	.885	.921	.944	.960

Table 274

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.070	.179	.413	.634	.794	.888	.941	.970	.983	.991	.995
.01	.069	.179	.410	.636	.791	.888	.941	.968	.983	.991	.995
.02	.070	.179	.414	.635	.795	.888	.940	.968	.983	.991	.995
.03	.070	.180	.412	.638	.792	.889	.941	.968	.982	.991	.995
.04	.070	.178	.411	.637	.794	.890	.941	.969	.983	.990	.995
.05	.070	.180	.410	.637	.796	.888	.940	.969	.983	.991	.995
.06	.069	.179	.411	.635	.795	.888	.942	.969	.984	.991	.995
.07	.070	.178	.411	.637	.795	.888	.940	.968	.983	.990	.995
.08	.071	.180	.414	.636	.793	.890	.941	.968	.983	.990	.995
.09	.070	.182	.413	.634	.795	.888	.941	.969	.983	.991	.995
.10	.069	.180	.411	.636	.796	.890	.942	.968	.982	.991	.995
.11	.071	.180	.409	.636	.794	.890	.940	.968	.983	.991	.995
.12	.071	.180	.413	.636	.796	.887	.941	.969	.983	.990	.995

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.370	.720	.893	.961	.985	.994	.998	.999		
.01	.048	.368	.717	.893	.960	.986	.994	.998	.999		
.02	.049	.369	.716	.893	.962	.985	.994	.998	.999		
.03	.049	.372	.717	.892	.961	.986	.995	.998	.999		
.04	.050	.367	.715	.893	.961	.986	.994	.998	.999		
.05	.050	.370	.715	.892	.961	.986	.994	.998	.999		
.06	.049	.369	.714	.893	.961	.985	.994	.998	.999		
.07	.049	.367	.713	.891	.960	.985	.994	.998	.999		
.08	.049	.369	.716	.893	.960	.985	.995	.998	.999	.999	
.09	.049	.369	.717	.891	.962	.985	.995	.998	.999		
.10	.049	.366	.713	.891	.961	.986	.995	.998	.999		
.11	.050	.367	.713	.891	.962	.986	.994	.998	.999	.999	
.12	.049	.366	.713	.891	.960	.985	.994	.997	.999	.999	

Table 275

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 30-30, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.019	.073	.229	.434	.621	.760	.856	.913	.946	.969	.980
.01	.019	.074	.227	.433	.619	.759	.853	.912	.948	.968	.981
.02	.019	.074	.230	.431	.619	.761	.854	.911	.947	.968	.981
.03	.020	.074	.227	.435	.619	.762	.855	.911	.947	.968	.980
.04	.020	.072	.228	.435	.623	.763	.855	.912	.946	.967	.980
.05	.019	.075	.227	.435	.622	.762	.853	.913	.947	.968	.980
.06	.019	.073	.229	.432	.623	.762	.855	.912	.948	.968	.980
.07	.020	.074	.228	.434	.623	.760	.854	.911	.947	.968	.980
.08	.020	.075	.229	.434	.622	.763	.854	.911	.947	.968	.980
.09	.019	.075	.229	.431	.623	.761	.854	.913	.948	.968	.981
.10	.019	.073	.228	.434	.624	.763	.855	.911	.946	.968	.980
.11	.020	.073	.227	.433	.621	.763	.855	.911	.946	.968	.980
.12	.020	.074	.228	.433	.623	.762	.854	.911	.946	.967	.980

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.148	.447	.703	.853	.930	.967	.983	.992	.996	.998
.01	.010	.148	.446	.702	.853	.930	.967	.984	.992	.996	.998
.02	.010	.148	.447	.701	.853	.930	.965	.983	.992	.996	.998
.03	.009	.149	.445	.703	.852	.930	.967	.983	.991	.996	.997
.04	.009	.148	.446	.704	.854	.930	.967	.983	.991	.995	.998
.05	.010	.149	.446	.701	.854	.929	.966	.984	.992	.996	.997
.06	.009	.148	.443	.702	.853	.929	.966	.983	.992	.996	.998
.07	.009	.146	.445	.703	.853	.930	.966	.983	.991	.995	.998
.08	.009	.148	.446	.703	.852	.930	.967	.982	.991	.995	.998
.09	.010	.148	.445	.699	.854	.930	.967	.983	.992	.995	.998
.10	.009	.146	.443	.702	.853	.931	.967	.984	.991	.995	.998
.11	.010	.146	.441	.699	.853	.930	.965	.983	.992	.995	.997
.12	.009	.146	.442	.700	.854	.929	.966	.983	.992	.995	.997

Table 276

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.055	.220	.599	.876	.973	.995	.999				
.01	.056	.220	.595	.876	.974	.996	.999				
.02	.057	.223	.599	.876	.974	.996	.999				
.03	.056	.221	.597	.877	.975	.996	.999				
.04	.057	.225	.600	.876	.973	.996	.999				
.05	.056	.219	.599	.876	.974	.996	.999				
.06	.057	.221	.599	.875	.974	.995	.999				
.07	.058	.222	.599	.877	.974	.996	.999				
.08	.058	.222	.598	.876	.975	.996	.999				
.09	.056	.220	.597	.877	.974	.996	.999				
.10	.056	.222	.598	.875	.975	.996	.999				
.11	.056	.221	.595	.874	.974	.996	.999				
.12	.057	.222	.600	.875	.974	.996	.999				

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.052	.495	.900	.988	.999						
.01	.050	.494	.897	.989	.999						
.02	.050	.500	.898	.988	.999						
.03	.050	.497	.897	.989	.999						
.04	.050	.499	.899	.989	.999						
.05	.051	.492	.897	.989	.999						
.06	.051	.492	.896	.989	.999						
.07	.050	.494	.896	.988	.999						
.08	.051	.493	.896	.989	.999						
.09	.051	.489	.895	.989	.999						
.10	.049	.490	.895	.988	.999						
.11	.049	.487	.894	.988	.999						
.12	.049	.488	.895	.988	.999						

Table 277

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 30-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.005	.051	.270	.622	.869	.965	.991	.998	.999		
.01	.006	.051	.269	.624	.869	.966	.992	.998	.999		
.02	.005	.051	.270	.625	.868	.966	.992	.998	.999		
.03	.005	.050	.269	.623	.870	.965	.992	.998	.999		
.04	.006	.052	.272	.623	.868	.964	.992	.997	.999		
.05	.005	.050	.271	.624	.868	.966	.992	.998	.999		
.06	.005	.050	.270	.623	.869	.966	.991	.998	.999		
.07	.006	.051	.272	.625	.869	.966	.991	.998	.999		
.08	.006	.050	.269	.621	.867	.966	.992	.998	.999		
.09	.005	.051	.267	.620	.869	.965	.991	.998	.999		
.10	.006	.051	.271	.622	.869	.965	.991	.998	.999		
.11	.006	.051	.270	.622	.868	.964	.992	.997	.999	.999	
.12	.005	.051	.274	.620	.867	.964	.991	.998	.999		

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.218	.682	.928	.988	.998					
.01	.010	.219	.678	.928	.988	.998					
.02	.010	.221	.680	.927	.988	.998					
.03	.010	.218	.679	.927	.988	.998					
.04	.010	.220	.681	.926	.989	.998					
.05	.010	.216	.679	.927	.988	.998					
.06	.009	.216	.679	.926	.988	.998					
.07	.010	.216	.679	.928	.988	.998					
.08	.010	.217	.674	.927	.988	.998					
.09	.010	.214	.676	.926	.988	.998					
.10	.010	.213	.673	.925	.988	.998					
.11	.010	.214	.672	.925	.987	.998					
.12	.010	.213	.675	.923	.988	.998					

Table 278

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.043	.174	.468	.730	.882	.952	.982	.993	.997	.999	
.01	.044	.176	.468	.730	.882	.953	.983	.993	.997	.999	.999
.02	.044	.175	.468	.731	.884	.952	.981	.993	.997	.999	.999
.03	.044	.174	.465	.731	.883	.953	.981	.993	.997	.999	
.04	.043	.174	.470	.733	.881	.952	.981	.993	.997	.999	.999
.05	.044	.172	.469	.731	.882	.952	.981	.993	.997	.999	.999
.06	.044	.173	.468	.731	.883	.953	.981	.993	.997	.999	
.07	.043	.175	.465	.731	.883	.953	.981	.993	.997	.999	
.08	.044	.176	.467	.732	.883	.953	.982	.993	.997	.999	
.09	.042	.174	.469	.730	.883	.952	.981	.992	.997	.999	
.10	.044	.174	.467	.732	.883	.952	.981	.993	.997	.999	.999
.11	.044	.175	.468	.730	.882	.953	.981	.993	.997	.999	.999
.12	.045	.171	.466	.729	.881	.953	.982	.993	.997	.999	

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.049	.493	.865	.972	.995	.999					
.01	.050	.493	.863	.973	.995	.999					
.02	.050	.492	.865	.972	.995	.999					
.03	.050	.492	.862	.973	.995	.999					
.04	.050	.493	.864	.973	.994	.999					
.05	.050	.491	.866	.972	.995	.999					
.06	.050	.491	.862	.972	.995	.999					
.07	.049	.491	.862	.972	.994	.999					
.08	.050	.491	.863	.972	.995	.999					
.09	.048	.489	.863	.973	.995	.999					
.10	.050	.488	.862	.971	.995	.999					
.11	.049	.491	.862	.973	.995	.999					
.12	.049	.486	.861	.972	.995	.999					

Table 279

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 45-45, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.008	.056	.237	.498	.719	.858	.933	.969	.986	.994	.997
.01	.007	.057	.241	.499	.717	.861	.934	.969	.985	.993	.997
.02	.008	.057	.236	.500	.722	.861	.933	.969	.985	.993	.997
.03	.008	.057	.238	.499	.720	.859	.932	.969	.985	.993	.997
.04	.008	.057	.238	.500	.719	.858	.932	.969	.986	.994	.997
.05	.007	.056	.238	.496	.722	.858	.932	.969	.985	.994	.997
.06	.008	.056	.238	.496	.720	.859	.932	.970	.986	.994	.997
.07	.008	.057	.236	.498	.721	.859	.932	.969	.986	.993	.997
.08	.008	.057	.239	.499	.719	.859	.935	.969	.986	.994	.997
.09	.008	.056	.238	.497	.722	.856	.933	.969	.986	.994	.997
.10	.007	.058	.236	.498	.720	.858	.932	.970	.986	.993	.997
.11	.008	.057	.237	.497	.718	.859	.933	.969	.985	.993	.997
.12	.008	.056	.238	.499	.717	.857	.932	.970	.986	.993	.997

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.236	.653	.888	.969	.992	.998	.999			
.01	.010	.236	.653	.889	.969	.992	.998				
.02	.010	.233	.654	.888	.968	.991	.998	.999			
.03	.009	.235	.653	.889	.969	.991	.998	.999			
.04	.010	.234	.654	.890	.968	.992	.997	.999			
.05	.009	.232	.656	.889	.969	.992	.998	.999			
.06	.009	.232	.651	.887	.969	.991	.998	.999			
.07	.010	.235	.652	.887	.969	.992	.997	.999			
.08	.009	.233	.651	.889	.969	.992	.998	.999			
.09	.009	.232	.652	.889	.969	.992	.998	.999			
.10	.009	.231	.649	.888	.969	.992	.998	.999			
.11	.010	.232	.652	.889	.968	.992	.997	.999			
.12	.010	.228	.649	.887	.969	.992	.998	.999			

Table 280

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.043	.230	.609	.867	.964	.992	.998				
.01	.042	.229	.611	.868	.964	.991	.998	.999			
.02	.043	.230	.612	.865	.964	.991	.998	.999			
.03	.044	.232	.610	.867	.963	.991	.998	.999			
.04	.042	.230	.612	.869	.964	.991	.998				
.05	.043	.232	.611	.867	.965	.991	.998				
.06	.042	.232	.610	.867	.964	.991	.998				
.07	.041	.229	.611	.867	.965	.992	.998	.999			
.08	.043	.229	.613	.868	.965	.991	.998				
.09	.043	.230	.613	.867	.965	.991	.998				
.10	.042	.232	.613	.866	.964	.992	.998				
.11	.043	.228	.612	.867	.964	.991	.998				
.12	.041	.229	.611	.867	.965	.992	.998	.999			

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.623	.951	.996							
.01	.048	.623	.952	.996							
.02	.050	.626	.952	.996							
.03	.050	.627	.951	.996							
.04	.049	.626	.953	.996							
.05	.049	.625	.952	.996							
.06	.050	.623	.951	.996							
.07	.048	.622	.951	.996							
.08	.049	.625	.951	.996							
.09	.049	.623	.952	.996							
.10	.049	.623	.951	.996							
.11	.049	.620	.951	.996							
.12	.050	.620	.950	.996							

Table 281

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 65-65, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.102	.407	.727	.902	.970	.991	.998	.999		
.01	.010	.102	.404	.728	.903	.970	.992	.998	.999		
.02	.011	.101	.406	.725	.903	.969	.992	.998	.999		
.03	.012	.102	.405	.726	.901	.971	.991	.997	.999		
.04	.010	.101	.408	.726	.904	.970	.992	.998	.999		
.05	.011	.104	.406	.726	.902	.970	.991	.998	.999		
.06	.010	.104	.405	.727	.902	.971	.992	.998	.999		
.07	.009	.100	.406	.726	.903	.971	.991	.997	.999		
.08	.010	.102	.409	.725	.904	.971	.992	.998			
.09	.010	.102	.407	.725	.903	.970	.991	.998	.999		
.10	.010	.103	.407	.726	.903	.971	.991	.998	.999		
.11	.011	.101	.403	.726	.903	.971	.992	.998	.999		
.12	.010	.101	.404	.727	.904	.971	.991	.997	.999		

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.009	.354	.834	.975	.997						
.01	.009	.353	.835	.976	.997						
.02	.010	.354	.836	.975	.997						
.03	.011	.358	.834	.975	.997						
.04	.010	.355	.834	.976	.997						
.05	.010	.354	.833	.975	.997						
.06	.009	.353	.834	.975	.997						
.07	.009	.353	.833	.976	.997						
.08	.010	.352	.834	.976	.997						
.09	.010	.352	.834	.976	.997						
.10	.009	.352	.833	.974	.997						
.11	.010	.347	.832	.976	.997						
.12	.010	.346	.830	.976	.997						

Table 282

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.05.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.053	.330	.776	.958	.994	.999					
.01	.053	.328	.778	.958	.994	.999					
.02	.053	.332	.779	.958	.994	.999					
.03	.052	.331	.774	.958	.995	.999					
.04	.052	.331	.776	.958	.995	.999					
.05	.052	.331	.779	.957	.995	.999					
.06	.052	.332	.779	.959	.995	.999					
.07	.051	.332	.778	.959	.995	.999					
.08	.053	.332	.776	.959	.995	.999					
.09	.053	.330	.778	.959	.995	.999					
.10	.052	.333	.776	.959	.994	.999					
.11	.051	.334	.776	.959	.994	.999					
.12	.052	.330	.776	.957	.994	.999					

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.050	.750	.988								
.01	.051	.748	.989								
.02	.050	.751	.988								
.03	.050	.750	.987								
.04	.049	.752	.988								
.05	.050	.749	.988								
.06	.048	.750	.988								
.07	.048	.749	.988								
.08	.050	.748	.988								
.09	.050	.746	.988								
.10	.049	.747	.988								
.11	.048	.746	.987								
.12	.050	.745	.987								

Table 283

Power Rates For One-Tailed Directional Test For Uni Distribution, Various Means Shifts And Variance Changes For Sample Size 90-90, 100,000 Repetitions, Alpha=.01.

Mood-Westenberg Chi-Squared

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.011	.150	.567	.874	.975	.996	.999				
.01	.011	.149	.566	.874	.974	.996	.999				
.02	.011	.149	.568	.874	.974	.996	.999				
.03	.011	.148	.564	.874	.975	.996	.999				
.04	.011	.149	.565	.875	.974	.996	.999				
.05	.011	.151	.567	.871	.976	.996	.999				
.06	.010	.150	.569	.875	.975	.996	.999				
.07	.011	.150	.566	.875	.975	.996	.999				
.08	.011	.151	.567	.874	.975	.996	.999				
.09	.011	.149	.568	.875	.975	.996	.999				
.10	.011	.152	.564	.876	.974	.996	.999				
.11	.011	.152	.567	.875	.975	.996	.999				
.12	.011	.149	.566	.872	.974	.996	.999				

Siegel-Tukey Z-Score

	Variance Change										
Means Shift	**1**	**1.25**	**1.5**	**1.75**	**2**	**2.25**	**2.5**	**2.75**	**3**	**3.25**	**3.5**
.00	.010	.494	.942	.997							
.01	.010	.492	.943	.997							
.02	.010	.493	.942	.997							
.03	.010	.494	.941	.996							
.04	.010	.496	.942	.997							
.05	.010	.492	.942	.997							
.06	.010	.493	.942	.997							
.07	.009	.493	.943	.997							
.08	.010	.491	.942	.997							
.09	.010	.488	.941	.997							
.10	.009	.487	.942	.997							
.11	.010	.490	.941	.997							
.12	.010	.487	.940	.997							

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ABSTRACT

ROBUSTNESS AND POWER COMPARISON OF THE MOOD-WESTENBERG AND SIEGEL-TUKEY TESTS

by

LINDA C. LOWENSTEIN

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Advisor: Shlomo S. Sawilowsky

Major: Education Evaluation and Research

Degree: Doctor of Philosophy

The author examined how, in the context of experimental design, one might become aware of the Behrens-Fisher problem (heteroscedasticity) in order to apply an approximate solution, such as the Yuen's statistic (1974). It was expected that both the Mood-Westenberg dispersion test (1948) and the Siegel-Tukey test (1960) would remain robust with respect to Type I and Type II error properties (and associated power levels) for detecting variance changes when their assumptions of equal means were slightly violated (i.e., the Behrens-Fisher problem). With the use of Monte Carlo Simulations, the author reviewed 34,606 permutations composed of interactions between various sample sizes, alpha levels, distributions/data sets, variance changes and means shifts. While the Mood-Westenberg (1948) and Siegel-Tukey (1960) tests both remained robust under certain conditions with respect to Type I and II error properties, the Siegel-Tukey test (1960) was by far the most robust of the two statistics, able to handle a more diverse set of conditions, and would therefore be the statistic of choice in identifying the Behrens-Fisher problem.

AUTOBIOGRAPHICAL STATEMENT

Linda C. Lowenstein
6353 Branford Drive
West Bloomfield, MI, 48322
(248) 960-3879
lclowenstein@gmail.com

Education

Doctor of Philosophy in Ed. Evaluation & Research
Wayne State University, Detroit, Michigan — May, 2015

Master of Business Administration
St. Louis University, St. Louis, Missouri — May, 1986

Certified Public Accountant
State of Missouri (current) — January, 1979

Bachelor of Science Business Administration
Accounting Major, Computer Science Minor
Washington University, St. Louis, Missouri — May, 1978

Work Experience

Independent Contractor (CPA/Tax) — 2000-present

Financial and EDP Auditor — 1978-2000
Computer Programmer and Analyst
Business Analyst
Manager, Employee Benefits
Employee Benefits Consultant

- General American Life Insurance Company
- The May Company
- Ceridian Employer Services
- The C & B (Employee Benefits) Consulting Group
- The Monsanto Company
- Touch Ross & Company (Deloitte & Touche)