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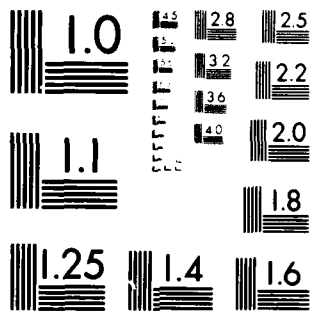
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## THESIS

PERFORMANCE IN THE MILITARY OF  
GENERAL EDUCATIONAL DEVELOPMENT  
CERTIFICATE PERSONNEL

by

Erkut Ersoy

December 1979

Thesis Advisor: Richard S. Elster

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Hopefully, this thesis will help military policy makers and recruiters make decisions which will lower first-term personnel loss rates.

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PERFORMANCE IN THE MILITARY OF GENERAL EDUCATIONAL  
DEVELOPMENT CERTIFICATE PERSONNEL

by

Erkut Ersoy  
Lieutenant Junior Grade, Turkish Navy

Submitted in partial fulfillment of the  
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL  
December 1979

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Dean of Information and Policy Sciences

## ABSTRACT

The objective of this study is to analyze adjustment to the military of a specific educational group: GED (General Educational Development) holders. This study also compares members of the GED and other educational groups on selected characteristics. Finally, this study analyzes first-term loss rates for these groups by applying a linear-group prediction model.

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TABLE OF CONTENTS

I.	OBJECTIVE-----	9
II.	BACKGROUND -----	10
	A. RECRUITING -----	10
	B. TRENDS IN QUALITY OF ACCESSIONS -----	10
	1. Mental Categories -----	10
	2. Educational levels -----	12
	3. Changes in representativeness of force -----	15
III.	ATTRITION -----	18
IV.	ANALYSIS OF THE GED GROUP -----	21
	A. WHAT IS A GED? -----	21
	B. GED TESTS AS PREDICTORS OF SCHOLASTIC SUCCESS ---	22
	C. GED TESTS AS PREDICTORS OF EDUCATIONAL LEVEL AND MENTAL ABILITY -----	23
	D. AGE OF MILITARY ENLISTED MEN AS FACTORS IN TESTS OF GENERAL EDUCATIONAL DEVELOPMENT -----	26
	E. PRESENT PRACTICE FOR ISSUING GED CERTIFICATES ---	30
	F. GED STATISTICS -----	31
	1. Attrition -----	33
V.	PREDICTION -----	35
	A. COMPARISON OF PREDICTION APPROACHES -----	35
	B. GROUP-LINEAR PROBABILITY MODEL -----	37
	C. APPLICATION OF THE MODEL -----	38
VI.	CONCLUSION AND RECOMMENDATIONS -----	47
	APPENDIX A - TABLES (I, II, III, IV, V, VI, VII) -----	50



APPENDIX B - COMPUTER OUTPUTS (TABLES VIII, IX, X)	-----	58
LIST OF REFERENCES	-----	62
INITIAL DISTRIBUTION LIST	-----	64

LIST OF TABLES

I.	THE RELATIONSHIPS OF GED TESTS SCORES TO AVERAGE FIRST TERM MARKS FOR YALE FRESHMEN -----	22
II.	RELATIONSHIP BETWEEN HONOR-POINT RATIO AND THE GED TESTS (FOR VETERANS AT MINNESOTA) -----	23
III.	MEANS AND STANDARD DEVIATIONS OF 304 ARMY ENLISTED PERSONNEL ON SUBTESTS OF THE GENERAL EDUCATIONAL DEVELOPMENT TEST ACCORDING TO LAST SCHOOL GRADE COMPLETED -----	25
IV.	CORRELATION OF GED SUBTESTS WITH ARMY GENERAL CLASSIFICATION TEST -----	27
V.	MEAN SCORES OF MEMBERS OF ARMED FORCES IN GED TESTS GROUPED ACCORDING TO AGES -----	29
VI.	COMPARATIVE TESTING DATA (GED TESTS), 1950-77-----	32
VII.	THREE-YEAR LOSS RATES OF ARMY, CY 1976 ENLISTED NPS ACCESSIONS -----	34
VIII.	COMPARISON OF PREDICTION APPROACHES -----	36
IX.	PREDICTION OF ARMY THREE-YEAR LOSS DATA USING INTERACTIVE VARIABLES -----	41
X.	PREDICTED AND ACTUAL THREE-YEAR LOSS RATES FOR ARMY, NPS, 1976 ACCESSIONS -----	42
XI.	PREDICTED THREE-YEAR LOSS RATES FOR ARMY, NPS, MALE, 1977 ENLISTED ACCESSIONS -----	43
XII.	PREDICTION OF ARMY THREE-YEAR LOSS DATA USING NO INTERACTIVE PREDICTORS -----	46
XIII.	ACTUAL THREE-YEAR LOSS RATES FOR ARMY, NPS, MALE ENLISTEES -----	49

LIST OF FIGURES

1.	Enlisted Recruiting Costs -----	11
2.	Active Duty NPS Enlisted Accessions by Mental Category-	13
3.	High School Graduates as a Percentage of Total Active Enlisted Personnel -----	14
4.	Blacks as a Percentage of Total Active Duty Officer Accessions -----	16
5.	Blacks as a Percentage of Total NPS Active Duty Enlisted Accessions -----	17
6.	Projections of 17-21-year-old male population -----	19

## I. OBJECTIVE

Since the all-volunteer force (AVF) became effective on 1 July 1973, the military services have experienced varying degrees of success in reaching their recruiting goals. However, attrition is a major problem. It is causing higher budget costs and creating manpower shortfalls within the services. Besides that problem, manpower predictions are indicating a sharp decline in the 18-21 years old age cohort in the 1980's. Unless the unemployment rate is very high, or military pay increases dramatically, etc., the military services will have difficulties in attracting enough manpower under the AVF. Manpower planners should know what types of personnel have the lowest attrition probabilities.

The objective of this study is to analyze adjustment to the military of a specific educational group: GED (General Educational Development) holders. This study also compares members of the GED and other educational groups on selected characteristics. Finally, this study analyzes first-term loss rates for these groups by applying a linear-group prediction model.

Hopefully, this thesis will help military policy makers and recruiters make decisions which will lower first-term personnel loss rates.

## II. BACKGROUND

### A. RECRUITING

With the advent of the AVF, all services began to broaden and intensify their recruiting efforts, and the role of the military recruiter changed significantly. Recruiting accomplishment was based on market supply as well as on accession requirements.

The major initial concern was with the Army's ability to recruit for the combat arms. In June 1972, a combat arms bonus had been authorized by Congress. That enabled the Army to maintain an average monthly combat arms accession total of 3000 through FY 1973. Two-thirds of the Army's combat arms enlistments were bonus enlistees.

Figure 1 shows that real resources spent on advertising, enlistment bonuses and recruiting, collectively, have more than doubled from FY 1970 through FY 1975.

### B. TRENDS IN QUALITY OF ACCESSIONS

The quality of the force has typically been measured in terms of mental test scores and educational achievement. Quality of officers has increased [Ref. 3], but major concern has concentrated on the quality of enlisted accessions.

#### 1. Mental Categories

The mental abilities of military accessions are measured by scores received on the Armed Services Vocational

ALL SERVICES  
**ENLISTED RECRUITING COSTS**  
 (1977 DOLLARS)

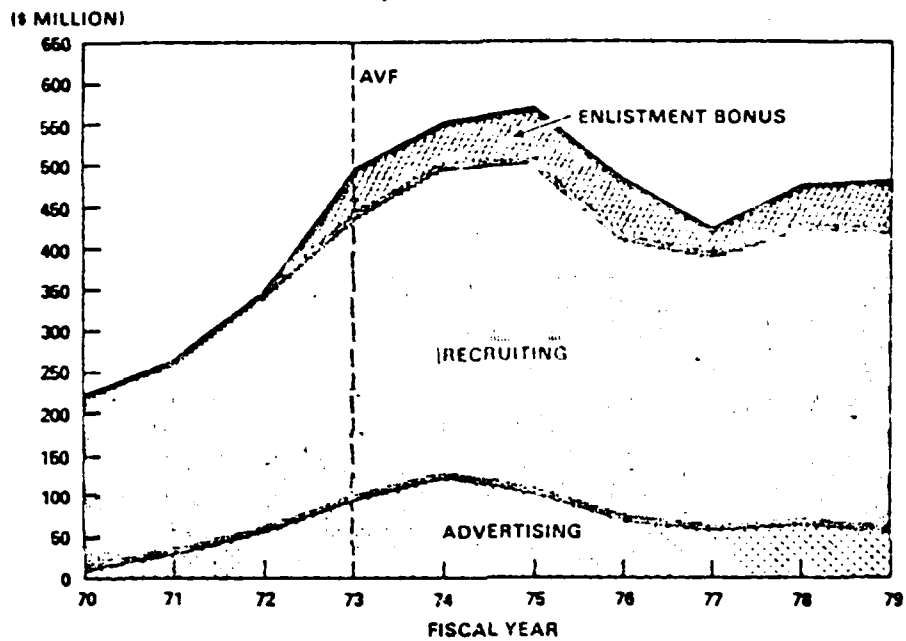


FIGURE 1.

SOURCE: Ref. [3]

Aptitude Battery (ASVAB). Several of the ASVAB scores are then converted to a standardized test score called the Armed Forces Qualification Test (AFQT). Based on AFQT percentile scores, enlistees are classified into one of five mental categories with Category I being the highest. The average AFQT score is 50, which divides mental Category III. The top 8% are in mental Category I. The next 27%, from 65 to 92, are in mental Category II. Mental Category III is from 31 to 64 and mental Category IV is from 10 to 30. Those scoring in Category V are disqualified from military enlistment. [Ref. 3]

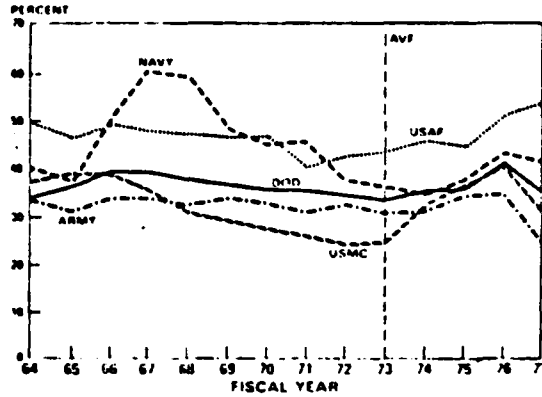
Figure 2 shows the trends for NPS enlisted accessions. In FY 1964, one out of every seven active force enlistees was in mental group IV. During the AVF years this percentage has declined steadily; by FY 1977 it was one in twenty. Mental Category IV accessions are easier to recruit, but are more likely to require additional time to complete training than do those in Categories I through II (and have higher losses than other accessions with the same educational level). [Ref. 3] Training costs to replace losses must be balanced against the increased recruiting costs associated with recruiting individuals from the higher mental categories.

## 2. Educational Levels

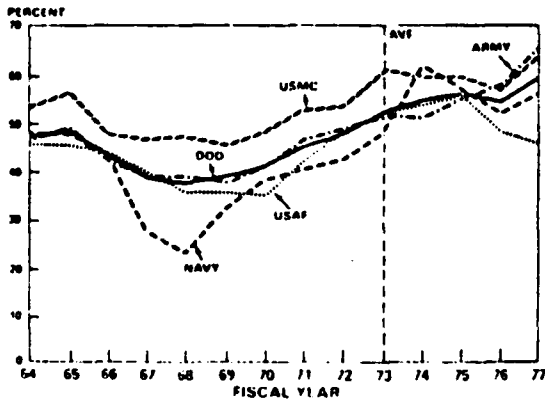
While the percentage of accessions who are highschool graduates has only slightly increased over the pre-Vietnam period, the percentage of the total active enlisted force with a highschool education (including GED certificates) has reached the highest level ever recorded, as shown in Figure 3.

Active Duty NPS Enlisted Accessions by Mental Category

**MENTAL CATEGORY I & II**



**MENTAL CATEGORY III**



**MENTAL CATEGORY IV**

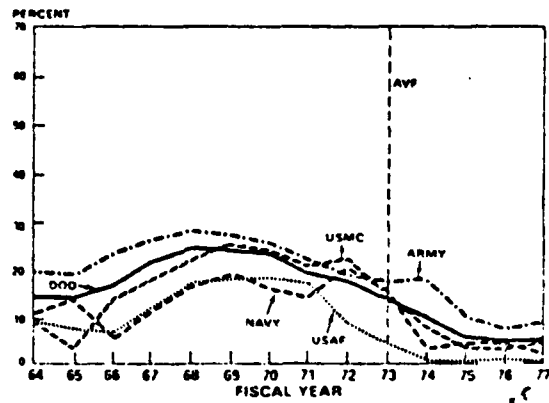


FIGURE 2.

SOURCE: Ref. [3]



### HIGH SCHOOL GRADUATES AS A PERCENTAGE OF TOTAL ACTIVE ENLISTED PERSONNEL

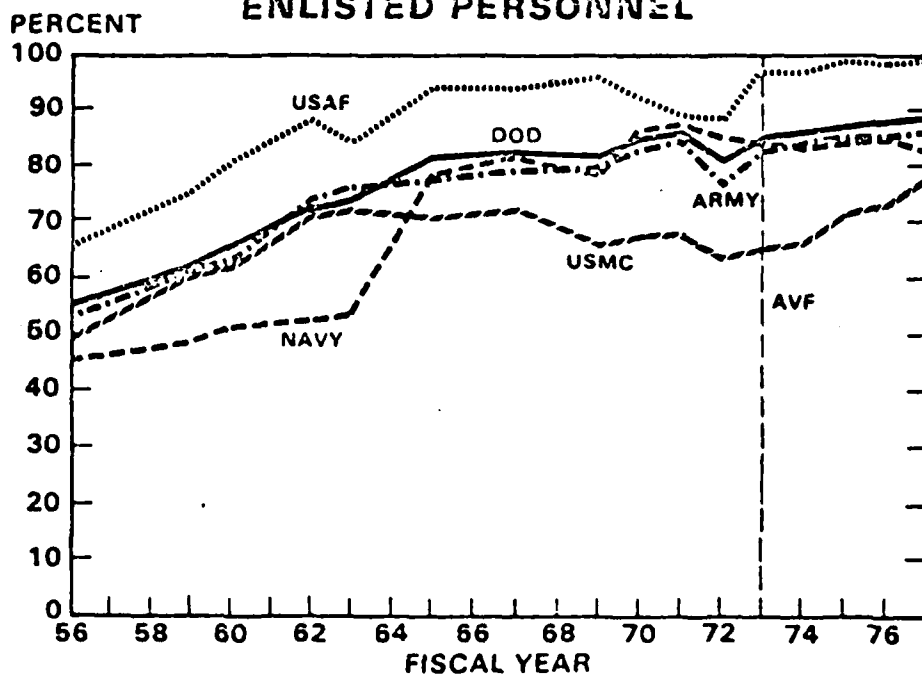


FIGURE 3.

SOURCE: Ref [3]

In December 1977, 88% of the active enlisted force had a highschool education or GED, compared to 81% in December 1972, the time of the last draft call, and about 75% during 1964 the last year before the Vietnam draft increases.

3. Changes in Representativeness of force

During the debate on the AVF in the early 1970's, there was concern that under the AVF the Armed Forces would become an Army of the black and poor, primarily recruited from the South. [Ref. 3]

Figure 4 shows the trends of black officer accessions since FY 1964. Black officer accessions have increased from 1.6% of all officer accessions in FY 1972 prior to the AVF to 5.4% in FY 1977.

Figure 5 shows the Enlisted Force trends since FY 1964 in black accessions. In FY 1964, blacks comprised about 10% of DoD's NPS active duty enlisted accessions. The number of black accessions under the AVF has grown so that blacks represent almost 30% of total active-duty Army NPS accessions.

### BLACKS AS A PERCENTAGE OF TOTAL ACTIVE DUTY OFFICER ACCESSIONS

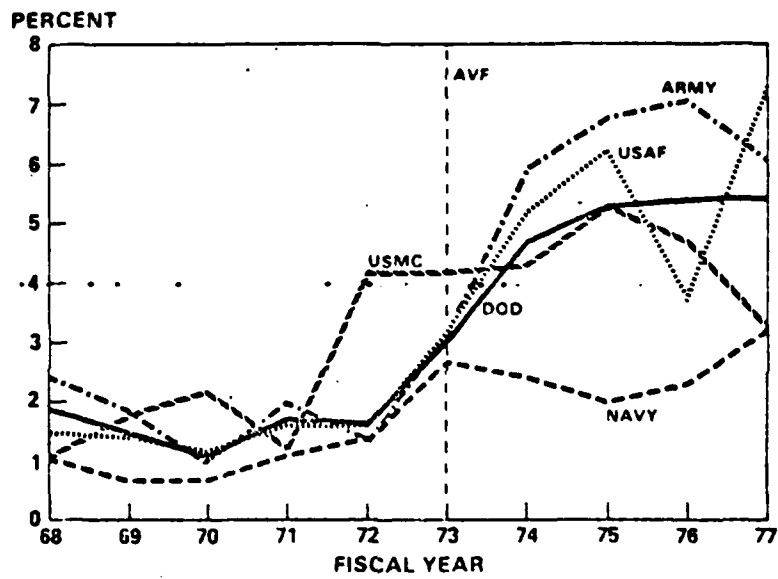


FIGURE 4

SOURCE: Ref [3]

**BLACKS AS A PERCENTAGE OF TOTAL NPS  
ACTIVE DUTY ENLISTED ACCESSIONS**

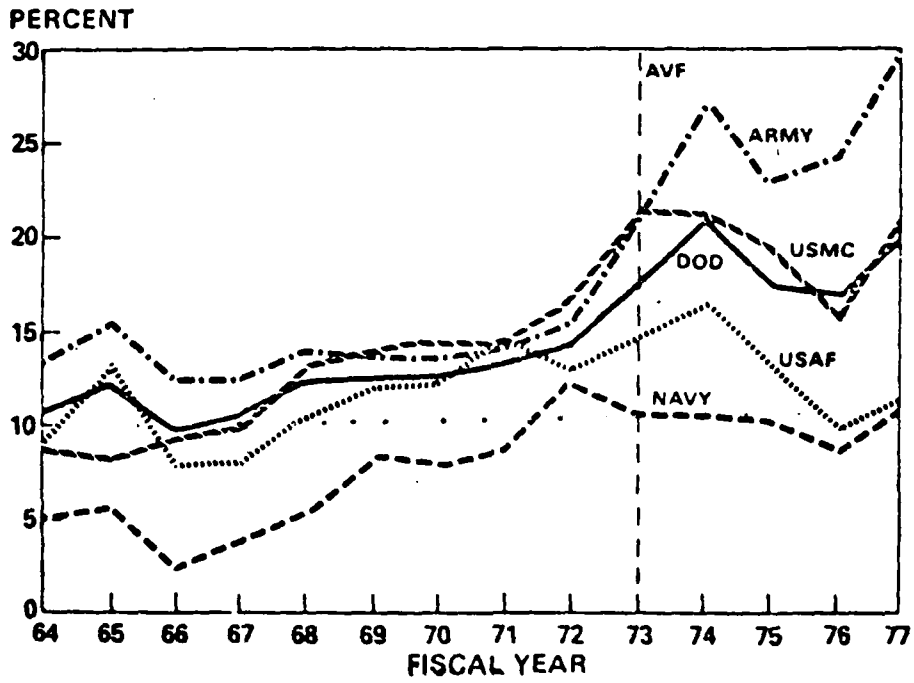


FIGURE 5

SOURCE: Ref [3]

### III. ATTRITION

It is true that more military personnel are being released before completion of their initial enlistment obligation now than during the draft. [Ref. 4] This attrition is expensive and disruptive, and represents a serious manpower dilemma. In an all-volunteer force, it often does not make sense to force people to stay in a service. It is known that such practices may be more expensive than releasing troublemakers early in their military career, and recruiting and training replacements. [Ref.4]

Attrition must be viewed in the context of its costs and the challenges to AVF recruiting represented by both a declining youth population in the 1980's and the likelihood of an improving economy making recruiting more difficult.

The future active force recruiting picture appears challenging. The declining youth population projected for the 1980's has focused attention on the question of the viability of the volunteer force during the next decade. The main question appears to center on the Services' ability to recruit in the face of a declining youth population base, and possible lower unemployment rates in the 1980's.

It is known that the number of 18-year-old men in the United States will decline after 1980. By 1985, the number of 18-year-old males will have declined gradually by about one-third of a million, or 15% less than in 1976. By 1992 the decline will have totalled more than one-half million, or 25%. Figure 6 shows this decline.

PROJECTION OF 17-21 YEAR OLD MALE POPULATION

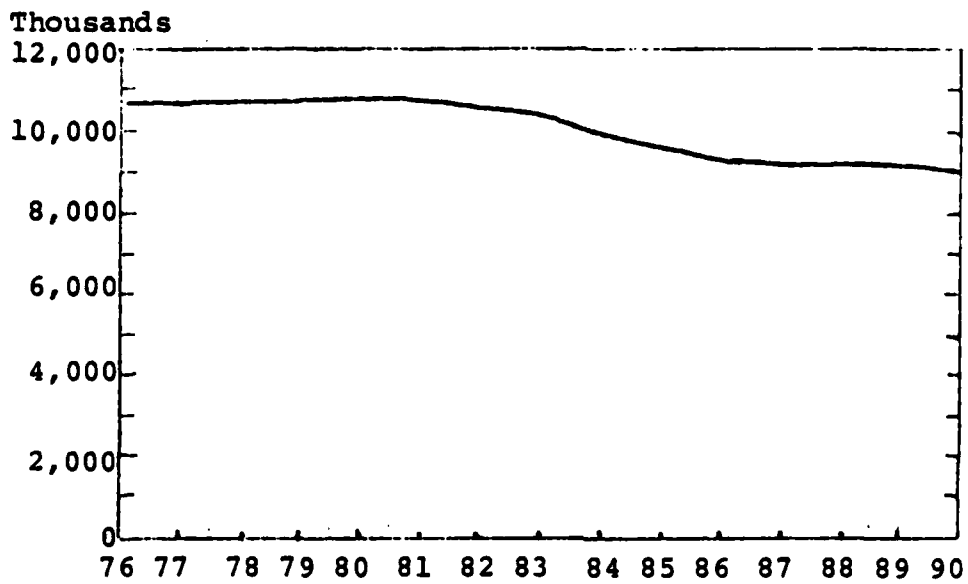


FIGURE 6.

SOURCE: Ref. [3]

More intense competition for highschool diploma graduates is likely. Highschool graduates are the preferred recruits. Nongraduates, other factors such as AFQT score being equal, are twice as likely to be separated early as are highschool graduates. (See Table XIII of this thesis.) Accession quality is an important determinant of first term attrition, but it takes more recruiting resources to recruit quality diploma graduates. [Ref.4]

Clearly, recruiting quality enlistees is becoming marginally very expensive, and this will increase dramatically unless the requirement for high quality male accessions can be reduced as the market declines. Reduction in attrition is one management option that must be addressed.

The sustainability of the AVF in the face of the declining market is obviously related to the Services' ability to implement effectively some mix of management options to reduce male accession requirements and/or increase supply by, for instance, increased use of women, increased use of civilians, increased use of career-force personnel, improved recruiting efficiency, lower mental/physical standards and, very importantly, reduced first-term attrition.

Under these circumstances, one of the most promising approaches would be to look into personnel selection and attempt to find new pre-service predictors to reduce attrition, and to identify what type of people the Services should try to attract.

In the following chapter, data from GED certificate holders will be investigated.

#### IV. ANALYSIS OF THE G.E.D. GROUP

##### A. WHAT IS THE GED

The tests of General Educational Development (G.E.D.) were developed in 1942 by the United States Armed Forces Institute in order to provide the veterans of World War II a means to readjust to civilian life as they resumed their educational and vocational plans. [Ref. 13] The GED tests provide the non-highschool graduate an opportunity to obtain a highschool equivalency certificate which is generally accepted as a regular highschool diploma by institutions of higher education, business organizations and the Civil Service Commission. [Ref. 14]

The GED test battery consists of five tests covering the areas of english, social studies, natural sciences, literature, and mathematics. The tests are designed to measure knowledge acquired in the typical general educational programs offered in secondary schools. Rather than emphasizing knowledge of details, the tests concentrate on the ability to generalize concepts and ideas, to comprehend exactly and to evaluate critically. The tests also seek to determine the extent to which informal educational experiences have had a long-term impact equivalent to that which might be the result of a good formal education. Thus, by means of these tests, individuals who have not formally completed their secondary school education may be certified as having the equivalent of a highschool diploma. [Ref. 13]



## B. GED TESTS AS PREDICTORS OF SCHOLASTIC SUCCESS

Although GED tests are not designed for such prediction purposes, some studies have shown that they can be used as predictors of later scholastic success.

A study of Yale students by Crawford and Burnham was designed to determine the value of GED test scores in predicting the scholastic success of freshmen. [Ref. 1] A representative sampling of the entire class, veterans and non-veterans, was used in this study with scores of the College Entrance Examination Board Tests (CEEB) used to select the sample. Total standard scores on the GED tests were found to correlate with first term freshmen's marks with a correlation coefficient of .56 as compared to a coefficient of .53 between CEEB total scores and first-term freshmen's marks. This coefficient (.56) was higher than that of any of the GED tests used single. Table I shows these relationships. [Ref. 11]

TABLE I.

The Relationships of GED test scores to Average First-Term Marks for YALE Freshmen, N = 135

	<u>M</u>	<u>S.D</u>	<u>R</u>
GED Total.....	270.4	20.9	.56
GED I .....	62.9	6.2	.51
GED II .....	69.5	7.7	.50
GED III.....	73.3	5.5	.36
GED IV .....	64.7	6.1	.41

Another study based upon service veterans who were students in the General College of the University of Minnesota showed similar results. Table II shows the results of the Minnesota study. [Ref. 11]

TABLE II

Relationship between Honor-Point Ratio and the GED Tests For Veterans at Minnesota

	<u>N</u>	<u>Mean</u>	<u>S.D</u>	<u>r</u>
GED Total .....	56	218.62	25.27	.72
GED I .....	58	48.28	6.80	.51
GED II .....	59	57.82	8.63	.60
GED III .....	59	57.99	8.76	.55
GED IV .....	58	53.40	7.72	.56

The honor-point ratios of the sample are based upon the first-term courses in General College and ranged from 3.0 to -.43, with a mean and standard deviation of 1.36 and .81 respectively. (Three honor points are given for a mark A, with other values ranging to -1.0 for a mark of F.)

Although the GED tests were not designed as predictors of scholastic success, it appears they might serve this capacity quite well.

C. GED TESTS AS PREDICTORS OF EDUCATIONAL LEVEL AND MENTAL ABILITY

In this section, the following two topics will be addressed: (1) to what extent does the GED differentiate among people having varying amounts of highschool education? and (2) what is the relationship of GED test scores to general mental ability, as measured by the Army General Classification Test?

The data consisted of the GED scores of 304 male enlisted personnel of the Army who had been administered the GED Test upon entry into the service. These inductees, whose residences were scattered throughout the entire country, had completed varying amounts of schooling (7-11 years) and, because they were tested immediately upon induction, had received no further education beyond their last year of school.

Table III shows the means and standard deviations for each of the five GED subtests according to the last year of school completed.

It will be observed in Table III that for the most part there is a graduate increase in mean score at each educational level, although the differences are small and there is considerable overlap, as can be seen by examining the standard deviations and the means. These differences are certainly too small to permit individual diagnosis, and in some cases do not even bring out group differences. Three tests (Social Studies, Natural Sciences, Literary Materials) fail to provide the expected discrimination between the 8th and 9th grade levels.

At the time of their induction, the same recruits were also given the military form of the Army General Classification Test [Ref. 2]. This test was designed to measure "general learning ability" and has shown its greatest validity in predicting success in various kinds of military training. The test contains three types of speeded items (vocabulary, arithmetic, and block counting) to measure verbal, numerical reasoning and spatial factors, respectively. These items were employed by the test's

TABLE III.

MEANS AND STANDARD DEVIATIONS OF 304 ARMY ENLISTED PERSONNEL ON  
SUBTESTS OF THE GENERAL EDUCATIONAL DEVELOPMENT TEST ACCORDING  
TO LAST SCHOOL GRADE COMPLETED

Grade	N	Expression		Soc. Stud.		Nat. Sci.		Lit. Mat.		Math. Abil.	
		M	SD	M	SD	M	SD	M	SD	M	SD
7th	25	35.14	4.23	42.00	7.64	45.00	9.18	43.63	5.95	42.50	6.73
8th	65	39.93	7.73	48.50	8.33	51.64	9.22	46.08	8.37	46.08	8.37
9th	65	41.10	4.68	48.02	7.43	51.09	6.70	45.72	6.88	47.76	6.99
10th	74	46.03	8.41	50.10	9.54	52.18	8.55	49.40	6.84	49.19	8.68
11th	75	45.66	9.10	53.13	8.68	55.46	7.40	53.40	8.20	50.74	7.76

SOURCE: Ref. [8]

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developers in an effort to avoid test content which would be greatly influenced by schooling beyond the first few grades. [Ref. 8] Despite this, the AGCT correlates .73 with the highest school grade completed. It has been claimed, however, that this relationship does not mean that the test is loaded with specific scholastic content, but rather that the school level reached acts as a screening device in the same manner as does the AGCT. [Ref. 15] Table IV shows the correlation of each GED subtest with the AGCT.

These coefficients indicate a substantial relationship between the GED and the AGCT, a finding which is in agreement with the studies previously cited, where other measures of mental ability were used. In Table IV the relationship is lowest for the Correctness and Effectiveness of Expression subtest and highest for the Social Studies and Literary Materials subtests. The latter relationship is somewhat surprising in view of the item content of the AGCT. In any case, if we accept the claim that the AGCT does not measure academic achievement, it appears that the GED shares a substantial amount of variance with the AGCT variance attributable to non-academic factors.

Considering both parts of this study jointly, the conclusion seems clear that there is limited evidence for the validity of the GED Highschool Level as a measure of educational development, apart from mental ability.

#### D. AGE OF MILITARY ENLISTED MEN AS FACTORS IN TESTS OF GENERAL EDUCATIONAL DEVELOPMENT

Is chronological age a factor in the scores on tests of factual knowledge, skills and interpretive reading? Does

TABLE IV.

CORRELATION OF GED SUBTESTS WITH ARMY GENERAL CLASSIFICATION TEST (N = 304)

GED SUBTEST	r WITH AGCT
Expression	.52
Social Studies	.64
Natural Sciences	.60
Literary Materials	.66
Mathematical Ability	.59

SOURCE: Ref. [8]

maturation play an important part in the ability to interpret reading material? Does an individual not in school increase his or her ability in factual information, arithmetic skills and interpretive reading at the same rate as an individual in school? Partial answers to these and similar questions can be found by examining the results of tests given to members in the Armed Forces during their stay in 1945 and 1946 at Camp Stoneman, Pittsburg, California. Tests of General Educational Development prepared by the United States Armed Forces Institute were administered to approximately 2,000 soldiers. Each examinee was instructed to state on his answer sheet his age in years as of his last birthday.

Table V shows the mean score and its corresponding percentile for each age group for each of the five tests.

Scores on tests of interpreting reading material in social science, natural science and literature show a definite improvement from one age group to higher age groups. For example, in Test II, Interpretation of Social Science, the 16-year-olds made an average score of 44.2, while the 26 year-olds-and-over made an average score of 55.6.

The coefficients of correlations shown in Table V are such as to make any prediction of test score placement by means of age particularly worthless. However, there seems to be a fairly significant increase in the ability to interpret reading material in Social Science, Natural Science and Literature from age 16 to 26, with a smaller increase in the ability in the skills of correct English usage and mathematics. (It should be noted that

TABLE V.

MEAN SCORES OF MEMBERS OF ARMED FORCES IN G. E. D.  
Tests Grouped According to Ages

Age	TEST I			TEST II			TEST III			TEST IV			TEST V		
	No.	Mean Std. Score	Per-centage	No.	Mean Std. Score	Per-centage	No.	Mean Std. Score	Per-centage	No.	Mean Std. Score	Per-centage	No.	Mean Std. Score	Per-centage
16	8	42.5	21	44.7	27	45.0	6	45.0	31	42.7	24	10	47.2	34	
17	251	47.5	31	45.5	46	50.8	20	50.8	24	47.6	50	212	48.5	45	
18	251	44.6	31	43.5	50	51.6	20	51.6	24	47.6	50	252	49.3	49	
19	284	46.0	34	46.1	50	52.9	21	52.9	24	47.6	50	284	50.3	50	
20	181	45.2	21	46.2	50	53.8	11	53.8	24	47.6	50	181	50.3	50	
21	81	45.2	21	46.2	50	53.8	11	53.8	24	47.6	50	81	50.3	50	
22	23	45.4	24	46.4	50	53.8	11	53.8	24	47.6	50	23	50.3	50	
23	29	45.4	24	46.4	50	53.8	11	53.8	24	47.6	50	29	50.3	50	
24	22	45.4	24	46.4	50	53.8	11	53.8	24	47.6	50	22	50.3	50	
25	121	45.4	24	46.4	50	53.8	11	53.8	24	47.6	50	121	50.3	50	
26 and over	1779	45.4	21	46.4	50	53.8	11	53.8	24	47.6	50	1779	50.3	50	
Total	9	45.4	21	46.4	50	53.8	11	53.8	24	47.6	50	9	50.3	50	
Sigma	9	45.4	21	46.4	50	53.8	11	53.8	24	47.6	50	9	50.3	50	
Range	9	45.4	21	46.4	50	53.8	11	53.8	24	47.6	50	9	50.3	50	
%	9	45.4	21	46.4	50	53.8	11	53.8	24	47.6	50	9	50.3	50	

\*Coefficient of correlation between test scores and age.

SOURCE: Ref. [9]



different educational accomplishments of the different age groups may account for the age group differences reported in Table V.)

#### E. PRESENT PRACTICES FOR ISSUING GED CERTIFICATES

The GED tests are given in five parts. Each section requires approximately two hours for completion. Applicants may take the tests through the State Department of Education at a local school, or under the direction of the Education Officer on a military base. Veterans eligible for G. I. benefits take the GED Tests through the United States Veterans Administration.

All scores must be at the 50th percentile or above, to be considered passing. Should the applicant not meet the requirements, additional private studies may be recommended, or the local adult educational program or community college may offer suitable courses. If evidence of further study can be presented, the tests may be taken again after six months have elapsed.

The applicant must pass the standardized tests of General Educational Development with acceptable scores which are no lower than either:<sup>1</sup> a. An average standard score on the five tests in the battery of not less than 45; or, b. Score of not less than 35 on any one of the five parts of the GED tests. [Ref.16]

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<sup>1</sup> However, these are the scores that the Commission has recommended for guidance only. Current state minimum requirements vary. Most can be described as either:

1. 35 or 45
2. 40 or 45
3. 35 and 45
4. 40 and 45

## F. GED STATISTICS

Table VI shows that as the number of GED centers increased over the years, the number of applicants for the tests increased. Also, the average age of applicants has dropped to 25. However, the percentage of applicants meeting the standards has decreased by about 10 percent since 1954.

In Appendix A, Table V shows the distribution of Educational Accomplishment Groups, Calendar Years 1973 through 1978, entering the services. The percentage of GED accessions reached 8.0% in some years. In the Air Force, the percentage of GED's is almost the same as the percentage of nonhighschool graduates.

Table VI (Appendix A) shows the distribution of Army nonprior service GED accessions over the States. Some States yielded 20-30 percent GED accessions, but some others yielded almost no GED accessions.

Table VII (Appendix A) shows Army accessions, and their distribution by Education, Sex, Race, Age and Mental Category from 1973 to 1978. It is very interesting to note that the proportion of Blacks is less in the GED groups than in the nonhighschool graduate (NHSG) groups. Also, GED groups have a greater proportion of accessions in Mental Groups I and II than do the NHS groups.

So far, this thesis has discussed the general problems of the AVF, specifically the attrition problem and the need for new resources to increase the manpower supply. Then, the thesis explored

TABLE VI

COMPARATIVE TESTING DATA, 1950-77

YEAR	Official GED Centers in Operation	Total Volume of Testing	Veterans (%)	Nonveterans (%)	Unchallenged (%)	Average Age	Number of Years of Previous Setbacks	Planned Follow-up Study (%)	Percent Meeting Standards
1950	563	36,583	.	.	.	.	.	.	.
1951	563	25,594	.	.	.	.	.	.	.
1952	567	23,733	.	.	.	.	.	.	.
1953	565	32,533	61.0	38.0	1.0	.	3.0	.	.
1954	571	42,141	65.0	35.0	.	.	.	.	80.0
1955	587	44,640	59.0	37.0	5.0	.	4.0	.	79.0
1956	597	52,552	46.0	29.0	25.0	.	4.0	.	77.0
1957	634	52,874	49.0	35.0	16.0	.	2.0	.	76.0
1958	642	58,723	43.0	41.0	16.0	27.0	3.0	.	75.0
1959	669	56,496	37.0	45.0	18.0	28.0	3.0	.	76.0
1960	658	61,093	32.0	44.0	24.0	29.0	3.0	.	77.0
1961	702	69,090	28.0	46.0	26.0	29.0	3.0	.	75.6
1962	745	75,428	27.0	50.0	22.0	29.0	3.0	.	75.0
1963	831	89,242	25.0	53.0	22.0	29.4	3.0	.	71.6
1964	840	116,575	22.0	58.0	20.0	31.0	3.0	.	74.0
1965	942	133,974	19.4	55.6	22.0	31.5	3.0	.	71.6
1966	1,071	165,776	18.7	59.7	21.5	31.3	3.0	.	71.7
1967	1,194	218,205	.	.	.	31.5	3.0	.	70.0
1968	1,346	265,499	.	.	.	31.5	3.0	.	61.4
1969	1,505	293,451	.	.	.	31.3	3.0	.	71.7
1970	1,711	331,544	.	.	.	31.1	3.0	.	70.8
1971	1,743	337,733	.	.	.	31.0	3.0	.	68.7
1972	1,967	379,596	.	.	.	31.4	3.0	.	97.4
1973	2,136	430,216	.	.	.	35.1	3.0	.	66.7
1974	2,421	501,503	.	.	.	37.2	3.0	.	64.9
1975	2,469	497,426	.	.	.	35.1	3.0	.	70.2
1976	2,569	600,623	.	.	.	25.4	3.0	.	67.9
1977	2,704	715,116	.	.	.	25.0	3.0	.	63.7

SOURCE: Ref. [12]

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the GED and some of the characteristics of the GED group. But the question remains, "Are GED holders any different from the other groups, such as non-highschool graduates, with respect to first-term attrition?"

1. Attrition

If we look at the attrition data in Appendix A, Tables I, II, III, And IV, we see that some groups have higher attrition rates than others.<sup>1</sup> Table VII shows some examples. From 1976 accessions, the Non-Highschool, Mental Group III-B, Non-Negro, Age 20+ group, has a 50 percent loss rate by the end of three years of service. With the same characteristics, except for the GED group instead of the NHS group, the loss rate is 45 percent. If we look at other groups identical except for education, then we see that the GED group has a higher loss rate than does the NHS group. As shown in this example, it is possible to have different results from the comparison of GED and NHS groups when the other characteristics of groups were changed.

Correlation studies are needed to find out what factors have significant relationships with first-term enlisted attrition. Is having a GED certificate important in terms of attrition rates? There are four different approaches to answering this question. In the next chapter, the different approaches will be examined.

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<sup>1</sup> All attrition data are taken from the Defense Manpower Data Center (DMDC) cohort file.

TABLE VII

THREE YEAR LOSS RATES OF ARMY, CY 1976  
 ENLISTED NONPRIOR SERVICE ACCESSIONS

<u>EDUCATION</u>	<u>MENTAL GROUP</u>	<u>AGE</u>	<u>RACE</u>	<u>LOSS RATE</u>
NHS	III-B	20+	Non-Negro	.50
GED	III-B	20+	Non-Negro	.45
NHS	IV	18 & 19	Negro	.34
GED	IV	18 & 19	Negro	.46

SOURCE: Analysis made using data from the Defense  
 Manpower Data Center cohort files.

## V. PREDICTION

### A. COMPARISON OF PREDICTION APPROACHES:

There are two main statistical approaches for attrition prediction purposes, with two variants of each. The main approaches are linear and non-linear in form, with the variants being the use of either individual or grouped observations. [Ref. 4]

The linear approach with individual observations has the disadvantage that it may not be best, especially when the relationship of the predictors to the chances of attriting is not linear. [Ref. 17]

Whereas the individual linear approach uses a binary dependent variable (stay-attrite), the grouped approaches use loss rates (linear) or the log of the odds of loss rates (non-linear) for groups of men defined by all possible combinations of the predictors. An example of a group is recruits with Highschool education, MG III-A, Age 18, and Black.

Both grouped approaches require redefinition or pooling of groups and an additional regression when a predictor variable is found not to be significantly related to the dependent variable. [Ref. 4] Both also require very large samples with even small numbers of predictors. Because of the large number of possible combinations of the predictors, enough men must be found in the groups to produce reliable loss rates. Table VIII compares the approaches.

TABLE VIII

COMPARISON OF APPROACHES

<u>Approach</u>	<u>Sample size</u>	<u>No. of variables</u>	<u>Computation</u>	<u>Data fit</u>
Linear - individual	Any	Many	1 stage	Poor
- grouped	Large	Fewer	2 stage	Fair
Non-linear - grouped	Large	Fewer	2 stage	Good
- individual	Large	Fewer	Iterative	Best

SOURCE: Ref.

## B. GROUPED LINEAR PROBABILITY MODEL

Given the variables thought to influence attrition, then the goal is to estimate the probability that an individual will attrite. Let  $X = (X_1, X_2, \dots, X_k)$  be the vector of variables (the characteristics of the individual, such as mental ability and educational level) thought to affect attrition.

Then with  $n$  observations on  $n$  individuals who have been in military service, of which  $n_1$  individuals were attriters and  $n_2 = n - n_1$  individuals were non-attriters, an equation can be estimated giving the probability that an individual with a given set of characteristics ( $X$  vector) will attrite.

The estimated equation may then be used for prediction purposes. In this model, the individual observations are grouped into cells on the basis of combinations of the  $X$ 's, and the dependent variable is the proportion  $P = a/n_i$  of the  $n_j$  individuals in the  $i$ 'th cell who were attriters.  $P$  is an estimate of the true probability  $P$  that individuals with a given set of characteristics will attrite. The total number of cells is the product over the number of variables, of the number of intervals for each variable. Thus if there are 3 education categories (NHS, GED, HSDG), 4 mental categories (I&II, III-A, III-B, IV), 3 age categories (17, 18&19, 20+), and 2 race groups there would be 72 cells.

The main formula for this model is:

$$Y_i = B_0 + B_1X_1 + B_2X_2 + \dots + B_kX_k + e \quad (1)$$



$Y_1$  is the dependent variable (Probability of attrition  $P = a_i/n_i$ ), X's are the independent variables,  $B_0$  is the constant term, and e is the error term.

### C. APPLICATION OF THE MODEL

The main objective of this thesis is to decide whether GED recipients differ in attrition rates from individuals from the other educational groups.

To examine the first-term attrition of GED and other groups, a grouped-linear model was developed using multiple regression techniques.

The predictors in the equation were:

#### EDUCATION:

- E1.....Non-Highschool
- E2.....G.E.D.
- E3.....Highschool Diploma Graduates

#### MENTAL CATEGORY:

- M1.....AFQT Category I & II
- M2.....AFQT Category III-A
- M3.....AFQT Category III-B
- M4.....AFQT Category IV

#### AGE:

- A1.....17
- A2.....18 & 19
- A3.....20+

#### RACE:

- R1.....Negro
- R2.....Non-negro

Interaction terms were also used in the equations according to their statistical significance level. For example, interaction terms such as:

$$EM11 = E1 * M1 \quad \text{or} \quad AR12 = A1 * R2$$

were investigated.

Since binary coding was used in all of our programs, the variables used as reference variables must be shown.

Within the educational accomplishment groups, E3 (HSDG) was chosen as the reference and always coded 0, because this group is the largest (number of people) among the others. The other variables coded as 0 or 1, depending on the case characteristics.

Among the mental ability variables, M3 is the reference variable and always coded as 0. The other mental ability variables were coded as 0's or 1's depending on the case characteristics.

Within the age variables, A2 is the base variable, and, within the race variables, R2 is the base variable for the same reason as above.

An example: For the group characteristics E2(GED), M2 (Mental Group III-A), A1 (Age 17), R2 (Non-negro), the coding is:

0	1	0	0	1	0	0	1	0	0	0	0	Y
E1	E2	E3	M1	M2	M3	M4	A1	A2	A3	R1	R2	Y

Y is the loss rate for that particular group.

Reference variables are subsumed in the intercept of the regression ( $B_0$  in Eq.[1]).

For simplicity, survival of non-prior service (NPS) personnel during the first three years of enlistment was examined. Only Army data were used. There were four years of accession data available for the study: 1973, 1974, 1975 and 1976. In the first regression study, time (years) was used as another variable. The result of this study showed that the year 1973 was different from the other years. The accession cohort entering in 1973 had a lower loss rate than did cohorts from the other years. (See Table IX) Also it was the first year of AVF experience. It was decided not to use the 1973 data in the other analyses, and data from the other years (1974-1976) were combined.

Since there were three years of attrition data, the validity of the model could be examined. By using the first two years of data (1974, 1975), we could predict the loss rates for the 1976 accessions and compare it with actual loss rates. The prediction equation is in Table IX (Appendix B). The results of this study are in Table X. The differences between the actual and predicted loss rates are very similar to results reported by Lookman. [Ref. 18]

Further, regressions were run with combined 1974, 1975, 1976 data. The results (predictions for 1977 accessions) are shown in Table XI. All computer outputs used are provided in Appendix B. Appendix B also includes a description of the computer program used in the analyses. [Statistical Package for Social Sciences, Ref. 6]

A stepwise regression routine was used which entered the variables in single steps, starting with the variable having the

TABLE IX

PREDICTION OF ARMY THREE-YEAR LOSS DATA  
USING INTERACTIVE VARIABLES

(Data are from 1973-1976 NPS Accessions)

Multiple R            0.93521  
R Squared            0.87462  
Adjusted R Square    0.86771  
Standard Error        4.22679

VARIABLES IN THE EQUATION

VARIABLE	B	BETA	STD ERROR B	F
E1	20.61290	0.83762	0.73780	780.553
E2	18.21433	0.74016	0.86817	440.171
M1	- 6.070351	-0.22658	0.96141	39.867
T1	- 2.201250	-0.08216	0.70446	9.764
AE12	6.125767	0.16595	0.95979	40.735
AE11	5.279048	0.14301	0.95979	30.252
R1	- 4.774027	-0.20576	0.78762	36.740
M2	- 3.966163	-0.14804	0.88058	20.286
AM11	- 3.869937	-0.09220	1.15755	11.177
T2	2.664028	0.09944	0.70446	14.301
MR11	4.152361	0.11838	1.22017	11.581
T3	1.920000	0.07167	0.70446	7.428
MR21	2.845417	0.08112	1.22017	5.438
ME41	- 2.235313	-0.05326	1.05670	4.475
ER21	2.101667	0.06752	1.05670	3.956
(CONSTANT)	28.87696			

TABLE X

PREDICTED AND ACTUAL THREE YEAR LOSS RATES  
FOR ARMY, NPS, 1976 ACCESSIONS

<u>Education</u>	<u>Mental Gr.</u>	<u>Race</u>	<u>Age</u>	<u>N. of Rec.</u>	<u>Predicted</u>	<u>Actual</u>	<u>Difference</u>
E1	M1	R2	A1	4409	48	45	+3
E1	M1	R2	A3	2043	46	46	-
E1	M2	R1	A1	655	51	50	+1
E1	M2	R1	A2	1287	44	42	+2
E1	M2	R2	A2	5895	48	47	+1
E1	M3	R1	A3	2675	48	45	+3
E1	M3	R2	A1	11384	57	49	+3
E1	M4	R2	A3	4491	51	47	+4
E2	M1	R2	A3	860	42	44	-2
E2	M1	R2	A2	946	42	42	-
E2	M1	R1	A2	69	95	45	-
E2	M2	R1	A1	38	50	50	-
E2	M2	R2	A1	305	52	50	+2
E2	M2	R2	A2	652	99	99	-
E2	M2	R2	A3	456	47	48	-1
E2	M3	R2	A1	369	55	52	+3
E2	M3	R2	A2	766	47	47	-
E2	M4	R1	A2	273	46	46	-
E2	M4	R2	A2	485	47	47	-
E3	M1	R1	A1	201	20	20	-
E3	M1	R2	A1	2071	19	22	+3
E3	M1	R2	A3	12012	23	24	-1
E3	M2	R1	A3	1716	24	27	-3
E3	M2	R2	A1	1233	25	25	-
E3	M2	R1	A1	373	22	22	-
E3	M3	R1	A2	6447	25	22	+3
E3	M3	R2	A3	5001	29	33	+4
E3	M4	R1	A2	3464	25	25	-
E3	M4	R2	A2	2869	29	33	-4

TABLE XI

PREDICTED THREE YEAR LOSS RATES FOR ARMY, NPS, MALE, 1977 ENLISTED ACCESSIONS

Mental Category	AGE	NHS		GED		HSDG	
		NEGRO	NON-NEGRO	NEGRO	NON-NEGRO	NEGRO	NON-NEGRO
I & II	17	46.0	46.6	49.2	47.4	18.7	19.3
	18-19	43.5	44.1	45.4	43.6	21.2	21.8
	20+	44.5	45.1	45.1	43.3	25.2	25.8
III-A	17	49	53.6	49.4	51.6	21.7	26.3
	18-19	44	48.6	43.1	45.3	21.7	26.3
	20+	45	49.6	42.8	45	25.7	30.3
III-B	17	51.5	56.1	51.9	54.1	24.2	28.8
	18-19	46.5	51.1	45.6	47.8	24.2	28.8
	20+	47.5	52.1	45.3	47.5	28.2	32.8
IV	17	43	53.6	51.9	51.1	24.2	28.8
	18-19	38	48.6	45.6	47.8	24.2	28.8
	20+	39	49.6	45.3	47.5	28.2	32.8

highest correlation with the dependent variable. Other variables entered the equation provided that they met the statistical criterion (explained in the next paragraph). The variable that explains the greatest amount of variance in the dependent variable will enter first, the variable that explains the greatest amount of variance in conjunction with the first will enter second, and so on. In other words, the variable that explains the greatest amount of variance unexplained by the variables already in the equation enters the equation at each step.

Since there were  $72 \times 3 = 216$  cases for three years of data, the .05 significance level for F to enter a variable in the equation is 3.8 (Degrees of Freedom changes as more variables entered: 1,214 to 1,200 but the F value is still about the same; 3.8). That means for F 3.8 the null hypothesis  $B = 0$  can be rejected, and the variables included in the equation.

The significant predictors and their F values are shown in Appendix B. An example will now be shown. The main formula was:

$Y = B_0 + B_1X_1 + \dots + B_kX_k + e$ , where  $k = 65$  in this case and includes interactive variables. For the group (NHS, Mental Category I&II, Non-Negro, Age 17), the significant coefficients are:

$$B_0 = 28.8 \quad B_{E1} = 22.3 \quad B_{M1} = -7.0 \quad B_{R1} = -4.6 \quad B_{AE11} = 5.0$$

$$B_{MR11} = 4.0 \quad B_{AM11} = -2.5$$

Putting those in the formula yields:

$$Y = 28.8 + 22.3 + 5.0 + 4.0 - 7.0 - 4.6 - 2.5 = 46.0$$

That means the predicted three-year loss rate for this group is 46 percent. The standard error of estimate was 3.6.

Another regression was run with no interaction variables. The results of this run are shown in Table XII. Similar to other studies, education variables have the highest correlation coefficients. This study also shows that if only education variables were considered, the GED group has lower loss rates than the NHS group.



TABLE XII

PREDICTION OF ARMY THREE YEAR LOSS DATA USING NO  
 INTERACTIVE PREDICTORS  
 (DATA ARE FROM 1974-1976 NPS ACCESSIONS)

MULTIPLE R	0.95272	ANALYSIS OF VARIANCE	DF
R SQUARE	0.90767	REGRESSION	8.
ADJUSTED R SQUARE	0.90220	RESIDUAL	135.
STANDARD ERROR	3.76652		

SUM OF SQUARES	MEAN SQUARE	F
18828.28318	2353.53540	165.89788
1915.19794	14.18665	

VARIABLES IN THE EQUATION

VARIABLE	B	BETA	STD ERROR B	F
E1	24.59646	0.96607	0.76884	1023.473
E2	22.47708	0.88282	0.76884	854.695
M1	- 4.303055	-0.15525	0.88778	23.493
A1	3.426042	0.13456	0.76884	19.857
M2	- 2.151667	-0.07763	0.88778	5.874
R1	- 1.950971	-0.08128	0.62775	9.659
A3	0.9731245	0.03822	0.76884	1.602
M4	0.7261102	0.02620	0.88778	0.669
(CONSTANT)	26.44874			

## VI. CONCLUSION AND RECOMMENDATIONS

As can be seen in Table XIII, the three-year loss rates from the Army of the GED group have always been less, other things being equal, than that of the Non-Highschool graduates since the beginning of the AVF.

Highschool graduates, other things being equal, have lower attrition rates than do the other educational accomplishment groups.

In Table XIII, if age is observed, it can be seen that the age 17 group has a much higher loss rate than do the other age groups. In the same table, mental group I & II have lower loss rates than do the other mental groups, and overall Blacks have lower loss rates than do the non-Blacks.

The predicted loss rates are very similar to the actual group loss data (see Table XI). In general the GED group's have lower loss rates than do NHS groups. But for some Negro groups, such as Mental Groups I&II and IV, GED's have higher loss rates than do the NHS groups. For non-Negros, GED groups always have lower loss rates than do the NHS groups.

The number of GED holders in the market is increasing. (See Table VI.) During the early 1960's there were about 50 thousand GED certificates issued per year, and now in the late 1970's it is about 500 thousand per year. Also, the average age of these people is about 24-25, quite available for recruiting.

During the 1980's, military services will face difficult recruiting, because of the declining youth population. (See Figure 6.) Within this declining youth population, there will be numerically fewer HSDG's, 17-21 years old. [Ref. 19]

As a result of this study, HSDG's appeared to be the best educational group to have in the services. However, GED certificate holders should in general be preferred to non-highschool graduates, if the Army desires to lower first-term enlisted attrition.

TABLE XIII

ACTUAL THREE YEAR LOSS RATES FOR ARMY, NPS, MALE ENLISTEES

VARIABLES	A C C E S S I O N   Y E A R S							
	N	1973	N	1974	N	1975	N	1976
NHS	67370	45	80119	50	61634	50	66574	48
GED	2680	41	8641	48	12996	47	7597	45
HSDG	91122	20	76125	24	87129	25	88838	25
I&II	48893	22	40599	30	44612	28	47038	29
III-A	36477	31	38373	39	40857	37	34975	36
III-B	49221	35	53928	42	58465	40	67478	41
IV	1226631	35	431985	41	617825	40	13518	32
17	33512	43	33984	48	30926	46	32328	45
18&19	85632	28	89395	36	83461	34	83015	32
20+	42007	24	41484	35	47344	34	47663	34
Negro	33715	32	46250	38	37545	34	40691	32
Non-Negro	127457	31	118635	39	124214	37	122318	37
TOTAL	161172	31	164885	39	161759	36	163009	36

APPENDIX A

TABLE I

ARMY CY 1973 INPUT AND FIRST TERM LOSS DATA FOR 3 YEARS OF NPS MALE RECRUITS

Mental Grade	AGE	NHSG		GED		HSDG		
		Negro	Non-Negro	Negro	Non-Negro	Negro	Non-Negro	
I & II	17	( 296)	43.92 (4269)	44.95 ( 8)	12.50 (118)	44.07 (126)	24.60 (2016)	19.74
	18-19	( 650)	41.08 (4966)	38.86 ( 21)	52.38 (463)	36.07 (978)	20.86 (18382)	16.94
	20+	( 260)	40.77 (1493)	39.05 ( 27)	33.33 (309)	42.39 (743)	22.34 (13714)	14.79
III-A	17	( 722)	44.88 (5555)	47.72 ( 19)	52.63 ( 90)	44.44 (243)	18.93 (1288)	24.46
	18-19	(1371)	44.69 (5841)	43.18 ( 67)	44.78 (309)	39.48 (900)	22.42 (10550)	20.23
	20+	( 568)	38.20 (1474)	43.69 ( 38)	47.37 (161)	36.02 (183)	24.94 (5096)	18.90
III-B	17	(1765)	46.23 (8929)	50.66 ( 20)	60.00 ( 90)	48.89 (505)	24.95 (1094)	28.43
	18-19	(3382)	42.93 (9025)	44.99 (104)	45.19 (270)	41.85 (866)	22.89 (9566)	22.76
	20	(1379)	39.16 (2376)	42.51 ( 60)	38.33 (152)	45.39 (247)	26.40 (4653)	21.99
IV	17	(1250)	47.04 (4480)	50.25 ( 21)	57.14 ( 49)	45.45 (543)	24.31 ( 521)	37.04
	18-19	(2140)	37.01 (3841)	45.51 ( 77)	32.47 (111)	49.55 (3870)	22.27 (3882)	25.71
	20+	(862)	37.94 (960)	45.63 ( 44)	43.18 ( 57)	49.12 (2124)	25.09 (1797)	28.44

\* (...) In parentheses, number of accessions.

APPENDIX A

TABLE II

ARMY CY 1974 INPUT AND FIRST TERM LOSS DATA FOR 3 YEARS OF NPS MALE RECRUITS

Mental Grade	AGE	NHSG		GED		HSDG		
		Negro	Non-Negro	Negro	Non-Negro	Negro	Non-Negro	
I & II	17	(739)	49.93 (4680)	49.19 (39)	46.15 (683)	46.85 (189)	23.28 (1941)	20.14 (13716)
	18-19	(1017)	44.64 (3829)	43.93 (58)	60.34 (989)	42.87 (264)	21.20 (13716)	19.80 (8066)
	20+	(577)	44.7 (1213)	50.78 (62)	46.77 (599)	46.41 (934)	27.73 (8066)	21.83 (1918)
III-A	17	(1341)	53.17 (7407)	52.54 (62)	56.45 (599)	50.92 (308)	20.13 (1147)	25.20 (8267)
	18-19	(2083)	48.10 (5758)	48.68 (125)	44.80 (815)	43.93 (2184)	25.18 (8267)	24.70 (3337)
	20+	(1142)	47.02 (1739)	50.03 (92)	45.65 (455)	47.47 (1506)	26.96 (3337)	27.69 (3491)
III-B	17	(1230)	52.85 (6684)	56.37 (182)	58.24 (1089)	57.21 (716)	23.88 (1034)	28.05 (7836)
	18-19	(5291)	48.21 (11685)	50.69 (220)	45.45 (702)	50.28 (4472)	25.22 (7836)	27.71 (397)
	20+	(2644)	45.76 (3325)	51.91 (201)	44.28 (397)	48.87 (2718)	30.10 (3491)	30.25 (1918)
IV	17	(515)	56.12 (1980)	58.79 (125)	51.20 (355)	55.49 (610)	23.28 (329)	32.52 (3343)
	18-19	(4283)	46.60 (6669)	53.10 (225)	46.67 (266)	96.99 (4298)	24.24 (3343)	30.30 (1918)
	20+	(2168)	45.57 (2105)	53.87 (129)	48.06 (171)	38.01 (2495)	28.54 (1918)	32.79 (1918)

APPENDIX A

TABLE III

		ARMY CY 1975 INPUT AND FIRST TERM LOSS DATA FOR THREE YEARS OF NPS MALE RECRUITS					
Mental Grade AGE		NHSG		GED		HSDG	
		Negro	Non-Negro	Negro	Non-Negro	Negro	Non-Negro
I & II	17	( 318)50.63	(3527)49.02	( 43)39.53	(1099)49.77	( 178) 19.66	( 2293) 19.89
	18-19	( 379)46.70	(3086)41.70	( 63)41.27	(1519)44.31	(1038) 19.17	(15526) 19.74
	20+	( 261)48.66	(1175)46.13	( 82)48.78	(1066)42.31	(1089) 22.96	(11864) 23.02
III-A	17	( 868)48.50	(7082)52.06	( 77)54.55	(1092)50.73	( 338) 18.05	( 1321) 26.27
	18-19	(1261)46.39	(5254)46.44	(142)41.55	(1287)46.00	(2235) 20.81	( 9742) 24.71
	20+	( 733)48.02	(1904)48.42	(130)43.08	( 761)46.91	(1792) 26.90	( 4829) 29.24
III-B	17	(1068)53.56	(5235)55.53	(299)51.17	(1718)57.16	( 789) 21.67	( 1156) 28.63
	18-19	(4372)48.86	(11760)51.54	(294)46.60	(1167)45.42	(5200) 23.21	( 9216) 28.49
	20+	(2333)46.76	(3986)52.81	(251)39.84	( 718)49.30	(3746) 26.70	( 5149) 31.60
IV	17	( 302)55.63	(1053)57.93	(122)52.46	( 291)59.11	(375) 24.53	( 282) 27.66
	18-19	(1531)48.92	(2477)56.84	(185)51.89	( 289)45.33	(2815) 24.72	( 2623) 32.41
	20+	(762) 46.72	(886) 54.18	(118)41.53	( 181)45.36	(1948) 29.11	( 1580) 34.49

APPENDIX A

TABLE IV

ARMY CY 1976 INPUT AND FIRST TERM LOSS DATA FOR 3 YEARS OF NPS MALE RECRUITS										
Mental Grade AGE	NHS		GED		HSDG					
	Negro	Non-Negro	Negro	Non-Negro	Negro	Non-Negro	Negro	Non-Negro	Non-Negro	
I	17	(353)40.79	(4409)45.02	(19)	42.11	(388)	47.42	(201)	20.40	(2071)22.0
&	18-19	(652)40.49	(4720)40.00	(69)	44.93	(946)	42.49	(1319)	17 13	(15018)20.2
II	20+	(392)39.03	(2043)46.94	(89)	47.19	(860)	44.53	(1475)	24.47	(12012)24.3
III-	17	(655)49.92	(5057)50.46	(38)	50.00	(305)	50.16	(373)	22.52	(1233) 25.63
A	18-19	(1287)42.42	(5395)47.32	(99)	38.38	(652)	44.63	(2335)	20.90	(8586) 24.61
	20+	(695)42.01	(2004)46.96	(98)	37.76	(456)	48.25	(1716)	27.56	(3991) 31.70
III-	17	(2302)49.83	(11384)54.59	(95)	53.68	(369)	52.53	(870)	21.72	(1187) 32.43
B	18-19	(4782)44.35	(12272)49.27	(272)	39.71	(766)	47.13	(6447)	22.68	(9705) 28.37
	20+	(2675)45.42	(4491) 50.12	(212)	41.51	(510)	45.69	(4137)	29.08	(5001) 33.71
IV	17	(46) 28.26	(163) 47.85	( 33)	48.48	( 90)	50.00	( 408)	25.74	( 279) 28.67
	18-19	(228)34.65	(374) 41.44	(273)	46.89	(485)	47.63	(3464)	25.03	(2869) 33.67
	20+	(74) 36.49	(119) 47.06	(194)	50.52	(279)	50.90	(2313)	29.79	(1827) 36.12



APPENDIX A

TABLE V

EDUCATIONAL DISTRIBUTION OF NPS MALE ENLISTEES, WITHIN THE SERVICE

<u>ENTERING YEAR</u>	<u>TOTAL NUMBER OF ACC.</u>	<u>% GED</u>	<u>% NHS</u>	<u>% HSDG</u>
<u>ARMY</u>				
1973	161,172	.017	.418	.565
1974	164,885	.052	.485	.461
1975	161,759	.080	.381	.538
1976	163,009	.046	.408	.544
1977	148,631	.028	.399	.572
1978	104,824	.036	.268	.695
<u>NAVY</u>				
1973	88,665	*	.308	.692
1974	83,070	*	.337	.662
1975	89,433	*	.283	.716
1976	79,298	.041	.206	.752
1977	81,664	.044	.219	.736
1978	59,026	.060	.200	.739
<u>AIR FORCE</u>				
1973	85,612	.027	.135	.837
1974	64,203	.083	.070	.895
1975	63,486	.060	.079	.860
1976	62,630	.046	.066	.887
1977	60,533	.031	.045	.923
1978	54,057	.073	.072	.854

\* Included in NHS

APPENDIX A  
TABLE VI

DISTRIBUTION OF THE ARMY, NPS, GED CERTIFICATE HOLDERS OVER THE STATES, 1973 - 1978  
MALE & FEMALE

STATES	1973		1974		1975		1976		1977		1978	
	#NPS ACC.	%GED	#NPS ACC.	%GED	#NPS ACC.	%GED	#NPS ACC.	%GED	#NPS ACC.	%GED	#NPS ACC.	%GED
Alabama	4501	.021	4958	.057	3856	.113	3569	.093	4793	.040	3297	.044
Alaska	284	.038	213	.192	171	.280	128	.085	214	.158	123	.138
American Samoa	2	-	346	-	195	-	176	.017	188	.010	113	.008
Arizona	1653	.038	2074	.100	2245	.187	2191	.098	2743	.010	1518	.096
Arkansas	2125	.024	2424	.060	2170	.061	2075	.031	2105	.021	1522	.024
California	16136	.028	18194	.076	17789	.078	17607	.048	19000	.036	9735	.034
Canal Zone	4	-	3	-	5	-	35	.057	33	.030	20	-
Colorado	1739	.033	2370	.054	2389	.115	2397	.070	2350	.057	1376	.059
Connecticut	1151	.017	1352	.043	1861	.053	2056	.017	2797	.015	1142	.023
Delaware	334	.017	428	.024	495	.038	524	.028	759	.021	468	.025
Dist. Columbia	469	.019	685	.119	758	.180	664	.115	989	.041	558	.041
Florida	7051	.014	7960	.025	7707	.051	7505	.040	10618	.023	7502	.029
Georgia	5436	.014	6067	.039	5422	.085	5002	.063	6657	.027	4819	.030
Guam	102	.029	261	.026	284	.042	308	.055	454	.061	345	.023
Hawaii	724	.007	940	.014	797	.028	707	.008	1031	.010	673	.023
Idaho	768	.017	819	.035	827	.077	767	.062	700	.092	316	.022
Illinois	7074	.016	6358	.039	7138	.044	7770	.020	9820	.022	5053	.023
Indiana	4077	.014	3825	.047	4454	.069	4818	.028	5303	.030	2625	.025
Iowa	2653	.017	2198	.057	2085	.110	2285	.049	2431	.090	1268	.057
Kansas	1636	.033	1768	.128	1672	.172	1558	.089	1723	.037	811	.050
Kentucky	3611	.021	3415	.094	2850	.154	2980	.053	3707	.040	2101	.052
Louisiana	3449	.014	3708	.075	2880	.053	2548	.059	3181	.091	1973	.055
Maine	860	.024	939	.079	953	.117	1002	.059	1332	.041	795	.075
Maryland	7560	.023	2735	.058	4506	.061	3162	.027	4341	.019	2616	.025
Massachusetts	3000	.015	2718	.039	3717	.045	3534	.034	4640	.020	2544	.032
Michigan	5976	.201	7440	.081	8567	.086	8277	.046	9098	.035	4159	.043
Minnesota	3425	.008	2732	.029	3341	.077	2898	.070	3414	.038	1749	.046
Mississippi	2309	.013	3156	.025	2401	.052	2273	.067	3110	.073	1879	.056
Missouri	3910	.010	3533	.036	3790	.050	3980	.031	5020	.028	2486	.025
Montana	760	.025	779	.051	696	.087	743	.068	711	.059	328	.054
Nebraska	1167	.014	1113	.085	1010	.126	1236	.084	1146	.073	703	.064

APPENDIX A

TABLE VI (Continued)

Nevada	416	.028	524	.120	499	.144	482	.080	521	.051	277	.054
New Hampshire	559	.030	728	.125	819	.134	845	.079	1039	.038	575	.073
New Jersey	3721	.016	3525	.058	4825	.048	4709	.026	6043	.019	2802	.039
New Mexico	1065	.050	1563	.106	1216	.202	1138	.134	1369	.078	802	.098
New York	9616	.021	9317	.050	11470	.056	12244	.039	16415	.021	7787	.034
N. Carolina	6883	.015	8707	.029	5974	.015	5482	.037	7425	.021	5409	.020
N. Dakota	734	.015	599	.036	573	.045	405	.034	453	.015	339	.029
Ohio	7960	.007	6646	.016	8271	.027	9802	.011	12244	.007	6687	.010
Oklahoma	2439	.022	2550	.032	2571	.071	2270	.047	2309	.046	1211	.046
Oregon	2420	.032	2785	.095	2553	.094	2562	.045	2178	.056	1033	.039
Pennsylvania	7201	.017	6732	.042	8368	.053	8926	.039	10838	.028	5614	.034
Puerto Rico	2339	.012	2778	.039	2229	.070	2208	.062	2841	.047	2776	.047
Rhode Island	493	.032	514	.114	730	.153	674	.059	881	.031	514	.091
S. Carolina	3230	.009	3802	.008	2771	.023	2574	.029	3825	.011	2921	.009
S. Dakota	624	.022	621	.008	669	.005	478	.121	595	.075	310	.077
Tennessee	3898	.023	4416	.053	3671	.105	3910	.054	4886	.027	2874	.026
Texas	10961	.003	12971	.124	11768	.221	10265	.131	11171	.088	6323	.048
Utah	911	.008	899	.057	951	.086	829	.043	557	.025	306	.042
Vermont	349	.010	365	.095	418	.098	453	.050	564	.028	334	.047
Virginia	4638	.014	5376	.067	4786	.072	4912	.031	6113	.021	3857	.014
Virgin Islands	87	.022	109	.045	111	.027	134	.044	255	.047	197	.020
Washington	3956	.030	3968	.070	3671	.112	3378	.050	3721	.044	1591	.042
West Virginia	2078	.024	1817	.150	1723	.298	1550	.110	1633	.091	1061	.073
Wisconsin	3635	.014	2700	.036	3310	.064	3447	.053	4180	.035	1969	.037
Wyoming	279	.025	299	.053	232	.120	235	.106	257	.097	118	.084
Total #												
NPS Access.	169,433		179,842		180,109		178,887		216,859		122,397	
Total # of GED	3507		10,643		15,084		9,045		7,481		4,379	

APPENDIX A

TABLE VII

EDUCATIONAL GROUPS ASSOCIATED WITH SEX, RACE, AGE, MENTAL GROUP  
AND THE ACCESSION YEARS WITHIN THE ARMY

TOTAL # OF	Sex		Race		Age			Mental Group				
	Male	Female	Negro	Non-Negro	17	18&19	20+	I & II	III-A	III-B	IV	
												NHS
Acc. Years:												
1973	100	---	.22	.78	.40	.46	.14	.18	.23	.39	.20	
67,381												
1974	100	---	.29	.71	.31	.51	.18	.15	.24	.39	.22	
80,118												
1975	100	---	.23	.77	.31	.49	.20	.14	.28	.47	.11	
61,635												
1976	100	---	.21	.79	.36	.45	.19	.19	.23	.57	.01	
66,808												
1977	100	---	.25	.75	.39	.42	.19	.13	.20	.65	.02	
77,602												
1978	100	---	.28	.72	.23	.54	.22	.14	.31	.52	.02	
28,592												
GED												
1973	.76	.24	.18	.82	.12	.53	.35	.40	.30	.20	.10	
3,507												
1974	.81	.19	.17	.83	.29	.42	.29	.36	.26	.26	.12	
10,643												
1975	.86	.14	.14	.86	.31	.40	.29	.35	.28	.30	.08	
15,084												
1976	.84	.16	.19	.81	.15	.47	.38	.36	.23	.26	.15	
9,045												
1977	.77	.23	.22	.78	.14	.42	.44	.35	.23	.27	.15	
7,481												
1978	.86	.14	.21	.79	.12	.43	.45	.29	.29	.39	.02	
4,379												

## APPENDIX B

TABLE VIII

COMPUTER PROGRAM FOR THE PREDICTION OF LOSS RATES OF THE ARMY  
1977, NPS, MALE ACCESSIONS

1	RUN NAME	MULTIPLE REGRESSION ;
2	VARIABLE LIST	E1,E2,E3,M1,M2,M3,M4,A1,A2,A3,R1,R2,T1,Tw,T3,Tr,Y,N
3	INPUT MEDIUM	CARD
4	N of CASES	216
5	INPUT FORMAT	FIXED (16F1.0,F5.2,F5.0)
6	ALLOCATE	TRANSPACE = 5500
7	COMPUTE	AE11=A1*E1
8	COMPUTE	AE12=A1*E2
9	COMPUTE	AE13=A1*E3
10	COMPUTE	AE21=A2*E1
11	COMPUTE	AE22=A2*E2
12	COMPUTE	AE23=A2*E3
13	COMPUTE	AE31=A3*E1
14	COMPUTE	AE32=A3*E2
15	COMPUTE	AE33=A3*E3
16	COMPUTE	ME11=M1*E1
17	COMPUTE	ME12=M1*E2
18	COMPUTE	ME13=M1*E3
19	COMPUTE	ME21=M2*E1
20	COMPUTE	ME22=M2*E2
21	COMPUTE	ME23=M2*E3
22	COMPUTE	ME31=M3*E1
23	COMPUTE	ME32=M3*E2
24	COMPUTE	ME33=M3*E3
25	COMPUTE	ME41=M4*E1
26	COMPUTE	ME42=M4*E2
27	COMPUTE	ME43=M4*E3
28	COMPUTE	AM11=A1*M1
29	COMPUTE	AM12=A1*M2
30	COMPUTE	AM13=A1*M3
31	COMPUTE	AM14=A1*M4
32	COMPUTE	AM21=A2*M1
33	COMPUTE	AM22=A2*M2
34	COMPUTE	AM23=A2*M3
35	COMPUTE	AM24=A2*M4
36	COMPUTE	AM31=A3*M1
37	COMPUTE	AM32=A3*M2
38	COMPUTE	AM33=A3*M3
39	COMPUTE	AM34=A3*Mr
40	COMPUTE	AR11=A1*R1
41	COMPUTE	AR12=A1*R2
42	COMPUTE	AR21=A2*R1
43	COMPUTE	AR22=A2*R2
44	COMPUTE	AR31=A3*R1
45	COMPUTE	AR32=A3*R2
46	COMPUTE	ER11=E1*R1
47	COMPUTE	ER12=E1*R2

APPENDIX B

TABLE VIII  
(Continued)

48	COMPUTE	ER21=E2*R1
49	COMPUTE	ER22=E2*R2
50	COMPUTE	ER31=E3*R1
51	COMPUTE	ER32=E3*R2
52	COMPUTE	MR11=M1*R1
53	COMPUTE	MR12=M1*R2
54	COMPUTE	MR21=M2*R1
55	COMPUTE	MR22=M2*R2
56	COMPUTE	MR31=M3*R1
57	COMPUTE	MR32=M3*R2
58	COMPUTE	MR41=M4*R1
59	COMPUTE	MR42=M4*R2
60	VAR LABELS	Y RESPONSE VARIABLE/
61		E1 NGH
62		E2 GED
63		E3 HSDG
64		M1 AFQT 1&2
65		M2 AFQT 3-A
66		M3 AFQT 3-B
67		M4AFQT 4
68		A1 AGE 17
69		A2 AGE 18&19
70		A3 AGE 20+
71		R1 NEGRO
72		R2 NON-NEGRO
73		T1 1973 ACC.
74		T2 1974 ACC.
75		T3 1975 ACC.
76		T4 1976 ACC.
77	REGRESSION	VARIABLES =E1 TO MR42
78		REGRESSION=Y WITH E1, #2, #3, M1, M2, M3, M4, A1, A2, A3, R1, R2
79		AE11 to MR42(1) RESID=0
80	STATISTICS	1,2,6
81	READ INPUT DATA	

APPENDIX B

TABLE IX

PREDICTION OF ARMY THREE YEAR LOSS DATA USING INTERACTIVE  
VARIABLES (DATA ARE FROM 1974-1975 NPS ACCESSIONS)

SUM OF SQUARES	MEAN SQUARE	F
19524.00941	1774.90995	192.12263
1219.47171	9.23842	

VARIABLES IN THE EQUATION

<u>VARIABLE</u>	<u>B</u>	<u>BETA</u>	<u>STD ERROR B</u>	<u>F</u>
E1	22.58315	0.88699	0.70273	1032.741
E2	18.73523	0.73586	0.88461	448.556
AE12	7.833362	0.20511	0.98998	62.610
M1	-5.500838	-0.19846	0.93937	34.291
AE11	6.039926	0.15815	0.98998	37.223
M2	-3.353793	-0.12100	0.72111	21.631
R1	-3.807338	-0.15861	0.68591	30.811
MR11	4.410186	0.12152	1.16990	14.211
AM11	-4.111097	-0.09467	1.18234	12.090
AM32	2.517212	0.05797	1.10253	5.213
ER21	2.261460	0.07022	1.07462	4.429
(CONSTANT)	29.20637			

MULTIPLE R	0.97016	ANALYSIS OF VARIANCE	DF
R SQUARE	0.94121	REGRESSION	11.
ADJUSTED R SQUARE	0.93631	RESIDUAL	132.
STANDARD ERROR	3.03948		

APPENDIX B

TABLE X

PREDICTION OF ARMY THREE YEAR LOSS DATA USING INTERACTIVE VARIABLES (DATA ARE FROM 1974-1976 NPS ACCESSIONS)

VARIABLES IN THE EQUATION

VARIABLE	B	BETA	STD ERROR B	F
E1	22.34372	0.91418	0.95610	546.141
E2	19.09398	0.78122	1.10082	300.858
M1	-7.058958	-0.26529	1.02901	47.059
AE12	6.280727	0.17132	1.07707	33.381
R1	-4.597330	-0.19951	0.66862	47.277
AE11	5.086144	0.13873	1.08707	21.891
MR11	4.070987	0.11685	1.14040	12.743
M2	-2.546241	-0.09569	0.63000	16.335
A3	3.995470	0.16347	0.91874	18.913
AM11	-2.559573	-0.06140	1.16213	4.851
AE32	-4.269220	-0.11645	1.39334	9.388
ER21	2.459028	0.07954	1.04753	5.511
AE31	-3.010886	-0.08213	1.39334	4.670
ME41	-2.544670	-0.06104	1.05861	5.778
ME12	2.821241	0.06768	1.22268	5.327
(CONSTANT)	28.80770			
MULTIPLE R	0.95297		ANALYSIS OF VARIANCE	DF
R SQUARE	0.90816		REGRESSION	15
ADJUSTED R SQUARE	0.90127		RESIDUAL	200
SUM OF SQUARES		MEAN SQUARE		F
26040.41152		1736.02743		131.83952
2633.54635		13.16773		

DESCRIPTION OF THE VARIABLES:

E1=NHS	R1=NEGRO	A3= 20+	AE31=A3*E1
E2=GED	AE11=A1*E1	AM11=A1*M1	ME41=M4*E1
M1=I&II	MR11=M1*R1	AE32=A3*E2	ME12=M1*E2
AE12=A1*E2	M2=III-A	ER21=E2*R1	M4=IV
A1=17			



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