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THESIS

**RAISING THE STANDARD: ANALYSIS OF THE
MARINE CORPS' PROPOSED CHANGES TO THE
AFQT SCORE REQUIREMENT FOR ENLISTMENT**

by

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June 2021

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PROPOSED CHANGES TO THE AFQT SCORE REQUIREMENT FOR
ENLISTMENT**

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ABSTRACT

This research analyzes the Commandant of the Marine Corps' proposed changes to the Armed Forces Qualification Test (AFQT) score required for enlistment within the Marine Corps. The proposed change includes raising the minimum AFQT score standard from 32 to 40. This research utilized a logistic regression model to assist in identifying potential effects on the retention of first term Marines. It was identified that AFQT scores have a negative relationship to the probability of a first term Marine submitting for reenlistment, thus, increasing the minimum AFQT score standard for enlistment has the potential to negatively impact the retention of first term Marines.

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TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	OBJECTIVES	2
B.	RESEARCH QUESTIONS.....	2
C.	SCOPE AND LIMITATIONS	3
	1. Scope.....	3
	2. Limitations.....	4
D.	ORGANIZATION OF THIS STUDY.....	5
II.	LITERATURE REVIEW	7
A.	COMMANDANT’S 2019 PLANNING GUIDANCE	7
	1. Education and Training	7
	2. Force Design and Warfighting.....	8
	3. Historical Significance of Aptitude.....	8
	4. Commandant’s 2020 Directed Actions.....	9
B.	TWENTY-FIRST CENTURY BATTLESPACE	9
C.	ARMED SERVICES VOCATIONAL APTITUDE BATTERY TEST	10
	1. Composite Scores	11
	2. Value of the Armed Forces Qualification Test for Recruiting	14
D.	THE MARINE CORPS REENLISTMENT PROCESS	15
	1. Types of Reenlistment, Extension, and Lateral Move Requests	16
	2. Quality of First Term Alignment Plan Marines.....	17
E.	DOD RECRUITING AND RETENTION LITERATURE	19
	1. Gap in the Literature.....	20
III.	METHODOLOGY	23
A.	DATA CONSOLIDATION.....	23
B.	OVERVIEW OF THE DATA.....	24
C.	TECHNIQUES APPLIED	27
D.	STATISTICAL SOFTWARE.....	27
E.	UNDERSTANDING THE DATA	28
	1. Eligible Reenlistment Cohort.....	29
	2. Applied for Reenlistment	30
	3. Approved for Reenlistment by MMEA.....	31
	4. Accepted Reenlistment	33

5.	RELM Approval by Quality Tier	34
F.	ASSUMPTIONS AND LIMITATIONS OF DATA.....	37
IV.	ANALYSIS	39
A.	DATA CLEANING.....	39
B.	DATA TRENDS.....	41
1.	Population Distribution	41
2.	Population RELM Request Submission.....	42
3.	Approval of RELM Requests.....	42
4.	Acceptance of RELM Requests	43
5.	Data Trend Summary.....	43
C.	RECODING THE DATA.....	43
D.	STRATIFYING DATA	44
E.	REGRESSION EQUATION	44
F.	MODEL VALIDATION	45
G.	LOGISTIC REGRESSION	46
H.	CHAPTER SUMMARY.....	47
V.	SUMMERY, CONCLUSION, AND RECOMMENDATIONS.....	49
A.	SUMMARY	49
1.	Research Question 1	49
2.	Research Question 2	50
3.	Research Question 3	51
4.	Research Question 4	51
B.	NARRATIVE OF THE RESEARCH FINDINGS.....	52
C.	CONCLUSION	52
D.	RECOMMENDATIONS FOR FUTURE RESEARCH.....	53
	APPENDIX. AFQT DISTRIBUTION: GENDER.....	55
	LIST OF REFERENCES.....	57
	INITIAL DISTRIBUTION LIST	61

LIST OF FIGURES

Figure 1.	FY 2014 Cohort Data Groups	4
Figure 2.	Marine Corps Reenlistment Process. Source: Gayman as cited in Cole (2014).	16
Figure 3.	Marine Corps Quality Tier Worksheet. Source: USMC (2014a).	18
Figure 4.	Marine Corps Tier Calculation. Source: Chunn (2020).	19
Figure 5.	Major Stages of the Reenlistment Process. Adapted from Cole (2014).	28
Figure 6.	FY 2014 Cohort AFQT Score Distribution. Adapted from USMC (2021).	29
Figure 7.	RELM Counts by AFQT Score. Adapted from USMC (2021).	30
Figure 8.	AFQT Score Breakdown of RELM Type by MMEA Approval. Adapted from USMC (2021).	32
Figure 9.	AFQT Score Breakdown of RELM type by Acceptance. Adapted from USMC (2021).	33
Figure 10.	AFQT Score Distribution by Tier Category. Adapted from USMC (2021).	35
Figure 11.	Recoded RELM Type to Binary Variable of Desire to Reenlist. Adapted from USMC (2021).	44
Figure 12.	Model Validation. Adapted from USMC (2021).	45
Figure 13.	Probability of RELM Submission versus AFQT Score. Adapted from USMC (2021).	47
Figure 14.	Probability of RELM Submission versus AFQT Score Grouped by Tier, PFT, and CFT. Adapted from USMC (2021).	48

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LIST OF TABLES

Table 1.	ASVAB Test Overview. Adapted from TOSOTA (n.d.).....	11
Table 2.	Marine Corps Composite Score Calculations. Adapted from USMC (2014b).....	12
Table 3.	Minimum ASVAB Standards by Enlistment Option Program. Adapted from USMC (2012).	13
Table 4.	AFQT Percentiles and Percentage of the Youth Population. Adapted from Sellman (2004).	14
Table 5.	Possible RELMs by Type. Adapted from USMC (2021).	17
Table 6.	FY 2014 Cohort Breakdown by Gender. Adapted from USMC (2021).	23
Table 7.	FY 2014 RELM Request Totals. Adapted from USMC (2021).	24
Table 8.	FY 2014 Cohort RELM Statuses. Adapted from USMC (2021).	25
Table 9.	Computed Tier Distribution. Adapted from USMC (2021).	26
Table 10.	Independent and Dependent Variables. Adapted from USMC (2021).	26
Table 11.	AFQT Score Breakdown. Adapted from USMC (2021).	30
Table 12.	RELM Submission Count by AFQT Range. Adapted from USMC (2021).	31
Table 13.	AFQT Breakdown by MMEA Approval. Adapted from USMC (2021).	32
Table 14.	AFQT Breakdown by Acceptance. Adapted from USMC (2021).	34
Table 15.	AFQT Score Breakdown by Tier, Approval, and Acceptance. Adapted from USMC (2021).	36
Table 16.	Duplicate Entry Example 1. Adapted from USMC (2021).	40
Table 17.	Duplicate Entry Example 2. Adapted from USMC (2021).	40
Table 18.	Duplicate Entry Example 3. Adapted from USMC (2021).	41
Table 19.	Parameter Estimates. Adapted from USMC (2021).	45

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LIST OF ACRONYMS AND ABBREVIATIONS

AETP	ASVAB Enlistment Testing Program
AFADBD	Armed Forces Active Duty Base Date
AFQT	Armed Forces Qualification Test
AI	Auto Information
AO	Assembling Objectives
AR	Arithmetic Reasoning
ASVAB	Armed Services Vocational Aptitude Battery
CL	Clerical/Administration
CMC	Commandant of the Marine Corps
CSIS	Center for Strategic & International Studies
CRS	Congressional Research Service
DOD	Department of Defense
DON	Department of the Navy
ECC	End of Current Contract
EDIPI	Electronic Data Interchange Personal Identifier
EI	Electronic Information
EL	Electronic Repair
FTAP	First Term Alignment Plan
FY	Fiscal Year
GS	General Science
GT	General Technical
HQMC	Headquarters Marine Corps
MC	Mechanical Comprehension
MCMAP	Marine Corps Martial Arts Program
MCTFS	Marine Corps Total Forces System
MCTIMS	Marine Corps Training Information Management System
MMEA	Marine Corps Enlisted Assignment Branch
MK	Mathematics Knowledge
MM	Mechanical Maintenance
MOS	Military Occupational Specialty

MPP	Manpower Plans and Policy Division
NDAA	National Defense Authorization Act
NJP	Non-Judicial Punishment
PC	Paragraph Comprehension
QMI	Quality Marine Identification
RELM	Reenlistment, Extension, and Lateral Move Request
SDA	Special Duty Assignment
SECNAV	Secretary of the Navy
SI	Shop Information
TFDW	Total Force Data Warehouse
TFRS	Total Force Retention System
U.S.	United States
UAS	Unmanned Aerial System
UUID	Universally Unique Identifier
USMC	United States Marine Corps
WK	Word Knowledge

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I. INTRODUCTION

Recruiting and retention are oftentimes the most challenging tasks facing the Marine Corps (Davis, 2008; Snow 2018a). Among all branches of the military, the Marine Corps is the least desirable organization to join and has the highest turnover rate of first term personnel at 76% (Chunn, 2020; Snow 2018a&b). Once Marines are recruited and perform well throughout their initial enlistment contract, persuading them to extend their tenure with all the various competitors in the marketplace has proved to be a difficult endeavor. For example, in fiscal years (FYs) 2017, 2018, and 2019, the Marine Corps failed to achieve first term alignment plan (FTAP) manpower goals (Kapp, 2020).

Compounding the inherent recruiting and retention challenges, the Marine Corps also desires to recruit and retain more Marines with superior cognitive capabilities who can better navigate the intellectual demands associated with twenty-first century conflict and leverage emerging technologies (Berger, 2019). In an effort to recruit and retain Marines with increased aptitude, the Commandant of the Marine Corps (CMC) has directed that the following study be accomplished.

Determine the opportunities, risks, and costs associated with raising the minimum AFQT [32 to 40] for enlistment...and provide a formal recommendation. Provide an evidence-based analysis that indicates this could irreparably damage recruiting efforts or operational readiness. (Berger, 2020, pp. 2)

The Armed Forces Qualification Test (AFQT), a composite score within the Armed Services Vocational Aptitude Battery (ASVAB) test, is the military's cognitive testing metric (The Official Site of the ASVAB [TOSOTA], n.d.). Higher AFQT scores positively correlate with superior job performance, learning ability, lower disciplinary problems, and lower first term attrition rates (Marrone, 2020; Sellman, 2004). In essence, recruiting and retaining Marines with higher AFQT scores will increase the readiness of the force (Berger, 2019). However, there are possible second- and third-order effects that may accompany these types of policy changes. To ensure increasing the AFQT score standard from 32 to 40 is appropriate, exploring its potential effects is required.

A. OBJECTIVES

The objective of this research is to analyze the relationship between AFQT scores and the desire of first-term enlisted Marines to reenlist. This research will observe the cohort of all enlisted Marines who joined the Marine Corps in FY 2014. Additionally, the desire to reenlist is depicted by a Marine voluntarily submitting a reenlistment, extension, or lateral move (RELM) request during their initial enlistment contract to the Marine Corps Enlisted Assignment Branch (MMEA). Due to the Marine Corps having various types of RELM requests, this research will only consider RELM requests that if approved, requires future service after one's initial service obligation. With the Marine Corps possibly increasing the minimum AFQT score for enlistment from 32 to 40, analyzing the AFQT scores of the Marines who submitted RELM requests will assist in identifying whether increasing the minimum AFQT score is an appropriate course of action.

B. RESEARCH QUESTIONS

The research questions are formulated around identifying whether raising the minimum AFQT score standard from 32 to 40 has any potential effects associated with manpower retention (Berger, 2020). Additionally, the research questions are focused on retention, but due to recruiting and retention having reciprocal effects, this thesis can provide valuable insights to MMEA and Marine Corps Recruiting Command (MCRC).

1. How would the FY 2014 cohort be affected after raising the minimum AFQT score from 32 to 40?
2. What is the relationship between AFQT scores and reenlistment desire?
3. What is the relationship between AFQT scores and MMEA approval rates of RELM requests?
4. What is the relationship between AFQT scores and a Marine accepting the approved RELM request?

C. SCOPE AND LIMITATIONS

Data for this research was received from the Marine Corps' Total Force Data Warehouse (TFDW) and Total Force Retention System (TFRS). The data collected includes all enlisted Marines who joined the Marine Corps during FY 2014. Primary attributes include Electronic Data Interchange Personal Identifier (EDIPI), gender, Military Occupational Specialty (MOS), Armed Forces Active Duty Base Date (AFADBD), End of Active Service (EAS) date, ASVAB scores, quality tier categorization, Physical Fitness Test (PFT) scores, and Combat Fitness Test (CFT) scores.

1. Scope

This primary objective of this research is to examine the relationship between AFQT scores and the FY 2014 cohort of enlisted Marines who submitted RELM requests during their initial enlistment contract. The primary independent variable in this research is AFQT score. The primary dependent variable is a RELM request that incurs an extension to one's obligated service. To address our research questions, a logistic regression analysis will be conducted in order to explicate the relationship between the independent and dependent variables.

To scrutinize the effects of raising the minimum AFQT score standards comprehensively, this research will examine all enlisted Marines who joined during FY 2014. The entire group of FY 2014 Marines will be further divided into three distinct groups based on the individual Marine's RELM request history. Once all three groups have been established, an analysis of the effects from increasing the minimum AFQT enlistment score has on each of the respective groups will be conducted.

The analysis will begin with all Marines who have an AFADBD during FY 2014. The common understanding pertaining to this group is that not all Marines who joined during FY 2014 submitted a RELM request to MMEA throughout their initial enlistment contract. The first division of the FY 2014 cohort will be limited to all FY 2014 Marines who submitted a RELM request to MMEA during their initial enlistment contract. The next group will be all FY 2014 Marines who submitted a RELM request during their initial enlistment contract and whose RELM requests were approved by MMEA. The final group

will contain the Marines whose RELM requests were approved by MMEA and accepted by the individual Marine. These groups are depicted in Figure 1.

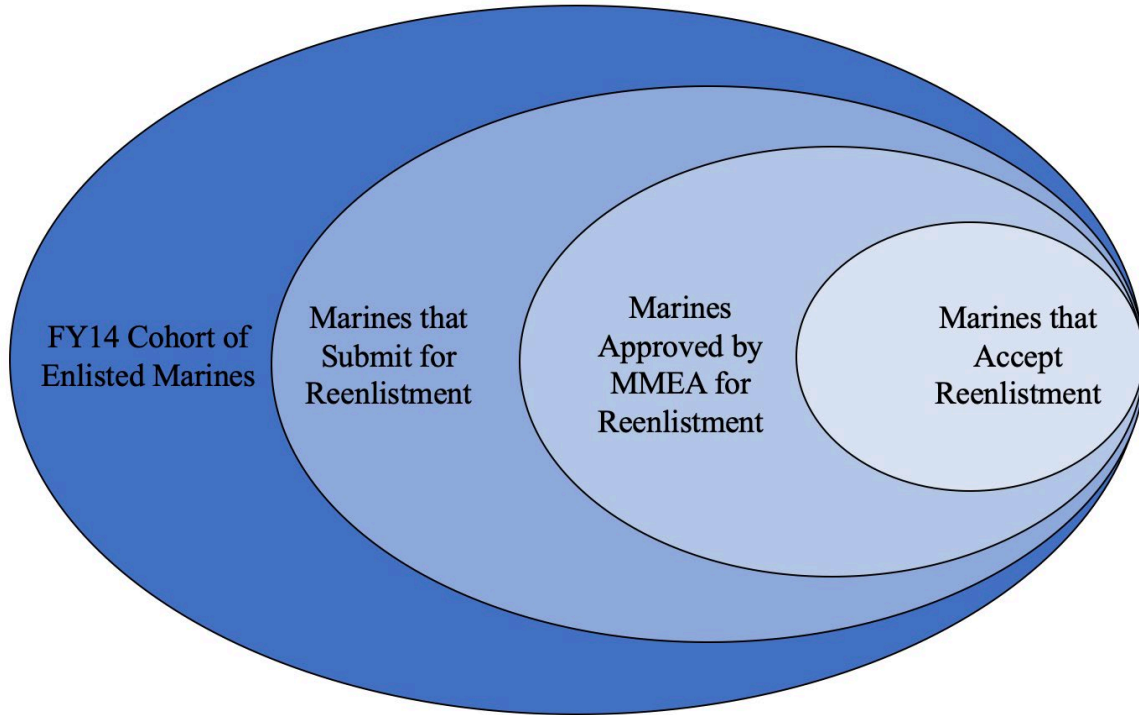


Figure 1. FY 2014 Cohort Data Groups

2. Limitations

This research analyzes the relationship between AFQT scores and the desire of a first term Marine to reenlist. It is acknowledged that there are other variables outside the scope of this research that can affect the decision of a first term Marine to submit a RELM request. Some of these variables include reenlistment incentives, operational tempo, marital status, economic status, unemployment rates, and job satisfaction (Lancaster et al., 2013; Vasterling et al., 2015). This research does not incorporate these variables and the reader should consider them if utilizing the findings within this thesis.

D. ORGANIZATION OF THIS STUDY

This study will consist of a literature review, methodology, analysis, and conclusion. The literature review will provide high-level information on the reenlistment process, the ASVAB, identify how this thesis contributes to a larger body of knowledge, and identify how this research supports the CMC's (2019) Planning Guidance. The ensuing sections will cover data collection, data consolidation, techniques applied, answers to the research questions, and recommendations for future research.

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II. LITERATURE REVIEW

This literature review will consist of five sections. The first section will provide an overview of the CMC's (2019) planning guidance and explain how this thesis contributes to the CMC's priorities for the force. The second section will analyze the strategic environment the Marine Corps will be required to operate within and illustrate why the CMC desires to recruit and retain Marines with superior cognitive capabilities. The third section will provide the reader with a high-level overview and purpose of the ASVAB to enable the reader's understanding of the research methods and findings. The fourth section will provide the reader with a summary of the Marine Corps' reenlistment process. Lastly, the fifth section will provide the reader with an overview of the current research on DOD recruiting and retention. The purpose of the fifth section is to display how this research will contribute to the larger body of knowledge pertaining to military recruiting and retention.

A. COMMANDANT'S 2019 PLANNING GUIDANCE

The CMC's (2019) Planning Guidance is the driving document behind this thesis. Within the CMC's Planning Guidance, it was identified that "The Marine Corps is not organized, trained, equipped, or postured to meet the demands of the rapidly evolving future operating environment" (Berger, 2019, pp. 1). To rectify this issue, the CMC outlined five focus areas to improve the readiness of the Marine Corps. These focus areas are force design, warfighting, education and training, core values, and command and leadership (Berger, 2019). This thesis falls within the CMC's education and training, force design, and warfighting focus areas.

1. Education and Training

Within the education and training discussion, the CMC identified that the twenty-first century operating environment will require a "highly educated force" that is able to rapidly improvise, adapt, and learn (Berger, 2019, pp. 16). The underlying premise with this claim is that a force with superior cognitive abilities is a more effective force. Because of this, the CMC desires to create a culture that prioritizes lifelong learning through continuous education and training throughout a Marine's career (Berger, 2019). This

includes prioritizing higher education opportunities for all Marines such as resident military education and graduate education (Berger, 2019).

2. Force Design and Warfighting

Portions of the force design and warfighting discussions focused on recruiting and retaining the “best and most innovative minds” to leverage emerging technologies and rid the Marine Corps of the industrial style manpower system (Berger, 2019, pp. 18). These sections also share an underlying premise with the education and training discussion which is that superior cognitive abilities increase military effectiveness. The idea behind the force design and warfighting discussions is that once quality personnel are recruited and retained, technology can be integrated to ameliorate their skills. Illustrating this, the CMC stated, “All of our investments in data science, machine learning, and artificial intelligence are designed to unleash the incredible talent of the individual Marine” (Berger, 2019, pp. 15). The Marine Corps sees its personnel as its competitive advantage; so, implementing policies that require increases in manpower performance metrics are crucial to recruiting and retaining the “best and most innovative minds” (Berger, 2019, pp. 18).

3. Historical Significance of Aptitude

The concept of aptitude increasing warfighting effectiveness is further reenforced by Laurence’s (1999) RAND research paper which analyzed the American all-volunteer force. Laurence (1999) identified that aptitude directly affects personnel trainability and performance; both of which contribute significantly to readiness. Laurence (1999) also discusses the DOD’s previous experience with low aptitude directly affecting force design. It was identified that military personnel with lower aptitude struggled to complete training courses and had less chances of being selected for promotion compared to personnel with higher aptitude (Laurence, 1999).

Further reinforcing Laurence’s (1999) research, Caylor et al. (1997) identified that aptitude correlates with increased retention and proficiency of job-related skills during training and increased job qualification test scores. Additionally, Cline et al. (1957) identified that aptitude levels distinguished military personnel as fighters from non-fighters during the Korean War. With MOSs and the current battlespace becoming increasingly

complex, clearly, increased aptitude among military personnel can contribute towards creating and sustaining competitive advantage (Berger, 2019).

4. Commandant's 2020 Directed Actions

Following the issuing of the 2019 Planning Guidance, the CMC published twenty-one directed actions to guide efforts toward improving the stated focus areas (Berger, 2020). Specifically, directed action (f) is the primary scope of this thesis and is aimed at improving education and training, force design, and warfighting. Directed action (f) is as follows.

Determine the opportunities, risks, and costs associated with raising the minimum AFQT [32 to 40] for enlistment...and provide a formal recommendation. Provide an evidence-based analysis that indicates this could irreparably damage recruiting efforts or operational readiness. (Berger, 2020, pp. 2)

By researching the potential effects of raising the minimum AFQT score from 32 to 40, this research can contribute towards future Marine Corps recruiting and retention endeavors.

B. TWENTY-FIRST CENTURY BATTLESPACE

Future military conflict will be characterized by complex operations integrated with highly advanced technology (Berger, 2019). Consequently, the intellectual demands associated with military operations have increased (Berger, 2019). Adversaries of the United States (U.S.) are advancing their technological capabilities, recruiting soldiers with higher cognitive abilities, and are contesting the U.S. in unconventional manners which has led to a reoccurrence of long-term great power competition (DOD, 2018a). With the Marine Corps being the nation's rapid-response force required to respond to myriad threats, it is safe to assume that more will be demanded of the Marine Corps moving further into the twenty-first century.

To counteract near-peer competitive response, the Marine Corps is prioritizing the integration of emerging technology into combined arms operations (Berger, 2019). Some of these emerging technologies include cyber weapons, artificial intelligence, advanced

fire-support applications, human-machine teams, and enhanced communication devices. However, to fully leverage these emerging technologies, recruiting and retaining Marines with increased cognitive capabilities is required (Berger, 2019). In 2019, the CMC stated,

Our manpower system was designed in the industrial era to produce mass, not quality. We assumed that quantity of personnel was the most important element of the system, and that workers (Marines) are all essentially interchangeable. As the complexity of the world has increased, the spread between physical jobs and thinking jobs has increased dramatically. War still has a physical component, and all Marines need to be screened and ready to fight. However, we have not adapted to the needs of the current battlefield. The only way to attract and retain Marines capable of winning on the new battlefield is to compete with the tools and incentives available to them in the marketplace. (Berger, 2019, pp. 7)

The CMC's guidance implies that simply obtaining advanced technology and having numerical superiority does not automatically equal a competitive advantage. The Marine Corps' competitive advantage will stem from the caliber of personnel that are recruited and retained (Berger, 2019). So, why does the CMC desire to explore the possibility of increasing the minimum AFQT score for enlistment from 32 to 40? By recruiting and retaining personnel with superior cognitive capabilities, the Marine Corps can further maximize the capabilities of emerging technology and build a more lethal force.

C. ARMED SERVICES VOCATIONAL APTITUDE BATTERY TEST

The ASVAB is the DOD's current method of determining one's eligibility for enlistment and identifies which military occupational specialties (MOSs) are best suited for an individual (TOSOTA, n.d.). The ASVAB determines MOS suitability because the test is a proven predictor of whether an individual can complete MOS specific training, and the follow-on duties required within their MOS (Sellman, 2004). The high-level subjects tested on the ASVAB are Mathematics, Verbal, Science, and Technical. Additionally, the ASVAB contains ten subordinate tests that fall within the high-level subjects. Table 1 shows the subjects tested and their associated subordinate tests and tasks.

Table 1. ASVAB Test Overview. Adapted from TOSOTA (n.d.).

ASVAB Test		
Subject	Test	Task
Math	Arithmetic Reasoning (AR)	Ability to solve arithmetic word problems
Math	Mathematics Knowledge (MK)	Knowledge of high school mathematics principles
Verbal	Word Knowledge (WK)	Ability to select the correct meaning of a word presented in context and to identify the best synonym for a given word
Verbal	Paragraph Comprehension (PC)	Ability to obtain the information from written passages
Science/Technical	General Science (GS)	Knowledge of physical and biological sciences
Science/Technical	Electronics Information (EI)	Knowledge of electricity and electronics
Science/Technical	Auto Information (AI)	Knowledge of automobile technology
Science/Technical	Shop Information (SI)	Knowledge of tools and shop terminology and practices
Science/Technical	Mechanical Comprehension (MC)	Knowledge of mechanical and physical principles
Science/Technical (Spatial)	Assembling Objectives (AO)	Ability to determine how an object will look when its parts are put together

1. Composite Scores

The Marine Corps further breaks down the ASVAB into composite scores, which combines various subordinate test scores into a composite score that measures an applicant's military potential and ability to perform a specific MOS (Sellman, 2004). The Marine Corps' composite scores are AFQT, GT, Mechanical Maintenance (MM), Electronic Repair (ER), and Clerical Administration (CL) (USMC, 2014b). Most

importantly, the AFQT composite score is the only composite score that is uniformly applicable to all branches of the military and is calculated by combining the scores of word Knowledge (WK), Paragraph Comprehension (PC), Arithmetic Reasoning (AR), and Mathematics Knowledge (MK) (USMC, 2014b). The other composite scores, GT, MM, EL, and CL, are not uniformly applicable to all military branches and must be converted appropriately (USMC, 2014b). Composite scores and their calculations are displayed in Table 2.

Table 2. Marine Corps Composite Score Calculations. Adapted from USMC (2014b).

Marine Corps Composite Score Calculations			Max Score
AFQT	=	WK + PC + AR + MK	99
GT (General Technical)	=	WK + PC + AR + MC	151
MM (Mechanical Maintenance)	=	AR + EI + MC + AS	161
EL (Electronic Repair)	=	AR + MK + EI + GS	151
CL (Clerical/Administration)	=	WK + PC + MK	141

The Marine Corps establishes minimum standards of entry into specific Enlisted Occupational Options (EOOs) based on composite score values computed in Table 2. EOOs, as depicted in Table 3, are high-level occupational categories containing specific MOSs. For example, the infantry option EOO contains numerous infantry MOSs such as rifleman, mortarman, and machine gunner. Based on one's composite scores, a potential recruit can be put into an MOS in accordance with their intellectual capabilities. For example, if a potential recruit desires to serve in the infantry, a minimum score of a 32 on the AFQT and an 80 on the GT is required; however, there are no minimum requirements for the MM, EL, CL, and VE composite scores.

As illustrated in Table 3, the lowest AFQT score a potential recruit can receive and still be eligible for enlistment is a 32 (USMC, 2012). However, applicants with AFQT scores less than 32 may be eligible for enlistment after an administrative review is conducted by the recruiting station's Commanding Officer and he or she finds them suitable for enlistment (USMC, 2011).

Table 3. Minimum ASVAB Standards by Enlistment Option Program.
Adapted from USMC (2012).

Description	Minimum Score by Section					
	AFQT	GT	MM	EL	CL	VE
Aviation Support	32	105	95	x	x	x
Aviation Mechanic	32	x	105	x	x	x
Enlisted Aircrew	32	110	105	x	x	x
Aviation Operation	32	105	x	x	x	x
Aviation Electronics Technician	32	x	x	105	x	x
Electronics Maintenance	32	x	x	115	x	x
Transportation Option	32	x	85	x	x	x
Legal and Administration Option	32	x	x	x	100	x
Supply and Accounting Option	32	x	x	x	105	x
Equipment / Vehicle Repair Option	32	x	95	x	x	x
Combat Support	32	90		x	x	x
Ordnance Technician / Metal Works	32	x	95	x	x	x
Public Affairs	32	110	x	x	x	45
Media Option	32	100	x	x	x	x
Logistics Option	32	100	x	x	x	x
Fire Direction / Control Specialist	32	105	x	x	x	x
Combat Vehicle Repair Option	32	x	105	x	x	x
Construction / Utilities Option	32	x	95	x	x	x
Service Management Option	32	x	x	x	90	x
Communications / Electrician	32	x	x	100	x	x
Cryptologic Linguist Option	32	105	x	x	x	x
Intelligence / Ground Electronic Warfare	32	100	x	x	x	x
Food Service Option	32	90	x	x	x	x
METOC / MAGTF	32	105	x	x	x	x
5-year Infantry Bonus (must meet AFQT and GT)	50	90	x	x	x	x
6-year Infantry Bonus (must meet AFQT and GT)	50	100	x	x	x	x
Reconnaissance	32	105	x	x	x	x
Parachute Rigger	32	100	x	x	x	x
Open Contract (only required to meet one)	32	90	95	90	100	x
Infantry Option	32	80	x	x	x	x
Nuclear, Biological and Chemical	32	110	x	x	x	x
Military Police and Corrections	32	100	x	x	x	x
Marine Corps Security Forces	32	90	x	x	x	x
Musician (must meet AFQT and GT)	50	100	x	x	x	x

2. Value of the Armed Forces Qualification Test for Recruiting

The principal value the AFQT provides as a testing metric is its ability to compare a potential recruit’s cognitive abilities to the overall aptitude of the youth population within the United States (Sellman, 2004). This enables the Marine Corps to understand who they are recruiting and adjust their recruiting strategies accordingly. Additionally, the AFQT serves as a risk indicator for the Marine Corps. Illustrating this, higher AFQT scores positively correlates with superior job performance, learning ability, lower disciplinary problems, and lower first-term attrition rates (Marrone, 2020; Sellman, 2004). In essence, when test scores increase, risk decreases.

The AFQT was normalized by the DOD through a 1997 study where a representative sample of Americans within the ages of 18 to 23 completed the ASVAB (TOSOTA, n.d.; Sellman, 2004). Because of this study, the DOD can compare the cognitive abilities of military recruits to the cognitive abilities of non-military citizens using percentile scores ranging from 1 to 99 (Sellman, 2004). For example, an AFQT score of 50 indicates that a recruit has scored greater than or equal to 50% of the 1997 sample. AFQT categories and their associated percentiles are displayed in Table 4.

Table 4. AFQT Percentiles and Percentage of the Youth Population.
Adapted from Sellman (2004).

AFQT Category	Score Range / Percentile	Percent of Civilian Youth Population
I	93-99	8%
II	65-92	28%
IIIA	50-64	15%
IIIB	31-49	19%
IVA	21-30	21%
IVB	16-20	
IVC	10-15	
V	1-9	9%

D. THE MARINE CORPS REENLISTMENT PROCESS

Every year, the Congressional Armed Services Committee renews the National Defense Authorization Act (NDAA). Within the NDAA, each service branch is authorized a specific active component end-strength which is the total amount of personnel serving on active duty. Once the NDAA is signed into law, the individual services utilize the NDAA to plan their recruiting and retention goals for the upcoming FY.

Prior to the upcoming FY, Headquarters Marine Corps (HQMC) issues first term alignment plan (FTAP) goals to assist in meeting manpower numbers established in the NDAA. Marines that are eligible for reenlistment during a FY must be towards the conclusion of their initial enlistment contract and possess an End of Current Contract (ECC) date between 1 October and 30 September (USMC, 2019). If a Marine's ECC date falls within the specified dates, they are referred to as an FTAP Marine. For example, a FY 2010 FTAP Marine would have an ECC date between 1 October 2009 and 30 September 2010. If a Marine's ECC falls within the specified dates, they have the option of submitting or not submitting a RELM request. If a Marine does not submit a RELM request, they will serve until their End of Active Service (EAS) date. If a Marine decides to submit a RELM request, they will execute the Marine Corps' reenlistment process which is displayed in Figure 2.

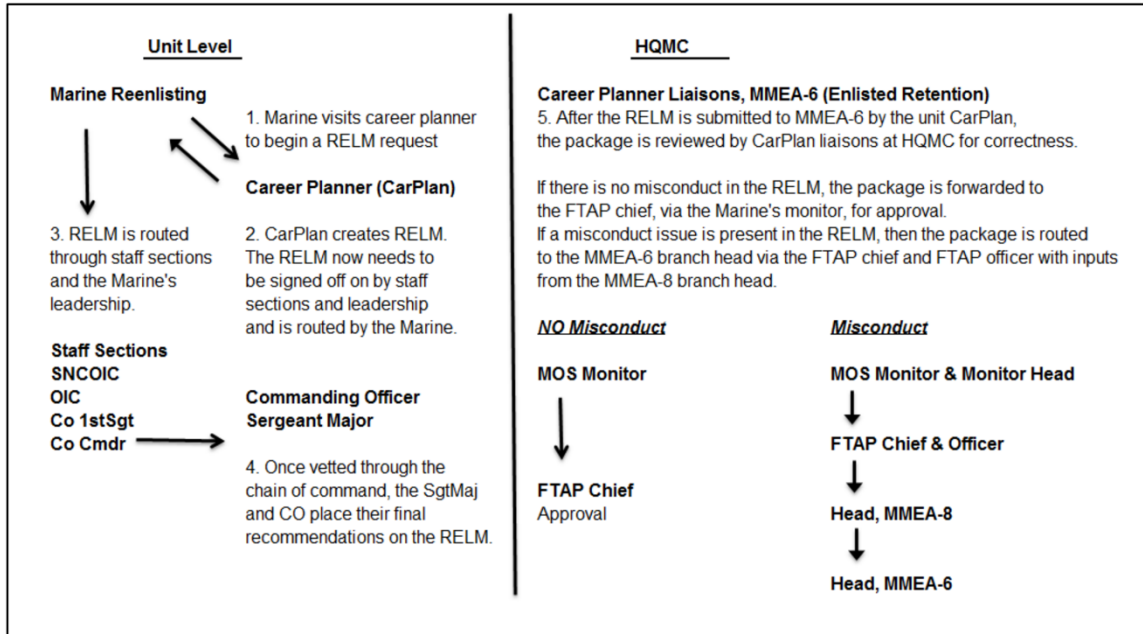


Figure 2. Marine Corps Reenlistment Process. Source: Gayman as cited in Cole (2014).

A Marine's RELM request will be submitted through their chain of command for recommendations on retention; however, MMEA maintains the final decision authority for all RELM requests. If a Marine's RELM request is denied by MMEA, the Marine will serve until their EAS date. If a Marine's RELM request is approved, the Marine has the option of either accepting or denying a subsequent enlistment contract.

1. Types of Reenlistment, Extension, and Lateral Move Requests

The objective of this research is to analyze the relationship between a Marine's AFQT score and their desire to reenlist. The desire to reenlist is indicated by Marine submitting a RELM request that if approved, requires future service. As previously stated, the primary dependent variable for this research is a RELM submission by a Marine from the FY 2014 cohort. Likewise, there are numerous RELM types a Marine is authorized to submit; however, not all the RELM types submitted incur a subsequent service obligation. This research is solely interested in the RELM requests that incur a future service obligation. If the RELM request does not incur subsequent service, it does not illustrate a Marine having the desire to reenlist and will not be significant to this research. Table 5

illustrates the types of RELM requests that were submitted by the FY 2014 cohort of Marines. A more in-depth discussion of the RELM types that were considered will occur in Chapters III and IV.

Table 5. Possible RELMs by Type. Adapted from USMC (2021).

RELM Type	If approved by MMEA, does the RELM request incur a subsequent service obligation?
Reenlistment	Yes
Reenlistment with Overseas Extension	Yes
Early Reenlistment	Yes
Special Duty Assignment (SDA) with Reenlistment	Yes
SDA Only	No
Lateral Move	Yes
Lateral Move with Overseas Extension	Yes
Quality Marine Identification (QMI)	Yes
QMI with Overseas Extension	Yes
MOS Reclassification	No
Special Officer Programs	Yes
Quality Reenlistment Program (QRP)	Yes
Prior Service Enlistment Program (PSEP)	Yes
Local Command Authority (LCA) Extension	No
Relief for Good of the Service	No
Relief for Cause	No
Separations (SEPS) Pay Determination	No
Tattoo Screening Request	No
Time on Station Waiver	No

2. Quality of First Term Alignment Plan Marines

The mission of FTAP is to select the most qualified Marines and retain sufficient Marines to achieve manpower requirements (USMC, 2019). A Marine's quality is determined by their tier categorization which is received during the reenlistment process. When a Marine submits a RELM request to MMEA, the Marine will be objectively assigned to one of four tiers which are percentile rankings within each MOS (USMC, 2014a). Marines within tier one are the most qualified Marines within their MOS, and

Marines within tier four are the least qualified Marines within their MOS. Figure 3 is an example of a Quality Tier Worksheet.







CPL I. M. MARINE		
MOS XXXX		
Event	MOS Avg	SNM's Scores
PFT	246	274
CFT	282	284
Proficiency Marks	430	430
Conduct Marks	430	430
Rifle Qualification	293	303
MCMAP	MMB - Tan Belt	MMD - Green Belt
Meritorious Promotion	N/A	0
 1691 		
Legal History	Type	Date
NJP(s) / Court Martial	N/A	N/A
Tier Chart		
Tier I (10%)		
Tier II (30%)		
Tier III (50%)	X	
Tier IV (10%)		
SNM ranks 53rd of 100 Marines reenlisting in FY'XX in MOS XXXX SNM falls in the 10 - 59 Percentile SNM is a Tier III Marine		

Figure 3. Marine Corps Quality Tier Worksheet. Source: USMC (2014a).

The variables involved in computing a Marine's tier are PFT, CFT, proficiency and conduct marks, rifle qualification score, Marine Corps Martial Arts Program (MCMAP)

belt level, and NJP information (USMC, 2014a). The calculation will output a Marine’s a total score; then the Marine’s total score will be compared to all other scores among the Marines in the same MOS and a tier category will be assigned (USMC, 2014a). The tier score calculation is displayed in Figure 4.

Computed Tier Score Method and Weights		
Component	Max Score	Max Weight
Rifle Marksmanship Score	350	16.3%
CFT Score	300	14%
PFT Score	300	14%
Average Duty Proficiency: _____ x 100	500	23.3%
Average Conduct: _____ x 100	500	23.3%
MCMAP Belt Points	100	4.7%
Meritorious Promotion	100	4.7%
	2150	100%

Figure 4. Marine Corps Tier Calculation. Source: Chunn (2020).

It is important to note that NJPs automatically determine the maximum tier a Marine can be assigned to. If a Marine received one NJP throughout their initial enlistment, the maximum tier the Marine can be assigned to is tier two (USMC, 2014a). If a Marine received two or more NJPs throughout their initial enlistment, the maximum tier the Marine can be assigned to is tier three (USMC, 2014a). Furthermore, if a Marine was court-martialed during their initial enlistment, the Marine is automatically placed into tier four (USMC, 2014a).

E. DOD RECRUITING AND RETENTION LITERATURE

According to Handy & Spoehr (2018), 71% of 18- to 24-year-olds do not meet the basic standards for enlistment into the military. The primary causes of ineligibility stem from obesity, medical issues, criminal behavior, and failing to meet the required AFQT

scores for enlistment. Moreover, of the eligible population able to serve, only a fraction of them desire to serve; totaling to approximately one-million Americans available for all the branches of the armed forces (Brilakis, 2014, as cited in Handy et al., 2018). The lack of qualified young Americans has made recruiting exponentially more challenging and some top-level DOD officials consider this challenge a national security dilemma (Handy & Spoehr, 2018).

Compounding the inherent recruiting challenges for the Marine Corps, among all branches of the armed forces, the Marine Corps is the least desirable force to join (Snow, 2018a). Of the one-million young Americans interested in military service, it is estimated that approximately 5% of them are interested in the Marine Corps (Snow, 2018a). This makes recruiting exponentially more difficult for the Marine Corps and highlights the importance of improving retention to reduce the risks stemming from recruiting. The two topics of recruiting and retention should not be viewed as mutually exclusive tasks. Rather, they should be viewed as two interdependent endeavors with reciprocating strategies to ensure longevity of the force (Davis, 2008).

In addition to the recruiting challenges, the Marine Corps also struggles with retention. Currently, the Marine Corps has an 18.5% attrition rate among Marines serving within their initial 36-month tour (Marrone, 2020). Additionally, the Marine Corps has the highest turnover rate among all branches of service at 76% and approximately 60% of Marines are Sergeants and below (Chunn, 2020; Snow, 2018b). To increase retention, the DOD has periodically implemented stricter recruiting policies to ensure recruiters are enlisting people with superior chances of fulfilling their initial service obligation (DOD, 2018b; Gebicke, 1997). These policies have included stricter incentive programs, personal conduct standards, and robust medical screening techniques (DOD, 2018b; Gebicke, 1997).

1. Gap in the Literature

One's AFQT score is a significant predictor variable for first term attrition rate (Marrone, 2020). The lower the AFQT score, the higher chances one has of being separated throughout their initial service obligation (Marrone, 2020). Moreover, when adding in additional independent variables such as drug waivers, criminal history, psychological

issues, and a higher body mass index, the chances of attrition continue to increase (Marrone, 2020). To analyze this issue in its entirety, there needs to be a change in mindset. Rather than solely focusing on the negativity associated with attrition, looking at the positive correlations associated with retention is going to be required. The literature has shown positive correlations between education, AFQT, and their relation to retention (Marrone, 2020). However, the link between AFQT, and the desire to reenlist has failed to be explored.

There is a lack of literature illustrating the relationship between AFQT scores and first term Marines voluntarily submitting for reenlistment. In a similar study for the Army, Budding (2005) analyzed the correlation between soldiers who reenlisted and their AFQT scores. The study found two useful insights pertaining to this research. First, AFQT score and reenlistment are inversely proportional (Budding, 2005). This indicates that soldiers with higher AFQT scores tend to transition out of the Army and soldiers with lower AFQT scores tend to reenlist in the Army. Second, soldiers with increased amounts of formal education reenlist at lower rates compared to soldiers with less formal education (Budding, 2005). However, what Budding's (2005) research does not explore is the relationship between AFQT scores and voluntarily submitting for reenlistment.

Most of the research in this field is broken down into two focus areas. The first focus area examines the relationships between educational attributes (level of education, AFQT score, and GT score) within the population of service members that are selected for reenlistment. The second focus area examines educational attributes and their relationship to attrition. This leaves a gap in research regarding the predictors of reenlistment desire. Although Budding's (2005) research shows a link to actual reenlistment, this does not take into effect the entire population that voluntarily submitted a reenlistment package. By better understanding the relationship between AFQT scores and the desire to reenlist, the Marine Corps can attain more situational awareness on potential affects that could occur from implementing changes to AFQT score standards.

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III. METHODOLOGY

This research observed the entire cohort of Marines with a AFADB in FY 2014. Due to specific data requirements needed for this research, data requests were submitted to TFDW and Manpower Plans and Policy Division (MPP-20). TFDW provided most of the administrative data on the FY 2014 cohort such as EDIPIs, gender, PFT scores, CFT scores, ASVAB scores, and EAS dates. To observe and understand the reenlistment habits of the FY 2014 cohort, MPP-20 provided RELM request data from TFRS. Data from TFRS included the RELM type, RELM status, and quality tier designators. As displayed in Table 6, the data contained 26,083 Marines.

Table 6. FY 2014 Cohort Breakdown by Gender. Adapted from USMC (2021).

Gender	Total
Male	23,199
Female	2,884
Total	26,083
Total Missing	0

A. DATA CONSOLIDATION

Data requests from both TFDW and MPP-20 contained numerous instances of duplicate entries individual Marines. Regarding the data received from TFDW, once a Marine was approved for a reenlistment and received an updated EAS date, a second observation was created containing a new EAS date without replacing the original EAS date entry. Regarding the TFRS RELM data, Marines within a single cohort may submit a RELM request in different FYs depending on the nature of the RELM and the contract length of the individual Marine. This required cross referencing of multiple FYs of TFRS data to ensure all RELM submissions from the FY 2014 cohort were recorded. All duplicates were removed from the data.

MPP-20 delivered a Microsoft Excel file of all RELM requests submitted by the FY 2014 cohort. To match AFQT scores to the occurrence of RELM submissions, the TFRS data was concatenated then joined with the data provided by TFDW by utilizing EDIPs as the joining attribute. This data was then merged into a JMP database and totaled to 33,536 records. Of the 33,536 records, there were 7,463 duplicate entries which were removed, resulting in a total of 26,083 records. Of the 26,083 records, 150 contained omissions of the AFQT score attribute. The instances of Marines with omitted AFQT scores were retained to maintain the integrity of the FY 2014 cohort of Marines.

B. OVERVIEW OF THE DATA

The focus of this study is to determine the relationship between AFQT score, and the desire of a first term enlisted Marine to reenlist. The desire to reenlist is indicated by a Marine submitting a RELM request that if approved, requires future service. All RELM requests that do not require future service were disregarded due to not depicting the desire to reenlist. The RELM requests disregarded were SDA only, MOS Reclassification, LCA, Relief for Good of the Service, Relief for Cause, SEPS pay determination, tattoo screening request, and time on station waiver. All the types of RELM requests obtained from TFRS that depict the desire to reenlist are shown in Table 7.

To retain the integrity of the cohort, RELM requests that did not depict the desire to reenlist were not analyzed, but the Marine and their associated data points were retained to ensure accurate counts were maintained. All 19,044 observations of Marines without a RELM request were designated as having no desire to reenlist and are displayed in Table 7.

Table 7. FY 2014 RELM Request Totals. Adapted from USMC (2021).

RELM Type	Does the RELM request incur a subsequent service obligation?	Total
Reenlistment	Yes	5,080
Reenlistment with Overseas Extension	Yes	106
Special Duty Assignment (SDA) with Reenlistment	Yes	1,091
Lateral Move	Yes	663
Lateral Move with Overseas Extension	Yes	1

RELM Type	Does the RELM request incur a subsequent service obligation?	Total
Quality Marine Identification (QMI)	Yes	79
QMI with Overseas Extension	Yes	1
Special Officer Programs	Yes	10
Prior Service Enlistment Program (PSEP)	Yes	8
Total Showing Desire to Reenlist		7,039
Total Not Showing Desire to Reenlist		19,044

The RELM status attribute indicated whether a RELM submission was approved or denied by MMEA. This enabled the understanding of the relationship between AFQT score and RELM request approval. All RELM statuses along with their respective counts of occurrence are shown in Table 8.

Table 8. FY 2014 Cohort RELM Statuses. Adapted from USMC (2021).

RELM Status	Description	Total
Accepted	A Marine's RELM request was approved by MMEA and accepted by the Marine.	4,889
Admin Closed	A Marine's RELM submitted request was submitted to MMEA then returned for correction, but no action was taken.	978
Declined	A Marine's RELM request was approved by MMEA, but the Marine chose to decline future service.	881
Deleted	A Marine's RELM request was deleted prior to submitting to MMEA.	208
Disapproved	A Marine's RELM request was disapproved by MMEA.	82
Revoked	MMEA initially approved a Marine's RELM request, but the decision authority was later rescinded.	1
Total		7,039
Total Missing		18,982

As previously discussed, a Marine's quality is determined by their tier categorization. Tier categorization enabled the understanding of the relationship between AFQT score, the quality of Marine who submitted a RELM request, and RELM request approval. Table 8 shows the tier distribution of the FY 2014 cohort.

Table 9. Computed Tier Distribution. Adapted from USMC (2021).

Tier I	1,392
Tier II	2,672
Tier III	2,618
Tier IV	206
Total	6,888
Total Missing	19,195

The variables utilized in this research are displayed in Table 10. As previously discussed, the scope of this thesis is to explicate the potential effects of raising the minimum AFQT score from 32 to 40. Thus, AFQT score is the primary independent variable for this research. The dependent variable in this research is desire to reenlist which is listed as RELMTYPE2 in Table 10. As previously discussed, desire is depicted by a Marine submitting a RELM request that if approved, requires future service.

RELMTYPE2 is a categorical variable that was obtained by recoding the independent variable RELMTYPE. This was required because the data contained numerous RELM types that could depict either desire or non-desire. If the RELM type incurred obligated service, it was recoded as a value of one. If the RELM type did not incur obligated service, it was recoded as a value of zero. For example, a Reenlistment RELM type is represented as a one because it depicts desire, but a Tattoo RELM type is represented as a zero because it does not indicate that the Marine has a desire to reenlist.

Table 10. Independent and Dependent Variables. Adapted from USMC (2021).

Variable	Description	Type
AFQT_SCORE	ASVAB: AFQT Composite Score	Numeric
GT	ASVAB: Composite GT Score	Numeric
EL	ASVAB: Composite EL Score	Numeric
MM	ASVAB: Composite MM Score	Numeric
CL	ASVAB: Composite CL Score	Numeric
GENDER	Gender	Binary

Variable	Description	Type
PFT_CLASS	Physical Fitness Test Class	Categorical
PHYS_FIT_SCORE_QY	Physical Fitness Test Score	Numeric
CFT_CLASS	Combat Fitness Test Class	Categorical
CBT_FITNESS_SCORE_QY	Combat Fitness Test Score	Numeric
RIFLE_QUAL_CLASS	Rifle Qualification Class	Categorical
RIFLE_QUAL_SCORE_CD	Rifle Qualification Score	Numeric
COMPUTEDSUBTIER	Computed Tier Placement	Categorical
MOS	Military Occupational Specialty	Categorical
RELMTYPE	RELM Type	Categorical
RELMTSTATUS	RELM Status	Categorical
RELMTYPE2 (Dependent)	Incurred Service Obligation RELM	Categorical

The recoded RELMTYPE data, RELMTYPE2, provided this research with a dependent variable demonstrating the desire to reenlist. Due to the unbalanced nature of RELMTYPE2, stratified data partitioning was required. The process of partitioning, balancing, and stratifying is explained in Chapter IV.

C. TECHNIQUES APPLIED

Due to the categorical nature of the dependent variable, this research utilized a logistic regression analysis to evaluate the relationship between AFQT score and the probability of a Marine submitting a RELM request that incurs future service. This will provide decision makers insight into the effects stemming from raising the minimum AFQT score from 32 to 40. Model evaluation and validation will be discussed in Chapter IV.

D. STATISTICAL SOFTWARE

This research utilized JMP and Microsoft Excel for formatting and statistical analysis. For JMP, a stratified split balanced add in was utilized to separate the data into a train, validate, and test partitions. This was required due to the unbalanced nature of the recoded dependent variable. Microsoft Excel was utilized to create data tables that enabled a high-level understanding of AFQT scores as they relate to the reenlistment process.

E. UNDERSTANDING THE DATA

The current AFQT minimum standard for a potential candidate to enlist in the Marine Corps is 32 (USMC, 2011). To fully understand the implications of increasing the AFQT score standard from 32 to 40, it is imperative to understand the group of Marines that will not meet this new standard. This was accomplished by separating the FY 2014 cohort of Marines into four distinct groups based on their stage in the reenlistment process.

The first group is the entire cohort of FY 2014 Marines. This group has the option to either submit or not submit a RELM request for reenlistment. The second group includes all the Marines who submitted a RELM request for reenlistment. Of the Marines who apply for reenlistment, MMEA will either approve or disapprove their RELM request. The third group contains all the Marines from the FY 2014 cohort whose RELM requests were approved by MMEA. Moreover, of the RELM requests that are approved, the Marine has the option to either accept or deny the offer to extend their service. The fourth group contains all the Marines who chose to accept the reenlistment offer to prolong their service. These major stages are illustrated in Figure 5.

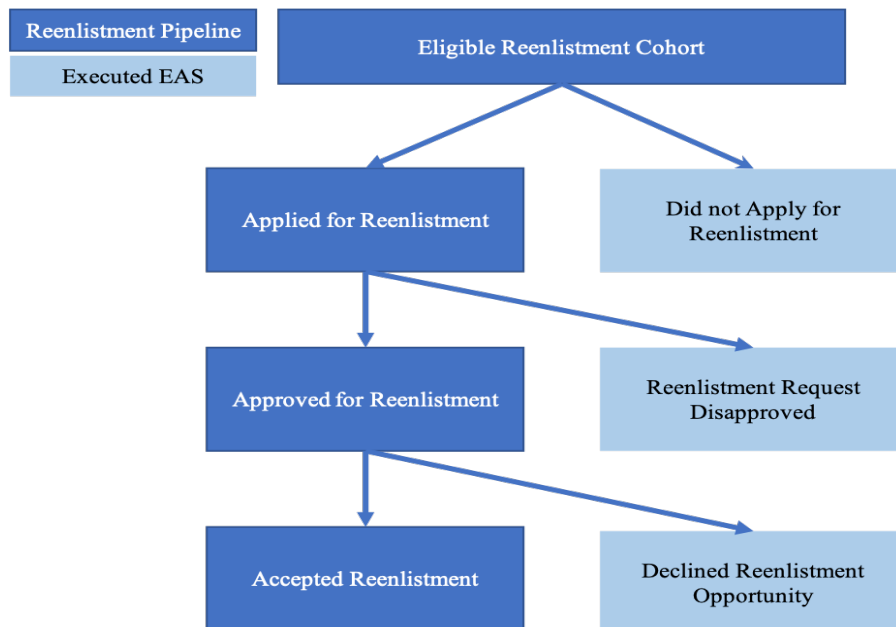


Figure 5. Major Stages of the Reenlistment Process. Adapted from Cole (2014).

1. Eligible Reenlistment Cohort

The first logical breakdown of the data was to analyze AFQT scores among the entire FY 2014 cohort, which is depicted in Figure 6. As expected, the AFQT scores of the FY 2014 cohort resemble a normal distribution with a mean of 62 and a standard deviation of 17.

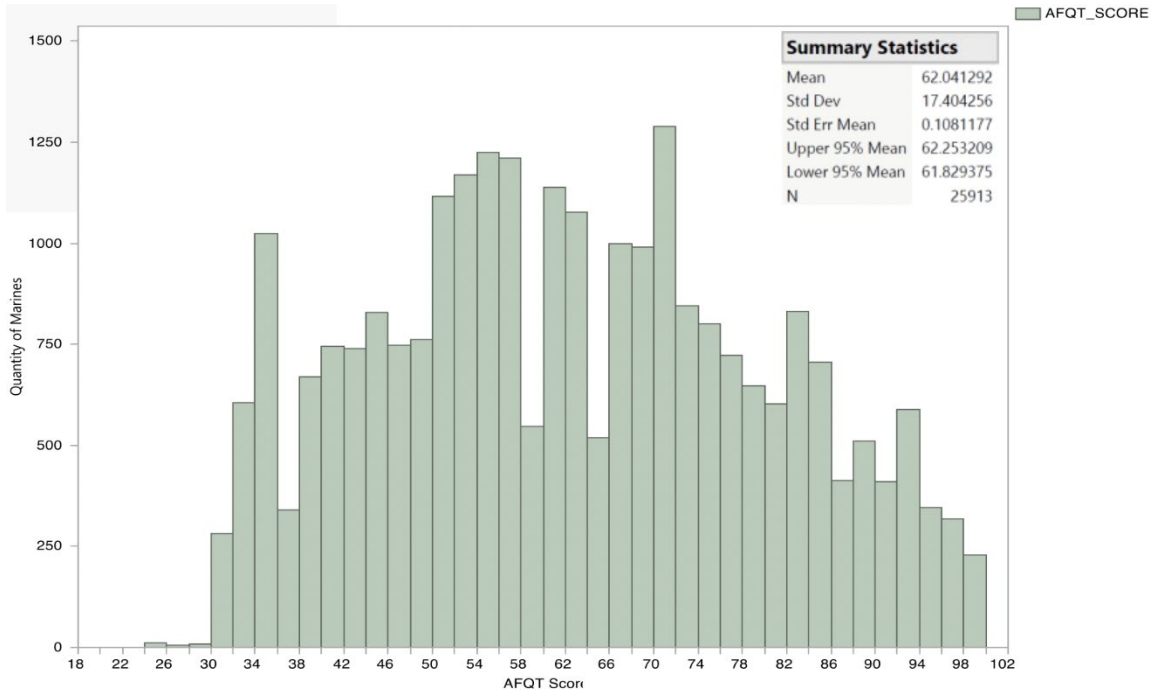


Figure 6. FY 2014 Cohort AFQT Score Distribution. Adapted from USMC (2021).

The next logical breakdown of the data was separating the FY 2014 cohort of Marines into groups based on their AFQT scores. The AFQT score ranges and the number of Marines within each range are depicted in Table 11. A score range of 32 to 39 was created to assist in understanding the effects of raising the minimum AFQT score from 32 to 40. The changes proposed by the CMC would directly impact 2,924 Marines, or 11.2% of the entire FY 2014 cohort, due to having an AFQT scores below 40.

Table 11. AFQT Score Breakdown. Adapted from USMC (2021).

AFQT Range	<32	32-39	40-49	50-64	65-92	93-99
Marines in this AFQT Range	295	2,629	3,808	7,980	9,977	1,224
Percent of total Marines	1.1%	10.1%	14.6%	30.6%	38.3%	4.7%

Percent of total Marines = Marines in AFQT Range / Total Marines in FY2014 cohort.

2. Applied for Reenlistment

As previously defined, the desire of a Marine to reenlist is characterized by a Marine submitting a RELM request that if approved, requires future service. Figure 7 illustrates all the RELM types submitted by the FY 2014 cohort that require future service. The three main RELM requests submitted by the FY 2014 cohort were Reenlistment, SDA with Reenlistment, and Lateral Move.

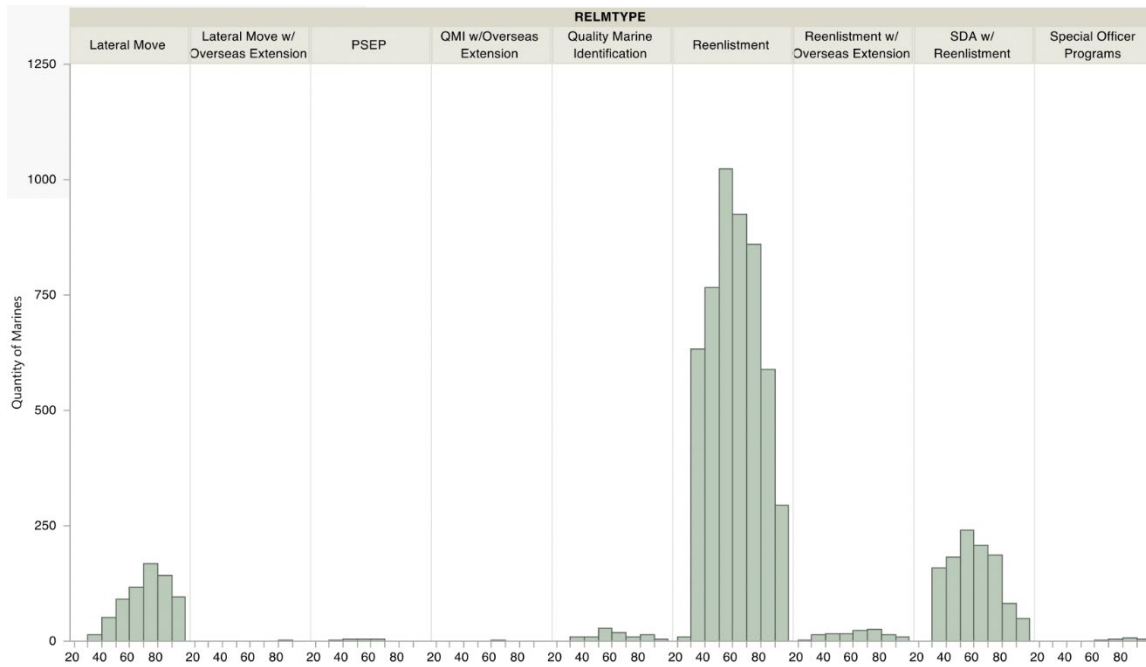


Figure 7. RELM Counts by AFQT Score. Adapted from USMC (2021).

To understand the rate at which Marines in each AFQT range submitted RELM requests that depict desire, the number of RELM requests submitted in each AFQT range

was divided by the total number of Marines within that respective range. Table 12 depicts the FY 2014 cohort's average rate of submission to be 27.16%. This represents that the highest RELM submission percentages originate from AFQT scores below 40.

Table 12. RELM Submission Count by AFQT Range. Adapted from USMC (2021).

AFQT Score Ranges	<32	32-39	40-49	50-64	65-92	93-99	Totals
Marines in AFQT Range	295	2,629	3,808	7,980	9,977	1,224	25,913
RELM Submissions	86	740	1,019	2,149	2,768	277	7,039
% of Marines submitting RELMs	29.2%	28.1%	26.8%	26.9%	27.7%	22.6%	27.16%
% of all RELMs submitted	1.2%	10.5%	14.5%	30.5%	39.3%	3.9%	100%

Percent of Marines submitting RELM = RELM Submissions / Marines in AFQT Range.

Percent of all RELMs submitted = RELM Submissions / Total RELMs submitted.

3. Approved for Reenlistment by MMEA

The next logical breakdown of the data was to analyze the group of Marines whose RELM requests were approved by MMEA. This facilitated the understanding of the relationship between the AFQT range and RELM approval rates. Figure 8 illustrates the approved RELM requests and their distribution among the AFQT score spectrum.

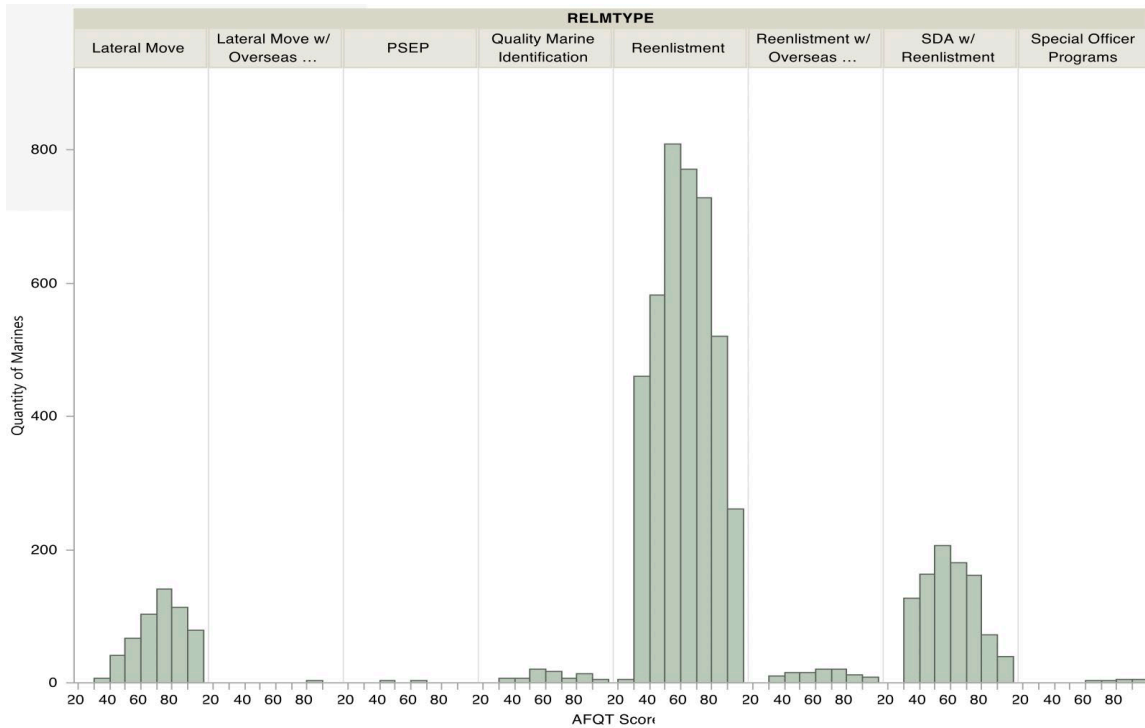


Figure 8. AFQT Score Breakdown of RELM Type by MMEA Approval. Adapted from USMC (2021).

Table 13 shows that as the AFQT scores increase, the percent of submitted RELM requests that get approved also increases. Additionally, Marines with AFQT scores less than 40 have the lowest approval rates. Although RELM requests submitted by Marine with AFQT scores less than 40 get approved at the lowest respective percentage, the approval percentage mirrors the overall percentage of Marines distributed throughout the respective AFQT range.

Table 13. AFQT Breakdown by MMEA Approval. Adapted from USMC (2021).

AFQT Range	<32	32-39	40-49	50-64	65-92	93-99	Totals
Marines in AFQT Zone	295	2,629	3,808	7,980	9,977	1,224	25,913
RELM Submissions	86	740	1,019	2,149	2,768	277	7,039
RELM Approval by MMEA	54	553	801	1745	2372	245	5,770
% of RELMs Approved	62.8%	74.7%	78.6%	81.2%	85.7%	88.4%	81.9%

4. Accepted Reenlistment

As previously discussed, once a RELM request is approved by MMEA, the Marine has the option to accept or deny future service. Thus, the group of Marines whose RELM requests were approved by MMEA was further filtered into a group solely containing the Marines who accepted future service. This facilitated the understanding of the relationship between AFQT scores and RELM approval and acceptance rates. Figure 9 illustrates the accepted RELM requests and their distribution among the AFQT score spectrum.

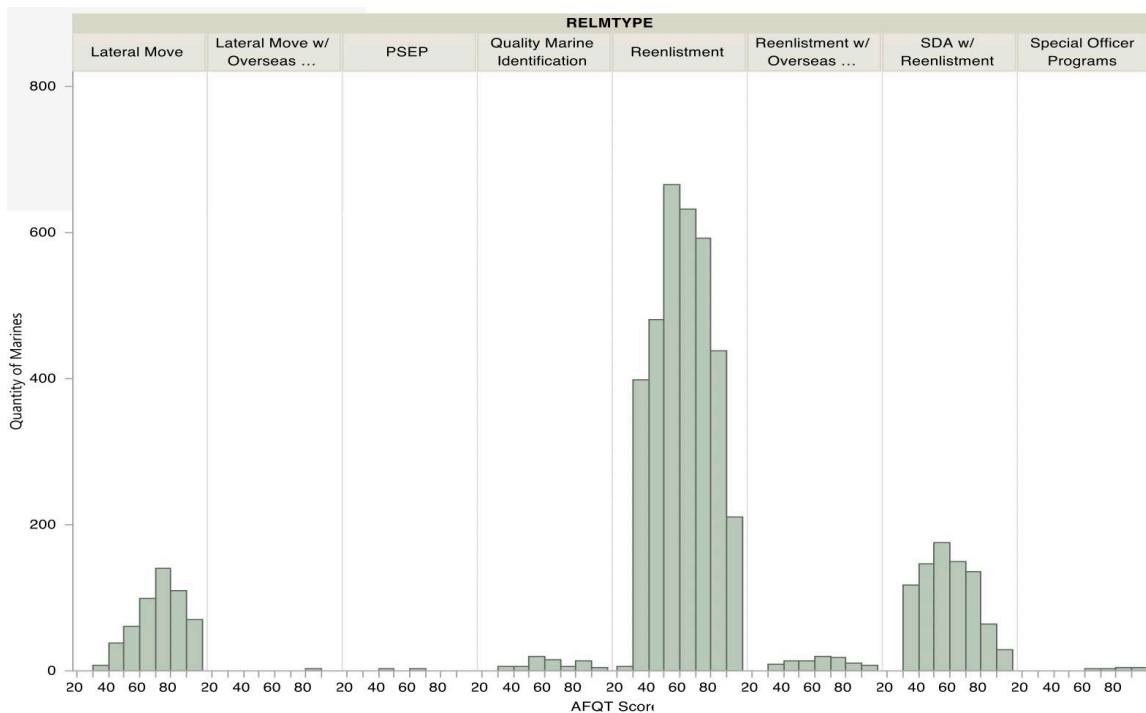


Figure 9. AFQT Score Breakdown of RELM type by Acceptance. Adapted from USMC (2021).

Table 14 shows that Marines with lower AFQT scores choose to accept the RELM request approval by MMEA at higher rates compared to Marines with higher AFQT scores. Additionally, according to the FY 2014 data, 31.5% of all submitted RELM requests that depict desire fail to result in future service of the Marine.

Table 14. AFQT Breakdown by Acceptance. Adapted from USMC (2021).

AFQT Range	<32	32-39	40-49	50-64	65-92	93-99	Totals
Marines in AFQT Zone	2,95	2,629	3,808	7,980	9,977	1,224	25,913
RELM Submissions	86	740	1,019	2,149	2,768	277	7,039
RELMS Approved by MMEA	54	553	801	1745	2,372	245	5,770
RELM Accepted by the Marine	48	488	679	1467	2002	205	4,889
% of Approved RELMs that get Accepted by the Marine	88.9%	88.2%	84.8%	84.1%	84.4%	83.7%	84.7%
% of Submitted RELMs Accepted by the Marine	55.8%	65.9%	66.6%	68.3%	72.3%	74.0%	69.5%
% of total Accepted RELMs	1.0%	10.0%	13.9%	30.0%	40.9%	4.2%	100%

5. RELM Approval by Quality Tier

The objective of this section is to analyze the quality of Marines who decide to extend their service with the Marine Corps. As previously discussed, when a Marine submits a RELM request to MMEA, he or she will be assigned to a tier category which compares the Marine to all other Marines within their MOS. Figure 10 illustrates the distribution of AFQT score among the four tier categories.

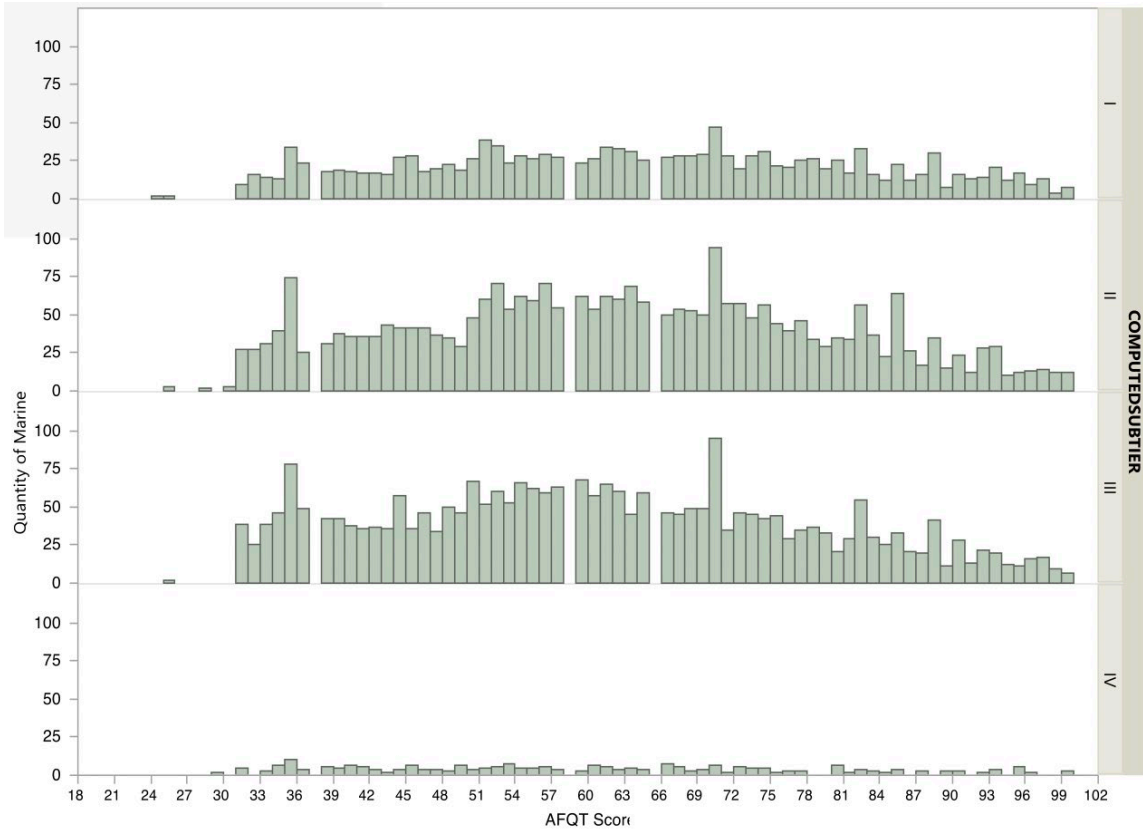


Figure 10. AFQT Score Distribution by Tier Category. Adapted from USMC (2021).

Table 15 separates tier categories by RELM request approved and acceptance rates. As displayed in Table 15, it is important to note that approximately 10% of tier I Marines are captured in the AFQT range below 40. Tier I Marines also get accepted at a rate inversely related to their AFQT score. Specifically, all ten tier I submissions from below the AFQT score of 32 were accepted.

Table 15. AFQT Score Breakdown by Tier, Approval, and Acceptance.
Adapted from USMC (2021).

AFQT Range	<32	32-39	40-49	50-64	65-92	93-99	Total
Marines in AFQT Zone from the total cohort	295	2629	3808	7980	9977	1224	25913
% of Total Marine in this AFQT zone	1.1%	10.1%	14.6%	30.6%	38.3%	4.7%	
TIER I Marines	10	131	193	393	588	77	1392
Approved	10	127	184	373	565	70	1329
Accepted	10	118	168	321	492	61	1170
% of Tier I reenlistments Approved	100.0%	96.9%	95.3%	94.9%	96.1%	90.9%	95.5%
% of Tier I reenlistments Accepted	100.0%	90.1%	87.0%	81.7%	83.7%	79.2%	84.1%
TIER II	31	259	365	831	1091	95	2672
Approved	24	219	329	725	971	90	2358
Accepted	22	193	283	608	809	70	1985
% of Tier II reenlistments Approved	77.4%	84.6%	90.1%	87.2%	89.0%	94.7%	88.2%
% of Tier II reenlistments Accepted	71.0%	74.5%	77.5%	73.2%	74.2%	73.7%	74.3%
TIER III	39	314	406	822	952	85	2618
Approved	19	191	259	577	732	70	1848
Accepted	15	164	203	476	611	61	1530
% of Tier III reenlistments Approved	48.7%	60.8%	63.8%	70.2%	76.9%	82.4%	70.6%
% of Tier III reenlistments Accepted	38.5%	52.2%	50.0%	57.9%	64.2%	71.8%	58.4%
TIER IV	5	29	38	58	65	11	206
Approved	0	10	14	32	42	7	105
Accepted	0	9	12	26	36	7	90
% of Tier IV reenlistments Approved	0.0%	34.5%	36.8%	55.2%	64.6%	63.6%	51.0%
% of Tier IV reenlistments Accepted	0.0%	31.0%	31.6%	44.8%	55.4%	63.6%	43.7%

F. ASSUMPTIONS AND LIMITATIONS OF DATA

Another purpose of this study is to derive analytical models and machine learning techniques that can be used in understanding the implications of any changes to the minimum required standard of AFQT scores for enlistment into the Marine Corps (Berger, 2020). Several assumptions were required for the utilization of the data obtained to provide insight into the relationship between AFQT score and retention habits of first term Marines. Our study contains the following assumptions and limitations.

- The computed tier score is the quality designation given to a RELM request package at the time of submission. This research assumes that the designation of quality implied by the Computed Tier Score is accurate and reliable.
- This study is concerned with the desire to reenlist and therefore, only concerned with RELM requests that incur future obligated service. RELM requests that do not incur future obligated service are considered in the same population as Marines who do not desire to reenlist.
- This data is limited to the population of Marines who enlisted into the Marine Corps in FY 2014.

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IV. ANALYSIS

This chapter will discuss the data cleaning process, the trends of this data set in relation to AFQT score and reenlistment process, and a logistical regression model to better understand the desire of a Marine to reenlist in relation to their AFQT score.

A. DATA CLEANING

The data received from TFRS contained multiple entries of individual Marines submitting more than one RELM request. In order to prevent a Marine from being observed more than once, cleaning the data until there was one instance for each Marine was required. The data cleaning process ensures the data set contains only one entry for each Marine as well as maintaining accurate submission, approval, and retention statistics for the FY 2014 cohort. The process to remove duplicate entries are as follows.

The initial step involved in the data cleaning process was to delete all RELM requests that did not indicate the desire to reenlist. If any duplicates remained, it indicated that a Marine submitted multiple RELM requests depicting desire. This required the utilization of a different attribute in order to decide which instance of a RELM request submission to delete. It was concluded that the RELM status attribute was most suitable for determining which instance of a RELM request submission to delete; the RELM status descriptions are shown in Table 8.

The RELM status attribute was determined to be most suitable because it enables accurate tracking of MMEA approval rates. All RELM status designations were classified into either approved or disapproved classifications as part of the multiple entry deletion process. Both Accepted and Declined indicate that MMEA selected a Marine for continued service and therefore, were classified as approved. Disapproved, Deleted, Admin closed, and Revoked indicate that MMEA did not select a Marine for continued service and therefore, were classified as disapproved. If an occurrence of a Marine with multiple RELM request submissions contained one instance of an approved status classification, all other instances of that Marine submitting a RELM were deleted. The examples of multiple entry deletions in Tables 16, 17, and 18 illustrate the deletion process.

Table 16. Duplicate Entry Example 1. Adapted from USMC (2021).

UUID	COMPUTEDSUBTIER	RELMFY	RELMTYPE	RELMSTATUS
49	III	2018	Reenlistment	Deleted
49	III	2018	SDA w/ Reenlistment	Declined

Table 16 shows an example of a duplicate entry that is identified for deletion. Duplicate Universally Unique Identifier (UUID) numbers indicates that a Marine submitted multiple RELM requests. In the instance of UUID 49, the Marine submitted a reenlistment RELM request and an SDA with reenlistment RELM request. For this research, the type of RELM request in this example is not important because they both show the Marine had the desire to reenlistment. The RELMSTATUS of Declined indicates that the Marine was approved for an SDA with reenlistment by MMEA but chose to decline the approval. Ultimately, the RELMSTATUS of Declined was kept to ensure the MMEA approval rate was accurate.

Table 17. Duplicate Entry Example 2. Adapted from USMC (2021).

UUID	COMPUTEDSUBTIER	RELMFY	RELMTYPE	RELMSTATUS
108	III	2018	Lateral Move	Deleted
108	III	2018	Reenlistment	Accepted

Table 17 shows another example of a duplicate entry that is identified for deletion. For UUID 108, the Marine submitted a reenlistment request and a lateral move request; both of which depict the desire to reenlist. In this situation, the RELMSTATUS of Accepted indicates the Marine was approved for a reenlistment by MMEA and chose to accept future service. For this example, the RELMSTATUS of Accepted was kept to ensure the MMEA approval rate was accurate.

Table 18. Duplicate Entry Example 3. Adapted from USMC (2021).

UUID	COMPUTEDSUBTIER	RELMFY	RELMTYPE	RELMSTATUS
236	III	2018	Lateral Move	Disapproved
236	III	2018	Reenlistment	Admin Close

Table 18 shows a third example of a duplicate entry that is identified for deletion. Similar to the example in Table 17, the Marine submitted a reenlistment and a lateral move RELM request. The difference in this example are the RELMSTATUS entries. The lateral move RELM request was disapproved by MMEA and the reenlistment RELM request was given a status of Admin Close. Admin Close is usually given when a RELM request is returned by MMEA to the Marine’s command for corrections. The importance of this duplication is that both RELM requests depict the desire to reenlist, but both were not approved by MMEA. In this situation, the RELM request that is deleted has no significance to this research. This process was continued until there was a single entry for each individual Marine in the entire cohort.

B. DATA TRENDS

Data trends were identified by analyzing the portion of the FY 2014 cohort that would be affected by the CMC’s proposed change to the minimum AFQT score standard. This research analyzed the affected population through three focus areas: population distribution, population quality, and reenlistment habits.

1. Population Distribution

For the FY 2014 cohort, 11.2% of the Marines have AFQT scores below 40. 382 are females and 2,542 are males. 382 female Marines accounts for 13.6% of the entire female population of the FY 2014 cohort. Conversely, the 2,542 male Marines accounts for 11.0% of the entire male population of the FY 2014 cohort. The population of Marines with an AFQT score below 40 is unbalanced between genders. Therefore, the proposed increase to the AFQT score standard for enlistment has the potential to exclude females at

a higher rate than their male colleagues. Refer to Appendix A for male and female AFQT score distribution.

2. Population RELM Request Submission

The data analysis shows that RELM request submission rates are inversely proportional to AFQT score. Marines with AFQTs scores less than 40 have a 28.2% RELM request submission rate. This is the highest submission rate within the AFQT ranges examined in this research. This group of Marines accounts 11.7% of the total RELMs submitted. Increasing the AFQT score minimum standard for enlistment may exclude the portion of Marines that submit RELM requests at the highest rate.

As previously discussed, the computed sub tier attribute was the metric utilized to measure the quality of a Marine who submitted a RELM request. A tier I Marine is considered a “eminently qualified Marine” that falls within the 90th percentile of their MOS (USMC, 2011a; USMC, 2014a). Of the 1,392 Marines designated as a tier I, 141 or 10.1% of them have AFQT scores below 40. A tier II Marine is considered a “highly competitive Marine” that falls within the 70th percentile of their MOS (USMC, 2011a; USMC, 2014a). Of the 2,672 Marines designated as a tier II, 290 or 10.9% of them have AFQT scores below 40. These statistics illustrate the potential loss in personnel quality if the AFQT minimum standard for enlistment is increased to 40.

3. Approval of RELM Requests

Examining the MMEA approval rate in relation to AFQT score accentuated significant differences between tiers. It was identified that the approval rate of tier I Marines is inversely proportional to AFQT score. For tiers II, III, and IV, the approval rate is directly proportional to AFQT score. Of note, 100% of tier I Marines with AFQT scores less than 32 were approved for reenlistment; additionally, 96.9% of tier I Marines with AFQT scores from 32 to 39 were approved for reenlistment. The tier I approval rate below the AFQT score of 40 emphasizes the importance of these Marines in the retention pipeline. Marines with an AFQT score below 40 not only submit reenlistments at the highest rate, but the quality Marines in this AFQT range are also approved at the highest rates.

4. Acceptance of RELM Requests

RELM request acceptance rates and AFQT scores are inversely proportional. As AFQT score increases, the rate at which Marines accept the reenlistment decreases. When examining the quality tier levels, the acceptance rates mirror the approval rates. Tier I Marines with AFQT scores below 40 accept their reenlistment at 93.4%. This acceptance rate is the highest among all AFQT ranges. Marines with AFQT scores below 40 submit RELM requests at the highest rate; furthermore, the tier I Marines in this population have the highest approval and acceptance rates.

5. Data Trend Summary

The trends identified in the above sections portray the reenlistment habits of the FY2014 cohort. The data indicates that AFQT score has an impact on the reenlistment habits of first term Marines. To better understand the probability of a Marine submitting a RELM request based on their AFQT score, a logistic regression model was utilized.

C. RECODING THE DATA

The dependent variable in this research is the desire to reenlist which is listed as RELMTYPE2 in Table 10. RELMTYPE2 is a categorical variable that was created by recoding the independent variable RELMTYPE. This was required because the data contained numerous RELM types that could depict a Marine either having the desire to reenlist or not having the desire to reenlist. If the RELM type submitted required future service, it depicted that the Marine had the desire to reenlist and received a value of one. All other RELM types submitted received a value of zero. The unbalanced nature of the recoded data is displayed in Figure 11. There were 18,874 Marines who did not submit a RELM request indicating a desire to reenlist and 7,039 Marines that submitted a RELM request indicating desire to reenlist.

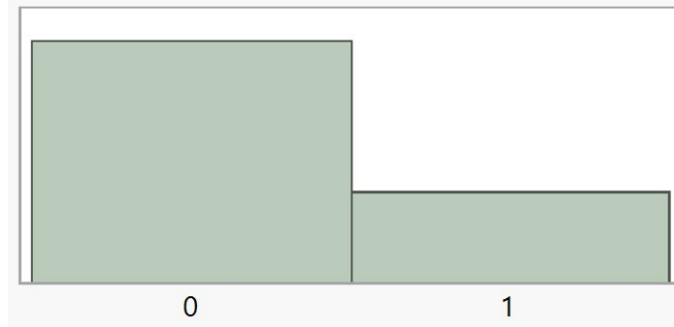


Figure 11. Recoded RELM Type to Binary Variable of Desire to Reenlist.
Adapted from USMC (2021).

D. STRATIFYING DATA

Once the dependent variable was created, it required stratified data partitioning due to its underrepresentation. The data set was partitioned into a “training”, “validation” and “test” set. Utilizing 0.6, 0.2, and 0.2 proportions for the training, validation, and test sets enabled the test and validations sets to contain over 5,000 observations. Additionally, it was deemed necessary to not allow JMP to alter group proportions to ensure the integrity of the stratification.

The training set contained 15,562 observations, the validation set contained 5,178 observations, and the test set contained 5,173 attributes. These sets were created as a subset of the original data and populated into a validation column to be utilized as input to the logistic regression model. This allowed a portion of the data set to be utilized to estimate the model parameters, while utilizing the other portion of the data set to assess the predictive ability of the model.

E. REGRESSION EQUATION

The variables utilized for the regression equation were AFQT score, PFT score, CFT score, and reenlistment desire. PFT and CFT scores were incorporated into the model due to being a common training metric utilized throughout recruitment and retainment.

Table 19. Parameter Estimates. Adapted from USMC (2021).

Regression Term	Estimate	Std Error	Chi-Sqr	Prob>Chi Sqr
AFQT_SCORE	-0.019083877	0.001299873	215.54	<.0001
PHYS_FIT_SCORE_QY	0.004438051	0.000409288	117.58	<.0001
(AFQT_SCORE-62.0413)*(PHYS_FIT_SCORE_QY-211.11)	6.99829E-05	2.48904E-05	7.91	0.0049
CBT_FITNESS_SCORE_QY	-0.00252421	0.000369892	46.57	<.0001
(AFQT_SCORE-62.0413)*(CBT_FITNESS_SCORE_QY-240.611)	0.000124162	2.78995E-05	19.81	<.0001
(PHYS_FIT_SCORE_QY-211.11)*(CBT_FITNESS_SCORE_QY-240.611)	-0.000034059	3.24E-06	110.71	<.0001
(AFQT_SCORE-62.0413)*(PHYS_FIT_SCORE_QY-211.11)*(CBT_FITNESS_SCORE_QY-240.611)	1.21E-06	2.03E-07	35.62	<.0001

F. MODEL VALIDATION

Once the data was stratified, a nominal logistic fit was conducted to validate the model. The intercept is excluded from the final regression analysis because it creates inconsistencies with the data. The confusion matrix in Figure 15 displays the results of the model validation. The model had a 72.2% accuracy, a 23.2% precision, 1.0% sensitivity, and a 98.8% specificity. Most importantly, the model has a p-value of less than 0.0001 which indicates the significance of the developed model.

Training			Validation			Test		
Actual	Predicted Count		Actual	Predicted Count		Actual	Predicted Count	
RELMTYPE 2	1	0	RELMTYPE 2	1	0	RELMTYPE 2	1	0
1	42	4181	1	11	1397	1	8	1400
0	139	11200	0	51	3719	0	57	3708

Figure 12. Model Validation. Adapted from USMC (2021).

G. LOGISTIC REGRESSION

The CMC has proposed raising the minimum AFQT score standard for enlistment from 32 to 40. This proposal would exclude candidates with AFQT scores less than 40 from enlisting into the Marine Corps. To better capture the impact of this proposal, the relationship between the independent variables and the desire to reenlist is further studied by analyzing the variation of probability with respect to AFQT score. In this part of the analysis, the default binary categorization of the JMP software is removed. The logistic regression model output illustrated in Figure 13 indicates that the probability of a first term Marine submitting a RELM request is inversely proportional to AFQT score. This finding suggests that Marines with lower AFQT scores have the highest probability of submitting a RELM request. This indicates that the desire of a Marine to reenlist decreases as their AFQT score increases. Therefore, if the CMC's proposal is implemented, this model suggests that there will be a decrease in RELM request submissions which has the potential to negatively impact the retainment of future cohorts.

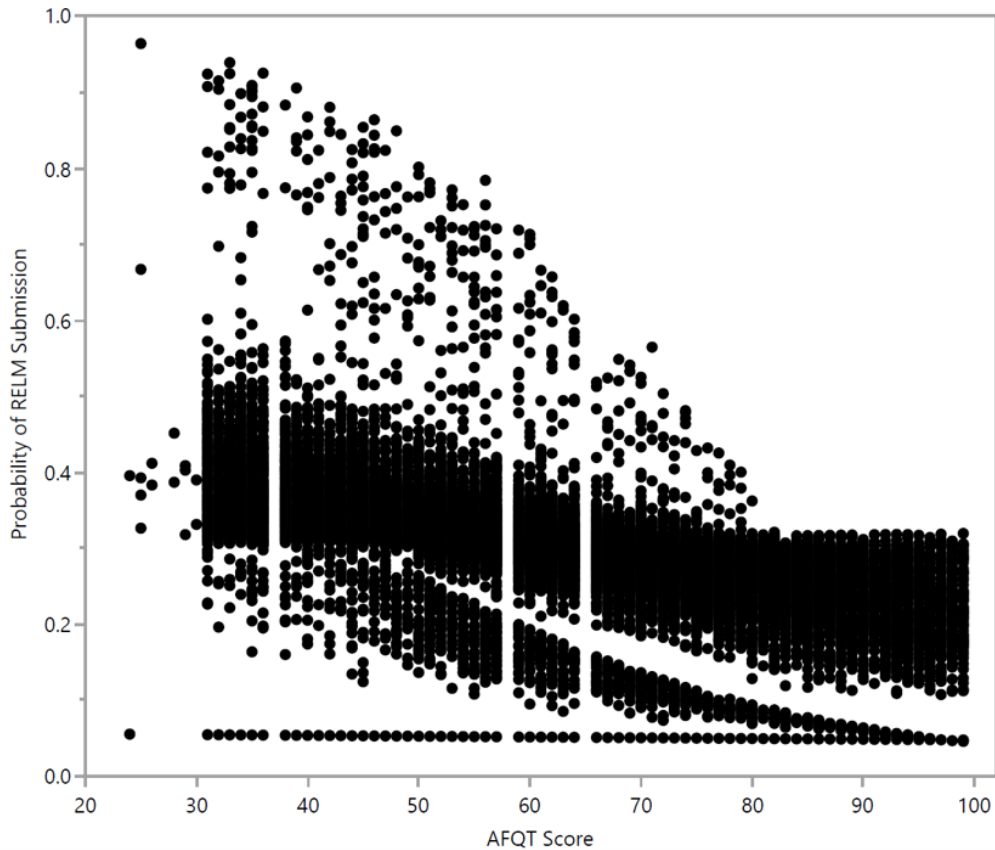


Figure 13. Probability of RELM Submission versus AFQT Score. Adapted from USMC (2021).

H. CHAPTER SUMMARY

This chapter has shown that AFQT score has a negative relationship to the probability of a Marine submitting for reenlistment. Within the FY2014 cohort, as AFQT scores increase, the desire to reenlist decreases. Figure 14 emphasizes that this inverse relationship is consistent across all tiers, PFT scores, and CFT scores. By increasing the minimum AFQT standard from 32 to 40, there is the potential to exclude the Marines most willing to continue service past their first enlistment.

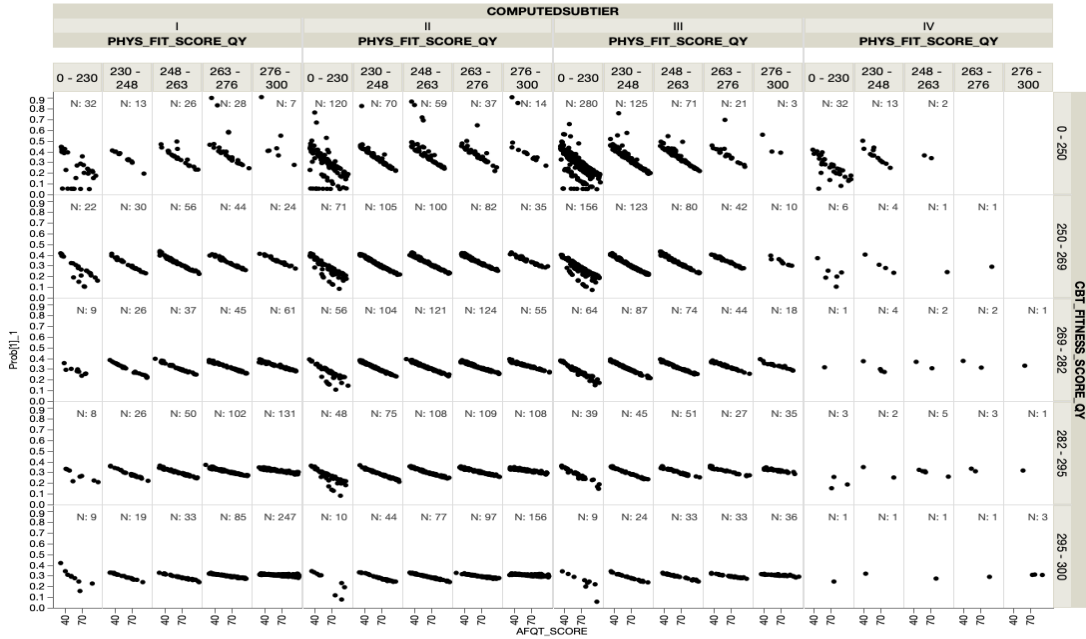


Figure 14. Probability of RELM Submission versus AFQT Score Grouped by Tier, PFT, and CFT. Adapted from USMC (2021).

V. SUMMERY, CONCLUSION, AND RECOMMENDATIONS

The objective of this thesis was to analyze the relationship between AFQT scores and the desire of first term Marines to reenlist. The desire to reenlist was indicated by a Marine submitting a RELM request to MMEA that if approved, required future service. This topic was decided upon because of its contribution to the CMC's (2020) directed action (f), which ordered the following study to be accomplished.

Determine the opportunities, risks, and costs associated with raising the minimum AFQT [32 to 40] for enlistment...and provide a formal recommendation. Provide an evidence-based analysis that indicates this could irreparably damage recruiting efforts or operational readiness. (Berger, 2020, pp. 2)

As previously discussed, higher AFQT scores positively correlate with superior job performance, learning ability, lower disciplinary problems, and lower first term attrition rates (Marrone, 2020; Sellman, 2004). In essence, recruiting and retaining Marines with higher AFQT scores will increase the readiness of the force. However, there are potential effects that may accompany these types of policy changes. This thesis contributes to the identification of potential effects that may arise from raising the minimum AFQT score for enlistment.

A. SUMMARY

To accomplish this study, administrative and RELM request data of all Marines who enlisted during FY 2014 was obtained from MPP-20 and TFDW. The data was analyzed by utilizing machine learning and logistic regression techniques with JMP and Microsoft Excel software. The following sections provide facts derived from the analysis that answer the research questions along with a supporting narrative.

1. Research Question 1

How would the FY 2014 cohort be affected after raising the minimum AFQT score from 32 to 40?

- 2,924 Marines, or 11.2% of the entire FY 2014 cohort have AFQT scores below 40. By applying the proposed AFQT score metric, these Marines would not be eligible for enlistment.
- 10% of tier I Marines in the FY 2014 cohort have AFQT scores less than 40.
- 382 female Marines from the FY 2014 cohort have AFQT scores less than 40. This accounts for 13.6% of all females within the FY 2014 cohort.
- Female Marines have a mean AFQT score of 59.5 with a standard deviation of 17.0.
- 2,542 male Marines from the FY 2014 cohort have AFQT scores less than 40. This accounts for 11.0% of all males within the FY 2014 cohort.
- Male Marines have a mean AFQT score of 62.4 with a standard deviation of 17.4.

2. Research Question 2

What is the relationship between AFQT scores and reenlistment desire?

- As AFQT scores increase, RELM request submission rates decrease.
- The average RELM request submission rate of the FY 2014 cohort was 27.16% with the highest submission rates originating from Marines with AFQT scores below 40.
- The RELM request submission rate of Marines with AFQT scores less than 32 was 29.2%.
- The RELM request submission rate of Marines with AFQT scores from 32 to 39 was 28.1%.

3. Research Question 3

What is the relationship between AFQT scores and MMEA approval rates of RELM requests?

- As AFQT scores increase, reenlistment approval rates increase.
- Tier I approval rates are inversely proportional to AFQT scores.
- Tier I Marines with AFQT scores less than 32 are approved at 100%.
- Tier I Marines with AFQT scores from 32 to 39 are approved at 96.9%.
- Tiers II, III, and IV approval rates are directly proportional to AFQT scores.

4. Research Question 4

What is the relationship between AFQT scores and a Marine accepting the approved RELM request?

- As AFQT scores increase, reenlistment acceptance rates decrease. Marines with lower AFQT scores are more likely to accept the approved reenlistment.
- For tier I Marines, as AFQT scores increase, acceptance rates decrease. Tier I Marines with lower AFQT scores are more likely to accept the approved reenlistment.
- Of all RELM requests submitted to MMEA, only 69.5% of them result in a reenlistment.
- Of all RELM requests approved by MMEA, only 84.7% of them are accepted by the Marines. The highest acceptance rates originate from Marines with AFQT scores below 40.
- The acceptance rate of Marines with AFQT scores less than 32 is 88.9%.

- The acceptance rate of Marines with AFQT scores from 32 to 39 is 88.2%.

B. NARRATIVE OF THE RESEARCH FINDINGS

As previously discussed, retention and recruiting have reciprocal effects. By increasing the AFQT score for enlistment from 32 to 40, recruiters will be required to enlist the same number of applicants among a further restricted candidate pool. Compounding this issue, the data analyzed shows that as AFQT scores increase, the desire to reenlist decreases. In turn, the Marines that terminate their service after their first term will have to be replaced by recruiting efforts in subsequent FYs.

The data shows that 10% of tier I Marines have AFQT scores less than 40. Additionally, tier I Marines with AFQT scores below 40 get approved by MMEA at 97.2% and accepted by the Marines at 93.4%; both of which are the highest percentages among all AFQT ranges within the FY 2014 cohort. Therefore, this data proves that increasing the minimum AFQT score from 32 to 40 for enlistment has the potential to negatively affect tier I Marines being retained.

By increasing the minimum AFQT score standard, potential negative effects into the diversity of first term enlisted Marines may occur. The data shows that by increasing the minimum AFQT score, female Marines may be impacted more significantly compared to their male colleagues. There are 382 female Marines from the FY 2014 cohort that have AFQT scores less than 40. This accounts for 13.6% of all female Marines who enlisted in FY 2014 that would be ineligible based on the proposed increase. Conversely, only 11.0% of male Marines would be affected by the same proposed increase. Due to female Marines having a lower mean AFQT score than male Marines, proposed changes to the minimum AFQT score standard may inadvertently affect the gender diversity among first term enlisted Marines.

C. CONCLUSION

Due to the increased intellectual demands associated with twenty-first century conflict, the CMC proposed raising the minimum AFQT score for enlistment from 32 to 40 (Berger, 2019; Berger, 2020). If the AFQT score minimum standard is increased for

enlistment, there will be immediate beneficial effects created, such as a smarter first term Marine. However, this research indicates potential negative effects in recruiting and retention stemming from the proposed increase.

This thesis analyzed the potential effects that may occur from the CMC's proposal to raise the minimum AFQT score for enlistment into from 32 to 40. It was identified that raising the minimum AFQT score may negatively affect tier I enlisted Marine retention, diversity among first term enlisted Marines, restrict the recruiting candidate pool, and decrease the number of Marines who have the desire to reenlist after their first term.

As previously discussed, this thesis solely analyzes the relationship between AFQT scores and reenlistment habits among first term Marines. Other factors such as job satisfaction, operational tempo, economic uncertainty, MOS designation, and marital status have effects on first term Marines reenlisting but were not analyzed in this thesis (Lancaster et al., 2013; Vasterling et al., 2015). Instead, this research contributes to the current gap in literature regarding the relationship between AFQT scores and the desire of first term Marines to reenlist.

D. RECOMMENDATIONS FOR FUTURE RESEARCH

To increase the impact and further examine the insights gained from this research, it is suggested that the following potential areas of study be examined.

1. Relationship between AFQT scores, reenlistment incentives, and the reenlistment habits of first term Marines

Marines with higher AFQT scores are more likely to terminate their service at the conclusion of their first enlistment, which is contrary to the desires of the Marine Corps. This research did not examine reenlistment incentives that were utilized for the FY 2014 cohort. It is recommended that a study be conducted which analyzes how AFQT scores combined with reenlistment incentives relate to the reenlistment habits of first term Marines. By understanding this relationship, incentives could be incorporated in a manner that targets the higher portion of the AFQT score spectrum, which reenlists at a lower rate.

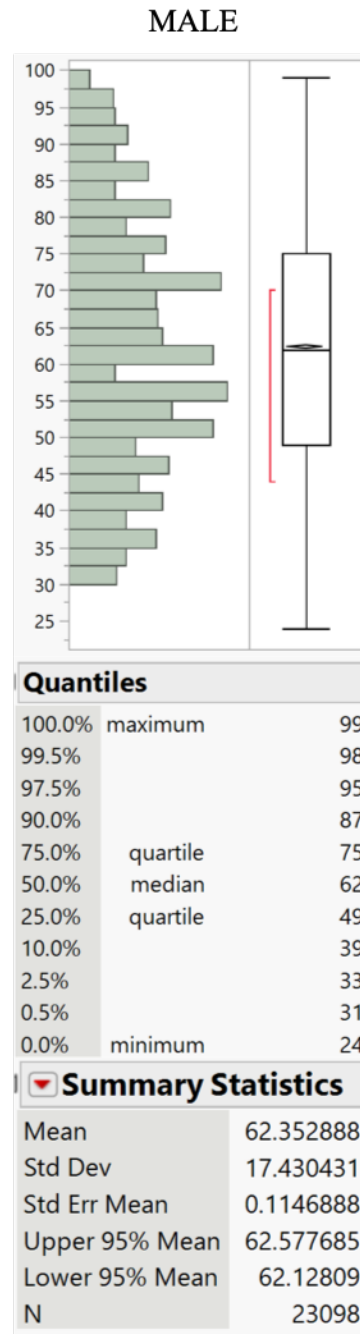
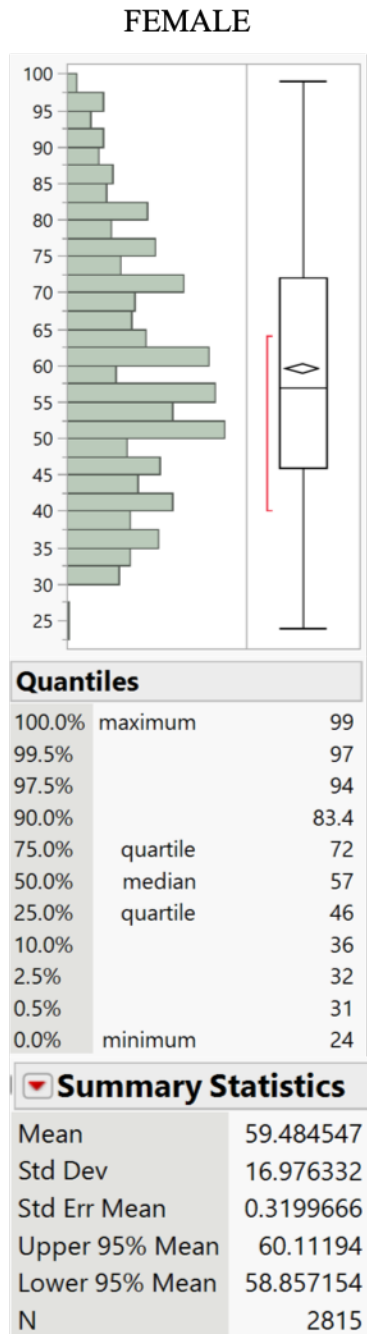
2. Potential impacts of raising the AFQT score minimum standard on the diversity of first term Marines

This research identified that there is a significant relationship between AFQT scores and the reenlistment habits of first term enlisted Marines. The relationship between AFQT scores and ethnicity and race were not examined. In efforts to make a more diverse Marine Corps, it is recommended that a study be conducted which analyzes the relationship between AFQT scores and the reenlistment habits of first term Marines among all demographics. This will enable decision makers to understand whether raising the minimum AFQT standard will inadvertently affect certain demographics in a biased manner.

3. MMEA approval rates of Tier I Marines

It was identified that the approval rate of tier I Marines were inversely proportional to AFQT score. Contrary, the approval rate of tier II, III, and IV Marines were directly proportional to AFQT score. Among common tier designations, it is assumed that a higher AFQT score would be considered superior to a lower AFQT score. However, this research has shown that the inverse relationship between MMEA approval rates of tier I Marines and AFQT score implies otherwise. It is recommended that a study be conducted that analyzes whether this inverse trend is an anomaly with the FY 2014 cohort or a recurring trend of approval rates among tier I Marines.

APPENDIX. AFQT DISTRIBUTION: GENDER



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