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THE RELATION OF APTITUDE TEST DATA TO FALL QUARTER GRADES — 998 CASES — FALL 1931

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This is a further study of the scholastic aptitude test which is given to entering students at Iowa State College.

Research on this problem has been presented before the Academy of Science from time to time. Vance,[1] in 1925, reported the correlations of parts of the test to quarter grades. In 1931, Cox,[2] reporting on a revised form of the test, showed that tests 2 and 6, that is, tests on arithmetical reasoning and artificial language were most closely related with abilities in Chemistry, English and Mathematics as required of Freshman Engineers at Iowa State College.

The tests used this year are the same as those reported by Cox, plus tests 8 and 9 on Perception and Linguistic ability. The aim of this study is to note the status of these two new tests with reference to the other tests and with reference to quarter average. Tests 8 and 9 were used for experimental purposes and were not used in the rating of students or in the total score of the aptitude test. The data have been treated according to Fisher's [3] method of multiple regression as adopted by Wallace and Snedecor.[4]

Table I — Description of I. S. C. Scholastic Aptitude Test

Test Name	Time in Minutes	Maximum Score	Range	Average Score	P E
1. Reading-Understanding	9	30	27	18.7	±.11
2. Arithmetical Reasoning	15	40	33	12.3	±.13
3. Word Relationships	2	30	29	19.4	±.09
4. Number Sequence	6	20	20	10.8	±.10
5. Memory for Faces	10	50	50	19.4	±.21
6. Artificial Language	12	40	38	21.1	±.17
7. Equation Completion	10	40	39	18.8	±.15
8*. Perception Test	2	25	23	6.7	±.06
9*. Linguistic Test	5	222	195	70.5	±.77

* Experimental tests.

Following are the directions and sample of Test 8:

1 Vance, T. F., The Iowa State College Reasoning Test. Proceedings of Iowa Academy, 1925.

2 Cox, G. M., The Use of Individual Parts of the Aptitude Test for Predicting Success of Students, Proceedings of Iowa Academy, 1931.

3 Fisher, R. A., Statistical Methods for Research Workers. London: Oliver and Boyd, 1928.

4 Wallace & Snedecor, Correlation and Machine Calculation. Iowa State College Publication, Vol. XXX, No. 4.

PERCEPTION TEST

Below you will find a series of rows of letters. As quickly as you can, look at each row and then *guess* which letter you think appears oftenest in that row. Do not stop to count the number of letters in the row as you will not have enough time to do this. Write the letter which you had guessed appeared oftenest in the row on the short blank line at the right hand end of the row. You will be given two minutes to guess as many as possible. Do not spend more than five seconds on each row.

The two rows under "Samples" below are marked correctly.

Samples:

OEOUEAAOEOEUAUAOEAEUAEUEOOEUEAEUAEUEOOAOOEOUOEAE....(E)
OEOAOOUEOUEUOUAOEAEOOAOUOEUAOUEUAOOEUAOOEEOEUAAO....(O)

This test was developed by Münsterberg, a pioneer in psychological testing and in industrial psychology. The blocks of letters were printed on cards and sorted into compartments according to the most frequently occurring letter. Using the test in the present form involves the perceptual aspects but eliminates the manipulation and manual dexterity.

Directions for and sample of Test 9:

LINGUISTIC TEST

Directions:

Below you will find material formed by dividing words within the word, and then making the spaces occur between these parts instead of between the words as usual.

You are to draw a line after each word in the material below so that it may be read with meaning. The sample below is divided properly so you may recognize its meaning.

Sample:

Ma ry| Ha d|a |lit t le|l a mb|
I ts|fle ece|wa s|wh it e|a s|s now.|

Test 9 will be recognized as a common type which has been reported by Whipple and others and has been used with very good success.

The correlations in Table II are recorded as part of the data used in calculating the multiple regression. These r's are not to be compared with each other to give relative importance of the various tests in predicting quarter average. Fisher says, "The idea of regression is usually introduced in connection with the theory of correlation, but it is in reality a more general, and, in some re-

Table II — Simple Correlations. 998 Entering Students, Fall 1931

Tests	B	C	D	E	F	G	H	I	J	X
	2	3	4	5	6	7	8	9	Total Score	Quar. Ave.
A 1	.312	.453	.339	.218	.361	.267	.162	.321	.596	.292
B 2		.363	.467	.090	.283	.493	.159	.266	.612	.337
C 3			.413	.290	.481	.437	.183	.476	.705	.320
D 4				.180	.354	.469	.129	.342	.645	.253
E 5					.341	.184	.273	.314	.599	.208
F 6						.346	.106	.481	.725	.410
G 7							.177	.434	.680	.265
H 8								.139	.189	−.003
I 9									.568	.374
J Total Score										.455

spects, a simpler idea, and the regression coefficients are of interest and scientific importance where the correlation coefficient, if used at all, is an artificial concept of no real utility." [5]

Table III — Standard Regression Coefficients: (Betas)

B xa = .0915	B xe = .0705	
B xb = .2194	B xf = .2179	
B xc = .0258	B xg = −.0141	
B xd = −.0191	B xi = −.1204	R = .5209
	B xj = .1769	

The Betas in Table III give the relative importance of the tests, independent of the influence of one on the other. The multiple R, which is the correlation between the actual and estimated values of X, is calculated as follows: $R^2 = r_{ax} \cdot B_{xa} + r_{bx} \cdot B_{xb}$ etc. The value of .52, which was obtained, is very significant in view of the fact that a value of .14 would occur only once in a hundred times in correlating unrelated variables.[6]

The regression equation may be written as in the table below:

Table IV — Statement of Regression Equation for Predicting Quarter Average

Quarter average increases:	
.16%	per unit increase in Test 1
.34%	per unit increase in Test 2
.05%	per unit increase in Test 3
.04%	per unit decrease in Test 4
.06%	per unit increase in Test 5
.24%	per unit increase in Test 6
.02%	per unit decrease in Test 7
.39%	per unit decrease in Test 8
.05%	per unit increase in Test 9

It is to be noted that the number of units in each test is not the same and this factor has not been equated. This may be accounted for in a general way by multiplying the regression value of each

[5] *Op. cit.*, pg. 112.
[6] Wallace & Snedecor, op. cit., pg. 62.

test by the range of that test. Table V gives the results of this procedure.

Table V — Possible Influence of Each Test in Predicting Quarter Average, Taking into Account the Range of Scores on Each Part of the Test

TEST	REGRESSION	RANGE	PRODUCT	PERCENT
A	.1628	27	4.3956	3.83
B	.3373	33	11.1309	9.69
C	.0544	29	1.5776	1.38
D	−.0375	20	.7500	.65
E	.0659	50	3.2950	2.87
F	.2444	38	9.2872	8.08
G	−.0187	39	.7293	.63
I	−.3892	23	8.9516	7.79
J	.0460	195	8.9700	7.81
Constant			65.8094	57.28
			Total 114.8966	100.00

The values in Table V indicate that the influence of tests 2, 6, 9, 8, 1, and 5, in the order named, have the most influence in determining quarter grades. A multiple R, using these six tests is slightly more significant than the multiple R for the entire battery.

Table VI — Relation of Quarter Average Decile to Test Scores

QUARTER AVERAGE DECILE	QUARTER AVERAGE IN PERCENT	AVERAGE TEST SCORE	AVERAGE NUMBER OF ERRORS
1	59.30	98.30	36.60
2	70.46	103.52	33.97
3	76.27	109.87	32.20
4	79.88	113.05	31.22
5	82.00	116.17	30.40
6	83.55	118.67	29.69
7	85.07	126.39	27.35
8	86.72	130.00	25.72
9	88.73	136.81	24.11
10	91.89	151.67	20.63

By way of paired comparison, Table VI illustrates very well the close relationship between quarter average and aptitude test score. It is to be noted that there is a consistent relationship with no inversions.

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