SIGNIFICANCE OF TEST SCORES AND OTHER FACTORS IN PREDICTING SUCCESS IN ENGINEERING AND AGRICULTURE OF VETERANS ENROLLED UNDER PUBLIC LAW 16 AT KANSAS STATE COLLEGE

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TABLE OF CONTENTS

INTRODUCTION	1
PROCEDURE	2
A REVIEW OF RELATED LITERATURE	6
RESULTS	9
DISCUSSION	19
CONCLUSIONS	27
ACKNOWLEDGMENTS	30
REFERENCES	31
APPENDIX	33

INTRODUCTION

Vocational counselors are constantly seeking factual material which will aid them in guiding young people struggling with the problem of choosing their life work.

It is important both to the individual and to society that an occupation be selected that is within the limits of the individual's capabilities and that is sufficiently interesting to him. The vocational choice must not only be one in which the individual will succeed, but it must also be one in which the individual's emotional needs will be met. It must be a source of satisfaction.

The following quotation from Bingham (1) indicates the need for a wise occupational choice.

> Misdirection of effort is costly. Loss is incurred by society as well as by the individual himself when ambitions are ill-advised. If a man is misplaced in his work, he is likely to find that adjustments are increasingly troublesome in his personal and family relations also.

The purpose of this study was to obtain information that might be helpful to those persons assisting college students in selecting a vocational goal. Several factors were evaluated by comparing a successful group of students with an unsuccessful group in the occupational fields of engineering and agriculture. Veterans attending Kansas State College under Public Law 16 were chosen as the comparison groups for this study because they formed the only group of students on which fairly complete data could be obtained.

From the results of this study by a method of selecting arbitrary cutting points, a practical test was determined to aid in predicting those students likely to be successful in the field of engineering. A similar test was devised to aid in the prediction of successful agriculture students.

PROCEDURE

The material that was used in this study was obtained from the files of the Veterans Administration Guidance Center at Kansas State College, Manhattan, Kansas, and from the Kansas State College Counseling Bureau. The study included all of those male veterans under Public Law 16 who had graduated from Kansas State College on or before January 27, 1950; had been dismissed from the college either by college officials or by the Veterans Administration; or had left school voluntarily. Each of these veterans had chosen his occupational objective with the guidance of a Veterans Administration Guidance Officer.

In order to maintain secrecy of the files, each veteran was designated by a case number and as much of the following information as was available was obtained for each case: marital status; date of birth; date training at Kansas State College under the Veterans Administration began; employment objective; percent disability; type of disability; education completed before the veteran entered school under Public Law 16; psychological test scores (raw scores); and grade point average for the last four semesters the veteran was in school. The above data will be found in original tables in the Appendix.

Nineteen of the 271 cases were not used because comparable test data were not available.

The cases were then grouped according to the college curriculum in which the veteran had been enrolled. The seven following classifications of curriculums were used: engineering, agriculture, veterinary medicine, science, teaching, administration, and accounting. Each group was then subdivided into two categories; successful and unsuccessful. The successful group was composed of students who had graduated in that particular field of study. Those who had been dismissed from college, had left school voluntarily, or had changed to another curriculum formed the unsuccessful group.

The engineering classification included chemical, civil, electrical, agricultural, mechanical, and architectural engineers and architecture students. All veterans studying to be farmers, agronomists, poultry hatcherymen, county agricultural agents, horticulturists, vocational agriculture teachers, animal husbandmen, and other related occupations composed the agriculture group. Geologists, bacteriologists, chemists, and entomologists comprised the science group. The teaching group included teachers of vocational agriculture, social sciences, and various high school subjects. Students studying for managerial positions made up the administrative group.

A given student might be in one or more of the seven classifications. For example, case 178 began work in the engineering curriculum then changed to accounting and was graduated in that curriculum. He was classified under the engineering group as unsuccessful and under the accounting group as successful. Separation from a curriculum did not necessarily mean inability to handle that type of work. Lack of interest in the work, illness, financial difficulties, and emotional problems were among the many reasons given for discontinuing study or changing to a different field of study. Probability of the student's completing the course rather than his ability to do the work was the chief concern of this investigation.

The means, ranges, and standard deviations were calculated for each group of successful and unsuccessful students in the engineering classification for the following factors and test scores: American Council on Education Psychological Test - total score, Q score, and L score; Minnesota Paper Form Board Test; Ohio State University Psychological Test; Meier Art Test; Otis Self-Administering Test of Mental Ability; Bennett Mechanical Comprehension Test (forms unknown); Purdue Pegboard Test - total score and assembly score; Minnesota Clerical

Aptitude Test - names score and numbers score; Engineering and Physical Science Aptitude Test; Cooperative Mathematics Test; Cooperative Reading Test; Cooperative English Test; Cooperative Natural Science Test; Cooperative Social Studies Test; California Occupational Interest Inventory - personal-social, natural, mechanical, business, artistic, sciences, verbal, manipulative, computational and level scores; Kuder Preference Record - mechanical, computational, scientific, persuasive, artistic, literary, musical, social service, and clerical scores; age to nearest month at time of entrance in Veterans Administration program; years of schooling prior to entrance in Veterans Administration program; and grade point average during the last four semesters of college work.

The same test scores and factors were analyzed in the same manner for the agriculture group with the exception of the Meier Art Test, the Bennett Mechanical Comprehension Test, the Purdue Pegboard Test, the Minnesota Clerical Aptitude Test, the Engineering and Physical Science Aptitude Test, the Cooperative Social Studies Test, and the Kuder Preference Record. These tests were not analyzed because there were too few scores available.

Since the aim of the study was to find a workable means of predicting success, the test results of the other curriculums were not analyzed because so few scores were available that it could be seen by inspection that the reliability was too low for a practical application.

To determine the significance of the differences in the means of the successful and unsuccessful groups, the critical ratios were computed. Determination of the significance of marital status and disability was by the chi-square test. The .05 level of significance or better was recorded for each comparison group.

Because of inaccuracies in recording, variations in procedures in giving tests in the various Veterans Administration offices, and the small number of cases, bi-serial correlations and regression equations were not used for prediction. A procedure involving the use of arbitrary cutting points was used in determining a practical means of prediction.

A REVIEW OF RELATED LITERATURE

A great many investigations have been made to find the significant factors in determining the college student's probability of succeeding or failing in a particular curriculum.

The studies which applied most directly to this investigation are reviewed in the following paragraphs. Others are found listed in the reference section of this thesis.

Garmezy and Crose (2) compared the academic achievement of matched groups of veteran and non-veteran freshmen at the University of Iowa. They found that within the veteran group there was no relation between age and academic achievement.

In forecasting first semester and first year marks of engineering students, Jones (3) found that the best combination of tests was the Cooperative Mathematics, Cooperative Physics or Cooperative Chemistry, and secondary school marks. Tests used included, in addition to the above, the Otis Quick Scoring Mental Ability and the Cooperative Reading tests. The tests alone correlated .59 and .57 respectively with the criterion in the two classes tested. He also found that the predictive value of the tests progressively decreased in forecasting second, third, and fourth year marks. Treumann and Sullivan (4) reported among other results, in predicting the academic achievement of freshmen engineering students, that the Q score of the American Council on Education Psychological Examination ranked low in predictive significance, and that the Engineering and Physical Science Aptitude Test was the best single indicator of scholastic achievement of the tests administered. Couprider and Laslett (5) correlated scores on the Stanford Scientific, the American Council on Education Psychological Examination, and the Ohio State University Psychological tests with grade point averages. They found that engineering grades could be predicted equally well from the American Council on Education Psychological Examination Q score ($r = .40$), the American Council on Education Psychological Examination total score ($r = .39$), the Engineering and Physical Science Aptitude Test score ($r = .39$), or the Stanford Scientific Aptitude Test score ($r = .37$).

A study (6) conducted by the Veterans Administration in predicting success in training for agriculture found that the coefficients ranged from .07 to .60 with a median of .36 when scholastic aptitude test scores and agricultural college achievement were correlated. Hertel and Di Vesta (7) evaluated five factors in predicting the success of students entering the New York College of Agriculture. The battery of tests used for prediction included the Ohio State University Psychological Test, the Cooperative Natural Science Test and the Cooperative Mathematics Test. They found that the high school grade average is the most important single factor in the prediction of the college average, and the most important test in the battery used was the Ohio State University Psychological Test. For agricultural science students the following correlations were found for test scores and college averages: Ohio State University Psychological Test, .478; Cooperative Mathematics Test, .233; and Cooperative Natural Science Test, .259. The corresponding correlations for the general agriculture students were: Ohio State University Psychological Test, .460; Cooperative Mathematics Test, .294; and Cooperative Natural Science Test, .361 with the college average.

All of the correlations reported in the preceding studies are too low for individual predictions. This indicates that some other means of prediction might prove more effective in forecasting success in engineering and agriculture.

RESULTS

A comparison of data for successful and unsuccessful engineers is given in Table 1.

Inspection of Table 1 shows extremely large ranges for most of the tests for both the successful and unsuccessful engineering groups. There was evidenced considerable overlapping in the distribution of test scores for the two groups. For example, the range of the Minnesota Paper Form Board Test for the successful engineers was 33 to 64 and for the unsuccessful engineers, 24 to 64. Although there was a large difference between the means in some of the tests, the number of cases was so few as to reduce the reliability of the results. For example, the mean difference found for the Cooperative Reading Test was 26.8, but there were only six successful engineers who had taken the test and eight unsuccessful ones so the results were not statistically significant. Those tests and factors found to be significant at the .05 level of confidence or better were the Ohio State University Psychological Test, the Bennett Mechanical Comprehension Test, the Minnesota Clerical Test, the Cooperative Mathematics Test, the amount of previous schooling, and the grade point average.

Table 1. Comparisons of data for successful and unsuccessful engineers.

Test	Successful engineers M	S.D.	Range	No. cases	S.E. mean.	Mean diff.	Unsuccessful engineers M	S.D.	Range	No. cases	S.E. mean	S.E. diff. mean	t	Level of signif.
ACE - Total	117.5	27.3	44-178	42	4.3	3.0	114.5	25.7	56-169	32	4.6	6.3	.48	
Q score	49.5	11.1	25- 70	28	2.1	.5	49.0	6.9	39- 64	17	1.7	2.7	.18	
L score	69.8	16.7	27- 90	28	3.2	2.1	67.7	16.1	29- 92	17	4.0	5.1	.41	
Paper F.B.	51.4	8.2	33- 64	51	1.2	3.6	47.8	8.9	24- 64	26	1.8	2.2	1.64	
Ohio	93.4	17.3	61-124	11	5.5	25.3	68.1	22.2	37-109	11	7.0	8.9	2.84	.01
Meier Art	107.7	10.3	88-121	7	4.2	2.2	105.5	3.0	101-109	4	1.7	4.5	.49	
Otis	59.4	7.1	44- 74	22	1.6	4.1	55.3	9.4	36- 66	15	2.5	3.0	1.37	
Bennett	49.8	5.9	36- 60	19	1.4	8.1	41.7	9.5	21- 59	9	3.4	3.7	2.19	.05
Purdue Tot.	41.8	4.8	36- 48	13	1.4	.8	41.0	6.6	33- 48	4	3.8	4.0	.20	
Assem.	9.5	1.5	8- 12	12	.45	.8	8.7	2.2	5½- 11¼	4	1.3	1.4	.57	
Minn.C.Nos.	118.5	25.7	60-167	21	5.8	18.3	100.2	9.8	90-118	6	4.4	7.3	2.51	.02
Names	114.2	30.3	42-160	21	6.8	21.4	92.8	15.4	67-116	6	6.9	9.7	2.21	.05
E.&P.S.A.	88.7	21.3	52-118	6	9.5	4.5	93.2	32.3	46-141	6	14.4	17.2	.26	
Coop. Math.	60.0	13.2	36- 85	13	3.8	12.7	47.3	14.9	18- 75	15	4.0	5.5	2.31	.05
Coop. Read.	118.0	18.6	85-143	6	8.3	26.8	91.2	28.6	45-135	8	10.8	13.6	1.97	
Coop.Engl.	175.3	46.8	96-272	17	1.2	19.3	156.0	43.2	90-229	18	10.5	10.6	1.82	
Coop.N.Sci.	52.7	13.3	28- 78	9	4.7	12.9	39.8	18.7	6- 71	12	5.6	7.3	1.77	
Coop.Soc.St.	56.0	14.4	37- 81	6	6.4	4.7	51.3	20.5	19- 83	11	6.5	9.1	.52	
Cal.- Art	16.6	5.8	9- 28	21	1.3	8.6	25.2	17.1	7- 76	12	5.2	5.4	1.59	
P.S.	15.4	4.6	3- 23	21	1.0	1.9	17.3	4.0	10- 25	11	1.3	1.6	1.19	
Bus.	20.2	5.5	8- 31	22	1.2	.7	19.5	5.1	11- 27	12	1.5	1.9	.37	
Comp.	10.0	2.7	4- 17	21	.6	.7	9.3	4.3	2- 15	10	1.4	1.5	.47	
Sci.	26.2	4.6	16- 38	23	1.0	1.0	27.2	8.9	8- 40	14	2.5	2.7	.37	
Verb.	8.8	3.8	2- 15	21	.85	.7	9.5	3.7	3- 16	11	1.2	1.5	.47	
Manip.	13.4	2.1	9- 19	22	.5	.6	12.8	2.7	8- 17	10	.9	1.0	.60	
Level	77.0	6.4	61- 83	22	1.4	3.4	73.6	7.6	61- 83	13	2.2	2.6	1.31	
Mech.	25.0	3.9	18- 23	23	.8	2.1	22.9	6.3	11- 34	14	1.8	2.0	1.05	
Nat.	16.9	6.4	5- 30	21	1.4	1.7	15.2	6.2	0- 25	13	1.8	2.3	.74	
Kuder-Mech.	94.2	11.2	75-116	12	3.4	3.5	90.7	13.3	80-113	6	6.0	6.9	.51	
Sci.	71.1	12.0	51- 93	12	3.6	4.9	76.0	18.0	53-106	6	8.0	8.8	.56	
S.Ser.	64.2	11.3	47- 85	9	4.0	11.0	75.2	23.3	45-111	6	10.4	11.1	.99	
Lit.	42.9	16.0	27- 81	9	5.6	.1	43.0	12.3	23- 61	6	5.5	7.8	.01	
Com.	40.3	11.6	21- 62	9	4.1	8.0	32.3	13.0	10- 52	6	5.8	7.1	1.13	
Pers.	69.4	15.4	45- 86	8	5.8	1.2	68.2	14.3	51- 96	6	6.4	8.6	.14	
Art.	58.4	19.2	36- 99	8	7.2	14.7	43.7	12.3	21- 57	6	5.5	9.1	1.62	
Mus.	12.2	6.6	4- 21	8	2.5	3.8	16.0	11.1	2- 36	6	5.0	5.6	.68	
Cler.	45.0	7.6	34- 59	8	2.9	0	45.0	12.5	31- 64	6	5.6	6.3	0	
Age	23.7	2.5	19.9-33.7	59	.33	.4	24.1	3.5	19.2-35.1	37	.58	.67	.60	
Prev.Sch.	12.8	1.1	11-15.5	68	.13	.3	12.5	0.33	11- 15	37	.06	.14	2.14	.05
Grade Av.	1.61	0.44	0.77-2.59	68	.05	.36	1.25	0.43	0.27-2.94	36	.07	.09	4.19	.01
% Disability			0- 80	70					0-100	45	chi square = 11.45			
Marital status			41 married 28 single						21 married 22 single		chi square = .81			

A comparison of data for successful and unsuccessful agriculture students is given in Table 2.

In comparing the test results of the successful and unsuccessful agriculture students, there was found extensive overlapping and extremely large ranges in the distributions. The mean differences were large for some of the tests but the small number of cases reduced the reliability of the results. The artistic sub-test of the California Occupational Interest Inventory was the only test found to be significant at the .05 level of confidence or better. The mean score of the unsuccessful agriculture students was higher than that of the successful agriculture students on this test.

Table 2. Comparisons of data for successful and unsuccessful agriculture students.

Test	Successful agriculture students M	S.D.	Range	No. cases	S.E. mean	Mean diff.	Unsuccessful agriculture students M	S.D.	Range	No. cases	S.E. mean	Mean diff.	t	Level of signif.
ACE - Total	100.3	26.8	66-138	27	5.4	6.4	93.9	17.6	58-120	16	4.5	7.0	.91	
Q score	43.2	11.9	18- 62	18	2.9	7.0	36.2	9.7	13- 53	16	2.5	3.8	1.84	
L score	60.3	12.6	43- 90	18	3.1	2.5	57.8	10.1	33- 77	16	2.6	4.1	.61	
Paper F.B.	43.6	8.7	29- 53	14	2.4	3.7	39.9	9.2	26- 55	10	3.1	3.9	.95	
Ohio	74.0	17.5	44- 99	7	7.1	1.2	72.8	26.1	41-103	5	13.0	14.8	.08	
Otis	50.8	8.5	36- 74	16	2.2	2.8	52.8	7.6	40- 60	6	3.4	4.0	.50	
Coop.Math.	33.6	8.9	23- 55	14	2.5	8.1	41.7	9.7	27- 56	9	3.4	4.2	1.93	
Coop.Read.	61.8	17.7	43- 95	8	6.7	6.0	67.8	24.8	31- 99	4	14.3	15.8	.38	
Coop.Engl.	133.4	27.6	68-168	22	6.0	3.2	136.6	38.2	70-203	16	9.8	11.5	.28	
Coop.N.Sci.	35.8	7.0	25- 52	15	1.9	0	35.8	6.6	27- 46	6	-	-	0	
Cal.- Art	10.6	3.8	2- 18	14	1.05	5.3	15.9	5.5	11- 29	9	1.9	2.2	2.41	.05
P.S.	16.8	6.5	8- 31	15	1.7	.6	17.4	6.9	7- 29	10	2.3	2.9	.21	
Bus.	21.6	4.8	12- 29	16	1.2	4.5	17.1	5.8	7- 23	8	2.2	2.5	1.80	
Comp.	9.4	2.5	6- 14	14	.69	.4	9.0	4.8	3- 17	10	1.6	1.7	.24	
Sci.	26.6	10.2	18- 60	17	6.6	4.7	21.9	7.8	13- 37	10	2.6	7.1	.66	
Verb.	10.8	2.8	5- 14	14	.8	.9	9.9	5.0	2- 18	9	1.7	1.9	.47	
Manip.	14.6	2.0	12- 17	14	.6	.3	14.3	2.4	12- 18	9	.8	1.0	.30	
Level	73.2	6.3	62- 85	14	1.7	10.7	62.5	15.9	26- 81	10	5.1	5.4	1.98	
Mech.	17.7	5.8	11- 31	15	1.6	1.3	19.0	6.6	8- 33	9	2.3	2.8	.46	
Nat.	33.9	18.2	12- 99	17	4.6	4.8	29.1	9.2	8- 39	9	3.3	5.7	.84	
Age	24.5	3.3	19.4- 33.7	39	.5	.4	24.9	4.7	19.4- 33.5	16	1.2	1.3	.31	
Prev.Sch.	12.6	1.1	11- 15	40	.18	.4	12.2	1.1	12- 15	22	.24	.3	1.33	
Grade Av.	1.66	5.0	.94- 2.77	42	.78	.68	.98	4.6	.50- 1.94	14	1.27	1.5	.45	
% Disability			0- 80	42					10-100	23	chi square = 9.37			
Marital status			26 married 12 single						11 married 11 single		chi square = 1.33			

A comparison of data for successful engineers and successful agriculture students is given in Table 3.

The following tests shown in Table 3 proved to be significant at the .05 level of confidence or better in comparing successful engineers and successful agriculture students: American Council on Education Psychological Examination - total score and L score; Minnesota Paper Form Board; Ohio State University Psychological Test; Otis Self-Administering Test of Mental Ability; Cooperative Mathematics Test; Cooperative Reading Test; Cooperative English Test; Cooperative Natural Science Test; and the mechanical and natural sub-tests of the California Occupational Interest Inventory. On each of the tests mentioned above with the exception of the natural sub-test of the California Occupational Interest Inventory, the mean scores of the engineers were higher than the mean scores of the agriculture students.

Table 3. Comparisons of data for successful engineers and successful agriculture students.

Test	Successful engineers						Successful agriculture students							
	M	S.D.	Range	No. cases	S.E. mean	Mean diff.	M	S.D.	Range	No. cases	S.E. mean	S.E. diff. mean	t	Level of signif.
ACE - Total	117.5	27.3	44-178	42	4.3	17.2	100.3	26.8	66-138	27	5.4	6.9	2.95	.01
Q score	49.5	11.1	25- 70	28	2.1	6.3	43.2	11.9	18- 62	18	2.9	3.6	1.75	-
L score	69.8	16.7	27- 90	28	3.2	9.5	60.3	12.6	43- 90	18	3.1	4.4	2.13	.05
Paper F.B.	51.4	8.2	33- 64	51	1.2	7.8	43.6	8.7	29- 53	14	2.4	2.7	2.89	.01
Ohio	93.4	17.3	61-124	11	5.5	19.4	74.0	17.5	44- 99	7	7.1	9.0	2.16	.05
Otis	59.4	7.1	44- 74	22	1.6	8.6	50.8	8.5	36- 74	16	2.2	2.7	3.18	.01
Coop.Math.	60.0	13.2	36- 85	13	3.8	26.4	33.6	8.9	23- 55	14	2.5	4.5	5.87	.01
Coop.Read.	118.0	18.6	85-143	6	8.3	56.2	61.8	17.7	43- 95	8	6.7	10.7	5.25	.01
Coop.Engl.	175.3	46.8	96-272	17	1.2	41.9	133.4	27.6	68-168	22	6.0	6.1	6.87	.01
Coop.N.Sci.	52.7	13.3	28- 78	9	4.7	16.9	35.8	7.0	25- 52	15	1.9	5.1	3.32	.01
Cal.- Art	16.6	5.8	9- 28	21	1.3	6.0	10.6	3.8	2- 18	14	1.05	1.7	3.53	.01
P.S.	15.4	4.6	3- 23	21	1.0	1.4	16.8	6.5	8- 31	15	1.7	2.0	.70	-
Bus.	20.2	5.5	8- 31	22	1.2	1.4	21.6	4.8	12- 29	16	1.2	1.7	.82	-
Comp.	10.0	2.7	4- 17	21	.6	.6	9.4	2.5	6- 14	14	.69	.9	.67	-
Sci.	26.2	4.6	16- 38	23	1.0	.4	26.6	10.2	18- 60	17	6.6	6.7	.06	-
Verb.	8.8	3.8	2- 15	21	.85	2.0	10.8	2.8	5- 14	14	.8	1.2	.17	-
Manip.	13.4	2.1	9- 19	22	.5	1.2	14.6	2.0	12- 17	14	.6	.8	1.50	-
Level	77.0	6.4	61- 83	22	1.4	3.8	73.2	6.3	62- 85	14	1.7	2.2	1.73	-
Mech.	25.0	3.9	18- 23	23	.8	7.3	17.7	5.8	11- 31	15	1.6	1.8	4.06	.01
Nat.	16.9	6.4	5- 30	21	1.4	17.0	33.9	18.2	12- 99	17	4.6	4.8	3.54	.01
Age	23.7	2.5	19.9-33.7	59	.33	.8	24.5	3.3	19.4-33.7	39	.5	.6	1.33	-
Prev.Sch.	12.8	1.1	11-15.5	68	.13	.2	12.6	1.1	11- 15	40	.18	.22	.91	-
Grade Av.	1.61	.44	.77-2.59	68	.05	.05	1.66	5.0	.94-2.77	42	.78	.25	.20	-
% Disability			0- 80	70					0- 80	42	chi square = 2.78			
Marital status			41 married 28 single						26 married 12 single		chi square = .50			

Since Tables 1 and 2 showed extremely large ranges, wide overlapping of distributions, and small numbers of cases for many of the tests, bi-serial correlations and regression equations were not calculated for prediction purposes. Instead, a more feasible means of prediction was sought. A method of predicting success by the use of cutting points was used. Arbitrary cutting points were made at the scores above which 75 percent of the scores of the successful students fell and the score below which 75 percent of the scores of the unsuccessful students fell. Scores at arbitrary cutting points used in predicting successful and unsuccessful engineers for the tests in which the differences between the means were statistically significant at the .05 level of confidence or better are shown in Table 4.

Table 4. Scores at arbitrary cutting points used in predicting successful and unsuccessful engineers.

Test	75% successful engineers made above score	75% unsuccessful engineers made below score
Ohio State Psychological Test	83	83
Bennett Mechanical Test	43	50
Cooperative Mathematics Test	52	62
Minnesota Clerical Test - Numbers	97	109
Minnesota Clerical Test - Names	107	109

Although the difference between the means of successful agriculture students and unsuccessful agriculture students was not found to be statistically significant on the California Occupational Interest Inventory - level scores and the American Council on Education Psychological Examination Q score, the total patterns of the distributions were so different that they could be used in prediction by establishing arbitrary cutting points. The score above which 75 percent of the scores of the successful agriculture students fell, and the score below which 75 percent of the scores of the unsuccessful students fell are shown in Table 5.

Table 5. Scores at arbitrary cutting points used in predicting successful and unsuccessful agriculture students.

Test	75% successful agriculture students made above score	75% unsuccessful agriculture students made below score
Calif. Occupational Interest - Level	68	70
Amer. Council on Education - Q score	36	43
	75% successful agriculture students made below score	75% unsuccessful agriculture students made above score
Calif. Occupational Interest - Artistic	14	11

Since the mean of the unsuccessful agriculture group was higher than the mean of the successful group on the California Occupational Interest Inventory - artistic score, the scores shown for this test in Table 5 are the score below which 75 percent of the scores of the successful agriculture students fell and the score above which 75 percent of the scores of the unsuccessful agriculture students fell.

Table 6. Prediction results using the forecasting data in Table 4 on engineering students in this study.

	Successful engineers	Unsuccessful engineers	Combined engineering groups
Correct predictions	27	19	46
% correct predictions	57.5	61.3	59.0
Incorrect predictions	9	5	14
% incorrect predictions	19.1	16.1	17.9
Questionable predictions	11	7	18
% questionable predictions	23.4	22.6	23.1

Table 7. Prediction results using the forecasting data in Table 5 on agriculture students in this study.

	Successful agriculture students	Unsuccessful agriculture students	Combined agriculture groups
Correct predictions	20	11	31
% correct predictions	69.0	64.7	67.4
Incorrect predictions	4	2	6
% incorrect predictions	13.8	11.8	13.0
Questionable predictions	5	4	9
% questionable predictions	17.2	23.5	19.6

Predictions as shown in Tables 6 and 7 were obtained by using the cutting point scores found in Tables 4 and 5. The student was given a pass, fail, or question mark depending upon his test score. For example, if a student in engineering made a score of 52 (above the cutting points) on the Bennett Mechanical Comprehension Test, he was given a pass mark. If his score was 39 (below the cutting points) he was given a fail mark. If his score was 46 (between the cutting points), he was given a question mark because the score was in the overlapping zone between the two cutting points. A pass, fail, or question mark was determined for each test that the student had taken. If the student had more passes than failures and question marks, it was predicted that he would succeed in that curriculum. If failing marks outnumbered the passing marks and question marks, a prediction of failure was recorded. If a student's test results indicated an equal number of passing marks and failing marks or if there were as many question marks as passing and failing marks, the prediction was classified as questionable. Passing predictions were "correct" predictions if the student was in the successful group. Failing predictions were "correct" predictions if the student was in the unsuccessful group.

Tables 12 and 13 in the Appendix show the prediction of success or failure for each engineering student using the cutting points as described in the above procedure. Predictions for agriculture students are also included in the Appendix in Tables 14 and 15.

DISCUSSION

In comparing the successful engineers with those who were unsuccessful, the results in Table 1 indicated that there was no statistically significant relationship between success in engineering and age at the time of entering the program. This is in agreement with Garmezy and Crose's findings with veteran freshmen at the University of Iowa (2).

Percent of disability was found to have no statistical significance. In a few cases seriously handicapped students left school for hospitalization, but others who had the same percent of disability were able to complete the work. The results of this investigation do not indicate whether physical disability is a handicap or not. If adequate data were available and further analyzed by grouping the veterans according to similar disabilities, more specific information might be obtained.

Marital status was found to have no significance. Clark (8) also found this to be true in a study using progress-towards-graduation as a criterion of college achievement.

The amount of previous schooling the engineer had had before entering the Veterans Administration program was found to be a significant factor. Sixty and three-tenths percent of the successful engineers had had more than 12 years (high school training) of previous schooling while only 29.8 percent of the unsuccessful engineers had had more than high school training. Because 38.2 percent of the successful engineers had had 12 years of previous schooling, and 67.6 percent of the unsuccessful engineers had had 12 years of previous schooling, it was impractical to arbitrarily designate a predictive cutting point as was done for the statistically significant psychological tests.

Since the grade point average is a measure of the student's success or failure in college, it was not used as a predictive factor.

In this study the statistically significant psychological tests in predicting engineering success were the Ohio State University Psychological Test, the Bennett Mechanical Comprehension Test, the Minnesota Clerical Aptitude Test, and the Cooperative Mathematics Test. Jones (3) also found the Cooperative Mathematics Test to have predictive value in forecasting the success of engineering students.

Treumann and Sullivan (4) concluded that the Engineering and Physical Science Aptitude Test was the best single indicator of scholastic achievement. Coupricer and Laslett (5) also found that engineering grades could be predicted equally well from the American Council on Education Psychological Examination Q score, total score, or the Engineering and Physical Science Aptitude Test. Since only six successful engineering students and six unsuccessful students had taken the Engineering and Physical Science Aptitude Test in this study, the number of cases was so small as to make the results unreliable. Treumann and Sullivan (4) found that the Q score of the American Council on Education Psychological Examination ranked low in predictive value while Couprider and Laslett (5) reported that both the Q score and total score of the American Council on Education Psychological Examination were predictive although the correlations with grade point averages were .40 and .39, respectively. The results of this investigation did not indicate that the American Council on Education Psychological Examination scores had any value in forecasting engineering success.

Neither the Otis Self-Administering Test of Mental Ability nor the Cooperative Reading Test results were statistically significant. This is in agreement with Jones' findings on engineering students (3).

In comparing the successful agriculture students with unsuccessful agriculture students the results of the Artistic sub-test of the California Occupational Interest Inventory were found to be statistically significant at the .05 level. Hertel and Di Vesta (7) reported that the Ohio State University Psychological Test was the most important test of a battery consisting of the Ohio State University Psychological Test, the Cooperative Mathematics Test and the Cooperative Natural Science Test in predicting success in agriculture. Reliability of the results of the Ohio State University Psychological Test and other tests in this study was reduced because of the small number of cases.

In comparing successful engineers with successful agriculture students, the factors of age at beginning of program; amount of previous schooling; marital status; degree of disability; and grade point average were not significant as shown in Table 3. The most important differences were revealed by the psychological test results. The following tests were statistically significant at the .05 level or better: American Council on Education Psychological Examination total score and L score; Minnesota Paper Form Board; Ohio State University Psychological Test; Otis Self-Administering Test of Mental Ability; Cooperative Mathematics Test; Cooperative English Test; Cooperative Natural Science Test; and the mechanical and natural sub-tests of the California Occupational Interest Inventory. The mean score of the successful engineers was higher in all of the above tests with the exception of the natural sub-test of the California Occupational Interest Inventory.

Test scores and grade point averages were not correlated because grades were not available for some of the students for more than one or two semesters. Many of the unsuccessful students did not complete one semester of work so no grade point average could be calculated.

Because of extreme ranges, greatly overlapping distributions, and the small number of cases, bi-serial correlations and regression equations could not be used.

In order to devise a practical prediction test, arbitrary cutting points were established for each of the tests that was found significant in determining the success or failure of engineering students and agriculture students. Although the difference between the mean of the level sub-test of the California Occupational Interest Inventory and the Q score of the American Council on Education Psychological Examination were not found to be statistically significant, the total patterns of the distributions were so different that they could be used in predicting success of agriculture students.

Cutting points were made at those scores above which 75 percent of the scores of the successful students fell and below which 75 percent of the scores of the unsuccessful students fell. Since the mean of the unsuccessful agriculture group was higher than the mean of the successful agriculture group on the Artistic sub-test of the California Occupational Interest Inventory, the scores shown in Table 5 are the scores below which 75 percent of the successful agriculture students fell and above which 75 percent of the scores of the unsuccessful agriculture students fell.

Predictions as shown in Tables 6 and 7 were obtained by using the cutting point scores found in Tables 4 and 5. The student was given a pass, fail, or question mark depending upon his test score. For example, if a student in engineering made a score of 52 (above the cutting points) on the Bennett Mechanical Comprehension Test, he was given a pass mark. If his score was 39 (below the cutting points), he was given a fail mark. If his score was 46 (between the cutting points), he was given a question mark because the score was in the overlapping zone between the two cutting points. A pass, fail, or question mark was determined for each test that the student had taken. If the student had more passes than failures and question marks, it was predicted that he would succeed in that curriculum. If failing marks outnumbered the passing marks and question marks, a prediction of failure was recorded. If a student's test results indicated an equal number of passing marks and failing marks, the prediction was classified as questionable. Passing predictions were "correct" predictions if the student was in the successful group. Failing predictions were "correct" predictions if the student was in the unsuccessful group.

The overlapping of the distributions between the two cutting points gave a zone in which the scores were common to both successful and unsuccessful students. In predicting the success or failure of a student in which several of his test scores fell in this indeterminate zone, it would be necessary to take into consideration other factors.

One of these factors that could not be handled statistically but would aid in the prediction of cases in this indeterminate zone was the amount of previous schooling before entrance in the Veterans Administration program. It was found in this study that 5 students of the 9 successful engineers predicted to fail had had more than 12 years of previous schooling. Four of the 11 successful engineers who were classified as questionable of succeeding had had more than 12 years of previous schooling. The use of these data would have increased the number of correct predictions.

Additional data that would aid in the prediction of "questionable cases" could be obtained from the comparison of data for successful engineers and successful agriculture students in Table 3.

In order to determine the value of predictions made by using the forecasting data in Tables 4 and 5, a comparison was made between the success of the Veterans Administration in predicting successful engineers and successful agriculture students and the success of the forecasting data as determined by this study.

Of the group of 116 engineers approved by the Veterans Administration for the engineering curriculum and expected to succeed in that field of study, 46 of this number, or 40 percent, were not successful and the predictions were incorrect. Using the forecasting data obtained in this study by the use of cutting points on the 78 students who had taken one or more of the criterion tests, 32 engineers were predicted to be successful and 5, or 16 percent, of this number were unsuccessful and the predictions were incorrect. The Veterans Administration approved 46 veterans for entrance into the agriculture curriculums. Twenty-three of these students, or 35 percent of the total number, were not successful and thus the predictions were incorrect. Using the forecasting data from this study, 22 agriculture students were predicted to succeed in agriculture curriculums. Two, or 9 percent of this number of students, did not succeed and thus the predictions were incorrect.

It would appear that the forecasting data obtained from this study would reduce the percentage of incorrect assignments of students to engineering courses from 40 percent to 16 percent, and for agriculture students from 35 percent to 9 percent. It is possible that if more information were available on the cases referred to as "questionable predictions" in this study, the percentage reduction of incorrect predictions would have been even greater.

CONCLUSIONS

From the results of this investigation, the differences of the means of the following tests were found to be statistically significant at the .05 level of confidence or better in predicting the success of engineering students under Public Law 16 at Kansas State College: Ohio State University Psychological Test; Bennett Mechanical Comprehension Test; Cooperative Mathematics Test; and the Minnesota Clerical Test. The amount of previous schooling prior to entrance in the Veterans Administration program also was found to be statistically significant.

Factors not found in this study to have any statistical significance in predicting engineering success were all other test data not mentioned above, marital status, percent of disability, and age at the time of entering the Veterans Administration program. These factors showed no statistical significance for prediction either because there is a lack of relationship between them and engineering success or because the sample used in this study was not representative of the population, or both.

In this study the difference in the means of the artistic sub-test of the California Occupational Interest Inventory was found to be statistically significant at the .05 level of confidence. Unsuccessful agriculture students tended to make higher scores on this test than successful agriculture students. Differences in the means of other tests and factors analyzed were not found to be statistically significant. Reliability of results was reduced by the small number of cases available for use in this study.

In comparing successful engineers with successful agriculture students in this study, differences in the means for the following test results were statistically significant at the .05 level of confidence or better: American Council on Education Psychological Examination total score and L score; Minnesota Paper Form Board; Ohio State University Psychological Test; Otis Self-Administering Test of Mental Ability; Cooperative Mathematics Test; Cooperative English Test; Cooperative Natural Science Test; and the mechanical and natural sub-tests of the California Occupational Interest Inventory. In all of the above tests with the exception of the natural sub-test of the California Occupational Interest Inventory, successful engineering students tended to make higher scores than successful agriculture students.

From the results of this study, forecasting data were obtained that were found to have practical value in predicting the success of engineering and agriculture students in their respective curriculums.

Since small numbers of cases were used in this study and the data were limited to veteran students attending college under Public Law 16, it is necessary to limit the conclusions reached from this study. It is believed that the use of this method in predicting success in engineering and agriculture by psychological test scores would make a profitable subject for further study with other groups and a larger number of cases.

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APPENDIX

Table 8. Test scores and other original data on 70 successful engineering students.

Case no.	ACE Total	ACE Q	ACE L	Paper Form Board	Ohio Psych.	Meier Art	Otis	Bennett Mech.	Purdue Pegboard Tot.	Purdue Pegboard Assem.	Minnesota Cler. Nos.	Minnesota Cler. Apt. Names	Eng. & Phys. Sci. Apt.	Coop. Math.	Coop. Read.	Coop. Engl.	Coop. N. Sci.
14	125	54	71												115	206	54
45	96			60							119	122				198	
42	109	46	63													148	
1	158	68	90	58							167	145		85	143		45
105				62			62										
74	133	56	77	60													
64	163	65	98	62		115								70	124	175	58
35	138			56							151	139					
32				51	85		61	48									
11	144	58	86	53					47	9¼				60	133	215	
10	97	70	27	51			63	53						60			
30				43				50			92	125					
151	143	55	88		103		64										
171				56			64										
174	112	56	56	53									73				
183	92	45	47	53	61		58	44						36		101	28
113				53			58				98	87					
232	108	50	58	56										53		128	52
130	178			60												252	
145						113											
149	52			52			66	36									
150	115			48			60		36	8½	126	88					
201	150	60	90	59							147	136					
205									38	8-3/4	60	51					
211				61				57			109	146					
218	132			64							138	113			85		
220	44			48			60	52½									
223					92						117	108		66		180	43
227					104												
187	106	44	62	59							134	118		67			
190				56	124			60									
255	120	44	76													159	
195	132																
196				54		88		51	46	11	114	119					
141								48									
253	130	50	80													193	
264	104	49	55	48					37	7-3/4						96	
274																	
271				52	81	121											
267				47	120		74										
259				48			53		41	9							
258				46			59				101	111					
247	97	40	57	33				54								148	
249				55	88		54		38	8¼							
251					85	109											

Case no.	California Occupational Interest Inventory Art.	P.S.	Bus.	Comp.	Sci.	Verb.	Manip.	Level	Mech.	Nat.	Kuder Mech.	Sci.	Soc. Serv.	Lit.	Comp.	Pers.	Art.	Mus.	Cler.
14																			
45			27		25				25										
42											85	65			36				
1	11	17	20	11	33	11	12	79	24	15									
105											97	74							
74																			
64	27	18	15	7	25	8	13	82	24	11									
35																			
32																			
11					27		19	77	25										
10																			
30	17	19	23	10	25	12	9	82	20	16									
151																			
171																			
174																			
183																			
113	16	3	22	12	38	3	14	83	23	18									
232																			
130	20	11	13	9	31	2	13	86	27	18									
145																			
149																			
150	9	14	27	11	28	8	14	82	28	14									
201	15	23	20	12	28	13	13	80	25	9									
205											87	77	59	45	44	86	49	8	34
211	21	12	14	9	32	6	15	71	27	14									
218	24	21	20	10	25	12	12	85	22	8									
220																			
223																			
227																			
187	10	17	22	7	21	10	16	76	29	20									
190																			
255																			
195																			
196																			
141																			
253																			
264	28	15	8	4	21	4	13	73	29	20									
274																			
271											101	51	85	27	34	55	99	6	41
267											100	79	63	56	31	85	36	13	39
259																			
258	22	12	18	5	19	4	12	73	29	19	86	57	77	31					
247	8	12	24	13	30	9	13	74	20	26									
249	11	13	20	11	25	13	11	78	32	19									
251																			

Case no.	Marital Status*	Coop. Soc. Studies	Age (years)	Percent Disability	Previous School (years)	Grade point av.
14	0	60	20.9	80	12	1.58
45	0		26.4	P-10	12	1.77
42			22.3	30	12.5	1.55
1	X		20.9	10	12.5	2.39
105	X		27.2	P-10	13.5	.85
74	0		21.4	P-40	13	1.70
64	0	64		P-30	15	2.29
35	X		20.8	30	12.5	2.54
32	0		21.7	P-20	12	1.01
11	X		25.0	0	12.5	.86
10	0		21.7	0	12	1.42
30	X		27.4	P-10	13	1.24
151	X		20.8	M- 0	13	2.05
171	X		24.3	30	13	.90
174	0			10	13.5	1.28
183	X	37	23.8	P-30	12	1.64
113	0		24.0	P-20	15	1.00
232	0	49	23.9	P-40	12.5	.77
130	0		22.0	P-10	12	2.26
145	X		24.6	P-20	15	1.44
149	0			10	15	1.18
150	X		22.0	P-20	13	2.42
201	X		22.3	P-50	14	2.59
205	X		27.2	P-30	14	1.82
211	X		33.7	P-10	11	2.36
218	X		20.1	P-30	13	2.12
220	X		26.9	P-60	12	.93
223	0	45	25.6	P-20	12	1.52
227	X			30	13	1.12
187	X			P-10		1.04
190	X		20.8	P-60	14	2.18
255	X		32.3	P-10	13	1.45
195	0		22.5	10	15.5	1.40
196	X			20	14	1.50
141	X		28.4	P-20	12	1.20
253	X		20.8	P-10	12	
264	0		21.8	P-10	12	1.32
274	X		23.2	P-10	13	2.03
271	X		25.1	P-10	14	1.78
267	X		26.3	P-10	14	1.82
259	X			P-10	12.5	1.22
258	X		22.9	P-20	13	2.16
247	0		24.3	P-10	12	1.10
249	0		22.8	P-10	13	1.16
251	0		24.5	P-10	13	1.72

Table 8. (concl.).

Case no.	ACE Total	ACE Q	ACE L	Paper Form Board	Ohio Psych.	Meier Art	Otis	Bennett Mech.	Purdue Pegboard Tot.	Purdue Pegboard Assem.	Minnesota Cler. Nos.	Minnesota Cler. Apt. Names	Eng. & Phys.Sci. Apt.	Coop. Math.	Coop. Read.	Coop. Engl.	Coop. N.Sci.	California Occupational Interest Inventory Art.	P.S.	Bus.	Comp.	Sci.	Verb.	Manip.	Level	Mech.	Nat.	Kuder Mech.	Sci.	Soc. Serv.	Lit.	Comp.	Pers.	Art.	Mus.	Cler.	Marital Status*	Coop. Soc. Studies	Age (years)	Percent Disa-bility	Previous School. (years)	Grade point av.
252	131	50	81	48									99															82	70	51	81	53	45	44	21	49	X		22.4	P-10	12	1.86
254				46			60		48	9¼	139	136						19	13	18	8	16	10	17	61	33	21										X		21.4	P-60	12.5	1.56
230	111	38	73				53						52																								X		23.7	P-40	12	2.56
233	80							41																				75	93								X			P-20	12	1.55
234				54		99	50	44						37																							0		21.8	P-10	12	1.11
241	67	31	36	40																																	X		24.3	P-20	12	1.79
244	110	28	82	40			62	59	36	9																											X		26.5	P-10	12	1.58
245				47				53			96	121																116	68	66	30	37	77	51	18	42	X		22.5	P-10 M-10	12.5	1.16
80	113			48		109			44	11	89	70																100	56	69	35	21	86	79	4	43	0		19.9	P-10	13	1.48
78	125	53	72	50	85								103																								0			P-10	12	1.55
76	125	52	73	52					43		85	42		72		170																					0		20.7	P-10	12	2.46
231	101			52																																	0		23.5	P-20	14	1.33
90	138			51													78																				0		22.0	30	13	2.12
91							63						87	60																							X		23.2	20	12	1.60
89	105	47	58					56										12	12	17	9	25	4	15	67	26	27										0		25.6	20		1.86
87	145	55	90													272																					0			P-30	12.5	1.61
82	105	35	70	44				42			135	160				132		21	20	12	9	24	8	10	75	19	24										0		21.7	P-40	12.5	1.32
39				41			44	48																													X		24.8	P-10	12	1.25
92				41										49				10	14	22	10	24	10	15	79	20	30										X		29.8	M-50	12.5	2.43
93	148			61					42	10-3/4	129	125						19	20	31	17	27	15	13	82	18	5										X		21.8	P-70	12	1.76
60				48			67						118				62	13	22	21	12	23	14	15	74	29	12										X			P-10	12	1.14
56				47																								91	88	47	45	62	53	57	21	59	X		23.3	-10	13	1.60
54	90	25	65																									110	75	61	36	45	68	52	7	53	0		20.7	30	12	1.16
49	137	62	75	52					48	12	143	137		65	108	207	55	16	16	30	13	30	10	10	76	20	8										X	81	23.6	30	15	1.25
40	125			54			52	49																													0		20.3	40	12	

* X = married
0 = single

Table 9. Test scores and other original data on 46 unsuccessful engineering students.

Case no.	ACE Total	ACE Q	ACE L	Paper Form Board	Ohio Psych.	Meier Art	Otis	Bennett Mech.	Purdue Pegboard Tot.	Purdue Pegboard Assem.	Minnesota Cler. Apt. Nos.	Minnesota Cler. Apt. Names	Eng. & Phys. Sci. Apt.	Coop. Math.	Coop. Read.	Coop. Engl.	Coop. N.Sci.	California Occupational Interest Inventory Art.	P.S.	Bus.	Comp.	Sci.	Verb.	Manip.	Level	Mech.	Nat.	Kuder Mech.	Sci.	Soc. Serv.	Lit.	Comp.	Pers.	Art.	Mus.	Cler.	Marital Status*	Coop. Soc. Studies	Age (years)	Percent Disability	Previous School (years)	Grade point av.
140	130	45	85								90	116		46	117	218		24	25	27	12	8	16	9	62	11	22										0		21.3	P-20	12	
34							58																														X			0		.84
28	56			44	56												6	23	13	25	12	17	9	15	61	21	21										0		22.8	P-50		1.20
98						105												26				23	6	14	73	29	25										0		23.6	P-10	14	.93
104	112	47	65	24														9	19	21	10	35	11		83	18	10										0		30.2	P-10	14	.44
112	99			42		101																33			83	25											0		22.5	P-10	13	
194	91			48							99	86				135		30	17	13	3	23	10	16	64	26	11										X			P-30	12	.43
228	126	50	76				59	59								181																					X			10		.71
215					81		66										65																				0			10		1.71
225	169												46																								X		25.3	0	12	
191	114			44					47	7-3/4				40				12	12	22	13	32	6	13	76	26	16										0		23.9	P-10	12	
179					109													29	18	13		40			76	20	0										0		21.7	P-20 M-20	11	
131							58	39																													0			P-10		.76
129	144	56	88	47			64	49								229		7	17	18	11	33	8	17	77	27	18										X				12	2.94
43							37		33	10¼																													22.8	30	12	1.25
29	150	58	92	50										68		228	71	76	10	11	4	32	3	12		34	17										X	83	19.6	P-40	12	.66
178	121	43	78				62							44		173																					X	77	19.2	P-30	12	2.23
121							58				94	86			94		48																				0	73	22.8	40	12	.95
17	102																																				0		26.7	30		1.17
160	114	46	68	36		107					109	94		43		146																							20.0	P-40	12	1.51
188				45	102			45																													X		32.9	P-30	15	
67	100	57	43		73											129																					0		26.0	P-20	12	1.49
250				52												148				19		36			77	31	12										X		19.7	P-30	12	.68
146	115	44	71	48										60	135	219	45	16	18	22	15	31	11	11	83	20	13										X	65	21.7	P-10	12	2.10
213	143			64																																	0		21.8	10	12	1.42
154				58				34																													0		25.2	P-30	13	1.40
125	104	51	53		52		57							31		92	28																				X	24	28.0	P-50	12	1.22
239				57	74		36	51						41	85	145	41											81	106	45	37	52	51	57	20	48	X	48	21.8	P-60	12	1.46
41	105	48	57	48				21																													X		21.1	P-10		2.62
101	144			62			65						96																								0		24.5	P-10		.75
263																																					0		23.1	M-10	12	1.39
69	84			48	39		45							18		90	18																				0	19	24.5	M-50	12	1.12
262	115	40	75											61	79	162	62											106	86	76	61	36	64	46	2	39	X	58	27.6	P-30	14	
37	117	45	72	49			54	41																				81	58	99	47	24	61	21	36	31	X		20.3	P-30	12	1.31
38													80															80	83	54	23	38	76	57	12	64	0		20.2	P-100	12	.27
182	145			42	70																																0		23.1	P-30	13	1.22
9	144			47					48	11¼				75	115			25	20	17	2	23	11	8	68	16	19	83	70	66	53	10	96	44	20	31	X			20	14	.82
59	64			35				34	36	5½	118	67				148																					0		35.1	P-10	12	
63	99	43	56	47										33	45	126	37																				X	35		P-10	12	1.35
7	68	39	29	42	56								141																								0		26.3	0	14	1.61
25	120	57	63											51	60	137	31											113	53	111	37	34	61	37	6	57	X	44	22.2	0	12	.84
134	88			40			49																														X		30.8	P-50	12	
66	144	64	80				62						126																								X		24.3	P-60	14	2.50
222	123			64		109							70																								0			30		.61
116	113			59							91	108		61				26	21	26	11	15	14	13	74	17	14												27.4	P-20	12.5	
15					37									38		103	25																				X	38	20.3	50	12	1.26

* X = married
0 = single

Table 10. Test scores and other original data on 42 successful agriculture students.

Case no.	ACE Total	ACE Q	ACE L	Paper Form Board	Ohio Psych.	Otis	Coop. Math.	Coop. Read.	Coop. Engl.	Coop. N.Sci.	California Occupational Interest Inventory Art.	P.S.	Bus.	Comp.	Sci.	Verb.	Manip.	Level	Mech.	Nat.	Marital Status*	Age (yrs.)	Percent Disability	Prev. Sch. (yrs)	Grade Point Av.
2	138	48	90		79																X	22.4	40	12.5	2.21
246	74	25	49			48	28		98	35											X	21.1	P-30	12	1.86
265	94	39	54																		X	23.7	10	13	1.24
268					77	47	55		131	36											X	19.5	P-30	12	2.49
26						54				50					60					99	X	23.0	P-30	12	1.88
229	106	56	50	45					109												X	20.2	P-60	12	1.70
143						45				25	18	13	27	12	21	14	14	70	12	29	0	28.2	P-10	15	1.70
83					44	44															X	28.4	0	13	1.51
8	91	44	47				23	62	120	34											0	27.6	P-50	14	1.31
20				35							13	27	23	6	22	14	14	77	20	14	X	33.7	20	12	1.78
273	113	46	67						146												X	24.8	P-10	13	1.18
96	70						25		96	25	10	23	14	6	26	10	16	70	11	36	0	19.9	P-30	12	.96
85	107	46	61			52	33		139	35											0	19.4	0	12	1.12
81	66	20	46	38		47	26	55	142	34		31									X	22.0	P-10	12	1.55
118						61					7	14	20	11	26	11	13	62	18	35	X	29.7	P-30	12	2.25
115	106					52															X	24.8	20	14	1.47
189				53		74															0	21.8	P-40	13	2.62
167	109						40	95			11	12	25	11	18	10	14		16	37		25.8	P-10	14	2.18
185				53	99						13	8	22	8	20	8	16	65	24	33	X	26.1	P-10	14	1.22
55	122	52	70				45	43	159	35											0	21.4	P-10	12.5	1.78
95	121	45	76						68				16		29					34	X	26.3	P-10	14	1.58
46	130	62	68	46		44			168												X	28.6	10	12	2.59
226	80									30	11	11	24	10	22	11	14	73	16	35	X	23.6	10	13	1.49
270								44	107												0	29.0	P-10		1.25
136						36				37											X	31.0	M-10 P-20	12.5	1.66
24	117	54	63	52		52			164												0	25.3	P-30	11	.98
137	125	43	82		90	57	32		151	52											X	25.8	M-50	13	2.34
156	104										13	12	19	7	20	14	17	69	19	37	X	22.4	P-10	12	1.10
181	121																				0		P-20	15	1.65
53				36							2	23	28	14	39	10	17	85	15	13	X	23.7	20	12	1.28
44	90	35	55				27	62	140	35	6	19	29	11	20	9	17	67	12	34	X	24.9	P-80	12.5	1.64
237						55															X	21.8	P-5C	12	2.03
243	101	50	51	52					123		16	19	23	10	18	14	15	78	13	31	X	24.0	P-10	12	1.53
248				51	56																0	22.0	P-10	12	1.14
202	72	18	54			45	28	85	162		9	9	12	6	27	5	12	77	27	33			20	12	1.66
204				29			34		155	38											X		P-10	12	1.67
210	89			33							9	17	24	10	25	10	14	75	12	33		22.1	P-10	12	2.43
97	96	37	59				32	48	145	36	10	14	21	10	24	12	12	80	20	31	X	28.1	P-10	13.5	2.77
67	100	57	43		73				129												0	26.0	P-20	12	1.49
250				52					148				19		36			77	31	12	X	19.8	P-30	12	.94
160	114			36			43		146													20.0	P-40	12	1.51
17	102																				0	26.7	30		1.17

* X = married
0 = single

Table 11. Test scores and other original data on 23 unsuccessful agriculture students.

Case	ACE			Paper	Ohio		Coop.	Coop.	Coop.	Coop.	California Occupational Interest Inventory										Mari-		Age	Percent	Prev.	Grade
no.	Total	Q	L	Form Board	Psych.	Otis	Math.	Read.	Engl.	N.Sci.	Art.	P.S.	Bus.	Comp.	Sci.	Verb.	Manip.	Level	Mech.	Nat.	tal Status	*	(yrs.)	Disa- bility	Sch. (yrs)	Point Av.
166	119	42	77	32		59	46	99	201	34	16	7	7	3	24	2	13	51	33	33	0		25.5	P-10	12	
216	93	40	53				34		165	30	13	21	22	9	13	13	16	57	20	30	X		23.9	P-10	12	1.94
157	66	13	53	33			34		70												X			P-30	12	1.92
120	90	31	59						144														21.9	P-10	12	
111				34					115												X		19.4	10	12	.52
102	86	36	50			47			203		18	13	11	5	24	5	12	78	19	36	X		27.5	P-10	7.5	
100				55		59															0			P-10	14	
103	58	25	33						87												0		33.5	P-90		
209					70																X			10	12	.85
200	92	46	46				36	31	103		13	14	21	5	14	9	12	53	23	31	0			10	12	.84
199	91	31	60						153												X			20	12	.81
197	112	44	68						115	41											X		25.4	P-70	13	.66
162	88	34	54	40			52			46	12	8	23	17	27	4	18	26	20	39	0		21.5	10	12.5	1.26
122	75	27	48						99		11	16	12	3	23	12	16	68	20	38	X		34.0	P-40	12	.84
224					48		36		126	27	20	18		13	13	14	13	63	8	25	0		19.6	P-20	12	
144	98	34	64	35			56		181												0		20.3	20	12	.48
219	107	42	65			60			131		29	22	21	8	14	18	17	81	12	22	X		24.3	P-100	12	
106	115	53	62	54		52						29		14	30			69			0		20.5	P-20	12	.50
3				26	103																0		22.2	P-30	12	1.28
203	93	32	61	45			27	70	125	37											X			10	14	.80
58						40															X		25.9	P-50	12	1.08
188				45	102																0		33.0	P-30	15	
186	120	49	71		41		54	71	168		11	26	20	13	37	12	12	79	16	8	0			40	12	

* X = married
0 = single

Table 12. Prediction results using the forecasting data obtained from this study on 47 successful engineering students.

Case no.	Ohio	Bennett	Cooperative Mathematics	Minnesota Numbers	Minnesota Names	Total prediction
45	-	-	-	P	P	P
1	-	-	P	P	P	P
64	-	-	P	-	-	P
35	-	-	-	P	P	P
32	P	?	-	-	-	?
11	-	-	?	-	-	?
10	-	P	?	-	-	?
30	-	P	-	F	P	P
151	P	-	-	-	-	P
183	F	?	F	-	-	F
113	-	-	-	?	F	?
232	-	-	?	-	-	?
149	-	F	-	-	-	F
150	-	-	-	P	F	?
201	-	-	-	P	P	P
205	-	-	-	F	F	F
211	-	P	-	P	P	P
218	-	-	-	P	P	P
220	-	P	-	-	-	P
223	P	-	P	P	?	P
227	P	-	-	-	-	P
187	-	-	P	P	P	P
190	P	P	-	-	-	P
196	-	P	-	P	P	P
141	-	?	-	-	-	?
271	F	-	-	-	-	F
267	P	-	-	-	-	P
258	-	-	-	?	P	?
247	-	P	-	-	-	P
249	P	-	-	-	-	P
251	P	-	-	-	-	P
254	-	-	-	P	P	P
233	-	F	-	-	-	F
234	-	?	F	-	-	F
244	-	P	-	-	-	P
245	-	P	-	F	P	P
80	-	-	-	F	F	F
78	P	-	-	-	-	P
76	-	-	P	F	F	F
91	-	-	?	-	-	?
89	-	P	-	-	-	P
82	-	F	-	P	P	P
39	-	?	-	-	-	?
92	-	-	F	-	-	F
93	-	-	-	P	P	P
49	-	-	P	P	P	P
40	-	?	-	-	-	?

Table 13. Prediction results using the forecasting data obtained from this study on 31 unsuccessful engineering students.

Case no.	Ohio	Bennett	Cooperative Mathematics	Minnesota Numbers	Minnesota Names	Total prediction
140	-	-	F	F	P	F
28	F	-	-	-	-	F
194	-	-	-	?	F	?
228	-	P	-	-	-	P
215	F	-	-	-	-	F
191	-	-	F	-	-	F
179	P	-	-	-	-	P
131	-	F	-	-	-	F
129	-	?	-	-	-	?
29	-	-	P	-	-	P
178	-	-	F	-	-	F
121	-	-	-	F	F	F
160	-	-	F	P	F	F
188	P	?	-	-	-	?
67	F	-	-	-	-	F
146	-	-	?	-	-	?
154	-	F	-	-	-	F
125	F	-	F	-	-	F
239	P	P	F	-	-	P
41	-	F	-	-	-	F
69	F	-	F	-	-	F
262	-	-	?	-	-	?
37	-	F	-	-	-	F
182	F	-	-	-	-	F
9	-	-	P	-	-	P
59	-	F	-	P	F	F
63	-	-	F	-	-	F
7	F	-	-	-	-	F
25	-	-	?	-	-	?
116	-	-	?	F	?	?
15	F	-	F	-	-	F

Table 14. Prediction results using the forecasting data obtained from this study on 29 successful agriculture students.

Case no.	ACE Q score	California Artistic	California Level	Total prediction
2	P	-	-	P
246	F	-	-	F
265	?	-	-	?
229	P	-	-	P
143	-	F	P	?
8	P	-	-	P
20	-	F	P	?
273	P	-	-	P
96	-	P	P	P
85	P	-	-	P
81	F	-	-	F
118	P	-	F	F
167	-	P	-	P
185	-	?	F	?
55	P	-	-	P
95	P	-	-	P
46	P	-	-	P
226	-	P	P	P
24	P	-	-	P
137	P	-	-	P
156	-	?	?	?
53	-	P	P	P
44	F	P	F	F
243	P	F	P	P
202	F	P	P	P
210	-	P	P	P
97	?	P	P	P
67	P	-	-	P
250	-	-	P	P

Table 15. Prediction results using the forecasting data obtained from this study on 17 unsuccessful agriculture students.

Case no.	ACE Q score	California		Total prediction
		Artistic	Level	
166	?	F	F	F
216	?	?	F	?
157	F	-	-	F
120	F	-	-	F
102	F	F	P	F
103	F	-	-	F
200	P	?	F	?
199	F	-	-	F
197	P	-	-	P
162	F	?	F	F
122	F	P	F	F
224	-	F	F	F
144	F	-	-	F
219	?	F	P	?
106	P	-	?	?
203	F	-	-	F
186	P	P	P	P