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AN EVALUATION OF THE PRODUCTION RECUITING INCENTIVE MODEL VS QUOTA-BASED RECRUITING USING MONTE CARLO SIMULATION

by

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December, 1997

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In recent years, the United States Navy has actively sought new and better ways of making the recruiting process more efficient. Towards this end, the Production Recruiting Incentive Model (PRIME) was developed at the Naval Postgraduate School.

This thesis evaluates recruiter production and incentives in the Navy's quota-based recruiting system against the PRIME system using Monte Carlo simulation Techniques in two spreadsheet models. The first spreadsheet model compares three distinct quota scenarios against PRIME in three separate recruiting market conditions. The second model evaluates the two systems as the variance of the recruiting market changes.

This study produces two main findings. First, in all cases, PRIME proves to be a superior recruiting system than its quota-based rival. Second, the simulation quantitatively illustrates the inherent flaws of quota-based recruiting. The author recommends that the Navy replace the current quota-based system with the more efficient PRIME system.

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AN EVALUATION OF THE PRODUCTION RECRUITING INCENTIVE MODEL VS QUOTA-BASED RECRUITING USING MONTE CARLO SIMULATION

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ABSTRACT

In recent years, the United States Navy has actively sought new and better ways of making the recruiting process more efficient. Towards this end, the Production Recruiting Incentive Model (PRIME) was developed at the Naval Postgraduate School.

This Thesis evaluates recruiter production and incentives in the Navy's quota-based recruiting system against the PRIME system using Monte Carlo simulation techniques in two spreadsheet models. The first spreadsheet model compares three distinct quota scenarios against PRIME in three separate recruit market conditions. The second model evaluates the two systems as the variance of the recruit market changes.

This study produces two main findings. First, in all cases, PRIME proves to be a superior recruiting system than its quota-based rival. Second, the simulation quantitatively illustrates the inherent flaws of quota-based recruiting. The author recommends that the Navy replace the current quota-based system with the more efficient PRIME system.

TABLE OF CONTENTS

I. INTRODUCTION

A. GENERAL

The Production Recruiting Incentive Model (PRIME) was first developed in 1993 by Professor Katsuaki Terasawa of the Naval Postgraduate School (NPS). Originally called the Bonus Recruiting Incentive Model, PRIME is a system that incentivizes recruiters to achieve their maximum production levels.

Although it complements the work of former NPS masters students who have explored ways of introducing PRIME into the United States Army Recruiting Command (USAREC), this thesis has taken a new direction. This thesis looks at the Naval Recruiting Command to determine whether PRIME is more efficient and effective in accessing new recruits than the current quota system.

B. OBJECTIVE

The objective of this thesis is to evaluate whether the PRIME system is a more efficient recruiting system than the Navy's current quota-based system by using Monte Carlo computer simulation techniques. This thesis will focus on whether individual and aggregate levels of production increase, under given market conditions, when a PRIME system replaces a quota system. It will also evaluate individual

recruiter incentive levels attained using both systems under identical market conditions. Finally, it will evaluate both systems as the market conditions change.

C. RESEARCH QUESTIONS

1. Primary research question

Will productivity of Navy recruiters increase when using the PRIME system vice the current quota-based system?

2. Secondary research questions

a. Will adopting the PRIME system increase long-term efficiencies in the overall recruiting process as current and reliable information becomes available?

b. What effect would an increase in the variance of the recruiting market have on the performance of PRIME as compared to a quota-based system?

c. What would be the effect on the overall recruiting effort of commands establishing quotas to insure a high probability of mission attainment, and how would this then compare with PRIME?

D. SCOPE AND LIMITATIONS

This thesis will assess the PRIME system as it applies to enlisted recruiting practices in the United States Navy. It will examine studies implementing PRIME within the USAREC during its research. This thesis will not address officer accessions or any tailored recruiting practices of the

Navy's specialty corps, such as the Religious Services, Legal Services, or Medical Service communities. It uses standard data analysis and Monte Carlo techniques in running the computer simulation.

E. METHODOLOGY

This thesis begins by reviewing literature, theses, and other studies conducted in recent years concerning recruiting incentives, quota-based recruiting systems, and the PRIME system. It identifies advantages and disadvantages with the two systems. Next, a PRIME model is constructed and used in computer simulation to evaluate PRIME against different permutations of a quota-based incentive system. This thesis compares production and recruiter incentive levels using computer-generated normalized market data in each of the permutations. The analysis also uses Monte Carlo simulation techniques to compare the two systems while altering the variance of the market data.

F. ORGANIZATION OF THESIS

Chapter I provides a general introduction to this thesis, including scope and limitations, methodology, and thesis organization.

Chapter II provides relevant background information, including the findings from the 1994 General Accounting

Office (GAO) report. It summarizes research conducted by the RAND Corporation and the Center for Naval Analyses (CNA), issues established by the Department of the Navy Organization, Management and Infrastructure Team (DONOMIT), and recent theses written on PRIME and quota-based systems at the Naval Postgraduate School.

Chapter III describes the current quota-based system, including the organization of the Naval Recruiting Command (NRC), the types of recruiters, and the accession process. It also examines the advantages and disadvantages of the quota system.

Chapter IV examines the PRIME system. It includes a detailed discussion of the truth-telling mechanism behind the system, as well as advantages and disadvantages of the model.

Chapter V discusses the computer simulation, including a walk-through of the model, parameter development and underlying assumptions.

Chapter VI analyzes the simulation results.

Chapter VII provides final conclusions and recommendations, including suggestions for further research.

II. BACKGROUND

A. INTRODUCTION

This chapter provides relevant background information to the study. After a general historical overview of the success of military recruiting, this chapter examines a 1994 General Accounting Office (GAO) report presented to Congress on the effectiveness and efficiency of military recruiting.

The chapter then reviews studies conducted by the Center for Naval Analyses (CNA) and the RAND Corporation which discussed recruiter performance, recruiter incentives, and quota systems. Next, the chapter presents research undertaken by former NPS masters students that address the PRIME system or offer conclusions on the viability of quota-based systems. It concludes with a short discussion of the Department of the Navy Organization, Management and Infrastructure Team (DONOMIT) "laundry list" presented to NPS in July 1997. The analysis issues addressed by this group underscore the immediacy and urgency for exploring innovative approaches to the Navy's recruiting process.

The PRIME system is presented in light of this background and current political climate.

B. GENERAL

Since the end of the Vietnam War, the United States military has been an all-volunteer force. As such, each of the military services have established huge recruiting force structures and have developed many comprehensive processes and systems to entice young men and women through their doors. These recruiting organizations have had varying degrees of success in the past quarter century. At the onset, the services were generally successful bringing in volunteers. Towards the end of the 1970's, however, they only achieved 90% of their goals. Congress acted quickly to offer incentives to potential enlistees, including signing bonuses and funding for advanced education. By the mid 1980's, the military recruiters were back on track. In fact, by 1986 all services were at or above their accession goals; recruit quality was at an all-time high.

The end of the Cold War brought down-sizing to the Department of Defense (DOD); with it came reductions in the recruiting industry. Budget levels for recruiting active enlisted personnel dropped from $1.6 billion in 1986 (in constant 1994 dollars) to $1.1 billion in 1994, a drop of almost 31 percent. (GAO, 1994, p. 15)

The size of the recruiting force changed as well. Services cut their recruiter forces by 10% across the board between 1992 and 1994. This cut was in response to

congressional direction. The Navy cuts were a bit more severe than the rest of the services, as illustrated by their initial 17 percent decrease in recruiting personnel. (GAO, 1994, pp. 34-35)

The recruiting budget and recruiter force were not the only things to fall. This period of military downsizing was accompanied by a decrease in the propensity for young adults to enlist in the services. Between 1989 and 1992, the positive propensity to enlist among young adult males fell from 32 percent of the population to 26.6 percent.

Recruiting experts in the services attributed this 17% drop to a variety of reasons, including a decrease in advertising funds, a public perception about the dangers of military service, as well as a belief that budget cuts make the services an unstable career choice. Whatever the cause, the resulting recruiting climate involves fewer recruiters, working with smaller budgets, finding customers who are more disillusioned than ever before. (GAO, 1994, p. 27)

The austere recruiting climate was particularly troublesome for the Navy. Pry (1996) observes that from fiscal year (FY) 1990 to FY 1995, the Naval Recruiting Command made its overall accession target in only four of six years. Furthermore, the percentage of recruiting districts that met their directed goals fell from 65% in FY

1990 to less than 20% in FY 1995. His findings are illustrated in Figure 2-1. (Pry, 1996, pp. 21-22)

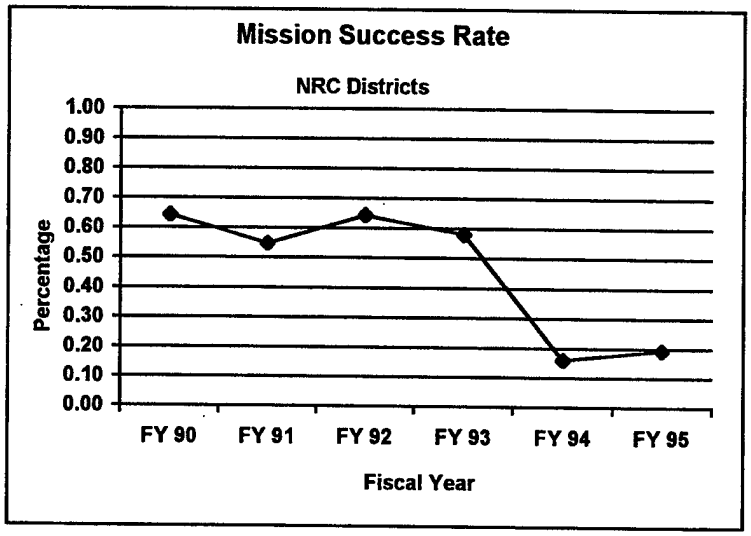

Figure 2-1
Mission Success Rate For NRC Districts
(Source: Pry, 1996 p.22)

C. GAO REPORT

In response to a request from Senator David Pryor, D-AK, the GAO published a December 1994 study of military recruiting operations. This study identified areas where the DOD could reduce its recruiting costs without adversely affecting its ability to meet military personnel requirements. The GAO report found that the quota system artificially constrains the total number of potential enlistees a recruiter can sign to contracts. Overproduction

is not rewarded and, in fact, could be negatively reinforced through an increase in future assigned quotas.

A higher quota in subsequent periods is bad for two reasons. First, it increases the recruiter's workload with no change in production deadlines. Second, it increases the possibility of not attaining the quota, which could have further negative consequences. The recruiters' performance evaluations are usually tied directly to their ability to make their quota. It is entirely possible, in the current recruiting system, that overproduction could be a career-damaging mistake. GAO thusly concluded that the effects of the quota system, coupled with historical performance data, suggest that current recruiter production levels could be higher (GAO, 1994, p. 36).

The study also found that the "DOD may not be maximizing the cost-effectiveness of its recruiting resources." One specific area that stood out was the geographic dispersion of its 6,000 recruiting offices throughout the country. Noting that "50 percent of these offices provide just 13.5 percent of the recruits," GAO recommended further study of how the military allocates its resources. (GAO, 1994, p. 3)

GAO further noted that the services shrank the size of the recruiting force in response to congressional direction in 1992. However, some of the services, including the Navy,

plan to increase the force in the near future to meet recruiting goals. GAO disagreed with this increase. Rather, it concluded that the relationship between accessions and recruiters cannot be determined due to the quota system (GAO, 1994 p. 36). It recommended that the services "revalidate the recruiting quota systems, which currently deter recruiters from maximizing the numbers of enlistments" (GAO, 1994, p. 53).

D. RAND CORPORATION STUDIES

The RAND Corporation has published studies that have attacked the viability of quota-based incentive systems. Dertouzos (1985), one of the first to analyze how the quota system negatively affects recruiters' incentives, reached conclusions that were almost identical to those of GAO almost a decade later. He stated:

> Although recruiter success and subsequent promotion depends on production relative to quota allocations, the rewards for overproduction may not, for a variety of reasons, be sufficient to induce maximum effort at all times..... Indeed preliminary evidence suggests that there may even exist disincentives to produce. (Dertouzos, 1985, p. 15)

Asch conducted several studies of the quota-based incentive programs, looking all the way back to the initiation of the Freeman Plan in the 1970's. She concluded that these incentive programs are not bringing about the desired recruiter behavior. As the recruiters "game" the

incentive system, they are not maximizing productivity. (Asch, 1990, pp. iii-ix)

Orvis and Asch (1997) analyzed recent recruiting trends and their implications. They concluded that recruiter effectiveness in accessing recruits has declined and that this trend is likely to continue for the near future. They recommended increasing recruiting resources to meet accession requirements. Additionally, they recommended rethinking recruiting management to "seek ways to enhance cost-effectiveness of recruiting in a post-drawdown environment." (Orvis and Asch, 1997, pp. 43-48)

E. CENTER FOR NAVAL ANALYSES STUDIES

The Center for Naval Analyses has conducted many studies into the field of recruiting that complement the GAO's conclusions. For example, Cymrot (1995) studied recruit quality and attrition trends in the Navy. Although he did not focus on incentive issues, he did analyze how resource allocation effects the degree to which new recruits attrite. He acknowledged that, given the present way of doing business in today's recruiting environment "with limited resources, a high recruiting requirement may not be achievable." (Cymrot, 1995, p. 1) This implies that the current allocation of resources can adversely affect the Navy's recruiting process. If the allocation process could be improved, the overall recruiting effort would benefit.

Cooke has published several studies in the past decade on the Delayed Entry Program, seasonal recruiting patterns, first-term attrition, and the Success Chances for Recruits Entering the Navy (SCREEN) program. A general theme throughout all of his work is that a favorable recruiting environment is directly related to a favorable retention environment. (Cooke, 1988, p. 34)

The correlation between the recruiting environment and retention underscores the importance of reliable recruiting market information. Simply put, the more reliable and accurate the market data, the easier it becomes to have a successful recruiting environment; this improves the retention environment. The implications of these second and third order relationships for the quota system make it even more imperative to adopt GAO's recommendations quickly. The longer the Navy employs a sub-optimal system, the greater the negative ramifications in the near and long-term.

F. NAVAL POSTGRADUATE SCHOOL STUDIES

Masters students at NPS have been the only source of research into the PRIME system. In addition to PRIME, they have studied the effects of existing quota systems and incentive mechanisms, with particular emphasis on the USAREC.

Barfield (1993) studied Navy recruiter productivity and incentive programs, including the Freeman Plan, The

Recruiter Advancement Through Excellence (RATE) program, and the Recruiter Excellence Incentive Program (REIP). She concluded that all three plans provide short-term incentives, but are inadequate for the challenge of today's recruiting environment. (Barfield, 1993, p. 20) In short, the incentives offered to new Navy recruits are insufficient to help recruiters reach their accession targets. Therefore, systematic change is required.

Lyons and Riester (1993) studied the USAREC quota-based recruiting process. Under a quota-based system, the recruiters have little incentive to exceed their quota. Lyons and Riester found that recruiters exhibit risk-averse behavior in performing their duty. They concluded that a quota system produces resource allocation inefficiencies. They suggested that the PRIME system could help solve the inefficiencies in USAREC's system. They recommended developing analytical procedures to test the model in a USAREC recruiting region.

O'Donnell (1996) built upon the work of Lyons and Riester. He, too, studied the way the PRIME model could improve the efficiency of the USAREC recruiting process. He offered a methodology for implementing PRIME into USAREC at the battalion level. Furthermore, he proposed a method to integrate PRIME incentive points with the recruit categories established in USAREC's "Success 2000" plan.

Pry (1996) analyzed the Navy's quota based system. He examined historical data and Navy recruiting trends from FY 1990 to FY 1995. He also compared human behavior patterns in the Navy against current organizational management theory. He concluded that successful private sector business management philosophy does not subscribe to quota-based production concepts. Furthermore, he concluded that the PRIME system embraces a management style helps maintain a competitive advantage; therefore, it is a more viable human resource strategy. Such a strategy would lead to greater successes across the entire recruiting spectrum. (Pry, 1996, p. 19)

Anderson and Whitaker (1994) addressed the feasibility of monetary incentives within the USAREC. They conducted field surveys of the USAREC recruiter force. The surveys concluded that recruiters would be more responsive to a PRIME system than the current quota system.

G. DONOMIT ISSUES

The Department of the Navy has been very proactive in improving the recruiting process. In April of 1997, DONOMIT published a comprehensive list of specific areas in which the Navy could improve their business practices. Analysis plans were formulated around each of the improvement areas. One such plan was to address recruiting issues.

One particular issue was the contention that recruiter incentives are not performance based. Using a long-term timeline, they hope to analyze whether performance based incentives will improve results; eventually, they plan to implement a pilot program to evaluate performance based incentives. (DONOMIT, 1997, p. 39)

This thesis applauds DONOMIT's effort to follow up on conclusions from previous studies and GAO's report. The analytical concerns addressed by this group underscore the immediacy and urgency for exploring innovative approaches, like PRIME.

H. SUMMARY

Many past studies, from a variety of research bodies, point to the need for more effective ways to recruit new enlistees into both the military in general, and the Navy in particular. Together with the austere, post-Cold War fiscal environment, these research projects have emphasized re-examining the quota-based recruiting system and the processes by which this system impedes recruiter productivity. Research performed by NPS students and faculty in this area justifies the Navy's interest in pursuing PRIME as an alternative to the quota system.

III. THE QUOTA SYSTEM

A. INTRODUCTION

This chapter discusses the Navy's current recruiting process and quota system. It describes today's recruiting environment, and discusses the Naval Recruiting Command's organizational structure. After explaining how the current quota system works, it concludes by examining the quota system's advantages and disadvantages.

B. GENERAL

Since the end of the Cold War, the size of the active duty Navy has decreased from almost 600,000 personnel in 1990 to just over 400,000 in 1997. The forecast is for reductions continuing over the next few years and then leveling off at the start of the next century. (DON Biennial Budget, 1997, p. 2-12)

Figure 3-1 graphically displays active duty Navy end-strength through fiscal year 2003.

Although the total force is shrinking, the demands on the recruiting system are not. The total requirements for Navy accessions remains almost 50,000 per year.

Figure 3-2 compares the total enlisted end strength to the total accession requirement for FY 1996 through FY 1999. (DON Biennial Budget p. 2-13)

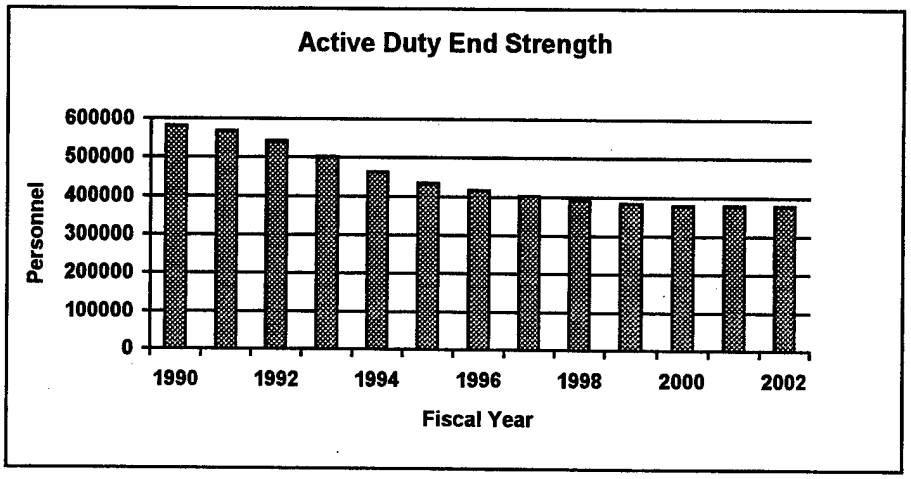

Figure 3-1
Active Duty End-Strength
(Source: DON Biennial Budget, FY97-98, p. 2-12)

	FY 1996	FY 1997	FY 1998	FY 1999
Enlisted End-Strength	355,048	341,748	331,107	325,880
Total Accessions	40,840	48,189	47,666	47,630

Figure 3-2
Comparison of Enlisted End-Strength
to Total Accessions
(Source: DON Biennial Budget, FY97-98, p2-13)

C. ORGANIZATIONAL STRUCTURE

The admiral in charge of the Navy's recruiting system is the Commander, Navy Recruiting Command (CNRC). CNRC's headquarters is situated in Arlington, Virginia; it is scheduled to move to Memphis, Tennessee in fiscal year 1999. CNRC divides the country into four Recruiting Areas

(scheduled for disestablishment). The Recruiting Areas are further divided into 31 Recruiting Districts, almost 200 Recruiting Zones and approximately 1400 Recruiting Stations. Additionally, there are Recruiting Districts operating outside the contiguous 48 states in Great Britain, Germany, Puerto Rico, Alaska, Hawaii, and Guam.

There are three types of recruiters located at the lowest levels of the organization. They are career recruiters, enlisted production recruiters, and specialized program recruiters.

Career recruiters are men and women who have spent most of their careers in the recruiting field. As full-time recruiters assigned to leadership positions throughout the organization, these senior enlisted personnel fulfill two functions: (1) train and assist the production recruiters; (2) bring cohesion and stability to the organization. There are approximately 550 career recruiters throughout CNRC.

Enlisted production recruiters are the primary source for enlisting new recruits into the Navy. They are men and women who do most of the grunt work that goes into accessing prospective recruits. There are approximately 3500 enlisted production recruiters in the organization.

Specialized program recruiters are personnel who are only temporarily assigned to recruiting duties. After completing their duty, they return to the normal career

tracks of their communities or ratings. The number of specialized program recruiters is constantly changing. Many recruiting commands feel that these people are an essential element of a successful recruiting campaign. They bring fresh "operational perspectives" to the organization and prospective recruits.

D. CURRENT RECRUITING PROCESS

The Navy's recruiting process starts when the Bureau of Personnel, Accession Policy Division, establishes a total number of accessions for the next fiscal year. This target is sent to CNRC, who derives the new contract objective for each of the Areas and Districts. The Area commands may use CNRC's recommended District quotas, or modify them to reflect the number of recruiters in the District, their assessment of the District's markets, and the District's past performance.

The Districts, in turn, disseminate their quotas to the Zones, using a computer application called Standardized Territory Evaluation Analysis Management (STEAM). The Zones use STEAM to set quotas for the Stations.

On the lowest levels, the accession process begins with the recruiter "prospecting" the market through various means to contact potential recruits. Prospecting is very resource intensive, usually requiring substantial time and money.

Once an applicant is found, the recruiter determines if the potential recruit can meet the Basic Enlistment Eligibility Requirements (also known as BEERS). If the BEERS are met, the applicant is sent to a Military Entrance Processing Station (MEPS) to undergo physical, mental, and oral testing. Once these tests are satisfied, the applicant enters into the Personalized Recruiting for Immediate and Delayed Enlistment (PRIDE) system. A very small percentage of recruits immediately fill a school opening, the vast majority enter into the Delayed Entry Program (DEP).

The Delayed Entry Program coordinates the recruit accession process with the recruit training process. An applicant enlists in the DEP while waiting for a seat in the Navy's basic training school: The Recruit Training Command (RTC) in Great Lakes, Illinois. This wait can sometimes take the better part of a year. In the meantime, the recruits are monitored by the recruiting office that signed them. If recruits fail to enter RTC, they are counted as "DEP losses". Since DEP losses waste recruiting resources, recruiting commands spend considerable time and effort ensuing the recruits ship out to RTC. Once the new enlistees arrive in RTC, the recruiter's obligation is over.

E. ADVANTAGES AND DISADVANTAGES OF A QUOTA SYSTEM

1. Advantages

There are not many advantages to quota systems in today's recruiting environment. A quota system often seems to be an effective way of scheduling and measuring production, especially when there is no other way of doing so. This was the was the case in the early 1970's. When the Navy started using the quota system, there was an immediate and urgent need to access many recruits. The quota system seemed to fit that need. There wasn't any reason to believe the system would be inefficient.

As the years went on, the Navy became more familiar with the quota system and, consequently, more comfortable also. Today these advantages remain:

a. Performance can be easily measured on an organizational and individual level.

b. It is easy to tie incentives to the quota system. It is also easy to plan on the amounts and types of incentives that will be administered.

c. It is easy to hold people accountable for their action or inaction. Either recruiters make their quotas or they don't. A command that doesn't make its mission can clearly identify the culprits. The "non-performers" cannot hide behind the successes of the "performers".

d. Goal-setting is a comfortable "fit" with a directive, machine-like management style that most Navy policymakers embrace. Upper management directs the system from above, rather than relying on the expertise of people several layers below them.

e. Quota systems allow upper management to be very specific in their requirements, yet permit middle management the flexibility to tailor the system to their unique management styles. Many different management plans can achieve the same objectives. For instance, the incentive plan for one Recruiting Station with historically high production levels, could be quite different from a Station that has historically low production levels.

2. Disadvantages

In contrast to the few advantages, a quota system has many disadvantages:

a. Quotas are set using historical data that, at best, approximate market conditions.

b. Assigning quotas equitably among commands and recruiters is very difficult. Regional markets and manpower resources can change quite rapidly. An initially fair quota allocation could quickly become unobtainable.

c. To ensure that they will be able to satisfy the quota imposed on them, each layer in the recruiting command hierarchy tends to over-inflate the requirements on

their subordinates. As a result, the Recruiting Stations' aggregate accession target can be significantly higher than the aggregate total set by CNRC.

d. The people who best know the market, namely the recruiters, play a limited and indirect role in establishing the quotas.

There are further disadvantages to quota systems that are a result of being tied to the Navy's reward structure:

a. The potential penalties for missing quotas (i.e. a poor fitness report or evaluation, increased peer pressure, increased demands in subsequent periods) are more significant than the reward for exceeding quotas. This creates a risk-averse working environment, and promotes risk-averse behavior.

b. Since the penalty for missing the quota is so great, there is strong pressure to lower quotas. As shown later in the simulation, lowering a quota increases the probability of success, but reduces total accessions.

c. Since historical performance is used to determine future quotas, recruiters are encouraged to pace their recruiting efforts. Recruiters who exceed their quota in one or more periods, face a significant probability of having their quota increased in subsequent periods. This would require increased effort with the same resources, and increase the probability of not achieving the mission. As a

result, after recruiters achieve quota in a period, they tend to "hip-pocket" the excess potential recruits to shift them to the next period.

d. Recruiters are not measured on how well they maximize their market potential. Consequently, reliable feedback on market potential never makes it back up the chain of command. Lyons and Riester (1993) summarize the negative effects of this situation:

> In this risk-averse environment, there is no incentive to surpass quotas from month to month regardless of a market's true potential. Unfortunately, in the process, valuable field information that could reduce aggregate recruiting costs is used only to help the recruiter in reducing his own quota. As a result, the biased information in turn unnecessarily lowers the perceived ability of recruiting and distorts management's view of actual regional market potential. Therefore, if the national aggregate total is to be met, it can only be accomplished through higher recruiting expenditures, which might not actually be necessary if the original recruiting structure were more efficient. (Lyons and Riester, 1993, p. 52)

e. There is no mechanism to ensure that recruiters working different markets are rewarded equitably for success or effort. In other words, recruiters achieving a quota of three in one Recruiting Station can reap the same reward as recruiters who match a quota of five in another Station. Similarly, recruiters meeting their quota can receive the same reward even if meeting the goals require drastically different effort levels.

F. SUMMARY

The Navy's quota-based recruiting system has been around for a quarter century. Although it accomplished its aim for the first fifteen years, austere budget conditions in the last decade have accentuated the system's inefficiencies. The quota system promotes risk-averse behavior, and does not maximize the potential of either the recruiter or the market. Furthermore, without reliable market information travelling up the chain of command, resources are allocated inefficiently throughout the system.

IV. THE PRIME SYSTEM

A. INTRODUCTION

This chapter presents the Production Recruiting Incentive Model (PRIME) system. It begins with a short background discussion of PRIME. This is followed by a presentation of the system's mechanics. The chapter concludes by addressing the advantages and disadvantages of PRIME.

B. BACKGROUND

PRIME was developed in 1993 at the Naval Postgraduate School by Professor Katsuaki Terasawa. Originally called the Bonus Incentive Recruiting Model (BIRM), it was offered as an alternative to the USAREC's inefficient quota system.

The basic idea underlying PRIME is as simple as it is radical from current recruiting philosophy: local market recruiters have the best understanding of how much production they are able to achieve in any given period. This level of production is a function of the local market conditions as well as their personal capabilities (i.e. knowledge, experience, ability to use available resources, etc). The local market conditions are not just the historical perspective of industry trends and the cyclic

nature of the market, but also encompass the socio-economic factors on a small, local scale.

In PRIME, the recruiters set their own production targets based on their knowledge of the market. The recruiters' production levels will sum to become the Recruiting Station's production which will sum to the Zone's level and so on. While recruit production is being achieved, PRIME will also afford exceptionally accurate market data on which CNRC can allocate its resources. This is achieved by statistically analyzing the recruiter's ability to attain his forecast production levels.

C. MECHANICS OF PRIME

At the core of PRIME is an efficiency-enhancing, truth-telling mechanism that also functions as a incentive point allocation system. This mechanism is considered efficiency-enhancing because it forces a recruiter to predict how many new recruits he can access in a period. If the recruiter actually achieves his forecasted total, he receives the maximum number of incentive points available. Therefore, it is in the recruiter's best interest to accurately forecast and produce the maximum number of recruits that the market can bear.

Figure 4-1 is an example of a PRIME efficiency-enhancing, truth-telling mechanism. It is also the

incentive points matrix that will be used in the computer simulation.

		FORECAST										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
P	**1**	**10**	9	8	7	6	5	4	3	2	1	0
R	**2**	12	**20**	12	11	10	9	8	7	6	5	4
O	**3**	15	24	**35**	24	15	14	13	12	11	10	9
D	**4**	19	29	41	**55**	41	29	19	18	17	16	15
U	**5**	24	35	48	63	**80**	63	48	35	24	23	22
C	**6**	30	42	56	72	90	**110**	90	72	56	42	30
T	**7**	37	50	65	82	101	122	**145**	122	101	82	65
I	**8**	45	59	75	93	113	135	159	**185**	159	135	113
O	**9**	54	69	86	105	126	149	174	201	**230**	201	174
N	**10**	64	80	98	118	140	164	190	218	248	**280**	248
	11	75	92	111	132	155	180	207	236	267	300	**335**

Figure 4-1
PRIME Incentive Point Matrix

The two variables in this grid are Production and Forecast totals. The production total is the amount of new recruits that are produced in a particular period (i.e. signed to a contract). The range of possible production values is from 1 to 11, as shown in the first column of boldface numbers on the left side of the matrix.

The forecast total is the number of new recruits the recruiter expects to produce in a given period. The range of possible forecast values is also 1 to 11, as shown in the first row of boldface numbers across the top of the matrix.

Reading down the columns and across the rows, one is able to see the different point totals that can be earned given the particular forecast and production totals. For instance, a recruiter forecasting a production of six recruits and producing seven will earn 122 points. Similarly, a recruiter who forecasts eight recruits, but only produces five, would earn 35 points.

There are two reasons why this device is considered "truth-telling". First, given a particular forecast, a recruiter will always earn the most points by recruiting as many people in a period as possible. Therefore, there is no reason to hold back from maximum production. For example, a recruiter forecasting a production of four and producing four, earns 55 points. However, he picks up an extra 8 points by producing five recruits, for a total of 63. Conversely, if he only produces three, he "loses" 29 points, for a total of only 24.

Second, a recruiter will also gain more points by forecasting as closely as possible the maximum amount of recruits he and the market can produce. For example, suppose the market can provide five recruits, but the recruiter believes it will only have four. By forecasting and producing four, the recruiter earns 55 points. By forecasting four and producing five the recruiter earns 63

points. However, by forecasting five and producing five, the recruiter earns the maximum 80 points.

Whenever there is a disparity between forecast and production totals, the recruiter can determine the opportunity loss of that disparity. In the above scenario, where the recruiter forecasts four yet produces only three, the recruiter is rewarded for actual production, but also incurs an "opportunity loss" for being off the forecast. If the forecast was in error (which implies the recruiter produced everything possible given both market and personal constraints), the opportunity loss is 11 points. The recruiter would have earned 35 points by correctly forecasting three. If the forecast was accurate (which implies the recruiter could have made the target), but production suffered inexplicably, the opportunity loss is 29.

Truth-telling forces are also at work when production exceeds the forecast. If the recruiter forecasts four and produces five, there is also an opportunity cost. In this scenario, because the forecast was in error the recruiter earns a total of 63 points, in instead of the 80 potentially earned with a more accurate prediction. This results in an opportunity loss of 17 points.

Assuming that a recruiter will try to maximize total expected incentive points (or minimize the opportunity

loss), this mechanism will encourage the recruiter to do his best in both forecasting and production. The farther he can move towards the lower right-hand corner of the matrix, the better off he will be. For this reason, the mechanism is considered to be "efficiency-enhancing" as well.

D. ADVANTAGES AND DISADVANTAGES OF PRIME

1. Advantages

There are many advantages to the PRIME system. Some of these are the same as the advantages of a quota system:

a. Performance can be easily measured on an organizational and individual level.

b. PRIME marries well with any incentive system, is very flexible, and can be modified as the need arises. When there is a fixed reward to allocate among all members of a command (for example, a specific number of liberty days), it is easy to convert incentive points to percentages of the reward.

c. PRIME permits CNRC to be very specific in setting and modifying overall accession requirements. It is very capable of maintaining quality marks (Anderson and Whitaker, 1994, pp. 28-30).

There are other advantages that are not found in quota systems. Some of those address deficiencies of the quota system.

a. There are no disincentives to production. Excess production is rewarded. Producing at low levels is also rewarded because low production is usually due to market conditions or factors outside the recruiter's control.

b. PRIME rewards good production and good forecasting. By doing so, it places value on correctly determining market conditions. It does not rely on inaccurate historical algorithms or census data to measure market potential. Data and economic decision-making are more up-to-date and useful.

c. Good forecasting permits a more efficient allocation of resources. The senior leaders can use the better information to improve how they distribute money, people, and support services.

d. It is very easy to identify people who might be in need of further training or additional resources. Disparities among recruiters working the same local market would stand out.

e. PRIME reduces, if not eliminates, the tendency to "hip-pocket" recruits from period to period. There is no pressure from above to produce as much in one period as was produced in the last.

2. Disadvantages

The only disadvantage to PRIME is that it must replace an archaic system that has a long tradition. Replacing the current system requires an implementation strategy which makes the transition painless. There cannot be any drop-off in current productivity during this change. This is an issue that must be researched and developed.

E. SUMMARY

The PRIME system maximizes a recruiters ability to forecast and produce in a given market condition. By combining forecasting with production, it proves to be both truth-telling and efficiency enhancing. These two qualities not only ensure that a high level of recruit accession is achieved, but also that superior market information is delivered up the chain of command. This information can assist in resource allocation decision-making.

The advantages of a PRIME system are numerous. They encompass most of the advantages of a quota system and address its disadvantages. As a result, PRIME is a more efficient and effective means of recruiting than the current quota-based system.

V. COMPUTER SIMULATION

A. INTRODUCTION

This chapter evaluates the PRIME system against the quota system using two simulation models. After a general overview, the first model is presented and its parameters and assumptions discussed. Then, the three scenarios the model compares are explained.

Next, the second model is presented and its parameters and assumptions discussed. Finally, the model's two runs are explained.

B. GENERAL OVERVIEW

Both computer simulation models use Monte Carlo random number generation around normal distributions to represent a hypothetical recruiting market. All simulation results include 5000 trials using Microsoft Excel's Crystal Ball program.

The first model was constructed to evaluate recruiter performance and incentive awards in both the PRIME and the quota systems, using identical market conditions. Three quota scenarios were developed to approximate three general recruiting environments. The recruiting environment affects the way a command performs under alternative incentive schemes. All three quota scenarios were evaluated against

PRIME on three separate runs. Using three runs helps eliminate the possibility that the overall results were unique to a particular market condition.

The second model evaluated the quota system against PRIME as the market variance increases. Whereas the first model analyzed market conditions that could affect a Recruiting Station, the second model looked at market conditions that a Recruiting Zone might face. Two distinct runs were conducted to evaluate different managerial approaches to establishing the target quota. The first run set the quota close to the market average; the second run established the quota at a value covered by the market 90% of the time.

C. FIRST MODEL SIMULATION

The first model compared three permutations of a quota system against a PRIME system under three separate market conditions. Specifically, it studied production and incentive points in each of the three quota system scenarios against PRIME production and incentive points, given the identical market conditions.

Appendix A shows a detailed spreadsheet representation of this model.

1. Parameters and Assumptions

The quota scenarios and the PRIME system were evaluated under the following parameters and assumptions:

a. A time interval including 36 periods. This is comparable to monthly reporting periods over a three year horizon.

b. No seasonality or cyclical trends in market conditions. Although these trends are present in real-world market conditions, they were assumed to be non-existent in the model's market.

c. Market conditions were constructed using Monte Carlo random number generation from a normal distribution. The first run used a normal distribution with a mean of six recruit accessions per period and a standard deviation of one. The second and third runs used a mean of seven recruit accessions per period and a standard deviation of two.

d. The normal quota for all three scenarios on the first two runs was five. This value was derived using the inverse of the normal cumulative distribution for both sets of market conditions. In each case, a value of five equates to an 85 percent confidence level. In other words, 85 percent of the time the market will yield more than five recruit accessions per period.

e. On the third run, the normal quota was set at six. This meant that there was only a 70 percent probability that the unadjusted market conditions would cover the quota. Therefore, it accentuates the behavioral patterns of the recruiters in the three scenarios.

f. Each period the market potential was adjusted to reflect a "carry-over" of unsigned recruits from the previous period. In this model, the number of recruits carried over assumed a 50 percent loss rate. For example, if four potential recruits were not signed from the previous period's market, two of these would "carry-over" and be added to the next period's unadjusted market conditions.

g. The penalty for "hip-pocketing" recruits (intentionally not signing a recruit in one period to use that recruit against the next period's quota) was the same as the carry-over loss rate. There was a 50-50 chance that delayed accession recruits would change their minds and not enlist in the Navy.

h. PRIME points were awarded using the same truth-telling incentive point matrix explained in the last chapter. Figure 4-1 illustrates this mechanism.

i. Quota incentive points were established to reflect the point values given in PRIME. The baseline used to equate the two systems was the average market condition established in each run. For example, meeting quota earned 110 points in the first run. This was the identical value one would receive under PRIME when forecasting and producing the market average of six recruits. In the second and third runs, the market average was seven. This corresponded to

145 incentive points on the PRIME matrix. Therefore, meeting quota also earned the recruiter 145 points.

j. Point values for exceeding quota were derived using the same matrix. In both cases, exceeding quota earned a point total that reflected moving up one level in PRIME. In the first run, exceeding quota earned 35 additional points. This equaled the increase the recruiter would earn in PRIME forecasting and producing seven recruits vice six. In the second and third runs, moving from a forecast and production level of seven to eight would increase points by 40 on the PRIME matrix (145 to 185). Therefore, exceeding quota on these runs also earned an additional 40 points for the recruiter. In the quota system, it did not matter how much the recruiter exceeded quota, the maximum additional point values were 35 or 40, depending on the run.

k. Not meeting quota earned zero points in all three runs. It did not matter how close the recruiter got to the target, missing by one was equivalent to falling short by several.

l. The recruiter, in all three quota scenarios, does not know the market variance. Normally, if a rational recruiter knew the variance of his market, it would be reasonable to expect him to behave accordingly. For example, if the recruiter knew that the market variance was

small and his target quota was below the market mean, then he would know there was a high probability that the market would deliver that specific value in the next period. This high probability would factor greatly into the amount of risk he would face in a given period, and consequently influence his behavior.

2. Scenario "A"

In scenario A, the command adjusted the recruiter's quota up (or down) if they observed a two period trend where accessions were above (or below) the recruiter's quota. For example, if the recruiter produced six recruits during periods one and two when its quota was five, his quota was adjusted to six the following period. The goal then remained at six until another trend was established. Conversely, if the recruiter produced only four for two periods given a quota of five, then the subsequent adjusted quota would drop by one recruit from five to four.

The recruiter's response, in this scenario, was to maximize points without increasing the next period's quota. The recruiter's performance depended on the points earned the previous period. For example, if bonus points were awarded in the previous period for exceeding quota, he would simply try to meet the adjusted quota in the current period. However, if he met or fell short of his quota in the

previous period, then it would be desirable to exceed the quota by one in the current period.

This scenario illustrated a very proactive management philosophy, where strong performance was amply rewarded but also resulted in greater expectations. The recruiter's response implied that the point system was an effective means for influencing the recruiter's behavior.

3. Scenario "B"

In scenario B, the command was even more proactive in restructuring the recruiter's quota to match production than it was in scenario A. Not only did it increase the normal quota if the two previous periods production exceeded goals, it also added any shortfalls in previous production to the current adjusted quota level. Furthermore, there was no downward adjustment for under-productive trends.

For example, if the recruiter produced only four recruits in the first period given a quota of five, then his quota was adjusted to six in the second period. If the second period's production was five, then period three's quota went up to seven. On the other hand, if period two's production was six (or seven), then period three's adjusted quota would revert to five again.

This scenario simulated a more aggressive management philosophy than in scenario A. Here, failure was not tolerated. Shortfalls in production today meant even more

was expected tomorrow. The fact that shortfalls may have been attributed to market conditions was irrelevant; all shortfalls carried the same consequences, whether for market conditions or having an inexperienced recruiter corps.

It is easy to imagine a risk-averse response to this environment. A risk-averse recruiter would try to meet the quota and "hip-pocket" all excess potential recruits. He would sacrifice this period's performance to heighten the probability of attaining the next period's quota. However, behavior in this scenario was the same as in scenario A. The recruiter tried to maximize points without increasing next period's quota.

4. Scenario "C"

In scenario C, the recruiting command was not proactive in restructuring the recruiter's quota to match production. Here, the recruiter's previous shortfalls were <u>not</u> added to the current period. Furthermore, upper management had no stated policy on overproduction or underproduction trends. They were more concerned with quota production over the long-term. For instance, if a recruiter produced four recruits in the first period when the quota was five, the next period's quota stayed at five. If period two's production was four recruits, period three's quota was still five.

This managerial approach implied a confidence in the historical quota setting process. The heads of the recruiting organization were confident that the system would operate effectively over the long-term.

Nonetheless, the recruiter still had a sense that the quota could increase if they overproduced; this belief helped guide recruiter behavior. In this scenario, the recruiter's response maximized points provided that production didn't exceed the cumulative quota totals. In this regard, incentive points were used to bring the recruiter back on track, and not to get ahead. For example, if the recruiter produced two recruits in the first period given a quota of five, then he would try to produce six recruits in periods two through four.

This scenario illustrated behavior that was consistent with a command that believed it was operating with limited resources that would be over-taxed if higher quota goals were assigned.

D. SECOND MODEL SIMULATION

The second model compared PRIME with a quota-based system as the variance of the market conditions changed. This model focused only on production, and not on incentive points. It included two runs using separate methods for establishing quotas.

1. Parameters and Assumptions

Both runs had the following parameters and assumptions:

a. A time span covering 36 periods to simulate monthly reporting periods over a three year horizon.

b. No seasonality or cyclical trends built into the market conditions.

c. Market conditions were constructed using Monte Carlo random number generation from a normal distribution around a mean of 100. The standard deviation was increased in each scenario by increments of five, starting at five and ending at 30.

d. In each scenario, the market potential was adjusted to reflect a carryover of unsigned potential recruits from the previous period. Like the first model, the adjustment assumed a 50 percent loss rate to encompass attrition, including the practice of "hip-pocketing".

e. With no incentives to complicate the process, the Zone commands tried to meet production and not exceed it. If the adjusted market potential was at or above the target quota, then production equaled the quota. If the adjusted market potential was below the target quota, then production equaled the adjusted market potential.

f. The main metric under evaluation was the loss in production. Loss was measured as the difference between production and the actual (unadjusted) market potential.

Because this unadjusted market potential was where PRIME production would occur, this loss also measured PRIME against the quota-system.

2. Run "A"

In run A, the assigned quota for all six scenarios was kept near the market mean, using a target of 90 recruits. Appendix B shows a detailed spreadsheet representation of this run.

3. Run "B"

In run B, the quota was changed in each of the six scenarios. The quota was set to a value that would be met under unadjusted market conditions at least 90% of the time. As the market variance increased, the target quota decreased to ensure a 90% success rate for the command. The target quota was derived using the inverse of the normal cumulative distribution for each of the six market conditions. Figure 5-1 shows the relationship of the quota to market conditions. Appendix C shows a spreadsheet representation of this run.

Standard Deviation Pop Mean of 100	Quota for 90% Success
5	93.592
10	87.184
15	80.776
20	74.369
25	67.961
30	61.553

Figure 5-1
Determination of Market Quota

VI. SIMULATION RESULTS AND ANALYSIS

A. INTRODUCTION

This chapter presents and analyzes the computer simulation results. It begins by looking at the first model's production results and incentive points for each of the three runs. Next, it analyzes PRIME's performance in each scenario. This is followed by an overall production and incentive analysis. The last segment of this chapter presents and analyzes the second model's results.

B. FIRST MODEL RESULTS

1. Production

Figure 6-1 shows the production results of the three runs.

On the first run, PRIME produced an average of 216.08 recruits over the 36 month span. The range of production went from a low of 192 to a high of 235. These values were all greater than any of the three quota system scenarios. Scenario A returned an average of 194.97 recruits with a low of 161 and a high of 198. Scenario B returned the highest mean of the three quota scenarios at 196.75 recruits, with a low of 188 and a high of 198. Scenario C had a mean of 179.98 recruits, and a range of just 178 to 180.

On the second run, PRIME's production increased to an average of 247.01 recruits, with a range of 207 to 287. The other three scenarios change relatively little. Scenario A actually decreased to a mean of 187.38 recruits, with a low of 123 and a high of 197. Scenario B returned a mean of 196.12 recruits, with a low of 188 and a high of 198. Scenario C returned an average of 179.9 recruits, and a range from 175 to 180.

First Run: N(6,1) and Quota = 5					
	Low	Mean	High	Range	Std Dev
PRIME	192	216.08	235	43	6.27
Scenario A	161	194.97	198	37	5.55
Scenario B	188	196.75	198	10	1.29
Scenario C	178	179.98	180	2	0.14
First Run: N(7,2) and Quota = 5					
	Low	Mean	High	Range	Std Dev
PRIME	207	247.01	287	80	12.23
Scenario A	123	187.38	197	74	12.52
Scenario B	188	196.12	198	10	1.34
Scenario C	175	179.9	180	5	0.44
First Run: N(7,2) and Quota = 6					
	Low	Mean	High	Range	Std Dev
PRIME	211	246.52	283	72	12.17
Scenario A	131	203.83	230	99	17.79
Scenario B	207	226.71	233	26	3.85
Scenario C	198	214.19	216	18	2.91

Figure 6-1
PRIME vs Quota Production

On the third run, PRIME's production stayed relatively unchanged, with a mean of 246.52 recruits, a low of 211 and

a high of 283. Performance in all three quota scenarios increased, however. Scenario A returned the lowest mean in this run at 203.83 recruits, with a low of 131 and a high of 230. Scenario B was still the highest of the three at 226.71 recruits, with a range of 207 to 233. Scenario C still had the smallest range, from 198 to 216, around a mean of 214.19 recruits.

2. Incentive Points Earned

Figure 6-2 shows the incentive points earned in the three runs.

First Run: N(6,1) and Quota = 5					
	Low	Mean	High	Range	Std Dev
PRIME	3345	4062.9	4690	1345	205.6
Scenario A	3825	4444.2	4590	765	122.82
Scenario B	2700	4358.5	4590	1890	244.64
Scenario C	3545	3916.1	3960	415	61.97
First Run: N(7,2) and Quota = 5					
	Low	Mean	High	Range	Std Dev
PRIME	4035	5440.4	7020	2985	443.66
Scenario A	4990	5592.6	5795	805	167.37
Scenario B	2970	5331.4	5795	2825	367.74
Scenario C	4515	5100.1	5275	760	111.52
First Run: N(7,2) and Quota = 6					
	Low	Mean	High	Range	Std Dev
PRIME	4185	5423.7	6800	2615	442.8
Scenario A	4330	5249.5	5795	1465	246.48
Scenario B	0	3809.4	5610	5610	1001.5
Scenario C	3630	4782.3	5290	1660	291.12

Figure 6-2
PRIME vs Quota Incentive Points

On the first run, PRIME earned an average of 4062.94 points, with a range of 3345 to 4690. This was similar to the means in all three scenarios. However, two of the quota scenarios earned greater totals. Scenario A averaged 4444.18 points, with a low of 3825 and a high of 4590. Scenario B earned a mean of 4358.45 points, with a low of 2700 and a high of 4590. Scenario C earned 3916.14 points on average, with a range of 3545 to 3960.

On the second run, with the market conditions a little less stable, PRIME earned 5440.41 points, with a range of 4035 to 7020. Scenario A, the only scenario to out-earn PRIME, averaged 5592.63 points, with a low of 4990 and a high of 5795. Scenario B had a mean of 5331.39 points, and a range of 2970 to 5795. Scenario C earned 5100.06 on average, with a low of 4515 and a high of 5275.

On the third run, with the quota raised to six, average PRIME results stayed relatively constant at 5423.73 points, with a range from 4185 to 6800. All three quota scenarios decreased in average points. Scenario A had a mean of 5249.45 points, and a range of 4330 to 5795. Scenario B had the lowest average, 3809.44 points, with a low of zero and a high of 5610. Scenario C earned an average of 4782.27 points, with a low of 3630 and a high of 5290.

C. ANALYSIS OF FIRST MODEL

1. Prime vs. Scenario A

In all three runs, PRIME produced more recruits than the quota-based system. The differences in production were 21.12, 59.63 and 42.69 recruits.

In incentive points, PRIME did not fair as well in two of the three runs. Differences in point totals were -381.24, -152.23, and 174.29 points. As one can see, however, PRIME's performance relative to the quota scenarios improves as the recruiting environment becomes more unpredictable.

Figure 6-3 compares PRIME to scenario A.

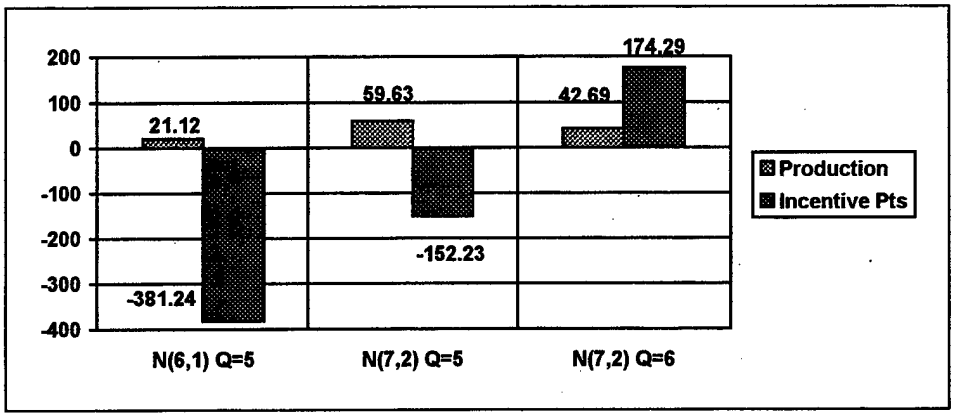

Figure 6-3
PRIME's Advantage Over Scenario A

2. Prime vs. Scenario B

In all three runs, PRIME produced more recruits than the quota scenario. However, the differences in production

were narrower than scenario A. Here the differences were 19.33, 50.9, and 19.81 recruits.

Regarding incentive points, PRIME earned more points on two of the three runs. Differences in point totals were -295.51, 109.02, and 1614.29 points. The last average underscores the quota scenario's volatility in an unpredictable environment.

Figure 6-4 compares PRIME to scenario B.

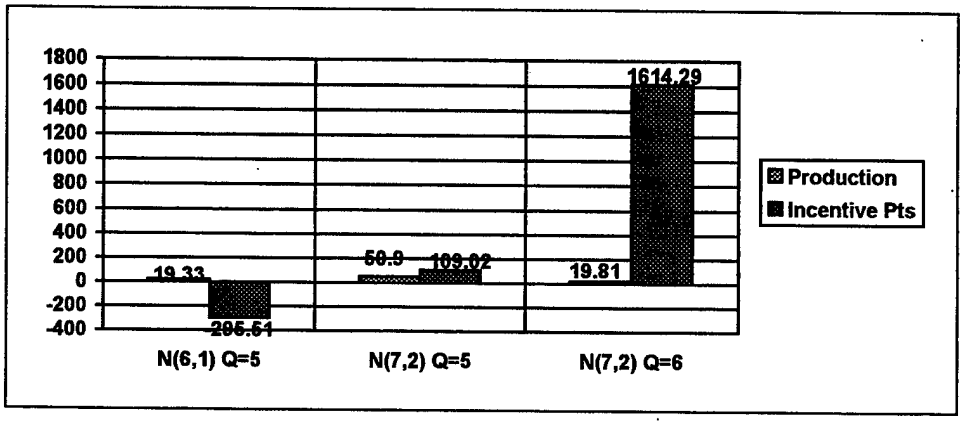

Figure 6-4
PRIME's Advantage Over Scenario B

3. PRIME vs. Scenario C

Once again, PRIME out-produced its quota rival in scenario C. The production difference here is 36.1, 67.11 and 32.34 recruits.

With incentive points, PRIME earned more on all three runs. Here, the difference was 146.8, 340.35 and 641.47 points.

Figure 6-5 compares PRIME to scenario C.

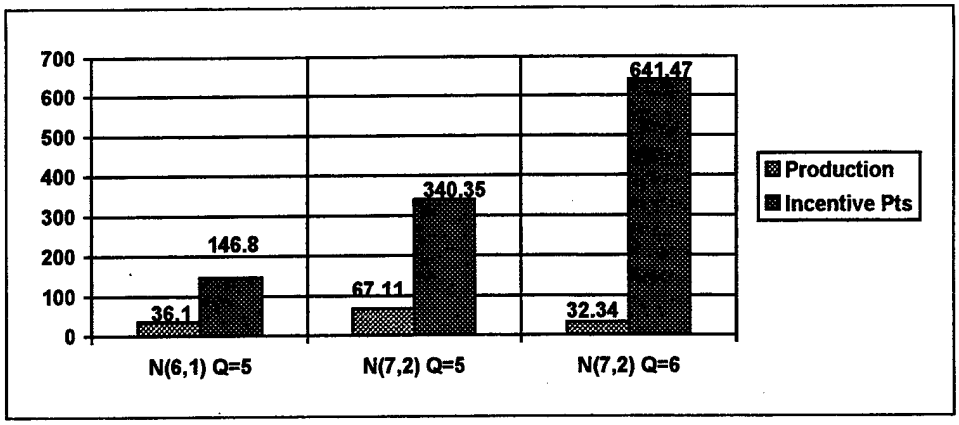

Figure 6-5
PRIME's Advantage Over Scenario C

4. Production Analysis

PRIME has shown that it will generate more recruits than its quota-based rivals, regardless of the recruiting environment. The closest any of the scenarios came to matching PRIME was scenario B in the first run. The increase in mean production in this run was still 19.33 recruits, which equates to almost four months of recruiting work at the quota level. The biggest increase was in scenario C during the second run. PRIME generated 67.11 more recruits, which equated to 9.5 months of recruiting work in PRIME and 13.5 months in the quota system.

The model also illustrates that a quota-based system's performance varies with the recruiting environment. In the first run, the environment is relatively stable (i.e. a

small market variance and a quota set at a level to ensure a high probability of success). All three quota scenarios were able to achieve their three-year cumulative quota of 180 recruits. In fact, scenarios A and B consistently exceeded their quota by almost 15 and 17 recruits, respectively.

In the second run, the environment became more unstable (i.e. a higher market variance). Only scenario C was able to maintain the same level of production, barely meeting its quota of 180 recruits. Scenarios A and B, while still exceeding quota, saw their excess levels drop to 7 and 16 recruits, respectively.

In the third run, the environment was the most unpredictable (i.e. the same market variance as the second run, with a quota set at a 70% success level). Here, only scenario B produced excess recruits; yet the level of excess dropped to 11. Scenarios A and C were not able to consistently make their quota, averaging respective shortfalls of approximately 12 and 2 recruits.

Figure 6-6 compares the production results of the first run.

5. Incentive Points Analysis

Comparing incentive point performance, PRIME showed varying degrees of success against the quota systems. PRIME outperformed scenario A only once, scenario B twice, and

scenario C all three times. From an individual recruiter perspective, this relative "lack of success" might seem to support the viability of the quota system. However, from a management point of view, it underscores the quota system's weakness. In all three cases, management was paying out extra incentives for significantly less production. This fact supports contentions that quota systems reward sub-optimum performance.

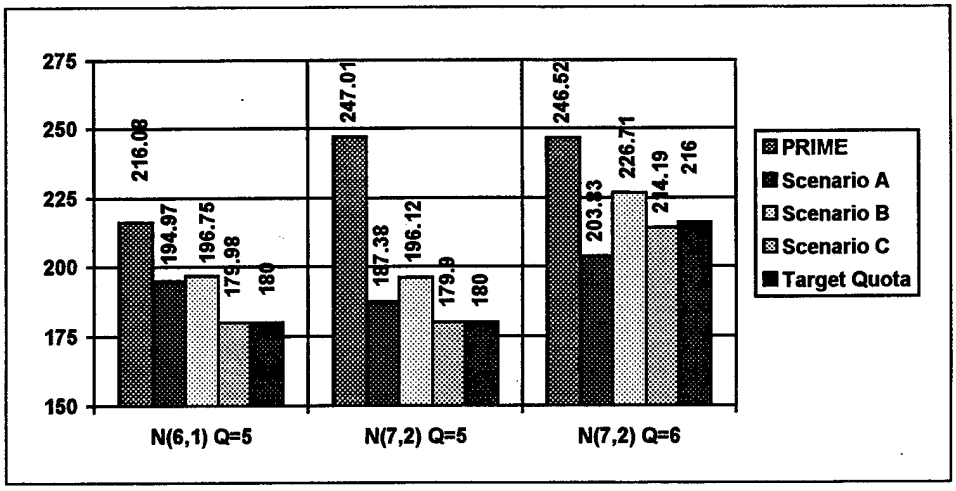

Figure 6-6
First Run Production

Similar to the production results, the quota system is affected by the recruiting environment. As the recruiting environment became more unstable or unpredictable, the quota system fared worse relative to PRIME. On the first run, both scenarios A and B earned more points than PRIME. On the second run, only scenario A earned more points. On the

third run, PRIME earned more points than any of the scenarios. Ironically, scenario B was the only scenario to average more than its three-year quota of 216 recruits during the last run, yet earned the fewest points.

Figure 6-7 compares PRIME to the quota scenarios.

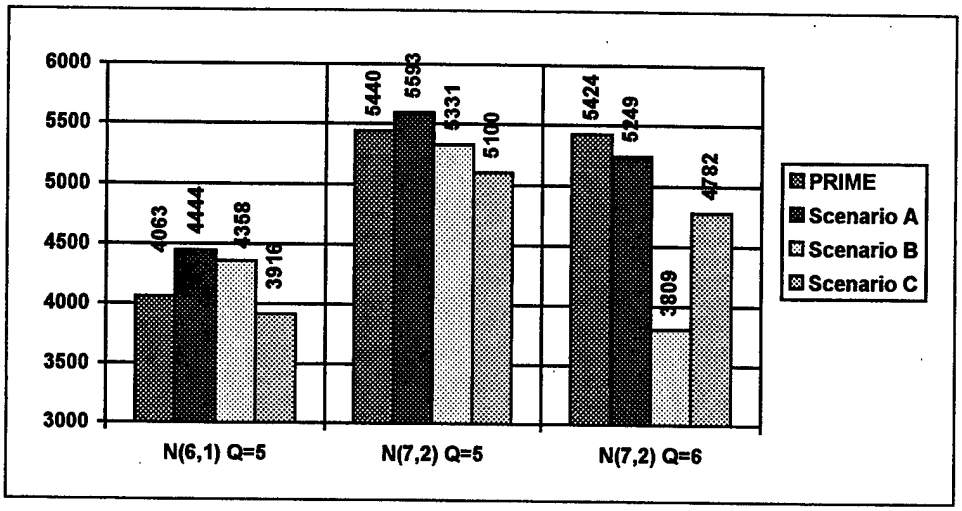

Figure 6-7
First Run Incentive Points

D. SECOND MODEL RESULTS

1. First Run Results

In the first run, when the target quota was kept at 90 recruits, production decreased as the variance of the market increased. Production went from a high of 3240 recruits, when the market's standard deviation was five, to a low of 3081 recruits, when the market's standard deviation was 30.

Figure 6-8 shows the quota production of the first run.

Market Std Dev	Quota Production	Production Std Dev	Low	High	Range
5	3239.93	0.49	3230	3240	10
10	3232.83	8.39	3178	3240	62
15	3206.66	23.89	3090	3240	150
20	3170.01	40.78	2940	3240	300
25	3127.96	57.34	2866	3240	374
30	3078.68	77.34	2707	3240	533

Figure 6-8
First Run Quota Production

Additionally, increasing market variance increased the Quota Loss total. When the market's standard deviation was five, quota loss averaged 362.03 recruits, with a range from 251 to 475. When the standard deviation was 30, the quota loss mean increased to 633.91 recruits with a corresponding increase in range from 215 to 1108.

Figure 6-9 shows quota loss results after the first run.

Market Std Dev	Quota Loss	Loss Std Dev	Low	High	Range
5	362.03	29.67	251	475	224
10	390.88	51.11	219	588	369
15	441.90	71.05	223	753	530
20	502.10	89.07	207	810	603
25	566.29	107.60	209	964	755
30	633.91	124.75	215	1108	893

Figure 6-9
First Run Quota Loss Results

The cumulative frequency counts indicate how many times the Zone achieved their three-year target. When the market's standard deviation was five, the Zone achieved its mission 97 percent of the time. When the standard deviation was 30, this success rate fell to one-tenth of one percent.

Figure 6-10 shows the Quota Success Rate at the different market variances.

Market Std Dev	Times Achieving 3 Yr Quota (5000 Trials)	Success Rate
5	4848	.9696
10	1453	.2906
15	181	.0362
20	39	.0078
25	11	.0022
30	7	.0014

Figure 6-10
Three Year Quota Success Rate

2. Second Run Results

In the second run, the target quota was set at a value corresponding to a 90 percent probability of achieving the period's goal. The overall results were similar to the first run. Production again decreased as the variance of the market increased. However, the decline was more dramatic, from a high of 3347.29 recruits, when the standard deviation was five, to a low of 2189.16, when the standard deviation was 30.

Figure 6-11 shows the quota production of the second run.

Mkt Std Dev	Quota	Quota Production	Prod Std Dev	Low	High	Range
5	93	3347.29	1.64	3332	3348	16
10	87	3129.75	4.37	3084	3132	48
15	80	2877.03	6.14	2825	2880	55
20	74	2659.42	8.81	2581	2664	83
25	68	2442.17	11.08	2355	2448	93
30	61	2189.16	13.04	2076	2196	120

Figure 6-11
Second Run Production

Additionally, there was a significant increase in Quota Loss. When the market's standard deviation was five, Quota Loss averaged 258.10 recruits, with a low of 156 and a high of 363. When the standard deviation was 30, the Quota Loss mean was 1455.19 recruits, with a range of 796 to 2090.

Figure 6-12 shows Quota Loss results after the second run.

Mkt Std Dev	Quota	Quota Loss	Loss Std Dev	Low	High	Range
5	93	258.10	28.16	156	363	207
10	87	484.67	55.19	295	719	424
15	80	741.37	82.91	487	1061	574
20	74	966.44	109.63	545	1404	859
25	68	1194.33	137.21	676	1706	1030
30	61	1455.19	167.71	796	2090	1294

Figure 6-12
Second Run Quota Loss Results

The cumulative frequency counts show that success (measured by the frequency with which the Zone met its cumulative three-year goal) was fairly constant at 60 to 75 percent.

Figure 6-13 shows the Success Rate at the different standard deviations.

Mkt Std Dev	Quota	Times Achieving 3 Yr Quota (5000 Trials)	Success Rate
5	93	3771	.7542
10	87	3218	.6436
15	80	3313	.6626
20	74	3123	.6246
25	68	3007	.6014
30	61	3056	.6112

Figure 6-13
Three Year Quota Success Rate

E. SECOND MODEL ANALYSIS

The first run shows that increases in market variance negatively impact recruit production under the quota system. As the market variance increases, recruit production decreases. Additionally, there is a larger differential between the market's potential and quota production. This difference equals the benefit the PRIME system has over the quota system.

The second run shows that lowering quotas to achieve desirable success rates further decreases production. It also increases the opportunity loss of using a quota system instead of a more efficient system like PRIME.

F. SUMMARY

There is great significance to the results presented by both simulation models. They illustrate the relative inefficiency of the quota system compared to PRIME. They also highlight a never-ending problem faced by upper echelon recruiting command management: What is the correct action to take in a quota system when the quota is not being achieved?

For example, in the second model's first run, the market's standard deviation was 15. The Recruiting Zone only achieved its three-year goal of 3240 recruits 3.6 percent of the time. To make matters more complicated, it missed its target by an average of only 32 recruits (3240 - 3207.92). How should the Recruiting District respond?

Increasing the Zone's quota could very well increase production, depending upon the relationship of the two levels and the Zone's behavior (as shown by the first model). However, the cost of this action is the increased probability that the Zone will not achieve its quota. If the District lowers the quota to increase the Zone's success rate, then the cost is substantially lower levels of production and higher levels of unsigned potential recruits. In a nutshell, this is the District's dilemma.

In any quota system operating in a relatively unstable market (i.e. a wide market variance),it does not matter if the commands are optimizing their recruiting environment or

enjoying the benefits of a generous carry-over rate (as was the case in both models). The quota system demands a trade-off between production and success in achieving the quota. These two desirable objectives are inversely related.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

This chapter concludes this thesis. It presents the study's overall findings and makes recommendations for follow-on action or future areas of research.

B. CONCLUSIONS

Previous research by NPS masters students has found PRIME to be a vastly superior recruiting system to the quota-based systems found in other services. The same holds true for the CNRC quota system, as demonstrated by the computer simulation. Specifically, the following conclusions apply:

1. Given identical market conditions, PRIME will always out-perform a quota-based recruiting system. This is due to the inherent deficiencies found in a quota system, as well as to the efficiency-enhancing truth-telling mechanics of PRIME.

2. As the variance of the market increases, the superiority of PRIME over a quota system increases in terms of production and recruiter reward.

Additionally, the computer simulation illustrated some of the inherent problems in any quota system:

1. Different managerial approaches to stimulating production will often have the reverse effect: recruiters adopt risk-averse behavior. Similarly, the extent of this negative effect will vary as the standard deviation of the market varies.

2. Under different market conditions, and assuming recruiters will respond rationally, there are quota control mechanisms that will have a greater negative impact than others.

3. As the variance of the market increases, under a ceteris parabis assumption, the probability of achieving quota decreases.

3. Reducing quotas to increase the probability of success in a given market, will lower production levels. Furthermore, it will increase the market opportunity loss that could have been eliminated using PRIME.

C. RECOMMENDATIONS

The author recommends the following:

1. Abandon CNRC's current quota-based recruiting system.

2. Implement the PRIME system into CNRC.

3. Study further how different managerial styles and attitudes can adversely affect production in a quota system.

4. Develop alternative reward plans that can be married to PRIME's incentive points matrix.

5. Develop methods for assessing the socio-economic conditions on a local market scale. Current algorithms use risky historical data on a scale that is too large to reflect the substantial local market variances.

6. Study cost-effective methods for implementing PRIME. Although long-run benefits outweigh the long-run costs, making PRIME a long-term asset, short-term transition costs could impede implementation.

APPENDIX A. FIRST MODEL

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	PRIME Incentive Table														
2		FORECAST													
3			1	2	3	4	5	6	7	8	9	10	11		
4	P	1	10	9	8	7	6	5	4	3	2	1	0		
5	R	2	12	20	12	11	10	9	8	7	6	5	4		
6	O	3	15	24	35	24	15	14	13	12	11	10	9		
7	D	4	19	29	41	55	41	29	19	18	17	16	15		
8	U	5	24	35	48	63	80	63	48	35	24	23	22		
9	C	6	30	42	56	72	90	110	90	72	56	42	30		
10	T	7	37	50	65	82	101	122	145	122	101	82	65		
11	I	8	45	59	75	93	113	135	159	185	159	135	113		
12	O	9	54	69	86	105	126	149	174	201	230	201	174		
13	N	10	64	80	98	118	140	164	190	218	248	280	248		
14		11	75	92	111	132	155	180	207	236	267	300	335		
15	Quota System Parameters														
16			Quota incentive plan:					Run #1			Run #2 & 3				
17				Meet quota:				110	pts		145	pts			
18				Exceed quota:				35	pts		40	pts			
19				No quota:				0	pts		0	pts			
20															
21	Scenario "A":		Quota is adjusted up/down if a two period trend (in which production is												
22				above or below quota) is evidenced.											
23			Production tries to maximize points earned. Exceeding quota is OK if												
24				it does not result in an increase in the next period's quota.											
25	Scenario "B":		Quota is adjusted if mission is not achieved the period before. Two												
26				period trends in production are of no consequence.											
27			Production tries to maximize points earned. Exceeding quota is OK if												
28				it does not result in an increase in the next period's quota.											
29	Scenario "C":		Quota stays the same from period to period with no adjustment.												
30			Production tries to maximize points. Exceeding quota is OK as long as												
31				cumulative quota value is not exceeded.											
32															
33															
34															
35															
36															
37															
38															
39															
40															
41															

APPENDIX A. FIRST MODEL

	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1		Rnd			Market	Quota		Prod		Norm	Market	Quota		Prod
2	Market	Mkt	Norm		Potent	Adj	Prod	Pts		Quota	Potent	Adj	Prod	Pts
3	N(6,1)	Pot	Quota		Adj "A"	"A"	"A"	"A"		Adj	Adj "B"	"B"	"B"	"B"
4			5		0.5									
5	8.8476	9	5		9	5	6	145		5	9	5	6	145
6	6.1954	6	5		7.5	5	5	110		5	7.5	5	5	110
7	5.8747	6	5		7.25	5	6	145		5	7.25	5	6	145
8	5.1858	5	5		5.625	5	5	110		5	5.625	5	5	110
9	6.2865	6	5		6.3125	5	6	145		5	6.3125	5	6	145
10	4.6768	5	5		5.15625	5	5	110		5	5.1563	5	5	110
11	5.9519	6	5		6.07813	5	6	145		5	6.0781	5	6	145
12	5.6249	6	5		6.03906	5	5	110		5	6.0391	5	5	110
13	6.5334	7	5		7.51953	5	6	145		5	7.5195	5	6	145
14	6.4011	6	5		6.75977	5	5	110		5	6.7598	5	5	110
15	4.6419	5	5		5.87988	5	6	145		5	5.8799	5	6	145
16	6.5772	7	5		7	5	5	110		5	7	5	5	110
17	6.0468	6	5		7	5	6	145		5	7	5	6	145
18	4.314	4	5		4.5	5	5	110		5	4.5	5	5	110
19	7.9039	8	5		8	5	6	145		5	8	5	6	145
20	6.5797	7	5		8	5	5	110		5	8	5	5	110
21	6.7774	7	5		8.5	5	6	145		5	8.5	5	6	145
22	6.3209	6	5		7.25	5	5	110		5	7.25	5	5	110
23	7.1328	7	5		8.125	5	6	145		5	8.125	5	6	145
24	6.5968	7	5		8.0625	5	5	110		5	8.0625	5	5	110
25	5.3035	5	5		6.53125	5	6	145		5	6.5313	5	6	145
26	4.9109	5	5		5.26563	5	5	110		5	5.2656	5	5	110
27	4.6032	5	5		5.13281	5	6	145		5	5.1328	5	6	145
28	3.8282	4	5		4	5	4	0		5	4	5	4	0
29	7.2512	7	5		7	5	6	145		5	7	6	7	145
30	6.5787	7	5		7.5	5	5	110		5	7	5	5	110
31	6.4767	6	5		7.25	5	6	145		5	7	5	6	145
32	5.1507	5	5		5.625	5	5	110		5	5.5	5	5	110
33	5.4208	5	5		5.3125	5	6	145		5	5.25	5	6	145
34	4.5275	5	5		5	5	5	110		5	5	5	5	110
35	4.389	4	5		4	5	4	0		5	4	5	4	0
36	6.1755	6	5		6	5	6	145		5	6	6	6	110
37	6.9527	7	5		7	5	5	110		5	7	5	6	145
38	4.341	4	5		5	5	5	110		5	4.5	5	5	110
39	4.4682	4	5		4	5	4	0		5	4	5	4	0
40	6.7941	7	5		7	5	6	145		5	7	6	7	145
41		212	180		231.175	180	194	4225		180	229.74	183	197	4225

APPENDIX A. FIRST MODEL

	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
1		Cum	Market	Quota		Cum	Prod		Market	
2		Norm	Potent	Adj	Prod	Prod	Points		Max Prod	PRIME
3		Quota	Adj"C"	"C"	"C"	"C"	"C"		(PRIME)	Points
4										
5		5	9	5	5	5	110		9	230
6		10	8	5	5	10	110		6	110
7		15	7.5	5	5	15	110		6	110
8		20	6.25	5	5	20	110		5	80
9		25	6.625	5	5	25	110		6	110
10		30	5.8125	5	5	30	110		5	80
11		35	6.4063	5	5	35	110		6	110
12		40	6.7031	5	5	40	110		6	110
13		45	7.8516	5	5	45	110		7	145
14		50	7.4258	5	5	50	110		6	110
15		55	6.2129	5	5	55	110		5	80
16		60	7.6064	5	5	60	110		7	145
17		65	7.3032	5	5	65	110		6	110
18		70	5.1516	5	5	70	110		4	55
19		75	8.0758	5	5	75	110		8	185
20		80	8.5379	5	5	80	110		7	145
21		85	8.769	5	5	85	110		7	145
22		90	7.8845	5	5	90	110		6	110
23		95	8.4422	5	5	95	110		7	145
24		100	8.7211	5	5	100	110		7	145
25		105	6.8606	5	5	105	110		5	80
26		110	5.9303	5	5	110	110		5	80
27		115	5.4651	5	5	115	110		5	80
28		120	4.2326	5	4	119	0		4	55
29		125	7.1163	5	6	125	145		7	145
30		130	7.5581	5	5	130	110		7	145
31		135	7.2791	5	5	135	110		6	110
32		140	6.1395	5	5	140	110		5	80
33		145	5.5698	5	5	145	110		5	80
34		150	5.2849	5	5	150	110		5	80
35		155	4.1424	5	4	154	0		4	55
36		160	6.0712	5	6	160	145		6	110
37		165	7.0356	5	5	165	110		7	145
38		170	5.0178	5	5	170	110		4	55
39		175	4.0089	5	4	174	0		4	55
40		180	7.0045	5	6	180	145		7	145
41			243	180	180		3735		212	3960

APPENDIX A. FIRST MODEL

	AN	AO	AP	AQ	AR	AS	AT	AU
1		PRIME vs	PRIME vs.	PRIME vs.		PRIME vs	PRIME vs	PRIME vs.
2		Quota "A"	Quota "B"	Quota "C"		Quota "A"	Quota "B"	Quota "C"
3		Prod	Prod	Prod		Points	Points	Points
4		Difference	Difference	Difference		Difference	Difference	Difference
5		3	3	4		85	85	120
6		1	1	1		0	0	0
7		0	0	1		-35	-35	0
8		0	0	0		-30	-30	-30
9		0	0	1		-35	-35	0
10		0	0	0		-30	-30	-30
11		0	0	1		-35	-35	0
12		1	1	1		0	0	0
13		1	1	2		0	0	35
14		1	1	1		0	0	0
15		-1	-1	0		-65	-65	-30
16		2	2	2		35	35	35
17		0	0	1		-35	-35	0
18		-1	-1	-1		-55	-55	-55
19		2	2	3		40	40	75
20		2	2	2		35	35	35
21		1	1	2		0	0	35
22		1	1	1		0	0	0
23		1	1	2		0	0	35
24		2	2	2		35	35	35
25		-1	-1	0		-65	-65	-30
26		0	0	0		-30	-30	-30
27		-1	-1	0		-65	-65	-30
28		0	0	0		55	55	55
29		1	0	1		0	0	0
30		2	2	2		35	35	35
31		0	0	1		-35	-35	0
32		0	0	0		-30	-30	-30
33		-1	-1	0		-65	-65	-30
34		0	0	0		-30	-30	-30
35		0	0	0		55	55	55
36		0	0	0		-35	0	-35
37		2	1	2		35	0	35
38		-1	-1	-1		-55	-55	-55
39		0	0	0		55	55	55
40		1	0	1		0	0	0
41		18	15	32		-265	-265	225

APPENDIX A. FIRST MODEL

	AV	AW	AX	AY	AZ	BA
1	**Legend**					
2	**(Same for all three runs)**					
3						
4	**Note: Formulas are the same for all scenarios unless noted below.**					
5	Col Q	Actual Market Potential (based on normal distribution parameters in parentheses)				
6	Col R	Market Potential (Col Q in integer form)				
7	Col S	Normal Quota (with quota value shown underneath)				
8	Col U	Adjusted Market Potential for given scenario (with Loss Rate shown underneath)				
9	Col V	Adjusted Quota for given scenario				
10	Col W	Production for given scenario				
11	Col X	Production Points earned in given scenario				
12	Col Z	Normal Quota Adjusted				
13	Col AG	Cumulative Normal Quota				
14	Col AK	Cumulative Production for given scenario				
15	Col AN	Market Maximum Production (also called PRIME production)				
16	Col AO	PRIME Points earned				
17	Col AQ	PRIME vs given scenario Production Difference				
18	Col AU	PRIME vs given scenario Points Difference				
19	R5	=ROUND(Q5,0)				
20	S5	=S$4				
21	U5	=R5				
22	U6	=IF(W5<U5,R6+((U5-W5)*LossRate),R6)				
23	V5	=S5				
24	V6	=IF(W5=V5,V5,IF(W5>V5,IF(W4>V4,V5+1,V5),IF(W4<V4,V5-1,V5)))				
25	W5	=ROUND(IF(X4<=H$17,IF(U5<=V5,U5,V5+1),IF(U5<=V5,U5,V5)),0)				
26	X5	=IF(W5>V5,H$17+H$18,IF(W5=V5,H$17,H$19))				
27	Z5	=S5				
28	Z6	=IF(AC5<=AB5,Z5,IF(AC5>AB5,IF(AC4>AB4,Z5+1,Z5)))				
29	AB6	=IF(AC5<AB5,Z6+(AB5-AC5),Z6)				
30	AG5	=AG4+S5				
31	AI5	=S5				
32	AJ5	=ROUND(IF(AL4<=H$17,IF(AH5<=AI5,AH5,IF(AK4<AG4,AI5+1,AI5)),IF(AH5				
33			<=AI5,AH5,AI5)),0)			
34	AK5	=AK4+AJ5				
35	AN5	=R5				
36	AO5	=IF(AN5=3,E$6,IF(AN5=4,F$7,IF(AN5=5,G$8,IF(AN5=6,H$9,IF(AN5=7,I$10,				
37			IF(AN5=8,J$11,IF(AN5=9,K$12,IF(AN5=10,L$13,M$14))))))))			
38	AQ5	=R5-W5				
39	AU5	=AO5-X5				
40						
41						

APPENDIX B. SECOND MODEL RUN A

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1		Actual	Int		Adj		Loss	P		Actual	Int		Adj		Loss	P
2	Rec.	Mkt Pot	Mkt	Q	Mkt	Prod	Due T	v		Mkt Pot	Mkt	Q	Mkt	Prod	Due T	v
3	Per.	N(100,5)	Pot	90	Pot		Quota	Q		N(100,10)	Pot	90	Pot		Quota	Q
4																
5	1	98.499	98	90	98.5	90	8	0		106.215	106	90	106.2	90	16	0
6	2	93.612	94	90	97.86	90	4	0		95.4545	95	90	103.6	90	5	0
7	3	101.22	101	90	105.2	90	11	0		115.284	115	90	122.1	90	25	0
8	4	106.38	106	90	114	90	16	0		108.935	109	90	125	90	19	0
9	5	105.99	106	90	118	90	16	0		113.527	114	90	131	90	24	0
10	6	108.67	109	90	122.7	90	19	0		95.2363	95	90	115.7	90	5	0
11	7	89.082	89	90	105.4	90	0	0		110.063	110	90	122.9	90	20	0
12	8	98.829	99	90	106.5	90	9	0		82.0065	82	90	98.47	90	0	0
13	9	105.48	105	90	113.7	90	15	0		104.202	104	90	108.4	90	14	0
14	10	94.566	95	90	106.4	90	5	0		87.5419	88	90	96.76	90	0	0
15	11	96.549	97	90	104.8	90	7	0		99.365	99	90	102.7	90	9	0
16	12	91.548	92	90	98.93	90	2	0		107.02	107	90	113.4	90	17	0
17	13	90.765	91	90	95.23	90	1	0		107.821	108	90	119.5	90	18	0
18	14	95.112	95	90	97.73	90	5	0		98.845	99	90	113.6	90	9	0
19	15	96.132	96	90	100	90	6	0		102.312	102	90	114.1	90	12	0
20	16	89.41	89	90	94.41	90	0	0		85.9609	86	90	98.02	90	0	0
21	17	97.16	97	90	99.36	90	7	0		96.1975	96	90	100.2	90	6	0
22	18	97.98	98	90	102.7	90	8	0		100.002	100	90	105.1	90	10	0
23	19	100.67	101	90	107	90	11	0		88.915	89	90	96.47	90	0	0
24	20	98.173	98	90	106.7	90	8	0		102.35	102	90	105.6	90	12	0
25	21	98.365	98	90	106.7	90	8	0		110.324	110	90	118.1	90	20	0
26	22	98.149	98	90	106.5	90	8	0		100.943	101	90	115	90	11	0
27	23	106.71	107	90	115	90	17	0		100.752	101	90	113.3	90	11	0
28	24	99.574	100	90	112.1	90	10	0		102.305	102	90	113.9	90	12	0
29	25	99.069	99	90	110.1	90	9	0		89.8646	90	90	101.8	90	0	0
30	26	97.434	97	90	107.5	90	7	0		88.784	89	90	94.7	90	0	0
31	27	109.86	110	90	118.6	90	20	0		117.99	118	90	120.3	90	28	0
32	28	104.33	104	90	118.6	90	14	0		97.2154	97	90	112.4	90	7	0
33	29	111.88	112	90	126.2	90	22	0		92.339	92	90	103.5	90	2	0
34	30	96.725	97	90	114.8	90	7	0		92.8394	93	90	99.61	90	3	0
35	31	108.31	108	90	120.7	90	18	0		103.551	104	90	108.4	90	14	0
36	32	91.938	92	90	107.3	90	2	0		104.219	104	90	113.4	90	14	0
37	33	102.69	103	90	111.3	90	13	0		104.796	105	90	116.5	90	15	0
38	34	104.51	105	90	115.2	90	15	0		99.5788	100	90	112.8	90	10	0
39	35	109.59	110	90	122.2	90	20	0		101.618	102	90	113	90	12	0
40	36	99.577	100	90	115.7	90	10	0		91.6291	92	90	103.1	90	2	0
41			3596	3240		3240	358	0			3606	3240		3240	382	0
42																

43	LEGEND			
44	I A =	Recruiting Period	Col H	=Production vs Quota
45	I B =	Actual Market Potential	C5	=ROUND(B5,0)
46	I C =	Integer of market Potential (Col B)	D5	=Quota
47	I D =	Quota (value below it)	E5	=IF(F4=ROUND(E4,0),B5,B5+(0.5*(E4-F4)))
48	I E =	Adjusted Market Potential	F5	=IF(D5>E5,ROUND(E5,0),D5)
49	I F =	Production	G5	=IF(ROUND(B5,0)-F5<0,0,ROUND(B5,0)-F5)
50	I G =	Loss Due To Quota	H5	=IF(F5>=D5,0,1)

APPENDIX B. SECOND MODEL RUN A

	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1		Actual	Int		Adj		Loss	P		Actual	Int		Adj		Loss	P
2		Mkt Pot	Mkt	Q	Mkt	Prod	Due T	v		Mkt Pot	Mkt	Q	Mkt	Prod	Due T	v
3		N(100,15)	Pot	90	Pot		Quota	Q		N(100,20)	Pot	90	Pot		Quota	Q
4																
5		76.1774	76	90	76.18	76	0	1		125.854	126	90	125.9	90	36	0
6		97.1527	97	90	97.15	90	7	0		74.2373	74	90	92.16	90	0	0
7		90.0509	90	90	93.63	90	0	0		108.814	109	90	109.9	90	19	0
8		101.318	101	90	103.1	90	11	0		86.2793	86	90	96.23	90	0	0
9		85.7662	86	90	92.33	90	0	0		118.044	118	90	121.2	90	28	0
10		127.473	127	90	128.6	90	37	0		83.3448	83	90	98.92	90	0	0
11		101.153	101	90	120.5	90	11	0		88.3545	88	90	92.82	90	0	0
12		92.2796	92	90	107.5	90	2	0		87.4636	87	90	88.87	89	0	1
13		84.3014	84	90	93.06	90	0	0		93.8464	94	90	93.85	90	4	0
14		125.092	125	90	126.6	90	35	0		79.8845	80	90	81.81	82	0	1
15		101.744	102	90	120.1	90	12	0		141.813	142	90	141.8	90	52	0
16		85.7031	86	90	100.7	90	0	0		141.544	142	90	167.5	90	52	0
17		91.7694	92	90	97.13	90	2	0		84.4637	84	90	123.2	90	0	0
18		114.2	114	90	117.8	90	24	0		91.6076	92	90	108.2	90	2	0
19		95.2667	95	90	109.2	90	5	0		93.4295	93	90	102.5	90	3	0
20		86.4274	86	90	96	90	0	0		132.22	132	90	138.5	90	42	0
21		83.8006	84	90	86.8	87	0	1		79.2056	79	90	103.4	90	0	0
22		97.9946	98	90	97.99	90	8	0		93.9041	94	90	100.6	90	4	0
23		102.285	102	90	106.3	90	12	0		116.483	116	90	121.8	90	26	0
24		119.946	120	90	128.1	90	30	0		120.539	121	90	136.4	90	31	0
25		121.85	122	90	140.9	90	32	0		96.8002	97	90	120	90	7	0
26		112.527	113	90	138	90	23	0		56.8761	57	90	71.89	72	0	1
27		102.132	102	90	126.1	90	12	0		144.219	144	90	144.2	90	54	0
28		87.4842	87	90	105.5	90	0	0		84.4285	84	90	111.5	90	0	0
29		119.707	120	90	127.5	90	30	0		115.619	116	90	126.4	90	26	0
30		85.6433	86	90	104.4	90	0	0		112.399	112	90	130.6	90	22	0
31		117.045	117	90	124.2	90	27	0		82.4067	82	90	102.7	90	0	0
32		122.311	122	90	139.4	90	32	0		109.977	110	90	116.3	90	20	0
33		112.607	113	90	137.3	90	23	0		109.91	110	90	123.1	90	20	0
34		119.653	120	90	143.3	90	30	0		90.3953	90	90	106.9	90	0	0
35		96.6969	97	90	123.4	90	7	0		109.091	109	90	117.6	90	19	0
36		76.6898	77	90	93.37	90	0	0		71.4762	71	90	85.25	85	0	1
37		86.2153	86	90	87.9	88	0	1		92.646	93	90	92.65	90	3	0
38		96.9281	97	90	96.93	90	7	0		115.592	116	90	116.9	90	26	0
39		78.1863	78	90	81.65	82	0	1		68.3548	68	90	81.81	82	0	1
40		149.2	149	90	149.2	90	59	0		65.6089	66	90	65.61	66	0	1
41			3644	3240		3213	478	4			3565	3240		3176	496	6
42																
43																
44																
45																
46																
47																
48																
49																
50																

APPENDIX B. SECOND MODEL RUN A

	AG	AH	AI	AJ	AK	AL	AM	AN	A	AP	AQ	AR	AS	AT	AU	AV
1		Actual	Int		Adj		Loss	P		Actual	Int		Adj		Loss	P
2		Mkt Pot	Mkt	Q	Mkt	Prod	Due T	v		Mkt Pot	Mkt	Q	Mkt	Prod	Due T	v
3		N(100,25)	Pot	90	Pot		Quota	Q		N(100,30)	Pot	90	Pot		Quota	Q
4																
5		76.8792	77	90	76.88	77	0	1		91.6869	92	90	91.69	90	2	0
6		107.624	108	90	107.6	90	18	0		92.2649	92	90	93.11	90	2	0
7		104.845	105	90	113.7	90	15	0		82.6078	83	90	84.16	84	0	1
8		105.081	105	90	116.9	90	15	0		97.2848	97	90	97.28	90	7	0
9		84.4411	84	90	97.9	90	0	0		82.7299	83	90	86.37	86	0	1
10		109.644	110	90	113.6	90	20	0		111.002	111	90	111	90	21	0
11		62.993	63	90	74.79	75	0	1		132.481	132	90	143	90	42	0
12		134.508	135	90	134.5	90	45	0		105.081	105	90	131.6	90	15	0
13		71.3452	71	90	93.6	90	0	0		61.187	61	90	81.97	82	0	1
14		103.443	103	90	105.2	90	13	0		133.695	134	90	133.7	90	44	0
15		111.017	111	90	118.6	90	21	0		36.5911	37	90	58.44	58	0	1
16		130.673	131	90	145	90	41	0		43.5627	44	90	43.56	44	0	1
17		114.059	114	90	141.6	90	24	0		107.009	107	90	107	90	17	0
18		117.153	117	90	142.9	90	27	0		115.145	115	90	123.6	90	25	0
19		115.564	116	90	142	90	26	0		121.078	121	90	137.9	90	31	0
20		67.8579	68	90	93.87	90	0	0		121.36	121	90	145.3	90	31	0
21		117.685	118	90	119.6	90	28	0		119.347	119	90	147	90	29	0
22		151.007	151	90	165.8	90	61	0		106.036	106	90	134.5	90	16	0
23		118.979	119	90	156.9	90	29	0		39.7701	40	90	62.04	62	0	1
24		89.9776	90	90	123.4	90	0	0		96.5072	97	90	96.51	90	7	0
25		87.2418	87	90	104	90	0	0		97.1212	97	90	100.4	90	7	0
26		87.3266	87	90	94.3	90	0	0		83.6135	84	90	88.8	89	0	1
27		101.114	101	90	103.3	90	11	0		96.3455	96	90	96.35	90	6	0
28		73.3074	73	90	79.94	80	0	1		134.108	134	90	137.3	90	44	0
29		84.6818	85	90	84.68	85	0	1		132.872	133	90	156.5	90	43	0
30		54.088	54	90	54.09	54	0	1		124.167	124	90	157.4	90	34	0
31		90.6415	91	90	90.64	90	1	0		128.852	129	90	162.6	90	39	0
32		136.367	136	90	136.7	90	46	0		72.406	72	90	108.7	90	0	0
33		19.4988	19	90	42.84	43	0	1		92.9179	93	90	102.3	90	3	0
34		113.275	113	90	113.3	90	23	0		88.4393	88	90	94.57	90	0	0
35		95.5793	96	90	107.2	90	6	0		129.885	130	90	132.2	90	40	0
36		97.0181	97	90	105.6	90	7	0		84.7946	85	90	105.9	90	0	0
37		75.1989	75	90	83.01	83	0	1		139.155	139	90	147.1	90	49	0
38		53.4862	53	90	53.49	53	0	1		75.4464	75	90	104	90	0	0
39		144.565	145	90	144.6	90	55	0		81.2345	81	90	88.23	88	0	1
40		96.9449	97	90	124.2	90	7	0		142.477	142	90	142.5	90	52	0
41			3505	3240		3070	539	8			3599	3240		3113	606	8
42																
43																
44																
45																
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48																
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50																

APPENDIX C. SECOND MODEL RUN B

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1		Actual	Int		Adj		Loss	P		Actual	Int		Adj		Loss	P
2	Rec.	Mkt Pot	Mkt	Q	Mkt	Prod	Due T	vs		Mkt Pot	Mkt	Q	Mkt	Prod	Due T	vs
3	Per.	N(100,5)	Pot	93	Pot		Quota	Q		N(100,10	Pot	87	Pot		Quota	Q
4																
5	1	98.499	98	93	98.5	93	5	0		106.215	106	87	106.22	87	19	0
6	2	93.612	94	93	96.36	93	1	0		95.4545	95	87	105.06	87	8	0
7	3	101.22	101	93	102.9	93	8	0		115.284	115	87	124.32	87	28	0
8	4	106.38	106	93	111.3	93	13	0		108.935	109	87	127.59	87	22	0
9	5	105.99	106	93	115.2	93	13	0		113.527	114	87	133.82	87	27	0
10	6	108.67	109	93	119.7	93	16	0		95.2363	95	87	118.65	87	8	0
11	7	89.082	89	93	102.5	93	0	0		110.063	110	87	125.89	87	23	0
12	8	98.829	99	93	103.6	93	6	0		82.0065	82	87	101.45	87	0	0
13	9	105.48	105	93	110.8	93	12	0		104.202	104	87	111.43	87	17	0
14	10	94.566	95	93	103.4	93	2	0		87.5419	88	87	99.755	87	1	0
15	11	96.549	97	93	101.8	93	4	0		99.365	99	87	105.74	87	12	0
16	12	91.548	92	93	95.93	93	0	0		107.02	107	87	116.39	87	20	0
17	13	90.765	91	93	92.23	92	0	1		107.821	108	87	122.52	87	21	0
18	14	95.112	95	93	95.11	93	2	0		98.845	99	87	116.6	87	12	0
19	15	96.132	96	93	97.19	93	3	0		102.312	102	87	117.11	87	15	0
20	16	89.41	89	93	91.5	92	0	1		85.9609	86	87	101.02	87	0	0
21	17	97.16	97	93	97.16	93	4	0		96.1975	96	87	103.21	87	9	0
22	18	97.98	98	93	100.1	93	5	0		100.002	100	87	108.11	87	13	0
23	19	100.67	101	93	104.2	93	8	0		88.915	89	87	99.468	87	2	0
24	20	98.173	98	93	103.8	93	5	0		102.35	102	87	108.58	87	15	0
25	21	98.365	98	93	103.8	93	5	0		110.324	110	87	121.12	87	23	0
26	22	98.149	98	93	103.5	93	5	0		100.943	101	87	118	87	14	0
27	23	106.71	107	93	112	93	14	0		100.752	101	87	116.25	87	14	0
28	24	99.574	100	93	109.1	93	7	0		102.305	102	87	116.93	87	15	0
29	25	99.069	99	93	107.1	93	6	0		89.8646	90	87	104.83	87	3	0
30	26	97.434	97	93	104.5	93	4	0		88.784	89	87	97.699	87	2	0
31	27	109.86	110	93	115.6	93	17	0		117.99	118	87	123.34	87	31	0
32	28	104.33	104	93	115.6	93	11	0		97.2154	97	87	115.39	87	10	0
33	29	111.88	112	93	123.2	93	19	0		92.339	92	87	106.53	87	5	0
34	30	96.725	97	93	111.8	93	4	0		92.8394	93	87	102.61	87	6	0
35	31	108.31	108	93	117.7	93	15	0		103.551	104	87	111.35	87	17	0
36	32	91.938	92	93	104.3	93	0	0		104.219	104	87	116.4	87	17	0
37	33	102.69	103	93	108.3	93	10	0		104.796	105	87	119.49	87	18	0
38	34	104.51	105	93	112.2	93	12	0		99.5788	100	87	115.83	87	13	0
39	35	109.59	110	93	119.2	93	17	0		101.618	102	87	116.03	87	15	0
40	36	99.577	100	93	112.7	93	7	0		91.6291	92	87	106.14	87	5	0
41			3596	3348		3346	260	2			3606	3132		3132	480	0
42																

LEGEND

Col A =	Recruiting Period	Col H	=Production vs Quota
Col B =	Actual Market Potential	C5	=ROUND(B5,0)
Col C =	Integer of market Potential (Col B)	D5	=Quota
Col D =	Quota (value below it)	E5	=IF(F4=ROUND(E4,0),B5,B5+(0.5*(E4-F4)))
Col E =	Adjusted Market Potential	F5	=IF(D5>E5,ROUND(E5,0),D5)
Col F =	Production	G5	=IF(ROUND(B5,0)-F5<0,0,ROUND(B5,0)-F5)
Col G =	Loss Due To Quota	H5	=IF(F5>=D5,0,1)

APPENDIX C. SECOND MODEL RUN B

	Q	R	S	T	U	V	W	Y	Z	AA	AB	AC	AD	AE
1	Actual	Int		Adj		Loss	P	Actual	Int		Adj		Loss	P
2	Mkt Pot	Mkt	Q	Mkt	Prod	Due To	vs	Mkt Pot	Mkt	Q	Mkt	Prod	Due T	vs
3	N(100,15)	Pot	80	Pot		Quota	Q	N(100,20)	Pot	74	Pot		Quota	Q
4														
5	76.1774	76	80	76.18	76	0	1	125.854	126	74	125.85	74	52	0
6	97.1527	97	80	97.15	80	17	0	74.2373	74	74	100.16	74	0	0
7	90.0509	90	80	98.63	80	10	0	108.814	109	74	121.9	74	35	0
8	101.318	101	80	110.6	80	21	0	86.2793	86	74	110.23	74	12	0
9	85.7662	86	80	101.1	80	6	0	118.044	118	74	136.16	74	44	0
10	127.473	127	80	138	80	47	0	83.3448	83	74	114.42	74	9	0
11	101.153	101	80	130.2	80	21	0	88.3545	88	74	108.57	74	14	0
12	92.2796	92	80	117.4	80	12	0	87.4636	87	74	104.75	74	13	0
13	84.3014	84	80	103	80	4	0	93.8464	94	74	109.22	74	20	0
14	125.092	125	80	136.6	80	45	0	79.8845	80	74	97.494	74	6	0
15	101.744	102	80	130	80	22	0	141.813	142	74	153.56	74	68	0
16	85.7031	86	80	110.7	80	6	0	141.544	142	74	181.32	74	68	0
17	91.7694	92	80	107.1	80	12	0	84.4637	84	74	138.13	74	10	0
18	114.2	114	80	127.8	80	34	0	91.6076	92	74	123.67	74	18	0
19	95.2667	95	80	119.1	80	15	0	93.4295	93	74	118.26	74	19	0
20	86.4274	86	80	106	80	6	0	132.22	132	74	154.35	74	58	0
21	83.8006	84	80	96.8	80	4	0	79.2056	79	74	119.38	74	5	0
22	97.9946	98	80	106.4	80	18	0	93.9041	94	74	116.59	74	20	0
23	102.285	102	80	115.5	80	22	0	116.483	116	74	137.78	74	42	0
24	119.946	120	80	137.7	80	40	0	120.539	121	74	152.43	74	47	0
25	121.85	122	80	150.7	80	42	0	96.8002	97	74	136.01	74	23	0
26	112.527	113	80	147.9	80	33	0	56.8761	57	74	87.883	74	0	0
27	102.132	102	80	136.1	80	22	0	144.219	144	74	151.16	74	70	0
28	87.4842	87	80	115.5	80	7	0	84.4285	84	74	123.01	74	10	0
29	119.707	120	80	137.5	80	40	0	115.619	116	74	140.12	74	42	0
30	85.6433	86	80	114.4	80	6	0	112.399	112	74	145.46	74	38	0
31	117.045	117	80	134.2	80	37	0	82.4067	82	74	118.14	74	8	0
32	122.311	122	80	149.4	80	42	0	109.977	110	74	132.05	74	36	0
33	112.607	113	80	147.3	80	33	0	109.91	110	74	138.93	74	36	0
34	119.653	120	80	153.3	80	40	0	90.3953	90	74	122.86	74	16	0
35	96.6969	97	80	133.4	80	17	0	109.091	109	74	133.52	74	35	0
36	76.6898	77	80	103.4	80	0	0	71.4762	71	74	101.24	74	0	0
37	86.2153	86	80	97.9	80	6	0	92.646	93	74	106.26	74	19	0
38	96.9281	97	80	105.9	80	17	0	115.592	116	74	131.72	74	42	0
39	78.1863	78	80	91.12	80	0	0	68.3548	68	74	97.217	74	0	0
40	149.2	149	80	154.8	80	69	0	65.6089	66	74	77.217	74	0	0
41		3644	2880		2876	773	1		3565	2664		2664	935	0
42														
43														
44														
45														
46														
47														
48														
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50														

APPENDIX C. SECOND MODEL RUN B

	AF	AG	AH	AI	AJ	AK	AL	AN	AO	AP	AQ	AR	AS	AT
1	Actual	Int		Adj		Loss	P	Actual	Int		Adj		Loss	P
2	Mkt Pot	Mkt	Q	Mkt	Prod	Due To	vs	Mkt Pot	Mkt	Q	Mkt	Prod	Due T	vs
3	N(100,25)	Pot	68	Pot		Quota	Q	N(100,30	Pot	61	Pot		Quota	Q
4														
5	76.8792	77	68	76.88	68	9	0	91.6869	92	61	91.687	61	31	0
6	107.624	108	68	112.1	68	40	0	92.2649	92	61	107.61	61	31	0
7	104.845	105	68	126.9	68	37	0	82.6078	83	61	105.91	61	22	0
8	105.081	105	68	134.5	68	37	0	97.2848	97	61	119.74	61	36	0
9	84.4411	84	68	117.7	68	16	0	82.7299	83	61	112.1	61	22	0
10	109.644	110	68	134.5	68	42	0	111.002	111	61	136.55	61	50	0
11	62.993	63	68	96.24	68	0	0	132.481	132	61	170.26	61	71	0
12	134.508	135	68	148.6	68	67	0	105.081	105	61	159.71	61	44	0
13	71.3452	71	68	111.7	68	3	0	61.187	61	61	110.54	61	0	0
14	103.443	103	68	125.3	68	35	0	133.695	134	61	158.47	61	73	0
15	111.017	111	68	139.7	68	43	0	36.5911	37	61	85.324	61	0	0
16	130.673	131	68	166.5	68	63	0	43.5627	44	61	55.725	56	0	1
17	114.059	114	68	163.3	68	46	0	107.009	107	61	107.01	61	46	0
18	117.153	117	68	164.8	68	49	0	115.145	115	61	138.15	61	54	0
19	115.564	116	68	164	68	48	0	121.078	121	61	159.65	61	60	0
20	67.8579	68	68	115.8	68	0	0	121.36	121	61	170.69	61	60	0
21	117.685	118	68	141.6	68	50	0	119.347	119	61	174.19	61	58	0
22	151.007	151	68	187.8	68	83	0	106.036	106	61	162.63	61	45	0
23	118.979	119	68	178.9	68	51	0	39.7701	40	61	90.586	61	0	0
24	89.9776	90	68	145.4	68	22	0	96.5072	97	61	111.3	61	36	0
25	87.2418	87	68	126	68	19	0	97.1212	97	61	122.27	61	36	0
26	87.3266	87	68	116.3	68	19	0	83.6135	84	61	114.25	61	23	0
27	101.114	101	68	125.3	68	33	0	96.3455	96	61	122.97	61	35	0
28	73.3074	73	68	101.9	68	5	0	134.108	134	61	165.09	61	73	0
29	84.6818	85	68	101.7	68	17	0	132.872	133	61	184.92	61	72	0
30	54.088	54	68	70.91	68	0	0	124.167	124	61	186.13	61	63	0
31	90.6415	91	68	92.1	68	23	0	128.852	129	61	191.41	61	68	0
32	136.367	136	68	148.4	68	68	0	72.406	72	61	137.61	61	11	0
33	19.4988	19	68	59.71	60	0	1	92.9179	93	61	131.22	61	32	0
34	113.275	113	68	113.3	68	45	0	88.4393	88	61	123.55	61	27	0
35	95.5793	96	68	118.2	68	28	0	129.885	130	61	161.16	61	69	0
36	97.0181	97	68	122.1	68	29	0	84.7946	85	61	134.88	61	24	0
37	75.1989	75	68	102.3	68	7	0	139.155	139	61	176.09	61	78	0
38	53.4862	53	68	70.62	68	0	0	75.4464	75	61	132.99	61	14	0
39	144.565	145	68	145.9	68	77	0	81.2345	81	61	117.23	61	20	0
40	96.9449	97	68	135.9	68	29	0	142.477	142	61	170.59	61	81	0
41		3505	2448		2440	1140	1		3599	2196	.	2191	1465	1
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