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THESIS

PREDICTING HIGH QUALITY AFQT  
WITH  
YOUTH ATTITUDE TRACKING STUDY DATA

by

Jackie Lynn Rickman

December, 1991

Thesis Co-Advisors:

George W. Thomas  
Linda Gorman

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WITH  
YOUTH ATTITUDE TRACKING STUDY DATA

by

Jackie Lynn Rickman  
Major, United States Marine Corps  
B.S., United States Naval Academy, 1979

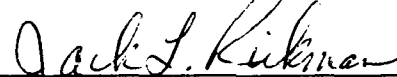
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Author:



Jack L. Rickman

Approved by:



George W. Thomas, Thesis Co-Advisor



Linda Gorman, Thesis Co-Advisor



David R. Whipple, Chairman  
Department of Administrative Sciences

**ABSTRACT**

This thesis demonstrates that Youth Attitude Tracking Study (YATS) data can be used to create a synthetic AFQT classification procedure for distinguishing high quality respondents. Unlike previous methods, the procedure does not rely on interest in the military to predict AFQT category. The estimates are based on an analysis of the YATS data matched with the Defense Manpower Data Center cohort data file using a binomial logistic regression model. The market segment analyzed is 17 to 21 year old males who are either high school graduates or prospective high school graduates. The dependent variable is whether or not a respondent would score above the fiftieth percentile on the Armed Forces Qualification Test. The explanatory variables reflect individual demographic, educational and labor market characteristics at the time of YATS interview. The YATS time frame is restricted to 1983 through 1985 in order to facilitate future bridging of YATS models with models estimated with similar time period data from the National Longitudinal Survey of Youth (NLSY). Additionally, the models may be used to provide estimates of AFQT quality for more recent YATS respondents.

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## I. INTRODUCTION AND BACKGROUND

The purpose of this thesis is to describe a method for estimating mental quality from Youth Attitude Tracking Study (YATS) data.

Today a new labor market confronts military manpower policy makers. Perhaps the most positive factor contributing to military labor demand is that a smaller military will require fewer enlistments. Enlistment requirements will decrease during the scheduled Department of Defense draw down and thereby help negotiate the anticipated trough in the youth labor market of the mid 1990's. Current indications are that some or all of the services may increase mental aptitude requirements in an effort to maximize the productivity of the reduced personnel structure. Such management decisions would dictate optimum distribution of recruiters across geographic areas that would obtain higher quality recruits and probably establish new demographic racial, ethnic and gender equilibria. A compelling task still awaits the recruiters: that of continuing to enlist high quality volunteer recruits at the least possible cost in the wake of a massive reduction both in the size of the force and recruiting resources. Mass reductions threaten to translate to a decreased sense of military job security for anyone considering enlistment.

The supply side of the 1990's military manpower market differs markedly from those of the past for several reasons. The qualified military available (QMA) pool is shrinking as the baby boomer generation ages; the pool will again begin to grow in the second half of the decade as the boomers' children enter the market. The competitive civilian labor force continues to lure many qualified youths away from prospective military service. Military advertising and recruiting costs continue to grow due to plant, operational and manpower costs at a time when Congress can be expected to oppose generous recruiting budgets.

Average achievement scores of those in the youth labor market continue to decline, requiring increased selectivity. The announcement in September, 1991, by the Scholastic Aptitude Test administrators that overall scores had dropped again sparked yet another nation-wide round of accusations and hand-wringing in the news. Meanwhile, the military services must get by with whatever quality they can extract from those available. The requirements for higher education that enable youth to obtain satisfying and lucrative careers compel many of the highest mental quality individuals to seek a college or even post graduate degree before even entering the labor market beyond part-time, school or summer employment.

Finally, tomorrow's QMA population may grow skeptical toward the likelihood of obtaining a satisfactory and promising career in the military if vignettes of those service people discharged during

the early 1990's reduction in force become human interest staples on television.

Many pertinent factors on the demand side of the market also make future recruiting more challenging. Manpower aptitude requirements continue to increase due to the high technology weapons, engineering, and communications systems employed by the military. A logical screening measure to meet increased aptitude needs during and after the draw down would be to increase category I through IIIA Armed Forces Qualification Test (AFQT) entrance requirements. The 1989 percentages of enlistees, category IIIA and above are presented in Table 1.

TABLE 1.--SCORES OF 1989 NON-PRIOR SERVICE (NPS) ACCESSIONS BY SERVICE<sup>1</sup> (IN PERCENT)

AFQT CATEGORY	ARMY	NAVY	MARINE CORPS	AIR FORCE	DOD AVERAGE
I-III A	63	59	66	85	65
III B	31	31	33	15	29
IV	7	11	*	*	6
TOTAL	100	100	100	100	100

Increasing entrance standards would inevitably restrict the number of entrants from disadvantaged educational backgrounds; i.e., the proportion of minorities entering the military would fall

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<sup>1</sup>For further discussion on demographic characteristics of actual enlistees for FY 1989, see Population Representation in the Military Services, Fiscal Year 1989, Office of the Assistant Secretary of Defense (Force Management and Personnel) of July 1990.

drastically.<sup>2</sup> Evolving expected threat scenarios portend changing missions and, hence, active duty force structure instability for the foreseeable future. The active duty versus reserve manpower mix can also be expected to change several times during the next generation as Defense Department planners seek a new active/reserve equilibrium. In short, despite any savings to be realized from the peace dividend, the force structures of individual services may change. Through all of these challenges the U.S. military must maintain maximum manpower readiness to respond to as yet unforeseen crises around the world with state of the art military technology.

All of the above supply and demand factors affect the recruiting force's mission and cannot be ignored when considering the military manpower environment of the 1990's and beyond. Recruiting must become more efficient than ever. Finding recruits at the lowest cost per recruit will remain at the heart of the recruiting service's mission.

Cost per recruit may be examined by investigating total recruiting costs, individual costs, and cost by categories of recruits. Central to minimizing recruiting costs in all three of the above measures is targeting qualified youth who are most likely to be interested in joining the military and to convert their interest into enlistment. Individuals are considered qualified military available (QMA) if they are 17 to 21 years of age, are

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<sup>2</sup>Sixty percent of all blacks who enlisted in the military in 1989 were categorized as IIIB or IV; i.e., they would have been ineligible under a I through IIIA only criteria.

high school graduates or equivalent, pass the armed forces medical physical examination, pass a computerized legal records background check, and score in the upper fiftieth percentile of the AFQT.

The basic goal of the recruiting service is to induct the number of qualified recruits necessary to perform the tasks required by today's and tomorrow's military systems. The goal must be achieved by an ongoing iterative process: identify those who are QMA, target them for recruitment, and induce them to enlist. Since some people are more inclined (or at least susceptible) to entering military service than others, it is to the recruiter's advantage to learn which QMA's are most likely to enter, where they are located, and then to target them specifically for recruitment.

Still, a significant percentage of disinterested youth eventually enlist and therefore must be actively sought out. Identifying who is mentally qualified and where they are is the first step. From the individual's perspective, choosing a job, even if it may last only two years, is a matter of personal well-being. The decision encompasses far more than simply comparing military wages and benefits to those of alternative civilian jobs; the nonpecuniary aspects of the two alternatives make it a matter of taste as well. Some people assign high intrinsic value to serving their country. Some cite reasons such as travel opportunities or friendships. Others may view the military as their best chance at overcoming socioeconomic barriers in their local area. If the recruiter could be armed with good indicators (predictors) of individual taste and ability, QMA youth might be

recruited at lower cost: the better the predictor, the better the recruiter's results. Unfortunately, concrete data do not exist that will tell in advance exactly who is qualified, where to send recruiters, or even who will or will not enlist once contacted. Intrinsically, the enlistment decision is fraught with individual tastes that may either magnify or dampen more quantifiable measures such as earnings comparisons.

Consequently, manpower analysts must often employ survey data in which cause-and-effect relationships are often tenuous at best. The manner or order in which survey questions are presented to respondents may introduce bias. Even the selection of the respondents may result in biased feedback. To obtain all of the variables necessary for the estimates desired, analysts may find it necessary to match or merge different data sets in order to capture both pecuniary and nonpecuniary factors. From the resultant "complete" data set the analyst hopes, with the aid of hindsight obtained from historical records, to document trends which can help predict, for example, where future QMA's with similar characteristics or profiles can be found, and based on their survey responses, what they will be inclined to decide.

Two data sets of interest in the military which have proven useful to manpower analysts are the National Longitudinal Survey of Youth (NLSY) and the Youth Attitude Tracking Study (YATS). The NLSY data set was initiated in 1979 to study the labor force behavior of American youth. The NLSY data are weighted to compensate for unequal probability of selection. The weights are

adjusted annually for respondents who drop out of the survey and the changing population represented by the sample (Bock and Moore 1984). The NLSY initially included 12,686 respondents (NLSY Documentation). Unfortunately, the 1979 cohort has aged 12 years and more current data would be desirable. Military interest questions were dropped after 1985. These two data sets are discussed more fully in Chapter III.

The YATS data set contains more than 300 variables on personal traits encompassing family background, education, employment, and interest in military service. YATS data do not include regional or local demographic, education, or labor force experience variables, but the study does contain responses about the respondents' perceptions of the job market. The data are collected annually by the Department of Defense using telephone surveys of a sample of American residents between 16 and 24 years of age without prior military service and who have less than two years of college experience. The respondents are segmented into four groups: 16 to 22 and 22 to 24 years old for both males and females. If the respondents provide their social security number, their responses can be matched with personnel files from the Defense Manpower Data Center to determine whether the respondent actually enlisted, entered the Delayed Entry Program, or completed an entrance examination.

A research plan for comparing interest in the military as measured by YATS and the NLSY would be as follows: using multinomial logistic regression, predict the probability of

enlistment by analyzing YATS matched data using techniques similar to those used by Thomas and Gorman (1991) on NLSY data. The similarly constructed regression models should render results that facilitate comparing the efficacy of the two surveys in predicting qualification and probability of enlistment.

A comparison of the enlistment predictive capabilities of YATS and NLSY data sets should yield several benefits. Since the data sets arise from different surveys they could logically be suspected of offering different insights into patterns of enlistment as well as other areas of interest to manpower analysts. One set may offer more predictive ability than the other in certain respects. A possible weakness of NLSY is that as its cohort ages the responses may no longer be representative of current and future youth in the 17 to 21 age category. YATS, on the other hand, gathers new data each year. One of its weaknesses is that AFQT scores are available for relatively few respondents because of optional social security number disclosure. The 40 percent of respondents who do not provide a social security number inject selectivity bias into the sample in that they cannot be matched to future enlistment actions. All NLSY respondents provided their social security numbers and took the Armed Services Vocational Aptitude Battery (ASVAB).

Exploiting the AFQT's of the NLSY and the annual sampling of data of the prime market by YATS may significantly improve a particular model's predictive ability. If YATS data produce the same results using a model similar to that used by Thomas and Gorman in 1990, the data from future YATS waves could be used in a

model in an effort to distribute recruiters optimally around the nation. The strengths and weaknesses of the two sets, once realized, may be exploited to reduce recruiting costs while increasing the number and quality of enlistees. Armed with this information manpower planners can more effectively assign recruiting goals and allocate resources to geographic areas during optimum time periods and economic conditions to obtain maximum recruiting results.

A first step in making any YATS and NLSY comparisons is to develop an acceptable predictor of AFQT scores from respondent information in YATS. Such a proxy is necessary to partition respondents into appropriate market segments. The purpose of this thesis, therefore, is to construct models that accurately predict high quality AFQT prospects by exploring DMDC-matched YATS data for theoretically consistent explanatory variables. The models for White, Black and Hispanic prime market males will then be evaluated based on actual AFQT scores contained in the DMDC-matched data set. Issues of secondary interest are: "What are the surveyed interests of the matched QMA respondents?" and, "How does the matched sample set compare to the non-matched sample set?"

Logistic regression analysis will be employed to analyze YATS, years 1983 and 1985.<sup>3</sup> The analysis by Thomas and Gorman on NLSY was considered the control analysis. By replicating their analysis using matching variables when possible and proxy data when

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<sup>3</sup>See Section 1 of Chapter 3 for rationale.

feasible, the predictive capacities of the two data sets may be compared in subsequent work.

## II. LITERATURE REVIEW

Since World War I, manpower analysts have sought to measure the mental aptitudes of young males, 17 through 21 years of age. Since the inception of the All Volunteer Force in 1974, analysts have attempted to ascertain an individual's propensity to join the military given that he is mentally qualified. Perhaps the best early independent study on military labor supply and demand is Cooper's work in 1974. Before then remarkably little independent work had been done on the subject.<sup>4</sup> Earlier propensity studies were hampered by a lack of empirical data regarding the attitudes and opinions of young people toward military service. Even if exhaustive surveys had been available, the lingering memories of the Vietnam War era would probably have skewed the responses so that projecting estimates for future years would have been difficult.

By the late 1970's, the Vietnam specter had faded and some detailed manpower related data sets had been constructed. Computerized data analysis costs had fallen enough to encourage the services to embark on serious enlistment propensity studies. YATS and NLSY construction, the two major data sets with which this paper is concerned, was begun in 1976 and 1979 respectively. Many

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<sup>4</sup>Cooper, R. V. L., Military Manpower and the All-Volunteer Force, RAND Report Number R-1450-ARPA, RAND Corporation, Santa Monica, CA, 1974

of the major definitive works on the youth labor market were developed during the 1980's using these two data sets along with other sources of demographic statistics.

Orvis (1982) determined that the YATS propensity data was a good predictor of an individual's future probability of enlistment despite the fact that some respondents actually decide a year or more after participating in the study. He also determined that the interests and intentions solicited by the study could best predict actions within 18 months and, to a lesser degree, up to 48 months later.

Later, Orvis (1984) showed that regional enlistment rates are positively correlated with regional enlistment interest. This finding constituted one of the earliest proofs that targeting the most lucrative geographic areas would be useful.

Orvis and Gahart (1985) demonstrated that the perception of pecuniary factors such as job characteristics, job security, opportunity for advancement, and educational benefits, influences young people to enlist. Less obvious, but more significant to this thesis, they found that the probability of enlistment varied with surveyed intentions. Orvis and Gahart concluded that intentions may better predict enlistment than demographic data alone. They also found that respondents indicating little enlistment interest nevertheless constituted a large proportion of eventual enlistees. Other studies such as Siegel and Borack (1981) and Hanssens and Levien (1983) have found that interest in a particular service and

the likelihood of enlisting in that particular branch are positively correlated as well.

Gorman and Mehay (1990) determined that interest data changes over time and with geography. Since intentions are not stable over time, older data sets may produce unreliable predictions. This finding is significant in that it suggests that a data set such as the NLSY, while valuable in many ways, has a decreasingly direct applicability over time. Data on interest in military service gathered from the 1980 NLSY cohort may not be easily substituted for the attitudes and opinions of the 17 to 21 year old age group of 1991. Combining the time variance with the geographic variance could turn out to be a recipe for gross errors in predictive capability, verifiable only after the fact.

Prior to embarking on theoretically valid QMI studies one must first accurately assess QMA. Since AFQT is the measure of choice for the American military it is imperative that the analyst first determine who is qualified and then focus on the resultant data set for propensities. The history of the art of mental aptitude and psychological testing is long and convoluted. Names like Sir Francis Galton of England who wrote Heredity Genius in 1869, Alfred Binet of France and Lewis Termin who wrote after the turn of the century comprise a representative group of early manpower analysts who addressed mental aptitude. A debate on the relative importance of nature versus nurture arose early and has never

abated; that is, are people born smart or can mental aptitude be developed by placing the subjects in a nurturing environment?<sup>5</sup>

The interest of the American military in this area has been reflected by its entrance tests, conceived during World War I and eventually developed into the ASVAB. The AFQT score is derived from the ASVAB score.<sup>6</sup>

Curtis, Borack and Wax (1987) first attempted to estimate regional QMA by clustering demographically similar counties, based on socioeconomic attributes that were correlated with AFQT scores, the major determinant of QMA. Goldberg and Goldberg (1989) and Orvis and Gahart (1989) found that the distributions among mental categories of population subgroups could be estimated.

Thomas and Gorman (1991) examined NLSY and its large sample of respondents who took the ASVAB in 1980. They applied the ASVAB scores of NLSY to a representative sample of the youth population, which was estimated by Woods and Poole racial/ethnics estimates. Using explanatory variables that can be obtained down to the county level or legitimate proxies they calculated geographical distributions of the actual number of enlistees, i.e, qualified military joiners (QMJ), derived sequentially from QMA and then those in that group interested in joining, qualified military interested (QMI).

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<sup>5</sup>For a more thorough treatment, see Peterson (1990).

<sup>6</sup>See Eitelberg (1988) for an excellent history of American military entrance and placement testing.

This thesis seeks to develop a model similar to that of Thomas and Gorman using a different data set, YATS, which may facilitate future comparison of the predictive capabilities of the two data sets while recognizing the potential future applicability to current youth population samples captured annually by YATS.

This thesis also seeks to build on a related work by Snyder (1989). Using YATS variables Snyder devised a preliminary AFQT model in order to establish a "YATS prime market" for use on subsequent analysis of QMA distribution and propensity to enlist.

### III. DATA AND METHODOLOGY

#### A. SAMPLE DESCRIPTION

YATS is part of the Joint Market Research Program which contributes to Department of Defense recruiting policy and marketing. Each military service may provide input through the Joint Market Analysis and Research Committee (JMARC). YATS yields annual data about the propensity of youth to enlist in both the active and reserve components of the U.S. military. It also measures youth awareness of military advertising, contact with recruiters, and knowledge of the financial incentives for enlisting.<sup>7</sup> Appendix A contains all YATS questions used in this thesis.

The first version of the study was originally known as YATS and was initially collected in the spring and fall of each year. In 1978 YATS was combined with the information from the Reserve Component Attitude Study (RCAS) to coalesce regular and reserve recruiting strategies. The spring collection effort was dropped in 1981. In 1983 YATS and RCAS questionnaires were combined into a single survey and became known as YATS II. The first eight years of YATS saw many changes in survey questions, weighting and sampling. The years with which this research is concerned, 1983

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<sup>7</sup>Defense Manpower Data Center Report on YATS II Wave 15, Fall 1984 of April 1985

through 1985, saw little change with the exception of question numbering (variable identification) and minor question changes. A market redefinition of 1986 occurred after the last year of this thesis' sample and does not affect this work.

The primary data for this research were contained in two files originally provided to the Defense Manpower Data Center (DMDC) by two<sup>8</sup> contract survey firms. The files contain the 1983 YATS I and 1985 YATS II surveys. These two years of survey data were matched by the respondents' social security numbers to personnel data files held by DMDC. YATS records of respondents who provided their social security numbers during their telephone interview were matched against social security numbers contained in the DMDC data set. There exists an a priori selectivity bias with the YATS matched data sets because DMDC is unable to match files to those respondents who did not provide their social security numbers. DMDC generates a record for each individual who takes a pre-enlistment examination, enters the Delayed Entry Program, or actually enlists in the armed forces. The DMDC-matched data sets include all YATS respondents' records whether or not they provide a social security number. DMDC appends DMDC data records to the YATS records only if there exists a social security number match.

The YATS calling strategy is based on a two-stage procedure known as Mitofsky/Waksberg random digit dialing. The first stage clusters households identified by the first eight digits of a ten-

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<sup>8</sup>The YATS survey contract company changed in 1984.

digit telephone number. The second stage uses a random selection of the last two digits. The Mitofsky/Waksberg procedure is modified to accommodate geographic breakdown according to servicing military entrance processing stations (MEPS) and differing sampling rates for the market segments. To prevent the likelihood of calling the same home twice the sampling is done "without replacement."<sup>9</sup> Market segment stratification is 50 percent younger male, 30 percent younger female, 10 percent older male, and 10 percent older female. Weighting was not a factor in this work since only one market segment was analyzed according to racial group. Total yearly sample goal is about 10,000.<sup>10</sup>

The years 1983, 1984, and 1985 were specifically chosen because YATS began asking questions similar to those asked in the NLSY in 1983. NLSY stopped asking military propensity questions after 1985; the cohort had aged beyond the prime market age parameters by then. The 1984 YATS was omitted from consideration from this research because there were 2,060 observations missing from the original 10,000-record data set, leaving only 54 matched records. The new contract company experienced difficulty with the 1984 records that stemmed from social security number data problems.<sup>11</sup> Typically 500 to 800 of those respondents who provide social

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<sup>9</sup>Waksberg, 1978, pp. 40-45 and Snyder p. 14.

<sup>10</sup>For an excellent summary of YATS constraints, requirements, and minimum specifications, see Snyder, pp. 12-15.

<sup>11</sup>Determined during a telephone conversation between author and Ms. Elaine Sellman of DMDC on 7 October 1991.

security numbers of the total 10,000 experience some later contact with the Department of Defense. With only 54 of the remaining 7,940 1984 respondents showing contact, there likely exists some selectivity bias for that year.

DMDC first matched its files with YATS in 1989. The latest recorded enlistment actions happened in September 1988; that date is late enough to encompass the vast majority of enlistment decisions of the most recent sample of this study, 1985. The youngest respondents were 17 in 1985 and would have aged four years to 21 by 1989, still in the prime market.

YATS I survey questions were recoded in 1984. A variable-matching procedure was necessary in this analysis to retain the 1983 to 1985 time frame integrity and sample size. All 1983 variables were renumbered to match 1985 variable names.

## **B. SAMPLE REDUCTION**

The goal of this thesis was to predict the AFQT of the DMDC file using YATS survey results for prime market males. The prime market for men is defined as upper fiftieth percentile AFQT males, 17 to 21 years of age, who possess high school diplomas. This work was aimed at males only. Most recruiting is directed at prime market males because the other markets are relatively self-recruiting; applicants of those categories generally apply for enlistment in more than sufficient numbers to meet current goals.

The initial data set was reduced to include only those in the male primary market, at both YATS interview date and ASVAB test

date, and those who had provided social security numbers to facilitate future AFQT feedback. Primarily the respondent's individual survey information was used to perform the reduction; the only DMDC-matched filter employed was the respondent's age at his ASVAB test date. If a respondent delayed taking the ASVAB until after his twenty-second birthday he was no longer a prime market candidate. Historically, 60 percent of YATS respondents provide their social security numbers. The other 40 percent either do not yet have a number, do not know it, or decline to provide it.

There were a total of 17,378 observations for YATS 1983 and 1985. Of these, 1,552 observations match DMDC files. Table 2 presents the comparison of matched and non-matched observations for both years.

TABLE 2.--DELETION OF UNMATCHED RECORDS

	1983	1985	TOTAL
TOTAL	7,419	9,959	17,378
MATCHED	698	854	1,552
UNMATCHED	6,721	9,105	15,826
PCT MATCHED	9.4	8.6	8.9

Gender (Q402) was used to eliminate all females. Of the 1,552 matched observations, only 156 were female. Table 3 portrays the deletion of females from the target sample resulting in 1,396 remaining observations.

TABLE 3.--DELETION OF MATCHED RECORDS OF FEMALES

	MATCHED	UNMATCHED	TOTAL
MALES	1,396	11,365	12,761
FEMALES	156	4,461	4,617
TOTAL	1,552	15,826	17,378

Age (Q403) was used to eliminate men not of prime market age. Of the 1,396 male observations, 402 were either 16 or 22 and older. This filter leaves 994 observations in the target sample as shown in Table 4.

TABLE 4.--DELETION OF 16 AND 22/ABOVE AGE GROUP RECORDS

	16	17 TO 21	22 TO 29	TOTAL
MATCHED RECORDS	286	994	116	1,396
TOTAL	3,415	11,630	2,333	17,378

The 119 matched male respondents who delayed taking the ASVAB until they had aged beyond the prime market were also deleted, leaving 875 observations.

Other reductions were more subtle. Identifying eligible respondents still in high school required several steps. First, non-high school graduates (Q406), 19 or older, not taking high school classes at a regular day school (Q406 and Q407) were deleted. This step deleted drop-outs and certificate holders: adult basic education (ABE) and general education (GED). If the respondent answered "none" to the types of degrees he had received

and stated that he was not or would not be enrolled in school the following year, he was classified as a non-graduate. This step removed 152 more observations, leaving 723 in the target sample. Table 5 depicts the results of this step.

TABLE 5.--DELETION OF RECORDS WITH NON-HIGH SCHOOL DIPLOMAS

TOTAL	NON-HS GRADS	HS GRADUATES & PROSPECTIVE GRADS
875	152	723

While care must be taken not to include non-graduates in the sample, prospective high school graduates should be retained. Many of the remaining respondents were still in school and, therefore, potential high school graduates. This reduction step attempted to identify whom could be considered to be likely future high school graduates and included in the male prime market analysis. Those still in high school but likely to graduate are of more interest to the recruiters than any other group. They are easily located and usually have not yet made career decisions. If the respondent replied that he would be in school and that the type of school program was a regular day high school, he was considered to be in school and a potential high school diploma graduate. These respondents were identified with questions Q700, Q698 and Q699.

High school graduates who probably would not receive a high school diploma were then eliminated. If a respondent stated his high school grades were C's and D's or D's and F's (69 and below average) and had never taken and did not plan to take a college

entrance test he was not considered a prospective high school graduate. This final reduction step excluded only 57 observations, leaving 666 observations for final AFQT analysis. Table 6 compares, by racial category, the number of respondents still in high school to the number of respondents who already graduated.

TABLE 6.--IN HIGH SCHOOL VERSUS OUT OF SCHOOL

	WHITE	BLACK	HISPANIC	TOTAL
STILL IN HIGH SCH	253	54	26	333
HIGH SCH GRADS	254	55	24	333
TOTAL	507	109	50	666

For DMDC's purposes, a YATS respondent can have four basic types of contact with the military. The respondent either takes the ASVAB only, takes the ASVAB and enters the Delayed Entry Program, is discharged from the DEP, or takes the ASVAB and immediately enlists in the military. Those who provided their social security numbers but who never took the ASVAB were recoded from zero to a missing value. Respondents who failed to provide their social security number were already coded as a missing value, whether or not they ever took the test because there is no way to match their records. These last two groups constitute the non-matched sample set in this analysis. Table 7 shows the military contact distribution by race of the selected matched sample 666 observation set.

TABLE 7.--MILITARY CONTACT BY RACE

	WHITE	BLACK	HISPANIC	TOTAL
TOOK AFQT	260	50	26	336
ENTERED DEP	23	4	1	28
ENLISTED	222	55	22	299
DISCH FROM DEP	2	0	1	3
TOTAL	507	109	50	666

C. DEPENDENT VARIABLE

AFQT percentile (AFQTPCT) from the YATS matched respondents was used to develop the dependent variable. Conversion to raw scores was not necessary since the AFQT percentile score was used to determine whether a respondent scored in the upper or lower half of all respondents. If a respondent scored in the fiftieth percentile or higher the respondent was categorized as high quality (HQ=1). If a respondent scored lower than the fiftieth percentile the respondent was categorized as non-high quality (HQ=0). The HQ/Non-HQ distribution for actual matched AFQT scores is presented in Table 8.

TABLE 8.--QUALITY DISTRIBUTIONS OF OBSERVATIONS

	WHITE	BLACK	HISPANIC	TOTAL
N	507	109	50	666
HIGH QUALITY	.59	.21	.38	.51
NON-HIGH QUALITY	.41	.79	.62	.49
TOTAL	1	1	1	1

#### D. METHODOLOGY

The DoD prefers to accept recruits from the youth population that score above the fiftieth percentile of the AFQT. The upper half mental groups are defined as mental categories I, II and IIIA. As stated earlier, this research focused on 17 to 21 year old males who were either high school graduates or prospective graduates. This group was selected because it is more supply constrained than the other demographic groups and, therefore, of more interest to the military. The target sample was partitioned into three demographic groups consistent with generally accepted DoD demographic categories: White, Black and Hispanic. Included in the White category were minorities other than Black and Hispanic, such as Oriental and Pacific Islanders, of which there were 20 observations in the matched set.

This research uses binomial logistic regression, often referred to as a logit model, to develop models that accurately predict whether a respondent was a high quality (HQ) prospect or a non-high

quality (non-HQ) prospect. Binomial, or binary, logistic regression simply means the dependent variable is dichotomous, i.e., true/false or yes/no. The logistic functional form restricts the probabilities to the range of zero to one.

$$P(HQ) = \ln [P/(1-P)] = (a + B_1X_1 + \dots + B_nX_n) + u$$

where:

$P(HQ)$  = probability that the respondent was a high quality prospect

$a$  = intercept term

$B_{1..n}$  = coefficients as estimated by the model

$X_{1..n}$  = YATS explanatory variables

$u$  = randomly distributed error term

In this work the dichotomous dependent variable was coded 1 for HQ and 0 for non-HQ.

There was no restriction on the types of explanatory variables; they could be continuous, categorical, or both. Theory and experience show that characteristics such as age, gender, race, education and socioeconomic status are highly correlated with mental test achievement. This research concentrated on YATS variables that best captured the effects of the above categories and accepted some multicollinearity among explanatory variables with the goal of achieving increased predictive ability of the estimated equations.

An application of the analysis was to estimate the AFQT percentiles of unmatched records, i.e., the rest of the population, and to compare the relative mental achievement of the two sample

sets. This step entails running the estimated logistic regression equations from the three target samples, White, Black and Hispanic, against the entire YATS populations of 17 to 21 year old male high school graduates and prospective graduates. The AFQT categories were estimated using the SAS (OUTP=PRED) option to calculate probabilities for missing dependent variable values of the non-matched records. The high quality cut-off point was a predicted probability greater than or equal to .5. Those observations with estimated HQ probability less than .5 were categorized as non-high quality.

#### **E. EXPLANATORY VARIABLES**

In a good econometric model specification bias and errors must be minimized. The effects of ethnic, cultural, economic and social contributors are difficult to quantify and must often be measured by proxy measures. Proper choice of relevant explanatory variables and omission of irrelevant variables are imperative.

Explanatory variables for this research were drawn only from the YATS survey. Only as YATS respondents take the ASVAB, which can be considerably later than the YATS interview, can they be matched to DMDC files. DMDC-matched YATS data becomes available one to four years after the survey. Enlistment may be the result of numerous factors not captured by the data, such as labor force changes. Therefore, using the DMDC-matched information may reasonably be viewed as adding bias to data already rife with selectivity biases.

YATS data is subject to selectivity bias in several ways. As mentioned earlier, the voluntary social security number disclosure on the part of respondents may well bias all DMDC-matched data, a possibly lucrative subject to explore if YATS is ever to be bridged to pooled data sets such as NLSY. The interest questions may cause multiple and hard-to-measure biases. By definition, those who eventually contact the military to be ASVAB tested turn out to be interested in military service, whether or not they stated so during their interview. Simply being asked military interest questions may pique a respondent's curiosity, which may later crystalize into contact with the military. Also, despite the AFQT bridge designed by RAND, the analyst can never know for certain just how accurate the bridge really is; there is no way to test it against respondents who have never taken the ASVAB or, even if they do, they do not disclose their social security number in the first place. Still, despite the inherent biases, YATS may well be the military's most current data set and lowest cost opportunity to locate high quality QMA and QMI; but, the bridging riddle must first be solved before the data can be deemed reliable enough to make sound, low-risk regional QMA decisions.

YATS questions that can potentially discern a respondent's aptitude may be categorized as demographic, educational and labor market status. Appendix A contains a detailed description of both YATS and cohort questions ultimately considered in this analysis. Table 9 lists the variable names used in this thesis, their

corresponding survey questions, and each variable's possible values.

TABLE 9.--LIST AND DESCRIPTION OF EXPLANATORY VARIABLES CHOSEN

VARIABLE NAME	YATS QUESTION	VARIABLE RANGE
WHITE (+ other)	Q714 (1+3+4)	1=YES, 0=NO
BLACK	Q714 (2)	1=YES, 0=NO
HISPANIC	Q715	1=YES, 0=NO
YATSAGE	Q403	17 - 21
SATPAST	Q698	1=YES, 0=NO
MOMED	Q713M	7 - 20
GRADE	Q700	1 - 7
HGCOMP	Q404	7 - 14
MATHT	Q703 (1) - Q709 (1) Summation of math courses higher than elementary algebra: plane geometry + intermediate algebra + trigonometry + calculus + physics	0 - 5
BUSMATHT	Q705	1=YES, 0=NO
COLGPREP	Q701	1=YES, 0=NO
COLGBND	Q411 (3 or 4)	1=YES, 0=NO
COLGSTUD	Q408 (9 or 10)	1=YES, 0=NO
EMPLOYED	Q416 (1) & Q408 (1)	1=YES, 0=NO
UNEMPLOYED	Q416 (2) & Q408 (1) not employed and not enrolled in school	1=YES, 0=NO
SELF EMPL	Q430 (3)	1=YES, 0=NO

**Note:** The letters "LN" preceding one of the above variables indicates natural log. The letters "SQU" following one of the above variables means the value of the variables squared, or raised to the second power.

## **1. Demographic Explanatory Variables**

Race indicators for White (plus other) and Black were determined by Q714, answers one, three and four. Hispanics were identified with an additional filter, Q715. Respondents who stated that they were of Hispanic descent were considered to be Hispanic independent of their racial category response.

Question Q403 was employed to determine the respondent's age at the time of YATS interview.

Past studies have shown that people from low income families, particularly those below "the poverty level" have a distinct disadvantage when taking mental achievement tests. There was no known way to estimate a respondent's poverty status from YATS, so this potentially telling variable cannot be analyzed.

Generally, mental achievement scores vary by region across the nation. Students from the Southeastern states, for example, tend to score lower than those in New England. However, analysis of the chosen sample contradicted past nationwide studies and conventional wisdom. Therefore, region was not addressed.

## **2. Education Explanatory Variables**

Some education variables did not perform as well as expected. The YATS analyst must keep in mind that the interview is conducted via telephone conversation with no expectation of verification or feedback. Math courses taken or planned (Q702 through Q709) did not perform as well as simply math courses taken (plans omitted). Higher math courses, i.e., those taken after

elementary algebra should be positively correlated to higher AFQT results. These courses include plane geometry (Q703), intermediate algebra (Q706), trigonometry (Q707), calculus (Q708) and physics (Q709). Business math was also considered as it is often taken by some students in order to fulfill a graduation requirement to avoid having to endure elementary algebra.

The response to Q699 (Do you plan to take the SAT/ACT?) also did not perform well. Q698, which ascertains whether the respondent had already taken a college entrance test, was used instead and it proved to be better correlated with AFQTPCT.

Parents' education could not be used in this analysis. Question Q713F, which obtains the respondent's father's highest grade completed was not asked until 1984, the year after this analysis' earliest YATS wave, 1983. Since mother's education also consistently performed well as a predictor, Q713M (mother's education) was used alone to represent parents' education. Mother's education was captured in both YATS I and II.

High grade completed was determined with Q404. This variable was not expected to be very significant because the sample reduction step deleted those matched respondents who had quit high school before graduation.

High school grades were estimated using Q700. This value should be viewed with some suspicion since the respondent may be motivated to inflate his grades despite the anonymity of the interview.

Finally, students who indicated that they intended to seek college education were identified with Q411.

### **3. Labor Market Status Explanatory Variables**

Questions Q408 and Q416 were employed to determine labor market status. Respondents' labor market status was defined in this study as high school student, college student, employed (full- or part-time), but not in school full time), and unemployed (not employed and not in school full time).

Theoretically, variables such as local unemployment rates are normally considered when discerning enlistment propensity. These data also have some relationship to the degree to which a respondent's unemployment status is correlated with achievement. In other words, an unemployed respondent from an area where the youth unemployment rate is 30 percent may be more a victim of circumstances than of his lack of mental ability, whereas an unemployed respondent from an area with only five percent unemployment may be more likely the cause of his own unemployment status.

### **4. Descriptive Statistics**

Table 10 depicts the descriptive statistics of the selected variables for both matched and non-matched records in each racial category. Several relationships, both among the racial groups and between the matched and non-matched respondents within each group, were notable.

TABLE 10.--DATA COMPARISON OF ALL MALES

MEAN	WHITE MATCH/NON	BLACK MATCH/NON	HISPANIC MATCH/NON	TOTAL MATCH/NON
RECORDS	507/4,171	109/542	50/400	666/5,113
YATS AGE	18.1/18.2	18.1/18.3	18.2/18.3	18.1/18.2
AFQTPCT	56.09/NA	35.28/NA	43.62/NA	51.75/NA
WHITE	1/1	0/0	0/0	.76/.81
BLACK	0/0	1/1	0/0	.16/.11
HISPANIC	0/0	0/0	1/1	.08/.08
SATFAST	.55/.64	.39/.48	.38/.48	.51/.61
MOTHER'S EDUCATION	12.4/12.9	12.4/12.4	11.9/11.7	12.4/12.7
COLLEGE PREF	.66/.73	.63/.61	.66/.68	.66/.71
HS GRADES	79.6/81.0	77.4/78.2	79.5/80.3	79.2/80.7
HIGH GRADE COMPLETED	11.8/12.0	11.8/11.8	11.8/11.8	11.8/11.9
HIGH MATH TAKEN	1.75/2.22	1.55/1.63	1.88/1.88	1.73/2.12
COLLEGE BOUND	.56/.61	.50/.54	.54/.59	.55/.60
HS STUDENT	.20/.30	.38/.32	.38/.30	.33/.31
COLLEGE STUDENT	.20/.28	.08/.17	.20/.23	.18/.27
EMPLOYED	.35/.31	.30/.32	.24/.32	.33/.31
UNEMPLOYED	.13/.10	.24/.19	.18/.16	.15/.12
SELF EMPL	.02/.04	.02/.03	.00/.03	.02/.04

a. **Matched Sample**

The matched sample was the set where the aforementioned biases most probably exist. This sample probably constituted a fair cross-sectional representation of the three

racial groups who arrived at the typical MEPS seeking enlistment. The mean AFQT percentiles of the three racial groups vary radically; Whites averaged 56 percent, Blacks 35, and Hispanics almost 43. Considering the long-standing trend of Blacks attending substandard schools along with the documented means in this sample, the reasons for this shortcoming were obvious. The sample's Black males took significantly fewer higher mathematics courses than White males. Blacks were enrolled full time in college at less than half the rate of Whites: 8 percent versus 20 percent. Still the average mother's education of Whites and Blacks were identical. The Blacks in the sample were almost twice as likely to be out of school and unemployed as Whites, despite the fact that all non-high school graduates had been filtered out of the sample. The matched Hispanics, on the other hand, had taken more higher math courses than the other two groups, were or had been enrolled in college preparatory curricula at the same rate as Whites, and were enrolled in college at the same rate as Whites. Yet their mean AFQT percentile lagged 13 percent below that of Whites. Two likely explanations exist for the above findings. Despite their relatively solid educational background, the language barrier may have held the Hispanics at a comparative disadvantage on the written ASVAB test. The Black males' poor showing may simply reflect the quality of their schooling and their often disadvantaged individual socio-economic backgrounds.

#### **b. Non-Matched Sample**

The comparisons and contrasts of matched and non-matched generally expected tend to hold true. Of course, actual AFQT percentiles on the non-matched set were unavailable and are predicted later in this thesis. The RAND AFQT bridging estimator has not been applied to YATS records earlier than 1986. Every variable selected for analysis showed that the mean non-matched White males to be higher mental test achievers than those of the matched sample: higher mother's education, more enrolled in college preparatory high schools, more higher math courses taken, more college bound, more enrolled in college, etc.. The same contrasts hold true for Blacks, but the differences were less pronounced. The Hispanic group in the non-matched sample and that of the corresponding matched sample were almost identical, suggesting that more than the other two groups, the Hispanic community provides a more representative cross section of its young males to military service.

#### **F. DATA AND METHODOLOGY SUMMARY**

The matched sample set selected for analysis contained 666 observations. Applying the same selection criteria to the non-matched population which had either withheld social security numbers or had no matched record or both yielded 5,113 observations.

Variables capturing the effects of characteristics measured by the YATS questions depicted in Appendix A were used in a binary

logistic regression analysis with the goal of obtaining a model with the highest possible predictive ability. Emphasis was placed more on theoretical consistency and predictive ability and less on explaining the effects of individual variables, minimizing multicollinearity among explanatory variables, or building a parsimonious model. Polynomial, exponential and logarithmic forms of all semi-continuous variables, e.g., mother's education (MOMED), high grade completed at time of interview (HGCOMP), higher math courses taken (MATHT) and high school grades (GRADE), to the dependent variable HQ were also explored.

Three key questions are conspicuously missing from YATS: "Do you live in an urban, suburban or rural area?" , "Have you or your family currently received any type of means-tested federal, state or local governmental assistance such as food stamps, welfare, etc., in the past 12 months?" and "Were you reared in a dual-parent family?" These questions would better identify a respondent's socio-economic status and help compare those surveyed by YATS to those queried by other surveys such as NLSY. These questions might also facilitate helpful comparisons with demographic studies such as the national census. The urban/suburban/rural question could be ferreted out of YATS by using the CTYFIPS2 and zip code variables, but not without an inordinate amount of painstaking effort.

#### IV. ANALYSIS

##### A. GENERAL

The logistic regression equations were estimated using the LOGIST procedure of SAS, version 5.16. The primary criterion for selecting the best model was goodness of fit as measured by the percentage of respondents correctly identified as high quality or non-high quality prospects. Theoretically consistent signs, parsimony and multicollinearity were also considered.

Comparisons of the means of the dependent and explanatory variables among the racial groups confirm expectations that the target matched sample differs significantly from the non-matched sample. The matched sample's bias was expected in that it appears to portray accurately the profile of youth who actually seek military service as opposed to portraying the "average" American youth.

##### B. LOGIT REGRESSION

Logit regression was used to develop estimating equations for whether DMDC-matched YATS male respondents were high quality, AFQT percentile greater than or equal to 50, or non-high quality. Since there were only two categories, the dependent variable was specified as binomial. The specific market segment analyzed was 17 to 21 year old males who were either high school graduates or prospective high school graduates.

## 1. MODELS

Separate models were developed for the three racial groups, White, Black and Hispanic. Table 11 presents results of selected predictive models by race.

TABLE 11.--RESULTS OF PREDICTIVE MODELS BY RACE

	WHITE	BLACK	HISPANIC
VARIABLE	COEFFICIENT /P-VALUE	COEFFICIENT /P-VALUE	COEFFICIENT/ P-VALUE
INTERCEPT	23.092 .205	12.677 .067	22.035 .214
YATSAGE	-0.362 .001	-0.963 .020	-----
SATPAST	0.370 .127	0.404 .492	-----
MOMED	-0.179 .624	-----	-----
MOMED SQU	0.008 .540	-----	-----
GRADE	0.108 .691	-----	-----
GRADE SQU	-0.001 .788	-----	-----
LN GRADE	-----	0.704 .418	-----
HGCOMP	-4.142 .087	-----	-----
HGCOMP SQU	0.189 .067	-----	-----
LN HGCOMP	-----	-----	-9.844 .175
MATHT	0.795 .001	0.639 .006	-----
MATHT SQU	-0.125 .007	-----	0.102 .077
BUSMATHT	-----	-----	-0.991 .229
COLGPREP	0.653 .004	-----	1.376 .173
COLGBND	0.481 .038	1.010 .102	-----
COLGSTUD	-0.432 .255	1.615 .100	2.833 .013
EMPLOYED	0.063 .300	-----	-----
UNEMPLOYED	-0.319 .377	0.379 .605	-----
SELF EMPL	-1.598 .043	-----	-----
N	507	109	50
MODEL CHISQU	122.15	27.36	22.19
"R"	0.36	0.35	0.43
PCT CORRECTLY PREDICTED	70.8	86.2	78.0
GOODNESS OF FIT: (-2 LOG LIKELIHOOD)	564.0	84.97	44.21

## 2. ANALYSIS OF EXPLANATORY VARIABLES

Age at interview significantly negatively affected the dependent variable for both Whites and Blacks, but was not significant for Hispanics. Age was omitted from the final Hispanic model because it did not contribute to its predictive ability. The YATS interview itself may spark some curiosity in the military on the part of the respondent, which translates to some unknown degree of selection bias.

Whether a respondent had taken a college entrance examination in the past positively affected the coefficients for both Whites and Blacks. YATS also asks whether the respondent intends to take a college entrance examination, but that variable proved to be a much weaker predictor. SATPAST for Whites was significant only at .127. SATPAST for Blacks was not significant, but did contribute to the model's predictive quality.

Prevailing experience indicates that mother's education interacts very little with most other background factors and is not highly correlated with mathematical skills.<sup>12</sup> It therefore promised to perform well in tandem with the mathematics experience

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<sup>12</sup>Mother's education tends to associate most directly with word knowledge, paragraph comprehension, general science, arithmetic reasoning, and mathematics knowledge. Still it stands to reason that mother's education is only beneficial in background information and is not as strong a predictor as a respondent's formal education. This condition is borne out by this analysis. An individual's math courses taken were more highly correlated to AFQT performance than mother's education. Also, see Profile of American Youth, p. 274.

discussed below in forming an accurate mental achievement profile. Mother's education (MOMED) was positively correlated with AFQT performance, consistent with past studies. However, mother's education was not as powerful a predictor as might be expected in the target sample, perhaps because there was not as great a variance as that of the general population. The target sample's MOMED variable showed that young males who enlisted tended to come from families whose mothers did not have a college degree, no matter what their race. Since most youth who show interest in the military tend to come from lower and lower-middle class families there is little variance in mother's educational backgrounds. The variable was not significant for any of the racial segments, attributable to the lack of a good MOMED spread for the target sample. Most mothers of respondents of all three racial subgroups tended to fall between tenth grade and college freshmen.

High school grades contributed to the predictive ability of both the White and Black models, but surprisingly little. Both GRADE and GRADE SQU were employed in the White model because they marginally improved the accuracy of the model. The GRADE variable transformation to the log fit best for Blacks, but still was not significant (.418).

High grade completed (HGCOMP) was relatively significant in the White model, both as HGCOMP and HGCOMP SQ: .087 and .067. This was intriguing in view of the target sample chosen. Only high school graduates or prospective high graduates were considered in the analysis, so this variable varied only when the respondent was

still in high school or had some college experience. Experience shows that by the time that all respondents have moved beyond the prime market the HGCOMP's should be clustered close to the mean and, therefore, offer little to the model. Recall that highest grade completed was the value recorded at the date of the interview. HGCOMP did not contribute to the Black model, perhaps reasons similar to those cited above. Few Blacks in the sample had gone on to college and most were still in high school. The LN HGCOMP variable was included in the final Hispanic model, but was significant only at .175.

Mathematics courses taken by the time of interview proved to be the most telling variables analyzed. One or more mathematics variables were included in all three race's models. For the purposes of this thesis, the summation of mathematics courses higher than elementary algebra constituted the variable MATHT. See Table 9 for a more complete description. For Whites, both MATHT and MATHT SQU were significant to .001 and .007. MATHT was also employed in the Black model and was significant as well, at .006.

Some individual mathematics courses, such as plane geometry and business math, performed much better than others. Plane geometry was most highly correlated to AFQT percentile for all three groups, but was included as a part of the MATHT variable. Students who take plane geometry quite likely demonstrate inherently greater math aptitude as well as receive valuable mathematical training from the course itself. The same may be said of all other higher math courses. But plane geometry proved a

superior predictor to other, more advanced, math courses because so few students who eventually sought military service took courses such as intermediate algebra, trigonometry, calculus or physics.

Business mathematics was negatively correlated with AFQT percentile for all three racial groups, but contributed most to the Hispanic model:  $-.99$  coefficient at  $.229$  significance. Business math is viewed by many high school students as an easy alternative for fulfilling high school graduation requirements, which may explain its negative correlation with AFQT percentile. Students with less mathematical ability or confidence who took business math without going on to more advanced courses apparently did not gain the necessary mathematical reasoning skills to perform well on the ASVAB.

High school curriculum confirmed a priori expectations that students from college preparatory curricula achieve higher scores on achievement tests. Respondents who answered affirmatively to college preparatory as opposed to business, technical or vocational schooling generally performed better on the ASVAB. As modeled, the dummy variable COLGPREP was one of the stronger coefficients, significant for Whites at  $.004$ . Since most students participate in at least nominal college preparatory curricula it was at first expected that there would not exist enough variance to make this variable a valuable predictor. This expectation proved true with regard to the Black model. COLGPREP also performs well for the Hispanic model, but with less significance,  $.173$ . A related variable that denoted those respondents who indicated positive

intentions to attend college after high school, COLGBND, contributed to both the White and Black models, but not well enough to include in the Hispanic model.

College students logically should be expected to perform better on achievement tests than those not in college. The variable, COLGSTUD, was used as a labor force category, the others being high school students (HSSTUD), EMPLOYED (not in school full time) and UNEMPLOYED (not in school full time). As expected, COLGSTUD performed well for the Black and Hispanic models. COLGSTUD boasted the highest coefficient in both models, Hispanic significant to .013. Surprisingly, COLGSTUD was negative in the White model, but significant only to .255. It did improve the White model accuracy and was retained in the final model. A possible explanation for the coefficient's negative value in the White model was that some White males who began college realized they were not ready for college and turned to the military as an alternative.

Other labor force variables served marginally well as predictors. Given that the respondent was not in school full time and was unemployed at the time of interview, UNEMPLOYED contributed to the White model, but was significant only at .377. Surprisingly, the Black UNEMPLOYED variable was positive, though not significant at .605. The positive valence of the Black UNEMPLOYED coefficient may simply reflect that Blacks who found getting a good job after graduation difficult eventually sought military service. At any rate, because it did improve the accuracy

of the model despite contradiction to expectations, it was retained. EMPLOYED contributed to the accuracy of the White model only.

The type of employment, whether private employer, government employer, family business or farm, or self employed, was not a significant factor with the exception of Whites. Self employed White respondents showed a significant negative predictor, -1.6 at .043. The scores of self employed Blacks were consistent with the base case, HSSTUD. There were no self-employed Hispanics in the target sample.

The direct, exponential and logarithmic relationships of all semi-continuous variables, e.g., mother's education (MOMED), high grade completed (HGCOMP), higher math courses taken (MATHT) and high school grades (GRADE), to the dependent variable HQ were explored and included if they contributed to model accuracy.

### C. APPLICATION OF MODEL RESULTS TO NON-MATCHED RESPONDENTS

After developing the estimating equations, the two samples were then compared and contrasted. First, the AFQT (high quality/non-high quality) probabilities for the non-matched sample were estimated based on the estimated equations developed from the matched racial groups' models. Then the quality distributions were examined as well as how they related to interest in the military.

1. **Application of Estimating Equations to Non-Matched Sample**

Using the OUTP (PRED) SAS option on the estimating equations for the matched sample, the results confirmed expectations that the general population was better qualified in QMA terms than those who actually took the AFQT. The high quality probabilities for actual matched AFQT scores and estimated non-matched probabilities are presented in Table 12.

TABLE 12.--COMPARISON OF MATCHED AND NON-MATCHED OBSERVATIONS (ACTUAL/ESTIMATED)

	WHITE	BLACK	HISPANIC
N	507/4,113	109/542	50/400
HIGH QUALITY	.59/.72	.21/.15	.38/.35
NON-HIGH QUALITY	.41/.28	.79/.85	.62/.65
TOTAL	1/1	1/1	1/1

The non-matched sample of Whites offered 72 percent high quality prospects, or QMA's, which significantly exceeded the matched sample of Whites, i.e., those who contacted the military in the form of at least taking the ASVAB at a minimum. The Black model revealed the opposite: 21 percent of those with military contact actually tested as high quality as opposed to only an estimated 15 percent of non-matched Blacks. The Hispanic samples mirrored the trend for Blacks, but at a much greater high quality probability: .38/.35. The trends portrayed by these samples were that the military was attracting fewer high quality Whites

percentage-wise, but more high quality Blacks and Hispanics than were available in the general population.

## 2. Interest Comparisons

An additional assessment of the AFQT model was provided by examining how the AFQT groupings in the estimated samples were distributed across interest categories. Compared with the interest distribution for the actual AFQT score sample, Table 13 shows that for the matched sample the more positive interest a White respondent indicated during the YATS interview, the lower the probability he would score as a high quality recruit. For instance, given that a White respondent from the matched sample stated that he was definitely interested in serving in the military, there was a .54 likelihood that he would be a high quality recruit prospect. The results for Blacks were somewhat mixed, but the general trend was the same: the more interested the respondent, the less likely that he would score as high quality. The Hispanic sample did not fit the general pattern of the other two racial groups. The highest probabilities lie at the two extremes of interest.

TABLE 13.--HIGH QUALITY PROBABILITY BY INTEREST CATEGORY: MATCHED  
VERSUS NON-MATCHED BY RACIAL GROUP

	WHITE M/NON-M	BLACK M/NON-M	HISPANIC M/NON-M
N	507/4,171	109/572	50/400
DEFINITELY YES	.54/.76	.17/.18	.53/.15
PROBABLY YES	.57/.64	.24/.09	.26/.22
PROBABLY NOT	.60/.73	.14/.18	.25/.34
DEFINITELY NOT	.61/.73	.23/.18	.50/.44
TOTAL	.59/.72	.21/.15	.38/.35

Comparing the high quality probabilities of the two samples within each racial group also confirmed a priori expectations. In the White samples the non-matched high quality probabilities were always higher, indicating that the military was attracting less than a representative share of high quality White recruits. The trend was mixed for Blacks and Hispanics, suggesting that many minority people considered military service as an economic opportunity rather than a near last resort.

## V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

### A. SUMMARY

Binomial logistic regression modeling was employed to develop estimating equations for matched YATS and DMDC files of high school and prospective high school graduate males, 17 to 21 years of age, from YATS waves of 1983 and 1985 in the racial groups White, Black, Hispanic. The predictive abilities of these models were then calculated against actual scores contained in the DMDC cohort files. The models were then applied to the larger unmatched population to estimate high quality or non-high quality categories. The results of both modeling evolutions were then considered in light of the respondents' interest in the military question.

### B. CONCLUSIONS

YATS selectivity biases, caused by voluntary social security number disclosure and the fact that only a fraction of those who disclose their social security number ever take an ASVAB test, offer some intriguing challenges to analysts. It is unfortunate that the RAND AFQT prediction procedures for the unmatched samples were only applied as far back as 1986. Currently there are no alternative AFQT categorization of these YATS respondents with which to compare model results.

Still, both matched and non-matched samples confirm expectations that high quality youth are less likely to seek

military service than non-high quality. Interest versus high quality distributions also confirmed this tendency, with expected deviations within minority groups.

The analysis supports the idea that the YATS data set exhibits tendencies not unlike NLSY in the aggregate. This thesis demonstrates that YATS survey data can be used to create a synthetic classification procedure for distinguishing high quality respondents. The method used in this thesis corrects the current deficiency of DMDC methods that rely on interest in military to predict AFQT category.

### C. RECOMMENDATIONS

#### 1. YATS Modifications

Applying the RAND AFQT routines to YATS years 1983 and 1985 may offer a basis for comparison that could facilitate building the desired bridge between YATS and NLSY in that the selectivity biases of YATS might be at least partially negated.

Adding a YATS question on whether the respondent is a product of a nuclear family or a broken home is also desirable. A social variable such as this would provide some insight on the effects of divorced or single parents on enlistment and at least ASVAB achievement behavior. The increased numbers of single parents in today's society may well demand that this factor be considered.

Refining the capability to capture the respondent's urban, suburban or rural demographic status would further aid in bridging

YATS to NLSY. The quality of education, though it may vary within the three categories, would offer some valuable insight into both interest and achievement not currently completely captured by YATS.

A YATS question to capture some degree the respondent's economic status would be beneficial, for example, poverty or non-poverty categories by virtue of whether the respondent's family received a means-tested subsidy during the past 12 months.

## 2. Further Study

Comparing and contrasting YATS 1983 through 1985 with the same years of NLSY are imperative if the two data sets are to be bridged. These years include the entire window in which both YATS and NLSY asked similar propensity questions. This thesis is only a modest first known step in that direction. The benefits, if they can indeed be realized, are enormous. The Department of Defense would have at its disposal a more current management decision system data set than currently exists with which to base recruiting force and resource allocation decisions.

Eliminating or at least partially reconciling the selectivity biases of YATS offer many opportunities for further study. Capturing and obtaining the reasons for non-disclosure could make it possible to examine the profiles of non-disclosure groups against those with known social security numbers and those with matched records. Some of the biases such as social security number disclosure may not affect YATS analysis as adversely as one might suspect.

This thesis, as most others, addresses only those respondents already in the prime market. Comparing and contrasting the behavior of 16 year old to those of the prime market should be considered. If 16 year old YATS respondents' yields analysis results similar to those already in the prime market a full year of lead time could be realized in applying the data set to management decisions.

Finally, applying these YATS results to subsequent YATS years, particularly to 1990, and comparing the synthetic YATS categories would also be beneficial. The RAND AFQT estimation method currently employed by DMDC could be further evaluated and perhaps validated or improved.

## APPENDIX A

This is a listing of YATS questions used in the conduct, either sample reduction or analysis, of this thesis with a listing of possible responses. Questions are categorized using the YATS II numbering scheme. Cross referenced YATS I questions numbers follow in parentheses.

Q402 (A2) - What is your gender?

- 1 - male
- 2 - female

Q403 (A3) - What was your age on your last birthday?  
The code is the reported age.

Range: 16-29

Q404 (A4) - Now I have a few questions about your educational experiences and plans. What is the highest grade or year of school or college that you have completed and gotten credit for?

- 7 - less than 8th grade
- 8 - 8th grade
- 9 - 9th grade
- 10 - 10th grade
- 11 - 11th grade
- 12 - 12th grade
- 13 - 1st year college/junior or community college/ vocational, business or trade school
- 14 - 2nd year college/junior or community college/ vocational, business or trade school
- . - BD

Q406 (HIDEGREE) - Do you have a regular high school diploma, a GED, an ABE, or some other kind of certificate (of high school completion)?

- 1 - regular high school diploma
- 2 - adult basic education
- 3 - graduate equivalency degree
- 4 - Some other kind of certificate of high school equivalency
- 5 - None of the above

Q407 (A11) - (In October, will you be/Are you)enrolled in any school, college, vocational or technical program, apprenticeship, or job training course?

- 1 - yes
- 2 - no

Q408 (A12) - What kind of school or training program (will you be/are you enrolled in?

- 1 - no schools or training programs
- 2 - ABE
- 3 - Taking high school classes in a regular, day high school
- 4 - GED or high school equivalency program
- 5 - skill development program
- 6 - on-the-job training program
- 7 - apprenticeship program
- 8 - vocational, business, or trade school
- 9 - two-year junior or community college
- 10 - four-year college or university

Q409 (A14) - Will you be enrolled:

- 1 - full-time or
- 2 - part time?
- 8 - DK
- . - LS

Q410B (A8) - How about sometime further into the future-- would you like to get more schooling?

- 1 - yes
- 2 - no
- 8 - DK
- . - LS

Q411 (A9) - What kind of school or college would you like to attend?

- 1 - high school
- 2 - vocational, business, or trade school
- 3 - two-year junior or community college
- 4 - four-year college or university
- 5 - graduate or professional school
- 8 - DK
- 9 - RE
- . - LS

Q416 (A17) - Are you currently employed, either full-time or part-time?

- 1 - yes
- 2 - no
- 9 - RE
- . - LS

Q417 (A18) - Are you looking for work now?

- 1 - yes
- 2 - no
- 9 - RE
- . - LS

Q419 (A19) - Have you ever had a job for pay?

- 1 - yes
- 2 - no
- 9 - RE
- . - LS

Q430 (A30) - At your (main/last) job, (are/were) you?

- 1 - an employee of a private company
- 2 - a government employee,
- 3 - self-employed in your own business, or
- 4 - working without pay in a family business or farm?
- 9 - RE
- . - LS

Q503 (B3) - How likely is it that you will be serving in the military? Would you say:

- 1 - definitely,
- 2 - probably,
- 3 - probably not, or
- 4 - definitely not?
- 8 - DK
- 9 - RE
- . - BD

Q693 (D64) - To help me ask the next few questions correctly, I need to know whether you are currently:

- 1 - married,
- 2 - widowed,
- 3 - separated,
- 4 - divorced, or
- 5 - have you ever been married?
- 8 - DK
- 9 - RE
- . - BD

Q698 (D70) - Have you ever taken a college entrance examination such as the PSAT (Preliminary Scholastic Aptitude Test), the SAT (Scholastic Aptitude Test), or the ACT (American College Testing Program)?

- 1 - yes
- 2 - no
- 8 - DK
- 9 - RE
- . - BD

Q699 (D71) - In the future do you plan to take a college entrance examination?

- 1 - yes
- 2 - no
- 8 - DK
- 9 - RE
- . - LS

Q700 (D72) - What grades did you usually get in high school?

- 1 - Mostly A's (A numerical average of 90-100)
- 2 - Mostly A's and B's (85-89)
- 3 - Mostly B's (80-84)
- 4 - Mostly B's and C's (75-79)
- 5 - Mostly C's (70--74)
- 6 - Mostly C's and D's (65-69)
- 7 - Mostly D's and F's (64 and below)
- 8 - DK
- 9 - RE
- . - LS

Q701 (D73) - Was your high school program:

- 1 - academic or college preparatory,
- 2 - commercial or business training,
- 3 - or vocational or technical?
- 8 - DK
- 9 - RE
- . - LS

Have you taken or do you plan to take the following courses in high school:

Q702 (D74A) - elementary algebra

- 1 - taken
- 2 - plan to take
- 3 - not taken
- 8 - DK
- 9 - RE
- . - LS

Q703 (D74B) - plane geometry

- 1 - taken
- 2 - plan to take
- 3 - not taken
- 8 - DK
- 9 - RE
- . - LS

Q704 (D74C) - business math

- 1 - taken
- 2 - plan to take
- 3 - not taken
- 8 - DK
- 9 - RE
- . - LS

Q705 (D74D) - computer science

- 1 - taken
- 2 - plan to take
- 3 - not taken
- 8 - DK
- 9 - RE
- . - LS

Q706 (D74E) - intermediate algebra

- 1 - taken
- 2 - plan to take
- 3 - not taken
- 8 - DK
- 9 - RE
- . - LS

Q707 (D74F) - trigonometry

- 1 - taken
- 2 - plan to take
- 3 - not taken
- 8 - DK
- 9 - RE
- . - LS

Q708 (D74G) - calculus

- 1 - taken
- 2 - plan to take
- 3 - not taken
- 8 - DK
- 9 - RE
- . - LS

Q709 (D74H) - physics

- 1 - taken
- 2 - plan to take
- 3 - not taken
- 8 - DK
- 9 - RE
- . - LS

Q713M (D77) - What is the highest grade or year of school or college that your mother completed?

- 7 - less than 8th grade
- 8 - 8th grade
- 9 - 9th grade
- 10 - 10th grade
- 11 - 11th grade
- 12 - 12th grade
- 13 - 1st year college/junior or community college/ vocational, business or trade school
- 14 - 2nd year college/junior or community college/ vocational, business or trade school
- 15 - 3rd year of 4-year college (JR)
- 16 - 4th year of 4-year college (SR)
- 17 - 5th year college/1st year graduate or professional school
- 18 - 2nd year graduate or professional school
- 19 - 3rd year graduate or professional school
- 20 - more than 3 years graduate/professional school
- 98 - DK
- 99 - RE
- . - BD

Q714 (D80) - Just to be sure we are representing all groups in our survey, please tell me whether you consider yourself . . . (If "HISPANIC" PROBE: Do you consider your race to be white, black, Asian, or American Indian?)

- 1 - white?
- 2 - black?
- 3 - Asian or Pacific Islander? (Includes Chinese, Japanese, Filipino, Korean, Vietnamese, Pacific Islander, Asian Indian, or other Asian)
- 4 - American Indian or Alaskan Native?
- 8 - DK
- 9 - BE
- . - BD

Q715 (D80) - Are you of Hispanic background?

- 1 - Yes
- 2 - No
- 8 - DK
- 9 - RE
- . - BD

The following variables are taken from the DMDC cohort data set and were not changed in 1984.

TYPE - Type of record on file at DMDC

- 0 - no contact with MEPS
- 1 - Record showing examination results
- 2 - Enlistment into delayed entry program (DEP)
- 3 - Enlistment to active duty
- 4 - Discharged from DEP
- 64 - No ASVAB score recorded
- . - LS (No social security number available with which to match YATS and cohort data)

AFQTPCT - 01 to 99 according to scores.

AGE - Age at time respondent was tested.

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