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Monterey, California

THESIS

MISSIONING
WITH
MINIMAL DELAYED ENTRY PROGRAM (DEP) LOSS

by

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September, 1993

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This thesis addresses the missioning problem which is to determine the number of individuals to be recruited or contracted each month by Army recruiters. After signing the contracts, these individuals are enrolled in the Delayed Entry Program (DEP) prior to their basic training. During DEP, some individuals may renege on their contracts, thus becoming DEP losses. Although DEP is costly, it is necessary since it acts as an inventory of recruits to smooth out the training loads at boot camps and allows the Army to perform a background check for each recruit.

The missioning problem is formulated as a linear program that minimizes the expected DEP loss subject to requirements imposed by the Deputy Chief of Staff for Personnel (DCSPER) and U.S. Army Recruiting Command (USAREC). Integral to the formulation are the estimates of DEP loss probabilities for various combinations of recruit categories and DEP durations. The estimates are based on a Binomial assumption and Isotonic regression.

The linear programming model of the missioning problem is implemented in GAMS and provides results indicating that DEP loss can be reduced from the current level of 11.46% to 8.59%. This translates to nearly $11 million saving annually. Other applications of the model are also provided.

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Missioning
with
Minimal Delayed Entry Program (DEP) Loss

by

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Submitted in partial fulfillment
of the requirements for the degree of

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ABSTRACT

This thesis addresses the missioning problem which is to determine the number of individuals to be recruited or contracted each month by Army recruiters. After signing the contracts, these individuals are enrolled in the Delayed Entry Program (DEP) prior to their basic training. During DEP, some individuals may renege on their contracts, thus becoming DEP losses. Although DEP is costly, it is necessary since it acts as an inventory of recruits to smooth out the training loads at boot camps and allows the Army to perform a background check for each recruit.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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EXECUTIVE SUMMARY

A. BACKGROUND

The United States Army Recruiting Command (USAREC) is responsible for recruiting civilians to enlist into the Army. The Department of the Army specifies the number (or volume) and quality of enlistments that USAREC must enlist annually.

To accomplish the task as specified by DA, Army recruiters must perform duties like a salesman, i.e., they must sell the Army to American youths between the ages of 17 and 21. These recruiters begin by contacting youths at high schools, at recruiting stations or through some informal introduction. If a youth is interested and eligible to join the Army, he or she is processed for enlistment at a Military Entrance Processing Station (MEPS). At this point, the youth usually selects a career and signs a contract agreeing to join the Army.

After signing the contract to join the Army, a recruit must wait from 1 to 12 months before he or she enters basic training. During this period, the recruit becomes a member of the Delayed Entry Program (DEP). The DEP serves two main purposes, it allows the Army to complete required background checks on the recruit and maintain a level training load at basic training locations.

While in DEP, recruits are left with time to pursue other career opportunities. In general, the longer a recruit remains in DEP, the higher the possibility that he or she will renege on the enlistment contract. When this occurs, the recruit becomes a DEP loss. USAREC estimates that approximately 15% of the enlistment contracts become DEP losses. Based on an estimated cost of $5000 per recruit and 13,400 annual DEP losses, the Army estimates it spends approximately $67 million each year on DEP loss, a considerable sum during the current budget cutting environment.

B. PROBLEM STATEMENT

On a quarterly basis, USAREC analysts must set monthly recruiting goals for each of its four recruiting brigades. The quotas simply specify the number of contracts each brigade must enlist each month. To set these quotas, the analysts must consider three main factors: the DA recruiting requirements, the USAREC recruiting policies and the expected DEP loss. To account for the expected DEP loss, USAREC simply increases the DA mission by 15%. Although this method is effective, it does not account for the differences in expected DEP loss for the different groups (i.e., female, male, high school graduate, non high school grad, etc.) within the recruit population. Thus, the goal of this thesis is to develop a method which accounts for DEP loss more efficiently in setting the monthly recruiting quotas.

C. APPROACH

The problem of setting the monthly recruiting quotas involves two areas of operations research: statistics and optimization. Statistics is used to estimate the probability a recruit will become a DEP loss. Given these probabilities, the problem of setting the recruiting quota is formulated as an optimization problem with the objective of minimizing DEP losses.

D. ACCOMPLISHMENTS

In achieving the above goal, this thesis made two major accomplishments. One is the estimation of the probability of a recruit becoming a DEP loss. The Army groups recruits into 22 classifications based on their gender, Armed Forces Qualification Test (AFQT) score, education and whether or not they have had prior military service. The probability of DEP loss depends on these 22 classifications along with the length of time a recruit remains in the DEP. Based on the recruiting data from 1988 to 1992, this thesis provides estimations of DEP loss for each combination of classifications and DEP length. By themselves, these probabilities provide USAREC with information useful for setting recruiting strategies at all levels of command, i.e., from the headquarters down to the recruiters. Furthermore, they also identify classifications that should be avoided if expenses are to be kept to a minimum.

The other accomplishment deals with an application of these probabilities in setting the monthly recruiting mission at the headquarters level. This thesis formulates the problem of setting monthly recruiting missions as an optimization problem with the objective of minimizing the number of DEP losses. The main data for this problem are the DEP loss probabilities, for they determine the expected number of DEP losses. The optimization model is implemented in the General Algebraic Modeling System (GAMS). Preliminary results indicate that the model facilitates the process of setting the monthly recruiting mission as well as allows for analysis of various recruiting policies.

I. INTRODUCTION

A. BACKGROUND

In support of ongoing cuts in the Army's budget, the United States Army Recruiting Command (*USAREC*) seeks various ways to reduce its operating cost. Despite this cost cutting effort, USAREC must continue to recruit quality young men and women to meet the future needs of the Army.

Among the many areas with high operating cost, USAREC is concerned with the rising cost due to the loss of recruits prior to being sent off to basic training. After signing a contract to enter the Army, a recruit must wait from 1 to 12 months before he or she enters basic training [Ref. 1]. During this period, the recruit becomes a member of the *Delayed Entry Program* (*DEP*). While in the DEP, some recruits decide not to join the Army and thus renege on their contract. This situation is referred to as *DEP loss.*

USAREC estimates that 15% of the DEP population will become a DEP loss prior to entering basic training. The Army estimates that it costs approximately $5000 to recruit an individual and there are approximately 13,400 DEP losses annually. This translates to $67 million the Army must spend on DEP loss alone [Ref. 2]. This sum is considerable during the current budget environment.

There are several alternatives to reduce the cost of DEP loss. First, USAREC could increase the required contact time between recruiters and their DEP recruits. These contacts include phone conversations and personal contacts in the form of social or Army related activities. These events are designed to maintain a recruit's interest in the Army and provide the recruiter with the setting to discuss the recruit's contractual obligation along with the continued career opportunities that exist in the Army. Second, the Army could exercise its legal right, forcing recruits to honor their enlistment contract. The contract is a legal document binding both parties to the terms therein. To date, the Army has not chosen to exercise this option. And finally, USAREC could incorporate expected DEP losses into their operational planning. In this case, a recruit is viewed as a commodity which is perishable with time, and recruits in DEP serve as an inventory to fulfill the Army's future demand for soldiers. However, the longer the recruits remain in DEP, the more likely they will become a DEP loss. This suggests a just-in-time inventory policy, which is not implementable for two reasons. First, recruiting is not a deterministic process. The number of recruits can vary greatly from month to month. Second, a minimum of one month DEP is required for performing a required background check on each recruit. Thus, a DEP is a necessary part of recruiting and should be efficiently managed.

B. THESIS OBJECTIVE

This thesis focuses on the last alternative to reduce the cost due to DEP loss. In particular, this thesis considers the problem of managing DEP loss as an optimization model and uses statistical techniques to estimate inputs to the model. One important input requiring statistical estimation is the probability of a recruit becoming a DEP loss. This probability depends on the characteristics of the recruit and the length of time he or she must spend in the DEP.

C. THESIS ORGANIZATION

Chapter II introduces the recruiting process within USAREC. Chapter III describes the optimization model. The model provides the best combination of recruit characteristics and DEP length that satisfy the needs of the Army. Chapter IV describes the statistical techniques used to estimate the DEP loss probability associated with each recruit characteristic and DEP length combination. It also studies the variation of DEP loss probabilities on a quarterly basis. Chapter V discusses the implementation of the optimization model. Finally, Chapter VI summarizes the results of the thesis and presents recommendations for future study.

II. RECRUITING PROCESS AT USAREC

The sections below provide information concerning the recruiting process at USAREC. The first section describes the organizational structure at USAREC and explains its interaction with the Deputy Chief of Staff for Personnel (DCSPER). The second section discusses the planning (or missioning) process at USAREC Headquarters (HQ). The last section describes the recruiting process at USAREC's lower organizational levels.

A. USAREC

1. USAREC Organization

At the top most level of the Army recruiting organization is the USAREC Headquarters (HQ), which consists of ten directorates (see Figure 1).

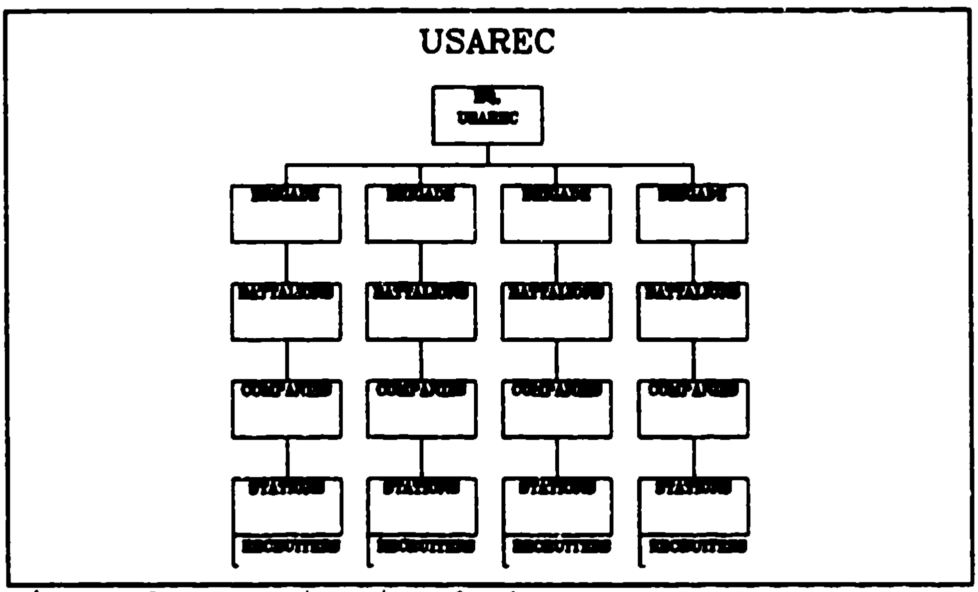

Figure 1 Organizational Chart

Under the direction of the Commanding General, these directorates coordinate and support the recruiting effort for the entire U.S. Army. The next level in the organization consists of four brigades, each responsible for recruiting in one of four separate geographical regions of the continental United States (CONUS). Under each brigade is a collection of battalions which are generally responsible for recruiting in one or two states. Then, there is a collection of companies in each battalion and, similarly, a collection of stations in each company. The recruiters producing enlistment contracts (i.e., On-Line Production Regular Army (OPRA) recruiters) are located at the stations. The OPRA recruiters form the sales force for the Regular Army (RA). The Army Reserve's mission is recruited by USAREC Reserve Recruiters working alongside the RA recruiters. This thesis only addresses the RA recruiting effort.

Currently, USAREC contains a total of 4 brigades, 42 battalions, 222 companies, 1495 stations and 4200 OPRA recruiters. These numbers are expected to change in the near future due to the ongoing Armv force reduction and realignment process.

2. Interactions With DCSPER

It is the Directorate of Personnel Management at DCSPER, who establishes the Army's future personnel needs and sets the Department of the Army (DA) *accession mission* for

USAREC. The DA accession mission specifies the number of individuals who must access into or enter the Army as well as the proportion of recruits in various categories. These categories group recruits by their service history, education level, test score on the Armed Forces Qualification Test (AFQT) and gender. Table I summarizes the accession mission for 1994.

Table I 1994 DA ACCESSION MISSION

Total Accessions (Volume) = 75,000
Service Mix = 70,000 Non-Prior Service (NPS)
= 5,000 Prior Service (PS)
Quality Mix for NPS accessions
- ≥ 95% must be high school graduates (HSDG)
- ≥ 67% must score in the top 50th percentile on the AFQT (NPS-A)
- ≤ 2% can score between the 21st and 30th percentile on the AFQT (TSC-4)*

Gender Mix for NPS accessions
- ≥ 14.8% must be female

* Current policy restricts TSC-4 to scores between the 26th and 30th percentile.

From Table I, there are six categories of interest. They include recruits (i) with prior military service (PS), (ii) with no prior military services (NPS), (iii) with a high school diploma (HSDG), (iv) with no prior service and an AFQT score in the top 50th percentile (NPS-A), (v) with no prior service and an AFQT score between the 26th and 30th percentiles (TSC-4) and (vi) female (FEM) recruits.

B. MISSIONING PROCESS AT USAREC

The analysts at the Mission Division of the Program Analysis and Evaluation (PAE) Directorate are responsible for insuring that USAREC fulfills the DA accession mission. To do so, the analysts must set a quarterly recruiting goal that specifies the number of individuals (or contracts) to be recruited during each month of the quarter. This goal is referred to as the *contract mission*. Since the analysts must account for DEP losses, the number of contracts produced annually is typically larger than the number of accessions required by DCSPER.

To insure that the accessions contain the required proportions of various DCSPER recruit categories, the analysts first group the recruits (or contracts) into 22 mission BOXES or classifications according to their service history, education level, AFQT score and gender. Below, Table II provides a description of the 22 mission BOXES and Table III specifies how each BOX contributes to each of the six DCSPER recruit categories described in Section A. Note that category HSDG (High School Degree Graduate) in Table III includes high school seniors, since they are expected to graduate before they depart for basic training.

Table II MISSION BOXES

MISSION BOXES							
SMA	GMA	SMB	GMB	SM4	GM4	NMA	NMB
SFA	GFA	SFB	GFB	SF4	GF4	NFA	NFB
MPS	FPS	HMA	HMB	HFA	HFB		

LEGEND

HIGH SCHOOL EDUCATION:
- G = Graduate N = Non-Graduate
- S = Senior H = General Equivalency Diploma

SERVICE HISTORY:
- PS = Prior Service NPS = Non-Prior Service

GENDER:
- M = Male F = Female

AFQT SCORE:
- A = 50th Percentile or better
- B = between 31st and 49th Percentile
- 4 = between 26th and 30th Percentile

Table III MISSION BOXES VS. RECRUITING CATEGORIES

BOX	PS	NPS	HSDG	NPS-A	TSC-4	FEM
SMA		YES	YES	YES		
GMA		YES	YES	YES		
SMB		YES	YES			
GMB		YES	YES			
GM4		YES	YES		YES	
NMA		YES		YES		
NMB		YES				
SFA		YES	YES	YES		YES
GFA		YES	YES	YES		YES
SFB		YES	YES			YES
GFB		YES	YES			YES
GF4		YES	YES		YES	YES
NFA		YES		YES		YES
NFB		YES				YES
MPS	YES					
FPS	YES					
HMA		YES		YES		
HMB		YES				
HFA		YES		YES		YES
HFB		YES				YES

Note: USAREC currently not recruiting SM4 and SF4

The next step requires dividing the monthly recruiting quotas into the number of contracts to be recruited within each mission BOX. In general, the task of setting the recruiting quotas by mission BOX is time consuming and requires analysts with considerable experience in recruiting. Ultimately, the monthly recruiting mission must produce the desired number of accessions with the desired mix of recruit categories. This requires the analysts to closely monitor the progress of recruiting on a continual basis in order to effect any necessary adjustments to the recruiting quotas.

On a quarterly basis, the monthly recruiting quotas are divided and assigned, by mission BOX, to each of the four brigades. For future reference, Table IV defines each of the quarters.

Table IV DEFINITION OF QUARTERS

QUARTER	SEASON	MONTHS
1	Fall	Oct/Nov/Dec
2	Winter	Jan/Feb/Mar
3	Spring	Apr/May/Jun
4	Summer	Jul/Aug/Sep

Given the time required to distribute the mission throughout the recruiting organization, analysts typically set the quarterly quotas at least one quarter in advance. This gives the brigades three to five months to distribute the mission to their battalions. Each battalion will do the same for its companies and so on until the mission finally reaches the recruiters. On average, a recruiter is expected to produce between one and two contracts per month.

C. RECRUITING PROCESS

To produce a contract in a given month, recruiters perform duties much like a salesman. In fact, they sell the Army benefits to American youths predominately between the ages of 17 and 21. These recruiters begin by making contacts with potential recruits at high schools, recruiting stations or through informal introductions. Once these young men and women become interested in joining the Army, they are given a physical and mental (AFQT) test to determine eligibility. Any AFQT score below 26 is an automatic ineligibility.

If the prospect is eligible to join the Army, he or she is processed for enlistment at a Military Entrance Processing Station (MEPS). It is at the MEPS where the prospect usually selects a career path and signs a contract agreeing to join the Army. However, the recruit does not become a member of the Army until he or she returns to the MEPS, is evaluated for continued eligibility, swears in to the active military and departs for a basic training installation.

During the period between signing the contract and the beginning of basic training, each recruit is enrolled in the DEP. While in DEP, the recruit is responsible to contact and verify eligibility with his or her recruiter on a regular basis. It is the responsibility of recruiters to insure that each of their recruits eventually enters basic training. If, while in DEP, a recruit decides not to join the Army, i.e., he or she becomes a DEP loss, the recruiter must replace the DEP loss with a new contract of the same mission box classification.

III. OPTIMAL MISSIONING MODEL

As stated in the previous chapter, the PAE Directorate at USAREC is responsible for developing the quarterly recruiting or contract mission for each of the four recruiting brigades. To ensure that USAREC recruiting meets the annual requirements set by DA, PAE analysts currently set the contract mission higher than the accession mission to account for DEP losses. In effect, they assume that every contract has a 0.15 probability of becoming a DEP loss.

Although this practice is effective, USAREC seeks a more cost efficient way to account for DEP losses when planning their recruiting missions. In particular, the assumption that all contracts have a 0.15 probability of becoming a DEP loss is costly. In fact, different mission BOXES have different DEP loss probability. Thus, using a constant (0.15) DEP loss probability results in USAREC under missioning contracts for some mission BOXES and over missioning for others.

In this chapter, the constant DEP loss assumption is relaxed and each mission BOX and DEP length combination has a unique DEP loss probability. The estimation of these probabilities is discussed in the next chapter. For this chapter, the first section describes the problem of planning recruiting missions (to be referred to as the *missioning problem*) and the second formulates it mathematically.

A. PLANNING RECRUITING MISSIONS

In planning recruiting missions for the quarter in question or *missioning quarter*, analysts of the Missioning Division must set the contract mission, i.e., determine the number of contracts needed in each category during each of the three months. The contract mission cannot be arbitrarily determined because it must be implementable, i.e., it must meet certain constraints imposed by DA requirements, operational necessities and future accession requirements.

1. DA Requirements

The DA requirements relate to the accession mission defined by the DCSPER. The DA mission includes volume, PS/NPS mix, quality and gender requirements. These requirements are discussed below.

a. Volume Requirement

This requirement insures that the total number of accessions satisfies the required number for each fiscal year (FY). For example, DA requires 75,000 accessions during both FY94 and FY95.

b. PS/NPS Mix Requirement

This requirement insures that a proper percentage of total accessions have no prior military service (NPS). For example, DA requires that 93% of FY94's accessions and 96% of FY95's accessions have no prior military service.

c. Quality Requirement

This requirement insures that there is a proper quality mix among all NPS accessions. As stated in Chapter II, DCSPER requires that, among all NPS accessions for FY94, at least 95% must be high school graduates, at least 67% must score in the top 50th percentile of the AFQT and at most 2% can score between the 26th and 30th percentiles on the AFQT.

d. Gender Requirement

This requirement insures that at least 14.8% of the NPS accessions are female.

2. Operational Requirements

In general, these requirements insure that the contract mission is operationally feasible and yields an even workload for recruiters throughout the year.

a. Recruiter Workload

USAREC has approximately 4200 recruiters and each recruiter is expected to produce between one and two contracts per month. This places an upper limit on the number of contracts that can be produced each month.

b. Monthly Accession Limitation

The Training and Doctrine Command (TRADOC) is responsible for training the recruits inducted into the Army. The number of basic training and Advanced Individual Training (AIT) spaces, or training seats, varies from month to month to reflect the normal fluctuation in enlistment throughout the year. Typically, there are more training seats during the months following high school graduation dates and less during the major holidays. The second column in Table V lists TRADOC's programmed accessions during each month in FY94 and FY95.

Table V MONTHLY ACCESSION REQUIREMENT

MONTH	FY94 & FY95 ACCESSIONS	FY94 # OF WORKING DAYS	FY95 # OF WORKING DAYS
Oct	7666	19	24
Nov	8784	23	18
Dec	2059	19	19
Jan	5241	23	23
Feb	5959	19	19
Mar	4679	20	20
Apr	4400	20	20
May	5808	24	24
Jun	6354	20	20
Jul	7656	19	24
Aug	8015	25	20
Sep	8397	19	19
TOTAL:	75018	250	250

c. Proportion of Annual Contracts Written Each Month

The number of contracts written in a month is a function of how many working days exist during the month. As illustrated by the last two columns in Table V, the number of working days varies depending on the number of holidays and weekends occurring during the month. To insure an even workload, the number of contracts written during each month should be proportional to the number of working days in that month. For example, since October has 19 of the total 250 contract days in FY94, then contracts written in October should be (approximately) 7.6% (19/250) of the total FY94 contracts.

d. Time in DEP Requirement

As mentioned before, every recruit enters the DEP once he or she signs the enlistment contract. The number of months a recruit remains in the DEP ranges from a minimum of 1 month to a maximum of 12 months. High school recruits must remain in the DEP until after their graduation date.

e. HSDG NPS-A Quality Mix Requirement

Operationally, it is more time efficient to recruit high school seniors than graduates. Recruiters request to meet with all seniors on a single visit to a high school. On the other hand, recruiters must generally visit high school graduates at their home or place of work individually. This requires more time and effort by the recruiter.

In terms of DEP loss, it is more effective to recruit high school graduates than seniors. Experience indicates that seniors exhibit higher DEP loss probabilities than do graduates with similar service, gender and mental aptitude.

To balance the time and DEP loss factors, USAREC requires that GMA make up approximately 70% of the combined GMA and SMA contracts. A similar rule applies to the GFA and

SFA mix. (See Table II in Chapter II for the description of these BOX classifications.)

3. Future Accession Requirements

Since recruiting is an unending process, USAREC typically requires recruiters to write contracts in the current FY that will access and, therefore, satisfy the accession requirement for the next FY. Without this requirement, recruiters would not have to write any contracts during the last few months of each fiscal year. For example, since there is a minimum of one month DEP, recruiters cannot write any contracts to access in the current year during September. Thus, USAREC typically imposes the following rules.

a. Volume Requirement

USAREC desires that 35% of the accessions for the next FY be contracted during the current FY. For example, this means that 26,250 (35% of 75,000) contracts written during FY94 should access in FY95.

b. Quality Requirement

USAREC desires that 45% of the NPS-A accessions for the next FY be contracted during the current FY. (See Table III in Chapter II for mission BOXES included in category NPS-A.) Recall that NPS accounts for 72,000 (96% of 75,000) of the FY95 requirement, and at least 67% of the NPS must possess an AFQT score category A. This means that 21,708 (45% of 67%

of 72,000) NPS-A contracts written in FY94 should access in FY95.

B. PROBLEM STATEMENT

The problem of setting the recruiting or contract mission is to determine the number of contracts to be written for each mission BOX and DEP length combination during each month of the missioning quarter. To be implementable, these contracts must satisfy the requirements in the previous section, be cost efficient and yield the least number of DEP losses.

C. PROBLEM FORMULATION

The problem of planning the contract mission (or the missioning problem) is formulated as a linear program. Implicit in this formulation is the assumption that a fractional number of contracts is acceptable. Considering the magnitude of the monthly quotas and realizing that the results are for planning purpose only, this is reasonable. The fractional number can be rounded to the nearest integer solution without significantly degrading the optimality of the solution. Furthermore, the planning horizon is divided into months and includes the first month of the missioning quarter up to September of the following FY. The inclusion of months beyond the missioning quarter forces the model to consider the effects of missioning decisions on future missioning quarters.

In the formulation below, the contracts are assumed to be independent and the event of them becoming a DEP loss can be represented as a collection of Bernoulli random variables. Then, the number of accessions from a collection of N contracts in a given BOX, for a given DEP length and written in a given month is a (independent) Binomial random variable with parameters N and p, where p is the probability of accession for the collection. (Note (1-p) is the corresponding probability of DEP loss.) To make this model manageable, the number of accessions or DEP losses are stated in terms of their probabalistic expectations.

INDICES:

y	=	fiscal year, e.g., 1, 2
b	=	BOX classification, e.g., SMA, ..., HFB
a, c	=	months in the planning period, e.g., OCTFY1, ..., SEPFY1, OCTFY2, ..., SEPFY2
t	=	time spent in the DEP, e.g., 1, ..., 12
q	=	category, e.g., PS, NPS, HSDG, NPS-A, TSC-4 and FEM
k	=	quarter, e.g., 1, 2, ..., 8

Note: The indices "a" and "c" are alias indices. They both represent months in the planning period. In the formulation below, "c" represents the month in which the contract was signed, and "a" represents the month the same individual accesses into the Army, i.e., begins basic training. Thus (a-c) represents the time an individual remains in the DEP (also denoted as t).

INDEX SETS:

Ω_q	=	set of BOX classifications which belong to category q, e.g., Ω_{PS} = (MPS and FPS), (See Table III in Chapter II.)

Λ_y = months belonging to FY y

θ_k = months belonging to quarter k

DATA:

S_a^y = available training seats in month a of FY y

f_q^y = required proportion for category q in FY y

d_{ba} = number of contracts in BOX b that were written prior to the mission quarter and expected to access during month a

α_{12} = proportion of FY2 volume requirement to be contracted during FY1

β_{12} = proportion of FY2 quality requirement to be contracted during FY1

w^y = number of monthly contracts to be produced by a recruiter during year y

R_a = number of available recruiters in month a

D_c = proportion of annual contracts that must be contracted during month c

p_{bt} = probability of accession for BOX b with t months in DEP, (In the formulation below, t is represented as (a-c), i.e., the difference between accession and contract months.)

N^y = number of accessions required for year y

mp^k = proportion of GMAs among GMA and SMA contracts in quarter k

fp^k = proportion of GFAs among GFA and SFA contracts in quarter k

ff^k = proportion of GFAs and SFAs among female contracts with no prior service in quarter k

VARIABLE:

X_{bca} = number of contracts to be recruited for BOX b in month c, and scheduled to access in month a.

NOTE: To simplify the notation, X_{bca} is assumed to be valid for combinations of c and a which yield a time in DEP of 1 to 12 months. All summations over indices c and a are also assumed to be over the range of valid combinations of c and a.

FORMULATION

The Missioning Problem

OBJECTIVE FUNCTION:

$$MINIMIZE \sum_{b}\sum_{a}\sum_{c} (1 - p_{b,(a-c)}) * X_{bca}$$

CONSTRAINTS:

$$\sum_{b\in\Omega_{NPS}}\sum_{a\in\Lambda_y} (d_{ba} + \sum_{c} p_{b,(a-c)} * X_{bca}) \geq f^{y}_{NPS} * N^{y} \qquad \forall\ y \quad (1)$$

$$\sum_{b\in\Omega_q}\sum_{a\in\Lambda_y} (d_{ba} + \sum_{c} p_{b,(a-c)} * X_{bca}) \geq$$
$$f^{y}_{q} * (\sum_{b\in\Omega_{NPS}}\sum_{a\in\Lambda_y} (d_{ba} + \sum_{c} p_{b,(a-c)} * X_{bca})) \qquad (2)$$
$$\forall\ y \text{ and } q = HSDG,\ NPS\text{-}A,\ FEM$$

$$\sum_{b\in\Omega_{TSC-4}}\sum_{a\in\Lambda_y} (d_{ba} + \sum_{c} p_{b,(a-c)} * X_{bca}) \leq$$
$$f^{y}_{TSC-4} * (\sum_{b\in\Omega_{NPS}}\sum_{a\in\Lambda_y} (d_{ba} + \sum_{c} p_{b,(a-c)} * X_{bca})) \qquad \forall\ y \qquad (3)$$

$$\sum_{b}\sum_{c} p_{b,(a-c)} * X_{bca} + \sum_{b} d_{ba} = S^{y}_{a} \qquad \forall\ y \text{ and } a \in \Lambda_y \quad (4)$$

$$\sum_{b}\sum_{a} X_{bca} \leq w^{y} * R_{c} * D_{c} \qquad \forall \;\; y \text{ and } c \in \Lambda_{y} \tag{5}$$

$$\sum_{b}\sum_{a \in \Lambda_{2}} \left(d_{ba} + \sum_{c \in \Lambda_{1}} p_{b,(a-c)} * X_{bca}\right) \geq \alpha_{12} * N^{2} \tag{6}$$

$$\sum_{b \in \Omega_{NPS-A}} \sum_{a \in \Lambda_{2}} \left(d_{ba} + \sum_{c \in \Lambda_{1}} p_{b,(a-c)} * X_{bca}\right) \geq \beta_{12} * f_{NPS-A}^{2} * f_{NPS}^{2} * N^{2} \tag{7}$$

$$\sum_{c \in \theta_{k}} \sum_{a} \left(X_{GMA,c,a}\right) = mp^{k} * \sum_{c \in \theta_{k}} \sum_{a} \left(X_{GMA,c,a} + X_{SMA,c,a}\right) \qquad \forall \;\; k \tag{8}$$

$$\sum_{c \in \theta_{k}} \sum_{a} \left(X_{GFA,c,a}\right) = fp^{k} * \sum_{c \in \theta_{k}} \sum_{a} \left(X_{GFA,c,a} + X_{SFA,c,a}\right) \qquad \forall \;\; k \tag{9}$$

$$\sum_{c \in \theta_{k}} \sum_{a} \left(X_{GFA,c,a} + X_{SFA,c,a}\right) \geq ff^{k} * \sum_{b \in \Omega_{FEM}} \sum_{c \in \theta_{k}} \sum_{a} X_{bca} \qquad \forall \;\; k \tag{10}$$

$$\sum_{b \in \Omega_{FEM}} \sum_{c \in \theta_{k}} \sum_{a} X_{bca} \geq \frac{f_{FEM}^{y}}{2} * \sum_{b \in \Omega_{NPS}} \sum_{c \in \theta_{k}} \sum_{a} X_{bca} \qquad \forall \;\; y \text{ and } k \tag{11}$$

$$\sum_{b}\sum_{a} X_{b,c,a} = D_c^y * \sum_{b}\sum_{c\in\Lambda_y}\sum_{a} X_{b,c,a} \qquad \forall \ y \text{ and } c\in\Lambda_y \qquad (12)$$

$$X_{bca} \geq 0 \qquad \forall \ b,\ c\ ,\ a \qquad (13)$$

The summand in the objective function is simply the expected number of DEP losses under the Binomial assumption. Summing over all possible valid combinations provides the total expected number of DEP losses from the missioning quarter to the end of the second FY.

Constraint (1) insures that there is a sufficient number of NPS contracts for each FY. The term inside the parenthesis is the expected number of accessions in month a. Summing over $b \in \Omega_{NPS}$ and $a \in \Lambda_y$ gives the number of NPS contracts for year y. The right hand side is simply the required minimum number of NPS accessions.

Constraints (2) and (3) guarantee that there are sufficient contracts in categories HSDG, NPS-A, FEM and TSC-4 to satisfy the required proportion. (See Table III in Chapter II for BOXES in these categories.) Similar to constraint (1), the summation on the left hand side is the expected number of contracts in category q, where q = HSDG, NPS-A, FEM and TSC-4. The summation on the right hand side represents the total number of NPS contracts. The ratio of the quantities on the left over the right hand side of the inequality gives the proportion of contracts for category q. For q = HSDG, NPS-A and FEM this value must be greater than or equal to the required proportion, f_q^y. For q = TSC-4 the ratio can not exceed the required proportion, f^y_{TSC-4}.

Constraint (4) insures that the number of accessions equals the programmed basic training seats for each month. The summations on the left hand side represent the expected number of recruits to access during month a. The first summation represents accessions due to contracts written during or after the missioning quarter, and the second represents accessions due to contracts written before the missioning quarter. The right hand side is the number of basic training seats available in month a.

Constraint (5) places an upper limit on the number of contracts that can be written each month. The summation on the left hand side is the number of contracts written during month c. On the right hand side, w^y, R_c and D_c represent the maximum number of contracts that a recruiter can write each month during year y, the number of available recruiters during month c and the proportion of working days in month c that are available for recruiting, respectively. The product, $w^y*R_c*D_c$, represents the maximum number of contracts that can be written during month c.

Constraint (6) guarantees that the required proportion of FY2's accessions are contracted during FY1. The summation on the left hand side is the expected number of contracts written in FY1, i.e., $c \in \Lambda_1$, that will access in FY2, i.e., $a \in \Lambda_2$. This sum must be at least equal to the required number $\alpha_{12}N^2$, where α_{12} represents the minimum proportion of FY2's accessions that must be contracted for during FY1, and N^2 is the total number of accessions required for FY2. Similarly, constraint (7) insures that the required proportion of FY2's accessions in the NPS-A category are contracted during FY1.

Constraint (8) guarantees that the proportion of GMA contracts among GMA and SMA contracts meets the desired proportion, mp^k, for each quarter. Constraint (9) applies to GFA and SFA in the same manner as constraint (8). (Recall from Table II in Chapter II that G, S, M, F and A represent graduate, senior, male, female and an AFQT score in the top 50th percentile, respectively.)

Constraint (10) insures that there are a desired proportion, ff^k, of GFA and SFA contracts among contracts in category FEM in each quarter. In the same manner, constraint (11) applies to contracts in category FEM with the desired proportion $F_{FEM}{}^y/2$.

Finally, constraint (12) insures that the proportion of contracts written in each month is the same proportion of working days in that month over the total number of working days of each year in the planning horizon. Constraint (13) simply insures that the number of contracts is nonnegative.

One of the most important input data for the missioning problem is the probability of DEP loss, $(1-p_{bt})$. This probability determines the additional number of contracts USAREC must produce in order to offset the losses during DEP. The estimation of this probability is the topic of the next chapter.

IV. ESTIMATING DEP LOSS PROBABILITIES

The DEP loss probability is the probability that a recruit becomes a DEP loss prior to leaving the MEPS for basic training or AIT. Intuitively, this probability varies with the time a recruit must stay in the DEP. From past experience, USAREC analysts indicate that the DEP loss probability is also a function of gender, mental capability, education, age, military service history, local unemployment rate, career choice (i.e., Military Occupational Specialty or MOS), etc. To limit the scope of this thesis, the sections below focus on estimating DEP loss probability as a function of time in DEP and the 22 mission BOX classifications. In doing so, factors such as gender, education, military service history and mental capability are included in the estimation. In addition, such estimation is well suited for the missioning problem described previously.

The outline for this chapter is as follows. The first section describes the data base maintained by USAREC. The second section discusses some preliminary analysis and irregularities in the data due to changes in recruiting policy during the past five years. The third section tests the overall differences in DEP loss probabilities by quarter. Finally, the last section provides procedures for estimating the DEP loss probabilities.

A. DESCRIPTION OF DATA

USAREC maintains records of all recruits that have been processed at the MEPS in files generally referred to as the MINIMASTER files. These files contain information concerning the recruits such as their social security number, responsible recruiting station, age, etc. Among these, contract date, accession date, mission BOX designation, AFQT score and contract status (i.e., in DEP, accessed or DEP loss) are pertinent to this thesis.

Note that the difference between contract and accession dates provides the duration each recruit agreed to spend in the DEP. Table VI below summarizes the records or contracts in the MINIMASTER files from FY88 to FY92. Note that not all contracts are considered; reasons for their deletion are indicated therein. In particular, mission BOX 23 designates special forces recruits, which are not considered in this thesis. Table VII lists the number of contracts by year and quarter.

Table VI MINIMASTER FILES FROM FY88-FY92

Total Records (Contracts)		= 535,746
Number of Records Deleted		= 6,213
BOX 23 (Special Forces)	= 1,996	
Missing Dates	= 163	
Wrong Record Type	= 1	
FY92 Open Records	= 4,053	
TOTAL records remaining		= 529,533

Table VII NUMBER OF RECORDS BY YEAR AND QUARTER

	QUARTER				
YEAR	1	2	3	4	TOTAL
FY88	29,497	33,610	28,656	33 552	125,315
FY89	33,610	35,050	33,703	33 931	136,294
FY90	32,385	30,269	18,781	23 171	104,606
FY91	24,736	21,432	19,933	24,653	90,754
FY92	18,315	19,492	16,201	18,556	72,564
TOTAL	138,543	139,853	117,274	133,863	529,533

B. PRELIMINARY ANALYSIS

Figure 2 displays the probability of DEP loss by quarter and year as computed from 529,533 contracts produced during FY88 to FY92.

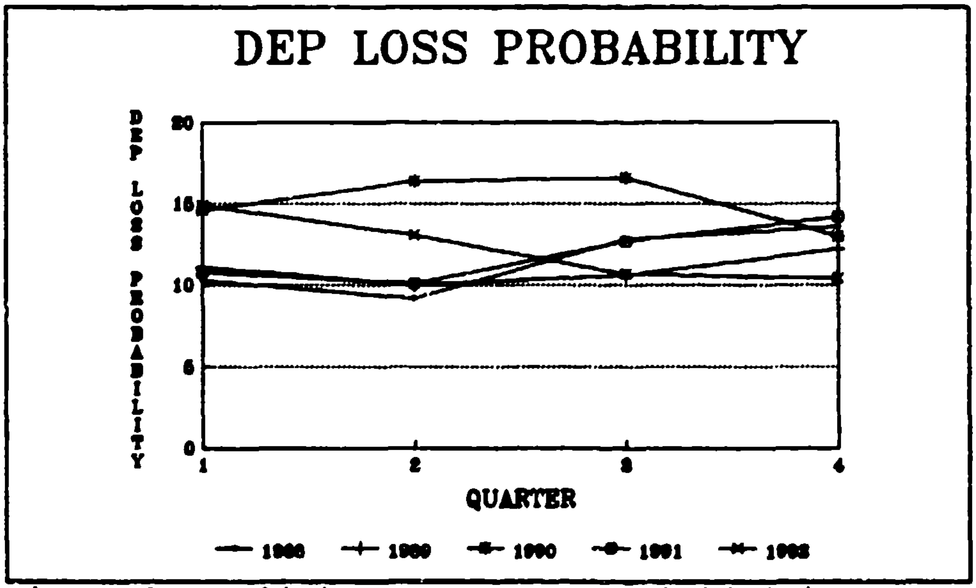

Figure 2 Preliminary DEP Loss Probabilities

From this figure, the DEP loss probabilities from quarters 1, 2 and 3 of FY90 and quarters 1, 2 and 4 of FY92 appear to be different than those from other fiscal years. To test whether these differences are statistically significant, hypothesis tests are conducted for the six quarters listed above. To illustrate, the hypotheses for quarter 1 of FY90 are:

H_o : $p_1^{90} = p_1^{POOLED}$ (Null Hypothesis)

H_a : $p_1^{90} \neq p_1^{POOLED}$ (Alternate Hypothesis)

where p_1^{90} is the DEP loss probability from quarter 1 of FY90 and p_1^{POOLED} is the DEP loss probability from quarter 1 pooled over FY88, FY89 and FY91. The following Chi-Squared statistic [Ref. 3] is used to perform the test:

$$\chi^2 = \sum_i \frac{(o_i - e_i)^2}{e_i}$$

where o_i and e_i, $i = 1, \ldots, 4$, represent the observed and expected number of observations for the cells in Table VIII. The expected frequencies are calculated as

$$e_i = \frac{(column\ total) \times (row\ total)}{total\ contracts}.$$

Using the data from Table VIII, the Chi-Squared statistic is computed as

$$\chi^2 = \frac{(27653-28572)^2}{28572} + \frac{(78420-77501)^2}{77501} + \frac{(4732-3813)^2}{3813} + \frac{(9423-10342)^2}{10342} = 344.$$

Table VIII EXAMPLE DATA NEEDED FOR CHI-SQUARED TEST

	YEAR		ROW
	FY90	POOLED	TOTAL
ACCESSIONS	27,653(28,572)*	78,420(77,501)*	106,073
DEP LOSS	4,732(3,813)*	9,423(10,342)*	14,155
COLUMN TOTAL	32,385	87,843	120,228
% DEP LOSS	14.61	10.73	11.77

* expected frequencies

Since the calculated Chi-Squared statistic (344) is greater than the $\chi^2_{\alpha=0.05}$ with 1 degree of freedom (3.841), the null hypothesis is rejected. So, the DEP loss probability associated with quarter 1 of 1990 is significantly different from the probability pooled over FY88, FY89 and FY91. Using the same Chi-Squared test, the DEP loss probabilities from each of the remaining five quarters (i.e., quarters 2 and 3 of FY90 and quarters 1, 2 and 4 of FY92) are also significantly different from the pooled DEP loss probabilities with p-values less than .05 (see the complete set of results in Appendix A). The fact that the data gives statistical significance is not too surprising given the large sample sizes used for each test. However, the differences in DEP loss probabilities also have practical significance.

When the above differences in DEP loss probabilities were conveyed to a senior USAREC analyst, he explained that during the early 90's there were changes in recruiting policy which resulted in "DEP purges." These purges encouraged recruiters to drop recruits from the DEP pool in order to achieve the lowered accession mission. In quarter 4 of FY92, the situation was reversed. As a result of DEP purges during earlier quarters, USAREC was in danger of not meeting the accession mission for the year. This induced an extra burden on the recruiters to prevent DEP loss at all costs, thereby producing an unusually low DEP loss probability for the last quarter of FY92. Because of these unusual circumstances, the records from the effected quarters are removed and the remaining data set reduces to 391,735 records. Table IX provides a summary of the reduced data set.

Table IX OBSERVATIONS USED FOR ANALYSIS

YEAR	# OF OBSERVATIONS
FY88	125,315
FY89	136,294
FY90	23,171
FY91	90,754
FY92	16,201
TOTAL	391,735

QUARTER	# OF OBSERVATIONS
1	87,843
2	90,092
3	98,493
4	115,307
TOTAL	391,735

C. DEP LOSS PROBABILITY BY QUARTER

USAREC analysts indicate that they experience a higher percentage of DEP loss during the summer months (quarter 4). During these months, DEP recruits are out of school and much of their time is uncommitted. This enables them to pursue more career options, to be influenced by others and, in unfortunate cases, to be involved in an accident causing them to become ineligible for military service. To test this observation, the following hypotheses are considered:

H_0: $p_1 = p_2 = p_3 = p_4$

H_a: p_i are not equal

where p_i = the DEP loss probability for quarter i.

Using the same procedure described in the previous section and the data in Table X, the Chi-Squared statistic evaluates to 675.385.

Table X QUARTERLY ACCESSIONS AND DEP LOSS

	QUARTER				
	1	2	3	4	TOTAL
ACCESSIONS	78,420	81,339	87,016	100,054	346,829
DEP LOSS	9,423	8,753	11,477	15,253	44,906
TOTAL	87,843	90,092	98,493	115,307	391,735
% DEP LOSS	10.73	9.72	11.65	13.23	11.46

Since the $\chi^2_{\alpha=0.05}$ with 3 degrees of freedom is only 7.815, the null hypothesis is again rejected (see Appendix A for further details).

So, the DEP loss probabilities significantly differ from quarter to quarter. These differences can be seen in Figure 3. Note that the DEP loss probability for quarter 4 is the largest which seems to corroborate the experience of USAREC analysts.

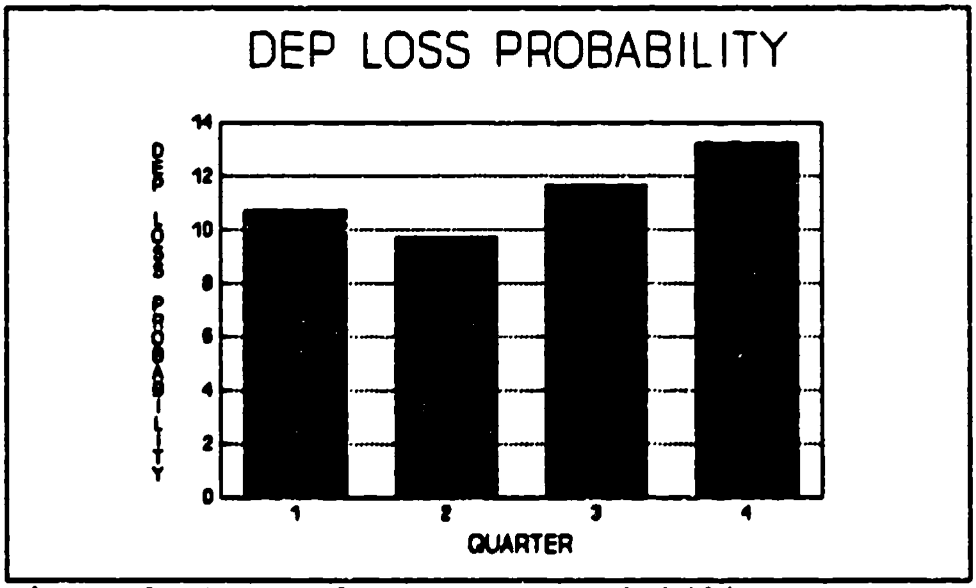

Figure 3 Quarterly DEP Loss Probability

However, the above test does not conclusively state that each probability, p_i, differs from the others. To test whether any two probabilities are the same, six pairs of hypotheses of the following form

$$H_o : p_i = p_j$$

$$H_a : p_i \neq p_j$$

are tested. In all cases, the null hypothesis is rejected (see Appendix A for further details), thereby implying that the DEP loss probabilities for each quarter are different and should be computed separately.

D. ESTIMATING DEP LOSS PROBABILITIES

One approach for estimating the probabilities is to view the number of DEP losses for a given BOX and DEP duration as a binomial random variable with parameters N_{bt} and p_{bt}. Here, N_{bt} is the number of contracts in BOX b with DEP duration t, and p_{bt} is the corresponding probability of DEP loss. Then, an unbiased estimator for p_{bt} is given by [Ref. 3]

$$\hat{p}_{bt} = \frac{L_{bt}}{N_{bt}}$$

where L_{bt} = the number of DEP losses in BOX b with DEP duration t. This estimate is used for BOX and DEP length combinations which contain at least 30 observations or contracts. Assuming normality, one can be $(1-\alpha)100\%$ confident that the error in the above estimate will not exceed [Ref. 3]

$$z_{\alpha/2}\sqrt{\frac{\hat{p}_{bt}(1-\hat{p}_{bt})}{N_{bt}}}\,.$$

To illustrate, Figure 4 displays the probability of DEP loss for GMA, along with the 95% confidence interval.

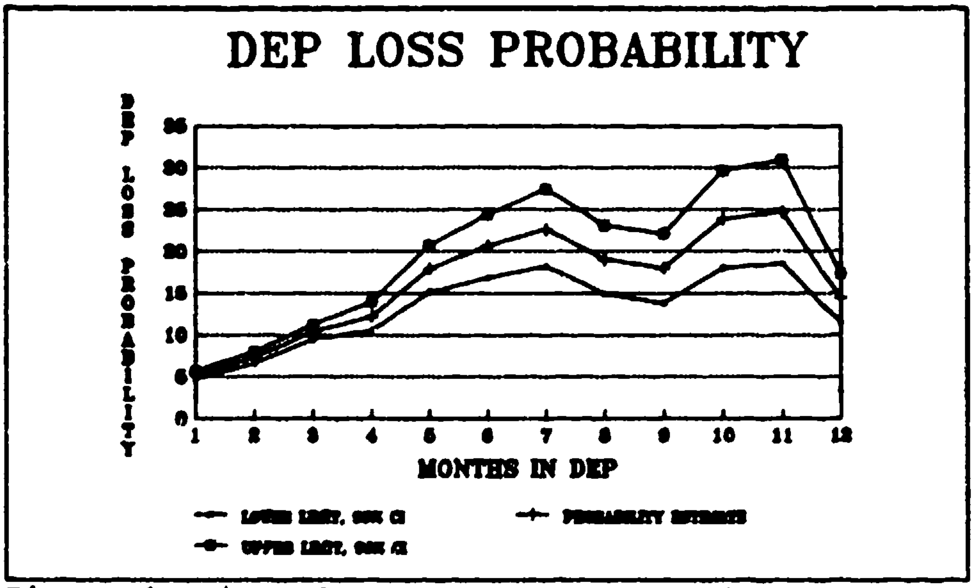

Figure 4 First Quarter DEP Loss For GMA

The other BOXES display similar shape (see Appendix B). In general, DEP loss probabilities tend to increase as the DEP length increases. The "dips" in DEP loss probability after months seven and eleven are counter-intuitive. One USAREC analyst indicated that recruits with a twelve month DEP length are generally assigned the MOS of their choice and are less likely to become a DEP loss.

Among the 22 mission BOXES, ten contain fewer than 30 observations for some DEP durations. These include two BOXES (SM4 and SF4) that are not being recruited, and eight BOXES (SFB, GF4, NMB, NFA, NFB, HMB, HFA and HFB) which have low priority. For each of the eight BOXES, it is assumed that the probability of DEP loss is the same for all four quarters. This assumption is valid for BOXES that do not involve high school seniors. The assumption remains valid for SFB contracts since almost every one of them became a DEP loss, regardless of when they were contracted. Under this assumption, isotonic regression [Ref. 4] is used to estimate the DEP loss probabilities. In isotonic regression, an estimate of DEP loss probability for a given BOB b, $\hat{p}_{bt}$, is taken to be an optimal solution to the following problem:

$$MIN \sum_{t} w_{bt} * (f_{bt} - p_{bt})^2$$

subject to

$$p_{bt} \le p_{b,t+1} \quad \forall \ t < 11 \tag{14}$$

$$p_{b,11} \ge p_{b,12} \tag{15}$$

$$p_{b,1} \le p_{b,12} \tag{16}$$

$$0 \le p_{bt} \le 1 \quad \forall \ t \tag{17}$$

where w_{bt} represents a weight for DEP duration t and is taken to be the number of observations and f_{bt} is the observed probability of DEP loss.

Recall that the DEP loss probabilities fluctuate in a counter-intuitive manner. Based on discussions with USAREC analysts, the estimated DEP loss probabilities should be nondecreasing in t up to month eleven and nonincreasing thereafter. Constraints (14) and (15) insure these two assumptions are satisfied. Constraint (16) insures that a twelve month DEP loss probability estimate is no smaller than that for a one month DEP duration. Constraint (17) insures that the probability estimates are nonnegative. As an example, Table XI compares the isotonic regression estimates for GF4 against the observed DEP loss probabilities (f_{bt}) most of which are based on less than 30 observations (w_{bt}). These estimates are obtained by solving the above optimization problem using the General Algebraic Modeling System or GAMS [Ref. 5]. Results from other low priority BOXES are in Appendix B.

Table XI RESULTS FROM ISOTONIC REGRESSION FOR GF4

DEP DURATION	w_{bt}	f_{bt}	$\hat{p}_{bt}$
1	60	0.067	0.106
2	8	0.375	0.419
3	4	0.250	0.419
4	5	0.400	0.419
5	1	0.000	0.419
6	0	0.000	1.000
7	0	0.000	1.000
8	0	0.000	1.000
9	1	1.000	1.000
10	0	0.000	1.000
11	0	0.000	1.000
12	5	0.000	0.106

V. MODEL IMPLEMENTATION AND ANALYSIS

The missioning problem described in Chapter III was implemented using GAMS [Ref. 5] on a 80486-33Mhz personal computer. To insure that the model always produces a solution, all constraints are made elastic. To do so, an artificial (or elastic) variable is added to each constraint to represent the amount of possible violation. In the objective function, each artificial variable is assigned a large penalty cost. When the missioning problem has a feasible solution, the optimal values for these artificial variables are zero. Otherwise, an optimal solution with non-zero artificial variables indicates the problem is infeasible and provides information as to which constraints can not be satisfied. To make the problem feasible, USAREC analysts can then modify their input data or parameters accordingly. The sections below describe data inputs, model outputs and sample analyses.

A. DATA INPUTS

Data necessary for determining an optimal contract mission for the first quarter of FY94 is used to illustrate and validate outputs from the model. The basic data inputs are summarized in Table XII. The number of required accessions and working days in each month are the same as those listed in

Table V of Chapter III. The remaining inputs are given in Appendices C and D and include the DEP loss probability matrix and the number of accessions generated by contracts from previous quarters, respectively.

Table XII USER DEFINED PARAMETER VALUES

PARAMETER	FISCAL YEAR FY94	FY95
ACCESSIONS (Volume)	75000	75000
SERVICE MIX		
NPS	70000	72000
PS	5000	3000
QUALITY (NPS)		
High School Graduate	95.0%	95.0%
AFQT Category A	67.0%	67.0%
AFQT Category 4	2.0%	2.0%
FEMALE (NPS)	14.8%	14.8%
FY95 VOLUME CONTRACTED DURING FY94	N/A	35.0%
FY95 QUALITY CONTRACTED DURING FY94	N/A	45.0%
# OF OPRA RECRUITERS	4200	4200
CONTRACTS/RECRUITER/MONTH	*2.0	1.9

* 1.9 is infeasible

It is important that USAREC meets the annual recruiting mission set forth by DCSPER. Thus, to insure that the solution has a high probability of meeting the DCSPER mission, the probability of DEP loss in Appendix C is actually the upper limit of the 97.5% one sided confidence interval. The upper limit is given by

$$\hat{p}_{bt} + 1.96 * \sqrt{\frac{\hat{p}_{bt}(1 - \hat{p}_{bt})}{N_{bt}}}$$

where, as before, $\hat{p}_{bt}$ and N_{bt} are the point estimate of the DEP loss probability and the number of observations for BOX b and DEP duration t, respectively. The number 1.96 is the 97.5 quantile of the standard normal distribution. When isotonic regression is used to estimate the DEP loss probability, N_{bt} is set at 30 to insure that the upper limit is no larger than one.

Part of the inputs to the missioning model are the estimates of how many contracts (by mission BOX) from previous quarters will actually access into the Army during the missioning quarter and beyond. These estimates should be functions of the conditional DEP loss probability which is a topic for future research. In this implementation, USAREC analysts provided the estimates which they refer to as the NETDEP matrix (see Appendix D).

B. MODEL OUTPUTS

Using the input described above, the resulting optimization problem contains 3,899 (continuous) variables and 115 constraints. The problem requires 1.8 cpu minutes on the 80486-33Mhz personal computer to produce an optimal solution.

The GAMS implementation of the missioning model summarizes the optimal solution in the form of output reports. There are a total of five different reports (see Appendix E). Four of which provide information regarding the feasibility of the solution obtained by GAMS. The remaining report provides an optimal contract mission and is discussed below.

Optimal Missioning Report: This report provides the optimal contract mission for each BOX during FY94 and FY95. However, only the contract mission for the first quarter of FY94 is of interest at this time. Information for other quarters should be considered as notional and is provided for long-range planning purposes. Table XIII below lists the recommended contract mission for the first quarter of FY94.

Table XIII RECOMMENDED CONTRACT MISSION FOR QTR1, FY94

	OCTFY1	NOVFY1	DECFY1
SMA		4063	
GMA	1146	1951	6384
GM4		1186	
NMA	2648	156	
SFA	250	372	
GFA	1452		
GFB	888		
CONTRACTS	6384	7728	6384
EXPECTED ACCESSIONS	5871	6812	5958
RECRUITER CAPACITY	6384	7728	6384
SHORTFALL			

The first row of Table XIII indicates that in November of FY94 USAREC should produce 4063 contracts which are high school seniors, male and have AFQT scores in the upper 50th percentile. Except for the last four rows, the other rows provide similar information. Three of the last four rows are the number of contracts written, accession expected and recruiting capacity for each month. The recruiting capacity is the number of contracts that can be written in a given month. This number is based on the number of working or recruiting days in a given month (see Table V in Chapter III), the number of recruiters and the write-rate of 2.0 contracts per month. If the number of contracts exceed the recruiting capacity in a given month, SHORTFALL will contain a positive number representing the number of contracts over the capacity, indicating that the inputs yield an infeasible problem. In this case, the analyst must increase the number of recruiters, write-rate or reduce the number of accessions required during a given month. In addition, the difference between the number of expected accessions and contracts is the number of DEP losses resulting from each month's contracts. For example, of the 6384 contracts written in October, 513 are expected to become DEP losses.

C. SAMPLE ANALYSES

To illustrate the potential of the missioning problem as a tool to aid in the decision making, two sample analyses are provided below. One concerns the proportion of females and the other concerns the contracts produced in FY94 to satisfy requirements in FY95.

1. Female Proportion

Using the data described in chapter II, one can estimate the DEP loss probabilities for each sex. Figure 5 below displays the resulting calculations graphically.

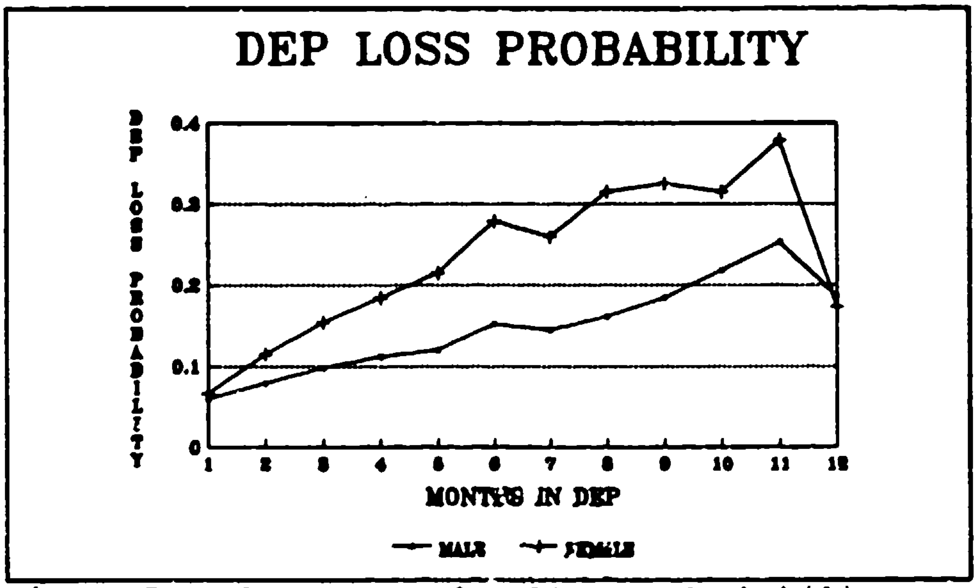

Figure 5 Male vs. Female DEP Loss Probability

It is clear from Figure 5 that the DEP loss probabilities for females are generally higher than males. Thus it is of concern as to how the required proportion of females effects the cost of recruiting as measured by the number of DEP losses. Table XIV summarizes the solutions from the missioning problem using various values for the required female proportion in the DCSPER mission.

Table XIV NPS FEMALE SENSITIVITY ANALYSIS

REQUIRED % NPS FEMALES	FY94 EXPECTED % DEP LOSS	EXPECTED # OF DEP LOSSES	COST OF DEP LOSSES
10.8	8.40	7053	$35,265,000
12.8	8.49	7134	$35,670,000
14.8	8.59	7216	$36,080,000
16.8	8.69	7297	$36,485,000
18.8	8.77	7366	$36,830,000
20.8	8.85	7437	$37,185,000

In the last column, the cost of DEP losses is based on the average cost of $5000 to produce one contract [Ref. 2]. In any case, the results from this table suggest that when the mission is optimally determined, an increase in female proportion does not significantly increase the cost of recruiting. In fact, a 93% increase in proportion from 10.8% to 20.8% only results in a 5.44% increase in the number of DEP losses. It should be noted that these results are due in part to the assumption that the supply of contracts is unlimited for all BOX and DEP length combinations.

2. Contracts Produced in FY94 for FY95 Accession

To insure a smooth transition in recruiting from one FY to another, USAREC requires that a proportion of the accessions for the next FY is contracted during the current FY. This practice forces recruits to remain in DEP longer, thereby increasing their chance of becoming a DEP loss. To analyze the effect of this policy, consider the current practice of recruiting 45% of FY95's NPS-A quality contracts during FY94. As before, Table XV below summarizes the results from the missioning problem as proportion is varied from 35% to 55%.

Table XV FY95 NPS-A ACC... ...NTRACTED DURING FY94

% OF FY95'S NPS-A ACCESSIONS CONTRACTED DURING FY94	FY94 EXPECTED % DEP LOSS	EXPECTED # OF DEP LOSSES	COST OF DEP LOSSES
35.0	8.38	7039	$35,195,000
40.0	8.48	7125	$35,625,000
45.0	8.59	7216	$36,080,000
50.0	8.74	7345	$36,725,000
55.0	*8.86	*7444	$37,220,000

* INFEASIBLE - not enough FY94 recruiters

Table XV shows that the current number of recruiters (4200) is insufficient to recruit 55% of FY95's NPS-A accessions during FY94. However, the 43% increase in NPS-A accessions from 35% to 50% results in a 4.35% increase in DEP losses. This increase is more significant than the one due to the increase in female proportion.

VI. CONCLUSION

A. SUMMARY

This thesis addresses the problem of determining the number of contracts to be recruited each month by Army recruiters. This missioning problem involves two areas of operations research: statistics and optimization. The statistical aspect involves estimating the probabilities that contracts will eventually become accessions based on the binomial assumption and isotonic regression. Using the probability estimates, the problem is formulated as a linear program that maximizes the expected number of accessions (or minimizes the number of DEP losses). The constraints in the problem include requirements established by DCSPER and USAREC.

The model for the missioning problem is implemented in GAMS and tested using data provided by USAREC analysts. Model outputs were presented and validated by USAREC analysts. Among these outputs is the optimal monthly level of contract mission for each mission BOX during the current and following fiscal years.

Although USAREC assumes a 15.0% DEP loss when setting their monthly mission, Table X in Chapter IV shows that only 11.46% of their contracts became DEP losses. Moreover, the model outputs indicate that, when the contracts are optimally missioned, the expected DEP loss probability can be reduced from 11.46% to 8.59%. This translates to nearly $11 million annual saving, a considerable sum during an austere budget environment.

In addition to providing the optimal missioning levels, the model can be used as a tool to analyze the impact of various policies. In particular, Chapter V examines two policies. One concerns the percentage of females among the new recruits to be accessed into the Army. Historically, females have higher DEP loss probability than males. The model is used to compute the expected DEP loss and associated cost as the percentage of required females varies between 10.8% and 20.8%. The other policy concerns the percentage of NPS-A quality recruits. Again, the model is used to evaluate the impact in terms of DEP loss and associated cost as the percentage of required NPS-A quality recruits is increased.

B. AREAS FOR FUTURE RESEARCH

This thesis identifies two topics for future research. They are described below.

1. Conditional DEP Loss Probabilities

As discussed in Chapter V, part of the inputs to the missioning model requires users to estimate the number of accessions that would be generated by contracts written during previous quarters. Such estimates should be functions of the conditional DEP loss probability. Assume that an individual is required to be in DEP for ten months. Given that eight months have elapsed and the individual has not become a DEP loss, the DEP loss probability should be conditioned on the fact that he or she has already been in DEP for eight months. Statistical techniques that accurately estimate the conditional DEP loss probabilities must take into account the fact that recruiters often delay reporting DEP losses in order to make the recruiting mission in a given month.

2. Missioning by Brigade

The model described in Chapter III addresses the missioning problem at the headquarters level. The next step in the process is to allocate the monthly mission at the headquarters level to the next level in the hierarchy, which is the brigade. Such allocations should be optimal, e.g., minimize expected DEP losses and consider the socio-economic factors, such as unemployment rate, education level and median income, in each brigade's recruiting territory. These socio-economic factors indirectly determine the supply of individuals with high propensities to enlist into the military in each of the geographical areas.

APPENDIX A CHI-SQUARED TEST

A. SUMMARY

	H_o	H_a	χ^2	p-value	Decision
1.	$p_1^{90} = p_1^{POOLED}$	$p_1^{90} \neq p_1^{POOLED}$	343.745	<.00005	Reject H_o
2.	$p_2^{90} = p_2^{POOLED}$	$p_2^{90} \neq p_2^{POOLED}$	1005.196	<.00005	Reject H_o
3.	$p_3^{90} = p_3^{POOLED}$	$p_3^{90} \neq p_3^{POOLED}$	348.675	<.00005	Reject H_o
4.	$p_1^{92} = p_1^{POOLED}$	$p_1^{92} \neq p_1^{POOLED}$	263.041	<.00005	Reject H_o
5.	$p_2^{92} = p_2^{POOLED}$	$p_2^{92} \neq p_2^{POOLED}$	202.219	<.00005	Reject H_o
6.	$p_4^{92} = p_4^{POOLED}$	$p_4^{92} \neq p_4^{POOLED}$	112.432	<.00005	Reject H_o
7.	$p_{Q1} = p_{Q2} = p_{Q3} = p_{Q4}$	At least one pair $\neq$	675.385	<.00005	Reject H_o
8.	$p_{Q1} = p_{Q2}$	$p_{Q1} \neq p_{Q2}$	49.613	<.00005	Reject H_o
9.	$p_{Q1} = p_{Q3}$	$p_{Q1} \neq p_{Q3}$	39.939	<.00005	Reject H_o
10.	$p_{Q1} = p_{Q4}$	$p_{Q1} \neq p_{Q4}$	292.269	<.00005	Reject H_o
11.	$p_{Q2} = p_{Q3}$	$p_{Q2} \neq p_{Q3}$	184.343	<.00005	Reject H_o
12.	$p_{Q2} = p_{Q4}$	$p_{Q2} \neq p_{Q4}$	604.565	<.00005	Reject H_o
13.	$p_{Q3} = p_{Q4}$	$p_{Q3} \neq p_{Q4}$	120.541	<.00005	Reject H_o

B. Detailed Analysis

Chi-Squared Test

H_o : $p_1^{90} = p_1^{POOLED}$
H_a : $p_1^{90} \neq p_1^{POOLED}$

POOLED = Pooled average of quarter 1 from 1988, 1989 and 1991

RECORD		YEAR: POOLED	YEAR: 1990	Row Total
ACCESS	3	78420	27653	106073 88.2
DEP LOSS	4	9423	4732	14155 11.8
	Column Total	87843 73.1	32385 26.9	120228 100.0

Chi-Square	Value	DF	Significance
Pearson	343.74538	1	.00000
Likelihood Ratio	330.63119	1	.00000
Mantel-Haenszel test for linear association	343.74252	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.841.

Since 343.745 > 3.841, reject H_o.

Chi-Squared Test

$H_o : p_2^{90} = p_2^{POOLED}$
$H_a : p_2^{90} \neq p_2^{POOLED}$

POOLED = Pooled average of quarter 2 from 1988, 1989 and 1991

RECORD		YEAR: POOLED	YEAR: 1990	Row Total
ACCESS	3	81339	25302	106641 88.6
DEP LOSS	4	8753	4967	13720 11.4
Column Total		90092 74.9	30269 25.1	120361 100.0

Chi-Square	Value	DF	Significance
Pearson	1005.19591	1	.00000
Likelihood Ratio	937.99627	1	.00000
Mantel-Haenszel test for linear association	1005.18755	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.841.

Since 1005.196 > 3.841, reject H_o.

Chi-Squared Test

H_o : $p_3^{90} = p_3^{POOLED}$
H_a : $p_3^{90} \neq p_3^{POOLED}$

POOLED = Pooled average of quarter 3 from 1988, 1989, 1991 and 1992

RECORD		YEAR: POOLED	YEAR: 1990	Row Total
ACCESS	3	87016	15671	102687 87.6
DEP LOSS	4	11477	3110	14587 12.4
	Column Total	98493 84.0	18781 16.0	117274 100.0

Chi-Square	Value	DF	Significance
Pearson	348.67477	1	.00000
Likelihood Ratio	325.91111	1	.00000
Mantel-Haenszel test for linear association	348.67180	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.841.

Since 348.675 > 3.841, reject H_o.

Chi-Squared Test

H_o : $p_1^{92} = p_1^{POOLED}$
H_a : $p_1^{92} \neq p_1^{POOLED}$

POOLED = Pooled average of quarter 1 from 1988, 1989 and 1991

RECORD		YEAR: POOLED	YEAR: 1992	Row Total
ACCESS	3	78420	15582	94002 88.5
DEP LOSS	4	9423	2733	12156 11.8
	Column Total	87843 82.7	18315 17.3	106158 100.0

Chi-Square	Value	DF	Signific
Pearson	263.04141	1	.0000(
Likelihood Ratio	247.26244	1	.00000
Mantel-Haenszel test for linear association	263.03894	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.841.

Since 263.041 > 3.841, reject H_o.

Chi-Squared Test

$H_0 : p_2^{92} = p_2^{POOLED}$
$H_a : p_2^{92} \neq p_2^{POOLED}$

POOLED = Pooled average of quarter 1 from 1988, 1989 and 1991

RECORD		YEAR: POOLED	YEAR: 1992	Row Total
ACCESS	3	81339	16932	98271 89.7
DEP LOSS	4	8753	2560	11313 10.3
	Column Total	90092 82.2	19492 17.8	109584 100.0

Chi-Square	Value	DF	Significance
Pearson	202.21945	1	.00000
Likelihood Ratio	191.10495	1	.00000
Mantel-Haenszel test for linear association	202.21760	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.841.

Since 202.219 > 3.841, reject H_0.

Chi-Squared Test

H_o : $p_4^{92} = p_4^{POOLED}$
H_a : $p_4^{92} \neq p_4^{POOLED}$

POOLED = Pooled average of quarter 4 from 1988, 1989, 1990 and 1991

RECORD		YEAR: POOLED	1992	Row Total
ACCESS	3	100054	16622	116676 87.2
DEP LOSS	4	15253	1934	17187 12.8
	Column Total	115307 86.1	18556 13.9	133863 100.0

Chi-Square	Value	DF	Significance
Pearson	112.43177	1	.00000
Likelihood Ratio	118.04553	1	.00000
Mantel-Haenszel test for linear association	112.43093	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.841.

Since 112.432 > 3.841, reject H_o.

Chi-Squared Test

H_o: $p_{Q1} = p_{Q2} = p_{Q3} = p_{Q4}$
H_a: at least one difference exists between the probabilities.

RECORD		QUARTER 1	2	3	4	Row Total
ACCESS	3	78420	81339	87016	100054	346829 88.5
DEP LOSS	4	9423	8753	11477	15253	44906 11.5
	Column Total	87843 22.4	90092 23.0	98493 25.1	115307 29.4	391735 100.0

Chi-Square	Value	DF	Significance
Pearson	675.38546	3	.00000
Likelihood Ratio	674.62498	3	.00000
Mantel-Haenszel test for linear association	474.69741	1	.00000

The $\chi^2_{\alpha=0.05,\ v=3}$ value is 7.815.

Since 675.385 > 7.815, reject H_o.

Chi-Squared Test

H_o: $p_{Q1} = p_{Q2}$
H_a: $p_{Q1} \neq p_{Q2}$

RECORD	Count	QUARTER 1	QUARTER 2	Row Total
ACCESS	3	78420	81339	159759 89.8
DEP LOSS	4	9423	8753	18176 10.2
	Column Total	87843 49.4	90092 50.6	177935 100.0

Chi-Square	Value	DF	Significance
Pearson	49.61305	1	.00000
Continuity Correction	49.50283	1	.00000
Likelihood Ratio	49.61293	1	.00000
Mantel-Haenszel test for linear association	49.61277	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.814.

Since 49.613 > 3.814, reject H_o.

Chi-Squared Test

H_o: $p_{Q1} = p_{Q3}$
H_a: $p_{Q1} \neq p_{Q3}$

RECORD	Count	QUARTER 1	QUARTER 3	Row Total
ACCESS	3	78420	87016	165436 88.8
DEP LOSS	4	9423	11477	20900 11.2
	Column Total	87843 47.1	98493 52.9	186336 100.0

Chi-Square	Value	DF	Significance
Pearson	39.93900	1	.00000
Continuity Correction	39.84611	1	.00000
Likelihood Ratio	40.00410	1	.00000
Mantel-Haenszel test for linear association	39.93879	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.814.

Since 39.939 > 3.814, reject H_o.

Chi-Squared Test

H_o: $p_{Q1} = p_{Q4}$
H_a: $p_{Q1} \neq p_{Q4}$

RECORD	Count	QUARTER 1	QUARTER 4	Row Total
ACCESS	3	78420	100054	178474 87.9
DEP LOSS	4	9423	15253	24676 12.1
	Column Total	87843 43.2	115307 56.8	203150 100.0

Chi-Square	Value	DF	Significance
Pearson	292.26875	1	.00000
Continuity Correction	292.03442	1	.00000
Likelihood Ratio	295.10328	1	.00000
Mantel-Haenszel test for linear association	292.26731	1	.00000

The $\chi^2_{\alpha=0.05, \nu=1}$ value is 3.814.

Since 292.269 > 3.814, reject H_o.

Chi-Squared Test

H_o: $p_{Q2} = p_{Q3}$
H_a: $p_{Q2} \neq p_{Q3}$

RECORD	Count	QUARTER 2	QUARTER 3	Row Total
ACCESS	3	81339	87016	168355 89.3
DEP LOSS	4	8753	11477	20230 10.7
	Column Total	90092 47.8	98493 52.2	188585 100.0

Chi-Square	Value	DF	Significance
Pearson	184.34333	1	.00000
Continuity Correction	184.14113	1	.00000
Likelihood Ratio	185.00642	1	.00000
Mantel-Haenszel test for linear association	184.34236	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.814.

Since 184.343 > 3.814, reject H_o.

Chi-Squared Test

H_o: $p_{Q2} = p_{Q4}$
H_a: $p_{Q2} \neq p_{Q4}$

Count	QUARTER 2	QUARTER 4	Row Total
RECORD ACCESS 3	81339	100054	181393 88.3
DEP LOSS 4	8753	15253	24006 11.7
Column Total	90092 43.9	115307 56.1	205399 100.0

Chi-Square	Value	DF	Significance
Pearson	604.56451	1	.00000
Continuity Correction	604.22425	1	.00000
Likelihood Ratio	613.23362	1	.00000
Mantel-Haenszel test for linear association	604.56157	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.814.

Since 604.565 > 3.814, reject H_o.

Chi-Squared Test

H_o: $p_{Q3} = p_{Q4}$
H_a: $p_{Q1} \neq p_{Q2}$

Count		QUARTER		
RECORD		3	4	Row Total
ACCESS	3	87016	100054	187070 87.5
DEP LOSS	4	11477	15253	26730 12.5
	Column Total	98493 46.1	115307 53.9	213800 100.0

Chi-Square	Value	DF	Significance
Pearson	120.54121	1	.00000
Continuity Correction	120.39723	1	.00000
Likelihood Ratio	120.95478	1	.00000
Mantel-Haenszel test for linear association	120.54065	1	.00000

The $\chi^2_{\alpha=0.05,\ v=1}$ value is 3.814.

Since 120.541 > 3.814, reject H_o.

APPENDIX B DEP LOSS PROBABILITY ESTIMATES

ALL QUARTERS DEP LOSS PROBABILITY ESTIMATES USING SIMPLE PROBABILITY and ISOTONIC REGRESSION														
			MONTHS IN THE DEP											
BOX/OB/DL			1	2	3	4	5	6	7	8	9	10	11	12
1		SNA	0.338	0.273	0.195	0.109	0.099	0.121	0.129	0.145	0.165	0.203	0.249	0.215
2		GNA	0.054	0.07	0.099	0.112	0.127	0.195	0.219	0.255	0.235	0.29	0.305	0.117
3		SNB	0.211	0.167	0.081	0.098	0.118	0.124	0.113	0.142	0.185	0.237	0.269	0.255
4		GNB	0.057	0.064	0.092	0.115	0.139	0.203	0.223	0.249	0.276	0.24	0.256	0.079
5	**	SN4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6		GN4	0.055	0.069	0.073	0.099	0.089	0.194	0.113	0.133	0.185	0.242	0.146	0.114
7		INA	0.088	0.157	0.103	0.159	0.118	0.155	0.258	0.169	0.1	0.127	0.09	0.068
8	*	INB	0.108	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.109
9		SFA	0.425	0.259	0.149	0.178	0.196	0.248	0.216	0.298	0.279	0.31	0.386	0.365
10		GFA	0.066	0.122	0.163	0.195	0.234	0.321	0.321	0.359	0.419	0.354	0.43	0.158
11	*	SFB	0.667	1	1	1	1	1	1	1	1	1	1	1
12		GFB	0.064	0.095	0.134	0.149	0.176	0.241	0.193	0.195	0.254	0.155	0.111	0.026
13	**	SF4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	*	GF4	0.062	0.333	0.333	0.333	0.333	1	1	1	1	1	1	0.062
15	*	IFA	0.13	0.13	0.5	0.5	0.571	0.571	0.571	0.571	0.571	0.571	1	0.5
16	*	IFB	0	0	0	0	0	0	0	0	0	0	0	0
17		HPS	0.055	0.08	0.098	0.112	0.096	0.113	0.136	0.172	0.133	0.13	0.086	0.102
18		FPS	0.053	0.088	0.103	0.09	0.137	0.142	0.193	0.147	0.133	0.152	0.04	0.013
19		HNA	0.059	0.079	0.132	0.126	0.17	0.25	0.243	0.242	0.131	0.283	0.182	0.102
20	*	HNB	0.079	0.12	0.12	0.217	0.233	0.233	0.233	0.233	0.233	0.233	0.265	0.265
21	*	HFA	0.11	0.25	0.25	0.286	0.286	0.333	0.333	0.333	1	1	1	0.5
22	*	HFB	0	0	0	1	1	1	1	1	1	1	1	1
	*	indicates BOX probability estimates calculated with data from all four quarters, using isotonic regression												
	**	indicates BOXes that are not recruited												

QUARTER 1 DEP LOSS PROBABILITY ESTIMATES USING SIMPLE PROBABILITY and ISOTONIC REGRESSION														
			MONTHS IN THE DEP											
BOX	OB	CL	1	2	3	4	5	6	7	8	9	10	11	12
1		SMA	0.216	0.355	0.313	0.104	0.2	0.183	0.169	0.146	0.138	0.14	0.284	0.38
2		GMA	0.052	0.072	0.103	0.122	0.179	0.206	0.226	0.19	0.18	0.238	0.247	0.144
3		SMB	0.114	0.152	0.17	0.1	0.148	0.154	0.132	0.144	0.152	0.165	0.247	0.471
4		GMB	0.054	0.053	0.08	0.102	0.126	0.196	0.143	0.176	0.302	0.151	0.128	0.124
5	**	SM4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6		GM4	0.048	0.07	0.06	0.017	0.079	0.167	0.208	0.147	0.122	0.059	0.059	0.059
7		NMA	0.097	0.123	0.124	0.118	0.102	0.067	0.04	0.013	0	0.156	0.098	0.081
9	*	NMB	0.108	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.108
9		SFA	0.344	0.344	0.44	0.429	0.333	0.3	0.227	0.278	0.244	0.237	0.395	0.537
10		GFA	0.064	0.118	0.172	0.226	0.204	0.347	0.277	0.272	0.405	0.298	0.29	0.148
11	*	SFB	0.657	1	1	1	1	1	1	1	1	1	1	1
12		GFB	0.05	0.106	0.179	0.149	0.201	0.224	0.213	0.204	0.16	0.167	0.057	0
13	**	SF4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	*	GF4	0.062	0.333	0.333	0.333	0.333	1	1	1	1	1	1	0.062
15	*	NFA	0.13	0.13	0.5	0.5	0.571	0.571	0.571	0.571	0.571	0.571	1	0.5
16	*	NFB	0	0	0	0	0	0	0	0	0	0	0	0
17		NPS	0.057	0.067	0.08	0.101	0.077	0.048	0.146	0.151	0.125	0.053	0.107	0.152
18		FPS	0.045	0.03	0.09	0.026	0.052	0.075	0.083	0.129	0.135	0.135	0.133	0.133
19		HMA	0.065	0.056	0.109	0.151	0.129	0.148	0.167	0.1	0.1	0.094	0.12	0.111
20	*	HMB	0.079	0.12	0.12	0.217	0.233	0.233	0.233	0.233	0.233	0.233	0.265	0.265
21	*	HFA	0.11	0.25	0.25	0.286	0.286	0.333	0.333	0.333	1	1	1	0.5
22	*	HFB	0	0	0	1	1	1	1	1	1	1	1	1

* indicates BOX probability estimates calculated with data from all four quarters, using isotonic regression

** indicates BOXes that are not recruited

QUARTER 2 DEP LOSS PROBABILITY ESTIMATES USING SIMPLE PROBABILITY and ISOTONIC REGRESSION														
			MONTHS IN THE DEP											
BOX/OB/DL			1	2	3	4	5	6	7	8	9	10	11	12
1		SMA	0.148	0.34	0.116	0.137	0.111	0.11	0.11	0.116	0.244	0.311	0.436	0.355
2		GMA	0.055	0.066	0.106	0.149	0.178	0.208	0.182	0.237	0.278	0.302	0.368	0.136
3		SMB	0.125	0.182	0.104	0.103	0.136	0.117	0.096	0.103	0.283	0.39	0.476	0.471
4		GMB	0.057	0.066	0.126	0.134	0.151	0.233	0.229	0.197	0.249	0.2	0.12	0.077
5	••	SM4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6		GM4	0.052	0.076	0.051	0.108	0.029	0.064	0.109	0.113	0.063	0.116	0.116	0.116
7		NMA	0.087	0.203	0.169	0.065	0.057	0.077	0.116	0.2	0.174	0.14	0.034	0
8	•	NMB	0.108	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.108
9		SFA	0.192	0.192	0.105	0.139	0.189	0.214	0.185	0.265	0.302	0.449	0.6	0.475
10		GFA	0.071	0.117	0.189	0.194	0.273	0.292	0.28	0.416	0.4	0.372	0.218	0.14
11	•	SFB	0.667	1	1	1	1	1	1	1	1	1	1	1
12		GFB	0.068	0.095	0.136	0.264	0.213	0.229	0.312	0.306	0.25	0.106	0.019	0
13	••	SF4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	•	GF4	0.062	0.333	0.333	0.333	0.333	1	1	1	1	1	1	0.062
15	•	NFA	0.13	0.13	0.5	0.5	0.571	0.571	0.571	0.571	0.571	0.571	1	0.5
16	•	NFB	0	0	0	0	0	0	0	0	0	0	0	0
17		HPS	0.053	0.09	0.117	0.1	0.089	0.139	0.146	0.163	0.143	0.152	0.091	0.054
18		FPS	0.072	0.123	0.077	0.082	0.111	0.141	0.163	0.157	0.151	0.077	0.077	0.077
19		HMA	0.051	0.063	0.125	0.122	0.147	0.183	0.118	0.125	0.121	0.167	0.105	0.031
20	•	HMB	0.079	0.12	0.12	0.217	0.233	0.233	0.233	0.233	0.233	0.233	0.265	0.265
21	•	HFA	0.11	0.25	0.25	0.296	0.286	0.333	0.333	0.333	1	1	1	0.5
22	•	HFB	0	0	0	1	1	1	1	1	1	1	1	1

* indicates BOX probability estimates calculated with data from all four quarters, using isotonic regression

** indicates BOXes that are not recruited

QUARTER 3 DEP LOSS PROBABILITY ESTIMATES USING SIMPLE PROBABILITY and ISOTONIC REGRESSION														
				MONTHS IN THE DEP										
BOX	JOB CL		1	2	3	4	5	6	7	8	9	10	11	12
1		SHA	0.328	0.17	0.078	0.104	0.087	0.126	0.198	0.219	0.264	0.366	0.334	0.202
2		GHA	0.058	0.078	0.094	0.114	0.113	0.205	0.216	0.252	0.343	0.296	0.38	0.101
3		SHB	0.2	0.104	0.072	0.091	0.097	0.122	0.25	0.162	0.289	0.377	0.5	0.233
4		GHB	0.062	0.065	0.089	0.138	0.155	0.189	0.205	0.281	0.364	0.282	0.131	0.069
5	**	SHJ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6		GHJ	0.06	0.044	0.081	0.117	0.119	0.139	0.167	0.18	0.205	0.27	0.27	0.27
7		NHA	0.084	0.149	0.227	0.101	0.107	0.15	0.306	0.25	0.25	0.173	0.132	0.111
8	*	NHB	0.108	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.108
9		SFA	0.375	0.189	0.143	0.178	0.197	0.312	0.375	0.378	0.4	0.5	0.533	0.319
10		GFA	0.074	0.151	0.151	0.189	0.2	0.349	0.39	0.436	0.385	0.3	0.5	0.153
11	*	SFB	0.667	1	1	1	1	1	1	1	1	1	1	1
12		GFB	0.067	0.084	0.123	0.123	0.124	0.218	0.138	0.224	0.258	0.283	0.082	0.039
13	**	SFJ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	*	GFJ	0.062	0.333	0.333	0.333	0.333	1	1	1	1	1	1	0.062
15	*	NFA	0.13	0.13	0.5	0.5	0.571	0.571	0.571	0.571	0.571	0.571	1	0.5
16	*	NFB	0	0	0	0	0	0	0	0	0	0	0	0
17		HPS	0.05	0.105	0.108	0.105	0.125	0.13	0.152	0.2	0.205	0.194	0.145	0.111
18		FPS	0.052	0.08	0.117	0.127	0.217	0.131	0.235	0.22	0.216	0.079	0.079	0.079
19		MHA	0.052	0.114	0.159	0.116	0.162	0.229	0.229	0.26	0.347	0.281	0.256	0.156
20	*	MHB	0.079	0.12	0.12	0.217	0.233	0.233	0.233	0.233	0.233	0.233	0.265	0.265
21	*	HFA	0.11	0.25	0.25	0.286	0.286	0.333	0.333	0.333	1	1	1	0.5
22	*	HFB	0	0	0	1	1	1	1	1	1	1	1	1
	*	indicates BOX probability estimates calculated with data from all four quarters, using isotonic regression												
	**	indicates BOXes that are not recruited												

			QUARTER 4 DEP LOSS PROBABILITY ESTIMATES USING SIMPLE PROBABILITY and ISOTONIC REGRESSION											
			MONTHS IN THE DEP											
BOX	OB	CL	1	2	3	4	5	6	7	8	9	10	11	12
1		SMA	0.476	0.752	0.203	0.245	0.165	0.185	0.241	0.327	0.262	0.231	0.237	0.193
2		GMA	0.35	0.366	0.099	0.133	0.121	0.18	0.264	0.328	0.376	0.313	0.287	0.107
3		SMB	0.333	0.613	0.532	0.269	0.23	0.255	0.282	0.486	0.352	0.261	0.251	0.225
4		GMB	0.056	0.072	0.093	0.134	0.125	0.197	0.288	0.313	0.31	0.301	0.239	0.068
5	••	SM4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6		GM4	0.07	0.071	0.08	0.119	0.154	0.143	0.152	0.216	0.117	0.109	0.071	0.026
7		NMA	0.07	0.169	0.096	0.232	0.129	0.167	[illegible]	[illegible]	0.2	0.094	0.091	0.06
8	•	NMB	0.108	0.118	0.118	0.118	0.118	0.118	0.118	0.118	0.113	0.118	0.118	0.108
9		SFA	0.679	0.75	0.604	0.2	0.39	0.238	0.419	0.36	0.344	0.299	0.35	0.327
10		GFA	0.055	0.11	0.159	0.188	0.252	0.307	0.328	0.353	0.463	0.396	0.446	0.174
11	•	SFB	0.667	1	1	1	1	1	1	1	1	1	1	1
12		GFB	0.072	0.095	0.113	0.15	0.225	0.287	0.136	0.136	0.127	0.132	0.063	0.037
13	••	SF4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	•	GF4	0.062	0.333	0.333	0.333	0.333	1	1	1	1	1	1	0.062
15	•	NFA	0.13	0.13	0.5	.5	0.571	0.571	0.571	0.571	0.571	0.571	1	0.5
16	•	NFB	0	0	0	0	0	0	0	0	0	0	0	0
17		MPS	0.059	0.077	0.096	0.139	0.063	0.137	0.053	0.079	0.08	0.086	0.08	0.076
18		FPS	0.042	0.058	0.118	0.081	0.05	0.097	0.094	0.09	0.068	0	0	0
19		TNA	0.101	0.102	0.135	0.125	0.174	0.352	0.326	0.299	0.323	0.268	0.142	0.103
20	•	HMB	0.079	0.12	0.12	0.217	0.233	0.233	0.233	0.233	0.233	0.233	0.265	0.265
21	•	HFA	0.11	0.25	0.25	0.286	0.286	0.333	0.333	0.333	1	1	1	0.5
22	•	HFB	0	0	0	1	1	1	1	1	1	1	1	1

• indicates BOX probability estimates calculated with data from all four quarters, using isotonic regression

•• indicates BOXes that are not recruited

APPENDIX C 95% CONFIDENCE INTERVAL UPPER VALUE PROBABILITY ESTIMATES

ALL QUARTERS PROBABILITY OF CEP LOSS (UPPER VALUE OF 95% C.I.)														
			MONTHS IN THE CEP											
BOX			1	2	3	4	5	6	7	8	9	10	11	12
1		SNA	0.37	0.296	0.12	0.119	0.107	0.131	0.137	0.154	0.174	0.213	0.258	0.225
2		GNA	0.356	0.079	0.104	0.117	0.133	0.229	0.236	0.277	0.322	0.32	0.338	0.129
3		SNB	0.244	0.191	0.096	0.111	0.131	0.136	0.123	0.154	0.2	0.255	0.286	0.273
4		GNB	0.06	0.069	0.099	0.124	0.152	0.231	0.258	0.295	0.335	0.299	0.323	0.095
5	**	SN4	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A
6		GN4	0.05	0.077	0.088	0.13	0.127	0.272	0.199	0.255	0.324	0.395	0.272	0.189
7		INA	0.339	0.185	0.128	0.198	0.159	0.239	0.367	0.26	0.166	0.209	0.153	0.101
8	*	INB	0.165	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.165
9		SFA	0.509	0.312	0.181	0.202	0.221	0.279	0.245	0.332	0.314	0.35	0.429	0.416
10		GFA	0.071	0.131	0.174	0.206	0.249	0.349	0.357	0.403	0.472	0.413	0.501	0.183
11	*	SFB	0.753	1	1	1	1	1	1	1	1	1	1	1
12		GFB	0.07	0.105	0.148	0.166	0.199	0.291	0.257	0.268	0.358	0.248	0.189	0.043
13	**	SF4	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A
14	*	GF4	0.106	0.419	0.419	0.419	0.419	1	1	1	1	1	1	0.106
15	*	IFA	0.191	0.191	0.591	0.591	0.661	0.661	0.661	0.661	0.661	0.661	1	0.591
16	*	IFB	0	0	0	0	0	0	0	0	0	0	0	0
17		NPS	0.058	0.087	0.113	0.133	0.118	0.14	0.176	0.237	0.21	0.228	0.178	0.14
18		FPS	0.062	0.11	0.14	0.13	0.187	0.201	0.276	0.266	0.255	0.28	0.11	0.237
19		HNA	0.064	0.099	0.149	0.153	0.209	0.32	0.322	0.346	0.216	0.413	0.284	0.145
20	*	HNB	0.128	0.179	0.179	0.232	0.31	0.31	0.31	0.31	0.31	0.31	0.346	0.346
21	*	HFA	0.167	0.329	0.329	0.369	0.369	0.419	0.419	0.419	1	1	1	0.591
22	*	HFB	0	0	0	1	1	1	1	1	1	1	1	1
	*	indicates BOX probability estimates calculated with data from all four quarters, using isotonic regression												
	**	indicates BOXes that are not recruited												

QUARTER 1 PROBABILITY OF DEP LOSS (UPPER VALUE OF 95% C.I.)														
			MONTHS IN THE DEP											
B#			1	2	3	4	5	6	7	8	9	10	11	12
1		SNA	0.329	0.463	0.393	0.16	0.288	0.232	0.191	0.156	0.147	0.153	0.315	0.419
2		GNA	0.357	0.079	0.112	0.139	0.207	0.244	0.27	0.231	0.222	0.296	0.309	0.173
3		SNB	0.228	0.274	0.278	0.193	0.237	0.198	0.153	0.157	0.168	0.193	0.304	0.56
4		GNB	0.06	0.061	0.095	0.134	0.174	0.272	0.215	0.258	0.44	0.247	0.233	0.169
5	••	SN4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6		GN4	0.057	0.083	0.084	0.051	0.165	0.3	0.353	0.274	0.239	0.143	0.143	0.143
7		NNA	0.122	0.185	0.242	0.233	0.21	0.156	0.11	0.054	0	0.282	0.204	0.148
8	•	NNB	0.165	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.165
9		SFA	0.514	0.514	0.618	0.606	0.502	0.395	0.274	0.319	0.284	0.309	0.502	0.689
10		GFA	0.075	0.136	0.195	0.257	0.248	0.417	0.365	0.354	0.517	0.429	0.45	0.206
11	•	SFB	0.753	1	1	1	1	1	1	1	1	1	1	1
12		GFB	0.06	0.128	0.213	0.182	0.268	0.341	0.36	0.348	0.291	0.3	0.14	0
13	••	SF4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	•	GF4	0.106	0.419	0.419	0.419	0.419	1	1	1	1	1	1	0.106
15	•	NFA	0.191	0.191	0.591	0.591	0.661	0.661	0.661	0.661	0.661	0.661	1	0.591
16	•	NFB	0	0	0	0	0	0	0	0	0	0	0	0
17		NFS	0.364	0.08	0.103	0.141	0.219	0.093	0.246	0.279	0.243	0.133	0.218	0.238
18		FFS	0.062	0.129	0.153	0.077	0.131	0.169	0.182	0.249	0.257	0.257	0.255	0.255
19		HNA	0.075	0.068	0.146	0.219	0.247	0.275	0.3	0.207	0.207	0.198	0.236	0.203
20	•	HNB	0.128	0.179	0.179	0.292	0.31	0.31	0.31	0.31	0.31	0.31	0.346	0.346
21	•	HFA	0.167	0.329	0.329	0.369	0.369	0.419	0.419	0.419	1	1	1	0.591
22	•	HFB	0	0	0	1	1	1	1	1	1	1	1	1

• indicates BOX probability estimates calculated with data from all four quarters, using isotonic regression

•• indicates BOXes that are not recruited

QUARTER 3 PROBABILITY OF CEP LOSS UPPER VALUE OF 95% C.I.														
			MONTHS IN THE CEP											
BO			1	2	3	4	5	6	7	8	9	10	11	12
1		SMA	0.243	0.467	0.164	0.132	0.124	0.122	0.12	0.131	0.288	0.359	0.491	0.4
2		GMA	0.058	0.072	0.12	0.17	0.203	0.238	0.21	0.28	0.346	0.376	0.46	0.163
3		SMB	0.24	0.313	0.15	0.127	0.157	0.131	0.108	0.129	0.372	0.496	0.563	0.56
4		GMB	0.062	0.077	0.155	0.173	0.199	0.295	0.291	0.296	0.115	0.333	0.236	0.119
5	**	SM4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6		GM4	0.059	0.096	0.09	0.175	0.068	0.152	0.221	0.226	0.15	0.231	0.231	0.231
7		NMA	0.106	0.298	0.303	0.153	0.14	0.172	0.231	0.343	0.31	0.264	0.099	0
8	*	NMB	0.165	0.177	[illegible]	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.165
9		SFA	0.333	0.333	0.185	0.18	0.223	0.25	0.223	0.345	0.44	0.588	0.762	0.63
10		GFA	0.081	0.134	0.222	0.236	0.319	0.355	0.349	0.526	0.562	0.517	0.366	0.197
11	*	SFB	0.753	1	1	1	1	1	1	1	1	1	1	1
12		GFB	0.079	0.119	0.18	0.346	0.296	0.368	0.478	0.471	0.405	0.216	0.068	0
13	**	SF4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	*	GF4	0.106	0.419	0.419	0.419	0.419	1	1	1	1	1	1	0.106
15	*	NFA	0.191	0.191	0.591	0.591	0.661	0.661	0.661	0.661	0.661	0.661	1	0.591
16	*	NFB	0	0	0	0	0	0	0	0	0	0	0	0
17		NPS	0.059	0.093	0.148	0.143	0.139	0.17	0.219	0.273	0.268	0.28	0.194	0.127
18		FPS	0.093	0.175	0.161	0.18	0.223	0.266	0.267	0.287	0.279	0.172	0.172	0.172
19		HMA	0.058	0.083	0.172	0.222	0.274	0.321	0.233	0.243	0.238	0.3	0.215	0.092
20	*	HMB	0.129	0.179	0.179	0.292	0.31	0.31	0.31	0.31	0.31	0.31	0.346	0.346
21	*	HFA	0.167	0.329	0.329	0.369	0.369	0.419	0.419	0.419	1	1	1	0.591
22	*	HFB	0	0	0	1	1	1	1	1	1	1	1	1

* indicates BOX probability estimates calculated with data from all four quarters, using isotonic regression

** indicates BOXes that are not recruited

QUARTER 3 PROBABILITY OF DEP LOSS (UPPER VALUE OF 95% C.I.)														
			MONTHS IN THE DEP											
B#			1	2	3	4	5	6	7	8	9	10	11	12
1		SNA	0.365	0.132	0.092	0.116	0.097	0.15	0.24	0.257	0.305	0.442	0.381	0.217
2		GNA	0.063	0.086	0.123	0.123	0.122	0.232	0.253	0.295	0.391	0.363	0.464	0.123
3		SNB	0.235	0.125	0.086	0.106	0.113	0.171	0.326	0.318	0.361	0.508	0.617	0.259
4		GNB	0.068	0.075	0.101	0.157	0.176	0.239	0.275	0.371	0.48	0.423	0.252	0.101
5	**	SN4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6		GN4	0.071	0.065	0.109	0.17	0.197	0.252	0.3	0.317	0.349	0.429	0.429	0.429
7		NNA	0.101	0.192	0.351	0.152	0.173	0.278	0.471	0.405	0.405	0.308	0.253	0.203
8	*	NNB	0.165	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.165
9		SFA	0.472	0.241	0.179	0.226	0.233	0.389	0.487	0.478	0.515	0.679	0.712	0.391
10		GFA	0.086	0.172	0.17	0.208	0.228	0.406	0.471	0.489	0.478	0.427	0.668	0.199
11	*	SFB	0.753	1	1	1	1	1	1	1	1	1	1	1
12		GFB	0.079	0.102	0.145	0.155	0.155	0.293	0.227	0.341	0.415	0.444	0.18	0.083
13	**	SF4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	*	GF4	0.106	0.419	0.419	0.419	0.419	1	1	1	1	1	1	0.106
15	*	NFA	0.191	0.191	0.591	0.591	0.661	0.661	0.661	0.661	0.661	0.661	1	0.591
16	*	NFB	0	0	0	0	0	0	0	0	0	0	0	0
17		NPS	0.057	0.126	0.139	0.144	0.165	0.171	0.221	0.317	0.349	0.336	0.271	0.195
18		FPS	0.073	0.126	0.198	0.234	0.302	0.203	0.378	0.366	0.363	0.176	0.176	0.176
19		HNA	0.061	0.14	0.213	0.161	0.222	0.304	0.368	0.417	0.517	0.442	0.412	0.282
20	*	HNB	0.128	0.179	0.179	0.292	0.31	0.31	0.31	0.31	0.31	0.31	0.346	0.346
21	*	HFA	0.167	0.329	0.329	0.369	0.369	0.419	0.419	0.419	1	1	1	0.591
22	*	HFB	0	0	0	1	1	1	1	1	1	1	1	1
	*	indicates BOX probability estimates calculated with data from all four quarters, using isotonic regression												
	**	indicates BOXes that are not recruited												

QUARTER 4 PROBABILITY OF CEP LOSS (UPPER VALUE OF 95% C.I.)														
			MONTHS IN THE CEP											
BO			1	2	3	4	5	6	7	8	9	10	11	12
1		SMA	0.552	0.809	0.298	0.332	0.222	0.243	0.32	0.419	0.294	0.245	0.245	0.204
2		GMA	0.055	0.072	0.107	0.11	0.131	0.2	0.299	0.374	0.434	0.363	0.336	0.124
3		SMB	0.432	0.703	0.711	0.428	0.335	0.375	0.423	0.648	0.414	0.286	0.269	0.251
4		GMB	0.361	0.079	0.104	0.115	0.144	0.245	0.365	0.404	0.417	0.407	0.339	0.089
5	**	SM4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6		GM4	0.084	0.085	0.118	0.197	0.267	0.268	0.28	0.363	0.232	0.221	0.163	0.075
7		NMA	0.136	0.221	0.121	0.262	0.183	0.3	0.452	0.51	0.343	0.198	0.189	0.111
8	*	NMB	0.165	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.165
9		SFA	0.846	0.9	0.779	0.343	0.565	0.39	0.596	0.532	0.443	0.353	0.4	0.418
10		GFA	0.064	0.124	0.177	0.206	0.276	0.35	0.387	0.433	0.552	0.489	0.542	0.214
11	*	SFB	0.753	1	1	1	1	1	1	1	1	1	1	1
12		GFB	0.087	0.112	0.137	0.185	0.27	0.382	0.238	0.259	0.246	0.253	0.146	0.066
13	**	SF4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	*	GF4	0.106	0.419	0.419	0.419	0.419	1	1	1	1	1	1	0.106
15	*	NFA	0.191	0.191	0.591	0.591	0.661	0.661	0.661	0.661	0.661	0.661	1	0.591
16	*	NFB	0	0	0	0	0	0	0	0	0	0	0	0
17		NPS	0.066	0.094	0.126	0.183	0.105	0.204	0.124	0.174	0.177	0.186	0.177	0.134
18		FPS	0.059	0.095	0.191	0.148	0.13	0.203	0.198	0.192	0.158	0	0	0
19		MNA	0.123	0.122	0.159	0.165	0.229	0.479	0.466	0.463	0.49	0.426	0.267	0.17
20	*	MMB	0.128	0.179	0.179	0.292	0.31	0.31	0.31	0.31	0.31	0.31	0.346	0.346
21	*	MFA	0.167	0.329	0.329	0.369	0.369	0.419	0.419	0.419	1	1	1	0.591
22	*	MFB	0	0	0	1	1	1	1	1	1	1	1	1
	*	indicates BOX probability estimates calculated with data from all four quarters, using isotonic regression												
	**	indicates BOXes that are not recruited												

APPENDIX D FORECASTED NETDEP MATRIX

ACCESSION MONTH

BOX	OCTFY1	NOVFY1	DECFY1	JANFY1	FEBFY1	MARFY1
SMA						
GMA	3955	2492				
SMB						
GMB	1703	1952	458	1164	430	
GM4	121	126				
NMA						
NMB						
SFA						
GFA	698	799	133			
SFB						
GFB	300	344	80	189		
GF4	21	7				
NFA						
NFB						
PS	511	317				
HMA	304	348	81	18		
HMB						
HFA	53	45				
HFB						

	APRFY1	MAYFY1	JUNFY1	JULFY1
SMA			3279	133
GMA				
SMB				
GMB				
GM4				
NMA				
NMB				
SFA			560	
GFA				
SFB				
GFB				
GF4				
NFA				
NFB				
PS				
HMA				
HMB				
HFA				
HFB				

APPENDIX E

A. MONTHLY CONTRACT REPORT

BOX	OCTFY1	NOVFY1	DECFY1	JANFY1	FEBFY1
		CONTRACT MONTH			
SMA		4063		4026	
GMA	1146	1951	6384	961	3768
GMB				1	
GM4		1186			
NMA	2648	156			2616
SFA	250	372		575	
GFA	1452			1343	
GFB	889			822	
MONTHLY CONTRACTS	6384	7728	6384	7728	6384
EXPECTED ACCESSIONS	5871	6812	5958	6737	6028
RECRUITER CAPACITY	6384	7728	6384	7728	6384
SHORTFALL					

BOX	MARFY1	APRFY1	MAYFY1	JUNFY1	JULFY1
		CONTRACT MONTH			
SMA			649		
GMA	4666	62	1453		3218
GMB	666	932	5154	6720	130
GM4					1597
NMA	1388				
SFA		251			
GFA		586			760
GFB		359			465
PS		4531	808		214
MONTHLY CONTRACTS	6720	6720	8064	6720	6384
EXPECTED ACCESSIONS	6338	6183	7457	6310	5826
RECRUITER CAPACITY	6720	6720	8064	6720	6384
SHORTFALL					

BOX	CONTRACT MONTH AUGFY1	SEPFY1	BOX TOTAL
SMA	4839		13577
GMA	3561	4510	31680
GMB		1548	15151
GM4			2783
NMA			6808
SFA		326	1774
GFA			4140
GFB			2535
PS			5553
MONTHLY CONTRACTS	8400	6384	
EXPECTED ACCESSIONS	7378	5885	
RECRUITER CAPACITY	8400	6384	
SHORTFALL			

B. **BASIC TRAINING SEAT UTILIZATION REPORT**

ACC MONTH	CONT	ACC	NETDEP	TOT	REQ ACC	# UNF	% FILL
OCTFY1			7666	7666	7666		100
NOVFY1	2598	2424	6430	8854	8784		101
DECFY1	1386	1307	752	2059	2059		100
JANFY1	4117	3870	1371	5241	5241		100
FEBFY1	5958	5529	430	5959	5959		100
MARFY1	4954	4679		4679	4679		100
APRFY1	4666	4400		4400	4400		100
MAYFY1	6203	5808		5808	5808		100
JUNFY1	2757	2515	3839	6354	6354		100
JULFY1	8051	7523	133	7656	7656		100
AUGFY1	8676	8015		8015	8015		100
SEPFY1	10009	8397		8397	8397		100

LEGEND:

ACC MONTH = month contract is programmed to access
CONT = number of new contracts written to mature in a given month
ACC = number of new contracts that are expected to assess in a given month
NETDEP = number of previously written contracts expected to assess in a given month
TOT = total number of new and previously written contracts expected to assess in a given month
REQ ACC = required number of accessions in a given month
UNF = difference between REQ ACC and TOT
% FILL = percent of required accessions expected to achieve

C. FY94 MILITARY SERVICE MIX REPORT

	CONT	ACC	NETDEP	TOTAL	DA MISN
PS	4531	4245	828	5073	5004
NPS	54844	50221	19793	70014	70014

LEGEND:

PS = prior service
NPS = non-prior service
CONT = number of new service category contracts written to mature in FY94
ACC = number of new service category contracts that are expected to assess in FY94
NETDEP = number of previously written service category contracts expected to assess in FY94
TOTAL = total number of new and previously written service category contracts expected to assess in FY94
DA MISN = total number of service category accessions required to assess in FY94

D. **QUALITY AND GENDER MIX REPORT**

CATEGORY	ACC	NETDEP	TOTAL	% ACHVD	% REQUIRED	% SHORT
HSDG	47570	18944	66514	95.00	95.00	
NPS-A	34012	12898	46910	67.00	67.00	
TSC-4	1126	275	1400	2.00	2.00	
FEMALE	7133	3229	10362	14.80	14.80	

ACC = number of new category contracts that are expected to assess in FY94
NETDEP = number of previously written category contracts expected to assess in FY94
TOTAL = total number of new and previously written category contracts expected to assess in FY94
% ACHVD = percent of required category accessions expected to achieve
% REQUIRED = percent of category accessions required to achieve
% SHORT = difference between % REQUIRED and % ACHVD

E. FY94 TO FY95 REPORT

CATEGORY	FY2 ACC	FY1 TO FY2	% ACHVD	% REQ	% SHORT
PS	3001	893	29.75	29.75	
NPS-A	48252	18456	38.25	38.25	
NPS	72017	21425	29.75	29.75	

FY2 ACC = number of FY95 category accessions
FY1 TO FY2 = number of FY94 category contracts expected to access in FY95
% ACHVD = percent of required category FY95 accessions that are contracted in FY94
% REQ = percent of category FY95 accessions required to contract in FY94
% SHORT = difference between % REQUIRED and % ACHVD

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