CNS 1100

LEVEL II

QUALITY OF MARINES: PRE-ENLISTMENT SCREENING BASED ON PREDICTED PERFORMANCE

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IN REPLY REFER TO

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From: Commandant of the Marine Corps
To: Distribution List

Subj: CNA Study CNS 1100: "Quality of Marines: Pre-Enlistment Screening Based on Predicted Performance"

Encl: Subject study

1. The enclosure is the final report of a study of the quality and performance of enlisted Marines. The study was conducted by the Marine Corps Operations Analysis Group of the Center for Naval Analyses in response to a request by the Deputy Chief of Staff for Manpower at Headquarters, Marine Corps.

2. The objective of the study was to develop a method of converting the information available about Marine Corps applicants into an estimate of the quality of service they will provide. Such estimates are required to achieve and maintain the improved manpower quality required in the all-volunteer environment.

3. The objective of the study has been met and it is approved for distribution. In particular, the study identified several variables highly correlated with attrition and desertion and validates the importance placed on a high school diploma in current enlistment standards.

4. A copy of this letter will be affixed inside the front cover of each copy of the subject study prior to its distribution.

W. H. FITCH
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SUMMARY

The objective of this study is to develop a method of screening applicants for enlistment into the Marine Corps that will result in improved manpower quality in the all-volunteer environment. Such a screening method must be based on the limited applicant information that is available to recruiters before the acceptance decision is made.

This study is based on data collected between July 1973 and June 1976. All regular Marines who began their service during FY 1974 (July 1973 through June 1974) were monitored through their first 24 months of service. The Marines in this sample are true volunteers, since they enlisted after the end of the military draft (December 1972).

Several measures of performance were analyzed in terms of the personal characteristics, aptitude test scores, and other data available on the sample of Marines, to determine how such information can be used to screen high quality applicants from others with less likelihood of performing well. The measures of performance examined included:

- Early promotion,
- Rank achieved,
- Desertion, and
- Early attrition.

The data found to be most highly correlated with these measures of performance included certain aptitude test scores, age at time of enlistment, and education. Since many of the same explanatory variables were found to be among the best predictors of several of the measures of performance examined (see tables 2 through 5), an aggregate measure--desertion combined with early attrition--was adopted for the analysis.

Education, age when entering the service, general classification test score (GCT), and classification inventory test score (CI) (see table 7) correlated most highly with the aggregate measure of manpower quality. The two test scores are from the test battery used before September 1976, but similar test scores are available in the Armed Services Vocational Aptitude Battery (ASVAB 6/7)--the all-service enlistment screening test now used. Correlations between the obsolete test scores and those from the ASVAB 6/7 were used to express the aggregate quality measure in terms of education, age, and the combat scale test score (CC) and mental group score from the ASVAB 6/7 (see appendix E).

Tables were developed that show the probability of successful service (i.e., service without desertion or early attrition), based on an applicant's age, educational level, CC score, and mental group score (see tables 8-11). The tables illustrate the relative importance of these dissimilar characteristics, and permit the comparison of, for instance, a high school graduate with low test scores and a nongraduate with high scores.

The method of selecting applicants that is recommended in this analysis gives recruiters more guidance than the present system, which gives only a single quota and the minimum standards for enlistment. The existing system provides no basis for devoting extra effort to searching for candidates whose chances of success are well above those of marginally qualified applicants. The method presented here recognizes the known differences in quality of service rendered by different enlistees. It provides this information in a form that can be used to help recruiters produce man-years of effective service rather than simply numbers of entering recruits.

I. INTRODUCTION

BACKGROUND

Prior to 1973, the military draft provided many recruits for the Army each year. Although a few draftees were assigned to the Marine Corps during the Vietnam War, the primary effect of the draft on the Marine Corps was to generate draft-motivated volunteers. Draft calls ended in December 1972, and the statutory authority for them expired on 1 July 1973.

When the draft ended, Marine Corps recruiting shortfalls began. In FY 1974, the Marine Corps enlisted 48,764 regular, male recruits. The quota was 57,800, and the shortfall of 9,036 amounted to almost 16 percent of the goal (reference 1). During FY 1975 and 1976, Marine Corps recruiting goals were achieved. However, monthly shortfalls in the published recruiting quota occurred from July 1976 through March 1977. The authorized end of year strength of the Marine Corps has been reduced from 196,000 to 191,500; the actual strength on 31 October 1977 was 192,069. Although scheduled and unscheduled discharges are currently below anticipated levels, the continuing shortfall in recruiting could become a problem affecting manpower planning and the future grade structure and promotion rates.

Several current trends will have an impact on future Marine Corps manpower requirements and supply. Technological advances in weaponry, communications, data processing, and other fields have brought more complex equipment into the Marine Corps inventory. Many of these items require operators, technicians, and repairmen who are more highly trained and more capable than the men they will replace. No doubt, this trend will continue to require relatively more recruits with higher mental aptitudes. As a result of fluctuations in the U.S. birthrate since 1950, the population of young men in the age group 17-21 will begin to decline after 1978. This population will decline from 10.7 million in 1978 to 9 million in 1990 (see reference 5). If a greater percentage of high school graduates attend college or trade school, the number actually available to the Marine Corps may decline even more. If Marine Corps manpower requirements remain fixed at current levels, and if the percentage of the eligible population entering the Marine Corps remains constant, the declining population will magnify the Marine Corps manpower shortfall in the years ahead.

These trends may lead the Marine Corps to more serious manpower shortfalls of both quantity and quality. The Marine Corps has responded by taking steps to: develop more attractive enlistment guarantees, improve recruiting efficiency, factor manpower requirements into the hardware design process, and improve retention.

While ea . of these efforts is required to help the Marine Corps adapt to the all-volunteer environment, their success depends in part on the selection of the best applicants for enlistment. If manpower supply exceeds requirements, then an effective screening procedure would admit those applicants whose chances of serving satisfactorily are high and exclude those whose chances are low. If manpower supply falls short of requirements, an orderly screening procedure could be even more important. It would allow the Marine Corps to decide at what point they should accept manpower shortages rather than men with lower chances of serving successfully. The point of minimum acceptable quality can and should be adjusted as conditions change.

OBJECTIVE AND APPROACH

The objective of this analysis is to develop a method of converting the information available about Marine Corps applicants into an estimate of the quality of service they will provide. Manpower quality will be measured by desertion, attrition, and promotion during the first two years of service. Attrition or desertion identify those men whose problems were so severe that they could or would not fit into the scheme of things in the Marine Corps. Promotion, which requires one to meet eligibility requirements and to be recommended by the commander, is assumed to be an indication of good quality service.

In order to identify the factors related to quality of service, many test scores, personal characteristics, and other data will be examined. This analysis will show which data are best for predicting quality of service, as well as the relative importance of different variables. The application of this analysis will show how the limited information available to recruiters can best be used to screen applicants for enlistment.

II. DATA AND METHODOLOGY

DATA

The data used in this analysis include most of the applicant information that is available to recruiters before an enlistment decision is made. (No attempt is made to consider the desirability of collecting new data for the recruiter's use; such considerations, while possibly useful, are beyond the scope of this analysis.) The variables are listed in table 1, and the means and standard deviations are shown in appendix A.

The data were collected from the records of the 49,540 regular, male, nonprior-service enlistees who reported for recruit training during FY 1974. These records were obtained from the Marine Corps Manpower Management System (MMS) and the Recruit Accession Management System (RAMS). Each man was tracked for 24 months, and his performance (in terms of promotion, early attrition, and desertion) was recorded. Incomplete records numbered 3,671 (or 7 percent).

Each FY-1974 enlistee was required to attain a mental group percentile score of 21 or more on the Armed Forces Qualification Test (AFQT). This range restriction in mental group can affect the results of the analysis by introducing bias into the coefficients. Thus, the data were corrected for range restriction, so they approximate the mobilization population. The procedure is described in appendix B.

The sa... vas selected for two reasons:

- All of the men in the sample enlisted into an all-volunteer environment and were therefore considered more representative of future enlistees than were earlier cohorts.
- They have been in the Marine Corps long enough to be evaluated on the basis of their performance in Fleet Marine Force (FMF) jobs.

It is assumed that actual job performance should be the fundamental and final criterion of manpower quality. The dependent variables used in this study are believed to be the best available measures of manpower quality. These measures are selected because they are ultimately determined by the officers and staff noncommissioned officers who supervise enlisted Marines and who are responsible for readiness. This analysis assumes that those Marines who are promoted early or who reach a higher rank during their first two years of service are somehow of higher quality than those who are not so recognized. Likewise, this analysis assumes that those Marines who desert or are discharged prior to serving two years are of lower quality. Although manpower quality cannot be defined, we assume that it is recognized by Marines and that it is reflected in favorable and unfavorable personnel actions.

TABLE 1

VARIABLES

Variable	Variable name	Values
Years of schooling	XA	8 if 8 years or less and no GED 9 if 9 years and no GED 10 if 10 years and no GED 11 if 11 years and no GED 11.5 if GED and no college or trade school 12 if diploma graduate and no college or trade school 13 if any college or trade school graduate
Age in years (25-age)	YA	8 if age < 17 upon regular enlistment 7 if age 18 upon regular enlistment 6 if age 19 upon regular enlistment 5 if age 20 upon regular enlistment 4 if age 21 or more upon regular enlistment
Age 17	A 17	0 if YA $\neq$ 8 1 if YA = 8
Age 18	A 18	0 if YA $\neq$ 7 1 if YA = 7
Age 19	A 19	0 if YA $\neq$ 6 1 if YA = 6
Age 20	A 20	0 if YA $\neq$ 5 1 if YA = 5

TABLE 1 (CONT'D)

Variable	Variable name	Values
Ninth grade education	HS 9	0 if XA $\neq$ 9 1 if XA = 9
Tenth grade education	HS 10	0 if XA $\neq$ 10 1 if XA = 10
Eleventh grade education	HS 11	0 if XA $\neq$ 11 1 if XA = 11
Diploma	HS 12	0 if XA $\neq$ 12 1 if XA = 12
GED	GED	0 if XA $\neq$ 11.5 1 if XA = 11.5
College training	Coll	0 if XA $\neq$ 13 1 if XA = 13
Race	Race	0 if non-white 1 if white
Marital status	Marit	0 if unmarried upon enlistment 1 if married upon enlistment
Age/education interaction (1)	Aged	(XA) (YA)
Age/education interaction (2)	Mix	(XA) (true age upon enlistment, in years)
General classification test	GCT	(AR+VE+PA) / 3
Too old	Age 21	0 if YA $<$ 5 1 if YA $\geq$ 4
Deserter	Des	0 if never deserted 1 if deserted once or more
Promotion	Prom	0 if promoted to E-2 after recruit training 1 if not promoted after recruit training
Rank	Rank	1 if grade E-1 after 2 months or discharge 2 if grade E-2 after 24 months or discharge 3 if grade E-3 after 24 months or discharge 4 if grade E-4 after 24 months or discharge 5 if grade E-5 after 24 months or discharge

TABLE 1 (CONT'D)

Variable	Variable name	Values
Verbal	VE	Army Classification Battery - 61 test scores range: 40-160
Arithmetic	AR	
Pattern analysis	PA	
Classification inventory	CI	
Mechanical aptitude	MA	
Army coding speed	ACS	
Army radio code	ARC	
General information	GIT	
Shop information	SM	
Automotive information	AI	
Electronics information	ELI	
Loss potential	VATTR	0 if Des = 0 and OVATTR = 0 1 if Des = 1 and/or OVATTR = 1
Early attrition	OVATTR	0 if serve 24 months active duty 1 if discharge prior to 24 months from enlistment
Quality index	QUAL	-1 if VATTR = 1 0 if VATTR = 0 and rank $\leq$ 4 +1 if rank = 5 and VATTR = 0

Measures of Effective Service

Both positive and negative measures of manpower quality are used in this analysis. The positive measures of quality are rank achieved and superior recruit training performance (as indicated by promotion at the end of recruit training). The negative measures are desertion and attrition from the Marine Corps during the first 24 months of service.

Explanatory Variables

The explanatory data consist of personal characteristics and aptitude test scores. Included among the personal characteristics are education, race, age, and marital status. The available test scores are from the Army Classification Battery (ACB-61). The men in this sample took the AFQT mental group test to determine their eligibility for enlistment. Upon arrival at a recruit training depot they took the ACB-61, which includes 11 subtests. The quality of their service (as indicated by several measures) will be analyzed in terms of the explanatory variables (see table 1).

METHODOLOGY

The method of analysis is multiple linear regression. A stepwise regression procedure is used to examine the explanatory power of the variables and to determine which linear combination of variables best predicts quality. The coefficients of correlation between each pair of variables, corrected for range restriction, are shown in appendix C. The linear function of the explanatory variables that best predicts quality of service is determined. This function is used to compute tables that show the probability of effective service for men with selected combinations of the test scores and other significant attributes. These probabilities can be used by the Marine Corps to screen applicants for enlistment. They can be easily adjusted by the Marine Corps when manpower policy, demand, or supply change.

Since the results of this analysis must be stated in terms of applicant test scores presently available, a procedure to scale the results from the ACB-61 scores to ASVAB 6/7 scores has been developed. This procedure is described in appendix E.

III. REGRESSION RESULTS

This analysis is designed to identify the mathematical relations between test scores and personal characteristics and each of several measures of manpower quality. Once known, these relations can be used to predict the various quality measures in terms of the available test scores and personal characteristics.

The results presented here are based on a forward step-wise regression procedure. This procedure considers all available variables and selects variables into the regression equation in the order of their joint value in predicting the dependent variable. The first variable shown (in the tables which follow) is the single best predictor of the dependent variable. The second variable is the single variable which adds the most predictive power to the regression equation after the first variable is considered. This procedure continues in steps as long as added variables are statistically significant. The cumulative R^2 values (the ratio of the regression sum of squares to the total sum of squares at each step) that are shown increase as more variables are added to the equation. The decision of where to cut off a regression equation is based on the significance of the variables, the increase in cumulative R^2 provided by each additional variable, and the operational usefulness of the variables. The standard error of the coefficients will be provided with these regression results.

The coefficients constitute the linear regression equation which best predicts the dependent variable. These coefficients should not be compared directly, since they are determined by variables measured in different units. In order to provide a measure of the relative importance of the variables in any regression equation, a model computed with normalized coefficients may be used. This model is:

$$\frac{Y_i - \bar{Y}}{S_y} = \sum_{i=1}^{n} \beta_i \frac{X_i - \bar{X}}{S_i} ,$$

where:

Y_i = dependent variable,

X_i = independent variables,

β_i = coefficients of the normalized independent variables, and

n = number of independent variables.

Since the variables are measured in normalized form, the beta coefficients of different (normalized) variables can be compared directly to determine the relative importance of (a unit of standard deviation of) each variable. The values of the beta coefficients are provided with the regression results.

MEASURES OF QUALITY

Desertion

Desertion is a widely accepted indicator of manpower quality used for inter-unit and inter-service comparisons. Of the 45,869 men in our sample with complete records, 12 percent deserted, although some were returned to duty. Table 2 shows the results of a regression of the available measured variables on desertion.

The single variable which best predicts desertion is high school diploma. The negative coefficient indicates that diploma high school graduates are less likely to desert than are Marines in the other educational categories. The coefficient value of -.1075 indicates that when all other variables (test scores, race, etc.) are held constant, the probability that a diploma high school graduate will desert is .1075 less than the probability that a nongraduate will desert. (See table 1 for definitions of variables.)

Once education is known, the arithmetic reasoning test score (AR) is the next best predictor of desertion. The negative sign of the coefficient indicates that men with higher AR scores are slightly less likely to desert. Other significant predictors of desertion are verbal (VE) and pattern analysis (PA). Alternative regressions with different variables used to measure age, education, and test scores are shown in tables F-1 and F-2 of appendix F.

Early Attrition

Another quality variable used in this analysis is early attrition during the first 24 months of service. Table 3 shows the regression results for early attrition. Again, high school education is the single best predictor. The second variable is classification inventory (CI), a psychological test of interests thought to be related to military service. The third variable is pattern analysis (PA), which is a non-verbal test of reasoning ability forming a part of the score that defines mental group. Men enlisting at age 21 or more are poorer risks. An alternative regression based on multi-valued age and education variables is shown in table F-3.

Rank Achieved

A positive measure of manpower quality is the rank achieved within 24 months of enlistment in the regular Marine Corps. The men in this sample ranged in rank from E1 (private) to E5 (sergeant). A regression of rank (1 through 5) on test scores and

TABLE 2

REGRESSION RESULTS: DESERTION

Explanatory variable[a]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Diploma	-.1075	.0030	-.1631	.034
Arithmetic	-.0006	.0001	-.0349	.038
Verbal	-.0006	.0001	-.0379	.039
Pattern analysis	-.0004	.0001	-.0209	.040
(Constant)	+.3185			

F = 512

[a]These variables were considered but not selected by the step-wise regression: marital status, age, race, CI, MA, ACS, ARC, GIT, SM, AI, and ELI.

TABLE 3

REGRESSION RESULTS: EARLY ATTRITION[a]

Explanatory variable[b]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Diploma	-.1547	.0041	-.1672	.041
Classification inventory	-.0024	.0001	-.1354	.068
Pattern analysis	-.0023	.0001	-.0959	.077
Too old	+.0856	.0067	+.0551	.080
(Constant)	+.8127			

$F = 1,077$

[a]Early attrition is attrition from the Marine Corps within the first 24 months of service and prior to completion of the contracted term of enlistment.

[b]These variables were considered but not selected by the step-wise regression: race, marital status, VE, AR, MA, ACS, ARC, GIT, SM, AI, and ELI.

personal characteristics is shown in table 4. A high school diploma proved to be the single best predictor of rank achieved. Test scores that are significant predictors of rank achieved include AR, CI, and PA. The alternative regression shown in table F-4 is based on multi-valued variables measuring age and education.

Superior Recruit Training Performance

The first opportunity a young recruit has to excel is during recruit training. Approximately 15 percent of the Marines in each recruit training class are selected for promotion to grade E2 at the end of their training. We have correlated this measure of quality with the test scores and other available data. Table 5 shows the results. Again, a high school diploma is one of the significant variables. Important ACB-61 test scores include CI, ARC, PA, ACS, and AR. In this regression, race is a significant predictor of the quality measure. Nonwhites are slightly more likely to achieve a higher rank when education and certain test scores are held constant. Table F-5 shows a similar regression with age and education measured differently.

AGGREGATE QUALITY MEASURE

Analysis of both positive and negative measures of manpower quality identifies some of the same variables as predictors of manpower quality. The high school diploma and PA score are identified as predictors of each of the four selected quality measures (tables 2, 3, 4, and 5) examined in the analysis. CI and AR were selected as significant predictors of three of these quality measures. Age is an important predictor of early attrition when education and certain test scores are considered. Since a single measure must be selected for enlistment screening, it is fortunate that some of the same explanatory variables are correlated with both positive and negative measures of performance. In this section, two aggregate quality measures will be defined.

The first quality measure incorporates both postive and negative quality indicators, and the other uses only negative indicators. The positive-negative measure, called quality index, takes a value of -1 for men who desert or are discharged during the first 24 months of service, a value of 0 for men who serve the 24 months without reaching grade E-5, and a value of +1 for men who serve satisfactorily and reach grade E-5 (see table 1). The other aggregate measure is called loss potential. This measure is valued at 0 for men who either desert or are discharged before completing 24 months of service and at 1 for other men (see table 1).

The regression results of each aggregate variable on the data are similar. The quality index variable, as a three-valued dummy variable, is based on an implicit assumption that the difference between the characteristics valued at -1 and 0 is the same as the difference between characteristics valued at 0 and +1. While this implicit

TABLE 4

REGRESSION RESULTS: RANK ACHIEVED

Explanatory variable[a]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Diploma	+.5825	.0099	+.2509	.096
Arithmetic	+.0067	.0003	+.1111	.138
Classification inventory	+.0049	.0002	+.1122	.151
Pattern analysis	+.0058	.0003	+.0983	.157
(Constant)	+.5824			

F = 2,312

[a] These variables were considered but not selected by the step-wise regression: race, age, marital status, VE, MA, ACS, ARC, GIT, SM, ELI, and AI.

TABLE 5

REGRESSION RESULTS:
SUPERIOR RECRUIT TRAINING PERFORMANCE[a]

Explanatory variable[b]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Classification inventory	+.0015	.0001	+.1085	.034
Army radio code	+.0013	.0001	+.0874	.049
Diploma	+.0477	.0033	+.0659	.055
Pattern analysis	+.0009	.0001	+.0470	.058
Race	+.0348	.0029	+.0558	.060
Army coding speed	+.0008	.0001	+.0434	.062
Arithmetic	+.0006	.0001	+.0343	.063
(Constant)	-.3577			

$F = 474$

[a]Superior performance as recognized by promotion to grade E-2 upon completion of recruit training.

[b]These variables were considered but not selected by the step-wise regression: marital status, age, VE, MA, GIT, SM, AI, and ELI.

assumption might be plausible, other plausible assumptions (such as values of -1.5, 0, +.3) would yield different results. The regression results of quality index on the independent variables are shown in table F-6.

Table 6 shows the regression of loss potential on the data. It does not appear to suffer from the exclusion of a positive indicator, and the results are consistent with the results shown in tables 2-5. High school diploma remains the single most useful predictor variable and explains more than half of the variance in loss potential (combined attrition and desertion) that can be explained by the available data (5.6 of the possible 9.5 percent). The PA, CI, AR, GIT, and age variables are also important predictors. (The CI score has never been used by the Marine Corps for enlistment screening but is used with other variables in assigning men to the infantry field.)

Three of the ACB-61 aptitude tests are PA, AR, and VE. These variables determine the GCT composite score and are analogous to the three components of the traditional mental group score of both the AFQT and ASVAB 6/7. Since mental group is widely used by the military services in enlisting and classifying men, it is desirable to know if GCT could replace other test scores in a regression of quality without a loss of predictive power. The results of such a regression are shown in table 7. The four variables considered were education, age, CI score, and GCT (PA+AR+VE)/3 . This equation explains approximately as much of the variance in the quality measure ($R^2 = 0.093$) as do the first four variables in table 6, and it offers the advantage of a link to mental group score. The remainder of this analysis will be based on the regression equation of table 7, which is shown here:

$$\text{Loss potential} = -.1826\ (\text{diploma}) - .0034\ (\text{GCT}) - .0018\ (\text{CI})$$
$$+ .0829\ (\text{age}) + .9179\ .$$

The regression equation predicting loss potential as a function of education, age, and certain test scores can be used to estimate the relative probability that recruits with different values of these variables will become losses to the Marine Corps within 24 months. The standard error of the individual predictions is .45. The standard error of the mean for a group of 500 applicants with the same scores, age, and education is .02.

Scaling to the ASVAB 6/7 Test Scores

The regression reported in table 7 provided a prediction equation in terms of education, age, and two ACB-61 test scores, CI and GCT.

This equation can be expressed in terms of education, age, and the two ASVAB 6/7 tests analogous to CI and GCT, which are combat scale (CC), a personality test, and mental group (MG) (see appendix E):

TABLE 6

REGRESSION RESULTS: LOSS POTENTIAL

Explanatory variable[a]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Diploma	-.1819	.0042	-.1898	.056
Classification inventory	-.0017	.0001	-.0952	.080
Pattern analysis	-.0016	.0001	-.0668	.089
Too old	+.0823	.0069	+.0512	.092
General information	-.0012	.0002	-.0459	.094
Arithmetic	-.0012	.0001	-.0462	.095
(Constant)	+.9588			

F = 869

[a] These variables were considered but not selected by the step-wise regression: marital status, race, VE, MA, ACS, ARC, SM, AI, and EL1.

TABLE 7

REGRESSION RESULTS: LOSS POTENTIAL WITH SELECTED VARIABLES

Explanatory variable	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Diploma	-.1826	.0042	-.1906	.056
General classification test	-.0034	.0002	-.1183	.083
Classification inventory	-.0018	.0001	-.1004	.090
Too old	+.0829	.0069	+.0515	.093
(Constant)	+.9179			

F = 1,263

$$\text{Loss potential} = -\ .1826\ (\text{diploma}) - .0038\ (\text{MG}) - .0063\ (\text{CC}) + .0829\ (\text{age}) + .6616\ . \qquad (1)$$

In order to convert the measure to a positive one, we define success potential as:

$$\text{Success potential} = 1 - \text{loss potential}.$$

Therefore:

$$\text{Success potential} = +\ .1826\ (\text{diploma}) + .0038\ (\text{MG}) + 0063\ (\text{CC}) - .0829\ (\text{age}) + .3384\ . \qquad (2)$$

The usefulness of this measure is not to predict quality of service of a particular individual, but to provide a method for screening or ranking groups of applicants according to their likelihood of success in the Marine Corps.

IV. APPLICATION OF RESULTS

The regression results in terms of the ASVAB 6/7 tests (equation 2) have been used to compute tables of succe s potentials. The success potential is a predicted success rate for applicants with similar characteristics. Tables 8-11 show the success potentials for groups of applicants defined by education, test scores, and age. (The analysis should be updated when the Marines who actually took the ASVAB have served longer in the Fleet Marine Force. The resulting analysis can then predict manpower effectiveness directly in terms of the variables available prior to enlistment.)

The use of these results for enlistment screening will contribute to Marine Corps efforts to reduce early attrition and disciplinary problems and will orient the recruiting establishment toward a few more good men.

TABLE 8

SUCCESS POTENTIAL: DIPLOMA GRADUATE, AGE 17-20[a]
(Probability of successfully serving 24 months)

Combat scale (CC)		ASVAB mental group (percentile score)					
Raw	(Percentile)	I (95)	II (80)	II (65)	IIIA (50)	IIIB (35)	IV (20)
21	98	.99[a]	.96	.90	.84	.79	.73
19	90	.99[a]	.94	.89	.83	.77	.71
17	74	.99	.93	.88	.82	.76	.70
15	54	.98	.92	.86	.81	.75	.69
13	36	.96	.91	.85	.79	.74	.68
11	22	.95	.89	.84	.78	.72	.67
9	13	.94	.88	.82	.77	.71	.65

Success potential = +.0038 (MG) +.0063 (CC) +.5210

[a]Success potential constrained to $\leq$ .99.

TABLE 9

SUCCESS POTENTIAL: DIPLOMA GRADUATE, AGE 21 OR MORE
(Probability of successfully serving 24 months)

Combat scale (CC)		ASVAB mental group (percentile score)					
Raw	(Percentile)	I (95)	II (80)	II (65)	IIIA (50)	IIIB (35)	IV (20)
21	98	.93	.87	.82	.76	.70	.65
19	90	.92	.86	.80	.75	.69	.63
17	74	.91	.85	.79	.74	.68	.62
15	54	.89	.84	.78	.72	.67	.61
13	36	.88	.82	.77	.71	.65	.60
11	22	.87	.81	.75	.70	.64	.58
9	13	.86	.80	.74	.68	.63	.57

Success potential = +.0038 (MG) +.0063 (CC) +.4381

TABLE 10

SUCCESS POTENTIAL: NONGRADUATE, AGE 17-20
(Probability of successfully serving 24 months)

Combat scale (CC)		ASVAB mental group (percentile score)					
Raw	(Percentile)	I (95)	II (80)	II (65)	IIIA (50)	IIIB (35)	IV (20)
21	98	.83	.77	.72	.66	.60	.55
19	90	.82	.76	.71	.65	.59	.53
17	74	.81	.75	.69	.64	.58	.52
15	54	.79	.74	.68	.62	.57	.51
13	36	.78	.72	.67	.61	.55	.50
11	22	.77	.71	.65	.60	.54	.48
9	13	.76	.70	.64	.59	.53	.47

Success potential = +.0038 (MG) +.0063 (CC) +.3384

TABLE 11

SUCCESS POTENTIAL: NONGRADUATE, AGE 21 OR MORE
(Probability of successfully serving 24 months)

Combat scale (CC)		ASVAB mental group (percentile score)					
Raw	(Percentile)	I (95)	II (80)	II (65)	IIIA (50)	IIIB (35)	IV (20)
21	98	.75	.69	.63	.58	.52	.46
19	90	.74	.68	.62	.57	.51	.45
17	74	.72	.67	.61	.55	.50	.44
15	54	.71	.65	.60	.54	.48	.43
13	36	.70	.64	.58	.53	.47	.41
11	22	.69	.63	.57	.51	.46	.40
9	13	.67	.62	.56	.50	.45	.39

Success potential = +.0038 (MG) +.0063 (CC) +.2555

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5. U.S. Department of Commerce, Bureau of the Census, Current Population Reports, Population Estimates and Projections, Series P-25, No. 601, Oct 1975

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APPENDIX A

MEANS AND STANDARD DEVIATIONS

TABLE A-1

MEANS AND STANDARD VARIATIONS OF VARIABLES[a]

Variable name	Mean	Standard deviation
XA	11.0658	1.1579
YA	6.5592	1.6760
A17	0.3082	0.4618
A18	0.3499	0.4769
A19	0.1714	0.3768
A20	0.0751	0.2636
HS9	0.0807	0.2724
HS10	0.1995	0.3997
HS11	0.1936	0.3951
HS12	0.4199	0.4935
GED	0.0434	0.2038
COLL	0.0348	0.1832
RACE	0.2717	0.5731
MARIT	0.0709	0.2646
AGED	72.1125	18.5842
MIX	204.5324	31.6990
GCT	98.9688	16.3692
AGE21	0.0955	0.2939
DES	0.1201	0.3251
PROM	0.1504	0.3575
RANK	2.5255	1.1457
VE	98.5996	19.8762
AR	93.8874	19.0646
PA	104.4193	19.4831
CI	95.1595	26.1481
MA	98.0186	17.4210
ACS	96.8649	16.4364
ARC	82.5095	24.3791
GIT	92.0904	17.9197
SM	95.4085	16.9044
AI	98.5338	17.4032
ELI	91.4469	21.8102
VATTR	0.3380	0.4730
OVATTR	0.2963	0.4566
QUAL	-0.3228	0.4990

[a]Variables weighted to approximate the mobilization population by GCT (see appendix B).

APPENDIX B

CORRECTION FOR RANGE RESTRICTION

APPENDIX B

CORRECTION FOR RANGE RESTRICTION

In FY 1974, all Marine Corps enlistees were required to pass the AFQT mental group test with a percentile score of 21 or more. Those scoring lower than 21 were excluded from enlistment and are, therefore, not in the 45,000-man sample. Since mental group or GCT is an important variable in explaining attrition and performance, it is prudent to correct the data foı this restriction in the range of mental group.

In recent years, the Marine Corps has enjoyed the benefits of double testing enlistees. Applicants were given the AFQT test prior to enlistment, and successful applicants were then given the ACB-61 test upon arrival at recruit training. The AFQT score, composed of verbal, arithmetic, and pattern analysis components, defines mental group. The ACB-61 test includes three analogous subtests: word knowledge, arithmetic, and spatial perception, which together form the GCT score.

During FY 1974, an apparent discrepancy between AFQT mental group scores and the subsequent ACB-61 scores of enlistees developed. It appears that a sizeable number of FY-1974 enlistees obtained higher AFQT mental group scores than would be expected based on their ACB-61 scores. The ACB-61 test, administered at the recruit depots under controlled conditions, is thought to be a better measure of the verbal, arithmetic, and spatial perception aptitudes of the men in the sample. Therefore, the correction for range restriction is applied based on GCT score.

Reference 2 provides an estimate of the GCT distribution of the mobilization population. This GCT distribution was compared with the actual GCT distribution of the 45,000-man sample, and weights were computed for each of seven segments of the GCT range. The weights were then applied to each man in the sample to produce the table of correlation coefficients shown as appendix C. These coefficients were used to conduct the regression analysis of this study. Table B-1 shows the relevant GCT distribution and the derived weights.

TABLE B-1

GCT DISTRIBUTIONS AND WEIGHTS

GCT range	Mobilization population distribution	FY 1974 Marine Corps distribution	Weight (2)÷(3)
(1)	(2)	(3)	(4)
130-160	6.924%	2.320%	2.984
110-129	29.954	24.832	1.206
100-109	18.394	23.343	.788
90-99	16.734	21.664	.772
80-89	12.801	15.126	.846
65-79	12.921	10.613	1.217
1-64	2.273	2.104	1.080
Total	100.0	100.0	-

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Total	100.0	100.0	-

APPENDIX C

TABLE OF CORRELATION COEFFICIENTS (WEIGHTED TO THE MOBILIZATION POPULATION)

TABLE C-1

CORRELATION COEFFICIENTS

A VALUE OF 99.00000 IS PRINTED
IF A COEFFICIENT CANNOT BE COMPUTED.

	XA	YA	A17	A18	A19	A20	HS9	HS10	HS11	HS12	GEO	COLL
XA	1.00000	-0.24206	-0.35187	0.10420	0.14659	0.09943	-0.52853	-0.45956	-0.02784	0.68636	0.07990	0.316 5
YA	-0.24206	1.00000	0.57447	0.19296	-0.15172	-0.26510	0.10229	0.15945	0.04950	-0.12269	-0.03569	-0.245 2
A17	-0.35187	0.57447	1.00000	-0.46954	-0.30353	-0.19020	0.17082	0.24927	0.01734	-0.29825	0.03453	-0.119 9
A18	0.10420	0.19295	-0.49964	1.00000	-0.33359	-0.20904	-0.07047	-0.08376	0.03589	0.14921	-0.04325	-0.165 4
A19	0.14659	-0.15172	-0.30353	-0.33359	1.00000	-0.12959	-0.06143	-0.10936	-0.02265	0.14300	-0.02479	0.039 4
A20	0.09943	-0.26510	-0.19020	-0.20904	-0.12959	1.00000	-0.04190	-0.06197	-0.02134	0.05507	-0.00187	0.102 5
HS9	-0.52853	0.10229	0.17082	-0.07047	-0.06143	-0.04190	1.00000	-0.14792	-0.14516	-0.25204	-0.06312	-0.055 1
HS10	-0.45956	0.15945	0.24927	-0.08376	-0.10936	-0.06197	-0.14792	1.00000	-0.24464	-0.42476	-0.10638	-0.094 4
HS11	-0.02784	0.04950	0.01734	0.03599	-0.02265	-0.02134	-0.14516	-0.24464	1.00000	-0.41684	-0.10440	-0.052 7
HS12	0.68636	-0.12269	-0.29825	0.14921	0.14300	0.05507	-0.25204	-0.42476	-0.41684	1.00000	-0.18127	-0.161 2
GEO	0.07990	-0.03509	0.03653	-0.04305	-0.02479	-0.00187	-0.06312	-0.10638	-0.10440	-0.18127	1.00000	-0.043 3
COLL	0.31695	-0.24832	-0.11969	-0.16874	0.03944	0.10265	-0.05621	-0.09474	-0.09277	-0.16142	-0.04043	1.000 0
WAGE	0.23834	-0.12932	-0.09064	-0.02675	0.03022	0.05225	-0.03277	-0.61703	0.04913	0.00741	-0.02562	0.013 8
MA-IT	-0.31709	-0.25365	-0.11954	-0.07559	0.01857	0.06966	0.01017	-0.03563	0.00063	-0.03443	0.03262	0.025 1
AGE0	0.16596	0.91062	0.41472	0.25655	-0.08511	-0.22638	-0.12550	-0.03140	0.05041	0.16924	0.00165	-0.155 0
MIX	0.81594	-0.75487	-0.56448	-3.06526	0.18377	0.22352	-0.40910	-0.40120	-0.05498	0.52759	0.07200	0.381 7
SCT	0.33424	0.00768	-0.04239	0.06044	0.00252	-0.01558	-0.14384	-0.10175	-0.08207	0.25163	0.02895	0.170 2
AGE21	0.10665	-0.78354	-0.21684	-0.23832	-0.14774	-0.09258	-0.03768	-0.05992	-0.03732	-0.09625	0.04908	0.221 1
DES	-0.20579	0.06907	0.03578	-0.04417	-0.05966	-0.02206	0.10037	0.11057	0.04068	-0.16582	0.00849	-0.047 9
PROM	0.11277	-0.01871	-0.06446	0.03039	0.01031	0.02035	-0.05970	-0.07363	-0.07938	0.12083	-0.01453	0.039 9
RANK	0.31593	-0.01395	-0.12525	0.08568	0.05747	0.02273	-0.13119	-0.17024	-0.09734	0.30920	-0.05026	0.092 2
VE	0.34095	-0.02516	-0.05562	0.06937	0.00434	-0.00577	-0.14420	-0.19924	-0.07309	0.24478	0.03576	0.175 6
AR	0.31018	-0.01195	-0.09145	0.05471	-0.00000	-0.00672	-0.13176	-0.15564	-0.08331	0.23425	0.02062	0.162 2
PA	0.20121	0.05683	0.00024	0.04843	0.00217	-0.02580	-0.08651	-0.10298	-0.05135	0.15544	0.01611	0.088 6
CI	0.23760	-0.03316	-0.04779	0.02935	0.00729	0.00179	-0.10829	-0.12252	-0.02419	0.15211	0.03346	0.113 4
MA	0.22133	0.02438	-0.01730	0.04918	-0.00207	-0.02170	-0.09202	-0.12587	-0.05704	0.17844	0.01655	0.091 7
ACS	0.24792	0.03416	-0.01778	0.05149	0.00104	-0.01707	-0.13769	-0.12900	-0.05442	0.13425	0.03590	0.105 1
ARC	0.21112	0.01315	-0.03420	0.05152	0.00315	-0.01130	-0.03817	-0.10452	-0.04232	0.16344	-0.00006	0.093 5
SIT	0.29450	-0.05189	-0.07030	0.04952	0.00336	0.00014	-0.12336	-0.17304	-0.06047	0.22069	0.03456	0.135 4
SM	0.23541	0.03398	-0.03380	0.05231	-0.00151	-0.01729	-0.10260	-0.13405	-0.05497	0.19051	0.02336	0.067 3
AI	0.16338	-0.04931	-0.06315	0.02509	0.01865	0.01038	-0.07426	-0.10366	-0.02875	0.13244	0.02606	0.053 5
ELI	0.16655	-0.02760	-0.03999	0.02560	0.00852	-0.00247	-0.06903	-0.07965	-0.04204	0.12708	0.01972	0.083 1
VAITR	-0.24789	-0.01998	0.07545	-0.07617	-0.01603	0.00151	0.11340	0.13276	0.05467	-0.23591	0.02142	-0.041 6
QVATTR	-0.21588	-0.03354	0.05668	-0.07558	-0.02850	0.00438	0.01982	0.11253	0.04421	-0.20500	0.01798	-0.034 9
QUAL	0.25734	0.01512	-0.08040	0.09019	0.03457	-0.00033	-0.11540	-0.13846	-0.06045	0.24350	-0.02465	0.053 8

TABLE C-1 (CONT'D)

	RACE	MARIT	AGED	MIX	GCT	AGE21	DES	PROM	RANK	VE	AR	PA
XA	0.03834	-0.01709	0.16596	0.81594	0.33524	0.10664	-0.20579	0.13277	0.31593	0.34095	0.31018	0.201 1
VA	-0.12932	-0.25366	0.91052	-0.75487	0.00768	-0.78354	0.04907	-0.01871	-0.01395	-0.07526	-0.01195	0.055 3
A17	-0.09054	-0.11954	0.41472	-0.56448	-0.04239	-0.21684	0.09578	-0.06446	-0.12525	-0.05562	-0.05145	0.003 4
A18	-0.02675	-0.07368	0.25656	-0.05525	0.[illegible]344	-0.23832	-0.04417	0.03000	0.08648	0.04937	0.05471	0.048 3
A19	0.03022	0.01867	-0.08511	0.18377	0.00252	-0.14774	-0.03966	0.03091	0.05747	0.00434	-0.00000	0.002 7
A20	0.05225	0.06866	-0.22638	0.22352	-0.01558	-0.09258	-0.02206	0.02035	0.02273	-0.00577	-0.00672	-0.025 0
HS9	-0.03277	0.01012	-0.12550	-0.40910	-0.14384	-0.03768	0.10037	-0.05970	-0.13119	-0.14420	-0.13176	-0.085 1
HS10	-0.01703	-0.00563	-0.03140	-0.40128	-0.18175	-0.05992	0.11057	-0.07363	-0.17024	-0.18924	-0.16564	-0.102 8
HS11	0.04[illegible]13	0.00063	0.05041	-0.05498	-0.08237	-0.03732	0.04068	-0.02908	-0.09734	-0.07309	-0.08301	-0.051 5
HS12	0.00741	-0.03443	0.16924	0.52759	0.25169	-0.00625	-0.18382	0.12083	0.30928	0.24478	0.23425	0.155 4
GED	-0.02562	0.03262	0.00165	0.07200	0.02895	0.04908	0.00849	-0.01453	-0.05926	0.03576	0.02062	0.015 1
COLL	0.01348	0.02831	-0.15660	0.38137	0.17022	0.22191	-0.04959	0.03839	0.09252	0.17826	0.16222	0.065 6
RACE	1.00000	-0.01052	-0.11558	0.10277	-0.31320	0.10023	0.01843	-0.00673	-0.07527	-0.28338	-0.26368	-0.242 1
MARIT	-0.01[illegible]	1.00000	-0.25943	0.13650	-0.02091	0.22189	0.02263	0.00453	-0.01653	-0.02780	-0.01486	-0.009 0
AGED	-0.11558	-0.25943	1.00000	-0.43471	0.14343	-0.75587	-0.03784	0.03746	0.11923	0.11092	0.11315	0.137 4
MIX	0.10277	0.13650	-0.43471	1.00000	0.22481	0.54053	-0.16575	0.09329	0.21861	0.24634	0.21693	0.103 5
GCT	-0.31320	-0.02091	0.14343	0.22491	1.00000	-0.02086	-0.12026	0.19110	0.30055	0.84542	0.86956	0.807 7
AGE21	0.10023	0.22189	-0.75587	0.54053	-0.02086	1.00000	-0.00818	-0.00530	-0.03762	0.00689	-0.00192	-0.057 4
DES	0.01643	0.02263	-0.03784	-0.16575	-0.12026	-0.00818	1.00000	-0.03984	-0.35559	-0.11029	-0.10910	-0.083 6
PROM	-0.00673	0.00453	0.03746	0.09929	0.19110	-0.00530	-0.03984	1.00000	0.24374	0.16109	0.16684	0.154 7
RANK	-0.07527	-0.01653	0.11923	0.21861	0.30055	-0.03762	-0.35559	0.24374	1.00000	0.24768	0.27208	0.239 3
VE	-0.28338	-0.02780	0.11092	0.24634	0.84542	0.00689	-0.11029	0.16109	0.24768	1.00000	0.64462	0.483 4
AR	-0.26388	-0.01486	0.11315	0.21693	0.86956	-0.00192	-0.10910	0.16684	0.27238	0.64402	1.00000	0.555 2
PA	-0.24211	-0.00980	0.13764	0.10305	0.80717	-0.05774	-0.08386	0.15407	0.23863	0.48054	0.55622	1.000 0
CI	-0.17500	0.00312	0.06233	0.18044	0.51053	0.01714	-0.07321	0.18308	0.23203	0.51020	0.42339	0.352 2
MA	-0.29224	-0.00593	0.11510	0.13464	0.62191	-0.03051	-0.07300	0.15269	0.21312	0.55765	0.51725	0.492 0
ACS	-0.20528	-0.00749	0.13452	0.14755	0.55041	-0.04166	-0.06878	0.16338	0.23651	0.41988	0.51073	0.459 1
ARC	-0.16791	-0.00697	0.09957	0.13442	0.48416	-0.02378	-0.05332	0.17474	0.18626	0.41024	0.43059	0.383 0
GIT	-0.33308	-0.00038	0.06810	0.22902	0.57944	0.02566	-0.10118	0.14955	0.25086	0.68362	0.56112	0.465 7
SM	-0.31006	0.00[illegible]91	0.10020	0.15624	0.52012	-0.01386	-0.07500	0.13871	0.22395	0.57258	0.50266	0.487 0
AI	-0.31856	0.05131	0.01848	0.13837	0.49178	0.02529	-0.05406	0.10296	0.17594	0.43498	0.39562	0.408 6
ELI	-0.23694	0.00989	0.03947	0.12896	0.53460	0.01259	-0.06413	0.09529	0.16776	0.47906	0.42040	0.447 2
VATTR	0.04164	0.03644	-0.12457	-0.15336	-0.21859	0.05348	0.51701	-0.13028	-0.66250	-0.17774	-0.19395	-0.173 5
OVATTR	0.03743	0.03588	-0.12425	-0.12431	-0.20613	0.05938	0.28847	-0.12794	-0.61329	-0.16569	-0.18172	-0.172 1
QUAL	-0.04438	-0.03379	0.12335	0.16269	0.23211	-0.04914	-0.50136	0.14296	0.64391	0.18991	0.20712	0.189 2

TABLE C-1 (CONT'D)

	CI	MA	ACS	ARC	GIT	SM	AI	ELI	VATTR	OVATTR	QUAL
XA	0.23760	0.22133	0.24792	0.21112	0.29450	0.23541	0.15338	0.16655	-0.24789	-0.21588	0.25734
YA	-0.03316	0.02498	0.03416	0.01315	-0.05188	0.00398	-0.04931	-0.02760	-0.01998	-0.03354	0.01512
A17	-0.04779	-0.01730	-0.01778	-0.03420	-0.07030	-0.03380	-0.06315	-0.03999	0.07545	0.05668	-0.08040
A18	0.02896	0.04918	0.05149	0.05152	0.04352	0.05201	0.02509	0.02560	-0.07837	-0.07358	0.08099
A19	0.00729	-0.00207	0.00104	0.00315	0.00336	-0.00151	0.01865	0.00852	-0.03603	-0.02850	0.03457
A20	0.00179	-0.02170	-0.01707	-0.01130	0.00014	-0.01729	0.01038	-0.00247	0.00151	0.00838	-0.00033
HS9	-0.10829	-0.09202	-0.10769	-0.09817	-0.12336	-0.10260	-0.07426	-0.05903	0.11340	0.09382	-0.11540
HS10	-0.12252	-0.12587	-0.12900	-0.10852	-0.17304	-0.13405	-0.10366	-0.09965	0.13278	0.11253	-0.13846
HS11	-0.02419	-0.05704	-0.05442	-0.04232	-0.06042	-0.05497	-0.02875	-0.04204	0.05467	0.04421	-0.06045
HS12	0.15211	0.17844	0.19425	0.16344	0.22069	0.19051	0.13244	0.12708	-0.23591	-0.20300	0.24350
G[illegible]	0.03046	0.01655	0.00590	-0.00036	0.03456	0.02336	0.02606	0.01972	0.02142	0.01798	-0.02465
COLL	0.11924	0.09337	0.10521	0.09335	0.13564	0.08743	0.05055	0.08321	-0.04196	-0.03449	0.05368
RACE	-0.17500	-0.29224	-0.20528	-0.16791	-0.33308	-0.31006	-0.31856	-0.23694	0.04164	0.03743	-0.04438
MARIT	0.00312	-0.00593	-0.00749	-0.00697	-0.00038	0.00191	0.05131	0.00989	0.03644	0.03588	-0.03373
AGED	0.06233	0.11510	0.13452	0.09957	0.06810	0.10020	0.01848	0.03947	-0.12457	-0.12425	0.12335
MIX	0.15044	0.13464	0.14755	0.13442	0.22902	0.15624	0.13837	0.12896	-0.15336	-0.12431	0.16269
GCT	0.51053	0.62191	0.55041	0.46416	0.67944	0.62012	0.44178	0.53460	-0.21859	-0.20613	0.23211
AGE21	0.01714	-0.03051	-0.04166	-0.02378	0.02566	-0.01386	0.02529	0.01259	0.05348	0.05938	-0.04914
DES	-0.07321	-0.07300	-0.06878	-0.05332	-0.10118	-0.07500	-0.05406	-0.06413	0.51731	0.28847	-0.50136
PROM	0.18308	0.15269	0.16338	0.17474	0.14355	0.13871	0.10296	0.03529	-0.13028	-0.12794	0.14296
RANK	0.23203	0.21312	0.23651	0.18626	0.25036	0.22395	0.17584	0.16776	-0.66258	-0.61329	0.69391
VE	0.51020	0.55765	0.41988	0.41024	0.68382	0.57258	0.43493	0.47904	-0.17774	-0.16569	0.18991
AR	0.42339	0.51725	0.51073	0.43039	0.56112	0.50268	0.39562	0.42040	-0.19395	-0.18172	0.20712
PA	0.39202	0.49250	0.45921	0.38010	0.46587	0.48700	0.40866	0.44742	-0.17985	-0.17271	0.18862
CI	1.00000	0.46609	0.37129	0.31143	0.49343	0.43789	0.35175	0.30892	-0.18886	-0.19363	0.19864
MA	0.46609	1.00000	0.45481	0.36795	0.57989	0.63028	0.54298	0.47568	-0.15408	-0.14691	0.16452
ACS	0.37129	0.45481	1.00000	0.45003	0.40265	0.41224	0.28718	0.26961	-0.14643	-0.13609	0.15900
ARC	0.31143	0.36795	0.45003	1.00000	0.36466	0.32668	0.21482	0.23151	-0.13406	-0.12691	0.14363
GIT	0.49343	0.57989	0.40265	0.36466	1.00000	0.63806	0.58941	0.52465	-0.19044	-0.18177	0.20127
SM	0.43789	0.63028	0.41224	0.32668	0.63806	1.00000	0.65966	0.53438	-0.16403	-0.15895	0.17206
AI	0.35175	0.54298	0.28718	0.21482	0.58941	0.65966	1.00000	0.54259	-0.12563	-0.12299	0.13068
ELI	0.30892	0.47568	0.26961	0.23151	0.52465	0.53438	0.54259	1.00000	-0.11644	-0.10837	0.12466
VATTR	-0.18886	-0.15408	-0.14643	-0.13406	-0.19044	-0.16403	-0.12563	-0.11644	1.00000	0.90815	-0.96973
OVATTR	-0.19363	-0.14691	-0.13609	-0.12691	-0.18177	-0.15895	-0.12299	-0.10837	0.90815	1.00000	-0.88066
QUAL	0.19864	0.16452	0.15900	0.14363	0.20127	0.17206	0.13068	0.12466	-0.96973	-0.88066	1.00000

APPENDIX D

AN ALTERNATIVE MODEL

APPENDIX D

AN ALTERNATIVE MODEL

An alternative to the model used in this analysis is a linear regression model with grouped data (see reference 4). An early attrition prediction model based on grouped data has been computed and will be compared with the individual data model used for the analysis.

Early attrition is one of the measures of effective service used in this analysis. Table 3 shows regression results which identify education, age, CI, and PA as the best four predictors of early attrition. These four variables have been used in a grouped model and in an individual data model so that the models can be compared.

This analysis is based on the 45,948 records which included values for attrition, education, age, and the test scores. The regression of table 3 was repeated with these records and resulted in the regression equation shown in table D-1. This equation was used to compute the predicted chances of early attrition for men at the midpoint of each test score group with each education and age value, also shown by table D-1.

The same variables were used to group the data. Education and age were each grouped into two values and the test scores were grouped into four values, as shown by table D-2. One value of each dummy variable is excluded in the regression; there are 64 possible combinations of the four variables. The grouped regression model is based on these 64 observations, with each observation consisting of the average attrition rate for the group and the unique combination of the four variables which define the group. The results of the grouped regression model are shown in table D-3. Table D-4 shows the predicted attrition for each group based on the equation of table D-3.

While the grouped-data model results in a larger R^2 value than does the micro model, it is not necessarily a better predictor of attrition. The reason is that the dependent variables of the micro model and the grouped model are different (see reference 6). The micro model explains 7.8 percent of variation in individual attrition, while the grouped model explains 76.9 percent of the variation between attrition of the 64 groups, after the within-group variation is removed by grouping. The attrition predictions generated by the two models were compared using a Chi-square test. Assume a uniform distribution of 100 Marines in each of the 64 groups and compute the number of observed attrition losses (based on the micro model) and the number of expected attrition losses (based on the grouped model). The Chi-square test can be used to test for any difference between the two distributions:

$$x^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

$$x^2 = 27.6$$

$$x^2_{63,\ .95} = 82.5$$

Therefore, we can reject the hypothesis that the two sets of predictions are different.

The individual data model has been shown to provide predictions not different from those generated by the grouped model. In addition, the individual data model offers an advantage in policy planning and implementation. The regression equation produces a unique attrition estimate for each combination of scores, age, and education. Such a presentation (as in tables 8-11) shows the relative importance of dissimilar variables in predicting attrition and facilitates the selection of screening standards. To do this with the grouped model would require a different computation of the equation for each grouping. The individual model is actually the limiting form of a grouped model, where each possible combination is recognized as a group. The individual data model is selected for this analysis. For an alternative formulation of an individual model, see reference 3.

TABLE D-1

PREDICTED EARLY ATTRITION RATES
INDIVIDUAL DATA REGRESSION MODEL

(Percentages)

	High School Graduate				Non-High School Graduate			
	Classification Inventory Score (CI)				Classification Inventory Score (CI)			
	136	104	87	59	136	104	87	59
Age less than 21								
Pattern Analysis Score (PA):								
139	1.9	7.3	10.2	15.0	17.0	22.5	25.4	30.1
112	7.8	13.3	16.1	20.9	23.0	28.4	31.3	36.1
98	10.9	16.3	19.2	24.0	26.1	31.5	34.4	39.1
65	18.2	23.6	26.5	31.3	33.3	38.7	41.6	46.4
Age 21 or more								
Pattern Analysis Score (PA):								
139	17.4	22.9	25.8	30.5	32.6	38.0	40.9	45.7
112	23.4	28.8	31.7	36.5	38.5	44.0	46.9	51.6
98	26.5	31.9	34.8	39.5	41.6	47.1	49.9	54.7
65	33.7	39.2	42.1	46.8	48.9	54.3	57.2	62.0

Predicted attrition rate = -.1515(HS) - .0022(PA) - .0017(CI) + .1556(Age) + .7073

$R^2 = .078$

TABLE D-2

VARIABLES USED IN GROUPED REGRESSION

Variable	Values				
Education	1	if	high school graduate	0	otherwise
Age	-	if	age 21 or more	0	otherwise
CI-1	1	if	CI $\geq$ 113	0	otherwise
CI-2	1	if	96 $\leq$ CI $\leq$ 112	0	otherwise
CI-3	1	if	79 $\leq$ CI $\leq$ 95	0	otherwise
PA-1	1	if	PA $\geq$ 119	0	otherwise
PA-2	1	if	106 $\leq$ PA $\leq$ 118	0	otherwise
PA-3	1	if	92 $\leq$ PA $\leq$ 105	0	otherwise

TABLE D-3

RESULTS OF GROUPED REGRESSION: EARLY ATTRITION

Variable	Regression Coefficient	Cumulative R^2
Education	-.1650	.494
Age	.1523	.594
CI-1	-.1096	.641
CI-2	-.0980	.692
CI-3	-.0704	.719
PA-1	-.0969	.735
PA-2	-.0794	.750
PA-3	-.0621	.769
(Constant)	+.4477	

n = 64

TABLE D-4

PREDICTED ATTRITION RATES: GROUPED DATA REGRESSION MODEL

(Percentages)

	High School Graduate Classification Inventory Score (CI)				Non-High School Graduate Classification Inventory Score (CI)			
	113+	96-112	79-95	1-78	113+	96-112	79-95	1-78
Age less than 21								
Pattern Analysis Score (PA):								
119+	7.6	8.8	11.5	18.6	24.1	25.3	28.0	35.1
106-118	9.4	10.5	13.3	20.3	25.9	27.0	29.8	36.8
92-105	11.1	12.3	15.0	.1	27.6	28.8	31.5	38.6
1-91	17.3	18.5	21.2	28.3	33.8	35.0	37.7	44.8
Age 21 or more								
Pattern Analysis Score (PA):								
119+	22.8	24.0	26.8	33.8	39.4	40.5	43.5	50.3
106-118	24.6	25.7	28.5	35.5	41.1	42.2	45.0	52.0
92-105	26.3	27.5	30.2	37.3	42.8	44.0	46.7	53.8
1-91	32.5	33.7	36.4	43.5	49.0	50.2	52.9	60.0

Predicted attrition rate = -.1650(HS) + .1523(Age) - .1096(CI1) - .0980(CI2) - .0704(CI3) -.0970(PA1) - .0794(PA2) - .0621(PA3) + .4477

$R^2 = .769$

APPENDIX E

SCALING FROM ACB-61 TEST SCORES TO ASVAB 6/7 TEST SCORES

APPENDIX E

SCALING FROM ACB-61 TEST SCORES TO ASVAB 6/7 TEST SCORES

The most useful prediction equation of the quality measure was shown to be (equation 1):

$$\text{Loss potential} = -\ .1826\ (\text{diploma}) - .0034\ (\text{GCT}) - .0018\ (\text{CI}) + .0829\ (\text{age}) + .9179 \qquad \text{(E-1)}$$

$$F = 1,263$$

$$N = 45,\ 869$$

This equation is expressed in terms of scores from the Army Classification Battery (ACB-61), which is no longer administered. The test now used for pre-enlistment screening is the Armed Services Vocational Aptitude Battery (ASVAB 6/7). A procedure to scale CI and GCT to the analogous scores of the ASVAB 6/7 is described below.

The ASVAB 6/7 is composed of 17 subtests. One of these, combat scale (CC), is designed to measure the aptitude measured by CI of the ACB-61. The ASVAB 6/7 mental group score (MG) is based on three tests: word knowledge (WK), arithmetic reasoning (AR), and spatial perception (SP). These three tests are analogous to the verbal (VE), arithmetic (AR), and pattern analysis (PA) tests of the ACB-61. A scaling technique was devised to convert equation (1) to a function of education, age, CC, and ASVAB mental group score.

During December 1975 and January 1976, 3,081 recruits arriving at the Marine Corps Recruit Depots at Parris Island and San Diego were administered both the ACB-61 and ASVAB 6/7. Approximately the same number of men were tested at each depot, and half of each group took the ACB-61 test first. Testing conditions were monitored and designed to produce consistent results. The analysis of the correlation between the tests of these two batteries has been published (see reference 2). The relevant correlations produced in that analysis are shown here:

COEFFICIENTS OF CORRELATION

		ACB-61		ASVAB 6/7	
		CI	GCT	CC	MG
ACB-61:	CI		.4313	.5617	.4044
	GCT			.3435	.8679
ASVAB 6/7:	CC				.3568
	MG				

The data from the two tests were used to derive prediction equations for CI and GCT in terms of the corresponding ASVAB 6/7 tests. The results are:

$$CI = 3.516(CC) + 40.475 \qquad (E\text{-}2)$$

$$R^2 = .32$$

$$F = 1,419$$

$$GCT = 1.12(MG) + 53.942 \qquad (E\text{-}3)$$

$$R^2 = .75$$

$$F = 9,400$$

Substituting in equation (E-1) and solving:

$$\text{Loss potential} = -\ .1826\ (\text{diploma}) - .0038\ (MG) - .0063\ (CC) + .0829\ (\text{age}) + .6616 \qquad (E\text{-}4)$$

The interpretation of the quality measure is the probability that an applicant with a given vector of age, test scores, and level of education will be lost to the Marine Corps within 24 months due to desertion or early attrition. In order to use a positive measure of manpower quality in the application of these results, success potential is defined:

$$\text{Success potential} = 1 - \text{loss potential}$$

$$\text{Success potential} = .1826\ (\text{diploma}) + .0038\ (MG) + .0063\ (CC) - .0829\ (\text{age}) + .3384 \qquad (E\text{-}5)$$

The interpretation of the success potential is the probability that an applicant (or the percentage of a group of applicants) with a given vector of age, test scores, and level of education will serve satisfactorily for 24 months as measured by desertion and early attrition.

APPENDIX F

ALTERNATIVE REGRESSION RESULTS

TABLE F-1

ALTERNATIVE REGRESSION RESULTS: DESERTION

Explanatory variable[a]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Years of schooling	-.0531	.0013	-.1892	.042
Arithmetic	-.0006	.0001	-.0359	.045
Pattern analysis	-.0004	.0001	-.0257	.045
Marital status	+.0229	.0054	.0136	.045
(Constant)	+.8084			

F = 589

[a]These variables were considered but not selected by the step-wise regression: age in years, race, mix, VE, CI, MA, ACS, ARC, GIT, SM, AI, and ELI.

TABLE F-2

ALTERNATIVE REGRESSION RESULTS: DESERTION

Explanatory variable[a]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Diploma	-.1324	.0055	-.2010	.034
Age/education interaction (2)	-.0002	.0001	-.0206	.040
General classification test	-.0011	.0001	-.0568	.045
College training	-.1267	.0113	-.0714	.046
Eleventh grade education	-.0486	.0047	-.0590	.047
General equivalency diploma	-.0540	.0081	-.0339	.048
(Constant)	+.3466			

F = 416

[a]These variables were considered but not selected: age 17, age 18, age 19, age 20, 9 years of schooling, 10 years of schooling, race, marital status, and CI.

TABLE F-3

ALTERNATIVE REGRESSION RESULTS: EARLY ATTRITION

Explanatory variable[a]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Years of schooling	-.1080	.0031	-.2740	.047
Classification inventory	-.0019	.0001	-.1077	.068
Pattern analysis	-.0016	.0001	-.0678	.076
Age/education interaction (2)	+.0020	.0001	+.1404	.082
General information test	-.0016	.0002	-.0619	.083
Verbal	+.0010	.0002	+.0452	.084
Arithmetic	-.0011	.0002	-.0439	.085
Race	-.0168	.0038	-.0211	.085
(Constant)	1.569			

F = 577

[a]These variables were considered but not selected: age in years, marital status, MA, ACS, ARC, SM, AI, and ELI.

TABLE F-4

ALTERNATIVE REGRESSION RESULTS: RANK ACHIEVED

Explanatory variable[a]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Years of schooling	+.2976	.0074	+.3008	.100
Arithmetic	+.0040	.0004	+.0665	.133
Classification inventory	+.0033	.0002	+.0756	.143
Pattern analysis	+.0043	.0003	+.0733	.150
Army coding speed	+.0037	.0003	+.0588	.153
Age/education interaction (2)	-.0030	.0003	-.0823	.155
General information	+.0031	.0004	+.0487	.156
(Constant)	-1.9409			

F = 1,311

[a]These variables were considered but not selected: age in years, race, marital status, VE, MA, ARC, SM, AI, and ELI.

TABLE F-5

ALTERNATIVE REGRESSION RESULTS: SUPERIOR RECRUIT TRAINING PERFORMANCE

Explanatory variable[a]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Classification inventory	+.0014	.0001	+.1051	.034
Army radio code	+.0013	.0001	+.0874	.049
Years of schooling	+.0176	.0015	+.0569	.054
Pattern analysis	+.0009	.0001	+.0472	.057
Race	+.0331	.0029	+.0531	.059
Army coding speed	+.0008	.0001	+.0435	.061
Arithmetic	+.0006	.0001	+.0326	.062
(Constant)	-.5250			

F = 464

[a]These variables were considered but not selected: age in years, marital status, mix, VE, MA, GIT, SM, AI, and ELI.

TABLE F-6

ALTERNATIVE REGRESSION RESULTS: QUALITY INDEX[a]

Explanatory variable[b]	Coefficient	Standard error of coefficient	Beta	Cumulative R^2
Diploma	+.2420	.0054	+.2391	.059
Classification inventory	+.0020	.0001	+.1044	.086
Pattern analysis	+.0019	.0001	+.0752	.097
College training	+.2321	.0129	+.0852	.101
Eleventh grade education	+.0691	.0061	+.0547	.103
Arithmetic	+.0014	.0001	+.0542	.105
Age 18	+.0970	.0065	+.0927	.107
Age 17	+.0737	.0068	+.0682	.108
Age 19	+.0648	.0073	+.0489	.109
(Constant)	-1.0374			

F = 676

[a] Standard error of the mean (of Q.I.) for n = 500 = .021.

[b] These variables were considered but not selected: age 20, 9th grade education, 10th grade education, GED, race, marital status, mix, VE, MA, ACS, ARC, GIT, SM, AI, and ELI.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This analysis examines the mathematical relations between the performance of first-term Marines and their test scores and selected personal characteristics. The objective is to predict performance when only certain test scores and personal characteristics are known (i.e., at time of application for enlistment). A step-wise linear multiple regression process is used to identify the variables which best predict performance. Measures of performance include early attrition, desertion, early promotion, and rank achieved.

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A procedure for expressing the results in terms of the (new) ASVAB preenlistment test is provided, and a method for application of these results to Marine Corps enlistment screening is presented.

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