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Crisis Airlift Management: Effective Scheduling

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THESIS

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Acknowledgments

I would like to sincerely thank the men and women of the Air Mobility Command for their tireless endeavor to continue at a wartime pace of operations during both peace and war. The activities of AMC continue to grow and the mission remains the same--put the right stuff in the right place at the right time. The dedicated personnel of AMC have been making the world safer for all. Were it not for the time I spent learning this dedication, first-hand, completion of this document would not have been possible.

Maj David “JC” Penny

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Abstract

This is a report on the basis, data, findings, and models developed for US Transportation Command and Headquarters Air Mobility Command. Focusing on the dynamic scheduling problem that arises during management of airlift assets into space-constrained airfields during a crisis, this research explains the conditions surrounding this event, discusses several areas of potential cross-functional applications, presents analysis of current performance, and provides several modeling possibilities for schedule efficiency. Past research in the Flow Management Problem (an airline flow control issue) is extensive, but specific applications in crisis airlift are long in coming, primarily due to the complexity of the environment. This complexity is restricted in this initial research with an iterative approach providing for relaxation of those restrictions to present a more representative model. The model presented in this research is a variable set of feeding channels into a single queue with interaction and stochastic behavior serviced by a variably capacitated server. Initial findings include a high variance to mean ratio resulting in poor schedule performance. The products of this research are several tables and charts designed to aid planners in the development of executable schedules.

CRISIS AIRLIFT MANAGEMENT:

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I. Overview

Introduction

Over the past several years, the United States has become the preeminent power in the world. We are the only superpower. No longer is global power determined through bipolar competition. This change in political reality has necessitated a change in a variety of national defense policies and the resultant strategies designed to fulfill those policies:

> The US military fulfills four fundamental demands of the national security strategy: 1) Ensuring strategic deterrence and defense, 2) Exercising forward presence in vital areas, 3) Responding effectively to crisis, and, 4) Retaining the national capacity to reconstitute forces. (USA, 1993: 1-3)

Performing item 3 has become a popular diplomatic tool, as witnessed by recent events in Somalia, Bosnia, Zaire, Florida, India, Bangladesh, Rwanda and Haiti. This popularity has placed an incredible burden on our airlift

forces, from aircraft and aircrews, to aerial ports, to enroute visibility. Effectively dealing with the crisis response requirements levied by the National Command Authority has proven to be a challenge. The transportation experts in Air Mobility Command (AMC) require better understanding and preparation. Full optimization of the limited resources is not just a goal, it is our duty!

Problem Statement

The planners in AMC require validated and efficient scheduling tools that are adaptable to any situation. Whether the mission is humanitarian aid to a developed country or peacemaking in an austere, under-developed nation, the planners need a baseline of rules and guidelines that will enable them to effectively focus the efforts of the airlift assets into airfields thousands of miles away from staging and supply bases.

To date, little has been done to develop a planning tool for the scheduling of aircraft into airfields. This research is prompted by that void as well as by the expressed desire on the part of HQ AMC to *improve its traffic flows*, thereby increasing the effectiveness of the military strategies employed in support of national defense policy.

Background

TACC and TALCE. The art of scheduling the aircraft into the enroute and destination airfields is a critical logistics function performed by the Tanker Airlift Control Center (TACC) at Scott AFB, Illinois. In this central control point, plans are drawn and taskings dispatched whenever a crisis occurs. While prior information on the amount and type of cargo required will be indeterminate, the baseline for scheduling assets into constrained airfields remains *essentially* deterministic.

During contingency airlift operations, a Tanker Airlift Control Element (TALCE) will be deployed to the airfield to provide on-scene command and control as well as to provide direct reporting to TACC about the performance of the assigned missions (USAF, 1995b: 7). These reports provide TACC with a means to tactically manage the resources transiting contingency airfields, allowing for near real-time scheduling of resources.

The goal of this scheduling task is to achieve maximum utilization of airfield and airlift resources. If aircraft are serviced (loaded/unloaded, refueled) at a rate quicker than the actual arrival rate, ground assets will sit idle and be under-utilized. If aircraft arrive more frequently than they can be serviced, ramp saturation will occur

resulting in airborne delays and/or diversions costing time, money, and perhaps even lives.

Discussions with the airlift planners at TACC revealed that there are no specific procedures or standardized techniques for scheduling aircraft into these crisis airfields (depicted in Figure 1). In fact, the prevailing opinion expressed by the planning community is that the situation is so dynamic that a best guess is sufficient to start with, allowing for the operators in the system to ensure the outcome is beneficial (Degrut, 1996). While this viewpoint recognizes the fluidity of the system, it falls short of realizing any potential gains that could be realized through the rigorous application of analytical methods.

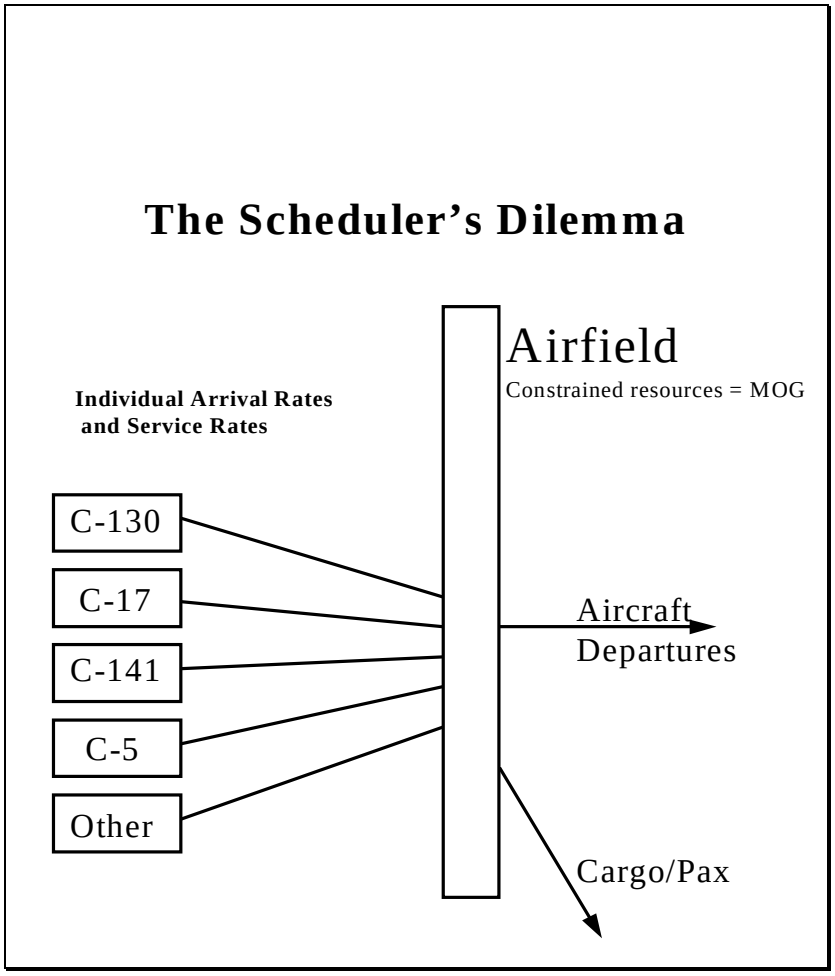

Figure 1. Crisis Airlift Environment

Contingency Operations. Contingency operations for the Air Force are controlled by the USAF/XO (USAF, 1995a: 1). These operations range in severity and requirements from single aircraft, single flight scenarios (e.g., a C-130 sent to extract US diplomats from a third-world country), to extended operations involving several aircraft, servicing a variety of airfields for an extended period of time (e.g., Operation Joint Endeavor in Bosnia). Specific requirements are derived and communicated to the commanders. Then,

airlift schedules are built to implement the mission after determining the cargo and passenger requirements along with their debarkation points. Success of the mission is dependent upon the ability of the AMC assets to move the personnel and equipment to and from the desired locations, in the minimum time, with minimum interruptions.

Enroute Airfields. Air Mobility Command currently operates out of twelve enroute support bases. These bases (shown in Table 1) serve as enroute servicing and control centers. Most missions outside the continental United States require a stop, either outbound or inbound (or both) at one of these enroute support bases. While not acting genuinely as hubs of a hub-and-spoke route structure, these fields experience a sufficiently large number of through-flights to create a large data base for analysis (Aykin, 1995).

Table 1. Enroute Airfields

Air Base	ICAO	Missions 1994
Ramstein	EDAR	3,821
Rhein Main	EDAF	5,332
Rota	LERT	1,369
Lajes	LPLA	1,329
Incirlik	LTAG	1,124
Mildenhall	EGUN	2,999
Hickam	PHIK	2,780
Elmendorf	PAED	2,336
Guam	PGUA	1,343
Yokota	RJTY	4,034
Kadena	RODN	2,619
Osan	RKSO	1,516
TOTAL		30,602

Various Aircraft Types. The airlift assets of AMC include line aircraft of the active-duty Air Force, Air National Guard, and Air Force Reserve (e.g., the C-130, the C-141, and the C-5). These backbone assets are customarily augmented by commercial carriers (e.g., the B-747 and the DC-10) and, at times, foreign military aircraft. All or part of these assets can be called into service during a crisis airlift. Table 2 provides a representative listing of the various aircraft used along with approximate capacities and sortie rates experienced during 1994.

Table 2. Aircraft Types

Aircraft	Operator	Standard Load (Approx.)		Sorties 1994
		Cargo (lbs)	Passengers	
C-5	USAF	76,189	33	17,633
C-9	USAF	2,339	13	5,273
C-17	USAF	33,055	15	983
C-21	USAF	792	5	20,251
C-27	USAF	3,739	8	979
C-130	USAF	12,945	32	44,555
C-141	USAF	25,481	21	42,377
KC-10	USAF	28,324	18	10,141
KC-135	USAF	9,332	14	24,215
B-727	Commercial	14,947	81	1,824
B-737	Commercial	15,384	25	941
B-747	Commercial	91,746	281	2,850
B-757	Commercial	25,110	117	1,136
DC-8	Commercial	24,667	50	7,433
DC-10	Commercial	50,863	206	745
L-011	Commercial	N/A	209	46
L-100	Commercial	N/A	11	2,538
L-1011	Commercial	N/A	188	1,515
MD-8	Commercial	N/A	96	47
MD-11	Commercial	N/A	237	47
TOTAL				185,529

Ramp Space/MOG. For most airfields found throughout the world, the amount of ramp space is finite yet sufficient to meet the needs of the airlift traffic using them. However, for many airports under many contingency scenarios, the number of aircraft capable of arriving and requiring service exceeds this physical constraint. Commercial passenger planners derive their primary restrictions from the number of available jetways, or terminal slots (Hassounah and Steuart, 1994). Military-airlift planners, on the other hand, usually have to contend with the limited parking spots on a ramp which are defined by the ramp space

and service required by each type of aircraft transiting the field. This restriction variable is called Maximum on Ground, or MOG. For the purposes of this study, MOG is defined as the maximum number of aircraft that can be safely parked and serviced on an airfield. MOG can be homogenous or heterogeneous, the latter resulting in combinatorial possibilities.

The first order of differentiation of MOG is aircraft type, consequently about six C-12s or three C-130s can park in the same space occupied by a C-5. Further, as with many military specific constraints, allowances are provided for contingencies permitting an increase in the number of aircraft allowed. Table 3 is a notional depiction of MOG assignment. Adding to the complexity of this arrangement are the various permutations that are possible with any airlift operation involving varying aircraft types and sequencing.

Table 3. Notional MOG Assignment

Aircraft	Peacetime	Contingency
C-5	6	8
C-12	36	46
C-130	18	22
↓	↓	↓

Research Questions

The absence of established planning procedures catalyzed by the need to improve the utilization of scarce resources presents the management problem: “How are we doing and can we do better?”

To answer the first part of the question, the study asks the researchable question: “How efficiently do AMC assets perform when compared to current schedules?” This query is further devolved in this report by understanding 1) how schedules are currently formulated, 2) how individual aircraft perform, and 3) how specific airbases perform.

The second part of this problem facing AMC planners is: “Given the current performance levels of airlift assets, what methods will improve this performance?” This study investigates various techniques and possibilities beginning with 1) a review of the constraints faced by planners and executers, 2) a review of current methods being employed in other areas of air traffic management, and 3) selective investigation into the theoretical impact of changes in current operational guidelines on the net performance of airfields and aircraft.

Assumptions

Many assumptions are required for a study of this magnitude. First, while three years of data were available

for analysis, the most recent year (1994) was selected as the source of data for study. Because the mission load for AMC aircraft has not relaxed since the Gulf War (circa 1991), it is relatively safe to assume that the most recent data available for analysis reflect current situations. However, the continued reduction in the military basing structure underway suggests the 1994 data may prove to be outdated in the near future. For more information on this matter, a good discussion can be found in the GAO report to Congress on base reductions overseas and the expected impact on the effectiveness of mobility forces (1994b).

The various sources of the data are also not entirely without doubt. These data are a combination of data streams supplied by dozens of separate operating entities (Command Posts) around the world. Some Command Posts prove to be far more accurate than others in reporting. For instance, the raw data showed that Mildenhall Air Base, in Great Britain, reported just 65% of the airlift activities arriving and departing with complete accuracy (all numbers recorded) while the reporting accuracy for Yokota Air Base, in Japan, approached 95%. After compilation of the raw data, the aggregate data is approximately 90% fully recorded (See Appendix A). Therefore, it is assumed that the data

adequately represent the true behavior of our airlift assets.

After analysis of the actual performance of the AMC fleet, it became apparent that no single distribution would be available for modeling. In the interest of providing a general report on scheduling methodology, these performance characteristics were approximated by normal curves. Since the actual data reflects a much less predictable level of performance, utilization of these probability distributions results in a more reliable result during modeling

Finally, for the purposes of this study, there is no discernible difference between the impact of weather, maintenance or crew actions. That is, the actual performance of aircraft and airfields is not defined to that level of differentiation. While this assumption rules out an important variable in the dynamic situation, the goal of this research is not to provide a full spectrum of possibilities. Instead, this research focuses on the *baseline* to commence planning while allowing for the planners to apply real-time decision processes to the plan as the conditions warrant.

Scope

The generalized nature of the data requires that any study be restricted to relative approximations. Because the

data set is all-inclusive of AMC assets, numerous sorties were excluded from the analysis to gain a tenable database for analysis. For instance, local training sorties flown by resident wing aircraft were deleted from the records because these types of missions have much greater take-off and landing deviations. Also, these missions would be curtailed or eliminated during contingencies, and are not involved in the concern of this research.

Additionally, the vast area of coverage of AMC is overwhelming for any single study. After initial review of the data, only samples of the data were used to determine population characteristics. These samples were drawn from the most highly reported section of the data (mode), whenever stratification was required. While this reduction in sample size adds to the infidelity of the results, the sheer size of the data sets utilized ensures a high (non-quantifiable) degree of confidence in the results.

Finally, the basic airfield system is initially defined as having the following restrictions, some of which will be relaxed in this study.

Table 4. Model Constraints

1.	Homogenous Aircraft
2.	MOG = 1
3.	24-hour Operations
4.	Depart Originating Airfield On Time
5.	No Maintenance Required
6.	No Weather Delays
7.	No Random, Rare Events.

Methodology

This research was conducted in a phased approach. The first step, to gain approval from the MAJCOM to perform the task, was accomplished through the sponsorship of HQ AMC/XPD. This office focuses on the planning requirements for AMC. Their direct involvement with airlift planning led to the sponsoring of the research. The second step, to gain access to the data on scheduling, was accomplished through contacts with TACC/XOMY. This office provided a CD-ROM with the AMC-controlled traffic data for all airfields during the calendar years 1992, 1993, and 1994. Each annual set of performance data contains approximately 200,000 flights to or from over 2000 different airfields.

The third step, to partition the data and perform initial analysis, was time-consuming. This apportionment resulted in an abundance of findings relevant to the study. Issues such as data fidelity and aircraft and airfield specific trends were studied and reported.

The fourth step was to derive probability distributions that modeled the performance of the aircraft in relation to their scheduled departure, flight, and ground times. Numerous data strings were developed that enabled a mapping of actual performance versus scheduled (or planned) times.

This analysis proved revealing of the way that airlift assets are actually performing their assigned tasks. One critical factor in this analysis is the fact that the performance measurement of AMC assets is based on a binary measurement: on-time or late. This phenomena results in a clustering (small variance) of data around the scheduled time with an underlying distribution described by a much wider variance.

The final step was to perform validation and sensitivity analysis using simulation. This use of modeling techniques was performed at a level of complexity below normally expected levels due to the incredible dynamics found in this system, dynamics that would create an unwieldy task of modeling research.

Summary

The basis for this research is operationally derived. Understanding how operational demands are placed on the airlift assets and how they are controlled is the first step in analysis of the efficacy of the plans. The data provided are indicative of the immense size of the activity AMC is charged with as well as the complexity of the system that projects our national power.

The implications of this research are far-reaching. First and foremost is the possibility of improved

efficiencies in the application of airlift assets in the imposition of national will. As stated earlier, the defense budget is decreasing while airlift requirements remain on an upward climb. All improvements in the efficiencies of the airlift assets are improvements in the strength and security of the United States.

As a possible means of collateral benefit, these methods may prove applicable for use in other MAJCOMs, branches, or services using ad-hoc methods for scheduling. If it can be proven that increased efficiencies are available by careful application of analytical models, the Defense Department stands to gain from the application.

Scheduling and theoretical applications are not new fields in science. Both deterministic and simulation strategies have been employed by scores of scholars. However, the peculiarities of the dynamic system experienced by the airlift experts require a specialized review of the research and literature that relates to this area so that a more efficient application of assets can be realized.

In the next section of this report, a broad review of pertinent literature is presented. This is by no means a compendium of all published literature that relates to this subject, but merely a review of research into applications in scheduling through the years.

II. Literature Review

Introduction

Studies into the specific nature of airfield dynamics began in earnest in the late 1950s (Galliher and Wheeler, 1958). From that time forward, the discussions concentrated on optimization of civilian resources, but none have specifically addressed military airlift nor operations in a hostile environment. These two added factors in the process require a new level of understanding of the basic research. Building on these factors and applying queuing and simulation techniques are the essence of the answer to this problem.

Civilian/Commercial Applications

Scheduling resources is a primary cost minimization function for any transportation or manufacturing-related commercial venture. The profit incentive, combined with the esthetically attractive solutions and the remarkably capable computers available to modern managers, have led to an explosion in the literature on scheduling and control of service-related assets. These reports originate mostly from the operations research (OR) field, providing significant insight into the actual performance of dynamic systems.

Three of the areas covered in OR reports are manufacturing scheduling, transportation planning, and service volume mediation. Additionally, several corporate-sponsored studies are performed each year, resulting in organization-specific optimizations. Each of these areas has particular applicability to the needs of the Air Force.

Single Machine Operations. The basis of single-machine algorithms is generated by the requirement to schedule a production shop in the most efficient way possible, given an abundance of uncertainty. Various articles have been published on this subject ranging from heuristic approaches to rolling time horizon, approximation techniques (Hall and Ashmoys, 1992; Kim and Yano 1994; Swarc and Mukhopadhyay 1995). Specifically applicable articles bear remarkable similarity in that they consider a single machine, with penalties for time variance and stochastic arrival and service (Sabria and Daganzo, 1989).

Queyranne and Wang present a formula-intense method for deriving a feasible schedule based upon minimized costs and precedence (1991). Hall and Ashmoys extend this discussion to cover these constraints as well as an effort to minimize the maximum lateness of the products (1992). Each of these approaches provides insight in the service time scheduling

requirements that are present outside the aircraft scheduling arena, yet endemic to the field of OR.

Scheduling and Routing. Many operational research studies have been conducted on the specific characteristics found in standard OR problems. Core to all is the Traveling Salesman Problem where cost-minimized schedules are derived for salesmen traveling through their districts. Early work in this area indicates a generalist approach to the problems and could provide a variety of solution methods (Cook, 1978). While most of these reports concern the scheduling and routing of surface traffic (from repair-service schedules to garbage trucks) (Bodin and Golden, 1981; Klincewicz 1990), cross-functional applications are applied directly to aircraft scheduling problems (Feo and Bard, 1989; Simao and Powell, 1992).

Flow Control. The two standard problems in aircraft management are the Flow Management Problem (FMP) and the Ground Holding Problem (GHP) (Andreatta and Romain-Jacur, 1987; Etschmaeir and Mathaisel, 1985; Hubbard, 1978; Jarrah et al, 1993; Teodrovic and Stojkovic, 1995). Both of these are essentially the same problem, only with a different focus. The FMP concentrates on the coordinated scheduling of airliners to provide for a terminal arrival pattern with minimum congestion. The GHP takes the same

problem and seeks to provide air traffic control with information designed to minimize the actual costs of delays. These costs are rooted in the fact that it is less costly and safer to hold an aircraft on the ground at the originating airfield rather than allowing it to proceed to the congested airfield and hold in the air.

The early work in this area was performed by Koopman, who concentrates on computational optimization due to a computer constraint of the day (1972) after Galliher and Wheeler focused on the strictly arithmetic modeling of systems (1958). As the understanding of this research grew, so did the capability of the heuristics. Most recent of these are reported by Odoni and Richetta in several different reports (see Richetta and Odoni, 1993a; Richetta and Odoni, 1993b; Richetta 1995; Peterson, Bertsimas, and Odoni, 1995; and Terrab and Odoni, 1993).

Other Commercial Operations. Modeling efforts of civilian airfields typically center on the issues associated with airliner and passenger flows (Vehicle Routing Problems and Facility Location Issues) and an efficient ground-delay assignment when traffic volumes are forecast to exceed capacity. In the early 1980s, TransWorld Airlines (TWA) sponsored and then used a heuristic planning tool for tactical, on-scene responses to changes in air-traffic

flows. This program was called GATES (Handbook of Industrial Engineering 1992: 2150-2151).

Other commercial air-carriers have also developed models to optimize their traffic flows, but these, like GATES, are difficult to examine due to proprietary rights. Preliminary indications, however, are that they all have the same tendency to exclude typical military considerations such as hostile fire, limited alternates, uncertain field conditions, and extremely unpredictable demand structures (Atack, 1978; Hubbard 1978; Teodorovic and Stojkovic, 1995). Moreover, as Koopman puts it, "The more realistic the law, the more complicated the mathematical problem it produces" (1972: 1091). Despite these real-world characteristics, military operations require a different perspective for study.

Air Force Instructions

Guidance for Air Force personnel regarding performance during contingency operations can be found in various levels of scope as well as breadth. The governing regulation is AFPD 10-4, Operations (1995b). This general guidance prescribes the basic responsibilities, while more detailed documents such as AFI 10-406 and AFI 10-404 explain more specific requirements for base and MAJCOM planners, respectively (1995a; 1994). These regulations prescribe

responsibility as well as reporting requirements. Nowhere during this search for formal guidance could a regulation, instruction, or pamphlet be found which detailed the specific methods that should be used when scheduling air assets during a crisis. This absence of directives is discussed in several of the scholarly reports emanating from the Air Force Institute of Technology and other schools of higher learning (Mann and Shook, 1982; Johnson, 1984; Sklar, Armstrong, and Samn, 1990).

Military Theses and Published Articles

MOG Determination. MOG is based upon many variables and its determination has been of great interest to strategic planners. Recent efforts on the part of the Rand Corporation and others have yielded a variety of measurement techniques. In their draft report, Rand researchers discuss key determinants in an airfield's capability to process (service) aircraft of varying types throughout a day. They define airfield capacity as "the maximum number of aircraft of the kinds specified that can be routed through and supported by the airfield during a specified day, given specified operational conditions and specified resource constraints." These areas of constraint include parking space, fueling equipment, maintenance personnel, and cargo-

loading resources (Berg, Stucker, Gerner, Sollinger, and Garla, 1995: xviii).

In deriving a planning MOG for airfields, the Rand researchers determine a 24-hour throughput capability model in deterministic scenarios. Their measurement of airfield capability is based upon the equation $MOG = \frac{\sum R_i}{A}$, where R_i is the resource used up by aircraft i and A is the amount of resource available for a given 24-hour period. By this methodology, they decrement the capacity of the constraints until they are depleted, resulting in a maximum 24-hour aircraft servicing capability. These results are simulated to produce maximum capability measurements an airfield can expect to service (Berg, et al, 1995).

While this report exists in draft form only, the concepts surrounding the determination of MOG remain applicable to any airlift study. As stated in the preliminary report, the advanced model should include stochastic arrival and service patterns to better represent the real world. Nonetheless, this means of airfield modeling is essential to providing the planners at AMC the raw data they need to provide for the baseline schedules required for crisis.

Targeting Airfields. From the military perspective, Mann and Shook developed a SLAM model for determining where to attack an enemy's airfield to reduce the airfield's sortie-generation capability. Their methodology is exemplary for development of a model designed for operational acceptance. They work a great deal of reality and expert advice into their design to ensure validity and accuracy (1982).

Cargo Shipment Planning. In 1984, Johnson developed a SLAM model designed to be usable at the operational level of airlift management. His model excludes factors that would cause complication without a commensurate level of accuracy in return (3). Lacking in this work is application of actual experiences: arrival rates and cargo loads are held constant for the purposes of sequence comparisons. The results demonstrate a preferable mix of airlift assets--but they do not provide for a saturation forecast in the event of variation (Johnson, 1984). This shortcoming provides for a starting point of a model that can be expanded to reflect real-world dynamics more accurately.

Loading Aircraft. Building on Johnson’s work, Cuda developed a SLAM model to analyze the operations of airlift through major hubs of activity. His measure of effectiveness is “tons-shipped” and, as others before him,

pays no regard to schedule variance (1985: 22-35). He does, however, isolate his research on the ramp-space allocation problem, revealing many of the important issues facing planners.

Crew Scheduling. Sklar, Armstrong, and Samn discuss the detail planning process required when constraints are placed on the available assets: the flight crew and the aircraft. By analyzing the dual-asset dilemma of a major, military-airlift flow, they produce a heuristic that allows for effective scheduling of crews against missions, over time (1990). While this method is useful for the scheduler on the local level, it does not address the requirement to planning the utilization of the key resource, the airfield.

Shortfalls in the Current Literature. Unfortunately, both the Johnson and the Cuda models are designed to determine the airfield utilization strategies based upon optimal (deterministic) situations. This design is generally adequate for strategic planning, but can lead to critical complications during actual contingencies (Johnson, 1984: 5). This strategic (capacity determination) versus tactical (scheduling) aspect presents problems with the dynamic nature of contingency operations (Degrut, 1996). The tactical view is more often performed by scheduling experts. These tacticians usually occupy separate fields of

research, and concentrate their efforts on analysis of a system and the effects changes have on it, often employing tools such as queuing theory.

Queues

Books and journal articles abound in this area of analysis. Lemoine defines a queue as consisting of an arrival process, a service process, and a waiting line (1977). Considering these common phenomena found in nature, queuing theory attempts to quantify the relationship of items processed by a system across time (Pritsker; 1986).

The basic variables used in the theoretical analysis of queues are service time/rate, arrival time/rate, and a process (Anderson, Sweeney & Williams, 1989; Galliher and Wheeler, 1958). These variables are manipulated in a variety of ways to determine the expected performance levels of a system. Galliher discusses the impacts of variable demand, but at the time of his work, computer capability limited his research to constant, deterministic models (1958: 268).

With regard to airfield scheduling, queuing theory is ideal. The framework of an airfield can be conceptually viewed as a server (runway/ramp), an arrival pattern (aircraft), and a process (cargo movement, maintenance, fueling). Rudimentary calculations can determine optimal

schedules, by making some basic assumptions (Koopman, 1972). However, airports are dynamic systems with a wide variety of factors that impact the process, either individually or interactively. Therefore, simulation of the queue is often more appropriate for studying them.

Simulation

Simulation techniques range from the relatively simple to the computationally esoteric. Pritsker reports that in any simulation study, the key is to model enough of the system to derive an answer and yet not model so much of the system that the analysis becomes overbearing (1986: 4). Thus, the art of simulating an airfield queue requires a certain level of intuitive understanding of what truly matters as well as a thorough and complete validation phase before placing the results in service (Mann and Shook, 1983: 7-10).

Banks states that before being simulated, a system needs to be analyzed for particular characteristics that will be relevant to the model (1984). After analyzing a system for the most likely factors of concern, “sample runs, based upon or correlated to actual data, should be performed to ensure that there is genuine connectivity between the model and real world” (Montgomery, 1986: 45). Using these validation techniques, the viability of optimization

strategies in solving the problem of airfield scheduling is demonstrated.

Summary

As can be seen by the breadth and depth of the literature, the scientific method of analysis provides many avenues to attack the specific problem of airfield scheduling. This problem, as the GAO pointed out in its recent report to Congress, has been around for many years and is now beginning to fester (1994b: 5). To ease the burdens of the policy-makers, the personnel that execute that policy must refine their procedures to even greater fidelity.

This new method could mean the development of a stand-alone simulator that is capable of determining efficient mixes--in real time. Or, it could mean a list of suggested, raw numbers that the planner would start with and then derive actual plans based upon subjective reasoning. Or perhaps a mix of these methods approaches is the ideal kind of tool the Air Force needs.

In the following sections, my research will show how the actual data (planned and observed) matches the planner's anticipated performance of the schedule. I will further demonstrate how some basic analytical methods and simulation techniques can provide a planner with a benchmark from which

to start, increasing the opportunity to succeed where others might fail.

III. Research Design

Introduction

The design of the research was developed to understand the nature of the data and its applicability to the issue of performance improvement. Due to numerous technical constraints dominated by the time and resources available to the researcher, a limited review of the data was performed, extracting only the information required to answer the questions: “How efficiently do AMC assets perform when compared to schedules?” and “Given the current performance levels of airlift assets, what methods will improve this performance?”

Data Source

The data for this study is comprised of aircraft activity information, including scheduled and actual takeoff and landing times. The data set provided by HQ AMC included three years of aircraft activity (1995). The detail of the data is sufficient for many analyses to be performed which enabled the research to progress with many avenues for insight.

The raw data included information on aircraft type, mission number, actual and planned takeoff and landing times

and locations, cargo, passengers, generalized delay rationale, and several kinds of other sortie-specific information that can be used to determine the performance level of AMC's airlift fleet (HQ AMC, 1995).

Data Manipulation

Because the data were provided in raw form, extensive manipulation was required to form it into a useable database. First, the Air Mobility Planning and Scheduling (AMPAS) data set was coded in MS Access. Spreadsheets were extracted from this database specific to the desired focus of study into MS Excel. Then for several of the analysis steps, these spreadsheets were then transformed into Borland Dbase V, manipulated and then transformed back into MS Excel for summarization. The product of this data translation is a set of data sets that are tailored to provide the information required for application.

Departure Time Deviation. A data set depicting the departure reliability was required to understand the performance of the airlift assets compared to their schedule. This data set was derived using the previously mentioned techniques, resulting in a variety of performance characteristics endemic to aircraft type and airfield.

Because the assets employed during contingencies are many and varied, these data were required to understand the

relative reliability of specific aircraft departing from specific airfields. Since any scheduler in charge of a stochastic and dynamic system requires comprehension of the arrival patterns, this step was critical in devising the remainder of the study.

Flight Time Deviation. AMC planners have access to a variety of tools that enable them to schedule flight times for the aircraft. Unfortunately, the reality of the environment plays a critical role in the performance to schedule. For instance, a flight routing that lasts 3 hours one day, may last only 2.5 hours the next, due to a favorable wind pattern or any number of a variety of other environmental factors.

Due to this fact of aircraft operation, a data set extraction methodology was performed to develop probability distributions for flight time. This method of analyzing the performance to schedule is also critical in devising a scheduling flow based upon a stochastic system.

Ground Time Deviation. Last, and perhaps most important, a data extraction method similar to the previous two was performed to gain insight into the interaction between aircraft and airfields when the aircraft are serviced while transiting the base. This extraction required two separate and related records from the database

which by the nature of the data set resulted in reduced numbers of observations.

The service reliability of an airfield depends on a variety of factors. The airfield may have experienced equipment breakdown, or the aircraft may have experienced maintenance troubles or received updated orders (re-routing). Also, the cargo type and fueling characteristics of the specific mission provide their own variance to schedule. Due to the down-scoping of this study, no attempt was made to develop all the interrelated nuances of performance to service schedule. Instead, a probability density function, similar to that in the other two data sets, was derived to enable rough estimations of the aggregate behavior of the airlift assets in the system.

Variance to Mean Ratio (VMR)

Throughout the rest of this report, the variance to mean ratio (VMR = σ^2/μ) of the performance measures will be discussed. Much of the analysis revolves around this statistic and, as will be shown, its behavior in the analytical environment results in substantial changes in the aggregate performance of airlift assets.

Variables

The variables, and their interrelationships in a dynamic model, are more or less infinite. Because of this fact, the research centers on specific constraints that can be relaxed as the model progresses from basic to generalizable. The basic definition of the model is constrained by the following variables:

1. Homogenous Aircraft

Initial analysis requires that the model depict only one type of aircraft. Because the C-130 and the C-5 demonstrate very different performance characteristics, both *to* schedule and *in* schedule, the initial model contains a single aircraft type. This restriction is later relaxed to demonstrate the commingling potential of airlift assets.

2. MOG

The initial model also contains a single server restriction. Using a lone server as the basic level of analysis enables a simple explanation of the behavior of resources in a system without relying on service priorities and sequencing. Later in the analysis, this restriction is also relaxed to show that efficient scheduling is possible with a variety of airfield capabilities.

3. 24-Hour Operations

While most airfields frequented by AMC assets are active around the clock, it is normal for austere environments to have reduced utilization during the hours of darkness. The initial model involves a 24-hour operation, but, this restriction is also relaxed later in the study to demonstrate the robustness of the model. In fact, the addition of this variable into the model provides the planners with additional mobility in their plans as the reduced utilizations experienced at night, during a daylight-only operation, provide for an ability of the servicing airfield to clear the queue on the ground, preparing for additional sorties when daylight allows for increases in the arrival rate.

4. Departure from Originating Airfield

The departure reliability of an aircraft provides a direct impact to performance of the plan. In the initial analysis of the basic model the departure reliability is arbitrarily set at on-time. Later in the study, the deterministic departure time constraint is relaxed to show that the variance in departure reliability results in extraordinary hardships on the servicing airfield due to the variance in arrival rates.

5. Maintenance Required

While this reality is present in everyday operations, this study does not directly allow for these phenomena. In one sense, the result of a maintenance delay has a direct reduction in the MOG of an airfield. In another sense, maintenance delays typify the nature of a dynamic system that requires the tacticians to react to when it becomes a reality.

6. Weather Delays

Similar to maintenance delays, the impact weather has on operations is not forecastable from a statistical study. The result of a weather delay on an aircraft on the ground effectively reduces the MOG. Likewise, the impact on arriving aircraft is one of diversion. These factors must be reacted to in a case by case basis as the operators see fit. Therefore, this variable is not introduced into the model.

7. Random, Rare Events

As with maintenance and weather, random events, such as Air Traffic Control (ATC) delays and airfield closures are difficult to model. Because the purpose of this study is to develop planning guidelines, not execution procedures, the impact of these random events was not considered. While the

neglect of random events may seem contrary to the concept of contingency planning, it is outside the realm of this study or any other study looking for baselines that enable the operations forces to employ their skills in the performance of the mission when the inevitable friction of war appears.

Airlift Model

The model presented in this research is a variable set of feeding channels into a single queue with interaction and stochastic behavior serviced by a variably capacitated server. The framework of the experiments consisted of incrementally adding demands on the system and reducing constraints placed on the original model.

The model presented in Figure 2 is a basic queue type of arrangement. Variability in departure time, flight time, and ground time is possible. Additionally, linking several of these queues to a single resource enables the model to expand to account for multiple demand channels. Finally, by adding a time-of-day generator, the demand patterns can be influenced with regard to the time-dependent demand (e.g., daylight operations) found in many airlift operations.

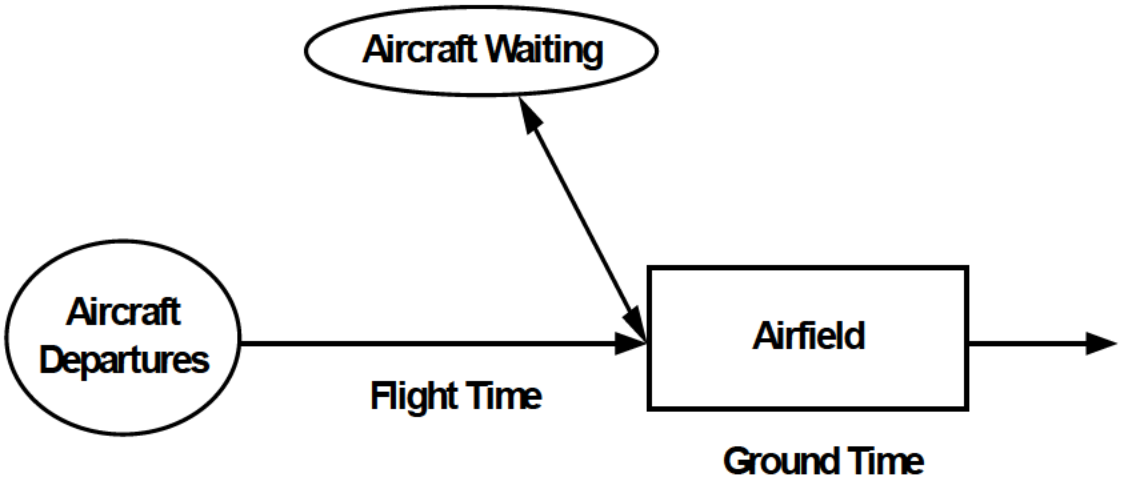

Figure 2. Basic Model (Representative)

Notation

Henceforth, model variables are described by the following notations:

Departure Sequencing From Previous Station = D

Flight Time = F

Ground Time = G

For purposes of predefined performance levels during the modeling phase of this study, the given set of probability density functions is displayed as: $D{:}\sigma$ / $F{:}\sigma$ / $G{:}\sigma$. For example, a mean departure separation of 2 hours with standard deviation of 30 minutes, a mean flight time of 3 hours with standard deviation of 15 minutes, and a mean ground time of 2 hours and 15 minutes with standard

deviation of 40 minutes, will be represented as 120 : 30 / 180 : 15 / 135 : 40.

Summary

As presented, the research design is simultaneously exhaustive and exploratory. Because the intent of this research is twofold, a dichotomous design is appropriate as well. Designing this model required extensive data analysis from an extremely rough data set. Following this derivation is the model formulation and evolution. An increased level of applicability is achieved in understanding the status of crisis airlift management by providing an increasing level of uncertainty in the model.

IV. Modeling and Experimentation

Introduction

This section shows the model progressing from basic to relatively dynamic. Selective outputs are included in Appendix B. Specific application of these models is possible should the need present itself. Simply by changing the parameters in each of the queues, different behavior patterns can be tested for performance.

Model Creation

After the development of adequate databases for the establishment of trends and behavior patterns, a systematic approach to model creation was employed to develop a model that would depict the crisis airlift management system. This model proved to be evolutionary and required sequential constraint relaxation as the study progressed.

Philosophy. The basic concept behind this model development process is to devise a simple system for determining a benchmark for timing aircraft flow during contingency. Using this objective in the process enables a progressive approach to creating a realistic model that can be improved to finer levels of fidelity. However, effecting changes to the model that refine the basic, rough model

beyond an uncertain level of realism will necessarily result in inaccuracies in the aggregate performance.

Model Validation. Validation of the models derived from this study is sufficient to meet the needs of the end users. The researcher's personal experience in the process of scheduling, controlling and performing contingency operations provides the foundation for this validation. Additionally, the model, as evolved, was audited by the HQ AMC/TACC planning staff for affirmation of its quality and fidelity.

Preceding this operational validation, each of the processes in the dynamic system was either controlled for or included as a part of the model. As was detailed in the previous section, the variables allowed to influence the model are initially restrictive with successive relaxations based upon actual performance characteristics. This exhaustive approach should provide for assurance as to the model's accuracy of the actual airlift management system.

Model Verification. The model is created via evolutionary process. This methodology provides for successive checks as to the accuracy and applicability of the model, as devised to emulate the system. Additionally, the results of the simulation were compared to the actual performance to demonstrate the similarity in results.

Finally, the various experimental descendants of the model were reviewed by simulation methodology experts on the AFIT/LA staff, to ensure programming integrity.

Steady State. For each of these models, the demand patterns are too low to develop any indications of a steady state system (Bloomfield and Cox, 1972). To account for this system characteristic, simulations were run for 200 days of operation with the second 100 days being used for performance measurement.

Experimentation

The model was interactively expanded to include the various characteristics found in the dynamic system. Table 5 details the experiments as they were developed with output provided in Appendix B.

Table 5. Experimental Evolution

Experiment Number	Scenario Parameters	Homo-genous Acft	MOG	Depart Orig. Afld On-Time	Hours of Operation
1	Basic	Y	1	Y	24
2	Basic / Delay	Y	1	N	24
3	Basic / 12-hour Ops	Y	1	Y	12
4	Basic / 12-hour Ops / Delay	Y	1	N	12
5	Basic / MOG=2	Y	2	Y	24
6	Basic / Delay / MOG=2	Y	2	N	24
7	Basic / 12-hour Ops / MOG=2	Y	2	Y	12
8	Basic / 12-hour Ops / Delay / MOG=2	Y	2	N	12
9	Med+Heavy / MOG=2:1	N	2:1	Y	24
10	Med+Heavy / MOG=2:1/ Delay	N	2:1	N	24
11	Small+Med+Heavy / MOG=4:2:1	N	4:2:1	Y	24
12	Small+Med+Heavy / Delay / MOG=4:2:1	N	4:2:1	N	24
13	Small+Heavy / MOG=4:1	N	4:1	Y	24
14	Small+Heavy / Delay / MOG=4:1	N	4:1	N	24
15	Small+Med+Heavy / MOG=4:2:1 / 12-hour / Delay	N	4:2:1	N	12
16	Small+Med+Heavy / MOG=4:2:1 / 18-hour / Delay	N	4:2:1	N	18
17	Small+Med+Heavy / MOG=12:6:3 / 12-hour / Delay	N	12:6:3	N	12

These experiments were run to determine the varying effects of schedule performance on the model as variables and variance are expanded. In each case, the simulations result in an extraordinary growth in airborne delays and diversions as the variance to mean ratio expands. Detailed results from the first and fifth experiments are indicative

of the impact of this factor on asset utilization. These are discussed in Chapter V.

Table Creation

Perhaps the most important step in this study is the formulation of the tables from which schedules can be derived. These tables were created after extensive simulations providing for a firm understanding of the impacts of the various variable relationships and interactions.

To ensure appropriateness of the processes devised, each of the entries in the tables was run in the simulation to ensure an adequate performance level was attained.

Tables and associated look-up charts are included in Appendix I for both experiment 1 and experiment 5 (MOG = 1 and MOG = 2). These tables allow the scheduler to choose a delay percentage, planned ground and flight times, and expected VMR. The preferred aircraft sequencing interval is obtained for the desired level of effect using these performance characteristics.

Summary

The models developed in this study are both explanatory and functional. By iteratively reducing the original restrictions placed on the model for basic formulation, a

useful representation of the crisis airlift environment is effected. After the models are created, performance tables can be created allowing for the benchmark on which schedulers can base their plans.

In the next section, the results of the study are displayed to a level of detail commensurate with the desires of the operational and planning community. While these results are a precursor to a complete understanding of the system dynamics of the crisis management environment in AMC, they provide for insight and inroads to the better utilization of resources that are required of all of us in the new defense establishment.

V. Findings

Introduction

The various findings represent a broad review of a portion of the story present in the raw data. For the purposes of this study, performance against schedule in departure time, flight time, and ground time were gathered and reported. These data sets, while grounds for specific studies in their own right, provide a basis for determining the best scheduling baselines in a stochastic and dynamic system.

One of the more surprising trends from the following statistics is the deviation from schedule. Not only are the airlift assets performing behind schedule the majority of the time, they also have wide variances that dramatically complicate scheduling. After a short illustration of the results, further discussion on the impact of these variances will be presented.

Departure Time Deviation

The scheduled departure time from the previous base reacts directly with the distribution of arrivals at the next base. This factor in the airlift scheduling process is ordinarily assumed not to impact schedule performance, but

as will be shown in a later section on the relaxation of this restriction in the model, large changes can come about due to an increased bunching of arrivals.

Departure time variations for aircraft are displayed in Figure 3, with additional information found in Appendix E and Appendix F. The numbers provided are merely the arithmetic means, to demonstrate the wide variety in performance. Of particular note in this graphical comparison, the C-5 exhibited an average departure delay of 4 1/2 hours. Conversely, most of the civilian aircraft averaged an early departure. Understandably, many factors will affect an aircraft's capability to perform its schedule, but it is clear from these findings that an improvement in either operations or schedule (or both) is required before an adequate and efficient airlift can be accomplished (see Appendix C).

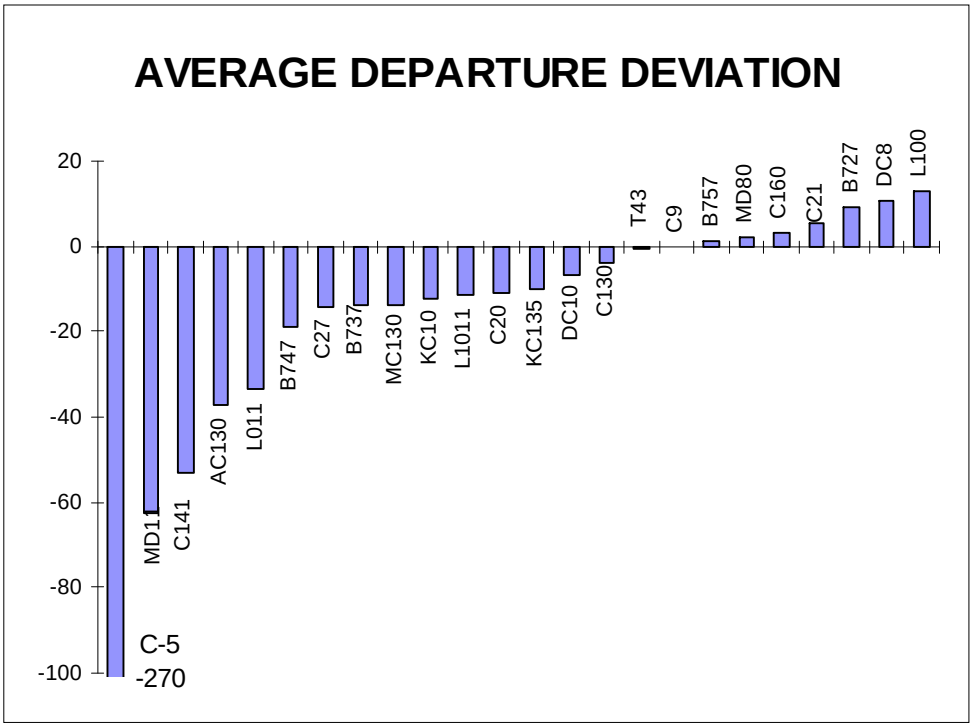

Figure 3. Departure Reliability (Aircraft)

Departure time variations for specific airfields are displayed in Figure 4. While these data are also the arithmetic means of the performance of the airfields, they demonstrate trends specific to the enroute servicing airfields. From a scheduler's viewpoint, these behavior patterns are normally assumed *not* to occur. The analysis, on the other hand, indicates that there are distinct differences among the individual enroute support bases in terms of schedule performance. Understandably, there may very well be an explanation for these variances, but the researcher has found none that reliably stand to justification. As with the deviations identified by

aircraft, if efficient schedules are to be developed for crisis airlift transportation, the reality of a debarkation airfield's performance to schedule must be considered in creating that schedule (see Appendix D).

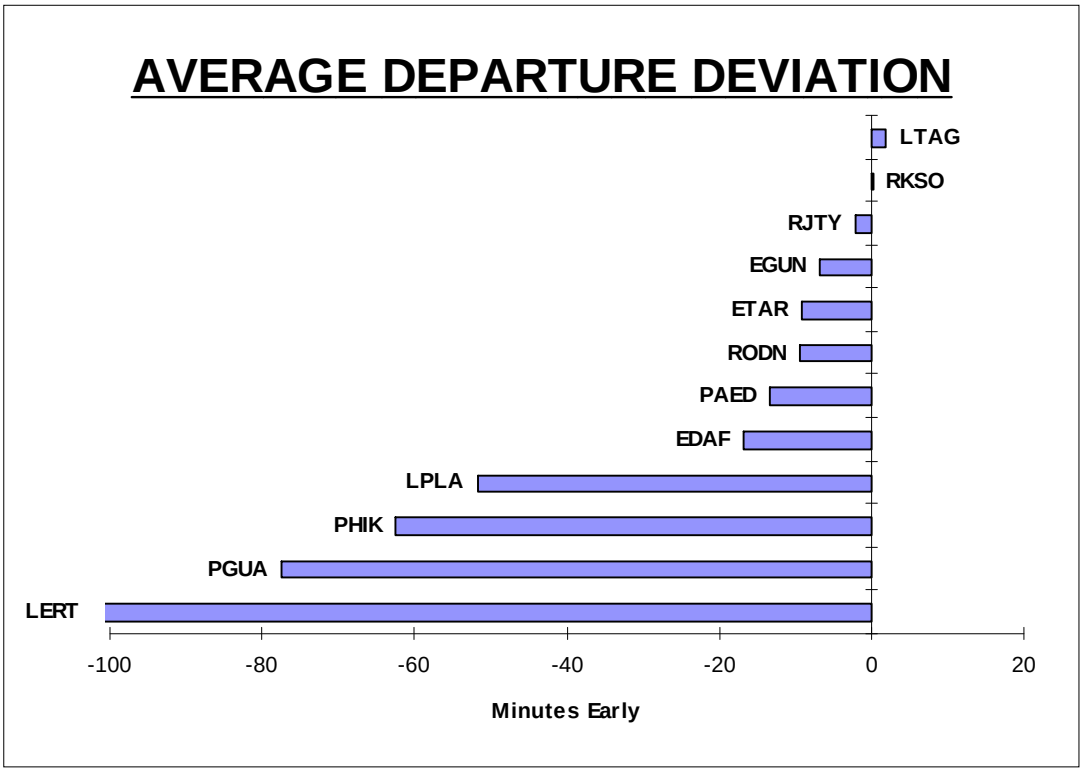

Figure 4. Departure Reliability (Airfields)
(Key to ICAO Identifiers in Table 1)

Flight Time Deviation

Flight times are determined either from experience (previous schedule), from computer generated flight plans, or from the scheduler's best estimate, based upon the distance. The deviation from this schedule adds to the unreliable arrival times at bases downstream in the airlift

flow. Because many different flight times were present in the data for each of the aircraft and airfields, samples were drawn from the mode and assumed to describe the population. By using the most commonly scheduled flight time, the resulting probability density function depicts the most common behavior of the aircraft. Additionally, after review of the other flight times in the data set, it is clear that the aggregate performance is similar to the aircraft's performance in the mode.

The deviations extracted from the raw data depict an approximately uniform trend in absolute performance (gross earliness/tardiness) for flights of reasonable length. Figure 5 is a graphical depiction of the mean deviation to scheduled flight time as the duration of the flight extends. This representation is the aggregate behavior of all AMC aircraft. Specific aircraft and airfield performance is reported Appendix E and Appendix F for reference. As this figure shows, for flights in excess of 1 hour, the percentage difference between actual performance and schedule is relatively constant. The cause of the dispersion in the short-flight performance was unclear, but it is expected that the presence of several incorrectly scheduled flights (i.e., scheduling errors) shifted the data to this extreme tardiness.

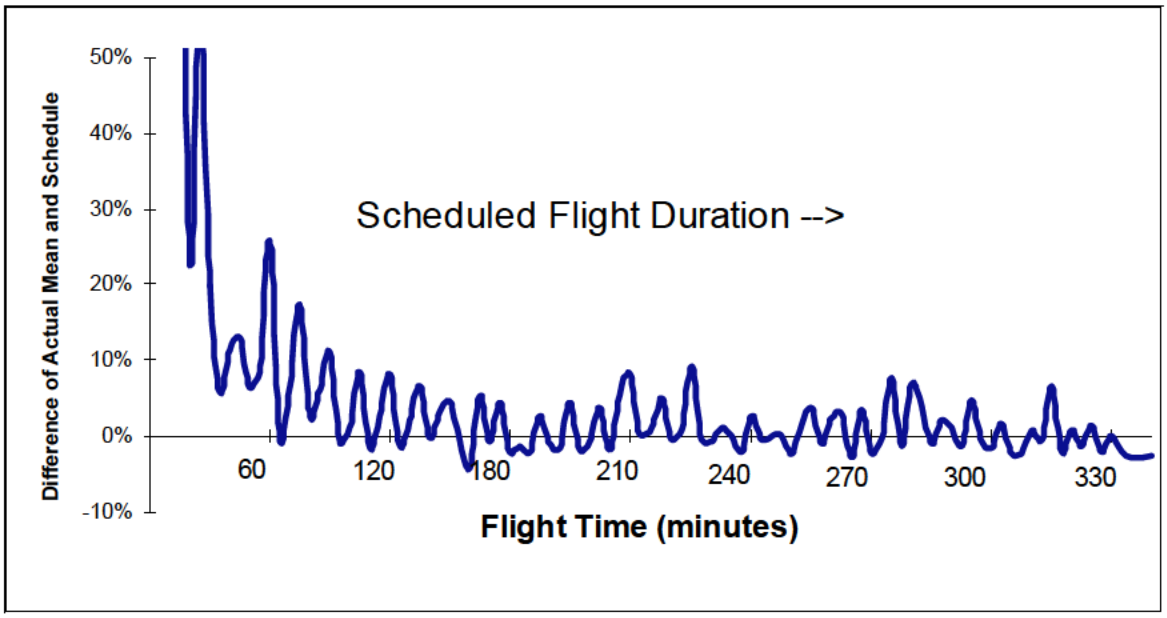

Figure 5. Flight Time Variance (aggregate 1994)

Some analysis of aircraft flight time variance was performed to determine prevalent characteristics. Excepting statistical outliers, the majority of scheduled flight times were performed with a standard deviation of between 30 and 40 minutes. This fact results in an enroute support base facing a 2-hour time window ($\pm 2\sigma$) for a 95% of scheduled arrivals. For precise scheduling of resources, this uncertainty is intolerable. Modern transportation structures insist upon much more accurate execution (Caulkins, Barnett, Larkey, Yuan, and Goranson, 1993; Teodorovic and Stojkovic, 1995).

Table 6 shows the relative performance of 5 airlift resources. The numbers presented are for the most commonly

scheduled (modal) flight time. With VMRs running from 2.5 to 5.5, these data are indicative of the inferior level of schedule performance being exhibited by the AMC fleet.

Table 6. Selected Flight Time Performance (Modal, 1994)

Aircraft (Modal Flight Time)	Average (minutes)	Standard Deviation	VMR
C-5 (5+00)	307.80	30.27	2.98
C-141 (3+00)	176.63	25.03	3.55
C-130 (0+30)	36.50	14.36	5.65
DC-8 (7+40)	465.52	33.68	2.44
B-747 (1+40)	125.94	25.29	5.08

Ground Time Deviation

The deviation from scheduled ground time, like flight time and departure time, leads to thought-provoking questions as to the cause. From a queuing or simulation perspective, the time spent on the ground is the service time. The majority of the data sets reflect a tendency to be late. Much of this tardiness is due to long delays caused by maintenance, crewing shortages, and weather. Nonetheless, this tardiness should be accounted for when schedules are devised.

As with the flight time deviations, the scheduler has the ability to choose the ground time for the schedule. This relative freedom results in many different scheduled flight times in the data set. However, governing

regulations provide for minimum times for specific mission-type, loads, and servicing requirements. Because these minimums are the most commonly used planning times, the mode of the data sets was used for analysis, and subsequently used to describe the population performance during modeling.

The ground times presented in Table 7 are representative of the entire fleet. Each of the analyzed data sets included a “long tail.” This population characteristic is expected, but discounted in further analysis, because the extended tardiness of a service activity is accounted for at the tactical level of the schedule (see Appendix G and Appendix H).

Table 7. Selected Ground Time Performance (minutes)

	Scheduled Ground Time	Average	Standard Deviation	VMR
C-5	135	139.18	18.47	2.45
	165	172.72	27.78	4.47
	195	197.46	24.56	3.06
	225 (*)	252.56	39.29	6.11
C-141	135	131.83	24.23	4.45
	165	166.99	23.05	3.18
	195 (*)	195.92	26.96	3.71
	225	219.99	25.57	2.97
C-130	135	132.80	30.75	7.12
	165	157.90	31.80	6.41
	195(*)	180.82	38.98	8.40
	225	225.84	39.62	6.95
DC-8	115	127.73	17.59	2.42
	160	175.32	23.30	3.10
	310	323.01	27.61	2.36
B-747	55	70.80	16.07	3.65
	100	125.94	25.29	5.08
	210	225.76	18.91	1.58
	430	438.37	28.63	1.87

(*) Normal minimum ground time

Each of the ground times analyzed (excluding long-tails) shows performance close to schedule, but variance to mean ratios (VMR = σ^2/μ) from 1 to 8. These ratios result in unreliable performance by the fleet and the resultant inefficient use of resources.

System Representation

As can bee seen from the deviations just reported, the actual performance of the AMC fleet is widely dispersed. There are many aircraft, flying to many airfields, with many scheduled times throughout the year. This characteristic

makes it difficult to model on a level that provides for specific application without prior knowledge of that event, and the performance expected.

The simulation phase of this research concentrated on building aggregate templates that provide for baseline comparisons. To accomplish this step, a general assumption was made about the performance characteristics of the AMC fleet.

It is assumed that each of the critical performance areas; departure, ground, and flight times are best represented by a normal distribution. While the data does not provide for a significant fit, Appendix C and Appendix D display the general behavior of the data.

Modeling

Basic Model (Experiment 1). The basic model is defined as a single aircraft, flying to an airfield that can service one aircraft at a time. Holding is performed when the airfield is occupied. Summary results are in Table 8.

Table 8. Basic Model Results (MOG = 1)

Departure Time ($\mu:\sigma$)	Flight Time ($\mu:\sigma$)	Ground Time ($\mu:\sigma$)	Variance to Mean Ratio (σ^2/μ)	Number Acft	Number Holding	Percent Delayed	Time Holding (Total Minutes)	Afld Utilization (ρ)
180:0	180:5	135:5	0.19	1599	0	0%	0	0.75
180:0	180:15	135:15	1.67	1599	64	4%	518	0.75
180:0	180:30	135:30	6.67	1599	359	22%	9847	0.75
180:0	180:60	135:60	26.67	1598	767	48%	59501	0.77
180:0	180:90	135:70	36.30	1598	916	57%	97605	0.79
180:0	180:180	135:135	135.00	1568	1566	100%	6159741	0.9984
180:20	180:5	135:5	0.19	1600	35	2%	320	0.75
180:20	180:15	135:15	1.67	1600	140	9%	2160	0.75
180:20	180:30	135:30	6.67	1600	404	25%	12743	0.75
180:20	180:60	135:60	26.67	1611	797	49%	63431	0.77
180:20	180:90	135:70	36.30	1602	941	59%	100261	0.79
180:20	180:180	135:135	135.00	1568	1566	100%	6868795	0.9985
180:50	180:5	135:5	0.19	1603	433	27%	17717	0.75
180:50	180:15	135:15	1.67	1603	474	30%	21392	0.75
180:50	180:30	135:30	6.67	1603	599	37%	34597	0.75
180:50	180:60	135:60	26.67	1630	892	55%	89852	0.78
180:50	180:90	135:70	36.30	1606	970	60%	125460	0.79
180:50	180:180	135:135	135.00	1568	1566	100%	7932342	0.9985

The basic model was based upon a standard, austere airfield. The representative notation is 180:σ/180:σ/135:σ. These scheduled times were then adjusted for varying levels of variance. As can be seen from the results, the total time aircraft spend holding increases dramatically as the variance is increased in any one of the three categories.

This model proves illustrative of the impact of the failure of an airlift operation to adhere to schedule. In point of fact, when the VMR increases towards the mean, the utilizations approach 1.00, and consequently, the time spent

holding (in the queue) expands to completely unacceptable levels.

Combining these results with those of the actual data, a representative crisis response scheduled under these conditions (180:50/180:30/135:30) could expect to have more than a third of the aircraft holding while service is performed on the preceding aircraft. These delays are unacceptable, even though the present methodology prescribes just such a plan (Degrut, 1996).

Also noteworthy in these results is the increase from about 4% airborne delays for VMR equal to roughly 1.5, to 25% airborne delays when the VMR approaches 5 or 6. As discussed previously, the current VMRs for the military aircraft in AMC are closer to the latter.

Basic Model with MOG = 2 (Experiment 5). The basic model was expanded to double the aircraft servicing capability. Applying current techniques for scheduling, the arrival separation is reduced proportionately with the MOG increase, essentially a deterministic assumption. The representative notation is 90:σ/180:σ/135:σ. This situation is descriptive of many of the operations found around the world where intermediate-sized airfields are used to process a crisis airlift response. Table 9 details the results of the simulations.

Table 9. Basic Model Results (MOG = 2)

Departure Time ($\mu:\sigma$)	Flight Time ($\mu:\sigma$)	Ground Time ($\mu:\sigma$)	Variance to Mean Ratio (σ^2/μ)	Number Acft	Number Holding	Percent Delayed	Time Holding (Total Minutes)	Afld Utilization (ρ)
90:0	180:5	135:5	0.19	3197	0	0%	0	1.50
90:0	180:15	135:15	1.67	3197	126	4%	1396	1.50
90:0	180:30	135:30	6.67	3197	635	20%	17063	1.49
90:0	180:60	135:60	26.67	3196	1293	40%	69489	1.54
90:0	180:90	135:70	36.30	3197	1566	49%	107637	1.60
90:0	180:180	135:135	135.00	3124	3122	100%	10490200	1.9973
90:20	180:5	135:5	0.19	3210	254	8%	3607	1.50
90:20	180:15	135:15	1.67	3210	457	14%	9041	1.50
90:20	180:30	135:30	6.67	3210	822	26%	26996	1.50
90:20	180:60	135:60	26.67	3225	1379	43%	83046	1.55
90:20	180:90	135:70	36.30	3196	1555	49%	115859	1.60
90:20	180:180	135:135	135.00	3124	3124	100%	10264600	1.9973
90:50	180:5	135:5	0.19	3198	1222	38%	71365	1.50
90:50	180:15	135:15	1.67	3198	1241	39%	75740	1.50
90:50	180:30	135:30	6.67	3198	1346	42%	88220	1.50
90:50	180:60	135:60	26.67	3234	1694	52%	161524	1.56
90:50	180:90	135:70	36.30	3175	1781	56%	172541	1.58
90:50	180:180	135:135	135.00	3113	3091	99%	7392963	1.9904

Similar to the single-aircraft modeling results, these results display the impact of increasing VMRs. Notable in these results is the fact that as the departure/arrival separation increases along with the departure time variance, an exceptional increase in delays occurs due to grouping and overlapping of aircraft being processed through the system. For the scheduler, this model performance demonstrates that a linear relationship between MOG and arrival rate is *not* prudent in a stochastic system.

Summary

The raw data was analyzed to determine the current performance of airlift aircraft. The flight time, departure reliability, and ground times can all be generalized by the term *tardy*. Also, the variance of this performance tends to be large in comparison to the mean. These population characteristics were modeled first, to demonstrate the correlation between VMR and system performance, and second, to describe more effective methods of scheduling the assets AMC has to control. Further, notional improvements in the adherence to schedule were simulated to demonstrate the increased efficiencies that are possible with modest improvements in performance.

In the final section of this report, several of the reasons for this difference are discussed, along with potential avenues for further research into the crisis airlift scheduling arena.

VI. Summary and Conclusions

The airlift system encountered by AMC planners and operators is an immensely dynamic and fluid environment. Whether in peacetime or contingency, uncertainty is the only certainty. Previous attempts to deal with this characteristic found in the military airlift environment have improved performance in relative terms. Few, if any, have looked to the specific reality of stochastic behavior. This research has been an initial attempt to apply current analytical methods to the field of crisis airlift management.

As has been shown, current performance is less than optimum. Schedules tend to depict a unitary goal-oriented mentality rather than a timeline to adhere to. That is, airlift personnel strive to achieve an on-time departure, but failure is not perceived as impacting anything outside the particular mission. The results of this patterned behavior are exhibited in the data by the persistent tardiness and large variance-to-mean ratios in each of the measures reviewed.

The various explanations for this performance have more to do with past experience than future expectations. First, airlift schedules ordinarily include a fair amount of management reserve to be used whenever actual performance of

a schedule becomes an impediment to the continued operation. Second, most airlift operations are not continuous events lasting several days. Instead they tend to be isolated surges that quickly taper off to allow for the eradication of any backlogs that may have occurred from inappropriate scheduling and/or performance. However, this reality of current methodology results in a false sense of security for a time when a genuine contingency develops. A contingency which could well require continuous flows into restricted airfields.

Contingencies Call for Accurate Scheduling

When the need arises, AMC must deliver. A contingency operation as experienced in the early parts of Operation Desert Shield (August 1991) was a classic experience in massive airlift overloading airfields (Breen, 1995). Poorly conceived schedules can and do result in poor performance. Instead, baselines for airlift operations need to be developed, optimized, and applied for such contingencies.

Data Transfer Problems

It became clear during this study that the data required to analyze performance is not completely recorded. As noted in Appendix A, the fidelity of the data was less than perfect. Even though AMC averages about 600 sorties a

day around the world, in today's communications-rich environment, accurate accounting of the activities is required for better analytical understanding that changes in procedures will yield.

Further Study

The models developed in this research intentionally excluded many real-world dynamics such as maintenance and weather. Adding the true impacts of these characteristics to the models tends to drive a continuous flow model to saturation whenever they occur. Therefore it is advised that further studies restrict their analysis to the top level understanding of the system and not attempt to refine the model to such a level of detail that the reality of dynamics outweigh the potential benefits that can be derived from careful and thoughtful application of the findings in this study.

Nonetheless, further study is warranted into the impact of these rare events on a schedule baseline. Quick and tactile responses to changes are the key to an effective implementation of an airlift plan. Gaining a better understanding of the probabilities and impacts of these events would greatly benefit the planning community.

A more impressive impact on performance would be provided by a detailed study into the consequences resulting

from reactions to schedule performance measurements. Because the current airlift system is currently graded on a binary system (on-time or late), a shift to relative performance (minutes early/late) would undoubtedly alter the performance and the outcome of many airlift operations.

But why are current performance measurements taken at aircraft departure? The unintended message of this type of performance measure is, "it doesn't matter when you *arrive*, just when you *leave*." It is likely that this departure-focused mentality leads to unnecessary operations and increases in the randomness with which the aircraft arrive at their destination. Investigations should be undertaken to determine the impact of basing performance measurements on the timeliness of arrivals, thereby allowing the ground support functions to achieve much greater scheduling power.

How are we doing?

The first question raised in this research was one of current performance. Since AMC continues to successfully complete each and every one of the assigned missions, the answer must be "good enough." But is it?

Aggregate. On the grand scale, the missions performed by airlift assets are performed late to schedule. Additionally, they are performed with such great variances that the resource utilizations suffer. This is manifested

in “Ramp Saturation,” diversions, and extended holding for the airlift fleet (Breen, 1995).

Compared to Commercial. Specific performance of the military airlift aircraft is poor compared to the commercial equivalents. While the C-5 trails the fleet in performance, the rest of the cargo aircraft are also, on average, tardy. Conversely, the majority of the civilian aircraft are performing their assigned missions with better mean times and lower variance.

Specific reasons for this startling fact is left to further research, but this researcher postulates a different measurement of success (profit) driving the commercial airlines to perform better than the military (Caulkins, et al, 1993).

It must also be stated that the missions of the military aircraft are more often to austere (limited support) locations, into hostile environments, and are frequently subject to change. The commercial airlift assets, on the other hand, are performing contract carriage, rarely in harm’s way, and usually into intensive logistics support networks. These differences provide fertile areas of research.

Can we do better?

Simply stated, yes. The current performance level of AMC assets, as indicated in the findings leave plenty of room for improvement. This report has focussed on the application of simulation techniques designed to provide more effective methods for developing schedules, and yet this is just one option for improvement.

As discussed earlier, many fields of research are designed to optimize schedules. For an improvement in the airlift schedule to occur, a solid baseline for the schedulers to start from is essential. To create this baseline, an understanding of the critical factors and character of the airlift management environment is required.

System Impactors. Many factors impact this system. For the purposes of this generalized study, the areas that are examined are multiple type aircraft, multiple service, and time-varying demand. These three areas are, perhaps, the three areas that the schedulers can foretell and influence when devising a schedule.

Dynamics. A drawback to creating a baseline is the dynamic nature of a crisis. Because there are continuous changes to the system, most of them dependent upon the outcome of previous activity, this research does not attempt to accommodate tactical changes. Instead, as these changes

occur, repeated reference to the baseline and subsequent alteration in the schedule are required to ensure efficient use of resources.

Benchmark Tables

The tables provided by this research only begin to answer the need of the planning community. Due to resource restrictions, just the small and non-complex systems were analyzed for bench mark purposes. Further work is possible to expand these tables to include more of the various airfields and crisis demands that may be encountered by our airlift forces. These alterations could include the mixing of aircraft, day-light operations, or even expand to include an analysis of the rare event impact on these results.

Additionally, these tables were devised using a simulation of a continuous airlift operation, far beyond what is normally encountered. To provide a benchmark for a finite time-horizon airlift operation, further study could be performed developing a probabilistic approach to successful implementation. To devise a useful version of this type of benchmark, intense interaction with the planning staffs and data describing the length and intensity of historical airlift operations would be necessary.

Appendix A: Data Fidelity

	Missing Data							Percentage of Total Data Set				
Acft Type	Number	SD	AD	SA	AA	TNG		SD	AD	SA	AA	TNG
C5	17633	1199	1469	1281	1401	4987		6.80%	8.33%	7.26%	7.95%	28.28%
C130	44555	984	4008	1043	3040	15353		2.21%	9.00%	2.34%	6.82%	34.46%
C141	42377	1541	4154	1656	3682	14078		3.64%	9.80%	3.91%	8.69%	33.22%
KC10	10141	153	2903	162	2885	1075		1.51%	28.63%	1.60%	28.45%	10.60%
KC135	24215	318	7385	358	7202	6000		1.31%	30.50%	1.48%	29.74%	24.78%
B707	137	5	2	4	2	0		3.65%	1.46%	2.92%	1.46%	0.00%
B727	1824	13	43	16	37	0		0.71%	2.36%	0.88%	2.03%	0.00%
B737	941	72	43	76	35	0		7.65%	4.57%	8.08%	3.72%	0.00%
B747	2850	58	95	82	91	0		2.04%	3.33%	2.88%	3.19%	0.00%
B757	1136	11	21	17	20	0		0.97%	1.85%	1.50%	1.76%	0.00%
DC10	745	20	12	23	12	0		2.68%	1.61%	3.09%	1.61%	0.00%
DC6	103	1	3	3	3	0		0.97%	2.91%	2.91%	2.91%	0.00%
DC8	7433	119	652	144	651	0		1.60%	8.77%	1.94%	8.76%	0.00%
L011	46	3	2	4	2	0		6.52%	4.35%	8.70%	4.35%	0.00%
L100	2538	44	69	52	68	0		1.73%	2.72%	2.05%	2.68%	0.00%
L1011	1515	54	29	66	30	0		3.56%	1.91%	4.36%	1.98%	0.00%
MD11	417	9	2	12	2	0		2.16%	0.48%	2.88%	0.48%	0.00%
MD83	47	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%
AC-130	339	13	11	13	9	123		3.83%	3.24%	3.83%	2.65%	36.28%
C9	5273	99	118	99	118	164		1.88%	2.24%	1.88%	2.24%	3.11%
C12	15	0	0	0	0	2		0.00%	0.00%	0.00%	0.00%	13.33%
C17	983	2	173	2	54	971		0.20%	17.60%	0.20%	5.49%	98.78%
C20	788	20	16	21	16	18		2.54%	2.03%	2.66%	2.03%	2.28%
C21	20251	169	222	173	217	196		0.83%	1.10%	0.85%	1.07%	0.97%
C22	743	7	22	7	20	7		0.94%	2.96%	0.94%	2.69%	0.94%
C26	36	0	7	0	3	36		0.00%	19.44%	0.00%	8.33%	100.00%
C27	979	18	63	20	42	2		1.84%	6.44%	2.04%	4.29%	0.20%
C135	43	0	1	0	1	35		0.00%	2.33%	0.00%	2.33%	81.40%
C137	21	0	0	0	0	0		0.00%	0.00%	0.00%	0.00%	0.00%
EC130	204	4	19	4	9	194		1.96%	9.31%	1.96%	4.41%	95.10%
EC135	184	3	35	3	35	0		1.63%	19.02%	1.63%	19.02%	0.00%
EC137	115	1	27	1	27	0		0.87%	23.48%	0.87%	23.48%	0.00%
HC130	1087	43	56	46	33	707		3.96%	5.15%	4.23%	3.04%	65.04%
HH60	510	4	470	5	2	283		0.78%	92.16%	0.98%	0.39%	55.49%
MC130	1087	44	35	44	31	647		4.05%	3.22%	4.05%	2.85%	59.52%
MH53	295	8	10	8	8	198		2.71%	3.39%	2.71%	2.71%	67.12%
MH60	152	10	2	10	1	83		6.58%	1.32%	6.58%	0.66%	54.61%
T43	367	9	9	9	9	22		2.45%	2.45%	2.45%	2.45%	5.99%
WC130	237	0	92	0	6	144		0.00%	38.82%	0.00%	2.53%	60.76%
C160	527	0	101	0	8	0		0.00%	19.17%	0.00%	1.52%	0.00%
Primary	138921	4195	19919	4500	18210	41493		3.02%	14.34%	3.24%	13.11%	29.87%
Other Mil	33709	454	1388	465	641	3832		1.35%	4.12%	1.38%	1.90%	11.37%
Comm	19732	409	973	499	953	0		2.07%	4.93%	2.53%	4.83%	0.00%
TOTAL	192889	5058	22381	5464	19812	45325		2.62%	11.60%	2.83%	10.27%	23.50%

SD = Scheduled Departure Time AD = Actual Departure Time
SA = Scheduled Arrival Time AA = Actual Arrival Time
TNG = Training Sortie

Appendix B: SLAM Models and Output

The following diagrams and computer outputs are representative results of the experiments performed on the airfield models. Presentation here is a matter of reference, with summarization occurring in the body of this report for better conceptual understanding.

Experiment 1

Experiment 1

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.443E+01	.000E+00	.000E+00	.443E+01	.443E+01	1

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	.029	.021	.00	.04	********	.04

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.000	.004	1	0	.003
2		.000	.000	0	0	.000
3	CALENDAR	2.750	.433	3	3	54.983

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0016	.2107	2	1	1600
2	.7483	.4340	1	1	1599
3	.0000	.0000	1	0	1
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	1	.75	.434	1	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+ + + + + + + + + + + +
1	1.000	.120E+02	+**********
0	.000	.240E+02	+ C
0	.000	.360E+02	+ C
0	.000	.480E+02	+ C
0	.000	.600E+02	+ C
0	.000	.720E+02	+ C
0	.000	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

180:0 / 180:10 / 135:5

Experiment 1

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.225E+02	.188E+02	.834E+00	.293E-01	.103E+03	251

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	28.858	16.913	.00	56.43	*********	56.43

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.020	.139	1	1	3.536
2		.000	.000	0	0	.000
3	CALENDAR	2.751	.441	4	3	53.172

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0048	.3649	2	1	1600
2	.7457	.4355	1	1	1598
3	.0000	.0000	1	0	251
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	1	.75	.435	1	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
88	.351	.120E+02	+******************
67	.267	.240E+02	+************* C
43	.171	.360E+02	+********* C
26	.104	.480E+02	+***** C
14	.056	.600E+02	+*** C
8	.032	.720E+02	+** C+
3	.012	.840E+02	+* C
1	.004	.960E+02	+ C
1	.004	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

180:0 / 180:30 / 135:15

Experiment 1

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.460E+02	.362E+02	.788E+00	.938E-01	.166E+03	573

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	134.933	78.608	.00	263.51	*********	263.51

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.091	.288	1	0	16.480
2		.000	.000	0	0	.000
3	CALENDAR	2.757	.479	4	4	51.042

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0145	.4654	2	2	1599
2	.7428	.4371	1	1	1598
3	.0000	.0000	1	0	573
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	1	.74	.437	1	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
108	.188	.120E+02	+*********
89	.155	.240E+02	+******** C
82	.143	.360E+02	+******* C
68	.119	.480E+02	+****** C
46	.080	.600E+02	+**** C
50	.087	.720E+02	+**** C
35	.061	.840E+02	+*** C
25	.044	.960E+02	+** C
34	.059	.108E+03	+*** C
13	.023	.120E+03	+* C
7	.012	.132E+03	+* C
7	.012	.144E+03	+* C
6	.010	.156E+03	+* C
3	.005	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

180:0 / 180:50 / 135:35

Experiment 2

Experiment 2

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.913E+01	.736E+01	.806E+00	.357E+00	.259E+02	35

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	1.667	.792	.00	3.20	*********	3.20

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.001	.033	1	0	.200
2		.000	.000	0	0	.000
3	CALENDAR	2.751	.444	4	3	54.709

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0010	.3049	2	1	1601
2	.7498	.4331	1	1	1600
3	.0000	.0000	1	0	35
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	1	.75	.433	1	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
25	.714	.120E+02	+**********
7	.200	.240E+02	+********** C
3	.086	.360E+02	+**** C
0	.000	.480E+02	+ C
0	.000	.600E+02	+ C
0	.000	.720E+02	+ C
0	.000	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

180:20 / 180:5 / 135:5

Experiment 2

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.264E+02	.217E+02	.823E+00	.103E+00	.109E+03	304

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	39.572	21.791	.00	80.20	*********	80.20

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.028	.165	1	0	5.010
2		.000	.000	0	0	.000
3	CALENDAR	2.749	.461	5	3	52.705

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0011	.3751	2	1	1601
2	.7474	.4345	1	1	1600
3	.0000	.0000	1	0	304
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	1	.75	.434	1	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
91	.299	.120E+02	+**********
78	.257	.240E+02	+**********C
56	.184	.360E+02	+*********C
30	.099	.480E+02	+*****C
21	.069	.600E+02	+***C
16	.053	.720E+02	+***C
4	.013	.840E+02	+*C
6	.020	.960E+02	+*C
0	.000	.108E+03	+C
2	.007	.120E+03	+C
0	.000	.132E+03	+C
0	.000	.144E+03	+C
0	.000	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

180:20 / 180:25 / 135:25

Experiment 2

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.621E+02	.487E+02	.783E+00	.469E-01	.236E+03	664

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	210.879	118.549	.00	412.59	*********	412.59

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.145	.361	2	0	25.936
2		.000	.000	0	0	.000
3	CALENDAR	2.774	.525	5	2	50.442

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0186	.5072	3	1	1610
2	.7556	.4297	1	0	1608
3	.0000	.0000	1	0	664
5 DIVERT	.0000	.0000	1	0	2

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	1	.76	.430	1	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
95	.143	.120E+02	+*******
80	.120	.240E+02	+******C
77	.116	.360E+02	+******C
60	.090	.480E+02	+*****C
63	.095	.600E+02	+*****C
59	.089	.720E+02	+****C
31	.047	.840E+02	+**C
40	.060	.960E+02	+***C
41	.062	.108E+03	+***C
31	.047	.120E+03	+**C
18	.027	.132E+03	+*C
16	.024	.144E+03	+*C
22	.033	.156E+03	+**C
8	.012	.168E+03	+*C
6	.009	.180E+03	+C
6	.009	.192E+03	+C
6	.009	.204E+03	+C
2	.003	.216E+03	+C
2	.003	.228E+03	+C
1	.002	.240E+03	+C
0	.000	INF	+C

180:30 / 180:50 / 135:45

Experiment 3

Experiment 3

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                  MEAN     STANDARD  COEFF. OF  MINIMUM   MAXIMUM  NO.OF
                  VALUE    DEVIATION VARIATION   VALUE      VALUE    OBS
HOLD TIME        .834E+02  .441E+02  .528E+00  .387E+02  .127E+03     3

                   MEAN   STANDARD  MINIMUM MAXIMUM  TIME     CURRENT
                   VALUE  DEVIATION VALUE   VALUE    INTERVAL  VALUE
TOTAL HOLD TIME     2.499      .087     .00    2.50 *********    2.50

FILE                    AVERAGE  STANDARD   MAXIMUM  CURRENT AVERAGE
NUMBER  LABEL/TYPE      LENGTH   DEVIATION  LENGTH   LENGTH  WAIT TIME
   1    LAND AWAIT         .001      .029       1        0       .208
   2                       .000      .000       0        0       .000
   3         CALENDAR     3.313      .584       5        3     85.034

ACTIVITY           AVERAGE      STANDARD     MAXIMUM CURRENT   ENTITY
INDEX/LABEL        UTILIZATION  DEVIATION    UTIL    UTIL      COUNT
   1                     .7509        .4469       2       1      1201
   2                     .5624        .4961       1       0      1201
   3                     .0000        .0000       1       0         3
   5 DIVERT              .0000        .0000       0       0         0

RESOURCE  RESOURCE  CURRENT   AVERAGE  STANDARD   MAXIMUM  CURRENT
NUMBER    LABEL     CAPACITY   UTIL    DEVIATION   UTIL     UTIL
    1     RAMP           1        .56       .496      1        0

                        **HISTOGRAM NUMBER 1**
                             HOLD TIME
OBS  RELA   UPPER
FREQ FREQ   CELL LIM 0        20        40        60        80       100
                    +    +    +    +    +    +    +    +    +    +    +
  0  .000  .000E+00 +                                                  +
  0  .000  .120E+02 +                                                  +
  0  .000  .240E+02 +                                                  +
  0  .000  .360E+02 +                                                  +
  1  .333  .480E+02 +*****************                                 +
  0  .000  .600E+02 +                C                                 +
  0  .000  .720E+02 +                C                                 +
  0  .000  .840E+02 +                C                                 +
  1  .333  .960E+02 +*****************              C                  +
  0  .000  .108E+03 +                               C                  +
  0  .000  .120E+03 +                               C                  +
  1  .333  .132E+03 +*****************                                C
  0  .000  .144E+03 +                                                  C
  0  .000  .156E+03 +                                                  C
  0  .000  .168E+03 +                                                  C
  0  .000  .180E+03 +                                                  C
  0  .000  .192E+03 +                                                  C
  0  .000  .204E+03 +                                                  C
  0  .000  .216E+03 +                                                  C
  0  .000  .228E+03 +                                                  C
  0  .000  .240E+03 +                                                  C
  0  .000    INF    +                                                  C
```

180(360):0 / 180:5 / 135:5

Experiment 3

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.161E+02	.230E+02	.143E+01	.422E+00	.111E+03	30

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	3.523	.944	.00	4.83	*********	4.83

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.002	.041	1	0	.402
2		.000	.000	0	0	.000
3	CALENDAR	3.313	.584	5	3	84.615

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	.7516	.4715	2	1	1201
2	.5614	.4962	1	0	1201
3	.0000	.0000	1	0	30
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	1	.56	.496	1	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
18	.600	.120E+02	+******************************
7	.233	.240E+02	+************ C
3	.100	.360E+02	+***** C
0	.000	.480E+02	+ C
0	.000	.600E+02	+ C
0	.000	.720E+02	+ C
1	.033	.840E+02	+** C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
1	.033	.120E+03	+** C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

180(360):0 / 180:15 / 135:15

Experiment 3

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.297E+02	.257E+02	.865E+00	.938E-01	.131E+03	192

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	28.250	17.159	.00	57.06	*********	57.06

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.020	.139	1	0	4.751
2		.000	.000	0	0	.000
3	CALENDAR	3.313	.591	5	4	82.270

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	.7528	.5171	2	1	1201
2	.5603	.4964	1	1	1200
3	.0000	.0000	1	0	192
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	1	.56	.496	1	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
64	.333	.120E+02	+******************
38	.198	.240E+02	+**********C
25	.130	.360E+02	+*******C
27	.141	.480E+02	+*******C
14	.073	.600E+02	+****C
10	.052	.720E+02	+***C
4	.021	.840E+02	+*C
5	.026	.960E+02	+*C
3	.016	.108E+03	+*C
1	.005	.120E+03	+C
1	.005	.132E+03	+C
0	.000	.144E+03	+C
0	.000	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

180(360):0 / 180:35 / 135:25

Experiment 4

Experiment 4

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                  MEAN     STANDARD  COEFF. OF  MINIMUM   MAXIMUM  NO.OF
                  VALUE    DEVIATION VARIATION   VALUE      VALUE    OBS
HOLD TIME        .937E+02  .415E+02  .442E+00  .504E+02  .133E+03     3

                   MEAN   STANDARD  MINIMUM MAXIMUM  TIME     CURRENT
                   VALUE  DEVIATION VALUE   VALUE    INTERVAL  VALUE
TOTAL HOLD TIME     2.807      .099     .00    2.81 *********    2.81

FILE                    AVERAGE  STANDARD   MAXIMUM  CURRENT AVERAGE
NUMBER  LABEL/TYPE      LENGTH   DEVIATION  LENGTH   LENGTH  WAIT TIME
   1    LAND AWAIT         .001      .031       1        0       .235
   2                       .000      .000       0        0       .000
   3         CALENDAR     3.307      .584       5        3     85.248

ACTIVITY            AVERAGE      STANDARD     MAXIMUM CURRENT   ENTITY
INDEX/LABEL         UTILIZATION  DEVIATION    UTIL    UTIL      COUNT
   1                      .7474        .4634       2       0      1196
   2                      .5595        .4964       1       1      1195
   3                      .0000        .0000       1       0         3
   5 DIVERT               .0000        .0000       0       0         0

RESOURCE  RESOURCE  CURRENT   AVERAGE  STANDARD   MAXIMUM  CURRENT
NUMBER    LABEL     CAPACITY   UTIL    DEVIATION   UTIL     UTIL
    1     RAMP           1        .56       .496      1        1

                      **HISTOGRAM NUMBER 1**
                           HOLD TIME
OBS  RELA   UPPER
FREQ FREQ  CELL LIM 0        20        40        60        80       100
                    +    +    +    +    +    +    +    +    +    +    +
  0  .000  .000E+00 +                                                  +
  0  .000  .120E+02 +                                                  +
  0  .000  .240E+02 +                                                  +
  0  .000  .360E+02 +                                                  +
  0  .000  .480E+02 +                                                  +
  1  .333  .600E+02 +*****************                                 +
  0  .000  .720E+02 +                C                                 +
  0  .000  .840E+02 +                C                                 +
  0  .000  .960E+02 +                C                                 +
  1  .333  .108E+03 +*****************              C                  +
  0  .000  .120E+03 +                               C                  +
  0  .000  .132E+03 +                               C                  +
  1  .333  .144E+03 +*****************                                C
  0  .000  .156E+03 +                                                  C
  0  .000  .168E+03 +                                                  C
  0  .000  .180E+03 +                                                  C
  0  .000  .192E+03 +                                                  C
  0  .000  .204E+03 +                                                  C
  0  .000  .216E+03 +                                                  C
  0  .000  .228E+03 +                                                  C
  0  .000  .240E+03 +                                                  C
  0  .000    INF    +                                                  C
```

180(360):10 / 180:5 / 135:5

Experiment 4

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.172E+02	.236E+02	.138E+01	.122E+01	.129E+03	52

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	6.595	1.496	.00	8.93	*********	8.93

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.003	.056	1	0	.748
2		.000	.000	0	0	.000
3	CALENDAR	3.302	.582	5	3	84.585

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	.7452	.4823	2	0	1193
2	.5568	.4968	1	1	1192
3	.0000	.0000	1	0	52
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	1	.56	.497	1	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
33	.635	.120E+02	+**********
9	.173	.240E+02	+********* C
5	.096	.360E+02	+***** C
2	.038	.480E+02	+** C
1	.019	.600E+02	+* C
0	.000	.720E+02	+ C
0	.000	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
1	.019	.120E+03	+* C
1	.019	.132E+03	+* C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

180(360):15 / 180:15 / 135:15

Experiment 4

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.351E+02	.280E+02	.796E+00	.438E+00	.130E+03	193

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	38.410	16.656	.00	67.80	*********	67.80

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.024	.152	1	0	5.702
2		.000	.000	0	0	.000
3	CALENDAR	3.298	.591	6	3	82.669

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	.7453	.5260	3	0	1189
2	.5529	.4972	1	1	1188
3	.0000	.0000	1	0	193
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	1	.55	.497	1	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
41	.212	.120E+02	+**********
44	.228	.240E+02	+**********C
30	.155	.360E+02	+********C
24	.124	.480E+02	+******C
21	.109	.600E+02	+*****C
14	.073	.720E+02	+****C
7	.036	.840E+02	+**C
2	.010	.960E+02	+*C
4	.021	.108E+03	+*C
4	.021	.120E+03	+*C
2	.010	.132E+03	+*C
0	.000	.144E+03	+C
0	.000	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

180(360):20 / 180:35 / 135:25

Experiment 5

Experiment 5

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                  MEAN    STANDARD  COEFF. OF  MINIMUM   MAXIMUM  NO.OF
                  VALUE   DEVIATION VARIATION   VALUE      VALUE    OBS
HOLD TIME                           NO VALUES RECORDED

                   MEAN   STANDARD  MINIMUM MAXIMUM  TIME     CURRENT
                   VALUE  DEVIATION VALUE   VALUE    INTERVAL  VALUE
TOTAL HOLD TIME     .000      .000     .00     .00 *********     .00

FILE                   AVERAGE  STANDARD   MAXIMUM  CURRENT AVERAGE
NUMBER  LABEL/TYPE     LENGTH   DEVIATION  LENGTH   LENGTH  WAIT TIME
   1    LAND AWAIT       .000      .000       1        0       .000
   2                     .000      .000       0        0       .000
   3         CALENDAR   4.498      .502       5        5     44.993

ACTIVITY           AVERAGE      STANDARD     MAXIMUM CURRENT   ENTITY
INDEX/LABEL        UTILIZATION  DEVIATION    UTIL    UTIL      COUNT

   1                   2.0018       .2989       3       3      3198
   2                   1.4958       .5015       2       1      3197
   3                    .0000       .0000       0       0         0
   5 DIVERT             .0000       .0000       0       0         0

RESOURCE  RESOURCE  CURRENT   AVERAGE  STANDARD   MAXIMUM  CURRENT
NUMBER    LABEL     CAPACITY   UTIL    DEVIATION   UTIL     UTIL
    1     RAMP           2       1.50       .501      2        1

                        **HISTOGRAM NUMBER 1**
                             HOLD TIME
OBS  RELA   UPPER
FREQ FREQ  CELL LIM 0        20        40        60        80       100
                    +    +    +    +    +    +    +    +    +    +    +

                   NO VALUES RECORDED.
```

180:0 / 180:10 / 135:5

Experiment 5

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.215E+02	.177E+02	.822E+00	.109E+00	.876E+02	525

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	54.240	31.972	.00	112.74	*********	112.74

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.039	.195	2	0	3.525
2		.000	.000	0	0	.000
3	CALENDAR	4.496	.526	6	6	43.393

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	2.0062	.5122	4	3	3198
2	1.4895	.5575	2	2	3196
3	.0000	.0000	1	0	525
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.49	.557	2	2

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + +
0	.000	.000E+00	+
192	.366	.120E+02	+******************
148	.282	.240E+02	+************** C
90	.171	.360E+02	+********* C
41	.078	.480E+02	+**** C
31	.059	.600E+02	+*** C
17	.032	.720E+02	+** C
4	.008	.840E+02	+ C
2	.004	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

180:0 / 180:30 / 135:15

Experiment 5

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.409E+02	.304E+02	.743E+00	.313E-01	.150E+03	944

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	191.172	108.517	.00	386.18	*********	386.18

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.134	.361	2	0	12.072
2		.000	.000	0	0	.000
3	CALENDAR	4.500	.601	7	5	42.203

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	2.0203	.6286	4	2	3199
2	1.4799	.6255	2	2	3197
3	.0000	.0000	1	0	944
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.48	.626	2	2

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + +
0	.000	.000E+00	+
181	.192	.120E+02	+**********
162	.172	.240E+02	+*********C
135	.143	.360E+02	+*******C
139	.147	.480E+02	+*******C
93	.099	.600E+02	+*****C
80	.085	.720E+02	+****C
60	.064	.840E+02	+***C
35	.037	.960E+02	+**C
31	.033	.108E+03	+**C+
14	.015	.120E+03	+*C+
8	.008	.132E+03	+C
3	.003	.144E+03	+C
3	.003	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

180:0 / 180:50 / 135:35

Experiment 6

Experiment 6

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.104E+02	.102E+02	.982E+00	.156E-01	.493E+02	96

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	4.863	3.051	.00	10.01	*********	10.01

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.003	.059	1	0	.313
2		.000	.000	0	0	.000
3	CALENDAR	4.499	.505	6	5	44.662

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	2.0002	.3814	3	2	3202
2	1.4990	.5067	2	2	3200
3	.0000	.0000	1	0	96
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.50	.507	2	2

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + +
0	.000	.000E+00	+
66	.688	.120E+02	+**********
21	.219	.240E+02	+********** C +
7	.073	.360E+02	+**** C+
1	.010	.480E+02	+* C+
1	.010	.600E+02	+* C
0	.000	.720E+02	+ C
0	.000	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

90:5 / 180:15 / 135:10

Experiment 6

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.252E+02	.216E+02	.859E+00	.156E-01	.113E+03	629

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	79.209	45.507	.00	158.46	*********	158.46

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.055	.231	2	1	4.952
2		.000	.000	0	0	.000
3	CALENDAR	4.504	.587	7	4	43.052

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	2.0029	.5668	5	1	3209
2	1.5016	.5596	2	2	3206
3	.0000	.0000	1	0	629
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.50	.560	2	2

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + +
0	.000	.000E+00	+
216	.343	.120E+02	+**********
147	.234	.240E+02	+********** C
100	.159	.360E+02	+******** C
76	.121	.480E+02	+****** C
42	.067	.600E+02	+*** C
21	.033	.720E+02	+** C
14	.022	.840E+02	+* C+
6	.010	.960E+02	+ C+
6	.010	.108E+03	+ C
1	.002	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

90:10 / 180:30 / 135:15

Experiment 6

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.468E+02	.358E+02	.765E+00	.156E-01	.211E+03	1063

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	262.830	137.744	.00	497.44	*********	497.44

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.173	.428	3	2	15.481
2		.000	.000	0	0	.000
3	CALENDAR	4.515	.742	8	3	41.849

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	2.0152	.7085	5	0	3215
2	1.4996	.6189	2	2	3211
3	.0000	.0000	1	0	1063
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.50	.619	2	2

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
166	.156	.120E+02	+********
162	.152	.240E+02	+********C
157	.148	.360E+02	+*******C
143	.135	.480E+02	+*******C
117	.110	.600E+02	+******C
92	.087	.720E+02	+****C
64	.060	.840E+02	+***C
49	.046	.960E+02	+**C
43	.040	.108E+03	+**C
25	.024	.120E+03	+*C
15	.014	.132E+03	+*C
14	.013	.144E+03	+*C
4	.004	.156E+03	+C
7	.007	.168E+03	+C
1	.001	.180E+03	+C
1	.001	.192E+03	+C
2	.002	.204E+03	+C
1	.001	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

90:25 / 180:45 / 135:35

Experiment 7

Experiment 7

```
                  MEAN     STANDARD  COEFF. OF  MINIMUM   MAXIMUM  NO.OF
                  VALUE    DEVIATION VARIATION   VALUE      VALUE    OBS
HOLD TIME        .419E+02  .000E+00  .000E+00  .419E+02  .419E+02     1

                   MEAN   STANDARD  MINIMUM MAXIMUM  TIME     CURRENT
                   VALUE  DEVIATION VALUE   VALUE    INTERVAL  VALUE
TOTAL HOLD TIME      .419      .014     .00     .42 *********     .42

FILE                    AVERAGE  STANDARD   MAXIMUM  CURRENT AVERAGE
NUMBER  LABEL/TYPE      LENGTH   DEVIATION  LENGTH   LENGTH  WAIT TIME
   1    LAND AWAIT         .000      .012       1        0       .021
   2                       .000      .000       0        0       .000
   3         CALENDAR     4.190     1.261       7        3     65.514

ACTIVITY            AVERAGE      STANDARD     MAXIMUM CURRENT   ENTITY
INDEX/LABEL         UTILIZATION  DEVIATION    UTIL    UTIL      COUNT
   1                     1.2529       .8548       3       1      2001
   2                      .9369       .7474       2       0      2001
   3                      .0000       .0000       1       0         1
   5 DIVERT               .0000       .0000       0       0         0

RESOURCE  RESOURCE  CURRENT   AVERAGE  STANDARD   MAXIMUM  CURRENT
NUMBER    LABEL     CAPACITY   UTIL    DEVIATION   UTIL     UTIL
    1     RAMP           2        .94       .747      2        0

                       **HISTOGRAM NUMBER 1**
                            HOLD TIME
OBS  RELA   UPPER
FREQ FREQ  CELL LIM 0        20        40        60        80       100
                    +    +    +    +    +    +    +    +    +    +    +
  0  .000  .000E+00 +                                                  +
  0  .000  .120E+02 +                                                  +
  0  .000  .240E+02 +                                                  +
  0  .000  .360E+02 +                                                  +
  1 1.000  .480E+02 +**************************************************
  0  .000  .600E+02 +                                                  C
  0  .000  .720E+02 +                                                  C
  0  .000  .840E+02 +                                                  C
  0  .000  .960E+02 +                                                  C
  0  .000  .108E+03 +                                                  C
  0  .000  .120E+03 +                                                  C
  0  .000  .132E+03 +                                                  C
  0  .000  .144E+03 +                                                  C
  0  .000  .156E+03 +                                                  C
  0  .000  .168E+03 +                                                  C
  0  .000  .180E+03 +                                                  C
  0  .000  .192E+03 +                                                  C
  0  .000  .204E+03 +                                                  C
  0  .000  .216E+03 +                                                  C
  0  .000  .228E+03 +                                                  C
  0  .000  .240E+03 +                                                  C
  0  .000    INF    +                                                  C
```

90(360):0 / 180:10 / 135:5

Experiment 7

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.198E+02	.160E+02	.807E+00	.117E+00	.779E+02	219

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	22.976	11.815	.00	43.40	*********	43.40

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.015	.122	2	0	2.169
2		.000	.000	0	0	.000
3	CALENDAR	4.192	1.260	7	3	64.033

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.2573	.9016	4	1	2001
2	.9347	.7651	2	0	2001
3	.0000	.0000	1	0	219
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	.93	.765	2	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
86	.393	.120E+02	+******************
59	.269	.240E+02	+************ C
43	.196	.360E+02	+********** C
16	.073	.480E+02	+**** C
9	.041	.600E+02	+** C+
5	.023	.720E+02	+* C
1	.005	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

90(360):0 / 180:30 / 135:15

Experiment 7

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.392E+02	.295E+02	.754E+00	.250E+00	.135E+03	403

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	80.599	43.239	.00	157.91	*********	157.91

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.055	.240	2	0	7.891
2		.000	.000	0	0	.000
3	CALENDAR	4.202	1.267	8	4	62.896

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.2694	.9409	4	1	2001
2	.9326	.7868	2	1	2000
3	.0000	.0000	1	0	403
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	.93	.787	2	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + +
0	.000	.000E+00	+
87	.216	.120E+02	+**********
65	.161	.240E+02	+******** C
62	.154	.360E+02	+******** C
57	.141	.480E+02	+******* C
34	.084	.600E+02	+**** C
33	.082	.720E+02	+**** C
29	.072	.840E+02	+**** C
17	.042	.960E+02	+** C
12	.030	.108E+03	+* C
4	.010	.120E+03	+ C
2	.005	.132E+03	+ C
1	.002	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

90(360):0 / 180:50 / 135:50

Experiment 8

Experiment 8

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.958E+01	.167E+02	.174E+01	.119E+01	.472E+02	7

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	.600	.054	.00	.67	*********	.67

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.000	.015	1	0	.034
2		.000	.000	0	0	.000
3	CALENDAR	4.166	1.259	7	2	65.728

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.2382	.8574	3	0	1982
2	.9282	.7468	2	0	1982
3	.0000	.0000	1	0	7
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	.93	.747	2	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
6	.857	.120E+02	+**
0	.000	.240E+02	+ C
0	.000	.360E+02	+ C
1	.143	.480E+02	+******* C
0	.000	.600E+02	+ C
0	.000	.720E+02	+ C
0	.000	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

90(360):5 / 180:10 / 135:5

Experiment 8

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.247E+02	.212E+02	.856E+00	.313E-01	.909E+02	218

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	26.432	15.803	.00	53.92	*********	53.92

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.019	.137	2	0	2.754
2		.000	.000	0	0	.000
3	CALENDAR	4.137	1.258	7	3	64.550

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.2223	.9010	4	0	1958
2	.9152	.7634	2	1	1957
3	.0000	.0000	1	0	218
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	.92	.763	2	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + +
0	.000	.000E+00	+
73	.335	.120E+02	+**********
56	.257	.240E+02	+**********C
38	.174	.360E+02	+*********C
21	.096	.480E+02	+*****C
11	.050	.600E+02	+***C
10	.046	.720E+02	+**C
5	.023	.840E+02	+*C
4	.018	.960E+02	+*C
0	.000	.108E+03	+C
0	.000	.120E+03	+C
0	.000	.132E+03	+C
0	.000	.144E+03	+C
0	.000	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

90(360):10 / 180:30 / 135:15

Experiment 8

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.424E+02	.315E+02	.744E+00	.375E+00	.152E+03	455

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	98.413	54.505	.00	192.75	*********	192.75

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.067	.267	3	0	9.829
2		.000	.000	0	0	.000
3	CALENDAR	4.161	1.287	8	3	63.136

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.2441	.9693	5	0	1961
2	.9170	.7869	2	1	1960
3	.0000	.0000	1	0	455
5 DIVERT	.0000	.0000	0	0	0

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	.92	.787	2	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
71	.156	.120E+02	+********
87	.191	.240E+02	+**********C
69	.152	.360E+02	+********C
62	.136	.480E+02	+*******C
55	.121	.600E+02	+******C
34	.075	.720E+02	+****C
29	.064	.840E+02	+***C
12	.026	.960E+02	+*C
14	.031	.108E+03	+**C
10	.022	.120E+03	+*C
6	.013	.132E+03	+*C
5	.011	.144E+03	+*C
1	.002	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

90(360):20 / 180:50 / 135:35

Experiment 9

Experiment 9

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.443E+01	.000E+00	.000E+00	.443E+01	.443E+01	1

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	.029	.021	.00	.04	*********	.04

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.000	.004	1	0	.003
2		.000	.000	0	0	.000
3	CALENDAR	3.750	.433	4	4	67.473

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0016	.2107	2	1	1600
2	.7483	.4340	1	1	1599
3	.0000	.0000	1	0	1
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	801
9 HEAVY	.0000	.0000	1	0	800

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.12	.781	2	2

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
1	1.000	.120E+02	+**********
0	.000	.240E+02	+ C
0	.000	.360E+02	+ C
0	.000	.480E+02	+ C
0	.000	.600E+02	+ C
0	.000	.720E+02	+ C
0	.000	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Medium 360:0 / 180:10 / 135:5
Heavy 360:0 / 180:10 / 135:5

Experiment 9

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.225E+02	.188E+02	.834E+00	.293E-01	.103E+03	251

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	28.858	16.913	.00	56.43	*********	56.43

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.020	.139	1	1	3.536
2		.000	.000	0	0	.000
3	CALENDAR	3.751	.441	5	4	65.464

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0048	.3649	2	1	1600
2	.7457	.4355	1	1	1598
3	.0000	.0000	1	0	251
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	801
9 HEAVY	.0000	.0000	1	0	800

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.12	.783	2	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + +
0	.000	.000E+00	+
88	.351	.120E+02	+******************
67	.267	.240E+02	+************* C
43	.171	.360E+02	+********* C
26	.104	.480E+02	+***** C
14	.056	.600E+02	+*** C
8	.032	.720E+02	+** C+
3	.012	.840E+02	+* C
1	.004	.960E+02	+ C
1	.004	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Medium 360:0 / 180:30 / 135:15
Heavy 360:0 / 180:30 / 135:15

Experiment 9

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.459E+02	.363E+02	.789E+00	.938E-01	.166E+03	572

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	134.444	78.326	.00	262.78	*********	262.78

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.091	.288	1	0	16.434
2		.000	.000	0	0	.000
3	CALENDAR	3.757	.479	5	5	63.068

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0145	.4654	2	2	1599
2	.7428	.4377	2	1	1598
3	.0000	.0000	1	0	572
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	801
9 HEAVY	.0000	.0000	1	0	800

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.11	.784	2	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
108	.189	.120E+02	+*********
89	.156	.240E+02	+******** C
82	.143	.360E+02	+******* C
68	.119	.480E+02	+****** C
46	.080	.600E+02	+**** C
50	.087	.720E+02	+**** C
34	.059	.840E+02	+*** C
25	.044	.960E+02	+** C
34	.059	.108E+03	+*** C
13	.023	.120E+03	+* C
7	.012	.132E+03	+* C
7	.012	.144E+03	+* C
6	.010	.156E+03	+* C
3	.005	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Medium 360:0 / 180:50 / 135:35
Heavy 360:0 / 180:50 / 135:35

Experiment 10

Experiment 10

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.701E+02	.414E+02	.590E+00	.133E+00	.143E+03	610

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	133.795	130.115	.00	427.61	*********	427.61

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.148	.356	1	0	26.742
2		.000	.000	0	0	.000
3	CALENDAR	3.749	.575	5	4	62.706

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0003	.7213	2	2	1599
2	.7490	.4336	1	0	1599
3	.0000	.0000	1	0	610
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	801
9 HEAVY	.0000	.0000	1	0	800

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.12	.781	2	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
63	.103	.120E+02	+*****
64	.105	.240E+02	+***** C
40	.066	.360E+02	+*** C
42	.069	.480E+02	+*** C
43	.070	.600E+02	+**** C
51	.084	.720E+02	+**** C
42	.069	.840E+02	+*** C
62	.102	.960E+02	+***** C
58	.095	.108E+03	+***** C
60	.098	.120E+03	+***** C
65	.107	.132E+03	+***** C
20	.033	.144E+03	+** C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Medium 360:5 / 180:10 / 135: 5
Heavy 360:5 / 180:10 / 135: 5

Experiment 10

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.687E+02	.406E+02	.591E+00	.625E-01	.160E+03	622

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	216.382	132.401	.00	427.06	*********	427.06

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.148	.355	2	0	26.691
2		.000	.000	0	0	.000
3	CALENDAR	3.749	.573	6	3	62.585

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0003	.7126	2	1	1600
2	.7483	.4342	2	0	1600
3	.0000	.0000	1	0	622
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	799
9 HEAVY	.0000	.0000	1	0	802

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.12	.782	2	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+ + + + + + + + + + + +
68	.109	.120E+02	+*****
43	.069	.240E+02	+*** C
56	.090	.360E+02	+***** C
53	.085	.480E+02	+**** C
46	.074	.600E+02	+**** C
50	.080	.720E+02	+**** C
68	.109	.840E+02	+***** C
61	.098	.960E+02	+***** C
59	.095	.108E+03	+***** C
44	.071	.120E+03	+**** C
42	.068	.132E+03	+*** C
19	.031	.144E+03	+** C
12	.019	.156E+03	+* C
1	.002	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Medium 360:15 / 180:30 / 135:15
Heavy 360:15 / 180:30 / 135:15

Experiment 10

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.714E+02	.475E+02	.666E+00	.252E+00	.226E+03	724

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	267.369	147.925	.00	516.65	*********	516.65

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.181	.391	2	0	32.431
2		.000	.000	0	0	.000
3	CALENDAR	3.776	.605	6	4	61.949

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0243	.6990	3	1	1609
2	.7520	.4330	2	1	1606
3	.0000	.0000	1	0	724
5 DIVERT	.0000	.0000	1	0	2
8 MEDIUM	.0000	.0000	1	0	807
9 HEAVY	.0000	.0000	1	0	803

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	2	1.13	.781	2	2

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+ + + + + + + + + + + +
76	.105	.120E+02	+***** C
78	.108	.240E+02	+***** C
52	.072	.360E+02	+**** C
57	.079	.480E+02	+**** C
75	.104	.600E+02	+***** C
49	.068	.720E+02	+*** C
63	.087	.840E+02	+**** C
53	.073	.960E+02	+**** C
44	.061	.108E+03	+*** C
53	.073	.120E+03	+**** C
44	.061	.132E+03	+*** C
26	.036	.144E+03	+** C
21	.029	.156E+03	+* C
15	.021	.168E+03	+* C
5	.007	.180E+03	+ C
4	.006	.192E+03	+ C
4	.006	.204E+03	+ C
4	.006	.216E+03	+ C
1	.001	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Medium 360:35 / 180:50 / 135:35
Heavy 360:35 / 180:50 / 135:35

Experiment 11

Experiment 11

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.443E+01	.000E+00	.000E+00	.443E+01	.443E+01	1

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	.029	.021	.00	.04	*********	.04

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.000	.004	1	0	.003
2		.000	.000	0	0	.000
3	CALENDAR	4.750	.433	5	5	85.461

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0016	.2107	2	1	1600
2	.7483	.4340	1	1	1599
3	.0000	.0000	1	0	1
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	400
9 HEAVY	.0000	.0000	1	0	400
10 LITE	.0000	.0000	1	0	801

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	4	1.50	1.370	4	2

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+ + + + + + + + + + +
1	1.000	.120E+02	+**********
0	.000	.240E+02	+ C
0	.000	.360E+02	+ C
0	.000	.480E+02	+ C
0	.000	.600E+02	+ C
0	.000	.720E+02	+ C
0	.000	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Light 360:0 / 180:30 / 135:15
Medium 720:0 / 180:30 / 135:15
Heavy 720:0 / 180:30 / 135:15

Experiment 11

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.239E+02	.194E+02	.814E+00	.375E+00	.103E+03	137

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	16.251	10.090	.00	32.72	*********	32.72

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.011	.106	1	0	2.045
2		.000	.000	0	0	.000
3	CALENDAR	4.751	.445	6	6	84.056

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0048	.3649	2	1	1600
2	.7458	.4535	2	2	1598
3	.0000	.0000	1	0	137
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	400
9 HEAVY	.0000	.0000	1	0	400
10 LITE	.0000	.0000	1	0	801

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	4	1.49	1.383	4	3

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
46	.336	.120E+02	+******************
33	.241	.240E+02	+************ C
24	.175	.360E+02	+********* C
17	.124	.480E+02	+****** C
10	.073	.600E+02	+**** C
4	.029	.720E+02	+* C
2	.015	.840E+02	+* C
0	.000	.960E+02	+ C
1	.007	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Light 360:0 / 180:30 / 135:15
Medium 720:0 / 180:30 / 135:15
Heavy 720:0 / 180:30 / 135:15

Experiment 11

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.447E+02	.355E+02	.795E+00	.469E+00	.154E+03	260

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALLUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALU
TOTAL HOLD TIME	60.027	35.591	.00	116.17	*********	116.17

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.040	.197	1	0	7.265
2		.000	.000	0	0	.000
3	CALENDAR	4.757	.506	6	6	82.861

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0145	.4654	2	2	1599
2	.7428	.5176	2	1	1598
3	.0000	.0000	1	0	260
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	400
9 HEAVY	.0000	.0000	1	0	400
10 LITE	.0000	.0000	1	0	801

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	4	1.48	1.425	4	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
53	.204	.120E+02	+**********
37	.142	.240E+02	+******* C
39	.150	.360E+02	+******** C
34	.131	.480E+02	+******* C
20	.077	.600E+02	+**** C
20	.077	.720E+02	+**** C
21	.081	.840E+02	+**** C
11	.042	.960E+02	+** C
9	.035	.108E+03	+** C
6	.023	.120E+03	+* C
2	.008	.132E+03	+ C
2	.008	.144E+03	+ C
6	.023	.156E+03	+* C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Light 360:0 / 180:50 / 135:35
Medium 720:0 / 180:50 / 135:35
Heavy 720:0 / 180:50 / 135:35

Experiment 12

Experiment 12

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.827E+02	.428E+02	.517E+00	.703E+00	.144E+03	221

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	38.620	54.246	.00	182.84	*********	182.84

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.063	.244	1	0	11.435
2		.000	.000	0	0	.000
3	CALENDAR	4.749	.569	6	5	83.184

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0003	.6813	2	2	1599
2	.7490	.5697	2	0	1599
3	.0000	.0000	1	0	221
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	400
9 HEAVY	.0000	.0000	1	0	400
10 LITE	.0000	.0000	1	0	801

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	4	1.50	1.466	4	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+ + + + + + + + + + +
20	.090	.120E+02	+*****
15	.068	.240E+02	+*** C
12	.054	.360E+02	+*** C
13	.059	.480E+02	+*** C
7	.032	.600E+02	+** C
7	.032	.720E+02	+** C
16	.072	.840E+02	+**** C
20	.090	.960E+02	+***** C
25	.113	.108E+03	+****** C
34	.154	.120E+03	+******** C
38	.172	.132E+03	+********* C
13	.059	.144E+03	+*** C
1	.005	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Light 360:5 / 180:10 / 135:5
Medium 720:5 / 180:10 / 135:5
Heavy 720:5 / 180:10 / 135:5

Experiment 12

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.727E+02	.460E+02	.633E+00	.391E+00	.236E+03	437

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	133.617	97.200	.00	317.88	*********	317.88

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.111	.333	2	0	20.037
2		.000	.000	0	0	.000
3	CALENDAR	4.747	.680	7	4	81.043

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	.9999	.7522	3	1	1599
2	.7474	.5930	2	0	1598
3	.0000	.0000	1	0	437
5 DIVERT	.0000	.0000	1	0	1
8 MEDIUM	.0000	.0000	1	0	400
9 HEAVY	.0000	.0000	1	0	401
10 LITE	.0000	.0000	1	0	799

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	4	1.50	1.487	4	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+ + + + + + + + + + +
38	.087	.120E+02	+**** +
40	.092	.240E+02	+***** C +
36	.082	.360E+02	+**** C +
45	.103	.480E+02	+***** C +
32	.073	.600E+02	+**** C +
38	.087	.720E+02	+**** C +
25	.057	.840E+02	+*** C +
39	.089	.960E+02	+**** C +
38	.087	.108E+03	+**** C +
34	.078	.120E+03	+**** C +
29	.066	.132E+03	+*** C +
23	.053	.144E+03	+*** C +
6	.014	.156E+03	+* C +
4	.009	.168E+03	+ C+
4	.009	.180E+03	+ C+
0	.000	.192E+03	+ C+
2	.005	.204E+03	+ C
0	.000	.216E+03	+ C
2	.005	.228E+03	+ C
2	.005	.240E+03	+ C
0	.000	INF	+ C

Light 360:15 / 180:30 / 135:15
Medium 720:15 / 180:30 / 135:15
Heavy 720:15 / 180:30 / 135:15

Experiment 12

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.753E+02	.529E+02	.702E+00	.156E-01	.239E+03	474

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALLUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALU
TOTAL HOLD TIME	177.672	103.095	.00	357.10	*********	357.10

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.128	.365	3	0	22.927
2		.000	.000	0	0	.000
3	CALENDAR	4.772	.732	7	6	80.730

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.0228	.7824	4	3	1605
2	.7495	.6048	3	0	1601
3	.0000	.0000	1	0	474
5 DIVERT	.0000	.0000	1	0	4
8 MEDIUM	.0000	.0000	1	0	402
9 HEAVY	.0000	.0000	1	0	401
10 LITE	.0000	.0000	1	0	805

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	4	1.50	1.497	4	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+ + + + + + + + + + + +
48	.101	.120E+02	+*****
40	.084	.240E+02	+**** C
46	.097	.360E+02	+***** C
41	.086	.480E+02	+**** C
41	.086	.600E+02	+**** C
32	.068	.720E+02	+*** C
43	.091	.840E+02	+***** C
30	.063	.960E+02	+*** C
28	.059	.108E+03	+*** C
31	.065	.120E+03	+*** C
16	.034	.132E+03	+** C
24	.051	.144E+03	+*** C
11	.023	.156E+03	+* C
16	.034	.168E+03	+** C
5	.011	.180E+03	+* C
8	.017	.192E+03	+* C
5	.011	.204E+03	+* C
2	.004	.216E+03	+ C
3	.006	.228E+03	+ C
4	.008	.240E+03	+ C
0	.000	INF	+ C

Light 360:35 / 180:50 / 135:35
Medium 720:35 / 180:50 / 135:35
Heavy 720:35 / 180:50 / 135:35

Experiment 13

Experiment 13

```
                  MEAN    STANDARD  COEFF. OF  MINIMUM   MAXIMUM  NO.OF
                  VALUE   DEVIATION VARIATION   VALUE      VALUE    OBS
HOLD TIME                           NO VALUES RECORDED

                   MEAN   STANDARD  MINIMUM MAXIMUM  TIME     CURRENT
                   VALUE  DEVIATION VALUE   VALUE    INTERVAL  VALUE
TOTAL HOLD TIME     .000      .000     .00     .00 *********     .00

FILE                   AVERAGE  STANDARD   MAXIMUM  CURRENT AVERAGE
NUMBER  LABEL/TYPE     LENGTH   DEVIATION  LENGTH   LENGTH  WAIT TIME
   1    LAND AWAIT       .000      .000       1        0       .000
   2                     .000      .000       0        0       .000
   3         CALENDAR    4.187      .635       5        4     60.312

ACTIVITY           AVERAGE      STANDARD     MAXIMUM CURRENT   ENTITY
INDEX/LABEL        UTILIZATION  DEVIATION    UTIL    UTIL      COUNT
   1                    1.2516       .4813       3       1      1999
   2                     .9355       .5550       2       1      1998
   3                     .0000       .0000       0       0         0
   5 DIVERT              .0000       .0000       0       0         0
   9 HEAVY               .0000       .0000       1       0       399
  10 LITE                .0000       .0000       1       0      1601

RESOURCE  RESOURCE  CURRENT   AVERAGE  STANDARD   MAXIMUM  CURRENT
NUMBER    LABEL     CAPACITY   UTIL    DEVIATION   UTIL     UTIL
    1     RAMP           5       1.50      1.578      5        1

                      **HISTOGRAM NUMBER 1**
                           HOLD TIME

OBS  RELA   UPPER
FREQ FREQ  CELL LIM 0        20        40        60        80       100
                    +    +    +    +    +    +    +    +    +    +    +


                    NO VALUES RECORDED.
```

Light 180:0 / 180:10 / 135:5
Heavy 720:0 / 180:10 / 135:5

Experiment 13

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.217E+02	.180E+02	.832E+00	.344E+00	.680E+02	61

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	6.928	3.888	.00	13.21	*********	13.21

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.005	.068	1	0	.661
2		.000	.000	0	0	.000
3	CALENDAR	4.189	.645	6	4	59.980

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.2562	.5653	3	1	1999
2	.9333	.5874	2	1	1998
3	.0000	.0000	1	0	61
5 DIVERT	.0000	.0000	0	0	0
9 HEAVY	.0000	.0000	1	0	399
10 LITE	.0000	.0000	1	0	1601

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.49	1.591	5	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + +
0	.000	.000E+00	+
24	.393	.120E+02	+**********
16	.262	.240E+02	+********** C
9	.148	.360E+02	+******* C
5	.082	.480E+02	+**** C
5	.082	.600E+02	+**** C
2	.033	.720E+02	+** C
0	.000	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Light 180:0 / 180310 / 135:15
Heavy 720:0 / 180:30 / 135:15

Experiment 13

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.321E+02	.273E+02	.852E+00	.961E+00	.116E+03	108

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	16.860	9.817	.00	34.68	*********	34.68

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.012	.109	1	0	1.735
2		.000	.000	0	0	.000
3	CALENDAR	4.200	.685	6	5	59.790

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.2681	.6263	3	1	1999
2	.9315	.6618	3	2	1997
3	.0000	.0000	1	0	108
5 DIVERT	.0000	.0000	0	0	0
9 HEAVY	.0000	.0000	1	0	399
10 LITE	.0000	.0000	1	0	1601

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.48	1.611	5	2

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
38	.352	.120E+02	+******************
15	.139	.240E+02	+*******C
13	.120	.360E+02	+******C
11	.102	.480E+02	+*****C
14	.130	.600E+02	+******C
6	.056	.720E+02	+***C
6	.056	.840E+02	+***C
2	.019	.960E+02	+*C
2	.019	.108E+03	+*C
1	.009	.120E+03	+C
0	.000	.132E+03	+C
0	.000	.144E+03	+C
0	.000	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

Light 180:0 / 180:50 / 135:35
Heavy 720:0 / 180:50 / 135:35

Experiment 14

Experiment 14

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.227E+01	.225E+01	.990E+00	.681E+00	.386E+01	2

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	.023	.019	.00	.05	*********	.05

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.000	.004	1	0	.002
2		.000	.000	0	0	.000
3	CALENDAR	4.185	.664	6	5	60.258

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.2492	.4841	3	2	1999
2	.9358	.5901	2	1	1998
3	.0000	.0000	1	0	2
5 DIVERT	.0000	.0000	0	0	0
9 HEAVY	.0000	.0000	1	0	400
10 LITE	.0000	.0000	1	0	1601

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.50	1.628	5	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + + +
0	.000	.000E+00	+
2	1.000	.120E+02	+**********
0	.000	.240E+02	+ C
0	.000	.360E+02	+ C
0	.000	.480E+02	+ C
0	.000	.600E+02	+ C
0	.000	.720E+02	+ C
0	.000	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Light 180:5 / 180:10 / 135:5
Heavy 720:5 / 180:10 / 135:5

Experiment 14

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.240E+02	.193E+02	.804E+00	.781E+00	.102E+03	59

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	6.746	4.204	.00	14.18	*********	14.18

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.005	.070	1	0	.708
2		.000	.000	0	0	.000
3	CALENDAR	4.185	.670	6	4	59.846

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.2496	.5793	3	2	2001
2	.9351	.6115	2	0	2001
3	.0000	.0000	1	0	59
5 DIVERT	.0000	.0000	0	0	0
9 HEAVY	.0000	.0000	1	0	400
10 LITE	.0000	.0000	1	0	1603

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.50	1.623	5	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + +
0	.000	.000E+00	+
15	.254	.120E+02	+**********
20	.339	.240E+02	+**********C
13	.220	.360E+02	+**********C
3	.051	.480E+02	+***C
5	.085	.600E+02	+****C
2	.034	.720E+02	+**C
0	.000	.840E+02	+C
0	.000	.960E+02	+C
1	.017	.108E+03	+*C
0	.000	.120E+03	+C
0	.000	.132E+03	+C
0	.000	.144E+03	+C
0	.000	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

Light 180:15 / 180:30 / 135:15
Heavy 720:15 / 180:30 / 135:15

Experiment 14

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.333E+02	.263E+02	.791E+00	.141E+00	.109E+03	125

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	21.948	11.394	.00	41.64	*********	41.64

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.014	.120	2	0	2.063
2		.000	.000	0	0	.000
3	CALENDAR	4.223	.749	7	4	59.450

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.2793	.6864	5	1	2018
2	.9433	.6801	3	1	2017
3	.0000	.0000	1	0	125
5 DIVERT	.0000	.0000	0	0	0
9 HEAVY	.0000	.0000	1	0	402
10 LITE	.0000	.0000	1	0	1617

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.50	1.622	5	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
			+ + + + + + + + + + +
0	.000	.000E+00	+
33	.264	.120E+02	+**********
27	.216	.240E+02	+**********C
18	.144	.360E+02	+*******C
14	.112	.480E+02	+******C
10	.080	.600E+02	+****C
8	.064	.720E+02	+***C
9	.072	.840E+02	+****C
4	.032	.960E+02	+**C
1	.008	.108E+03	+C
1	.008	.120E+03	+C
0	.000	.132E+03	+C
0	.000	.144E+03	+C
0	.000	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

Light 180:35 / 180:50 / 135:35
Heavy 720:35 / 180:50 / 135:35

Experiment 15

Experiment 15

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.343E+02	.333E+02	.973E+00	.334E+00	.135E+03	127

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	4.978	8.647	.00	43.51	*********	43.51

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.015	.141	2	0	2.362
2		.000	.000	0	0	.000
3	CALENDAR	8.014	1.193	11	7	120.931

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.1517	.8808	4	1	1842
2	.8625	.7401	3	0	1842
3	.0000	.0000	1	0	127
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	400
9 HEAVY	.0000	.0000	1	0	400
10 LITE	.0000	.0000	1	0	1043

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.61	1.682	5	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
48	.378	.120E+02	+******************
19	.150	.240E+02	+*******C
13	.102	.360E+02	+*****C
8	.063	.480E+02	+***C
10	.079	.600E+02	+****C
6	.047	.720E+02	+**C
10	.079	.840E+02	+****C
5	.039	.960E+02	+**C
5	.039	.108E+03	+**C
2	.016	.120E+03	+*C
0	.000	.132E+03	+C
1	.008	.144E+03	+C
0	.000	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

Light 150(480):5 / 180:10 / 135:5
Medium 2-in-12:5 / 180:10 / 135:5
Heavy 2-in-12:5 / 180:10 / 135:5

Experiment 15

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.812E+02	.551E+02	.678E+00	.469E+00	.240E+03	636

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	220.063	172.286	.00	516.65	*********	516.65

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.185	.537	4	0	28.853
2		.000	.000	0	0	.000
3	CALENDAR	8.011	1.426	13	7	114.741

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.1526	1.0758	5	1	1843
2	.8585	.8452	4	0	1837
3	.0000	.0000	1	0	636
5 DIVERT	.0000	.0000	1	0	6
8 MEDIUM	.0000	.0000	1	0	400
9 HEAVY	.0000	.0000	1	0	400
10 LITE	.0000	.0000	1	0	1044

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.60	1.762	5	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+ + + + + + + + + + +
61	.096	.120E+02	+*****
53	.083	.240E+02	+**** C
45	.071	.360E+02	+**** C
46	.072	.480E+02	+**** C
57	.090	.600E+02	+**** C
46	.072	.720E+02	+**** C
43	.068	.840E+02	+*** C
55	.086	.960E+02	+**** C
39	.061	.108E+03	+*** C
45	.071	.120E+03	+**** C
28	.044	.132E+03	+** C
30	.047	.144E+03	+** C
16	.025	.156E+03	+* C
21	.033	.168E+03	+** C
9	.014	.180E+03	+* C
14	.022	.192E+03	+* C
12	.019	.204E+03	+* C
7	.011	.216E+03	+* C
4	.006	.228E+03	+ C
5	.008	.240E+03	+ C
0	.000	INF	+ C

Light 150(480):15 / 180:30 / 135:15
Medium 2-in-12:15 / 180:30 / 135:15
Heavy 2-in-12:15 / 180:30 / 135:15

Experiment 15

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.694E+02	.485E+02	.699E+00	.781E+00	.239E+03	337

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALLUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALU
TOTAL HOLD TIME	127.890	74.708	.00	233.85	*********	233.85

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.081	.333	4	0	12.606
2		.000	.000	0	0	.000
3	CALENDAR	8.046	1.224	12	7	117.944

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.1782	.9714	5	0	1855
2	.8682	.7966	4	1	1854
3	.0000	.0000	1	0	337
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	401
9 HEAVY	.0000	.0000	1	0	401
10 LITE	.0000	.0000	1	0	1053

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.61	1.690	5	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+ + + + + + + + + + +
33	.098	.120E+02	+*****
29	.086	.240E+02	+**** C
43	.128	.360E+02	+****** C
36	.107	.480E+02	+***** C
25	.074	.600E+02	+**** C
30	.089	.720E+02	+**** C
28	.083	.840E+02	+**** C
19	.056	.960E+02	+*** C
19	.056	.108E+03	+*** C
13	.039	.120E+03	+** C
24	.071	.132E+03	+**** C
9	.027	.144E+03	+* C
10	.030	.156E+03	+* C
8	.024	.168E+03	+* C
4	.012	.180E+03	+* C
1	.003	.192E+03	+ C
4	.012	.204E+03	+* C
1	.003	.216E+03	+ C
0	.000	.228E+03	+ C
1	.003	.240E+03	+ C
0	.000	INF	+ C

Light 150(480):35 / 180:50 / 135:35
Medium 2-in-12:35 / 180:50 / 135:35
Heavy 2-in-12:35 / 180:50 / 135:35

Experiment 16

Experiment 16

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.325E+02	.301E+02	.926E+00	.156E-01	.131E+03	263

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	59.709	27.115	.00	85.57	*********	85.57

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.030	.200	2	0	3.751
2		.000	.000	0	0	.000
3	CALENDAR	8.494	1.116	12	7	103.012

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.4259	.8467	4	1	2281
2	1.0683	.7024	3	0	2281
3	.0000	.0000	1	0	263
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	400
9 HEAVY	.0000	.0000	1	0	401
10 LITE	.0000	.0000	1	0	1481

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.82	1.635	5	0

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
83	.316	.120E+02	+**********C
51	.194	.240E+02	+**********C
41	.156	.360E+02	+********C
24	.091	.480E+02	+*****C
21	.080	.600E+02	+****C
11	.042	.720E+02	+**C
11	.042	.840E+02	+**C
5	.019	.960E+02	+*C
5	.019	.108E+03	+*C
8	.030	.120E+03	+**C
3	.011	.132E+03	+*C
0	.000	.144E+03	+C
0	.000	.156E+03	+C
0	.000	.168E+03	+C
0	.000	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

Light 150(480):5 / 180:10 / 135:5
Medium 2-in-12:5 / 180:10 / 135:5
Heavy 2-in-12:5 / 180:10 / 135:5

Experiment 16

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.633E+02	.417E+02	.659E+00	.484E+00	.214E+03	528

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	174.477	90.560	.00	334.09	*********	334.09

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.116	.394	3	0	14.615
2		.000	.000	0	0	.000
3	CALENDAR	8.498	1.143	12	8	100.614

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.4297	.9297	5	1	2286
2	1.0687	.7541	3	1	2285
3	.0000	.0000	1	0	528
5 DIVERT	.0000	.0000	0	0	0
8 MEDIUM	.0000	.0000	1	0	400
9 HEAVY	.0000	.0000	1	0	401
10 LITE	.0000	.0000	1	0	1486

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.82	1.655	5	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
51	.097	.120E+02	+*****
72	.136	.240E+02	+******* C
54	.102	.360E+02	+***** C
46	.087	.480E+02	+**** C
51	.097	.600E+02	+***** C
40	.076	.720E+02	+**** C
37	.070	.840E+02	+**** C
41	.078	.960E+02	+**** C
43	.081	.108E+03	+**** C
34	.064	.120E+03	+*** C
32	.061	.132E+03	+*** C
16	.030	.144E+03	+** C
6	.011	.156E+03	+* C
3	.006	.168E+03	+ C
0	.000	.180E+03	+ C
1	.002	.192E+03	+ C
0	.000	.204E+03	+ C
1	.002	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Light 150(480):15 / 180:30 / 135:15
Medium 2-in-12:15 / 180:30 / 135:15
Heavy 2-in-12:15 / 180:30 / 135:15

Experiment 16

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.677E+02	.499E+02	.737E+00	.125E+00	.238E+03	365

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALLUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALU
TOTAL HOLD TIME	138.699	65.197	.00	247.11	*********	247.11

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.087	.351	4	0	10.858
2		.000	.000	0	0	.000
3	CALENDAR	8.531	1.022	12	8	101.602

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.4568	.8746	5	1	2302
2	1.0743	.7795	4	1	2300
3	.0000	.0000	1	0	365
5 DIVERT	.0000	.0000	1	0	1
8 MEDIUM	.0000	.0000	1	0	401
9 HEAVY	.0000	.0000	1	0	401
10 LITE	.0000	.0000	1	0	1501

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	5	1.84	1.624	5	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+ + + + + + + + + + +
45	.123	.120E+02	+******
30	.082	.240E+02	+****C
37	.101	.360E+02	+*****C
40	.110	.480E+02	+*****C
32	.088	.600E+02	+****C
34	.093	.720E+02	+*****C
25	.068	.840E+02	+***C
32	.088	.960E+02	+****C
14	.038	.108E+03	+**C
19	.052	.120E+03	+***C
16	.044	.132E+03	+**C
14	.038	.144E+03	+**C
5	.014	.156E+03	+*C
5	.014	.168E+03	+*C
3	.008	.180E+03	+C
6	.016	.192E+03	+*C
0	.000	.204E+03	+C
6	.016	.216E+03	+*C
1	.003	.228E+03	+C
1	.003	.240E+03	+C
0	.000	INF	+C

Light 150(480):35 / 180:50 / 135:35
Medium 2-in-12:35 / 180:50 / 135:35
Heavy 2-in-12:35 / 180:50 / 135:35

Experiment 17

Experiment 17

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.874E+01	.767E+01	.877E+00	.156E-01	.430E+02	65

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	3.508	1.584	.00	5.68	*********	5.68

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.002	.044	1	0	.228
2		.000	.000	0	0	.000
3	CALENDAR	10.722	1.323	14	10	121.369

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.5558	1.0379	4	1	2490
2	1.1659	.8714	3	1	2489
3	.0000	.0000	1	0	65
5 DIVERT	.0000	.0000	0	0	0
8	.0000	.0000	1	0	601
9	.0000	.0000	1	0	600
10 LITE	.0000	.0000	1	0	1290

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	7	2.29	2.154	7	1

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
51	.785	.120E+02	+********** +
12	.185	.240E+02	+********* C +
1	.015	.360E+02	+* C+
1	.015	.480E+02	+* C
0	.000	.600E+02	+ C
0	.000	.720E+02	+ C
0	.000	.840E+02	+ C
0	.000	.960E+02	+ C
0	.000	.108E+03	+ C
0	.000	.120E+03	+ C
0	.000	.132E+03	+ C
0	.000	.144E+03	+ C
0	.000	.156E+03	+ C
0	.000	.168E+03	+ C
0	.000	.180E+03	+ C
0	.000	.192E+03	+ C
0	.000	.204E+03	+ C
0	.000	.216E+03	+ C
0	.000	.228E+03	+ C
0	.000	.240E+03	+ C
0	.000	INF	+ C

Light 135(420):5 / 180:10 / 135:5
Medium 3-in-12:5 / 180:10 / 135:5
Heavy 3-in-12:5:5 / 180:10 / 135:5

Experiment 17

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.569E+02	.407E+02	.714E+00	.469E-01	.230E+03	427

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALUE
TOTAL HOLD TIME	82.010	82.690	.00	243.14	*********	243.14

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.084	.354	3	0	9.757
2		.000	.000	0	0	.000
3	CALENDAR	10.720	1.646	16	10	117.924

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.5550	1.2022	5	0	2492
2	1.1647	.9879	5	2	2490
3	.0000	.0000	1	0	427
5 DIVERT	.0000	.0000	0	0	0
8	.0000	.0000	1	0	601
9	.0000	.0000	1	0	600
10 LITE	.0000	.0000	1	0	1291

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	7	2.28	2.262	7	3

HISTOGRAM NUMBER 1
HOLD TIME

OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
54	.126	.120E+02	+******
63	.148	.240E+02	+*******C
48	.112	.360E+02	+******C
32	.075	.480E+02	+****C
45	.105	.600E+02	+*****C
37	.087	.720E+02	+****C
35	.082	.840E+02	+****C
30	.070	.960E+02	+****C
32	.075	.108E+03	+****C
22	.052	.120E+03	+***C
12	.028	.132E+03	+*C
8	.019	.144E+03	+*C
2	.005	.156E+03	+C
5	.012	.168E+03	+*C
1	.002	.180E+03	+C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
0	.000	.216E+03	+C
0	.000	.228E+03	+C
1	.002	.240E+03	+C
0	.000	INF	+C

Light 135(420):15 / 180:30 / 135:15
Medium 3-in-12:15 / 180:30 / 135:15
Heavy 3-in-12:5:15 / 180:30 / 135:15

Experiment 17

	MEAN VALUE	STANDARD DEVIATION	COEFF. OF VARIATION	MINIMUM VALUE	MAXIMUM VALUE	NO.OF OBS
HOLD TIME	.588E+02	.441E+02	.749E+00	.625E-01	.209E+03	235

	MEAN VALUE	STANDARD DEVIATION	MINIMUM VALLUE	MAXIMUM VALUE	TIME INTERVAL	CURRENT VALU
TOTAL HOLD TIME	50.968	36.317	.00	138.28	*********	138.28

FILE NUMBER	LABEL/TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAIT TIME
1	LAND AWAIT	.048	.264	4	0	5.492
2		.000	.000	0	0	.000
3	CALENDAR	10.767	1.299	16	12	118.854

ACTIVITY INDEX/LABEL	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL	ENTITY COUNT
1	1.5937	1.0696	5	2	2518
2	1.1730	.9131	4	2	2516
3	.0000	.0000	1	0	235
5 DIVERT	.0000	.0000	0	0	0
8	.0000	.0000	1	0	602
9	.0000	.0000	1	0	601
10 LITE	.0000	.0000	1	0	1317

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTIL	STANDARD DEVIATION	MAXIMUM UTIL	CURRENT UTIL
1	RAMP	7	2.29	2.104	7	5

HISTOGRAM NUMBER 1
HOLD TIME

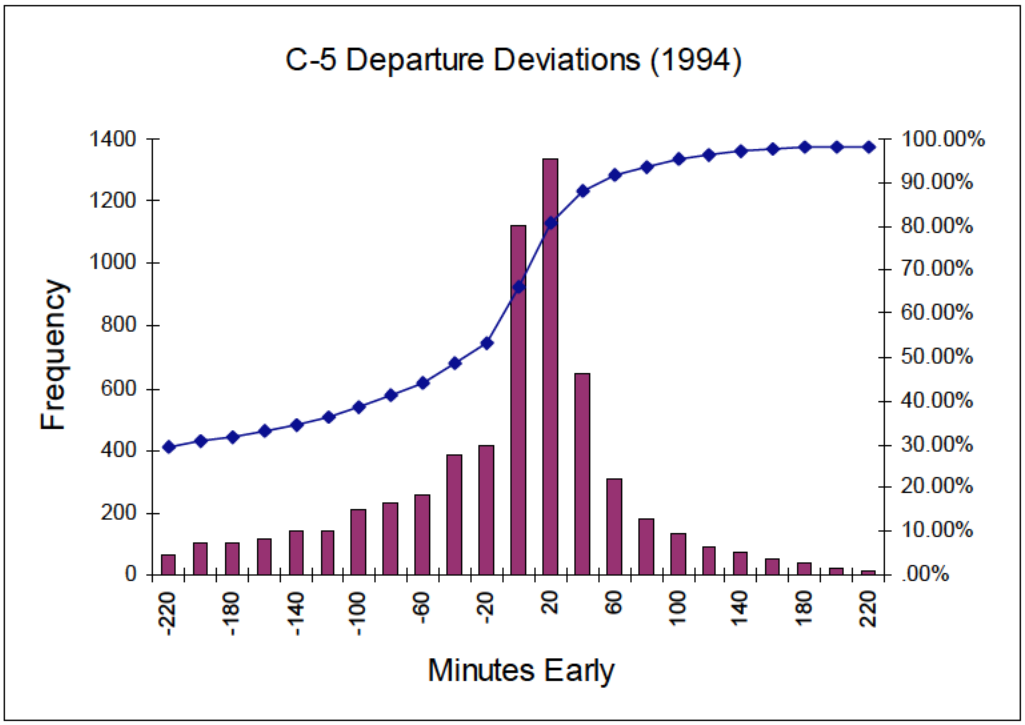
OBS FREQ	RELA FREQ	UPPER CELL LIM	0 20 40 60 80 100
0	.000	.000E+00	+
31	.132	.120E+02	+*******
29	.123	.240E+02	+******C
29	.123	.360E+02	+******C
27	.115	.480E+02	+******C
14	.060	.600E+02	+***C
26	.111	.720E+02	+******C
19	.081	.840E+02	+****C
16	.068	.960E+02	+***C
6	.026	.108E+03	+*C
10	.043	.120E+03	+**C
9	.038	.132E+03	+**C
7	.030	.144E+03	+*C
5	.021	.156E+03	+*C
3	.013	.168E+03	+*C
3	.013	.180E+03	+*C
0	.000	.192E+03	+C
0	.000	.204E+03	+C
1	.004	.216E+03	+C
0	.000	.228E+03	+C
0	.000	.240E+03	+C
0	.000	INF	+C

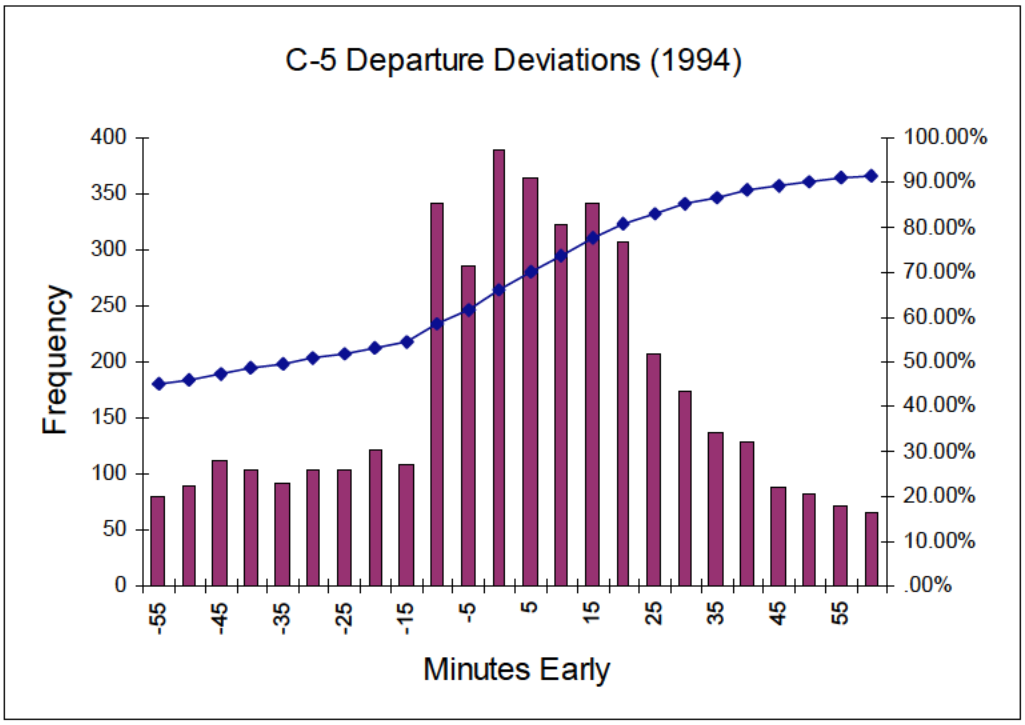
Light 135(420):35 / 180:50 / 135:35
Medium 3-in-12:35 / 180:50 / 135:35
Heavy 3-in-12:35 / 180:50 / 135:35

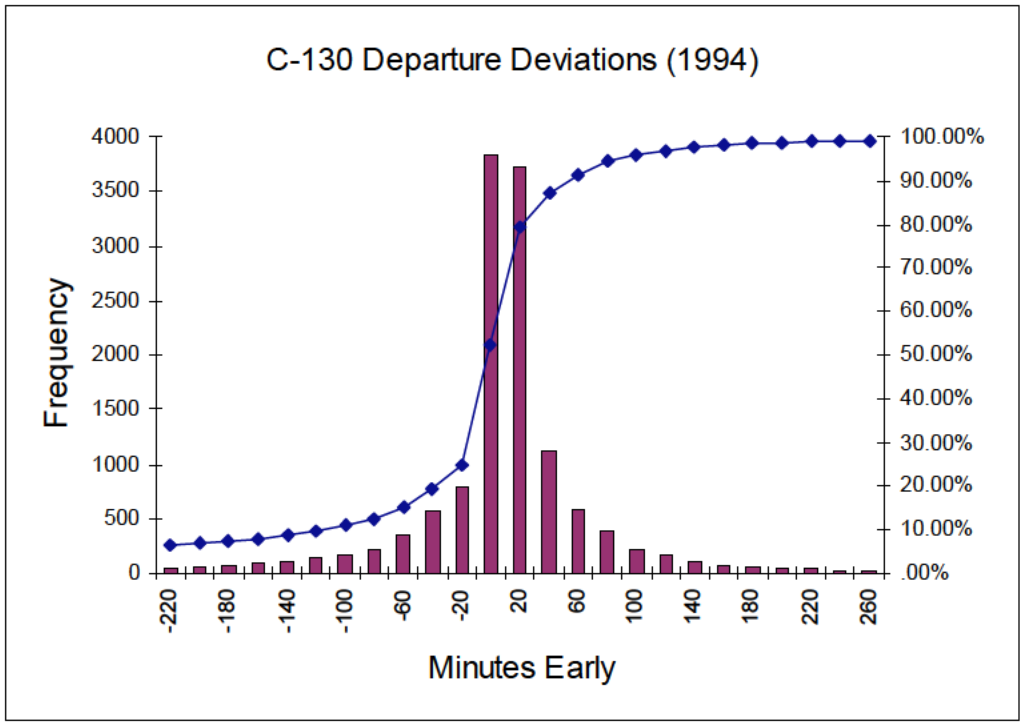
Appendix C: Aircraft Departure Deviations

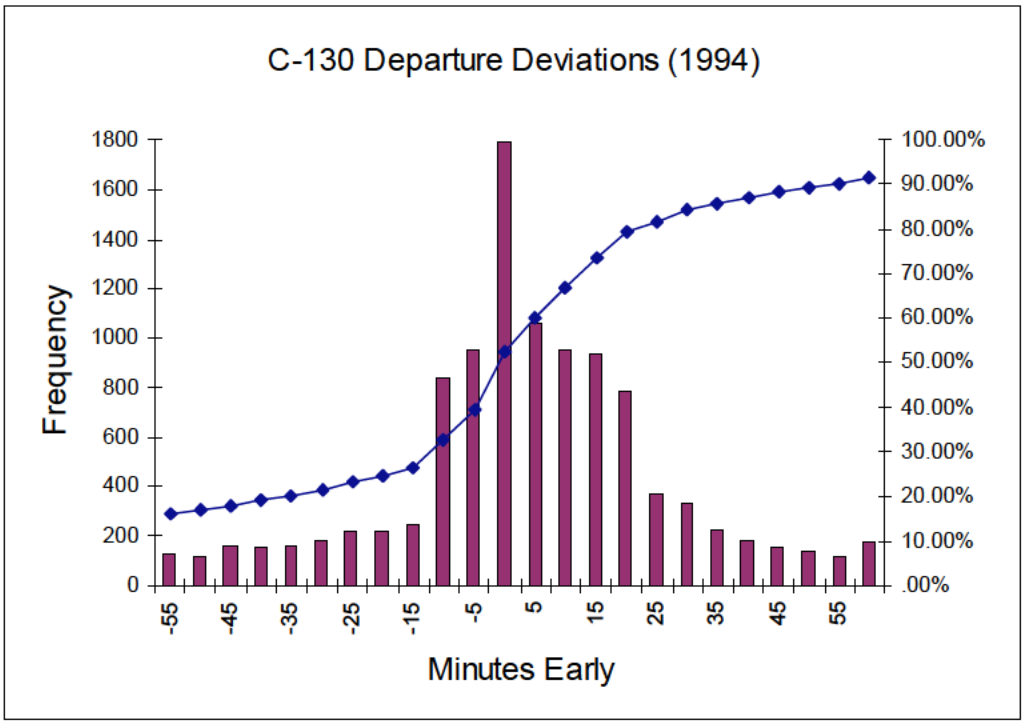
The following charts are representative of the data for aircraft performance in 1994. Each of the aircraft performance data has been displayed with two different scales to accentuate the localized performance characteristics in the vicinity of the “on-time” data point.

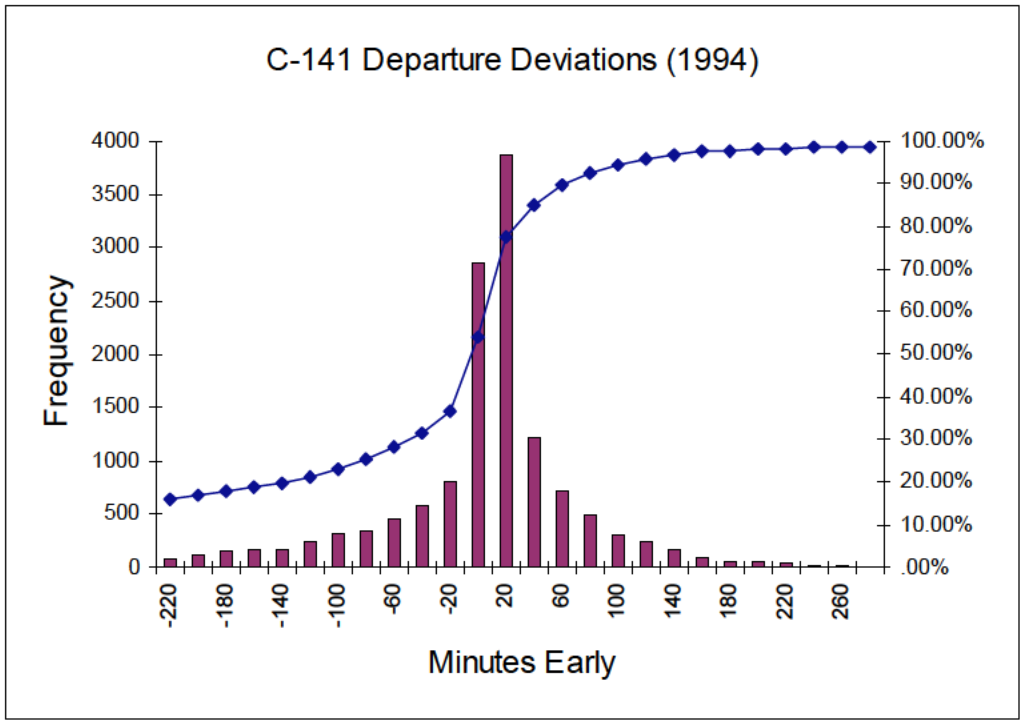
Other histograms were developed, but not included due to commonality of their results with these.

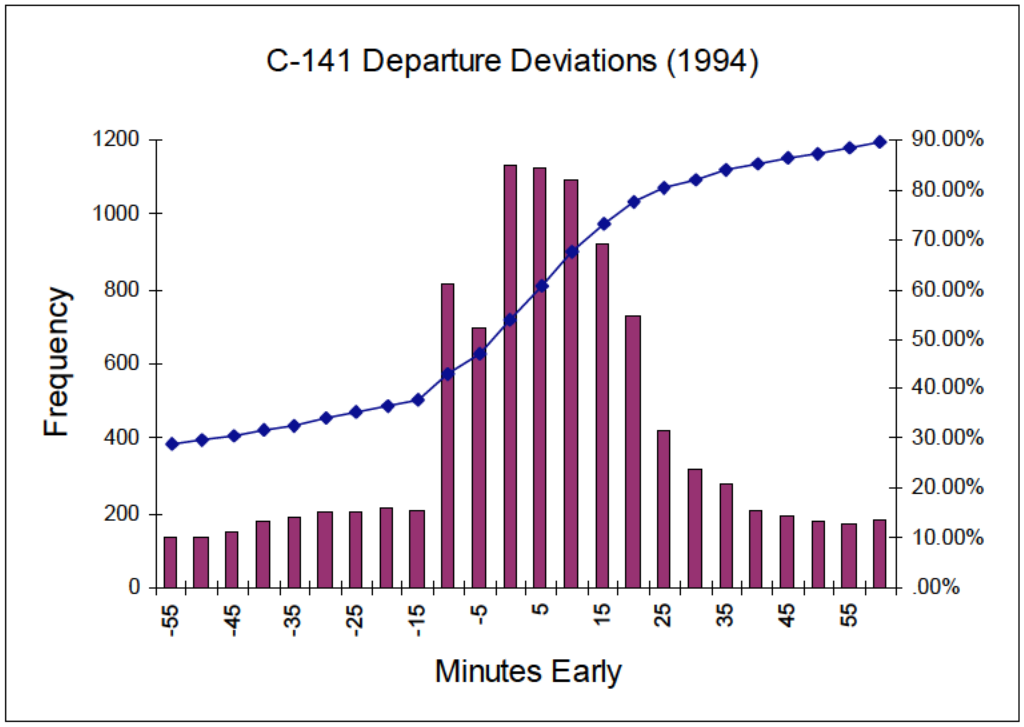

C-5 Departure Deviations (1994)
Frequency
1400
1200
1000
800
600
400
200
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-220
-180
-140
-100
-60
-20
20
60
100
140
180
220
Minutes Early

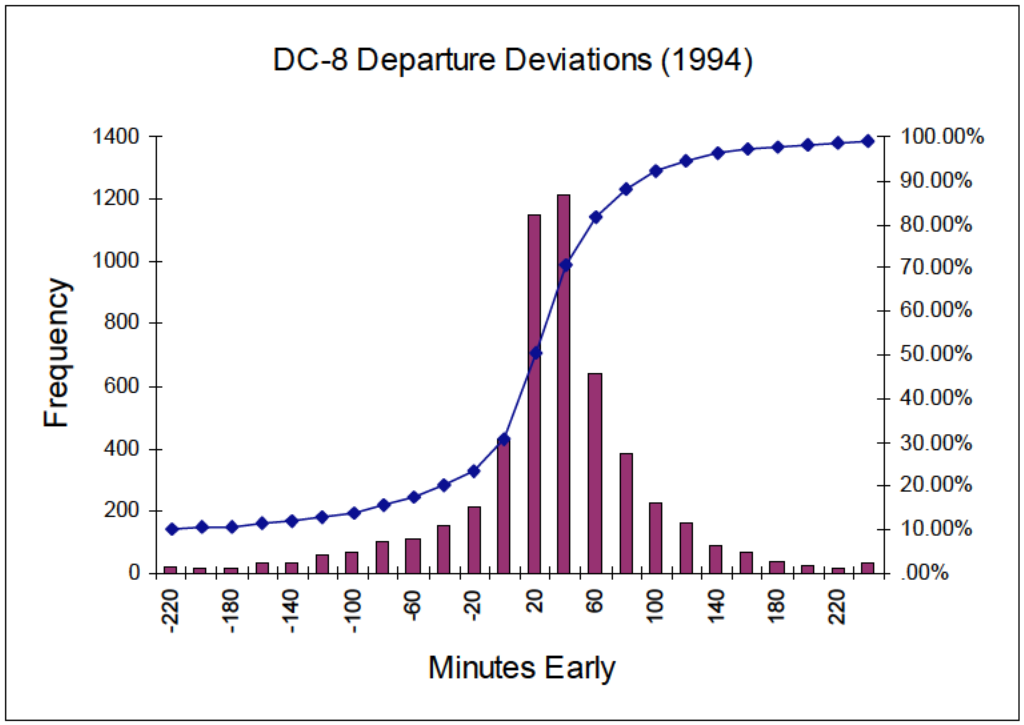

C-5 Departure Deviations (1994)
Frequency
400
350
300
250
200
150
100
50
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-55
-45
-35
-25
-15
-5
5
15
25
35
45
55
Minutes Early

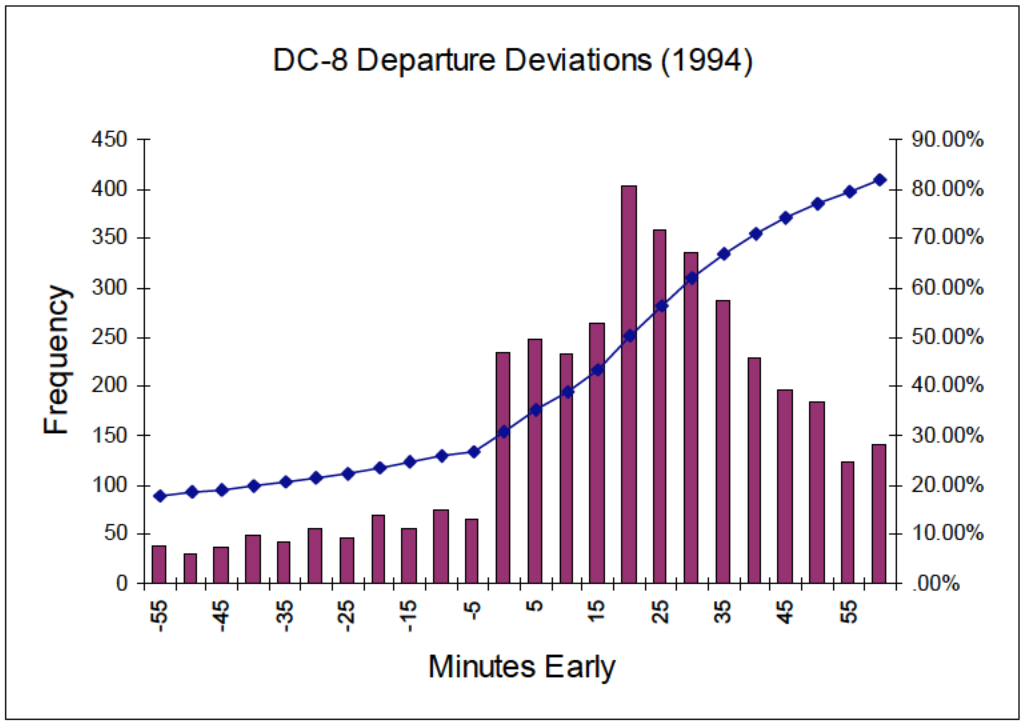

C-130 Departure Deviations (1994)
Frequency
4000
3500
3000
2500
2000
1500
1000
500
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-220
-180
-140
-100
-60
-20
20
60
100
140
180
220
260
Minutes Early


C-130 Departure Deviations (1994)
Frequency
1800
1600
1400
1200
1000
800
600
400
200
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-55
-45
-35
-25
-15
-5
5
15
25
35
45
55
Minutes Early


C-141 Departure Deviations (1994)
Frequency
4000
3500
3000
2500
2000
1500
1000
500
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-220
-180
-140
-100
-60
-20
20
60
100
140
180
220
260
Minutes Early


C-141 Departure Deviations (1994)
Frequency
1200
1000
800
600
400
200
0
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-55
-45
-35
-25
-15
-5
5
15
25
35
45
55
Minutes Early

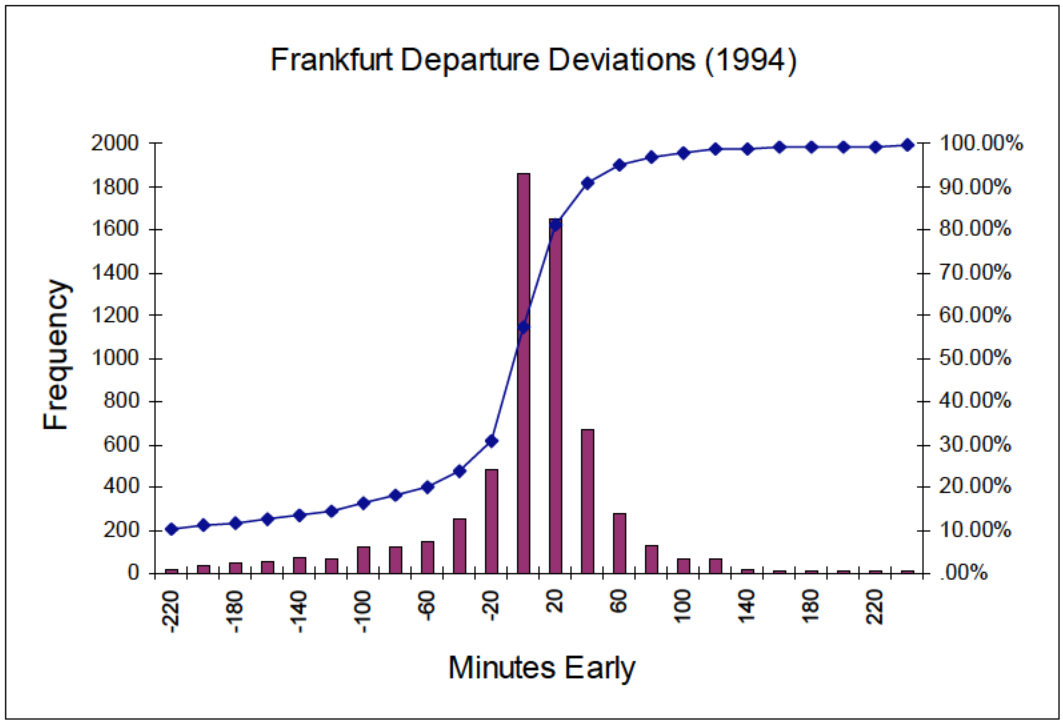

DC-8 Departure Deviations (1994)
Frequency
1400
1200
1000
800
600
400
200
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-220
-180
-140
-100
-60
-20
20
60
100
140
180
220
Minutes Early

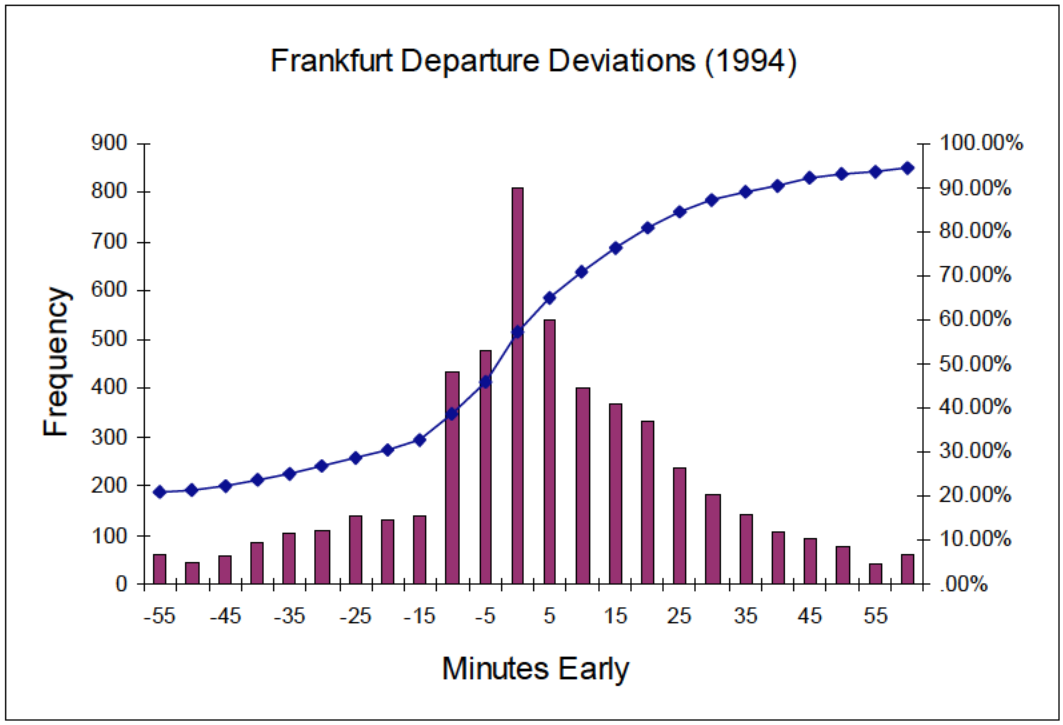

DC-8 Departure Deviations (1994)
Frequency
450
400
350
300
250
200
150
100
50
0
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-55
-45
-35
-25
-15
-5
5
15
25
35
45
55
Minutes Early

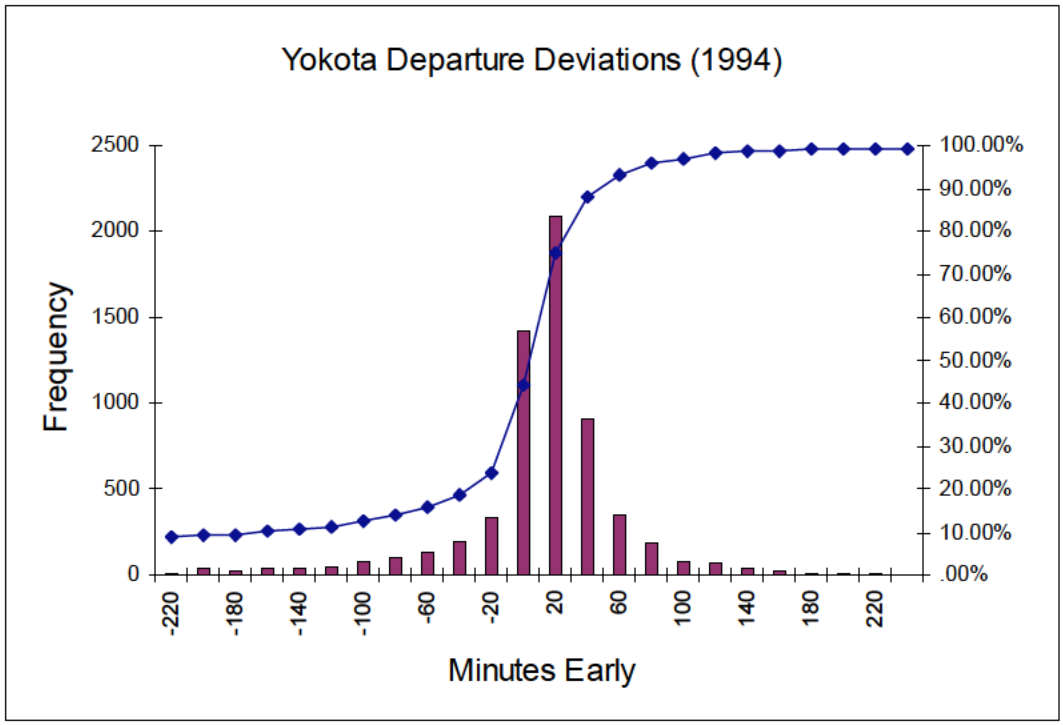
Appendix D: Airfield Departure Deviations

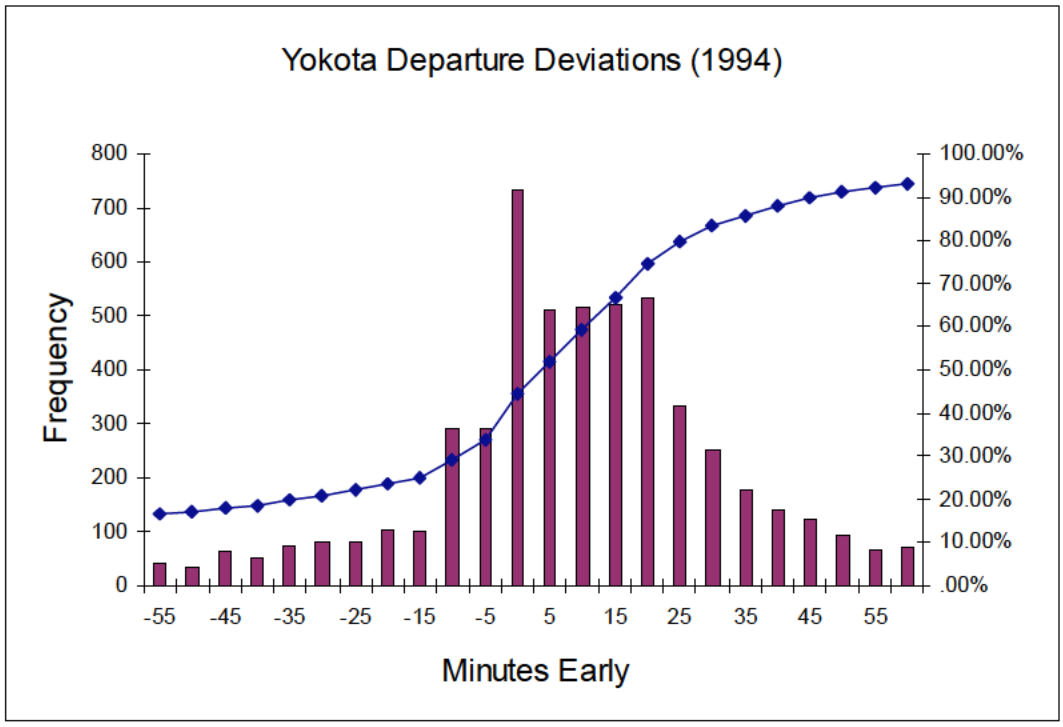
The following charts depict three of the busiest airfields during 1994. These charts are representative of the performance levels experienced by the majority of the airfields being frequented by AMC aircraft.

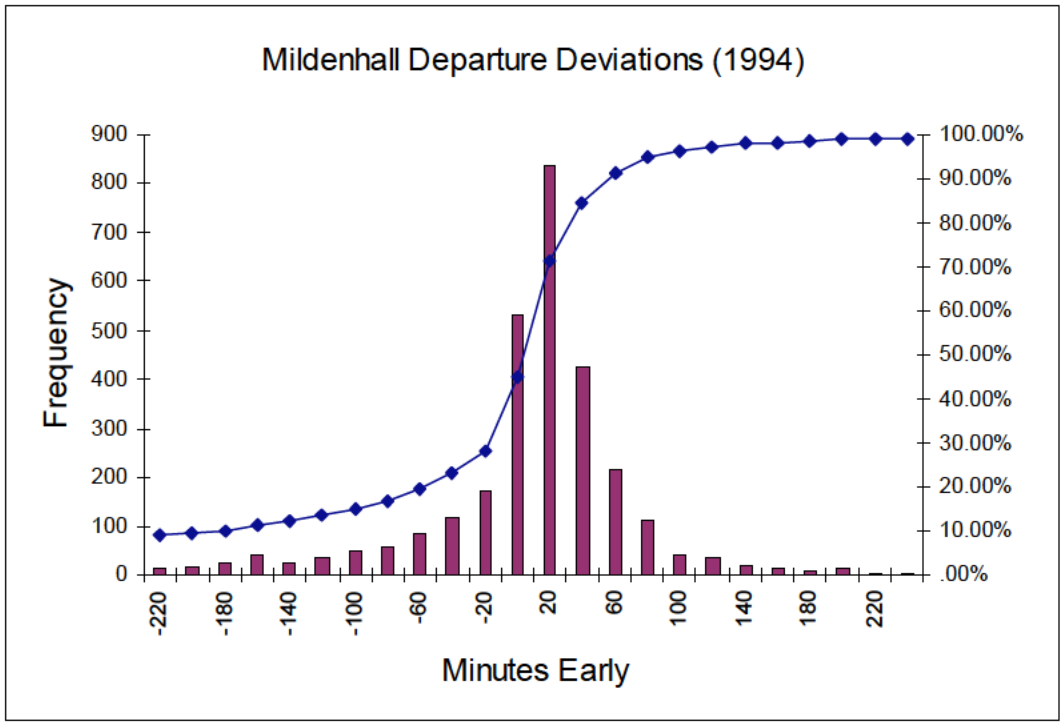
As with the aircraft specific charts, these charts display the performance in a broad range and then with finer detail to better observe the performance of the airfields with regards to schedule.

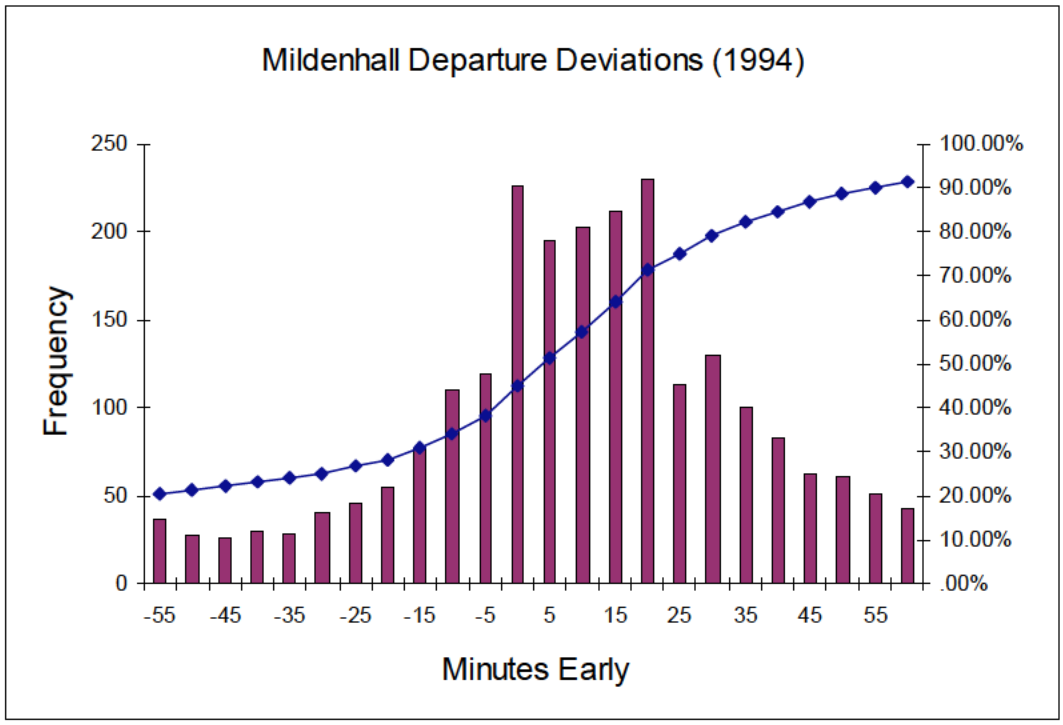

Frankfurt Departure Deviations (1994)
Frequency
2000
1800
1600
1400
1200
1000
800
600
400
200
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-220
-180
-140
-100
-60
-20
20
60
100
140
180
220
Minutes Early


Frankfurt Departure Deviations (1994)
Frequency
900
800
700
600
500
400
300
200
100
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-55
-45
-35
-25
-15
-5
5
15
25
35
45
55
Minutes Early


Yokota Departure Deviations (1994)
Frequency
2500
2000
1500
1000
500
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-220
-180
-140
-100
-60
-20
20
60
100
140
180
220
Minutes Early


Yokota Departure Deviations (1994)
Frequency
800
700
600
500
400
300
200
100
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-55
-45
-35
-25
-15
-5
5
15
25
35
45
55
Minutes Early


Mildenhall Departure Deviations (1994)
Frequency
900
800
700
600
500
400
300
200
100
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-220
-180
-140
-100
-60
-20
20
60
100
140
180
220
Minutes Early


Mildenhall Departure Deviations (1994)
Frequency
250
200
150
100
50
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
.00%
-55
-45
-35
-25
-15
-5
5
15
25
35
45
55
Minutes Early

Appendix E: Aircraft Flight Time Performance

Scheduled	T43	T43	MD80	MD80	MD11	MD11	MC130	MC130	L100	L100	L011	L011
	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num
5												
10									21	1		
15	75	1					77	5				
20	25	3			30	1	40	1				
25	40	5	44	18	51	3			50	53		
30	32	21			60	1	74	4	58	1		
35	42	7			65	1						
40	46	16	48	1	71	16	409	1	68	38		
45	45	14			54	1	56	1				
50	57	19	68	2								
55	58	9	110	1	65	16	39	1			71	1
60	63	12			144	6	83	14				
65	72	12			81	2					63	1
70	68	14			98	6			108	534	83	1
75	82	8					50	2				
80	79	14			80	1	89	3				
85	94	1	111	2	92	5	70	2	86	2	111	3
90	99	12			119	2	99	23	100	24		
95	96	4			103	6	93	1				
100	85	5			125	12	106	4	129	38	122	1
105	110	10					97	9				
110	101	3			116	2	79	3				
115	119	3			125	4	125	1	151	3	117	1
120	120	13			109	2	128	47	111	3		
125	163	3			138	1						
130	137	5			150	11			156	103		
135	159	3			168	6	115	3				
140	143	4	155	1	156	2			159	23		
145	122	2	202	1	145	1					170	1
150	152	6			132	2	135	18				
155	148	1	165	1								
160	169	3	176	18	186	7	161	2	168	94		
165	159	3			213	1	152	1				
170	171	2	200	1			170	1			185	1
175	168	1			205	1	100	1				
180	171	5	175	1	233	5	149	16			182	1
185	162	1			212	5						
190					196	7			167	298	146	2
195	190	6					244	2			212	1
200	192	1			240	2	204	1				
205	167	2			210	1					244	3
210	209	5			225	10	217	8	232	1		
215	229	1										
220	237	3			225	12	153	1	241	83	271	2
225	207	4			257	1						
230	214	1			248	2	161	2				
235					244	1			262	2	265	1
240	260	6			245	6	248	61	292	3		
245												

Scheduled	T43	T43	MD80	MD80	MD11	MD11	MC130	MC130	L100	L100	L011	L011
	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num
250	263	5			270	6			273	95	270	1
255	272	3			295	5	212	2				
260					265	4						
265	236	1			291	6			303	37	275	1
270	264	5			308	3	252	20	350	4		
275	277	2			275	7			330	1		
280	312	2			305	8	333	1	328	369	302	2
285	287	1										
290	290	4			275	2					257	1
295					327	3					305	1
300					323	1	286	21	263	1		
305	307	1							282	5	305	1
310	315	3			352	2	330	1	323	64		
315	313	10			331	8						
320					342	4	197	1			330	1
325									304	5	298	1
330					335	1	331	15				
335												
340									359	121		
345												
350					405	12						
355					355	2						
360					379	6	277	12	340	1	470	1
365					396	2						
370	370	1			421	6						
375					380	2	226	2				
380											397	1
385					402	3			426	2		
390	318	1					391	10	383	2		
395					401	1						
400					419	7	313	1	430	12		
405											438	1
410												
415					434	3						
420					426	2	419	10	285	1		
425					443	1						
430					461	2			482	257	490	1
435					447	3	442	2				
440					451	5						
445					483	1						
450					446	12	421	2	433	1		
455												
460					470	8	424	1	495	1		
465					474	2	405	1				
470					530	1						
475					421	1						
480							439	4				
485												
490					485	4						
495												

Scheduled	T43	T43	MD80	MD80	MD11	MD11	MC130	MC130	L100	L100	L011	L011
	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num
500					513	8						
505					502	2					488	1
510					542	1	349	2				
515												
520					541	4						
525					504	2					590	1
530					536	2						
535					587	3						
540					577	1	519	3				
545												
550					571	3						
555					593	2	538	3				
560												
565					558	3						
570					566	3	444	2				
575												
580					604	4						
585												
590					610	2						
595					635	1						
600					612	4	435	1				
605					715	1						
610												
615					615	1						
620												
625												
630												
635												
640					654	2						
645												
650												
655					667	1						
660							693	1				
665												
670					682	7						
675												
680							631	1				
685					684	1						
690					772	1	634	1				
695												

Scheduled	KC135	KC135	KC10	KC10	DC8	DC8	DC10	DC10	C9	C9	C5	C5
	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num
5									40	1		
10			70	1			60	1	23	2		
15	25	1							23	62	35	3
20	48	4	76	3			20	1	24	99	64	2
25	51	3	42	4	65	28	71	3	23	4	45	4
30	54	58	41	33	37	72			29	167	45	169
35	67	5	43	3			68	2	33	81	322	21
40	52	7	54	9	57	400	68	16	40	152	-468	11
45	58	30	58	149	28	1	19	1	46	321	49	186
50	68	21	71	9	54	40	55	5	51	155	48	33
55	61	4			79	180	64	18	55	167	84	13
60	72	249	59	94	76	28	66	7	62	258	63	444
65	77	7	78	4	68	38	101	3	64	87	76	23
70	79	8	76	24	87	154	85	10	68	140	79	34
75	87	64	80	26	80	3	92	1	75	292	78	331
80	97	23	85	20	88	34			79	203	95	73
85	75	3	87	6	108	270	100	10	81	67	90	42
90	93	124	97	38	99	49	78	1	88	262	95	443
95	115	16	92	2					95	58	105	34
100	104	15	119	4	113	296	133	10	101	35	105	40
105	102	131	92	20	90	3	88	4	104	129	104	206
110	113	17	111	21	120	4			110	99	109	37
115	116	12	109	11	127	386	130	1	110	68	127	19
120	117	377	117	85	136	3	123	6	118	288	124	388
125	144	29	135	2					116	34	129	29
130	124	34	134	7	175	86	155	17	135	91	126	39
135	126	50	149	22	142	4	177	9	132	163	139	154
140	125	17	149	5					138	60	152	40
145	167	29	186	3	165	81	173	10	148	56	164	16
150	149	131	152	112	148	16	198	1	152	123	157	253
155	155	28	195	3					155	69	168	31
160	179	19	149	8	175	369	187	11	153	72	156	9
165	163	149	183	31	206	1	184	4	155	76	172	198
170	172	20	193	4	200	1			159	64	174	17
175	158	8	170	3	193	72	165	3	175	51	180	18
180	184	194	175	151	177	16	193	8	176	119	186	344
185	176	36	202	4					187	29	206	21
190	184	21	175	11	201	229	165	6	193	33	206	6
195	192	73	190	16	171	16	194	2	193	113	197	228
200	177	29	210	13					206	19	195	57
205	193	90	184	5	212	196	224	2	203	15	206	29
210	193	120	212	45	238	10	225	3	204	91	209	221
215	213	14	214	17					209	22	222	5
220	215	19	241	9	270	57	221	26	215	12	217	13
225	211	49	227	16			246	3	206	37	224	111
230	217	21	221	15					227	5	228	11
235	220	26	234	4	257	6	280	5	244	2	282	4
240	229	155	236	62	235	2	239	11	245	31	240	210
245	214	19	280	35	240	1					289	5

Scheduled	KC135	KC135	KC10	KC10	DC8	DC8	DC10	DC10	C9	C9	C5	C5
	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num
250	223	15	273	28	287	152	251	11	225	1	265	33
255	238	23	259	15	268	2	280	9	236	8	267	206
260	240	18	266	26	297	1	280	8	210	4	262	9
265	236	6	262	64	286	36	283	4	227	3	269	11
270	256	93	269	63			290	11	255	36	272	199
275	237	10	274	54	276	12	415	1	249	4	271	15
280	254	15	279	59	305	221	293	13	256	13	285	19
285	254	26	278	91	293	42			285	6	289	156
290	247	8	296	54	312	4	359	6	274	1	274	43
295	284	7	299	16	306	51	307	8	104	1	295	38
300	283	97	292	191	312	56	350	4	258	6	307	369
305	275	11	302	30	331	13			278	1	307	12
310	344	5	300	21	323	284	342	7			314	19
315	298	22	312	79	301	7	332	12			320	246
320	293	9	294	24	345	19	366	7			323	21
325	330	12	314	13	333	78					317	90
330	304	92	307	40	333	31	341	3	330	1	330	196
335	326	13	311	6	347	34					339	37
340	331	10	332	31	369	83	356	1			340	13
345	338	17	337	15					185	1	338	123
350	314	6	375	4	357	40	414	10	285	1	448	2
355	346	2	332	3	387	14	405	3			376	18
360	334	59	337	47	371	5	368	4			360	159
365	330	1	381	3			388	4			443	4
370	383	5	343	3	379	65	404	11			374	4
375	291	8	395	16	339	2					364	75
380	348	5	375	54			384	1			429	4
385	394	2	383	7	415	198	380	3	180	1	450	20
390	383	121	393	13	377	3	403	1			391	86
395	407	4	400	3	412	1					400	1
400	387	6	403	3	424	147	402	57			412	13
405	365	49	413	20	438	1	457	2			405	84
410	384	2	421	1	427	3	445	1			426	30
415	422	5	397	4	403	62	429	7			435	16
420	415	185	422	29	438	3					426	141
425	432	4	431	3	420	3					427	14
430	492	3	394	2	432	261	437	29			328	4
435	382	6	433	17			331	2			433	115
440	464	4	411	38	371	2	435	107			454	16
445	468	2	419	42	476	46	458	2			467	7
450	445	86	430	68	489	16	447	6			444	184
455	421	3	425	4							460	7
460	467	3	471	3	465	513	488	3			465	19
465	415	2	476	14							478	118
470	465	3	473	15	498	3					477	35
475	467	2	470	12	538	55	488	4			494	38
480	467	95	469	40	410	2	467	3			471	320
485	478	5									470	10
490	496	6	448	6	506	34	480	4			489	14
495	571	6	481	34							489	112
500	488	4	506	2			515	11			505	15

Scheduled	KC135	KC135	KC10	KC10	DC8	DC8	DC10	DC10	C9	C9	C5	C5
	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num
505	509	5	527	12	514	2	523	16			463	4
510	504	41	484	47	505	1	518	35			495	149
515			504	1	575	1					522	2
520	479	4	460	6	511	51	512	5			527	5
525	426	2	551	5			547	2			528	47
530	521	4	399	1	542	4	544	4			556	5
535	463	1			591	2	515	2			546	1
540	528	67	528	29	507	4					553	73
545	529	4										
550	513	6	530	3	529	24	562	3			486	5
555	534	9	533	5							529	45
560	508	3	600	2	577	2					537	19
565	548	4			595	2	577	2			556	3
570	530	36	540	9							566	60
575	538	4									561	4
580	467	1			527	4	459	1			568	11
585	472	6	522	16			560	1			569	16
590			658	1							528	9
595			645	1	566	1	563	4				
600	582	53	579	17							587	28
605	593	5	594	1								
610	573	2	590	2							598	7
615	609	4	635	21							625	11
620	569	2	623	15							660	1
625	512	5	579	2	642	1					656	1
630	596	18	619	41							634	7
635	586	8	688	1							597	2
640	549	2										
645			646	2							476	1
650	577	2	659	2								
655	598	2										
660	622	18	631	12	685	1					643	10
665	594	2										
670	537	2			616	1						
675			429	1							558	6
680			693	3							680	1
685	654	2										
690	603	6	692	3							698	8
695												

Scheduled	C27	C27	C21	C21	C20	C20	C160	C160	C141	C141	C130	C130
	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe
5	10	1	8	1			65	1				
10			35	2							40	5
15	33	3	47	18	27	1			31	21	30	58
20	36	3	31	22	26	3			58	3	38	39
25	37	1	35	9	21	9			38	11	32	17
30	48	38	34	614	30	75	36	87	41	329	36	1469
35	32	2	35	77	36	29	46	3	42	78	44	60
40	48	35	45	61	44	21			48	37	41	182
45	50	18	41	1299	44	17	48	87	48	403	52	1076
50	94	2	52	50	53	34	53	2	54	66	54	170
55			57	39	58	14	59	4	60	50	57	670
60	76	122	61	1714	67	38			58	845	68	818
65	101	2	71	201	71	16	65	188	70	134	72	75
70			76	212	75	25			73	127	76	230
75	82	30	73	2790	75	14	55	2	75	865	76	508
80	83	12	82	68	85	14			81	59	80	158
85	70	1	92	36	90	4			96	79	97	81
90	99	178	89	942	89	13	88	3	90	823	92	950
95	124	2	93	68	89	8			95	115	112	74
100	111	9	110	74	101	15			101	238	100	259
105	111	28	102	1804	112	14			105	775	102	418
110	115	5	115	70	103	8			103	61	106	119
115	142	3	118	45	116	4			110	65	130	42
120	129	23	118	1737	115	15			117	690	112	573
125	128	4	131	37	124	14			118	208	134	48
130	119	1	129	60	125	6			124	125	119	69
135	142	47	131	1051	149	7			131	436	132	244
140	146	1	142	71	140	4			150	21	135	115
145	204	1	148	24	136	2			145	52	141	83
150	155	30	146	523	147	14			154	452	145	822
155	172	6	164	16	145	3			166	36	149	36
160	167	3	169	18	158	3			182	18	158	481
165	169	20	162	599	157	22			166	369	157	378
170	176	4	174	21	158	12			155	125	162	49
175	182	2	188	5	177	6			179	56	165	45
180	189	103	174	479	182	7			176	537	173	690
185	191	3	192	28	188	6			184	33	185	16
190	218	1	204	7	192	7			193	59	178	72
195	182	9	191	270	186	9			195	422	180	191
200			208	8	207	6			189	101	193	20
205			239	8	201	9			206	42	208	15
210	200	17	204	254	204	10			208	413	207	361
215	226	16	223	5	212	4			205	56	207	25
220	178	3			232	7			215	18	204	61
225	223	2	219	239	237	3			219	225	225	185
230			268	1	242	5			232	27	221	50
235					230	2			240	13	226	12
240	220	5	229	100	239	8			234	174	231	327
245					248	4			255	6	242	16
250					231	3			258	13	229	17

Scheduled	C27	C27	C21	C21	C20	C20	C160	C160	C141	C141	C130	C130
	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe
255			211	10	251	3			253	170	242	129
260			263	3	266	3			257	23	257	14
265					220	1			271	35	291	13
270	289	5	252	8	253	9			266	341	269	227
275	295	1			278	4			269	12	283	13
280					267	7			289	16	277	26
285	310	1	289	7	292	5			284	274	276	85
290			132	1	282	8			290	52	257	13
295			34	1	280	1			297	49	286	14
300	310	1	127	4	286	5	351	2	300	446	296	260
305					285	1			294	91	286	17
310					323	4			311	213	301	20
315	281	2	180	1	312	4			311	404	310	93
320					322	12			319	46	317	45
325					310	4			324	75	315	103
330	322	3	224	5	315	18			325	403	314	156
335					335	1			330	66	353	26
340					324	9			344	29	364	39
345			52	1	355	2			340	437	351	43
350					338	3			353	71	325	20
355									346	50	348	7
360			159	3	318	4	350	39	356	289	346	638
365			460	1	349	5			365	14	346	29
370					364	7			364	5	328	13
375	353	2	368	3	360	1			366	129	383	39
380					367	9			385	13	373	19
385					360	2			424	9	382	4
390			268	5	366	3			386	132	384	76
395					388	2			423	22	406	27
400									380	13	394	8
405									399	106	404	34
410									418	86	405	19
415									404	2	445	4
420			318	2					412	147	400	160
425									415	15	412	4
430									426	36	391	9
435									435	122	423	61
440									449	13	427	9
445									444	19	440	5
450									447	259	425	247
455									459	8	428	7
460									449	47	433	6
465			40	1					458	128	433	39
470									464	11	478	4
475									481	13	471	3
480			428	3					469	330	471	114
485									493	30	510	2
490									465	17	466	12
495									490	113	461	18
500									506	51	459	4

Scheduled	C27	C27	C21	C21	C20	C20	C160	C160	C141	C141	C130	C130
	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe
505									484	2	508	9
510			532	1					501	120	512	46
515									520	14	532	3
520									462	4	500	3
525			571	2					523	67	517	18
530									522	5	548	13
535									542	2	499	2
540			212	2					528	70	505	57
545											507	4
550									555	8	454	8
555			546	1					552	40	520	6
560									555	2		
565									548	8		
570									552	79	576	17
575									590	5		
580									595	8	580	1
585			129	1					593	45	480	1
590									576	6	555	1
595												
600			600	1					586	106	538	10
605									592	1		
610									600	23		
615			651	1					570	6		
620									582	9		
625									619	2		
630			605	1					612	5	569	5
635												
640												
645									558	2	648	1
650												
655												
660			633	2					632	2	656	4
665												
670												
675					240	1						
680									708	1		
685											585	1
690			682	2								
695												

Scheduled	B757	B757	B747	B747	B737	B737	B727	B727
	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe
5	48	1						
10	69	1	40	1			37	55
15	50	1					42	57
20			49	6				
25	74	20					49	104
30			51	2			49	2
35			46	1			36	1
40	59	59	63	22			69	59
45	60	29	66	4			79	21
50	65	4	73	7			78	32
55	56	43	80	37			76	47
60	58	66	100	5	59	93	80	91
65			83	4	218	1	80	58
70	80	6	105	28			86	85
75	72	2	77	5	76	145	104	11
80	108	22	96	8			95	60
85	99	28	112	23			103	38
90	130	5	103	35			112	58
95	130	1	102	65				
100	107	7	127	136			126	134
105	142	3	120	26			119	123
110	127	4	126	34			118	40
115	173	3	131	33			134	51
120	119	1	123	9	136	1	124	28
125	42	1	138	4	197	19	156	4
130	158	5	155	63			141	52
135	158	4	150	5	130	1	145	14
140	157	17	158	17			152	7
145	174	7	174	10			159	9
150	158	3	182	8			178	10
155	201	3	165	6			144	3
160	176	27	179	42			171	108
165	205	7	187	7			186	4
170	162	4	180	19				
175	206	9	180	15			244	21
180	207	20	207	47			196	9
185	229	13	206	73	188	110	170	1
190	212	28	202	38	190	1	227	17
195	212	5	198	28			224	7
200	227	4	224	15			200	1
205	226	47	243	3			241	25
210	227	12	225	75			237	16
215	237	2	249	4	205	27	269	1
220	244	44	241	43	211	96	242	12
225	221	5	215	8			223	2
230	254	1	243	32			243	1
235	254	30	249	39			240	21
240			248	35			240	5
245	258	19	250	23			264	68
250	272	4	253	38			246	10

Scheduled	B757	B757	B747	B747	B737	B737	B727	B727
	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe
255	287	5	252	13			273	3
260	266	2	268	2			296	14
265	289	17	285	19			282	27
270	292	13	294	21			278	3
275	311	5	296	19				
280	305	38	290	29	202	21	294	49
285	334	3	302	14				
290	346	5	296	14				
295	309	4	312	16				
300	333	12	333	10			303	3
305	308	8	310	17			301	22
310	344	5	327	34			302	4
315	312	2	310	21				
320	360	6	317	16				
325	354	32	362	8				
330	328	40	330	4				
335	362	26	329	7				
340	345	99	341	33				
345	368	24	364	2			300	1
350	368	3	386	1				
355	391	12	388	13				
360	384	2	384	7				
365	371	9	393	6				
370	388	2	403	42				
375			374	5				
380			390	27				
385	422	6	410	27				
390	397	2	399	7				
395	448	24	420	7				
400	425	16	416	67				
405	442	1	429	31				
410			432	9			295	1
415			436	35				
420	460	1	436	21				
425			434	43				
430	479	2	438	131				
435			448	12				
440			443	13				
445	476	4	460	17				
450	470	1	446	17				
455			448	9				
460	457	2	457	46				
465	463	1	495	3				
470			484	6				
475	517	2	488	12				
480			509	14				
485			474	10				
490			506	65				
495			550	1			456	1
500			520	8				

Scheduled	B757	B757	B747	B747	B737	B737	B727	B727
	Averag	Numbe	Averag	Numbe	Averag	Numbe	Averag	Numbe
505			493	18				
510	530	1	520	6				
515			495	1				
520			535	11				
525			564	3				
530			553	7				
535			529	2				
540			625	1				
545	562	1	541	1				
550			543	2				
555								
560			583	10				
565								
570			572	5				
575								
580			553	23				
585	576	1						
590			583	1				
595			560	2				
600			588	48				
605								
610								
615								
620								
625			493	2				
630			669	2				
635								
640								
645								
650								
655								
660								
665								
670			685	69				
675								
680								
685			661	14				
690								
695								

Appendix F: Airfield Flight Time Performance

	EDAF	EDAF	EGUN	EGUN	ETAR	ETAR	LERT	LERT
Scheduled	Actual	Count	Actual	Count	Actual	Count	Actual	Count
5								
10	36	54			37	53		
15	40	68			43	60		
20	37	1	25	1	37	1		
25	34	9	16	1	28	10		
30	36	289	37	25	35	521	31	5
35	39	19	43	11	35	83		
40	47	16	52	3	45	67	50	1
45	46	139	73	36	5	144	50	14
50	74	62	77	51	54	42	51	1
55	60	18	75	44	69	59	111	2
60	71	94	75	177	68	346	49	5
65	79	92	74	107	71	126		
70	104	199	103	644	94	622		
75	85	42	81	64	79	75	149	2
80	82	14	85	34	80	79	86	1
85	88	4	86	19	88	61	89	2
90	95	155	92	192	95	349	101	23
95	97	7	87	8	95	83		
100	116	61	114	14	106	88	113	1
105	111	295	90	27	106	169	110	3
110	113	51	116	22	110	82	123	16
115	129	35	124	38	110	45	114	1
120	121	217	118	25	115	237	131	18
125	150	1			121	47	127	3
130	162	9	145	34	127	87	145	53
135	133	53	146	32	134	59	146	45
140	141	38	146	4	143	80	149	50
145	156	9	161	2	147	52	167	70
150	146	275	160	22	148	145	156	106
155	135	3	167	2	157	16	159	26
160	162	458	173	28	158	54	170	266
165	164	98	178	12	161	81	164	84
170	171	11	212	1	158	20	165	43
175	163	11	184	3	217	32	174	20
180	176	118	175	35	179	82	173	269
185	179	5	169	2	177	11	182	9
190	171	84	197	9	160	184	191	7
195	199	61	195	8	185	29	195	70
200	203	1	203	1	215	3		
205	243	1			210	9	210	1
210	208	78	206	7	212	40	222	11
215	226	4			178	7	238	1
220	255	28			277	5	262	2
225	211	47	223	13	223	32	215	9
230	232	4	234	4	189	4		

	EDAF	EDAF	EGUN	EGUN	ETAR	ETAR	LERT	LERT
Scheduled	Actual	Count	Actual	Count	Actual	Count	Actual	Count
235	258	3			239	4	179	1
240	235	67	276	24	235	64	239	32
245	254	3			265	52		
250	296	44	244	2	291	54		
255	254	54	259	5	250	35	268	11
260	282	3	230	1	291	17		
265	282	29			273	4	281	1
270	270	57	246	4	261	113	265	18
275	237	4			275	6	251	2
280	278	16	311	33	285	66	287	10
285	274	86	298	5	273	47	339	5
290	319	3	290	1	274	4	317	1
295	301	4	290	1	192	2	104	1
300	300	121	320	56	293	72	316	24
305	299	26			278	1		
310	338	3	316	4			317	6
315	309	44	323	4	303	60	324	13
320	333	7	300	3	318	10		
325	307	21	377	1	299	2		
330	305	40	309	7	323	20	339	12
335	334	11						
340	349	20	315	1	374	16		
345	321	23	356	9	315	17	336	15
350	335	20			403	17		
355	345	3	355	1	444	1		
360	337	634	401	17	364	14	358	12
365	348	30			354	3	451	3
370	395	25	424	7	389	7	416	14
375	364	7	402	24	380	21	364	7
380	403	2	383	1	364	5	327	1
385	377	5	415	197	410	4		
390	387	26	409	24	414	15	392	9
395	401	1	418	4			420	26
400	410	89	396	4	412	10	425	59
405	427	30	434	2	404	7	400	18
410	439	8	423	1	420	3	439	5
415	430	32	434	3	400	15	442	2
420	416	49	430	88	401	62	432	26
425	416	7	462	1	432	14		
430	444	305	428	6	470	228	427	4
435	432	30	429	59	434	69	441	20
440	428	106	551	1	425	2	495	14
445	448	3	469	7	405	1	455	1
450	439	216	446	83	420	117	440	114
455			458	2			463	3
460	453	257	484	201	460	49	470	17
465	466	47	464	17	443	30	461	45
470	468	10	527	1			471	3
475	535	61			490	3		

	EDAF	EDAF	EGUN	EGUN	ETAR	ETAR	LERT	LERT
Scheduled	Actual	Count	Actual	Count	Actual	Count	Actual	Count
480	475	161	470	116	469	127	471	53
485	493	17	480	3	511	1	500	1
490	512	61	489	12	484	5	497	19
495	487	49	489	24	472	36	491	33
500	508	21	400	1	514	19	500	6
505	517	61	495	5	524	14		
510	512	73	503	71	512	11	500	118
515	501	1	523	1	495	1	489	2
520	493	5	519	5	569	6	496	36
525	542	28	533	10	556	5	531	9
530	552	9	527	1	549	5	528	3
535	576	3					615	1
540	546	42	521	68	553	25	523	33
545	562	1	524	5			491	1
550	503	6	516	5	564	1	550	5
555	540	33	555	7	559	24	526	3
560	539	19	520	2				
565	552	8	550	2	566	1	570	2
570	561	51	540	25	570	17	528	29
575	589	3			551	2		
580	566	29	523	2	539	11		
585	573	13	613	3	585	32	545	1
590	538	13	627	1				
595			645	1			627	2
600	580	81	590	38	593	8	563	10
605	590	2			558	2		
610	598	24	605	1				
615	550	4	606	5	634	2	620	1
620	572	8	643	1				
625	632	1	490	4				
630	575	6	608	5			613	2
635			587	6				
640			578	1				
645	599	1	650	1			518	1
650			682	1				
655	667	1	599	1				
660	653	9	666	5				
665								
670			524	1				
675								
680								
685			585	1				
690	690	2	607	6	695	5		
695								
700								
Total		6876		3121		6204		2166

	LPLA	LPLA	LTAG	LTAG	PAED	PAED	PGUA	PGUA	PHIK	PHIK
Scheduled	Actual	Count	Actual	Count	Actual	Count	Actual	Count	Actual	Count
5										
10					51	2				
15			13	3			25	4	45	2
20							20	2	168	1
25							20	1		
30			48	4	32	3	34	326	36	5
35					46	2				
40			85	1	82	8				
45			78	3	49	7			33	1
50			49	13	57	24			59	15
55			53	5	64	11			52	3
60			64	124	63	261	45	2	29	2
65			80	1	73	86				
70			75	4	81	83	37	1		
75			72	87	84	63				
80			83	17	95	10			90	3
85			89	7	85	9			50	6
90			84	215	99	15	105	8	90	3
95			87	2	113	11			107	4
100			128	4	97	19			112	16
105			82	87	103	5				
110					109	10			110	1
115			85	3	116	5			119	125
120	135	1	116	48	124	21	125	15	118	62
125	125	1	126	1	156	54	237	2	121	56
130			163	2	126	13			317	1
135			127	6	131	17			127	1
140	142	9			152	23	180	1		
145	143	2	180	4	141	3	156	3		
150	153	47	168	17	141	5	179	10		
155	157	5	177	5	159	7			162	2
160	161	55	205	1	172	24	182	8		
165	164	12	193	10	165	23	190	7		
170	167	25	184	4	179	2	180	19	176	10
175	174	7	253	18	182	41	184	4	170	7
180	176	25	200	24	176	16	198	74	167	31
185	187	2	202	9	188	111	201	9	178	1
190	186	4	206	4	197	103	200	65		
195	182	16	220	7	193	15	200	95	189	1
200	181	2	224	13	200	39	196	29	186	1
205	210	1	216	2	196	99	212	97		
210	215	11	208	19	206	47	209	155	277	1
215	238	1	228	1	207	52	209	16		
220	170	1	222	30	211	104	215	12	307	2
225	245	7	216	3	215	14	217	88		
230	243	2			183	6	222	4		

	LPLA	LPLA	LTAG	LTAG	PAED	PAED	PGUA	PGUA	PHIK	PHIK
Scheduled	Actual	Count	Actual	Count	Actual	Count	Actual	Count	Actual	Count
235	240	40	279	3	218	9				
240	247	31	246	18	238	24	228	41	279	3
245			266	20	203	1	237	1		
250	245	3	276	3	262	42	260	2	282	5
255	250	60	275	14	264	34	234	8	109	1
260	276	13	293	15	260	14			283	4
265	279	41	268	4	268	29	259	3	290	15
270	266	126	275	26	270	81	278	35	298	14
275	276	18	271	2	283	2	257	4	285	4
280	294	50	332	269	263	58	262	5	301	78
285	292	46	276	23	284	45	271	13	287	35
290	288	3			279	16	236	3	296	26
295	281	3			297	35	305	3	299	39
300	299	71	308	20	288	49	309	27	305	88
305	325	17			283	11	267	1	287	21
310	296	44	333	25	324	8	376	4	315	298
315	314	27	308	11	320	2	317	21	314	186
320	356	25			260	1	311	23	314	21
325	334	78	355	1	306	11	311	81	322	121
330	315	141	329	12	320	14	318	19	324	75
335	366	2			347	2			330	49
340	338	7			340	2			356	18
345	351	15	312	15	336	4	333	3	342	261
350	307	3							348	45
355					371	3			343	18
360	375	43	377	18	372	6	361	5	332	10
365	384	2			355	2				
370	379	4			379	51			349	1
375	369	39	432	1	363	3	402	4	383	3
380	388	8	410	1					380	1
385	360	1	426	2	320	1	425	2	389	2
390	377	54	411	19	383	94	412	17	376	17
395	415	19			397	2				
400	408	4	465	2	427	70	416	21	415	21
405	376	106	448	1	415	29	423	19	403	30
410	437	1			409	87	420	1	347	4
415	370	1			376	18	425	5	460	2
420	403	61	393	64	419	109	431	30	428	25
425	383	2			435	2	451	11	448	11
430	493	1	480	268	428	44	449	60	449	65
435	421	23	425	70	417	16	433	27	439	7
440	450	2			443	1	459	14	455	14
445	429	1			464	4	471	54	470	57
450	443	34	424	248	432	20	446	78	460	63
455	458	4			425	4	452	5	441	5
460	447	7			448	44	455	8	456	8
465	440	29	430	25	476	23	464	20	471	30
470	491	5			494	1	475	30	475	39
475	439	2			469	9	471	12	473	13

	LPLA	LPLA	LTAG	LTAG	PAED	PAED	PGUA	PGUA	PHIK	PHIK
Scheduled	Actual	Count	Actual	Count	Actual	Count	Actual	Count	Actual	Count
480	455	33	457	30	476	34	469	102	468	80
485	470	1			493	8	468	8	459	2
490	491	5	470	1	492	15	481	12	471	7
495	488	7	415	1	498	30	493	40	488	25
500	514	2			512	14	498	27	497	30
505	526	4	501	1					525	6
510	524	11	485	10	515	13	492	42	488	40
515	515	1			529	9	520	2	504	1
520					599	1			523	6
525	502	5			512	28	510	17	528	8
530	548	13			512	3				
535	509	1			463	1				
540	517	18	480	14	542	19	546	4	538	18
545	512	2	491	1						
550	550	2			519	2			533	7
555	509	2	478	2	578	1			548	5
560	562	1							576	1
565										
570	573	18	438	1	549	3			535	5
575	522	3					577	1	582	4
580	619	1			420	1			631	1
585					558	1			549	10
590	555	1			658	1				
595										
600	548	5			595	5	592	16	537	8
605										
610									574	3
615					616	3	633	1	608	2
620									609	1
625	442	1			642	1			600	1
630	606	4			593	2			628	1
635									543	1
640	521	1								
645										
650									478	1
655										
660	526	3							524	1
665										
670										
675							334	2		
680	631	1							708	1
685									646	1
690	634	1							632	1
695										
700										
Total		1700		2069		2805		2051		2494

	PHNL	PHNL	RJTY	RJTY	RKSO	RKSO	RODN	RODN
Scheduled	Actual	Count	Actual	Count	Actual	Count	Actual	Count
5							13	1
10	70	1	23	2				
15	25	1	23	65	24	3	23	4
20	18	4	26	104	37	9	100	1
25	300	1	21	2				
30	30	18	29	109	36	114	29	11
35			27	1	33	33		
40			73	71	36	157		
45	37	2	51	14	38	33		
50	50	47	62	2	48	2		
55	63	1	71	30	53	4		
60	56	39	68	438	60	12	71	6
65			70	104	66	3		
70	42	1	74	123	69	60	111	4
75			74	193	68	35	92	12
80	70	3	83	72	90	2	110	3
85			106	124	112	151	114	93
90	101	2	91	279	98	48	98	86
95			102	85	104	71	111	2
100	110	21	105	272	117	177	120	105
105			103	300	105	254	113	56
110			121	56	121	46	116	19
115	126	19	129	245	119	153	133	184
120	122	13	120	633	118	483	123	715
125	125	10	119	93	120	86	127	19
130	120	1	144	79	120	102	129	140
135			133	264	130	116	132	270
140			144	64	135	31	146	51
145			137	63	135	45	144	38
150	150	2	141	267	138	111	149	292
155			155	5	137	2	151	19
160			158	39	152	27	162	65
165			163	146	167	32	166	172
170	153	5	151	91	142	1	156	111
175			163	31	162	28	184	5
180	191	6	177	243	165	105	183	246
185			200	3			193	8
190			190	59	171	28	197	57
195	188	2	196	90	204	5	194	186
200	200	7	205	18			198	28
205			214	77			202	19
210			210	224	209	11	204	172
215			216	6			218	15
220	215	3	215	19			212	14
225			215	68	228	2	211	45
230			221	3			215	1

	PHNL	PHNL	RJTY	RJTY	RKSO	RKSO	RODN	RODN
Scheduled	Actual	Count	Actual	Count	Actual	Count	Actual	Count
235			210	1				
240	341	1	229	45	197	5	228	42
245			240	1			270	2
250			215	2	255	3	215	2
255	273	2	272	5	210	6	221	8
260	273	2						
265	284	7			257	2		
270	285	13	225	5	268	19	272	13
275	279	8	288	1	246	2	297	10
280	278	12	289	1	270	1	298	2
285	295	24	279	2	273	4	330	13
290	314	6						
295	311	15	403	1			295	2
300	304	61	324	27	213	8	298	40
305	320	10					308	13
310	320	67	273	2			348	13
315	308	63	319	20	243	2	300	14
320	323	22	313	27			304	9
325	325	25	313	79			323	18
330	328	63	293	29	370	5	328	57
335	338	27					346	12
340	328	10	391	1			388	21
345	336	39	364	3	279	2	326	19
350	352	14					382	1
355	348	25	406	4	226	2	394	1
360	341	42	309	8	311	5	349	25
365			412	5				
370	372	2	386	6			357	1
375	364	19	373	24	387	3	362	13
380	382	4	379	82			376	1
385	380	4	383	13	395	1		
390	377	25	384	17	358	1	374	13
395			422	2	400	1	387	3
400	383	15	416	56				
405	413	27	418	44	363	3	361	2
410			422	22	430	2		
415	430	8	423	25			408	1
420	494	10	421	72	392	2	413	17
425	427	16	428	36				
430	433	5	446	38	455	4	562	1
435	445	16	432	41	433	1	422	4
440	459	5	412	42	467	1	467	1
445	436	13	427	63			451	1
450	453	54	447	82	430	6	428	10
455	461	4	439	12				
460	471	5	442	30	465	2	450	10
465	464	18	469	47	505	2	481	6
470	476	5	481	16	497	1	486	4
475	494	13	481	22	516	2	474	5
480	470	68	455	107	485	15	470	26

	PHNL	PHNL	RJTY	RJTY	RKSO	RKSO	RODN	RODN
Scheduled	Actual	Count	Actual	Count	Actual	Count	Actual	Count
485	471	7	495	8	485	1	511	2
490	476	9	489	17	533	5	479	5
495	491	38	495	42	505	2	506	8
500	492	1	512	14			511	1
505	533	13	526	12	493	1	493	2
510	487	26	490	17	506	1	486	18
515	520	2	529	9			504	1
520	528	6	523	6	538	6	521	1
525	511	19	519	22	533	2	542	16
530			493	1	503	1	552	8
535	545	3			516	1		
540	510	15	553	16	512	13	540	23
545	494	1						
550			556	3	650	1	544	7
555	482	3	567	5	636	3	575	8
560	556	3	569	1	549	1	568	5
565	580	1	580	1			570	1
570	569	5	560	13	584	7	559	9
575	597	2	590	5				
580	624	3					613	5
585	666	1	588	7	542	1	551	5
590	583	1					610	5
595	575	1	596	1			575	1
600	609	12	582	70	559	6	587	12
605			594	1				
610			528	5			590	2
615	630	1	618	7			615	5
620			623	15			588	3
625	549	4	555	1	656	1	620	4
630	606	4	620	37			640	7
635					611	1	688	1
640							654	2
645	648	1			631	1		
650	637	1					478	1
655								
660	606	3	641	13	648	3	664	4
665								
670			687	74				
675			778	1	240	1		
680							708	1
685			725	1	651	4	661	10
690			772	1				
695								
700								
Total		1289		6870		2758		3914

Appendix G: Aircraft Ground Time Performance

	T43	T43	MD83	MD83	MD11	MD11	KC10	KC10	DC10	DC10
Sch Gnd	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg
5							1	1602		
10										
15							1	1534		
20										
25										
30	2	39					2	15		
35										
40							1	30		
45	1	44					4	561		
50									1	62
55										
60	3	48					7	99	2	58
65			2	95						
70	5	64			2	104	2	21		
75	103	64					1	74	2	52
80	1	63	3	134	1	145			10	70
85	1	55			1	125				
90	3	70			4	216	2	102	11	174
95					3	116			18	77
100	1	102			1	100	3	80	3	115
105	1	110			1	89			1	108
110	1	116	18	93	67	122	2	589	109	135
115					6	97			1	51
120	2	76			3	159	26	154	6	112
125					5	115			12	85
130	2	159			1	67			2	102
135			1	95	1	126	7	121		
140	1	101	1	89	96	148	1	129	167	138
145	2	154							5	138
150	1	157	1	80	1	220	11	138		
155					1	170	1	155	3	112
160					1	114				
165							1	186		
170					1	480	1	165	13	140
175					1	131				
180					7	258	94	244	4	425
185					2	223			1	152
190					2	285				
195	1	247					16	281		
200					32	305	1	221	27	168
205							1	173		
210	1	224			5	132	8	304	2	109
215					7	136	2	134	10	126
220							2	188		
225							4	213		
230	1	205			4	192	1	154	4	211
235	1	194								
240	2	201					473	249		

	T43	T43	MD83	MD83	MD11	MD11	KC10	KC10	DC10	DC10
Sch Gnd	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg
245	1	284			3	200	2	254		
250					1	238	2	252	1	720
255							23	235		
260	1	253			6	238	3	198	5	219
265					2	238	4	249		
270					1	120	4	206		
275							1	246		
280	1	285			3	220			1	133
285							1	292		
290					4	228	2	299	10	287
295										
300							4	266	2	286
305	1	316			1	235	3	311		
310	2	323								
315	2	327					1	301		
320							3	317	1	453
325	2	328								
330										
335							2	332		
340							2	348		
345							1	338		
350	1	257			1	306	1	337		
355							2	337		
360							3	313	2	315

	C5	C5	L100	L100	L1011	L1011	C27	C27	C160	C160
Sch Gnd	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg
5									1	108
10										
15							4	64		
20					1	104	8	86		
25										
30	2	42	5	77			12	18	181	17
35									3	49
40	2	168					3	30		
45	3	140					26	51	16	43
50					2	290			13	61
55									1	58
60	4	655			11	58	95	52	8	63
65									12	73
70							2	29	1	78
75	2	696			1	660	16	52	17	67
80			78	67	83	60	4	62	7	83
85					1	75	1	55		
90	5	102	4	56	30	80	191	93	11	85
95					35	80	2	90	1	115
100					6	133	4	103		
105	1	243			5	135	6	78	1	104
110			907	95	418	117				
115					2	128	1	50		
120	56	122	4	46	57	129	48	119	2	94
125			14	78	29	125			1	134
130					2	125				
135	20	178			3	112	13	130		
140	1	1640	245	108	24	118	2	63		
145					1	94				
150	4	103			2	2196	22	324		
155					2	97	1	44		
160	2	255			1	125	1	167		
165	6	136			2	167	1	82		
170			10	89	10	125				
175	1	175								
180	27	367	1	650	12	208	12	155		
185					3	236				
190	3	208			1	109				
195	1040	353			1	146	1	121		
200	3	1364			60	170				
205	3	246			1	165	1	193		
210	10	1187			2	220			1	198
215	1	189			2	169				
220					4	263				
225	97	277								
230	2	135			46	179				
235					1	215	1	381		
240	47	258			12	241	2	263		

	C5	C5	L100	L100	L1011	L1011	C27	C27	C160	C160
Sch Gnd	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg
245	1	279								
250	4	209								
255	1395	395			6	260			1	14
260	1	3383	4	278	38	221				
265	1	202			2	119				
270	6	220	1	317	1	329				
275	1	263			4	215				
280										
285	11	348								
290	1	336			2	199				
295					16	228				
300	23	321			2	109	2	202		
305	2	474			1	301				
310	1	325								
315	93	435								
320										
325					4	242				
330	1	1593			1	338				
335					4	292				
340										
345	5	307								
350	2	314	1	395	3	349				
355					1	346				

	C141	C141	B757	B757	B747	B747	B737	B737	B727	B727
Sch Gnd	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg
5										
10	2	15								
15	4	589								
20	3	99								
25	5	193								
30	256	34								
35	1	97								
40	1	40								
45	12	64	1	40			306	48	2	45
50	1	50	3	46					13	52
55					1	39				
60	250	69	13	56			5	56	11	58
65			3	56			2	40	5	46
70	18	75	2	63					2	44
75	37	183	1	50	2	54			6	61
80			80	71	17	108	29	90	67	73
85	8	101	1	88	2	120			2	376
90	236	105	19	83	6	153			16	99
95			13	69	4	107			300	73
100	11	219	3	119	4	110	1	121	35	130
105	32	162	30	92	5	111	1	85	4	115
110	6	109	350	119	276	113			307	99
115	9	111	3	310	4	200			3	93
120	59	133	27	125	12	139	1	50	9	180
125	3	274	77	131	7	111			97	100
130	7	365			2	112			24	101
135	3645	175			2	157			3	96
140	23	139	35	123	611	161			48	120
145	7	189	1	120	7	123			14	119
150	76	207	11	168	5	131			1	122
155	3	123	2	184	4	209			1	813
160	2	256	1	93	64	238			33	151
165	235	181	1	145	4	162				
170	7	173	63	148	44	182			62	105
175	4	145			3	205			11	158
180	156	212	9	137	6	140			2	852
185	7	168			5	213				
190	13	161	1	105					2	213
195	2894	227	1	167	3	156				
200	17	187	18	166	206	183			2	158
205	10	196			1	137			22	160
210	46	261			6	190				
215	1	1025			1	215				
220	5	268	11	132	3	262				
225	30	217								
230	3	173	1	170	18	195			15	142
235	2	183			2	253				
240	36	277			8	204				

	C141	C141	B757	B757	B747	B747	B737	B737	B727	B727
Sch Gnd	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg
245	2	192			6	242				
250	2	202			3	177				
255	65	347	20	236	3	201				
260	1	217	13	197	111	280			1	220
265	2	195			3	261				
270	23	257			4	199				
275					1	365				
280	1	275	2	511	12	237				
285	5	262								
290	2	466	1	308	48	258			3	856
295					1	187				
300	13	490								
305	3	336			1	180				
310					1	267				
315	6	269			4	265				
320	2	375			57	292				
325	2	766			5	368				
330	3	332			6	256				
335	1	110			1	495				
340	3	297			5	349				
345	5	648			4	344				
350	2	346			2	323				
355	7	338								
360	50	285	1	489	2	170				

	DC8	DC8	C130	C130	KC135	KC135	C9	C9	C21	C21
Sch Gnd	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg
5			20	7	1	1370	1	20	2	45
10			44	25	2	34	2	10	1	80
15			186	18	11	25	10	56	28	38
20			65	25	3	39	256	23	3	18
25			91	40	4	23	53	29		
30	1	227	1942	30	139	47	485	33	107	35
35			19	33	9	36	70	36	1	46
40			94	46	14	53	195	48	6	32
45			423	50	69	73	250	52	53	49
50			60	57	13	84	120	44	2	38
55			25	87	7	70	117	59	4	83
60			1413	73	225	107	1337	71	523	57
65	111	32	19	143	10	182	12	65	4	52
70			77	97	18	69	45	59	10	63
75	5	171	376	89	22	60	110	70	6990	70
80	19	66	55	109	6	85	9	94	12	82
85	1	60	36	140	9	65	3	73	8	98
90	28	82	1157	106	85	91	74	84	1859	98
95	21	76	21	96	4	230	1	98	11	85
100	2	158	46	93	8	101	6	143	3	102
105	28	118	152	127	11	193	3	108	157	110
110	393	89	20	102	7	165	1	125	9	104
115	1	100	16	111	5	105	1	100	3	194
120	23	112	780	119	130	202	43	132	262	127
125	357	106	9	109	8	252	3	172	6	79
130	38	100	25	183	3	134	1	130	8	143
135	9	133	1574	155	112	144	11	137	133	140
140	1593	144	20	136	2	615			5	116
145	1	117	9	362	4	121	1	172	7	141
150	17	158	133	186	34	214	13	141	176	160
155	8	94			6	139	2	175	1	61
160	1	142	4	112	1	40	1	126	5	177
165	13	158	28	165	8	169	3	175	118	166
170	101	144	10	261	5	130	1	100	4	191
175			7	319	2	131			6	143
180	33	163	99	259	166	223	6	144	169	179
185	13	206	4	134	5	192	1	205	3	148
190	1	62	17	228	6	340			4	182
195	4	475	68	184	242	194	2	202	92	200
200	370	200	11	325					4	171
205			8	327	1	140			4	211
210	2	158	29	240	2	282	4	176	113	222
215	5	164	5	222	1	1122	1	215	6	214
220	1	154	13	199			1	180	5	223
225			12	243	2	221	1	225	65	238
230	4	205	6	213	2	167			5	464
235			1	219	1	235			3	269
240			21	241	47	276	1	247	108	236

	DC8	DC8	C130	C130	KC135	KC135	C9	C9	C21	C21
Sch Gnd	Num	Avg	Num	Avg	Num	Avg	Num	Avg	Num	Avg
245			3	344	1	190	1	275		
250			8	215	1	255	1	320	4	268
255			13	409	7	489	2	274	55	250
260	8	217	4	230					4	264
265			2	291	1	353			2	290
270	3	293	12	228	7	264	2	213	88	259
275	2	210	4	218	1	261			2	208
280			4	1531			1	300	4	281
285			4	210	1	147	2	217	37	288
290	3	228	5	211	1	240	1	315	4	279
295			3	288	1	275			1	301
300			23	242	5	297	1	170	68	294
305	1	513	3	246						
310			4	175			1	130	3	284
315			6	373	3	282			37	328
320	9	384	4	333	1	286	1	230	1	252
325					1	75				
330			15	314	2	322			53	332
335	1	80	2	66			2	230	2	346
340			6	332					2	496
345			7	360	2	315	1	333	30	335
350			2	1702	1	389				
355			2	355			1	280	1	314
360			13	331	4	345			46	352

Appendix H: Airfield Ground Time Performance

	EDAF	EDAF	EGUN	EGUN	ETAR	ETAR	PHIK	PHIK
SCHEDULED	AVG	NUM	AVG	NUM	AVG	NUM	AVG	NUM
5	7	1						
10								
15	142	9			95	1	10	5
20								
25								
30	34	88			42	8	28	11
35								
40	44	27	54	4	47	5		
45	78	4			60	4	27	6
50			53	1				
55			54	12	54	2		
60	77	17	96	69	72	57	55	3
65	48	1	42	1	42	2		
70			70	1	91	5		
75	99	36	85	55	78	279	58	2
80			97	3	73	6		
85	30	1	55	1				
90	78	9	70	8	91	10	115	45
95			72	110	65	108		
100	114	2	125	3				
105	122	5	94	2	111	9	53	1
110	111	157	72	60	107	361	149	33
115			119	1	135	1		
120	145	31	268	11	156	43	87	3
125	76	2			90	66	124	2
130	163	1			107	26		
135	223	122	215	44	180	101	261	136
140	163	149	174	22	138	74	154	110
145	137	6	94	1	129	1		
150	142	8	140	3	135	5	151	4
155					1053	1		
160	186	1			152	35	280	1
165	155	5	123	4	200	2		
170	203	6	137	24	204	13	98	13
175	212	1			159	13		
180	368	61	530	4	278	8	215	1
185	285	1			153	1	194	1
190	213	1			190	1	62	1
195	276	130	448	66	262	96	310	120
200	191	130	234	9	215	8	191	182
205	160	22			208	3		
210	227	16	135	1	241	9	193	2
215	207	4			214	2		
220	328	3			312	1	825	4
225	214	13	204	2	239	7	154	1
230	638	8	230	3	224	17	134	1

	EDAF	EDAF	EGUN	EGUN	ETAR	ETAR	PHIK	PHIK
SCHEDULED	AVG	NUM	AVG	NUM	AVG	NUM	AVG	NUM
235	215	1			248	1		
240	232	21	276	2	346	11	339	4
245					280	2		
250	263	2	282	1	238	2		
255	474	75	474	30	363	47	677	23
260	280	9	279	1	255	7	247	2
265	233	1			292	3	239	2
270	320	4	124	2	288	5		
275	245	5						
280	280	1			4588	1	221	3
285			147	1	287	4	333	1
290	246	6	219	3	263	7		
295	274	2	274	1	350	1		
300	449	7			274	9	266	3
305	236	2					293	1
310								
315	276	5	342	1	353	5	345	2
320	290	31			311	16	308	2
325	242	4			325	1		
330	267	9	962	2	297	6	134	1
335	292	4			128	1		
340	333	1			348	1	213	1
345	330	1					362	3
350	266	1			257	1	387	1
355	338	2			280	1		
360	593	2			300	1		
365	363	1			347	1	398	1
370	311	9	553	1	411	1		
375	348	2			326	2	280	3
380	370	5	357	1	373	3	1728	1
385			160	1				
390	319	7			359	5		
395	375	1			450	1		
400	413	3			401	1		
405	420	2			598	6		
410	417	1			357	6		
415	452	2						
420	413	4			355	4		
425	415	1			434	1		
430	362	4			261	1	430	1
435	410	1			447	6		
440	448	3						
445					552	1		
450	466	2	509	1	480	5		
455	540	4			448	1		
460								
465	510	1						

	EDAF	EDAF	EGUN	EGUN	ETAR	ETAR	PHIK	PHIK
SCHEDULED	AVG	NUM	AVG	NUM	AVG	NUM	AVG	NUM
470	500	1			535	1		
475								
480	414	1			407	1	264	1
485								
490	503	1			415	2		
495	495	3			481	1	649	1
500					453	1		
505	519	3						
510	623	3			522	3		
515								
520	532	1			509	1		
525	499	2			581	1		
530	560	6			525	1		
535	560	3			517	1		
540					531	2	500	1
545	755	1			569	2		
550	550	1						
555	577	6			573	4		
560	471	2	1335	1	965	2		
565					588	1		
570	824	3			474	5	615	1
575	471	1	569	1	585	2		
580	593	3						
585	642	4			500	5		
590								
595	607	1			501	1		
600	598	6			611	2		
605	628	2						
610					619	2		
615	790	2						
620	700	1	702	1	674	6	533	1
625	634	23			642	3		
630	733	3	722	1	561	3		
635	602	1			561	1		
640					692	3		
645	653	1						
650					720	1	576	35
655	692	4						
660					748	2		
665	677	2			689	1		
670					638	3		
675	692	23			756	3		
680	926	7			546	7		
685	692	3						
690	976	3			689	5		
695	691	5			603	4	629	19

	LERT	LERT	LPLA	LPLA	LTAG	LTAG	PAED	PAED
SCHEDULED	AVG	NUM	AVG	NUM	AVG	NUM	AVG	NUM
5								
10							89	1
15							15	1
20							60	1
25								
30			20	1			66	10
35								
40	51	3					79	2
45	224	5	229	5			48	44
50	54	1					55	1
55	67	8	67	8				
60	172	122	384	41	136	16	56	29
65							810	2
70							96	4
75	80	3			84	11	80	7
80	84	2	57	3			92	30
85							80	3
90	115	4	109	5	78	11	84	171
95			74	37			74	2
100							121	1
105	75	13			100	1		
110	89	39	152	76	101	3	75	17
115	100	1						
120	94	48	186	8	61	38	131	8
125			111	48	124	1	177	9
130								
135	324	58	211	106	107	120	168	30
140	123	133	157	1	190	2	204	95
145								
150					170	3	304	2
155							155	1
160					144	16		
165	145	1						
170	120	1					119	1
175								
180	293	5	194	1	130	2	133	2
185	645	1						
190					194	3	173	2
195	422	90	341	77	573	2	245	109
200	182	6	126	1	157	1	141	11
205							173	1
210			1636	1			111	1
215					185	1		
220	208	1						
225	458	4					226	2
230					140	14		

	LERT	LERT	LPLA	LPLA	LTAG	LTAG	PAED	PAED
SCHEDULED	AVG	NUM	AVG	NUM	AVG	NUM	AVG	NUM
235								
240	263	24	417	13			886	1
245							192	2
250								
255	478	36	583	13	343	8	453	17
260					209	4	137	1
265							313	1
270			241	1				
275								
280								
285								
290					259	15	318	1
295					225	5		
300								
305					513	1		
310								
315	409	1	928	1			218	2
320					372	1		
325								
330			1986	1				
335								
340								
345								
350					347	2		
355								
360	316	2						
365								
370								
375								
380	878	2						
385								
390								
395								
400								
405								
410								
415								
420								
425								
430								
435								
440								
445								
450								
455								
460								
465								

	LERT	LERT	LPLA	LPLA	LTAG	LTAG	PAED	PAED
SCHEDULED	AVG	NUM	AVG	NUM	AVG	NUM	AVG	NUM
470								
475								
480								
485								
490								
495			254	1				
500								
505								
510							538	1
515								
520								
525					562	3		
530							723	1
535					468	1		
540							512	1
545								
550								
555					663	1		
560								
565								
570	770	1						
575								
580								
585					465	1		
590								
595								
600								
605								
610								
615								
620								
625							621	1
630					660	2		
635								
640								
645								
650							659	2
655					757	1		
660					705	2		
665								
670							600	1
675					753	2	610	1
680							487	7
685								
690					748	2		
695								

	PGUA	PGUA	RJTY	RJTY	RKSO	RKSO	RODN	RODN
SCHEDULED	AVG	NUM	AVG	NUM	AVG	NUM	AVG	NUM
5			1602	1			1	1
10								
15	41	2	554	3	13	2		
20							9	2
25								
30	24	250	42	12	55	9	43	8
35								
40							30	1
45	82	2	391	6			71	7
50			85	1				
55								
60	59	29	105	77	126	45	93	164
65			76	1			71	2
70			94	1			68	1
75			83	5	95	95	206	6
80	111	1	85	2	96	1		
85	87	1	117	3				
90	89	14	107	376	157	97	109	200
95								
100			87	3	95	2	105	2
105	219	1	214	41	123	35	132	3
110	116	9	101	121	159	1	170	8
115			155	1				
120	185	10	122	47	141	29	132	46
125	112	1	118	15	130	3	228	42
130			151	2			167	1
135	158	45	145	102	160	101	151	220
140	134	80	134	269	163	171	113	14
145			172	1	147	2	145	3
150	158	13	217	37	255	16	213	14
155			98	2				
160			167	2			142	1
165			506	5	191	5	181	4
170	130	43	157	10	804	2	141	5
175			165	1	710	2	272	2
180	217	22	197	25	298	105	250	8
185			162	1	219	1	162	1
190					172	1		
195	347	66	290	73	270	134	207	183
200	171	34	156	71	196	42	263	42
205								
210			415	13	204	2	352	6
215					209	2		
220			214	1	153	2	154	1
225	202	2	223	8	218	2	265	10
230			122	1	129	2	197	16

	PGUA	PGUA	RJTY	RJTY	RKSO	RKSO	RODN	RODN
SCHEDULED	AVG	NUM	AVG	NUM	AVG	NUM	AVG	NUM
235								
240	200	2	324	10	255	8	210	4
245	252	5			229	1	201	3
250			260	2	282	1	237	1
255	741	29	343	45	347	66	342	41
260	239	22	305	17	211	16	184	30
265			235	1			233	3
270	203	1	242	8	219	5	240	3
275	217	1						
280							223	13
285			267	4	180	1	242	2
290	261	4	276	4	242	2	260	34
295							187	1
300	224	1	269	8	300	6	321	2
305	133	1			288	1		
310								
315			544	25	492	37	341	2
320			195	2	267	3	224	5
325			637	3				
330	174	1	358	13	412	2	330	1
335			222	2			333	1
340			386	6	399	3		
345	292	1	354	2	266	1	292	1
350			407	5			348	3
355			384	1				
360	255	1	360	19	308	4	183	1
365			365	1				
370			362	3				
375			371	7			345	1
380			360	3				
385			378	1				
390			387	6			362	2
395			353	1				
400			407	1				
405			459	3				
410								
415			503	1				
420			435	1			435	1
425								
430								
435			475	1				
440			440	1				
445			427	1				
450			397	6	467	1	269	1
455								
460								
465			474	1				

	PGUA	PGUA	RJTY	RJTY	RKSO	RKSO	RODN	RODN
SCHEDULED	AVG	NUM	AVG	NUM	AVG	NUM	AVG	NUM
470	660	1						
475								
480			449	6				
485			1021	2				
490								
495			511	1				
500							447	1
505								
510			511	8			510	3
515			513	2				
520			545	4				
525			546	9			544	1
530			528	3				
535			544	7				
540			568	13				
545			584	1				
550			642	1				
555			564	4				
560			566	1				
565								
570			622	39	568	1	615	1
575			565	1				
580			565	1				
585	531	1	515	1			565	1
590								
595								
600			773	8			529	2
605			713	1				
610			651	1				
615			682	3	759	2	913	1
620			728	1				
625							510	1
630	600	1			425	1		
635			592	1				
640								
645			658	4				
650			642	1			675	1
655								
660	645	1	645	3			848	3
665			741	1				
670								
675	950	1	710	7			661	1
680	673	1	722	1				
685			728	3				
690			1055	5			2503	1
695			700	2				

Appendix I: Extended Benchmark Tables

The following pages are representative tables and look-up charts designed for airlift crisis planner use. To determine the optimum departure separation between scheduled flights, the scheduler chooses the chart with the following known factors:

1. Variance to Mean Ratio (VMR)
2. Planned Ground Time
3. Planned Flight Time
4. Acceptable level of delays (1%, 5%, 10%)

While these tables are merely representative of the separation required to ensure relatively uncongested operations, it should serve as a benchmark for the scheduler. Specific operational considerations will have to be used to adjust these times as the situation warrants.

MOG = 1 VMR = 2 < 1% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	70	107	144	180	216
120	94	128	163	193	232
180	103	136	171	206	240
240	113	145	179	213	246
300	121	153	186	220	253
Est. Utilzation	31%	44%	53%	58%	63%

MOG = 1 VMR = 2 < 5% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	58	95	129	164	197
120	74	107	141	172	205
180	82	114	147	180	213
240	89	120	152	185	217
300	96	125	158	192	222
Est. Utilzation	38%	53%	61%	66%	70%

MOG = 1 VMR = 2 < 10% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	52	86	120	142	186
120	65	97	130	157	194
180	71	102	135	161	200
240	76	108	140	165	204
300	80	113	144	166	208
Est. Utilzation	40%	58%	66%	70%	75%

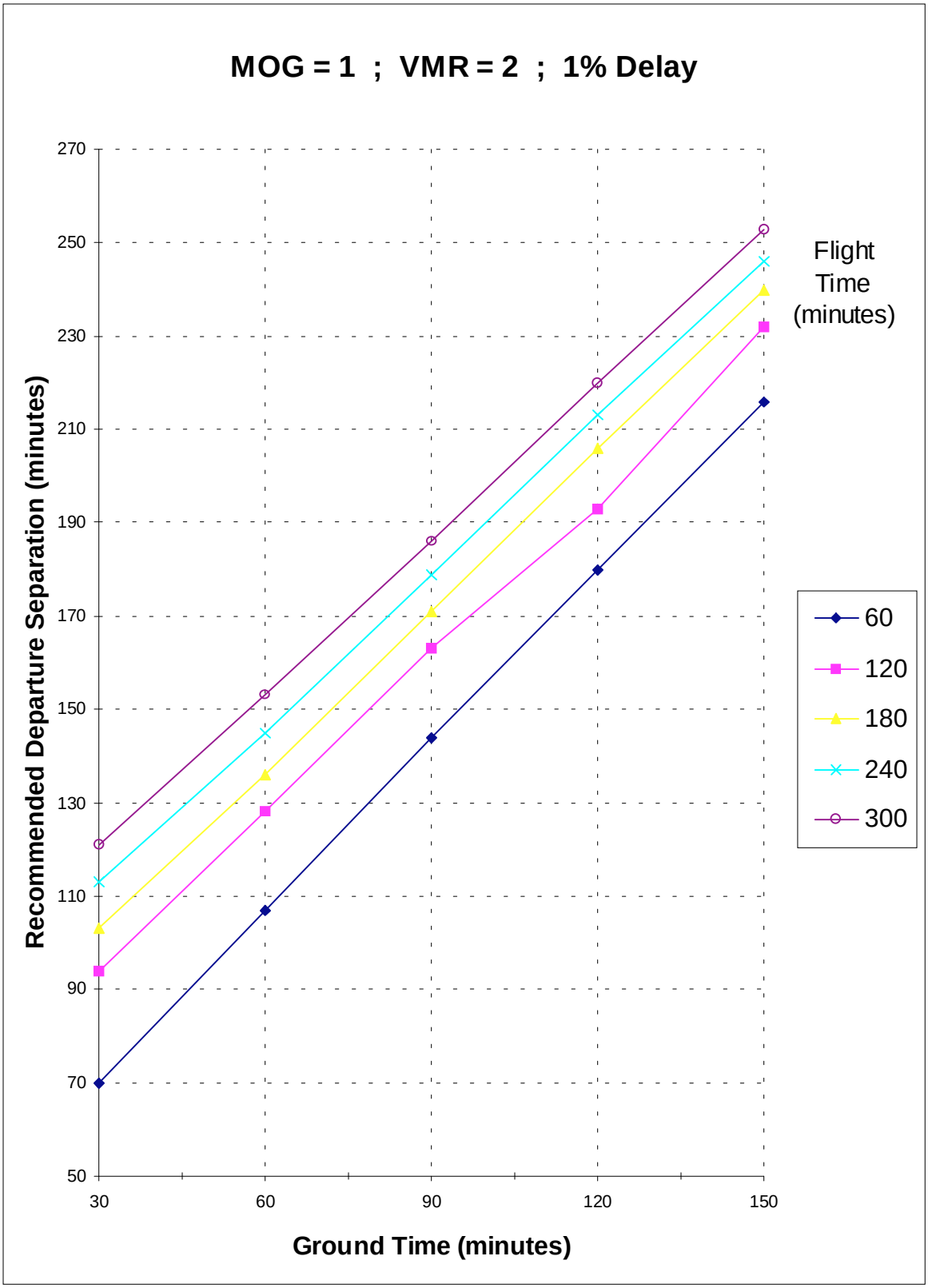


Figure 6. Planning Chart 1

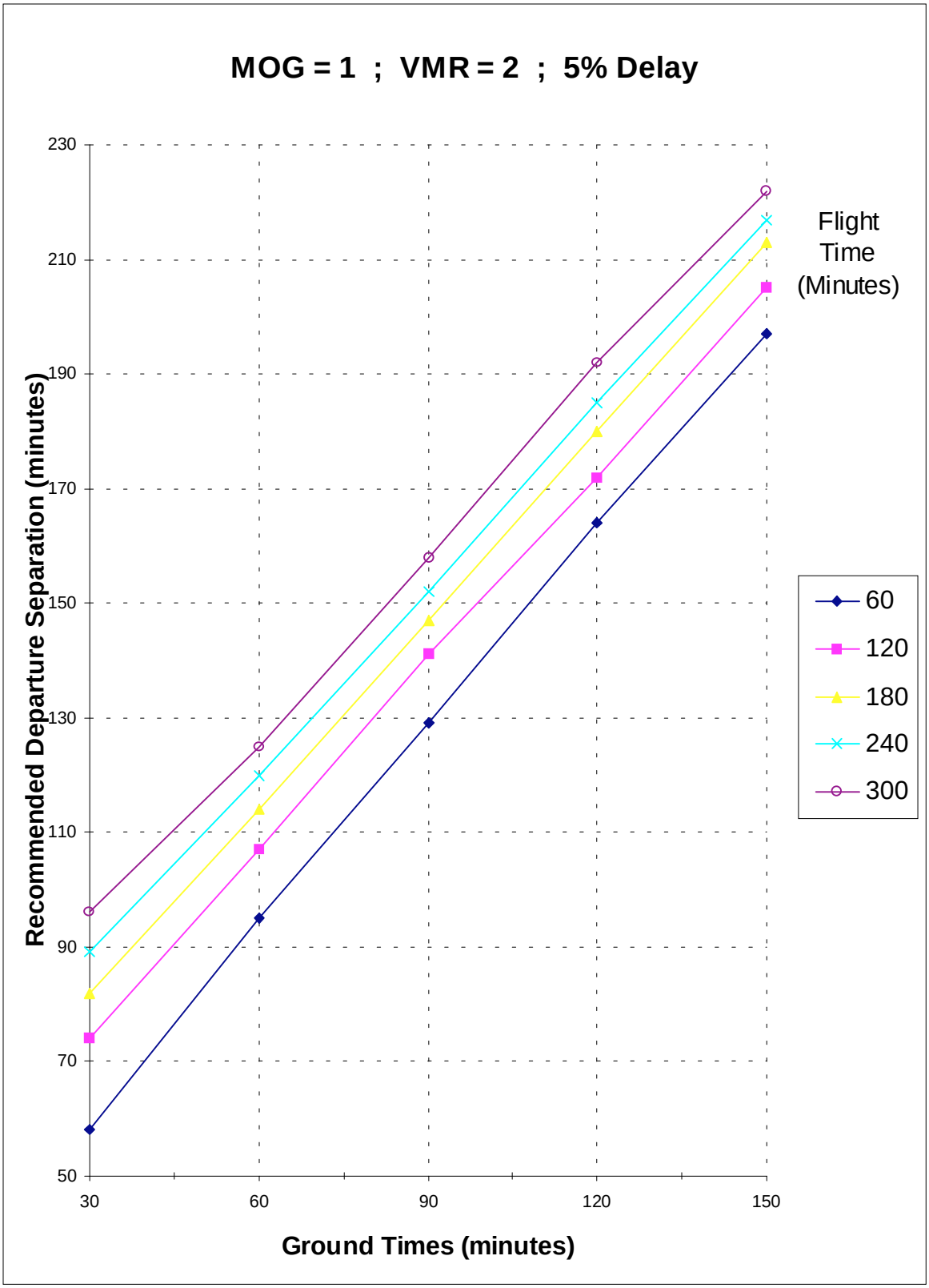


Figure 7. Planning Chart 2

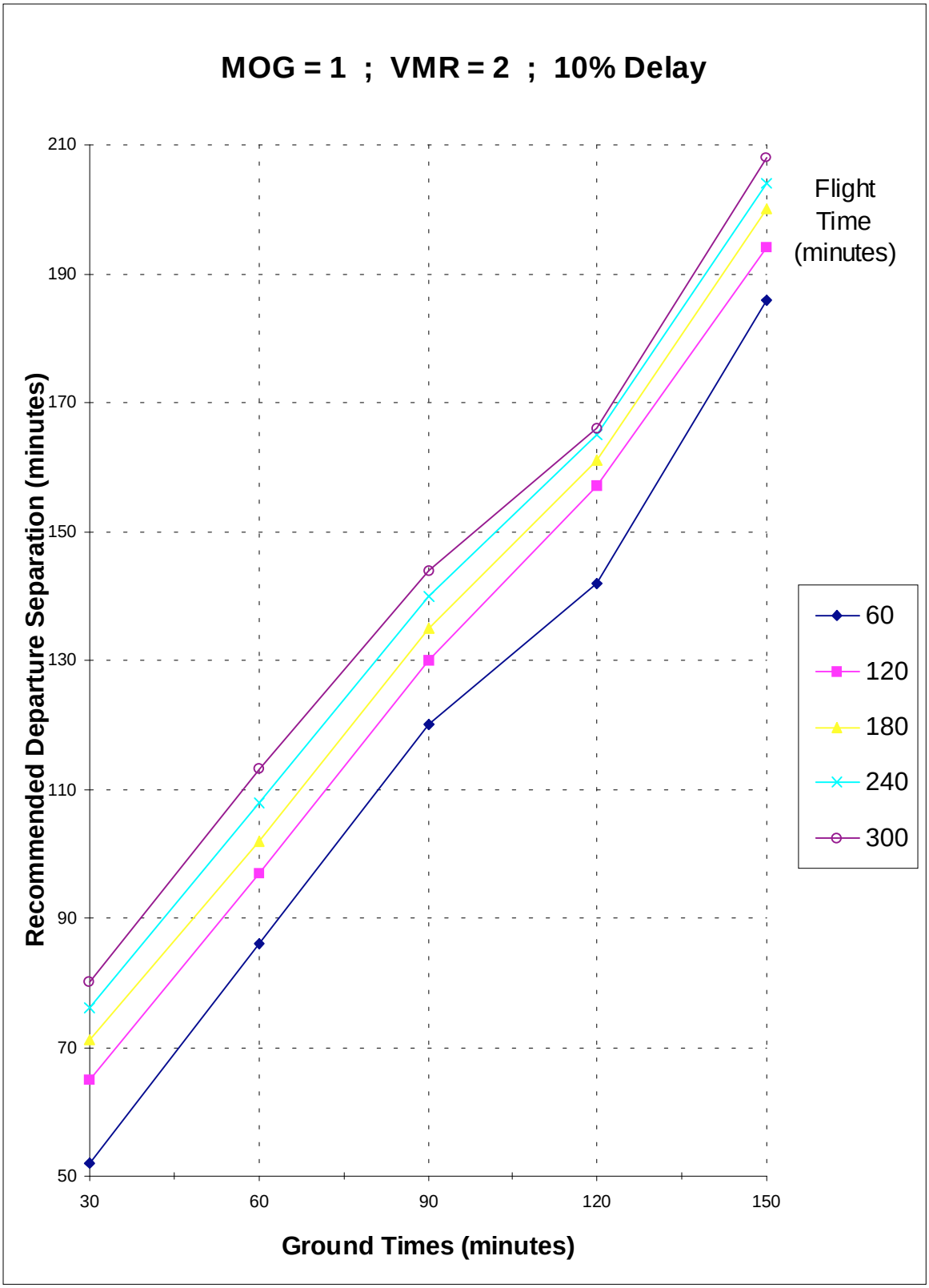


Figure 8. Planning Chart 3

MOG = 1 VMR = 3 < 1% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	80	118	155	193	228
120	112	139	179	209	239
180	127	157	184	213	242
240	136	171	189	218	245
300	142	177	193	222	250
Est. Utilzation	26%	38%	49%	56%	62%

MOG = 1 VMR = 3 < 5% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	66	99	136	167	195
120	87	119	148	187	218
180	95	128	162	195	226
240	101	136	168	200	230
300	106	144	173	206	236
Est. Utilzation	35%	47%	56%	61%	66%

MOG = 1 VMR = 3 < 10% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	58	92	127	159	186
120	76	105	138	171	202
180	83	113	145	176	207
240	88	119	150	180	211
300	94	124	155	184	215
Est. Utilzation	41%	53%	62%	68%	72%

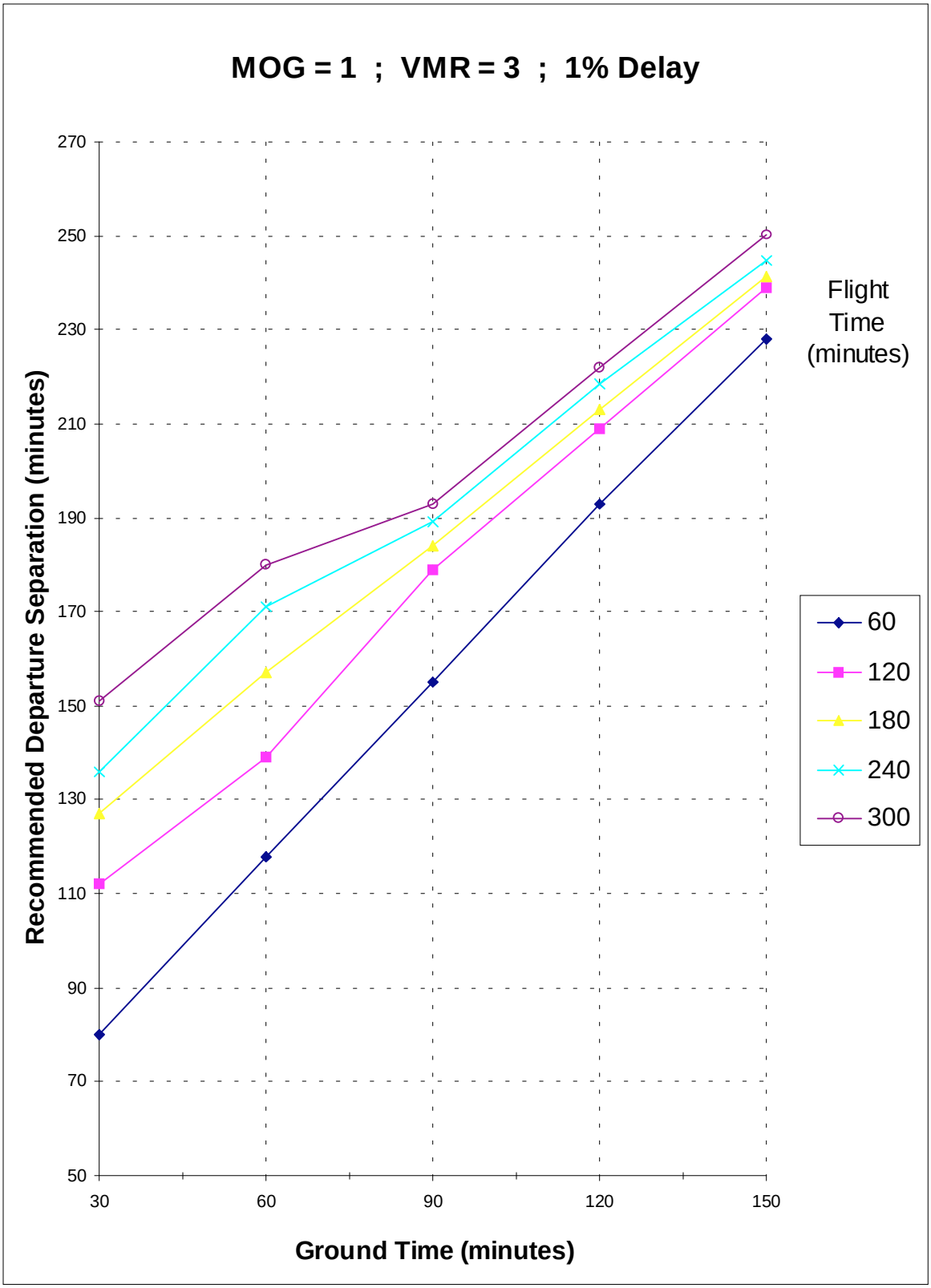


Figure 9. Planning Chart 4

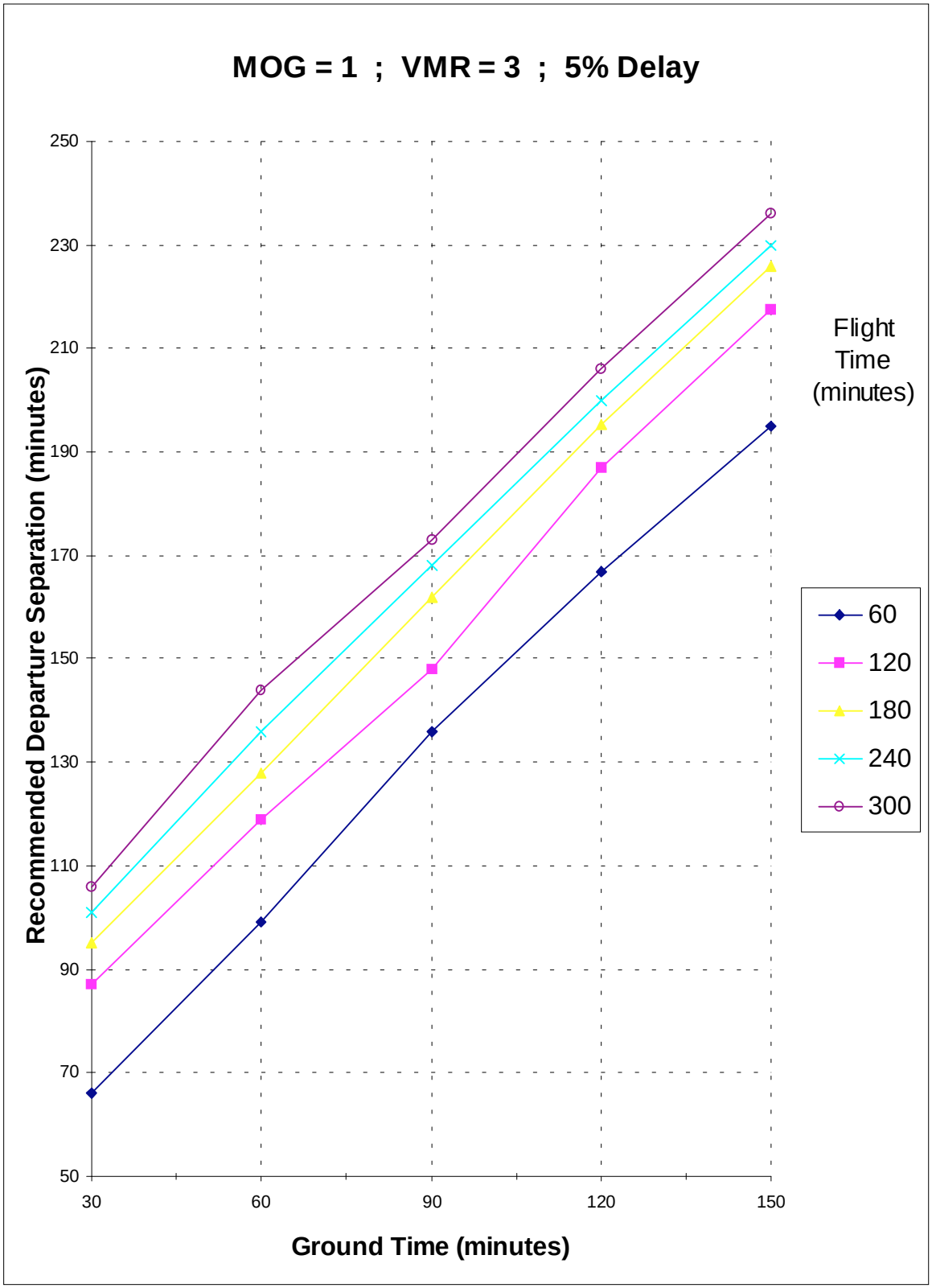


Figure 10. Planning Chart 5

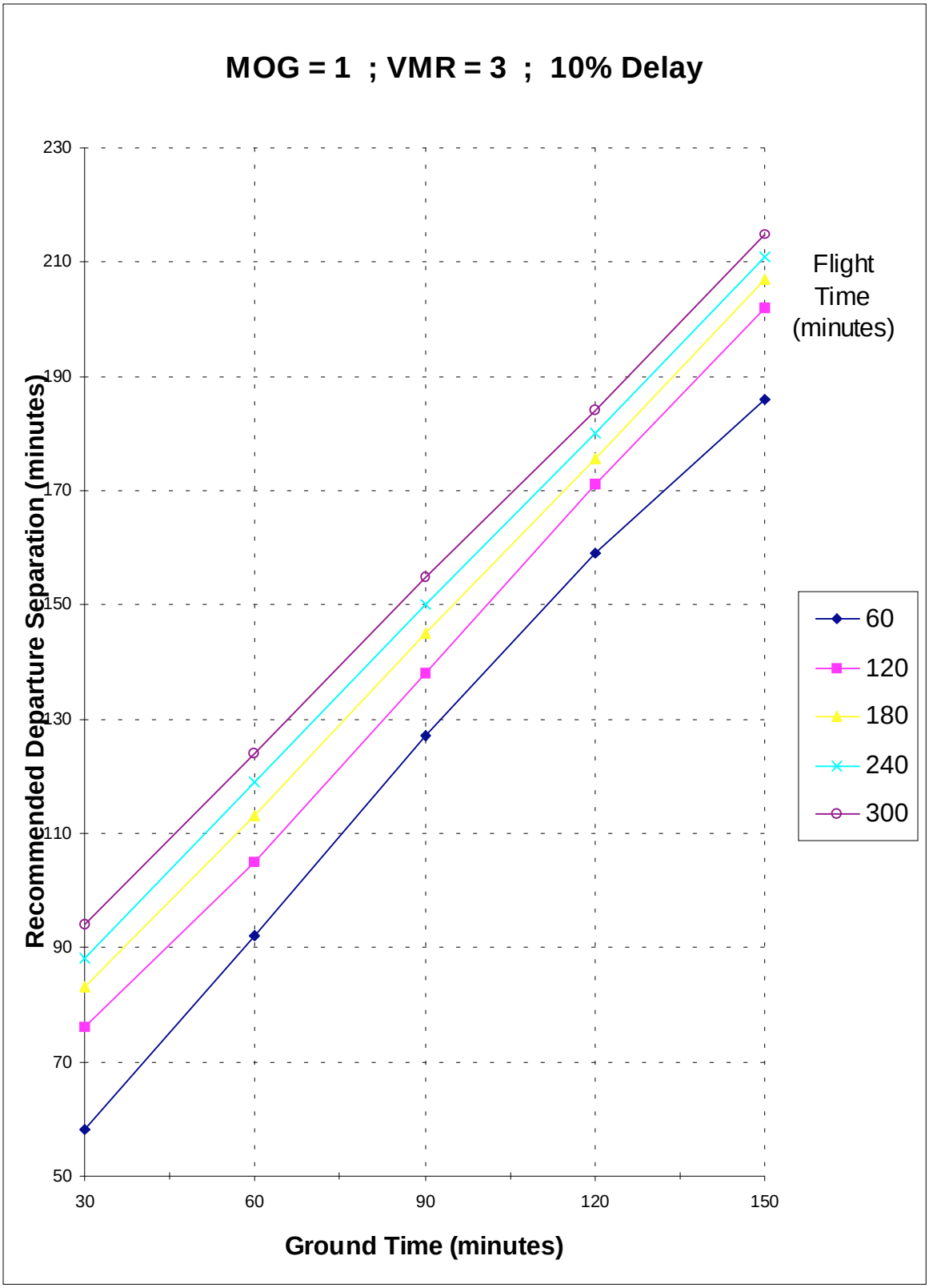


Figure 11. Planning Chart 6

MOG = 1 VMR = 4 < 1% Delayed

Ground Time

Flight Time	30	60	120	120	150
60	112	146	176	223	255
120	126	161	198	235	271
180	137	174	213	245	283
240	148	183	220	251	287
300	156	192	227	258	293
Est. Utilzation	31%	38%	43%	50%	59%

MOG = 1 VMR = 4 < 5% Delayed

Ground Time

Flight Time	30	60	120	120	150
60	72	121	156	188	230
120	96	129	166	198	233
180	104	138	175	207	242
240	110	150	182	214	250
300	115	163	193	222	261
Est. Utilzation	42%	47%	51%	60%	68%

MOG = 1 VMR = 4 < 10% Delayed

Ground Time

Flight Time	30	60	120	120	150
60	65	106	141	173	211
120	82	113	149	181	214
180	91	122	158	189	222
240	98	128	165	195	228
300	104	136	172	202	236
Est. Utilzation	47%	52%	61%	66%	72%

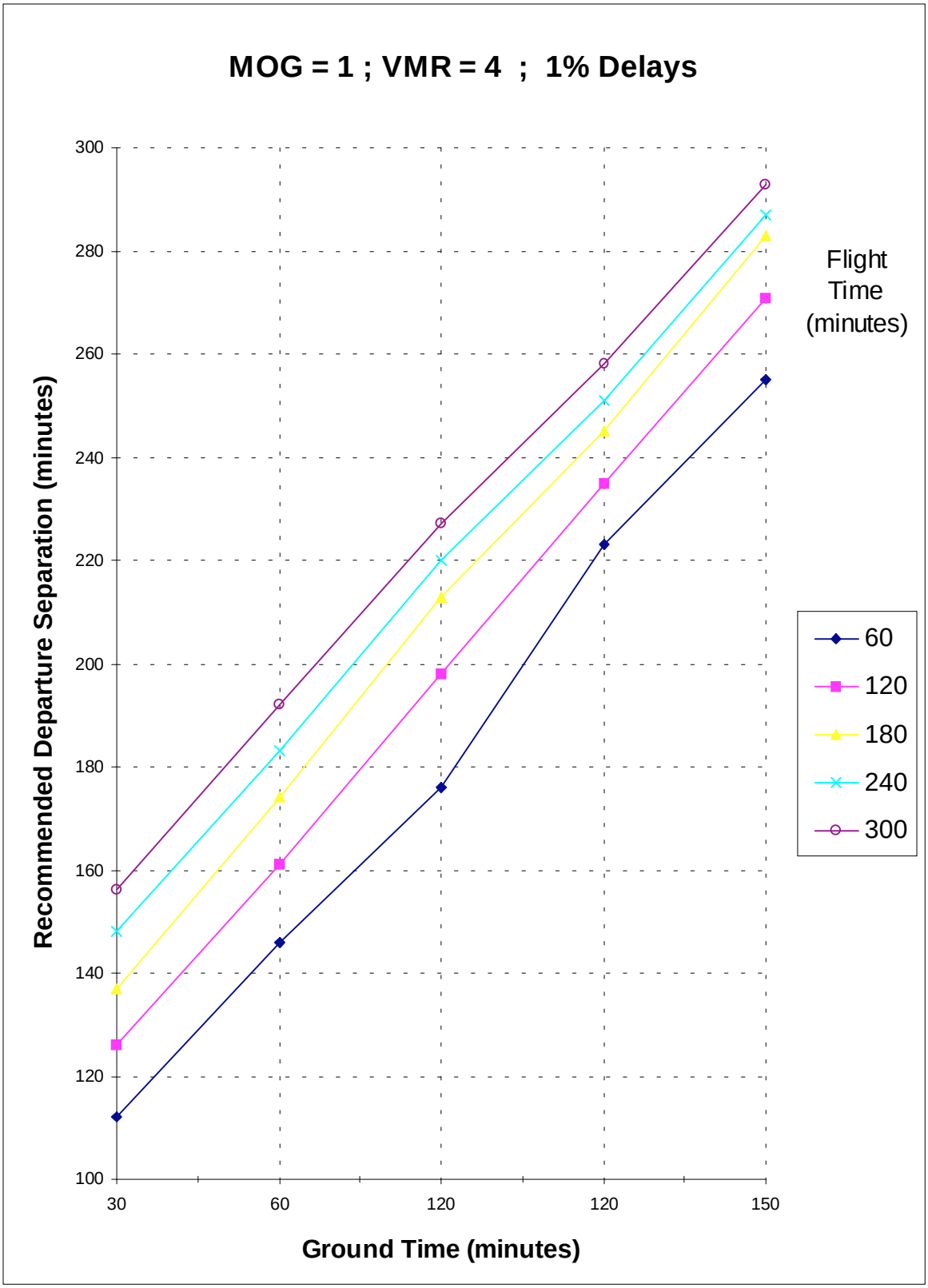


Figure 12. Planning Chart 7

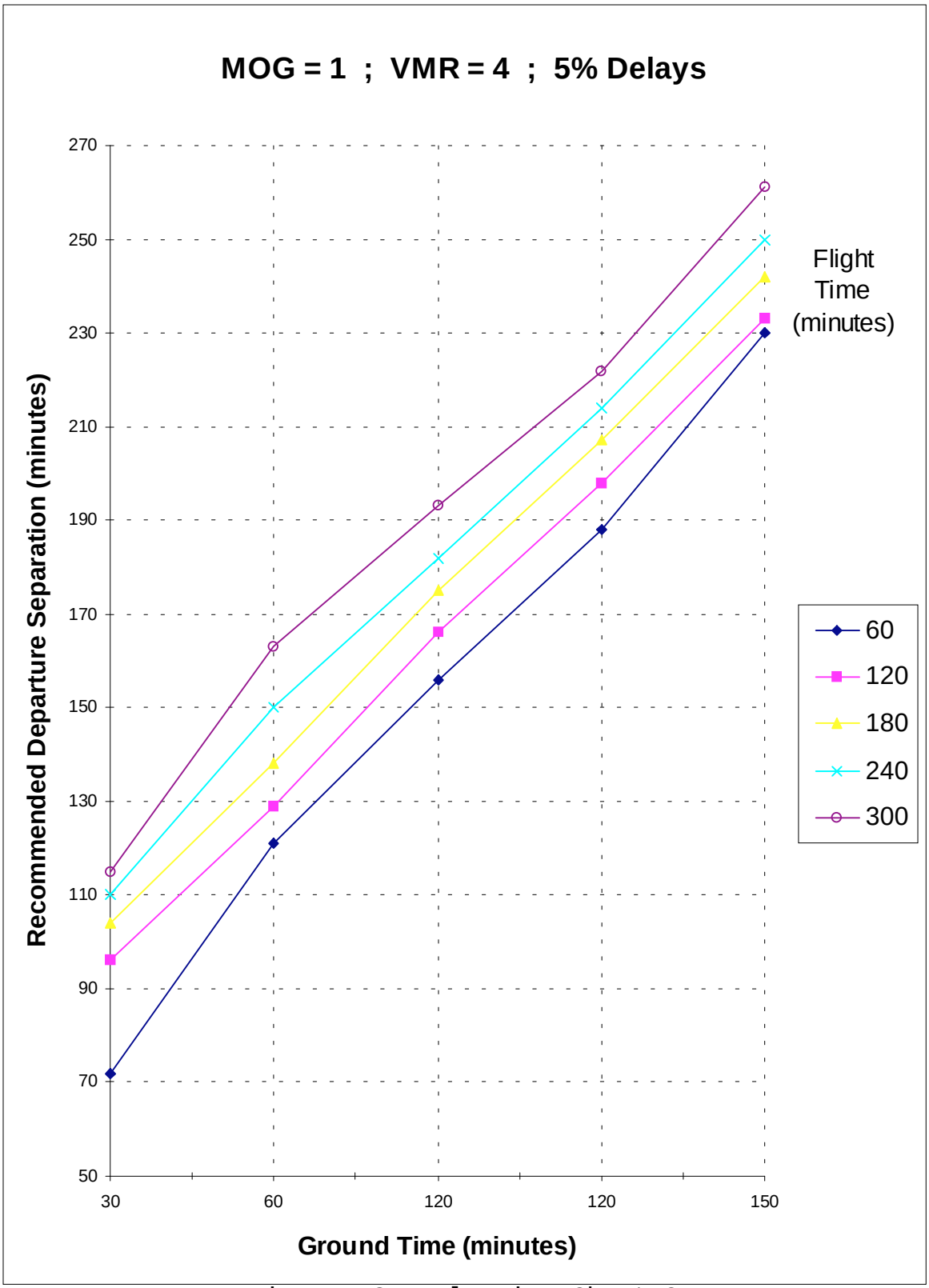


Figure 13. Planning Chart 8

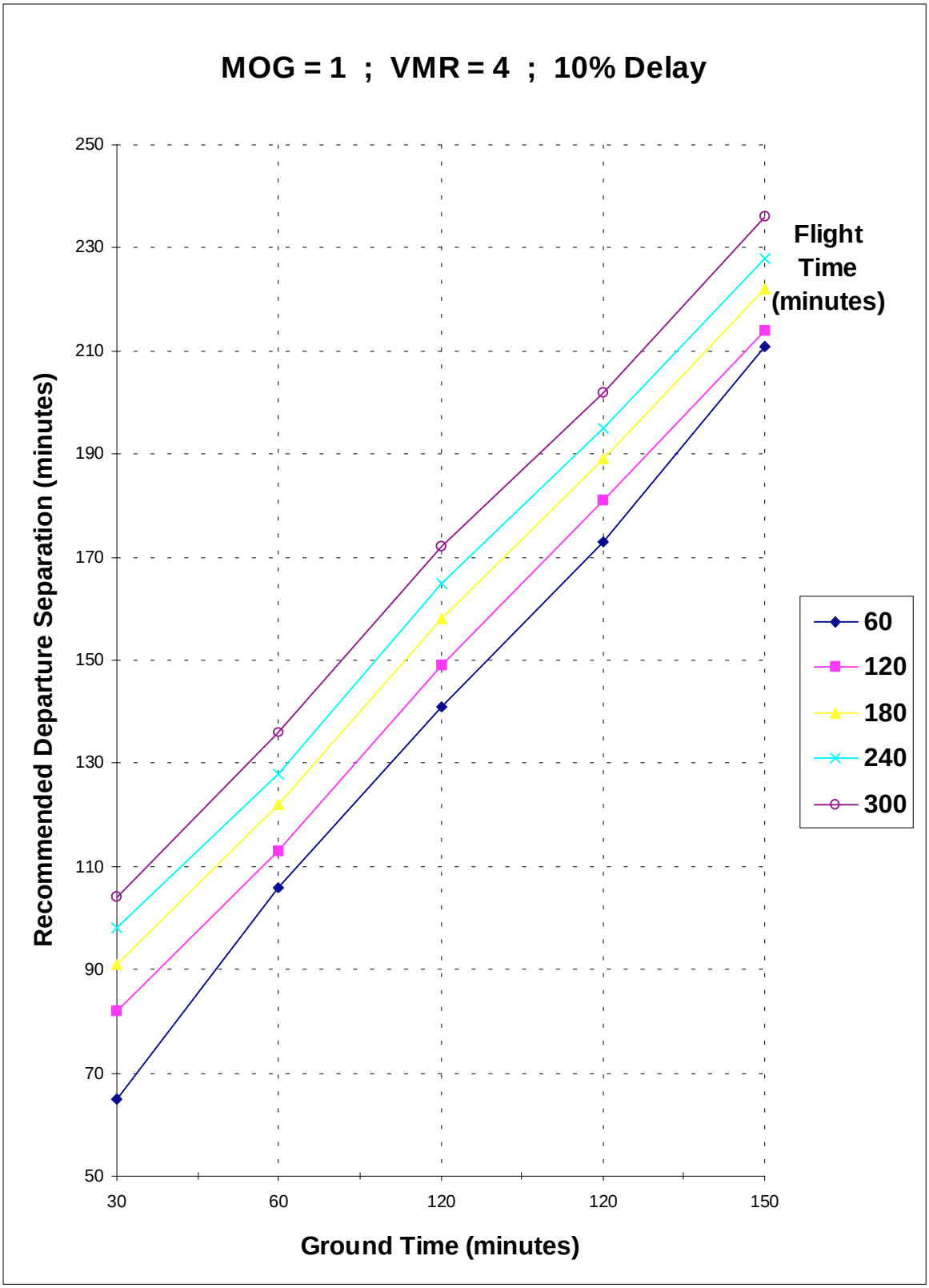


Figure 14. Planning Chart 9

MOG = 2 VMR = 2 < 1% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	35	54	71	88	106
120	46	63	81	98	115
180	50	68	86	102	118
240	52	72	89	105	121
300	53	74	90	107	123
Est. Utilization	31%	44%	52%	59%	63%

MOG = 2 VMR = 2 < 5% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	29	47	64	81	97
120	35	53	70	86	103
180	38	56	73	89	106
240	40	59	75	91	108
300	42	61	77	93	109
Est. Utilization	40%	54%	62%	77%	71%

MOG = 2 VMR = 2 < 10% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	24	43	60	77	93
120	31	48	65	81	97
180	33	50	67	83	99
240	34	51	68	84	100
300	35	51	69	85	100
Est. Utilization	48%	60%	67%	72%	76%

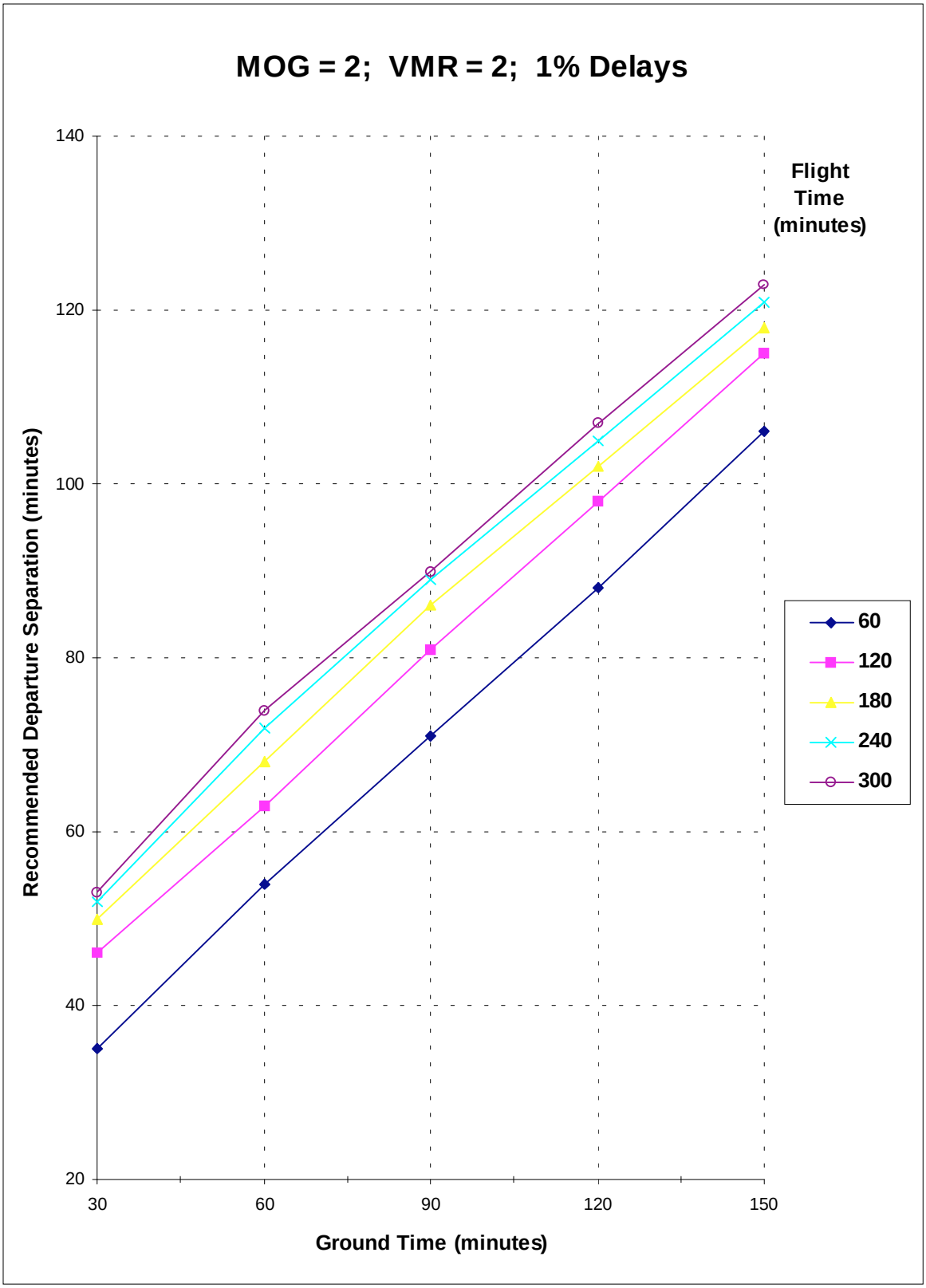


Figure 15. Planning Chart 10

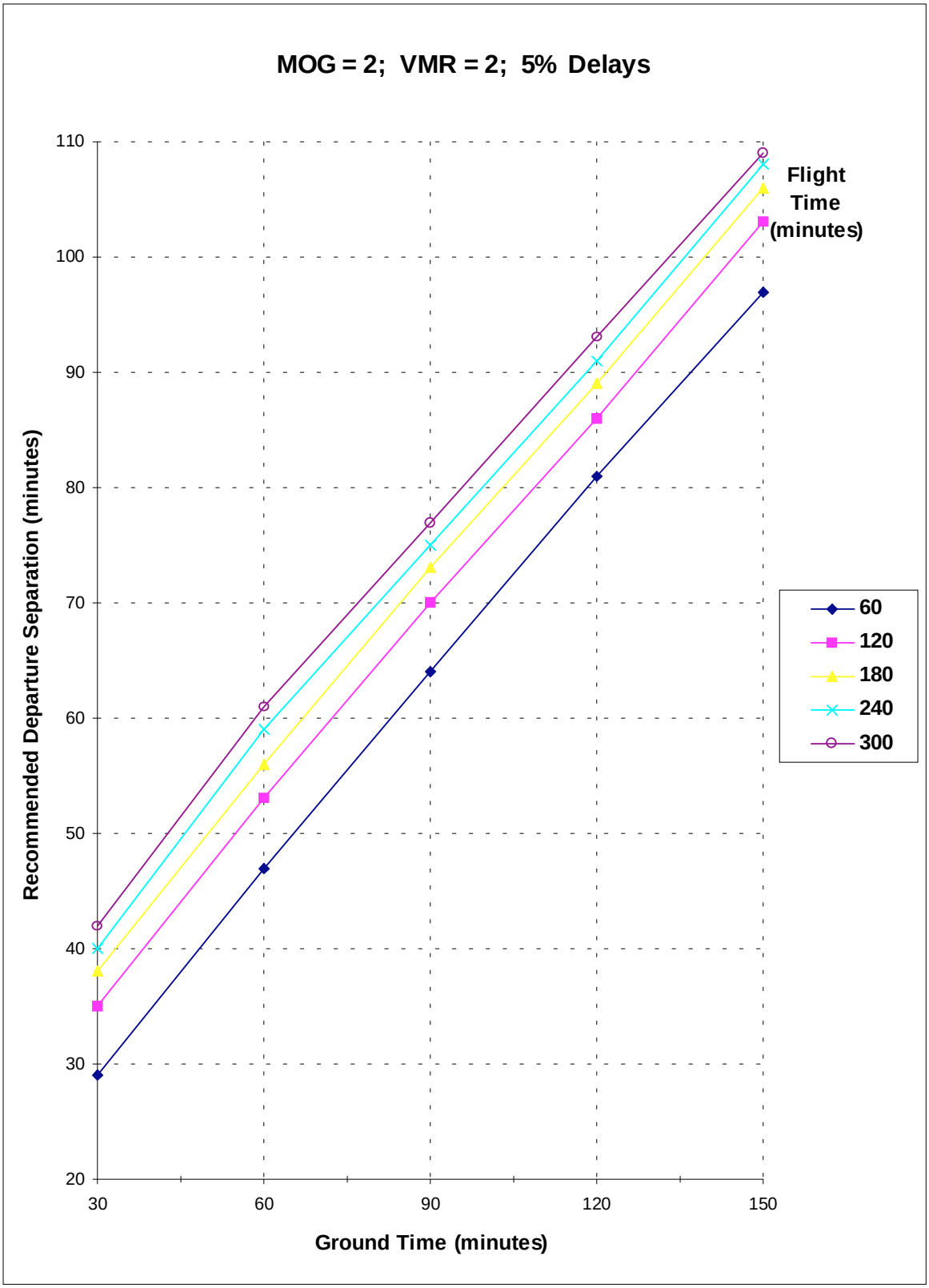


Figure 16. Planning Chart 11

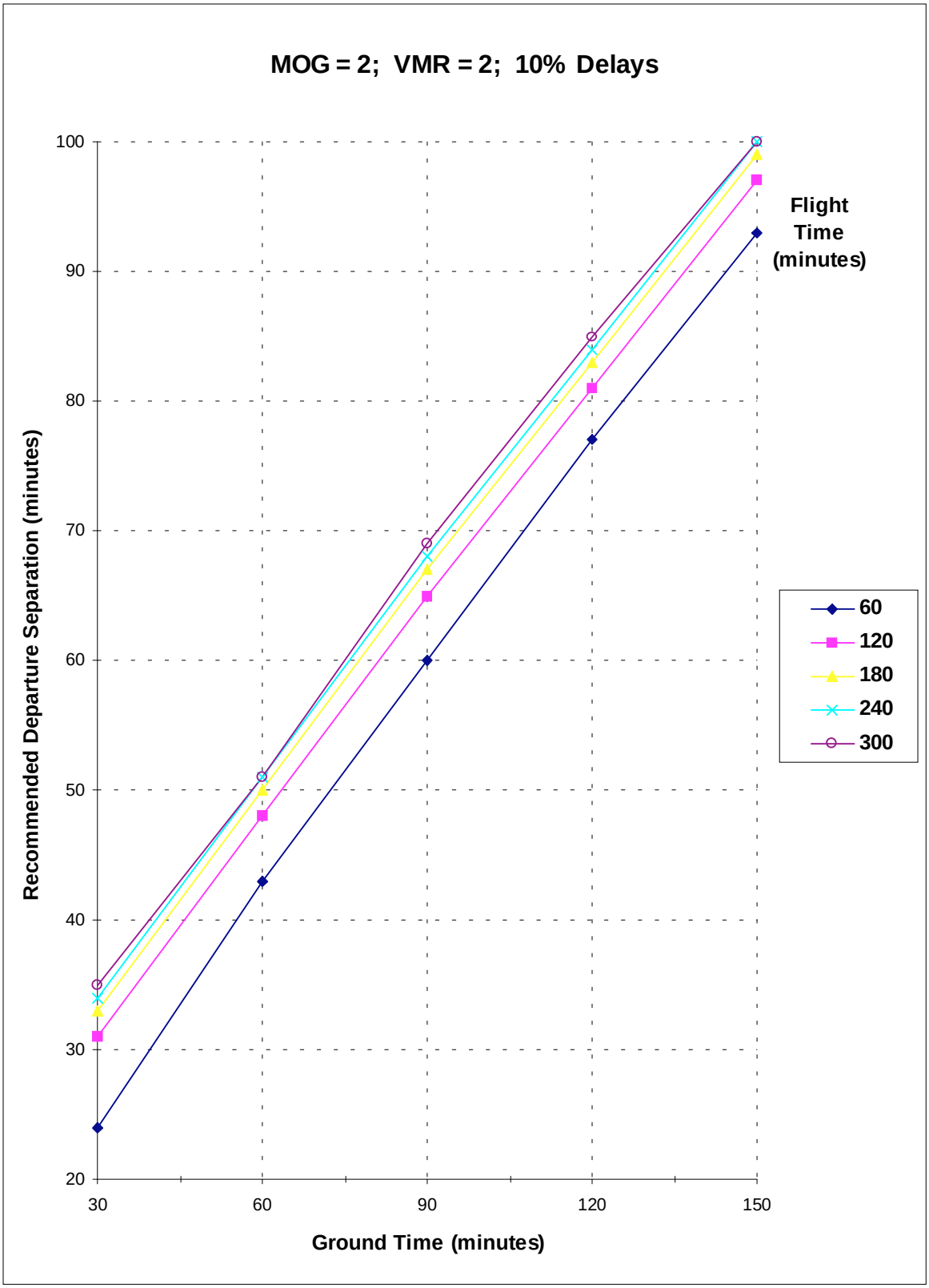


Figure 17. Planning Chart 12

MOG = 2 VMR = 3 < 1% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	40	59	77	95	116
120	50	71	88	107	127
180	56	77	95	113	131
240	60	82	99	117	136
300	63	86	103	120	139
Est. Utilization	30%	39%	47%	53%	57%

MOG = 2 VMR = 3 < 5% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	33	50	69	85	102
120	39	58	76	94	110
180	42	61	79	96	113
240	45	63	81	98	115
300	47	65	83	99	116
Est. Utilization	39%	49%	57%	63%	66%

MOG = 2 VMR = 3 < 10% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	29	46	64	81	97
120	34	50	69	86	102
180	36	52	71	88	105
240	38	55	72	89	107
300	40	58	75	91	108
Est. Utilization	45%	57%	64%	68%	71%

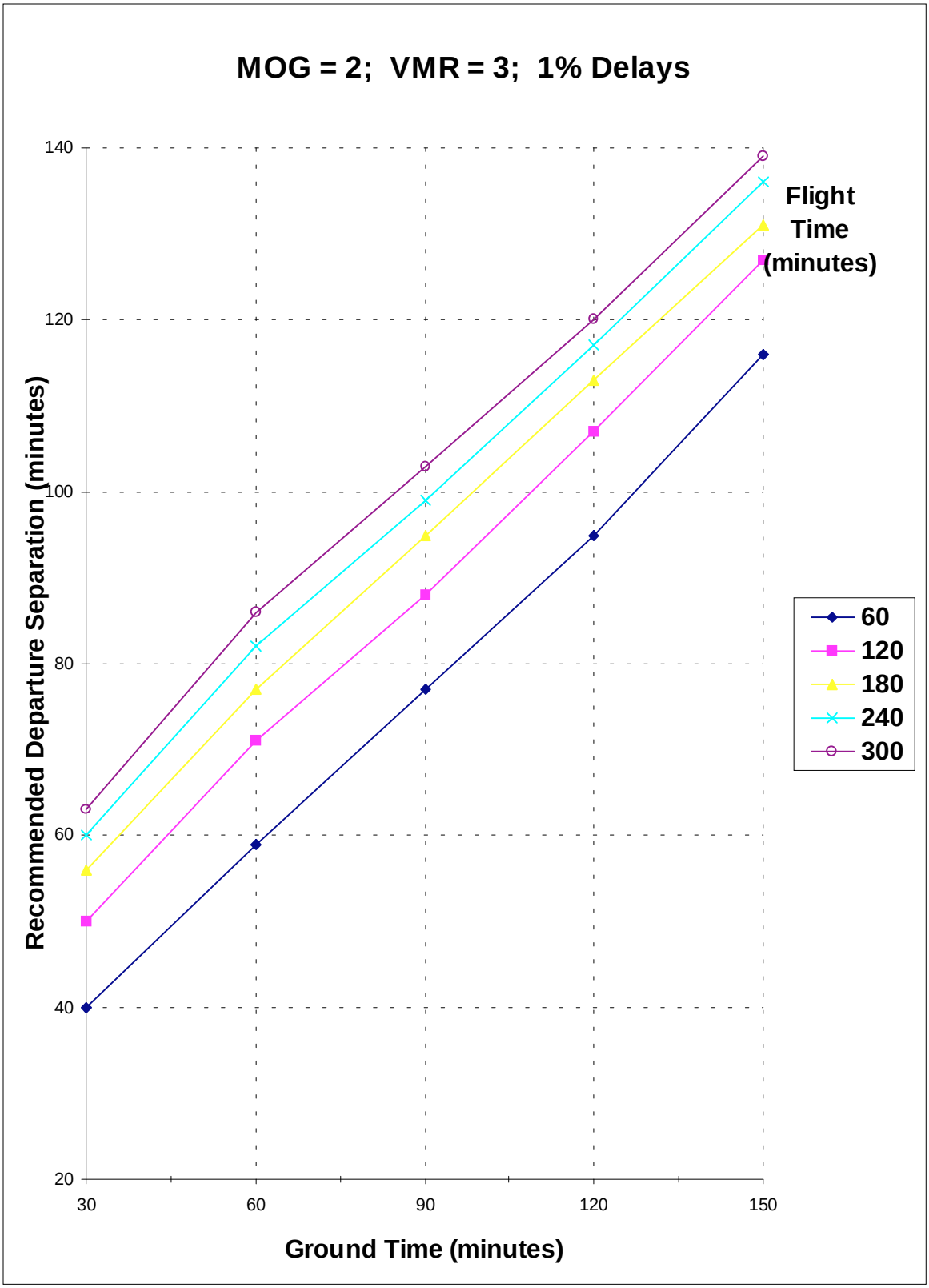


Figure 18. Planning Chart 13

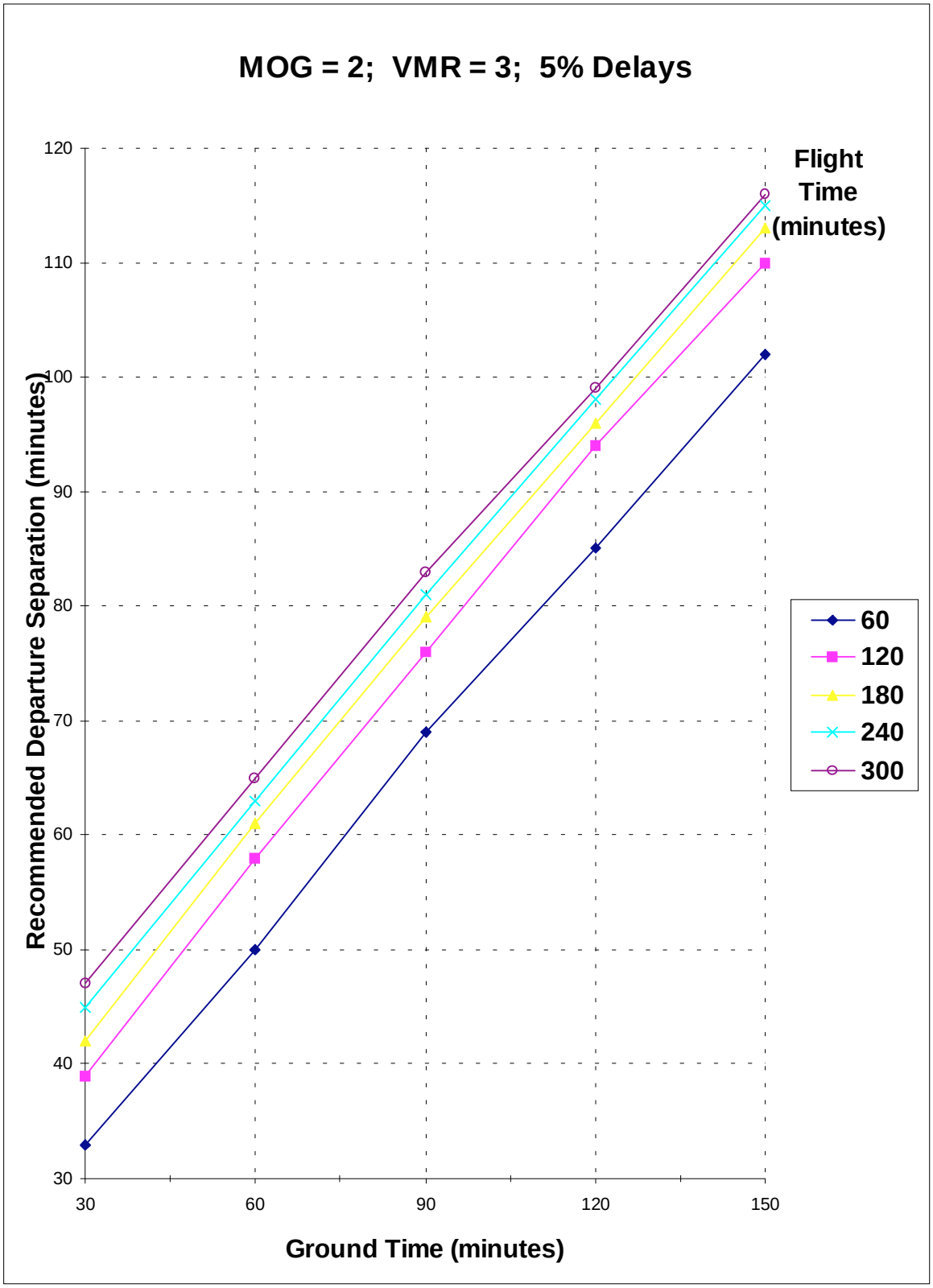


Figure 19. Planning Chart 14

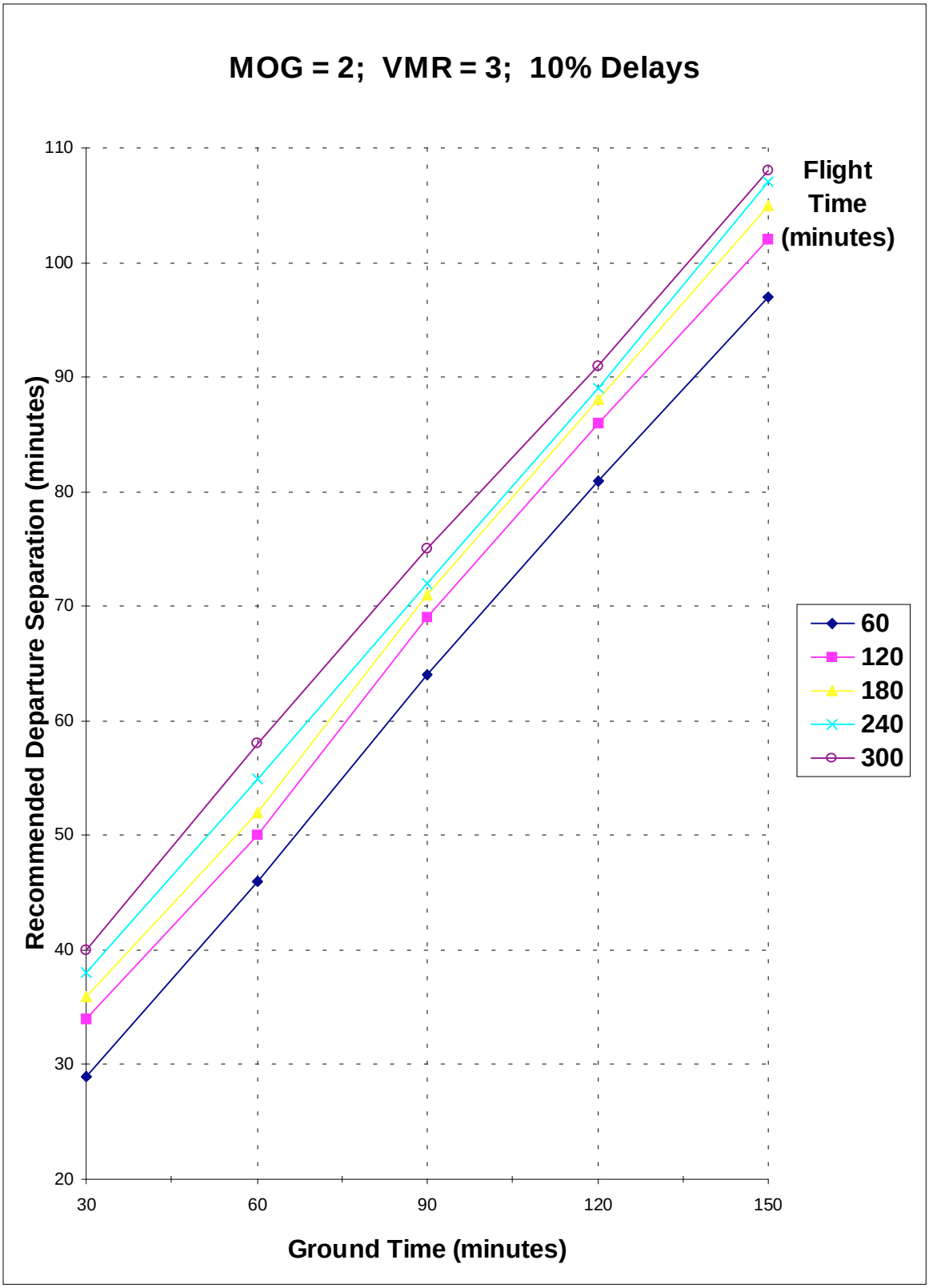


Figure 20. Planning Chart 15

MOG = 2 VMR = 4 < 1% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	45	65	82	105	125
120	58	77	96	117	135
180	62	82	102	123	142
240	68	86	108	126	145
300	72	90	113	132	153
Est. Utilization	27%	37%	44%	49%	54%

MOG = 2 VMR = 4 < 5% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	36	54	73	90	107
120	43	62	80	97	114
180	46	66	84	102	119
240	49	69	88	106	122
300	51	71	90	107	124
Est. Utilization	37%	47%	54%	59%	63%

MOG = 2 VMR = 4 < 10% Delayed

Ground Time

Flight Time	30	60	90	120	150
60	31	48	66	82	100
120	36	55	72	89	107
180	39	58	75	92	110
240	41	59	78	95	114
300	43	62	81	97	115
Est. Utilization	43%	53%	60%	65%	69%

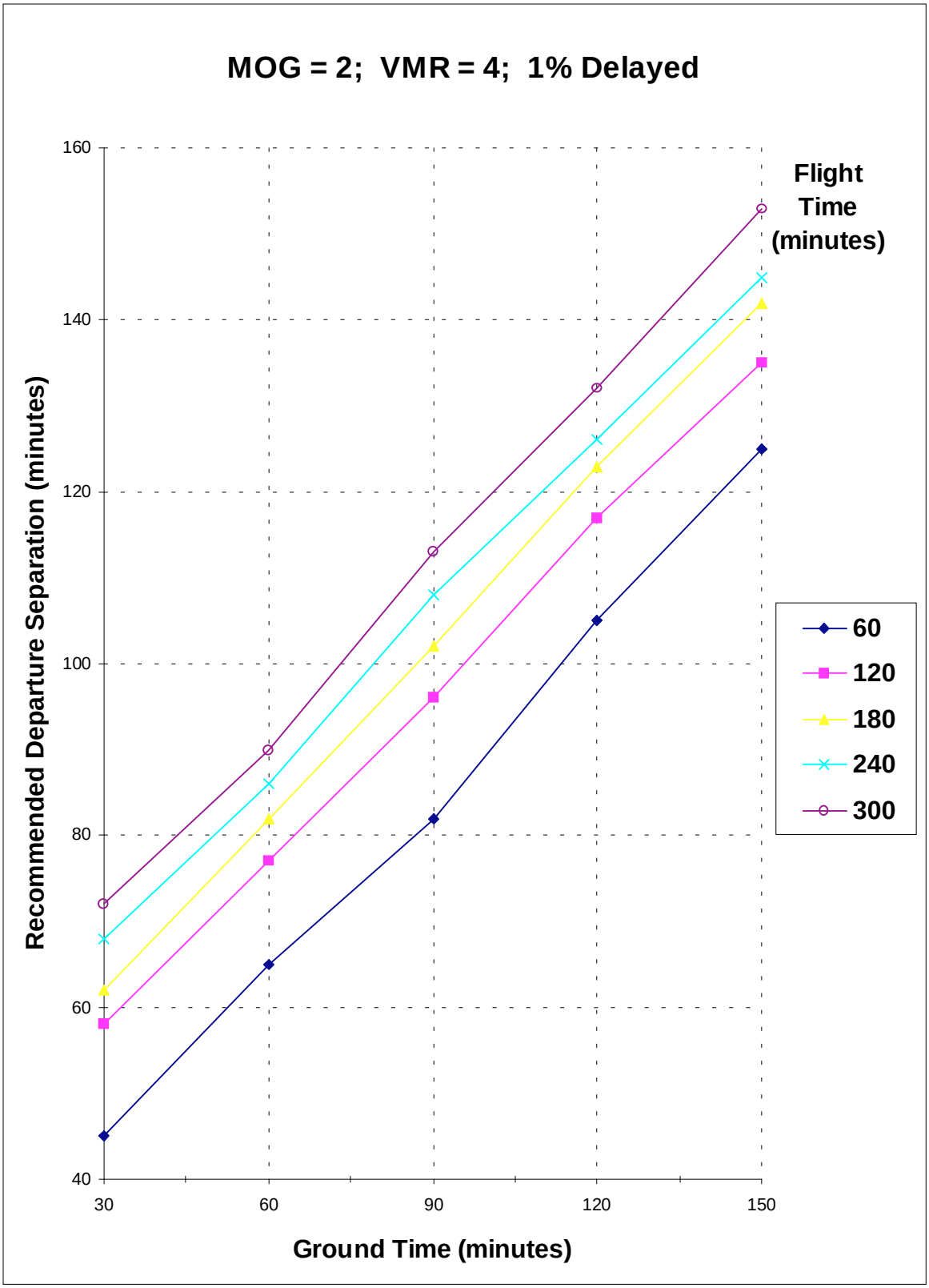


Figure 21. Planning Chart 16

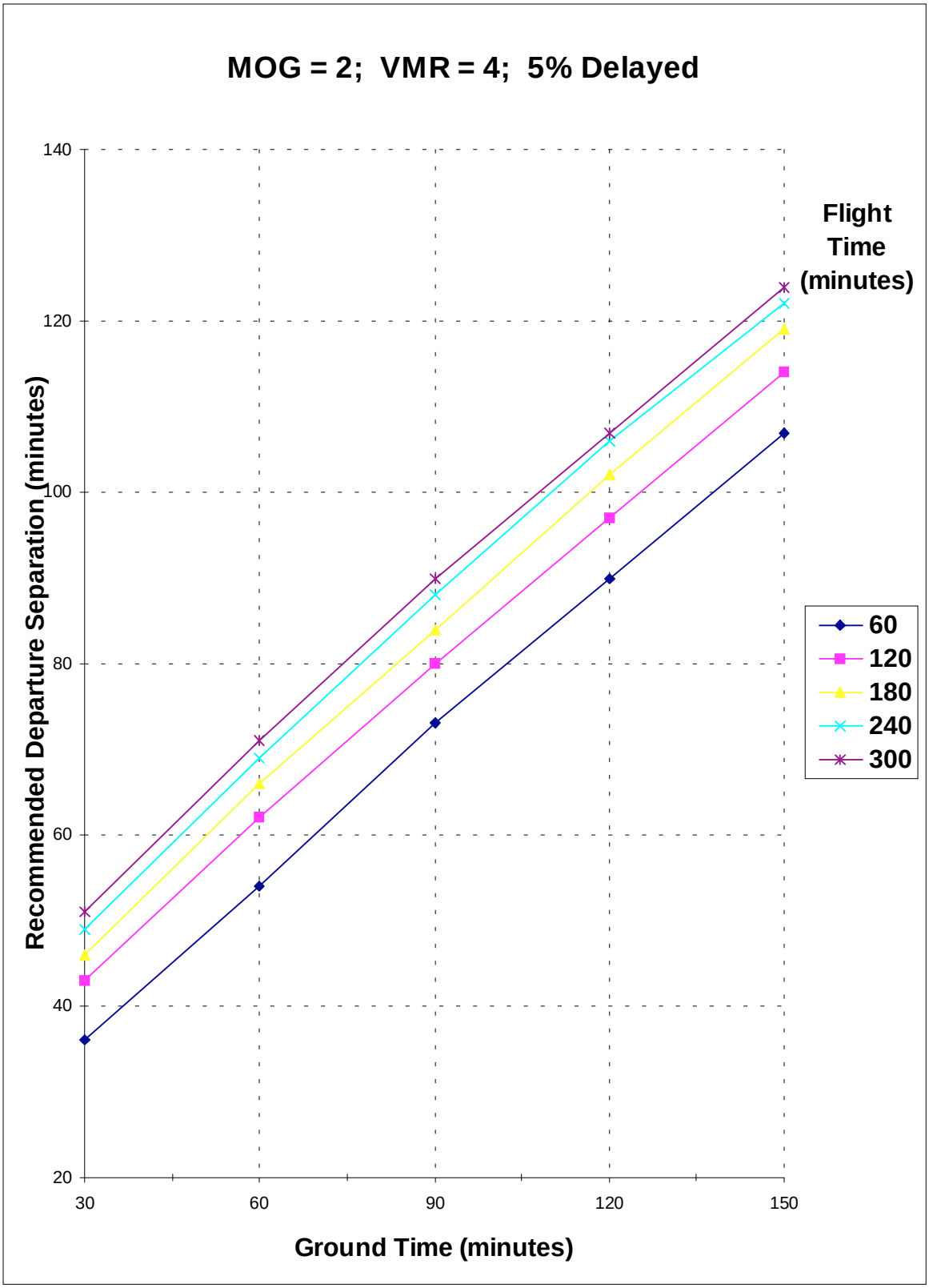


Figure 22. Planning Chart 17

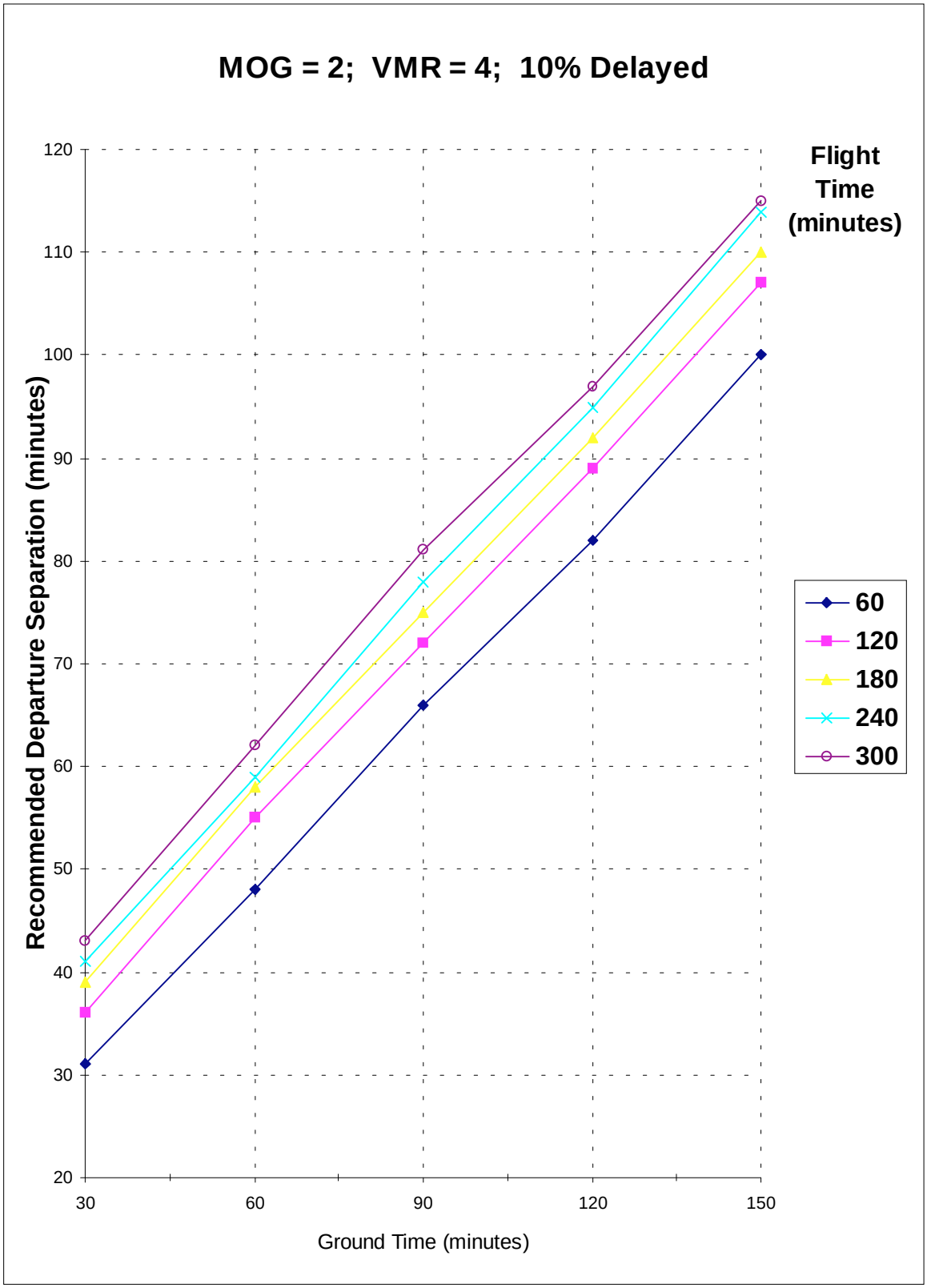


Figure 23. Planning Chart 18

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Vita

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