

NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

**A STATISTICAL ANALYSIS OF THE
DETERMINANTS OF NAVAL FLIGHT
OFFICER TRAINING ATTRITION**

by

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March 1998

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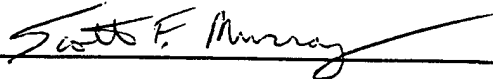
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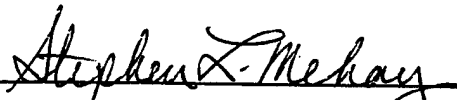
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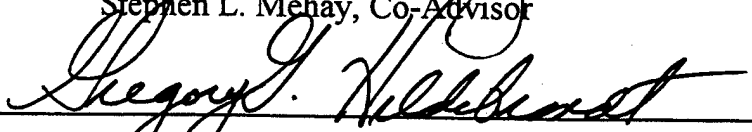


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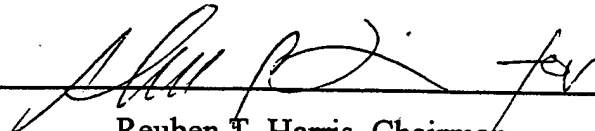
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ABSTRACT

The purpose of this thesis is to identify factors that lead to naval flight officer training attrition. Data was compiled on student NFO cohorts who entered between 1991 and 1996. A multinomial logit model is specified with the dependent variable categorized into four outcomes: attrition for performance failure of the individual, attrition for medical reasons, dropping on request and passing aviation training. Independent variables utilized in the model include commissioning source, race, and undergraduate major. The statistical analysis sought to determine the effect of each of these demographic factors on the probability of attrition by reason.

The results show that commissioning source has a significant effect on attriting for performance failure and dropping on request. United States Naval Academy graduates had the lowest attrition rates for these reasons, followed by ROTC then OCS graduates. Caucasian student NFOs had the lowest attrition rates among the race categories. Undergraduate major also affects attrition behavior with technical majors succeeding (earning wings) at a slightly higher rate than non-technical undergraduate majors.

TABLE OF CONTENTS

I.	INTRODUCTION	1
A.	BACKGROUND.....	3
B.	OBJECTIVE	5
C.	RESEARCH QUESTIONS	6
D.	SCOPE AND LIMITATIONS	6
E.	ORGANIZATION.....	7
II.	LITERATURE REVIEW	9
A.	HEALTH OF NAVAL AVIATION MANPOWER UPDATE	9
1.	CDR Ryan, "Street to Fleet," Briefing for the Chief of Naval Operations, July 1997.....	9
2.	CDR Ryan, "Naval Aviation Officer Community Study," Brief, Aviation Community Manager.....	11
B.	ATTRITION TRENDS	12
1.	William R. Bookheimer, "Predicting Naval Aviator Attrition Using Economic Data," Thesis, Naval Postgraduate School, March 1996.....	12
2.	Robert DuMont, "Junior Surface Warfare Officer Retention," Thesis, Naval Postgraduate School, March 1997	13
C.	NFO SPECIFIC STUDIES	14
1.	Julie A. Hopson, Glenn R. Griffin, Norman E. Lane, and Rosalie K. Ambler, "Development and Evaluation of a Naval Flight Officer Scoring Key for the Naval Aviation Biographical Inventory" Naval Aerospace Medical Research Laboratory, Pensacola, Florida, December 1978	14

2.	William C. Johnson, "Marginal Cost of Training a Naval Flight Officer," Thesis, Naval Postgraduate School, December 1990	15
3.	Robert A. Hunt, "The Incremental cost of F/A-18F Naval Flight Officers," Thesis, Naval Postgraduate School, June 1997	15
4.	Russell S. Turner, "The Impact of the Military Drawdown on USN Aviator Retention Rates," Thesis, Naval Postgraduate School, March, 1995.....	16
D.	SUMMARY	16
III.	DATA METHODOLOGY	19
A.	DATA	19
B.	DEPENDENT VARIABLE.....	23
C.	INDEPENDENT VARIABLES.....	25
1.	Commissioning Source	25
2.	Race and Ethnicity.....	26
3.	Education Major	27
4.	Undergraduate Major Variable Creation	27
D.	SUMMARY	33
IV.	STATISTICAL ANALYSIS.....	35
A.	ATTRITION MODEL.....	35
B.	MODEL VALIDATION	37
C.	MODEL RESULTS.....	38
V.	CONCLUSIONS AND RECOMMENDATIONS	45
A.	CONCLUSIONS	45

1.	Attrition Model Results	45
2.	Model Fit.....	48
B.	RECOMMENDATIONS.....	49
APPENDIX A. THE <i>LOGISTIC</i> PROCEDURE		51
APPENDIX B. SAS CODING.....		53
LIST OF REFERENCES		55
INITIAL DISTRIBUTION LIST.....		57

LIST OF FIGURES

Figure 1.1	NFO Inventory by Source (Ryan).....	2
Figure 1.2	NFO Undergraduate Training Pipeline	5
Figure 2.1	NFO Accessions.....	9
Figure 2.2	Aviator End Strength.....	11
Figure 3.1	NFO Accessions vs. SNFO Cohort File.....	23
Figure 3.2	SNFO Cohorts by Commissioning Source	25
Figure 3.3	SNFO Cohorts by Race	26
Figure 3.4	SNFO Cohorts by Undergraduate Major.....	29
Figure 3.5	Winged Percentage of SNFOs by Commissioning Source	31
Figure 3.6	Winged Percentage of SNFOs by Race and Ethnicity.....	31
Figure 3.7	Winged Percentage of SNFO's by Undergraduate Degree	32
Figure 4.1	Predicted Probabilities of Attrition for Nontech Majors.....	43
Figure 4.2	Predicted Probabilities of Attrition for Tech Majors	43
Figure 5.1	Predicted Probabilities of Attrition for Nontech Majors.....	46
Figure 5.2	Predicted Probabilities of Attrition for Tech Majors	46

LIST OF TABLES

Table 3.1	Dependent Variables for SAS Programming.....	24
Table 3.2	Undergraduate Majors - Technical	27
Table 3.3	Undergraduate Majors - Non-Technical	28
Table 3.4	Attrition by Commissioning Source and Demographics.....	30
Table 3.5	Population Profiles	33
Table 4.1	Maximum-Likelihood Analysis-Of-Variance.....	38
Table 4.2	Parameter Estimates From Multinomial Attrition Model	39
Table 4.3	Predicted Probabilities of Population Profiles.....	40
Table 4.4	Delta in Predicted Probability from "Notional" Population Profile	42

I. INTRODUCTION

This study examines the factors that lead to naval flight officer (NFO) training attrition in the U.S. Navy. Training naval flight officers is one of the most expensive investments in human capital made by the Department of the Navy. The marginal cost of training an NFO is estimated to range from \$51,244 to \$309,833 in 1990 dollars (Johnson, 1995). Naval flight officer training attrition is currently 17 percent. Reasons for attrition include the physical inability to remain in a flight status for medical deficiencies, academic and flight training failure, and dropping on request. Attrition costs the Navy personnel and money, both scarce resources which today's Navy must allocate efficiently. Having a model to predict training attrition will assist manpower planners to manage naval flight officer candidate accessions in order to accurately meet future manning requirements. Such a model will help determine proper screening devices for new entrants, which can reduce high attrition rates and improve the efficiency of the NFO training pipeline. Focusing recruiter attention on quality accessions can reduce attrition rates by improving the initial candidate's potential for future development.

Recently NFO accessions have fallen short of the goal for fiscal years 1995, 1996 and 1997 (Ryan, 1998). High training attrition rates coupled with unmet accession goals have posed challenges to manpower managers to adequately support the fleet. Joint NFO training commands such as VT-10 now find

themselves responsible for training Air Force navigators, as well as NFOs, adding additional burdens to the effective training of aviators. In addition to reduced accession pools, training pipelines are faced with aging aircraft, outsourced civilian maintenance, and smaller experienced year group pools from which to select quality instructors (Ryan, 1998).

As depicted in Figure 1.1 the NFO inventory currently consists of 33 percent from OCS, 33 percent from NROTC, 27 percent from USNA, and the remaining 7 percent from other commissioning sources. The demographics of all aviators, pilots and NFOs, as of September 1996, consists of 92 percent Majority, 3 percent Black, 3 percent Hispanic, and 2 percent Asian Pacific Islander. Student aviator demographics are 85 percent Majority, 6 percent Black, 6 percent Hispanic, and 3 percent Asian Pacific Islander. Women comprise 3 percent of the total of naval aviators as of September 1996. The naval aviator community consists of 4,628 NFOs and 9,302 pilots (Ryan, 1998).

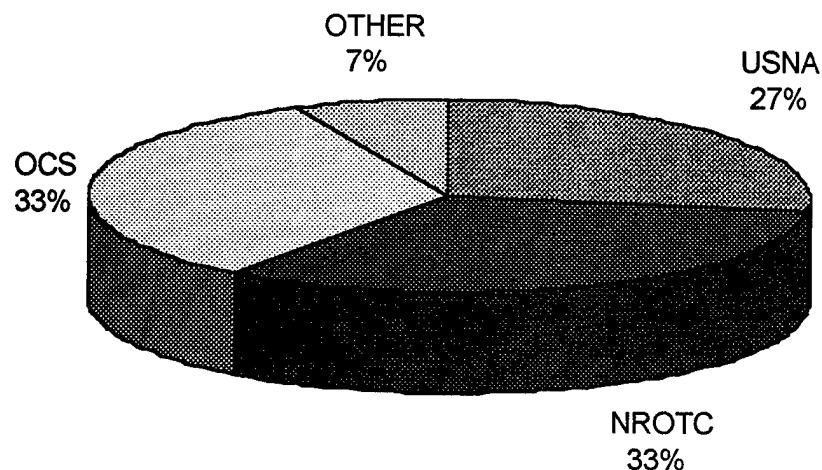


Figure 1.1. NFO Inventory by Source (Ryan)

The CNO has set goals for the Navy's officer force to be composed of 12 percent African American, 12 percent Hispanic, and 5 percent Asian/Pacific Islander/Native American ethnic categories. Studying attrition trends can assist in determining whether the 12/12/5 policy is a realistic goal in the NFO community, and whether policies are needed to help minority NFO candidates succeed in flight training.

A. BACKGROUND

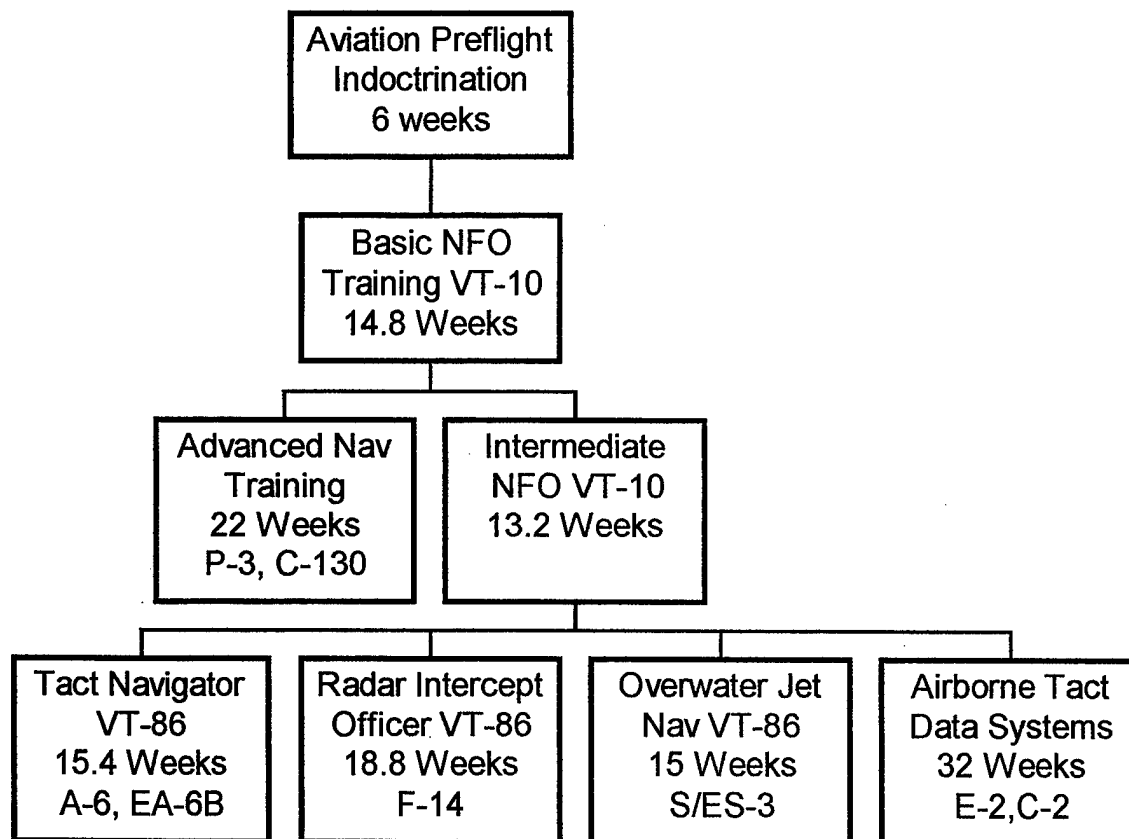
A naval flight officer is responsible for the navigation and the tactical implementation of the weapon systems of the aircraft to which they are assigned. Specific training is required to train NFOs to perform the set of complex skills utilized in the dynamic environment of flight. NFOs allow pilots to concentrate on manipulating the controls of the aircraft in flight, without being distracted by tactics and weapons systems. Communication responsibilities are also passed to NFOs in order to reduce a pilot's work load. Mission responsibility can rest with either the pilot or NFO depending upon the experience of the individual crew members.

The naval flight officer undergraduate training pipeline varies in duration depending upon aircraft type. Duration of training ranges from 43 weeks for a P-3 NFO to 64 weeks for a E-2 NFO. Aviators, pilots and NFOs all begin training by receiving 6 weeks of aviation indoctrination. General aviation training is provided

to all aviators during the initial six weeks of Aviation Preflight Indoctrination. Pensacola, Florida is the “cradle of naval aviation,” and the location of the initial training for all aviators. Basic navigation, aerodynamics, and powerplant courses are introduced to the beginning students. Pilots and navigators then part ways and pursue separate pipelines. Pilots take approximately twenty four months and NFO’s take approximately fourteen months to complete undergraduate training. The vast majority of aviator undergraduate training attrition studies have focused primarily on pilots, due to the slightly higher cost and duration of pilot training.

Upon completion of Aviation Preflight Indoctrination NFOs continue to VT-10 for 15 weeks of basic NFO training. After finishing the 15-week basic NFO training, P-3 and C-130 navigators are sent to complete undergraduate training at Randolph AFB, Corpus Christi, Texas. All other NFOs complete intermediate training, consisting of 13 additional weeks of training at VT-10. Following intermediate training NFO’s are further divided depending on aircraft type. The majority of the NFOs complete specific aircraft training at VT-86 ranging from 15 to 30 weeks, then graduate and continue the remainder of training at specific aircraft fleet replacement squadrons.

Figure 1.2 depicts the different NFO undergraduate training pipelines dependent upon aircraft type. The chart shows the various commands and duration of training for each aircraft type.



Source: Johnson

Figure 1.2. NFO Undergraduate Training Pipeline

B. OBJECTIVE

The objective of this thesis is to create a unique data set in order to study some of the factors that lead to NFO training attrition. This study focuses on whether demographic characteristics such as commissioning source, race, and undergraduate major have a significant effect on attrition.

C. RESEARCH QUESTIONS

1. Primary Research Question

Can a model be developed to predict naval flight officer training attrition in the U.S. Navy?

2. Secondary Research Questions

Is commissioning source a significant variable in predicting attrition? Are race and ethnicity significant demographic variables in predicting attrition? Is undergraduate major a significant variable in predicting attrition?

D. SCOPE AND LIMITATIONS

This study analyzes only NFO undergraduate flight training attrition. A multinomial model is estimated utilizing historic data to analyze the effects of demographic characteristics on attrition. This study develops a statistical model to analyze these effects. Several other factors could be considered when determining why individuals attrite: academic performance, sports participation and extracurricular activities. Unfortunately, analysis of these factors is beyond the scope of this study. This thesis creates a data base, using combined historical information and specifies and estimates a multinomial logit attrition model. The model is used to describe the effects of demographics and other factors on attrition probabilities.

E. ORGANIZATION

The introduction chapter has addressed the basic elements of the NFO community. Chapter II reviews the current state of the NFO community as well as research relevant to the NFO attrition problem. Chapter III describes the data methodology, the variables used in the analysis and assumptions made in this study. Chapter IV describes the statistical results of the multinomial logit model. Chapter V contains conclusions and recommendations.

II. LITERATURE REVIEW

A. HEALTH OF NAVAL AVIATION MANPOWER UPDATE

1. CDR Ryan, "Street to Fleet," Briefing for the Chief of Naval Operations, July 1997

The following is a summary of a brief given to the CNO by CDR Ryan, an aviation community manager. The brief uses two triangles to explain the health of naval aviation. The first triangle consists of three sides: hardware, manpower, and training. The second triangle focuses on the manpower side of the triangle and is composed of accessions, retention, and production. Recent drawdowns in military forces have created a "HONA notch" in the manpower force structure as depicted in Figure 2.1.

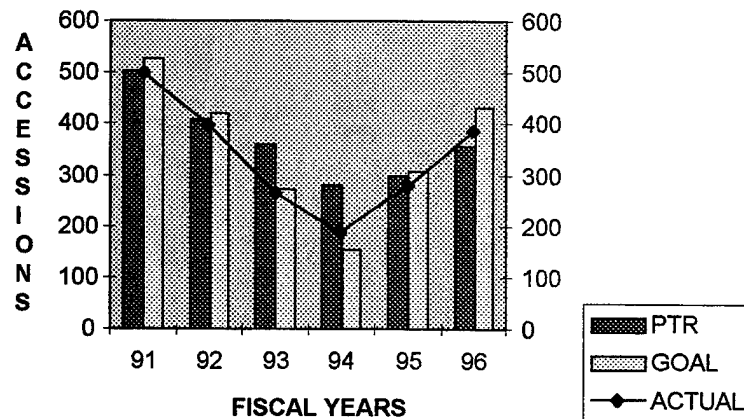


Figure 2.1. NFO Accessions

The chart demonstrates planners projected NFO training rates (PTR), goals, and the actual number of NFOs trained from fiscal year 1991 through fiscal year 1996. Year groups 1991-1995 were "deliberately goalled below force sustainment

levels to implement drawdown.” As a result, these critical year groups have created a manning shortage of NFOs as they progress through the typical aviator career path.

Detailers currently have a limited ability to allow for career flexibility due to the reduced inventory/billet ratio. Operational tempo remains at a high level with considerably fewer aviators available to carry out the missions. The total pilot and NFO billet shortfall is 960 officers in the HONA notch. A temporary solution to this manning dilemma is to extend first sea tours to 42 months, from the original 36 months. The negative impact of this policy is to adversely affect the morale of the aviators extended. Sea tours lead to extended family separation, and affect the quality of life. Another viable short term solution is to restructure rank composition, by increasing LCDRs by 2-3 per squadron in order to fill the Junior Officers void from the critical year groups. The drawback to this solution is that there is a limited number of department head billets, and achieving department head status has a significant effect on promotion from LCDR to CDR. Other problems associated with the HONA notch are that opportunities for officer professional development such as JPME, joint duty, and graduate education are drastically reduced if nonexistent for the critical year groups in question. Long term solutions include increasing instructors available to train aviators, and increasing accessions. Accessions are currently being increased by 304 in Officer Candidate School through June 1998.

2. CDR Ryan, "Naval Aviation Officer Community Study," Brief, Aviation Community Manager

The brief describes the aviation community as "facing a significant manpower challenge wrought by mandated downsizing initiatives that placed aviation at the leading edge of a drawdown targeted for completion in fiscal year 1999." The drawdown consists of a 30 percent reduction in endstrength from fiscal year 1990 to fiscal year 1999 as depicted in Figure 2.2.

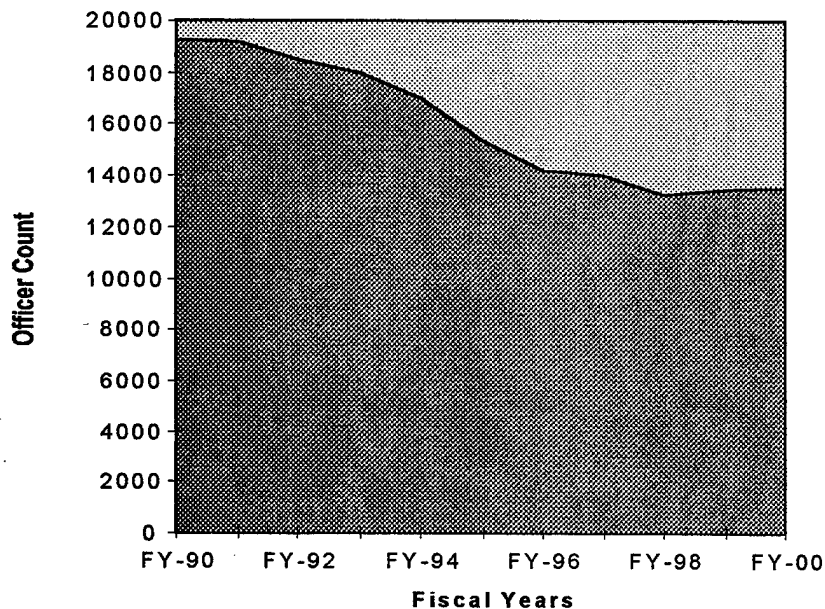


Figure 2.2. Aviator End Strength

NFO accessions fell further below goal as more aircraft were required than anticipated for aviation communities. The recent unexpected addition of 5 squadrons increased the number of the NFO billets required to be filled. CDR Ryan states "...our primary objective will be to man deploying units at 100 percent." This point stresses the importance of military readiness over

professional development or joint military experience. He further states
“...recovery from the impact of consecutive years of under accession requires
sustained production by the training commands and the fleet replacement
squadrons.”

The brief further stresses the importance of maintaining efficient training
pipelines. Drastic reductions in aviator pools while in training commands has
been effective in reducing the time to train, both for pilots and NFOs. Presumably
the reduction in student aviator pools is due to the reduction in the accession of the
critical year groups progressing through training. Efforts are ongoing to allow
USNA and ROTC students to attend the 6 week aviation preflight indoctrination
training in the summer between junior and senior years to further reduce the time
to train period.

B. ATTRITION TRENDS

- 1. William R. Bookheimer, “Predicting Naval Aviator Attrition
Using Economic Data,” Thesis, Naval Postgraduate School,
March 1996**

The study uses economic and attrition data from 1978 to 1990 to develop a
model of aviator attrition. The thesis focuses on pilot attrition, calculating
regressions to explain the effects various economic indicators have on attrition.
The independent variables created in the model correspond to tools that describe
the relationship between economic conditions and attrition rates, for example, the

model describes how increases in the national unemployment rate negatively affects attrition behavior. But, surprisingly, airline employment rates had an "inconclusive effect on attrition rates." Several other indicators and regressions are explained in the study, however the important aspect of the study is the methodology used to create the attrition model. Economic variables play an important role in determining attrition behavior.

2. Robert DuMont, "Junior Surface Warfare Officer Retention," Thesis, Naval Postgraduate School, March 1997

The study estimates the marginal cost of the average surface warfare officer is \$48,000. Since commissioning sources are fundamentally the same for aviators it is reasonable to assume there is much the same cost for commissioning an aviator. This estimate gives a clear understanding for what is lost when an individual attrites from a training program.

In his study, DuMont describes the trends across demographics regarding the tendency to quit:

Race was found to have an inconsistent role in turnover: When certain personal and job characteristics were controlled, Bleu and Kahn found that blacks actually quit significantly less than whites (Blau and Kahn 1981). Some research suggests that racial/ethnic discrimination in labor markets, which has the effect of making job searches more difficult for minorities, also work to deter members of minority groups from quitting (Holmlund and Lang, 1985; Zax, 1989) (Kellough and Osuna, 1995).

While this statement is in regard to the civilian labor market, the military has its own labor market and it is possible that the two markets share certain similar characteristics.

C. NFO SPECIFIC STUDIES

- 1. Julie A. Hopson, Glenn R. Griffin, Norman E. Lane, and Rosalie K. Ambler, "Development and Evaluation of a Naval Flight Officer Scoring Key for the Naval Aviation Biographical Inventory" Naval Aerospace Medical Research Laboratory, Pensacola, Florida, December 1978**

The study addresses an NFO undergraduate training attrition problem in the late 1970s. Attrition rates rose from 20 percent in the 1960s to more than 40 percent in the late 1970s. The report suggests a change in the Navy and Marine Aviation selection Test Battery criteria for NFOs. Previously the same tests were given to pilots and NFOs resulting in an unacceptable NFO training attrition rate. The tests were subsequently altered by removing the aerospace knowledge questions on the NFO tests, as these questions were not useful in determining an accurate job match.

The study developed a model to predict attrition based on the various sections of the test battery consisting of an academic qualification test, mechanical comprehension test, spatial apperception test, and the biographical inventory. The sections were analyzed to determine if a correlation existed between each section and the resulting pass/attrite criterion. New criterion was developed utilizing a

multiple regression creating a prediction for attrition omitting the aerospace knowledge questions. The study proved that omitting the aerospace questions raised the efficiency of the test score to predict successful NFO candidates.

2. William C. Johnson, "Marginal Cost of Training a Naval Flight Officer," Thesis, Naval Postgraduate School, December 1990

This thesis determined the marginal costs of training Category I and Category II NFOs. Category I training include NFO undergraduate training and aircraft specific graduate training conducted at the Fleet Replacement Squadrons. Category II is refresher training for prospective NFO department heads. The study determines "Category I marginal costs range from \$51,244 for a P-3 Naval Flight Officer to \$309,833 for an A-6 Naval Flight Officer." The marginal cost calculation considers the cost of training one additional NFO, factoring in the expense of salary, undergraduate flight training, permanent change of station moves, and Fleet Replacement squadron training.

3. Robert A. Hunt, "The Incremental cost of F/A-18F Naval Flight Officers," Thesis, Naval Postgraduate School, June 1997

This thesis described the number and cost of NFOs that are required as a result of changing the F/A-18F to a multi versus single person aircraft. The study described all requirements of the F/A-18F NFO's career path and training requirements, and the associating costs of each.

4. Russell S. Turner, "The Impact of the Military Drawdown on USN Aviator Retention Rates," Thesis, Naval Postgraduate School, March, 1995

This thesis created a data base in order to study continuation rates of NFOs and naval aviators for the 15 year period of 1977-1993. The data base was drawn from the Officer Master File. The methodology utilized various filters to ensure only aviators in specific year groups were considered in the sample. The officers that were studied were officers who had served minimum service requirements (MSR) and were eligible to resign. A regression in the form of ordinary least squares was calculated for each aviation community. The independent variables in the equation were aviation continuation pay, voluntary separation incentive/special bonus programs, involuntary reduction in active duty policy, MSR point through MSR + 2 years, MSR + 3 years through MSR + 5 years, and civilian unemployment. The dependent variable was the specific aviation community's continuation rates. The results of the thesis indicate economic factors have a significant effect on continuation rates.

D. SUMMARY

The literature review is designed to create a understanding of the importance of attrition studies in naval aviation. The discussion pertaining to the health of naval aviation is relevant to this study because it is important to develop and understand the environment into which NFOs are being accessed. Marginal

cost of training studies emphasize that particular attention must be given to the NFO community and training progression. Chapter II also describes the various methods that have been utilized to create attrition models. Chapter III describes the methodology utilized to create the student NFO cohort file designed for this thesis.

III. DATA METHODOLOGY

A. DATA

This thesis creates a cohort data base composed of student NFO from year groups 1991 through 1995. As stated in the introduction, the majority of attrition studies focus on pilots due to the slightly higher training costs and time necessary to train pilots. This thesis creates a unique data set by combining CNATRA's Aviation Training Demographic Statistical Report and the Navy's Officer Master File. The data base provides manpower planners with an additional tool for analyzing the NFO training pipeline and accession policies.

The Navy's Officer Master File (OMF) is maintained at the Naval Postgraduate School. The Aviation Training Demographic Statistical Report (Statistical Report) is maintained by The Chief of Naval Air Training in Corpus Christi, Texas. The Statistical Report is utilized to identify attritors and the specific reasons for attrition. The Navy Officer Master File is utilized to determine the demographics and commissioning source of all student NFOs, both successful and unsuccessful.

The Active Duty Navy Officer Submission Master File is administered at Naval Postgraduate School by Judy Willis, Code 05H. The data file originates at the Bureau of Naval Personnel (BUPERS), which updates the file on a quarterly basis. According to Willis, the Active Duty Navy Officer Submission Master File contains "...longitudinal data of over 312 unique personal data elements including

service-specific fields such as subspecialty codes, duty station, education data, and designator.” The file also contains demographics and commissioning sources of each individual on active duty for each fiscal year. Ms. Willis describes the file as “...an unedited snap shot of the Navy forces at the specific time (fiscal year) for all Navy personnel on active duty, including midshipmen and officer candidates.”

CNATRA’s Aviation Training Demographic Statistical Report is a quarterly report containing information used to evaluate Naval Air Training programs and to develop recruiting goals. The data base contains information on individual procurement source, attrition codes, sex, race, and ethnic codes. For the purpose of this thesis attrition codes are divided into three categories: performance, medical, and dropping on request. The limitation of CNATRA’s Statistical Report in this study is that it does not contain the demographic characteristics of NFOs who successfully complete aviation training, i.e., who are winged.

The cohort file is created by first searching each year’s OMF file for all NFOs and student NFOs in year groups 1991 through 1995. Then a separate file is merged which is created by searching the OMF for attritors based on the social security numbers of the individuals who have attrited in the years 1992 through 1996 as provided by CNATRA’s Statistical Report. The assumption behind utilizing attrite files from 1992 through 1996 is that an individual that is listed as an attrite in year T would have been commissioned in year T-1. This assumption becomes more convincing considering time lags such as pools awaiting training, temporary active duty assignments such as officer home town recruiting programs,

PCS moves, and indoctrination periods. Initially the possibility existed that the data set could be missing some records. However, several methods have been employed to ensure its completeness. First, the OMF was searched from 1991 through 1997 for all NFOs and student NFOs in the year groups 1991 through 1995, so that if an individual had been commissioned in year groups 1992 through 1995 and attrited that same year the search would match the social security number. Secondly, attritors' social security numbers were matched with each OMF file from 1991 through 1997. This limits the possibility of missing records for an individual who, for example, is commissioned in 1991 and immediately attrites, leaving the Navy before the end of 1991. This possibility is further limited by the amount of time it takes to in-process into flight training, attrite, and be outprocessed from the Navy. Further, this possibility is reduced by the fact that in 1991 student aviators typically were pooled months before beginning flight training. Finally, an additional search of the Officer Loss Files from 1990 to present ensured no individual records were missed due to expeditious attrition. Social security numbers were then sorted ordinally and duplicate records were discarded. The Student Naval Flight Officer (SNFO) cohort file was then sorted by year group and screened for any individuals who were not commissioned during the time period 1991 through 1995.

The combined cohort data set is composed of 1,375 individual records, of which 1,165 come from the three primary officer commissioning programs

(USNA, ROTC, and OCS). The cohort file created for this thesis is referred to as the Student Naval Flight Officer (SNFO) cohort file. The 1,165 records are divided into 1,006 winged NFOs (successfully completed training), and 159 student NFOs who attrited from training. The difference between the 1,375 and the 1,165 ($1,006 + 159$) is explained by the fact that this study only considers those who are commissioned in either the USNA, ROTC, or OCS, while the SNFO file contains 210 individual records from other commissioning sources. The 210 other records are dispersed among a variety of the different commissioning sources used for NFO accessions. These records are omitted from the study in order to provide adequate sample size for each population profile and for ease of model interpretation. There are numerous minor commissioning sources and pooling them into an “other” category in this analysis would yield very uncertain conclusions.

As described in the literature review, accessions for student NFOs during fiscal years 1991 through 1995 total 1,626. The difference between these two totals (1,626 and 1,375) lies in the fact that year groups in the OMF are based on calendar years and accessions are based on fiscal years. Downsizing during 1991 through 1995 impacts the cohort file one quarter later than is reflected in NFO accession figures. Although it is not accurate to compare accessions with year groups using different year definitions, a comparison is helpful to validate the data set. Figure 3.1 graphs reported NFO accessions according to (Hona, 1997) which

utilizes fiscal year concurrently with the SNFO Cohort data set utilizing year groups based on calendar years. The difference in 1992 officers results from to the disparity in year definitions.

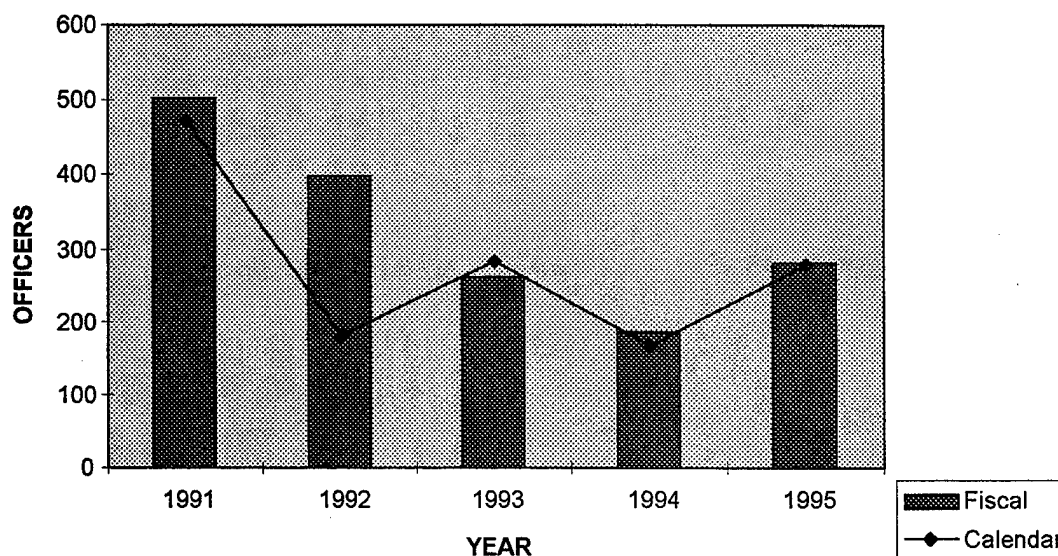


Figure 3.1. NFO Accessions vs. SNFO Cohort File

B. DEPENDENT VARIABLE

This thesis creates a dependent variable based on the attrition reason code. CNATRA's Statistical Report contains 63 possible attrition codes. For this study, the codes are grouped into three possible categories: performance failure, medical, and dropping on request. A successful category is created for student naval flight officers who graduate training and become a winged NFO. One dependent variable is created which has four possible outcomes. The names for these four outcomes are designated NFO 0, NFO 1, NFO 2, and NFO 3 as shown in Table 3.1.

Table 3.1. Dependent Variables for SAS Programming

NFO 0	NFO 1	NFO 2	NFO 3
PERFORMANCE	MEDICAL	DOR	WINGED

The NFO 0 (Performance) is composed of the following attrite codes as defined by CNARTAINST 1542.116A: Flight failure, lack of reading skills, lack of math skills, lack of comprehension, lack of language proficiency, academic other, demonstrated lack of performance-not school of choice, demonstrated lack of performance-school not what expected, and demonstrated lack of performance-negative training attitude.

NFO 1 (Medical) is composed of the following attrite codes as defined by CNARTAINST 1542.116A: Alcohol rehabilitation, unsuitability, hardship, pregnancy, orthopedic, podiatry, general surgery, urology, ophthalmology, neurology, dermatology, internal medicine, ear, nose, throat, gynecology, psychiatric, psychiatric suicidal, psychological enuresis, psychological sleepwalking, psychological situation reaction, not aeronautically adaptable, medical other, substance abuse/incident, homosexuality, death, physical-non-swim, physical failures-PRT failures, obesity, physical performance failure, drug subsequent screen.

NFO 2 (DOR) is composed of the following attrite codes as defined by CNARTAINST 1542.116A: Dropping on request (DOR), negative navy attitude, arrest by civil conviction, declared deserter, flight discipline, breach of contract, misconduct.

NFO 3 (WINGED) includes all successfully designated NFOs.

C. INDEPENDENT VARIABLES

1. Commissioning Source

The entire NFO population contains 33 percent OCS graduates, 33 percent ROTC graduates, 27 percent USNA graduates, and the remaining 7 percent from other commissioning sources. This study will focus only on OCS, ROTC, and USNA graduates. After omitting the 7 percent from the “other” commissioning sources, the five year cohort file created for this thesis is divided into 32 percent OCS graduates, 32 percent ROTC graduates, and 36 percent USNA graduates. Dummy variables are created for each commissioning source OCS, ROTC, and USNA. Figure 3.2 shows a pie graph of the percentages of the commissioning sources of the sample in the SNFO cohort file.

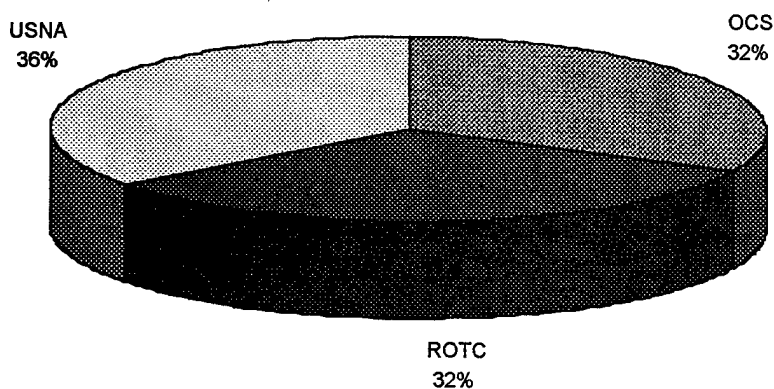


Figure 3.2. SNFO Cohorts by Commissioning Source

2. Race and Ethnicity

Race is divided into three dummy variables. The variables represent the three major categories of race used in the comparison: Caucasian, Black, and Asian Pacific or Indian. Ethnicity is also considered in the study by use of the Hispanic dummy variable coded HISP. For the purpose of simplification individuals are categorized based on response to race and separately categorized based on the ethnicity response.

The Hispanic variable represents the major ethnic category considered in the Navy's 12/12/5 policy. The SAS coding for these variables are CAUC, BLK, HISP and API. Figure 3.3 shows the percentage of the three race categories of the cohort group. Hispanics represent 3 percent of the overall population of the cohort group.

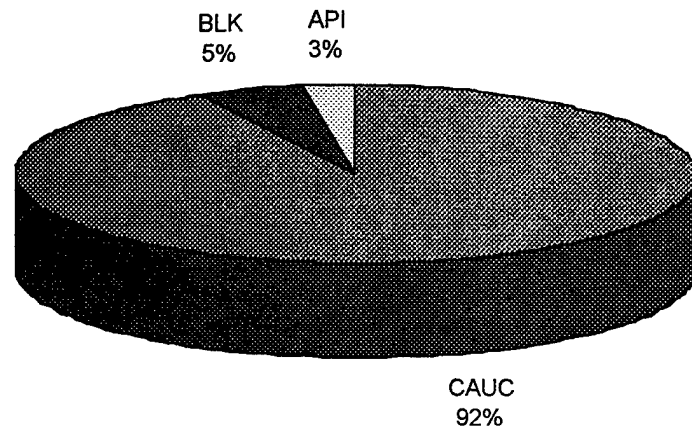


Figure 3.3. SNFO Cohorts by Race

3. Education Major

The Officer Master File contains an extensive list of undergraduate majors. This list is condensed into two categories, technical and non-technical, for ensurance of adequate population profile sample sizes. The dummy variable created in the SAS coding is TECH for a technical undergraduate major and NONTECH for the non-technical undergraduate major.

4. Undergraduate Major Variable Creation

TECH includes the following definitions of undergraduate majors as shown in Table 3.2.

Table 3.2. Undergraduate Majors - Technical

Operations Research	Meteorology	Chemistry	Biochemistry
Naval Sciences	Metallurgy	Math	Physics
Astronomy	Physical Sciences	Civil Engineering	Agricultural Engineering
Systems Technology	Safety Engineering	Naval Architect	Nuclear Engineering
Ordnance Engineering	Industrial Engineering	Chemical Engineering	Electrical Engineering
Mechanical Engineering	Textile Engineering	Engineering	Communication Engineering
Aeronautical Engineering	Mineral Engineering	Petroleum Engineering	Metal Engineering
Architecture	Statistics	Biological Sciences	Sciences
Nautical Science	Microbiology		

NONTECH includes the following definitions of undergraduate majors as shown in Table 3.3.

Table 3.3. Undergraduate Majors - Non-Technical

Management	Broadcasting	Communications	Journalism
Radio/TV	Speech	Design	Podiatry
Psychotherapy	Occupational Therapy	Audio	Speech Therapy
Physician Assistant	Medical Technician	Hospital Administration	Health Care
Philosophy	Agriculture	Forestry	Ceramics
Range Science	Miscellaneous Agriculture	Theology	Botany
Bacteriology	Language	Physiology	Zoology
Entomology	Parasitic	Virology	Miscellaneous Biology
Medicine	Pharmacy	Public Health	Dentist
Nursing	Optometry	Veterinarian Science	Pharmaceutical
Osteopatics	Anatomy	Pathology	Miscellaneous Medicine
Foreign Affairs	Political Science	Public Administration	Industrial Arts
History	Industrial Management	Personnel Administration	Psychology
Anthropology	Archeology	Economics	Accounting
Geography	Business Economics	Business Administration	Finance
Merchandise	Physical Education	Education	Home Economics
Law	Liberal Science	Socialwork	Social Science
Fine Arts	English	Classical	none reported

Figure 3.4 shows the proportion of SNFO cohort file by undergraduate that is TECH or NON TECH.

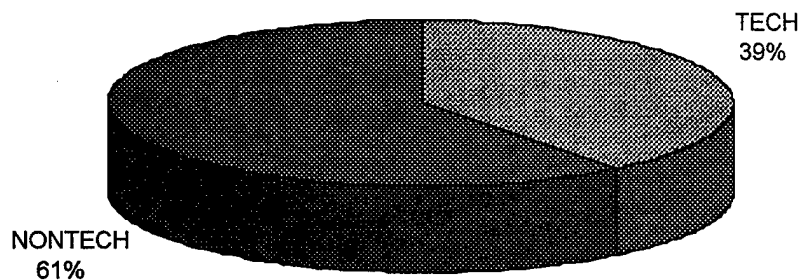


Figure 3.4. SNFO Cohorts by Undergraduate Major

The introduction stated that NFO training attrition is currently 17 percent. The SNFO cohort file created for this study, including all student NFOs in year groups 1991 through 1995, is shown in cross tabulation Table 3.4. The SNFO five year cohort file has an attrition rate of 13.6 percent. Table 3.4 lists each percentage and number of attriters in each category by commissioning source and demographic characteristics.

Table 3.4. Attrition by Commissioning Source and Demographics

	ATTRITION						WINGED		TOTAL	
	PERFORMANCE		MEDICAL		DROP ON REQUEST					
VARIABLE	% of total	No.	% of total	No.	% of total	No.	% of total	No.	%	No.
USNA	3.94	16	5.42	22	1.9	8	88.67	360	100	406
ROTC	6.91	32	3.46	16	2.8	13	86.83	402	100	463
OCS	9.8	29	3.04	9	4.7	14	82.43	244	100	296
CAUC	6.29	75	5.2	62	3.0	36	85.49	1019	100	1192
BLK	20.0	16	3.75	3	6.2	5	70.00	56	100	80
HISP	14.29	5	5.71	2	2.8	1	77.14	27	100	35
API	11.43	4	14.29	5	2.2	1	71.43	25	100	35
TECH	7.3	43	4.24	25	2.8	17	85.57	504	100	589
NON-TECH	8.11	66	6.27	51	3.5	28	82.08	646	100	791

In order to provide an adequate picture of the SNFO cohort file each independent variable is presented next to the percentage of individuals in that same independent variable category who became winged as an NFO. The three commissioning sources considered in this study each have different screening devices for admissions and varying investments in human capital. Figure 3.5 shows the difference in percentages of successfully winged student NFOs by these three commissioning sources.

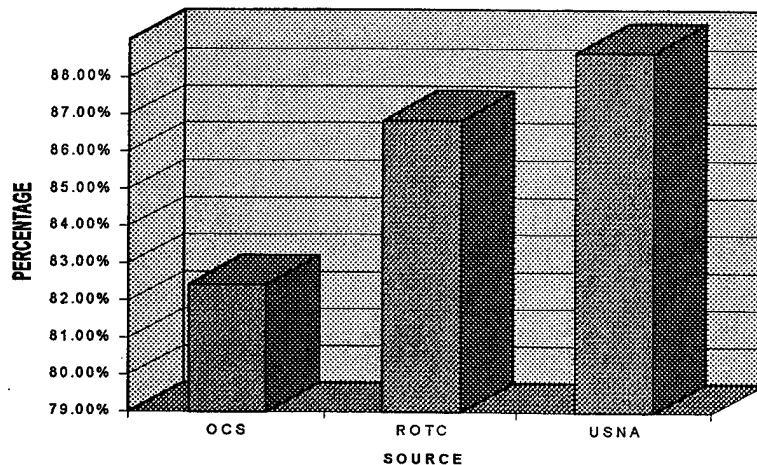


Figure 3.5. Winged Percentage of SNFOs by Commissioning Source

The SNFO cohort file contains approximately 5 percent BLK, 3 percent HISP, and 3 percent API. Figure 3.6 shows the percentage of SNFOs winged by race and ethnicity. The number of minorities who enter NFO training may limit the reliability of the estimates of success for this group. Other explanations of the differences in the winged percentages by race and ethnicity are not addressed in this study. This study examines the effects that particular demographics have on NFO training attrition.

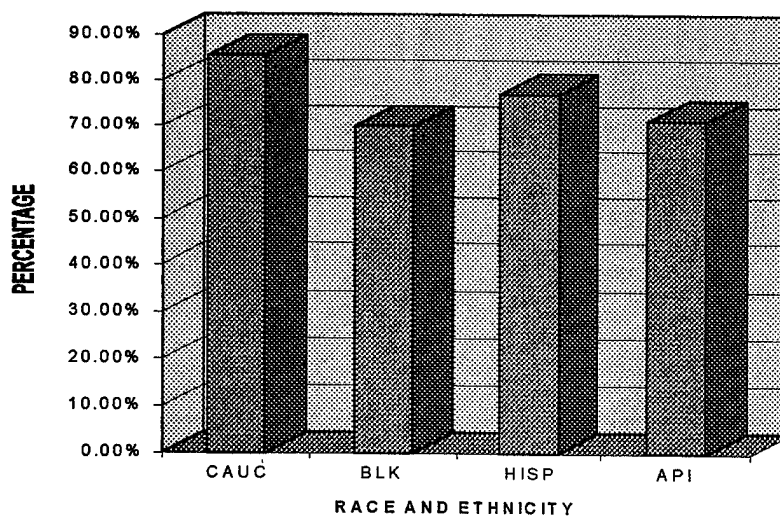


Figure 3.6. Winged Percentage of SNFOs by Race and Ethnicity

Figure 3.7 reveals the differences in the percentage of winged NFOs based on undergraduate degree. NFO tasks in-flight involve a variety of duties. However, regardless of aircraft assigned, a common ability of intensive analytical skills is required in order to perform functionally in an aircraft. Perhaps this fact is helpful in explaining the differences in the percentage of winged NFOs by undergraduate degree.

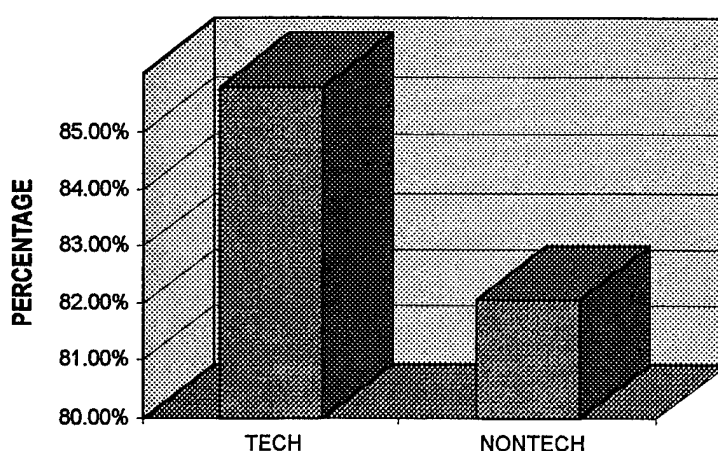


Figure 3.7 Winged Percentage of SNFOs by Undergraduate Degree

The SNFO Cohort File is composed of 22 different possible population profiles that are based on dummy variable combinations. These population profiles samples are a combination of commissioning source, race, ethnicity, and undergraduate degree. The largest population profile is a Caucasian, ROTC graduate who had an undergraduate degree in a non-technical major. Table 3.5 summarizes the various population profile samples of the groups analyzed in the statistical analysis chapter. An explanation of the selection of these groups for the model development is discussed in the next chapter.

Table 3.5. Population Profiles

COMSRC	RCRSP	Undergrad Degree	Sample size	Percent of Sample
USNA	CAUC	NONTECH	140	12
USNA	CAUC	TECH	214	18
USNA	BLK	NONTECH	8	1
USNA	BLK	TECH	6	1
USNA	API	NONTECH	9	1
USNA	API	TECH	9	1
OCS	CAUC	NONTECH	170	15
OCS	CAUC	TECH	74	6
OCS	BLK	NONTECH	25	2
OCS	BLK	TECH	16	1
ROTC	CAUC	NONTECH	263	23
ROTC	CAUC	TECH	154	13
ROTC	BLK	NONTECH	7	1
ROTC	BLK	TECH	5	1
ROTC	API	NONTECH	6	1
ROTC	API	TECH	5	1

D. SUMMARY

This chapter describes the data methodology used in data collection, merging of files, data validation, and variable creation. Also discussed are the various population profiles utilized in the statistical analysis. Attrition is divided into three categories; performance, medical, and dropping on request; the other possible dependent variable outcome is to become a winged NFO. The independent variables are divided into dummy variables representing commissioning source, race and ethnicity, and undergraduate degree. Chapter

Four describes the multinomial statistical analysis utilized to estimate the attrition model.

IV. STATISTICAL ANALYSIS

A. ATTRITION MODEL

The statistical analysis in this chapter focuses on the estimation of a multinomial logit model to determine the differential effects of each variable on the generalized logits as defined in this chapter. A preliminary logit based on two outcomes (attrite, succeed) was first estimated and the results are displayed in Appendix A. The results show that OCS graduates, Blacks, and Asians are significantly more likely to attrite (than USNA graduates and Caucasians). The TECH and ROTC variables are not significant in the logit attrition model. While this simple logit provides some insight into attrition behavior, the multinomial logit model will determine differences in the type of attrition for each demographic characteristic. By so doing, the thesis may provide some guidance as to the weaknesses associated with NFO candidates with different backgrounds.

Since the SNFO cohort file contains attrition codes that are categorical, a model is utilized which contains multiple outcomes. Attrition based on performance does not have any ordered or ranked structure compared to attriting based on medical or even dropping on request. Rather, the concern of this study is to determine what effect each independent variable has on the relative probability of attriting for each response category.

The multinomial logit to be estimated is specified as follows:

$$NFO_j = \beta_0 + \beta_1(USNA) + \beta_2(OCS) + \beta_3(CAUC) + \beta_4(BLK) + \beta_5(NONTECH)$$

where j = four outcomes

$$NFO_j = 0 \text{ if PERF,}$$

$$NFO_j = 1 \text{ if MED,}$$

$$NFO_j = 2 \text{ if DOR, or}$$

$$NFO_j = 3 \text{ if WING.}$$

Logits are calculated based on the log odds of the ratio of the probability of attrition for a particular reason to the probability of the individual being winged.

The model for a four-level response computes three separate logits. The logits are calculated based on the effects of the specific independent variable on the relevant log odds. The statistical analysis thus yields an understanding of what the predicted probabilities of a notional individual in a particular population profile sample has of becoming a winged NFO. The model divides reasons for attrition into the three categories. As discussed in chapter III, the categories are labeled performance, medical, and dropping on request.

There are three generalized logits which are calculated for each of the categories of independent variables as shown below:

Log (prob PERF / prob WING)

Log (prob MED / prob WING)

Log (prob DOR / prob WING)

Initially the model included the HISP categorical variable. However, computation difficulties precluded the HISP variable from being retained in the model by itself. Rather than combine race and ethnicity, the HISP variable is eliminated from the statistical analysis.

B. MODEL VALIDATION

As shown in Table 4.1, the goodness of fit is adequate for this model as $\text{Chi-square} = 35.36$ with 30 df and $p = .2299$. This means that a fully saturated model that includes all interaction terms (e.g., race category * commissioning source category, ect.) does not have significant additional explanatory power (Schlotzhauer). Commissioning source is significant at the 5 percent level. Race response is significant at the 1 percent level. Undergraduate degree (TECH) is marginally significant at the 10 percent level.

According to page 214 of the SAS User's Guide: Statistics version 5 edition: "The ANALYSIS OF VARIANCE TABLE for the maximum-likelihood analysis, printed when the ML option is specified for the standard response functions, is similar to the table produced for the least-squares analysis. The CHI-SQUARE test for each effect is a Wald test based on the information matrix from the likelihood calculations. The likelihood ratio statistic compares the specified model with the unrestricted model, and is an appropriate goodness-of-fit test for the model."

Table 4.1. Maximum-Likelihood Analysis-Of-Variance

Source of variation	Degrees of freedom	Chi-square	Probability
INTERCEPT	3	166.49	.0000
COMSRC	6	12.87	.0451
RCRSP	6	21.33	.0016
TECH	3	7.49	.0578
Likelihood ratio	30	35.36	.2299

C. MODEL RESULTS

The parameter estimate model Table 4.2 displays the effect of the independent variables in the three logit equations. A negative effect means that specific variable reduces the log odds of attriting for that response category, relative to becoming a winged NFO. Notice the significance associated with the variables in the logit calculations for PERF/WING. While most of the variables are significant at the 5 percent level, the variable BLK is marginally significant.

Table 4.2. Parameter Estimates From Multinomial Attrition Model

Variable	ATTRITION MODEL					
	Log (prob PERF/ prob WING)		Log (prob MED/ prob WING)		Log (prob DOR/ probWING)	
	Coef	P-Value	Coef	P-Value	Coef	P-Value
INTERCEPT	-2.00	<.01	-3.11	<.01	-2.99	<.01
USNA	-.4864	.0188*	.4313	.0516	-.3552	.2093
OCS	.4000	.0312*	-.2594	.3420	.3738	.1441
(ROTC	Omitted)					
CAUC	-.7871	.0017**	-.2040	.6112	-.4495	.2665
BLK	.4951	.1135	-.9218	.1937	.2867	.5733
(API	Omitted)					
NONTECH	-.0275	.8307	.4694	.0083**	.1329	.4779
(TECH	Omitted)					

* = Significant at the 5 percent level ** = Significant at the 1 percent level

The coefficients shown above are interpreted as follows. The coefficients for the USNA variable equal the differential effect for the USNA on the log of the three relative probabilities. The negative differential effect for USNA of .4864 in the first coefficient column means that entering aviation training from the United States Naval Academy has a negative effect on the log odds of attriting for performance reasons relative to becoming a successfully winged naval flight officer. Naval Academy graduates, therefore, have a lower relative probability of attriting for performance reasons. Conversely, OCS graduates have a higher relative probability of attriting for performance reasons. It should be noted that the sum of the effects of each independent variable category sum to 0. For example, the category, ROTC is omitted from the table. A USNA= -.4864 and OCS= .4000 implies that the coefficient of ROTC equals .0864. It is also seen in Table 4.2 that Caucasians have a lower relative probability of attriting for performance

reasons. In the second two columns, USNA, and NONTECH have a higher relative probability of attriting for medical reasons. The DOR attrition category, does not contain any explanatory variables that are significant.

The population profiles used to model the attrition patterns observed in year groups 1991-1995 are shown on Table 4.3. The rows of the table correspond to the different categorical variable combinations considered in the multinomial logit equations. The columns represent predicted probabilities for the nominal response categories obtained from the model.

Table 4.3. Predicted Probabilities of Population Profiles

COM SRC	RC RSP	Undergrad Degree	Smpl size	Predicted probability (± Standard Error)			
				PERF	MED	DOR	WING
USNA	CAUC	NONTECH	140	.0317(.009)	.0774(.019)	.0221(.009)	.8687(.023)
USNA	CAUC	TECH	214	.0353(.009)	.0319(.010)	.0178(.007)	.9149(.015)
USNA	BLK	NONTECH	8	.1072(.043)	.0354(.035)	.0433(.028)	.8141(.058)
USNA	BLK	TECH	6	.1162(.044)	.0142(.015)	.0340(.022)	.8355(.050)
USNA	API	NONTECH	9	.0720(.044)	.2260(.100)	.0315(.032)	.6705(.102)
USNA	API	TECH	9	.0886(.052)	.1029(.055)	.0281(.029)	.7804(.076)
OCS	CAUC	NONTECH	170	.0747(.017)	.0377(.013)	.0445(.014)	.8431(.024)
OCS	CAUC	TECH	74	.0813(.021)	.0351(.014)	.0351(.014)	.8684(.025)
OCS	BLK	NONTECH	25	.2201(.057)	.0150(.015)	.0759(.038)	.6890(.063)
OCS	BLK	TECH	16	.2360(.065)	.0059(.006)	.0590(.033)	.6990(.068)
ROTC	CAUC	NONTECH	263	.0564(.012)	.0424(.011)	.0310(.009)	.8702(.018)
ROTC	CAUC	TECH	154	.0614(.015)	.0171(.007)	.0245(.009)	.8970(.009)
ROTC	BLK	NONTECH	7	.1753(.058)	.0179(.018)	.0559(.033)	.7509(.064)
ROTC	BLK	TECH	5	.1878(.063)	.0071(.007)	.0434(.027)	.7616(.066)
ROTC	API	NONTECH	6	.1323(.074)	.1280(.068)	.0456(.046)	.6941(.095)
ROTC	API	TECH	5	.1521(.084)	.0545(.034)	.0381(.039)	.7554(.092)

*NOTE : There were no API individuals who attended OCS in the SNFO cohort file so the model did not calculate the predicted probabilities for that population profile.

The small number of minorities in their population profiles reduce the relativity of estimates for this attrition model. Ideally at least, 25 individuals in each identified category for each response is recommended (Schlotzhauer, 1998). However, only five years worth of cohort data were available for this thesis. As the sample sizes of the population profiles declines this may decrease the confidence in the findings. It is especially important to consider this factor for the case of minorities.

The predicted probabilities for the PERF category might be better understood by calculating the change in the predicted probability observed by altering one independent variable. Moving to a demographic profile, which is different from the base case reveals the change in the predicted probability as a result of this move. For example, the “delta” in the predicted probability of PERF for a population profile of USNA, CAUC, and NONTECH to USNA, BLK, and NONTECH is $.1072 - .0317 = .0755$. This is interpreted as a 7.5 percentage point difference (increase) in the predicted probability of attriting based on performance for Blacks compared to Caucasians. The “delta” for the predicted probability of PERF for a population profile of USNA, CAUC, and TECH to USNA, BLK, and TECH is $.1162 - .0353 = .0809$. Table 4.4 shows the change in the predicted probabilities moving from the “notional person” (base case) population profile of USNA, CAUC, and NONTECH, to the various other population profiles. Figures

4.1 and 4.2 show the differences in the predicted probabilities based on undergraduate degree.

Table 4.4. Delta in Predicted Probability from “Notional” Population Profile of USNA, CAUC, and NONTECH

Population Profile			PERF	MED	DOR	WING
USNA	CAUC	NONTECH	Base Case Population Profile			
USNA	CAUC	TECH	0.36%	-4.55%	-0.43%	4.62%
USNA	BLK	NONTECH	7.55%	-4.20%	2.12%	-5.46%
USNA	BLK	TECH	8.45%	-6.32%	1.19%	-3.32%
USNA	API	NONTECH	4.03%	14.86%	0.94%	-19.82%
USNA	API	TECH	5.69%	2.55%	0.60%	-8.83%
OCS	CAUC	NONTECH	4.30%	-3.97%	2.24%	-2.56%
OCS	CAUC	TECH	4.96%	-4.23%	1.30%	-0.03%
OCS	BLK	NONTECH	18.84%	-6.24%	5.38%	-17.97%
OCS	BLK	TECH	20.43%	-7.15%	3.69%	-16.97%
ROTC	CAUC	NONTECH	2.47%	-3.50%	0.89%	0.15%
ROTC	CAUC	TECH	2.97%	-6.03%	0.24%	2.83%
ROTC	BLK	NONTECH	14.36%	-5.95%	3.38%	-11.78%
ROTC	BLK	TECH	15.61%	-7.03%	2.13%	-10.71%
ROTC	API	NONTECH	10.06%	5.06%	2.35%	-17.46%
ROTC	API	TECH	12.04%	-2.29%	1.60%	-11.33%

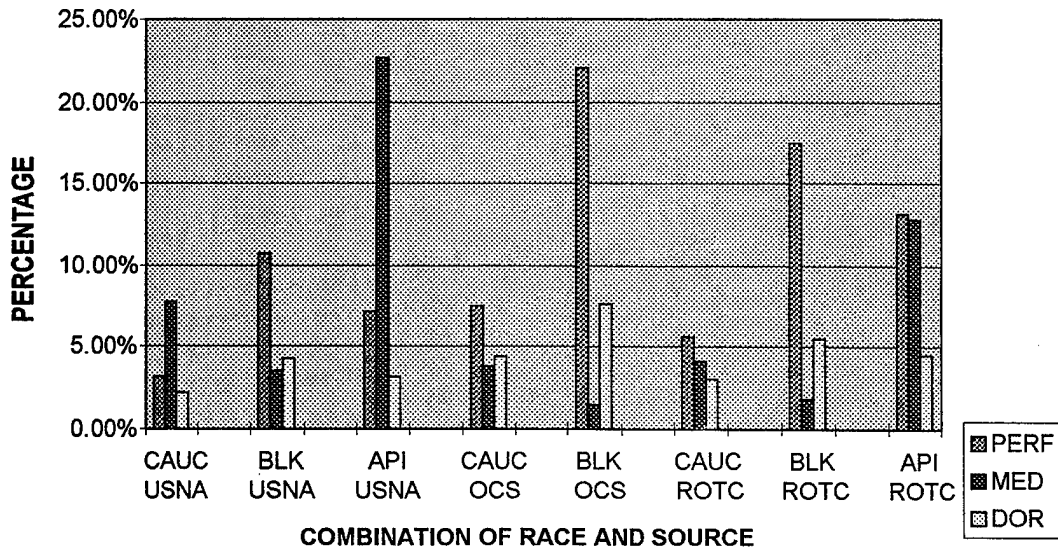
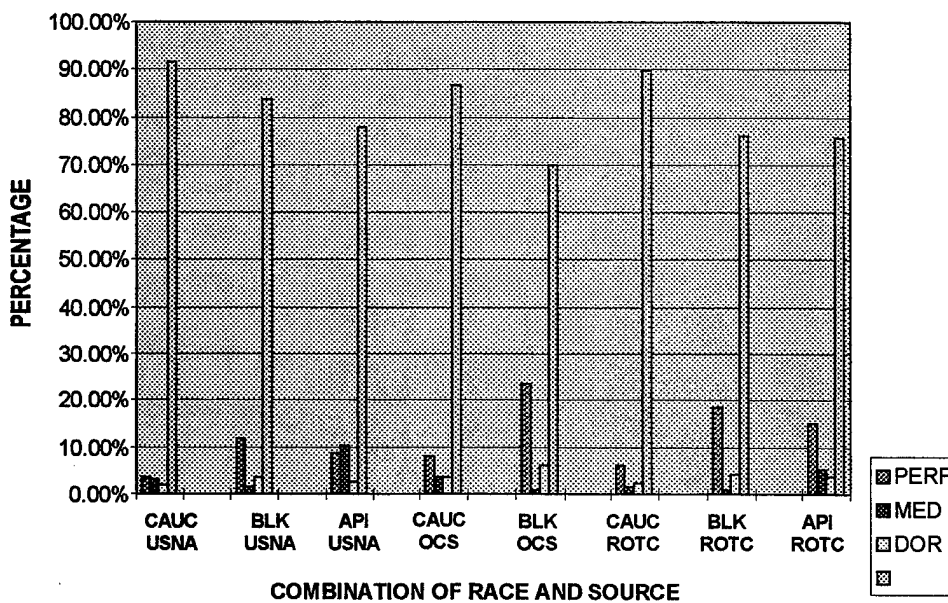


Figure 4.1. Predicted Probabilities of Attrition for Nontech Majors



Note: The predicted probabilities calculated by the SAS CATMOD procedures are graphed in Figure 4.4 and Figure 4.5 *. The SAS User's Guide states "...printed for each response function within each population are the observed and predicted function values, their standard errors, and the residual (observed-predicted)."

Figure 4.2. Predicted Probabilities of Attrition for Tech Majors

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Attrition Model Results

The main effects model enhances ones understanding of NFO training attrition patterns. To understand the effects of commissioning sources, it is necessary to appreciate that the officer training programs are fundamentally different in cost, duration, and candidate qualifying criteria. This study showed graduates from the Naval Academy, other things equal, had a significantly lower predicted probability of attriting for performance and dropping on request. This effect might have occurred because of the rigorous initial screening of Naval Academy Candidates (ability bias) or the lengthy intensive officer training program conducted at the Naval Academy. ROTC follows the Naval Academy with the next lowest predicted probability of attriting based on performance or dropping on request. OCS has the highest predicted probability of attrition based on PERF and DOR experienced in the attrition model.

Interestingly, Naval academy graduates have a higher probability of attriting for medical reasons. There are no obvious reasons for this. OCS candidates may have the most recent medical screening upon commissioning, as OCS is a three month training program. However, these hypotheses must be analyzed in future studies.

The attrition model calculates the predicted probabilities associated with the various independent variable categories. Figure 5.1 graphs the predicted probabilities of the three attrition categories for non-technical majors by race and commissioning source. Figure 5.2 graphs the reasons for attrition of technical majors pairwise by race and commissioning source.

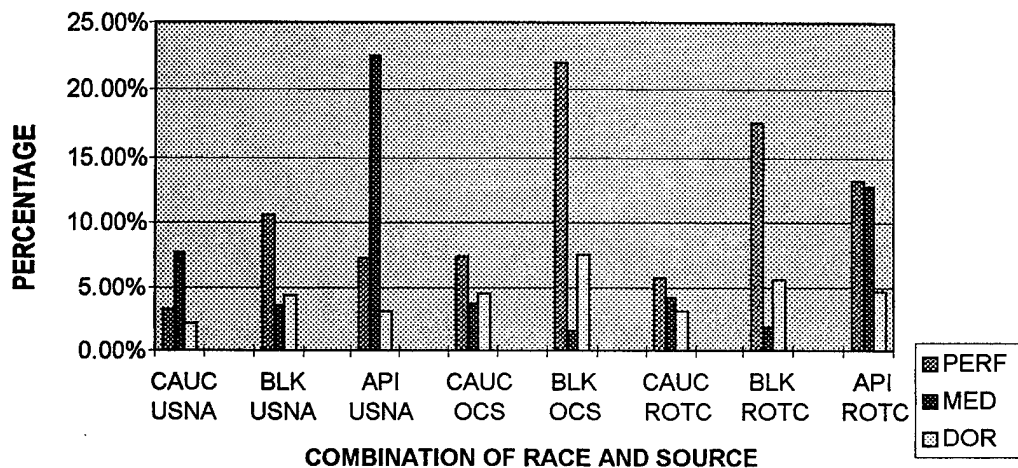


Figure 5.1. Predicted Probabilities of Attrition for Nontech Majors

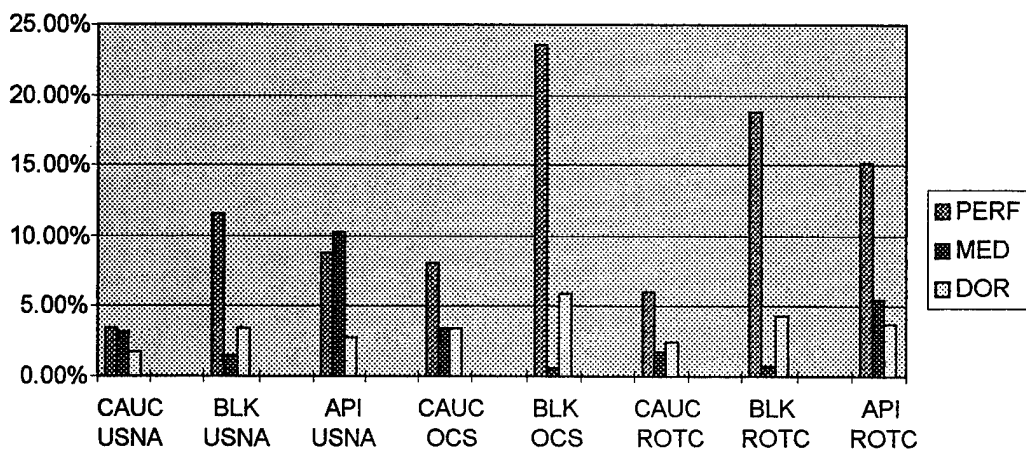


Figure 5.2. Predicted Probabilities of Attrition for Tech Majors

The USNA has the lowest probability of attriting for performance and dropping on request. ROTC follows the USNA with the next lowest probability of attriting for performance and dropping on request. The predicted probability for attriting for medical reasons is approximately the same for Caucasians officers commissioned from ROTC and OCS, while USNA is considerably higher for a NONTECH undergraduate. Further research is required to fully understand why USNA graduates attrite less for performance and dropping on request and more for medical reasons.

The race categories reveal differences in the predicted probabilities of attrition categories. The analysis indicates that minorities attrite at a higher percentage than Caucasians. Specifically, blacks have the highest probability of attriting based on performance. In fact, the combination of being black and a OCS graduate yields over a 20 percent predicted probability of attriting based on performance compared to the 8 percent predicted probability of USNA, BLK regardless of undergraduate degree. API follows with the next highest probability of attrition based on performance.

The other side of these attrition probability for TECH versus NONTECH majors can be noted from these two figures. As seen in the right hand columns of table 4.3 TECH majors are consistently more successful in being winged than NONTECH majors. For example, a USNA, Caucasian, technical graduate has about .046 higher success probability than the USNA, Caucasian, non-technical

graduate. Recall, however, that the TECH variable was not statistically significant in the logit model. Further analysis of this issue, therefore, is merited.

2. Model Fit

The multinomial logit equation explains the differential effects of the independent variables on the various response categories. The main effects model is used to calculate predicted probabilities. Given the assumptions of the multinomial logit procedure, the model has predictive and explanatory power. The analysis of variance Table 4.1 shows the significance of the separate independent variable categories. The likelihood ratio test shows that a model that includes all interaction terms does not significantly enhance the explanatory power of the model.

Sample size for minorities is less than optimal. Ideally there should be 25 individuals in each population profile-response combination. An example of an ideal sample size would be a population profile of say BLK, USNA, TECH, with a sample size of 25 in each of the three attrition categories and in the winged category. Although the total sample size contained in the SNFO cohort file is 1,165, the distribution of individuals within the cohort file is skewed toward Caucasians. Also, the distribution in the response categories are skewed towards the winged category, as 86 percent of the individuals contained in this study became a winged NFO. However, one needs to recall that these represent the population of NFO trainees, not samples. Hence there is no way to increase the

number of individuals in each category except by increasing the number of cohorts.

B. RECOMMENDATIONS

Further analysis is needed of the reasons associated with the performance and dropping on request attrition outcomes by commissioning source. Additional analysis should also examine the differences in attriting for medical reasons by commissioning source. An aviator-wide attrition data base might be created utilizing the same methods employed in this study. This future work would contain a larger number of observations in the demographic categories. The SNFO cohort file should be updated periodically to increase the number of observations of these models and the type of the analysis undertaken in this thesis should be continued in order to better understand the significant trends in NFO attrition, the type of attrition, and its correlates.

APPENDIX A. THE *LOGISTIC* PROCEDURE

Response Variable: ATT
Response Levels: 2
Number of Observations: 1165
Link Function: Logit

Response Profile

Ordered Value	ATT	Count
1	1	159
2	0	1006

WARNING: 212 observation(s) were deleted due to missing values for the response or explanatory variables.

Model Fitting Information and Testing Global Null Hypothesis BETA=0

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	930.559	921.341	.
SC	935.619	951.704	.
-2 LOG L	928.559	909.341	19.218 with 5 DF (p=0.0018)
Score	.	.	21.812 with 5 DF (p=0.0006)

Analysis of Maximum Likelihood Estimates

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-sqr	Pr > Chi-sqr	Standardized Estimate	Odds Ratio
INT	1	-2.04	.191	114.2	.0001	.	.
OCS	1	.422	.232	3.2	.0699	.101	1.52
ROTC	1	.169	.214	.6	.4298	.0456	1.18
BLK	1	.831	.300	7.6	.0056	.1067	2.29
API	1	1.1	.431	6.6	.0099	.957	3.05
TECH	1	-.217	.182	1.4	.2327	-.059	.805

Association of Predicted Probabilities and Observed Responses

Concordant = 52.9%	Somers' D = 0.203
Discordant = 32.6%	Gamma = 0.238
Tied = 14.5%	Tau-a = 0.048
(159954 pairs)	c = 0.602

APPENDIX B. SAS CODING

* CREATION OF TECH AND NONTECH VARIABLES PER OFFICER

MASTER FILE CODING

```
IF UMAJ>41 AND UMAJ<67 OR UMAJ=90 OR UMAJ=10  
OR UMAJ=09 OR UMAJ=13 OR UMAJ=36 OR UMAJ=38  
OR UMAJ=34 OR UMAJ=35 OR UMAJ=39 THEN TECH=1;  
ELSE TECH=0;
```

* CREATION OF COMMISSIONING SOURCE VARIABLES PER OFFICER

MASTER FILE CODING

```
IF SOC=01 THEN DO;  
    USNA=1; ROTC=0; OCS=0;  
END;  
IF SOC=38 THEN DO;  
    USNA=0; ROTC=0; OCS=1;  
END;  
IF SOC=03 THEN DO;  
    USNA=0; ROTC=0; OCS=1;  
END;  
IF SOC=06 THEN DO;  
    USNA=0; ROTC=0; OCS=1;  
END;  
IF SOC=04 THEN DO;  
    USNA=0; ROTC=1; OCS=0;  
END;  
IF SOC=05 THEN DO;  
    USNA=0; ROTC=1; OCS=0;  
END;  
IF SOC=36 THEN DO;  
    USNA=0; ROTC=1; OCS=0;  
END;
```

* CREATION OF RACE AND ETHNICITY VARIABLES PER OFFICER
MASTER FILE CODING

```
IF ETHNIC='1' THEN
  HISP=1; ELSE HISP=0;
IF RACE='C' THEN
  CAUC=1; ELSE CAUC=0;
IF RACE='N' THEN
  BLK=1; ELSE BLK=0;
IF RACE='M' THEN
  API=1; ELSE API=0;
IF RACE='R' THEN
  IF ETHNIC='1' THEN
    HISP=1; ELSE HISP=0;
```

* CREATION OF CATEGORICAL INDEPENDENT RESPONSES

```
IF USNA=1 THEN COMSRC=0; ELSE IF OCS=1 THEN COMSRC=1;
  ELSE IF ROTC=1 THEN COMSRC=2;
IF CAUC=1 THEN RCRSP=0; ELSE IF BLK=1 THEN RCRSP=1;
  ELSE IF API=1 THEN RCRSP=2;
IF NFO=0 THEN CAT=0; ELSE IF NFO=1 THEN CAT=1;
  ELSE IF NFO=2 THEN CAT=2;
```

* TABLES

```
PROC FREQ; TABLES NFO*(USNA ROTC OCS CAUC BLK API HISP
TECH);
```

*MODEL

```
PROC SORT;BY NFO;
PROC CATMOD;
MODEL NFO=COMSRC RCRSP TECH /PRED=PROB;
RUN;
```

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