LOGICALLY WEIGHTED PREDICTORS:

COMPOSITE PROGNOSTIC SCORES[1]

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The Composite Prognostic Score (CPS) was developed to use standardized test results in a relatively simple scheme of prediction. It enables the prediction of future school success by logically weighting the predictor test scores. It is a multiple-predictor single-criterion technique in which the predictor variables are weighted logically.

The calculation of a CPS involves identifying the abilities and achievements which constitute the criterion; i.e., the variable to be predicted. The available predictor measures are analyzed in a similar way to reveal their constituent abilities and achievements. The predictor measures are then weighted according to their assumed importance. Where similar pairs of abilities or achievements are found in the criterion and predictor, the predictor element, based on its importance, has the same numerical weight as the criterion element. Since some elements which appear in the criterion might not appear in the predictor series, it is necessary to adjust the weights given the predictor elements. For ease of interpretation, the weights should total ten to give a CPS range of 10 - 90. The Composite Prognostic Score is then calculated by multiplying each predictor score, in stanine form, by its associated weight, then summing these products. The sum of the products is called the Composite Prognostic Score.

Because predictor test scores will have different means and standard deviations, it is necessary that each test score distribution be converted to a common distribution. This is done most simply by converting all scores to z scores, having a mean of zero and a standard deviation of one; then converting these standard scores to stanine scores according to Table 1.

A detailed calculating guide follows:

Procedure for Calculating a CPS

Step 1. Analyze the criterion to determine the type of abilities and achievement which constitute it.

Step 2. Identify available predictor data (i.e., those measures of ability defined in (1) which are on hand or can be obtained).

Step 3. Assign weights to the predictors   based   on their relative importance with respect to the criterion and in such a manner that the sum of the assigned weights equals 10.

Step 4. Convert each predictor score distribution to a standard score distribution. Then use Table 1 to convert standard scores to stanine scores.

Step 5. For each student, multiply the stanine score for each predictor by the weight assigned to the predictor in (3) above. Sum these products to find the Composite Prognostic Score for the student.

Step 6. Use the score ranges in Table 1 to obtain the predicted stanine for the student.

Table 1

Score Equivalents

Stanines	Standard Score	CPS
9	Above 1.75	Above 80
8	1.23 to 1.75	71-79
7	.74 to 1.23	63-70
6	.25 to .74	55-62
5	-.25 to .25	46-54
4	-.74 to -.25	38-45
3	-1.23 to -.74	30-37
2	-1.75 to -1.23	21-29
1	Below -1.75	Below 20

Sample Problem 1

A guidance director has available standardized test results in raw score form for all ninth grade students from the Florida State-Wide Ninth-Grade Testing Program.   The test data are Verbal Ability, Quantitative Ability, and Total Ability; in addition,

achievement data in Reading, Language, Mathematics, Social Studies, and Science are available.

The guidance director wishes to group students in 10th grade algebra so that students will be distributed over classes of high ability, median ability, and low ability for a parallel track program. Hypothetical ninth grade test results for a student are listed in Table 2.

Table 2

Hypothetical Test Scores for a Student

Test	Raw Score	Standard Score	Stanine
Verbal	41	.4	6
Quantitative	34	.6	6
Total	75	.6	6
Reading	35	.7	6
Language Total	56	.6	6
Arithmetic Comprehension	39	1.2	7
Problem Solving	40	1.6	8
Social Studies	39	.8	7
Science	39	.9	7

The guidance director uses the procedure previously given to calculate a CPS in order to predict the class in which the student will be placed. To do step 1, the guidance director asks the 10th. grade algebra teachers what abilities are necessary for success in algebra and is told that students need above average ability in both verbal and quantitative skills and above average achievement in reading, problem solving, arithmetic, and analysis. The guidance director's second step is to analyze the ninth grade data for measures of ability as stated by the algebra teachers. For step 3, the measures of ability thus defined as predictors are weighted as shown in Table 3. After converting the predictor scores to standard form (z scores), the guidance director changed the standard scores into stanines (step 4). Next, each student's test score, as represented by a stanine, is multiplied by the assigned weight (see Table 3). The sum of the products is the student's CPS. Step 6 is the conversion of the obtained CPS of 65 into a stanine score 7 (Table 1).

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Table 3

Calculation of the CPS for Problem 1

Predictors	Assigned Weights	Stanine X Assigned Weights
Quantitative Ability	3	6 x 3 = 18
Verbal Ability	2	6 x 2 = 12
Reading	2	6 x 2 = 12
Problem Solving	2	8 x 2 = 16
Computation	1	7 x 1 = 7
Total	10	CPS = 65

Validation of a CPS

To validate a CPS, criterion data must be obtained that will indicate the accuracy of the prediction. On the basis of these data, it may be necessary to construct another CPS for the same prediction situation with different weights assigned to the predictors. This may involve the elimination of some factors and the addition of other predictor factors in the CPS calculation process in order to arrive at the best set of logically weighted predictors.

The method to be used is that of relating the criterion of success and the CPS in the form of an "experience table." Since experience table is a scattergram, a Pearson product-moment correlation coefficient can be calculated to indicate the strength of relationship between the CPS and the criterion. If the CPS is predicting accurately, the experience table will show linear relationship and high correlation between the CPS and the criterion. If this situation is not obtained, then the CPS probably needs to be redefined and recalculated.

If the CPS is needed to predict a score in some future testing situation, the CPS must be constructed with the criterion data available. Using the method of validation of a CPS, expectancy tables can be constructed that give the probability that a student will achieve a particular test score given his CPS. To use this method, the CPS and criterion data must be based on the same or equivalent populations.

Sample Problem 2

The guidance director in sample problem 1 has the same ninth grade test data available for use in calculating a CPS for prediction of a student's score on the Florida Twelfth-Grade Test Battery. He also has an expectancy table (Table 4) showing the probability of achieving a 300 score or better, given his stanine CPS.

Table 4

Probability of Obtaining a Senior Test Score of 300 or Better for Various CPS Stanines

CPS Stanine	Probability
	1.00
9	.91
8	.65
7	.45
6	.31
5	.18
4	.07
3	.03
2	.00
1	

First, the director remembers that the Florida Twelfth-Grade Test Battery purports to measure General Scholastic Ability and achievement in mathematics, English, social studies, and science. The second step is to determine which of the ninth grade test data give measures of the abilities to be tested by the Twelfth-Grade Test Battery. These ninth grade test scores are listed and weighted as shown in Table 5. In this case, the guidance director uses the scores converted for Sample Problem 1 in step 4. The next step is to multiply each student's test score, as represented by a stanine, by the assigned weight (see Table 5). The products are then summed to give the student's CPS. The final step is accomplished when the CPS of 65 is converted into a stanine of 7 using Table 1. The expectancy table (Table 3) shows that a student with a CPS stanine of 7 has a probability of .65 of making a senior test score of 300 or better.

Table 5

Calculation of CPS for Problem 2

Predictors	Assigned Weights	Stanine x Wt. Assign
SCAT Total	3	6 x 3 = 18
Language Total (English)	2	6 x 2 = 12
Prob. Solving	1	8 x 1 = 8
Computation	1	7 x 1 = 7
Social Studies	1	7 x 1 = 7
Science	1	7 x 1 = 7
Reading	1	6 x 1 = 6
	10	CPS = 65

Validation is the final step in the process of calculating a Composite Prognostic Score. The greatest strength of the CPS is in predicting for a situation for which no criterion data is available. The school can use a CPS in this way for constructing homogeneously grouped classes, while the teacher can use it in constructing ability groups in the individual classroom. Where criterion data is available, the CPS can be used in determining objective cutoffs as course pre-requisites or predicting success for use in guidance activities.

References

1. Durost, W.   The Characteristics, Use, and Computations of Stanines. Test Service Notebook, No. 23, New York: Harcourt, Brace and World, Inc., 1961.

2. Durost, W. (ed.). Manual for Interpreting Metropolitan Achievement Tests. New York: Harcourt, Brace and World, Inc., 1962.

3. Hart, Irene. Using Stanines to Obtain Composite Scores Based on Test Data and Teachers' Rank.   Test Service Bulletin, No. 86, New York: Harcourt, Brace and World, Inc. 1957.