FINANCIAL AID AWARDS — PREDICTORS OF GRADE-POINT AVERAGES

by Edward E. Nichols, Sr.

Since 1964, aid officers have performed for most of their students some form of multi-packaging of student aid programs based on complicated federal formulae. Students may be provided all or any of the many programs of assistance in varying dollar amounts based on their inability to pay for their education.

State and federal agencies which provide grants, loans, work-study, scholarship and other aid are now requiring students to measure up to a minimum standard of academic progress. The implications of such a standard imply that there is a relationship between scholarships, work-study, grants, loans, and grade-point averages.

It was the purpose of this study to determine the degree of relationship between various types of financial aid, sex, socio-economic status, independent or dependent student status, college standing and grade-point average (GPA). To accomplish this objective a prediction regression equation was generated. This equation was of the form, $Y^1 = b_0+b_2X_2+ \ldots +b_{11}X_{11}$ in which b's represents stepwise regression coefficients and in which Y' is the estimated criterion score (GPA), X_2 is the Basic Educational Opportunity Grant (BEOG), X_3 is the Supplemental Educational Opportunity Grant (SEOG), X_4 is the National Direct Student Loan (NDSL), X_5 is the College Work-Study Program (CWSP), X_6 is the socio-economic status (SOCIOECO), X_9 is the student status (Independent 0/Dependent 1) (STUDSTA), X_{10} is the Missouri Student Grant (MSG), and X_{11} is the college standing (Freshman 0/Sophomore 1) (FRESSOPH).

Cross validation precedure was a shrinkage formula of the form:

$$\hat{R} = 1-\sqrt{[\,(1-R^2)\ (\frac{N-1}{N-m-1})\,]}$$

Where R = estimate of population R, N = sample size; and m = number of predictor variables. This generated predictor regression equation can be used to predict GPA's when presented with new numerical data on its variables.

Some hypotheses which may be stated using the above equation are as follows:

1. There is no relationship between socio-economic status and academic achievement.
2. There is no relationship between financial aid and academic achievement.
3. There is no relationship between sex and academic achievement.

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If it is determined through these hypotheses that the contributions of scholarships or grants which are provided to students account for the major proportion of grade-point averages, then the government could shift loan and work-study funds to grants and scholarship programs. Thus scholastic success could be maximized.

Review of the Literature

Many factors which influence GPA's of college students have been noted; no single factor, in and of itself should be used to explain GPA's. What must be emphasized is the need to consider all factors that might contribute to GPA's rather than placing the "blame" on any single variable.

The relationship between grade-point averages (GPA) and scholarships, work-study (employment), grants, loans, sex, and socio-economical status (income) has been extensively studied. These studies have primarily consisted of investigations which looked at GPA's as correlated with one of the variables mentioned above.

The literature used in the study of this problem has been divided into the following categories:

1) Multifactors and GPA
2) Scholarships and GPA
3) College work-study and GPA
4) Socio-economic status and GPA
5) Loans and GPA

These categories are summarized as follows:

Review of the literature has not identified research which has used statistical techniques such as multiple regression, inter-correlation and correlations to predict grade-point averages by the use of factors such as financial aid programs, independent or dependent student status, sex, and income level. However, some studies were found which used regression and at least one of the variables relative to this study. Some of the findings of these studies indicate that a method of comparing grading standards using regression equation for majors could be accomplished (Goldman, Schmidt, Hewitt, and Fisher, 1974) and that predictability is systematic but that characteristics of samples are related to the magnitude of predicted correlations (Munday, 1978).

Schoenfieldt and Brush (1975) found that GPA as a preferred criterion in predictor research is not multi-faceted but could be singular for most predictive purposes; however, Astin (1968) found academic ability and sex were among the most important predictors of GPA.

Another variable important to this study is scholarships. Reserach reveals that in some cases scholarships assist student college attendance (Parker, Wright, and Clark, 1955). Studies indicate that scholarship recipients have significantly higher grades at graduation than non-recipients (Bergen, Upham, and Bergen, 1970 and Clark, Wright, and Parker, 1957).

In studies conducted on the relationship of work-study to academic performance, many have concluded that part-time employment has no detrimental effect on college grades. This is the conclusion Gaston (1973), MacGregor 1966), Kaiser (1968) Hay (1969), and Augsburger (1974).

Another factor related to employment may be that academic performance is the same for low socio-eccnomic level students as for other students (Merritt, 1970) and that employment in a student major may raise students' grades as compared to employment in a non-major field (Trueblood, 1957). The issue of socio-economic status tends to be positively related to academic ability and academic achievement (Astin, 1964) and upper socio-economic students are far more likely to receive non-repayable grants while low socio-economic students may expect to receive a loan or employment (Schlekat, 1968).

Hansen, Gold, and Labovitz (1972) found that a relatively simple casual ordering exists for SES influences, IQ, GPA and intent which in turn influence college entry and that social status is part of a casual chain resulting in differing educational achievement.

When loan and GPA are studied, it has been noted that borrowers with high GPA's are less likely to be delinquent than borrowers with minimal grades (Bergen, Bergen, and Miller, 1972) but as loan amounts increase the percentages of those students repaying on schedule decreases (Harrison, 1972).

This summary suggest that a linear trend exists between the variables of this study and that they could have implications for predictability.

Analyses of the Data and Findings

The statistical procedures which were used were the BMDP computer program. This program performed backward elimination regression, forward selection regression, and step-wise regression analysis techniques.

The data analyzed were obtained from a population of 360 financial aid profile cards of students enrolled at a rural junior college in Missouri. The 198 financial aid profile cards used for this study were selected on the basis of their being full-time students, having a cumulative grade-point average for the academic year 1978-79, at least one financial aid award, and a reported socio-econmic status. Those not used were students whose profile lacked a critical determinant such as full-time student, cumulative grade-point average, sex or socio-economic status. Some of those not used were unavailable either because the students were not obligated to report them or they were not collected.

The data collected were as follows: cumulative grade-point average (the dependent variable), the dollar amount of assistance provided by the Basic Educational Opportunity Grant, the National Direct Student Loan, the College Work-Study Program, Institutional Scholarships, the Missouri Student Grant Program, sex, socio-economic status (adjusted gross income and/or nontaxable income), independent or dependent student status, and whether the student was a freshman or a sophomore (the independent variables). The critical elements of analysis are provided in the tables which follow. These tables are A Mean and Standard Deviations table, A Correlation Matrix table, A Stepwise Regression Coefficients table, A Partial Correlations Table, and A Summary table of Multiple R and RSQ.

A step-wise multiple regression analysis was calculated to determine the amount of unique variance each of the individual variables added to prediction. The procedure started with the variable that had the highest single order correlation with the criterion. The second variable selected had the highest correlation with the first selected variable partialed out. A multiple correlation was

computed using the first two predictors. The process was repeated until the gain in the multiple R was less than .01.

This multiple regression technique was selected for its ability to predict scores on a single dependent variable, once one was given knowledge on two or more independent variables. This technique also provides the intercorrelation between predictor variables. The best combination of the two or three predictors can be used to produce a multiple regression equation. Once this regression equation is available, it can be used to analyze trial sets of values for use in allocating funds to students. This final regression equation can be used by trial and error to increase and find the student's highest possible predicted GPA.

The means and standard deviations reported in Table 1 are deflated by the inclusion of 9's to represent awards where aid may not have been awarded. For this reason the smallest and largest values are also reported.

It was hypothesized that (1) students' socio-economic status is not related to their academic success. (2) The type of financial aid received by students is not related to their academic success. (3) There is no relationship between sex and academic achievements. These relationships are shown in Table 2.

The primary thurst of this study was two-fold. The first was to produce a multiple regression equation which could be used with all the variables in this study to predict GPA's. The second was to determine which of the variables were discriminant enough to produce a GPA without the aid of all of the other variables.

The multiple regression equation which was discussed above is at step 10 of table 3.

From table 3 the following regression equation was developed for the prediction of grade-point averages from the ten variables:

$$Y' = 2.8629 - 0.0004X_2 - 0.0004X_3 + 0.0005X_4 + 0.0000X_5 + 0.0005X_6 + 0.1090X_7\ (_1{}^0) - 0.0000X_8 - 0.0271X_9\ (_1{}^0) + 0.0001X_{10} + 0.2143X_{11}\ (_1{}^0)$$

in which Y' is the estimated criterion score, X_2 is the Basic Educational Opportunity Grant, X_3 is the Supplemental Educational Opportunity Grant, X_4 is the National Direct Student Loan, X_5 is the College Work-Study Program, X_6 is the Institutional Scholarship, X_7 is the sex (male 0/female 1), X_8 is the socio-ecoomic status, X_9 is the student status (Independent 0/Dependent 1), X_{10} is the Missouri Student Grant, and X_{11} is the college standing (Freshman 0/ Sophomore 1).

From table 3 the following regression equation was developed for the prediction of grade-point averages from the backward elimination regression at step 3. $Y' = 2.8553 - 0.0005X_2 + 0.0003X_6 + 0.2001X_{11}\ (_1{}^0)$, in which Y' is the estimated criterion score, X_2 is the Basic Educational Opportunity Grant, X_6 is the Institutional Scholarship, and X_{11} is the college standing (Freshman 0/Sophomore 1).

Tables 4 and 5 have been included to show the partial correlations and multiple R and RSQ as contributing factors to the multiple regression equation after the backward elimination regression at step 3.

Cross validation procedures used a shrinkage formula of the form,

$$\hat{R} = 1-\sqrt{(1-R^2)\,\frac{N-1}{N-m-1}}$$

Where R = estimate of population R, N = sample size, and m = number of predictor variables. This computation results in R = .2805 and may be compared to the multiple R of the regression equation of .3543.

Summary

The purpose of this study was to examine the relationship and effects of financial aid packaging on college grade-point averages. The emphasis of this study was on the need to reduce the subjectivity of packaging student financial aid awards. This subjectivity has been adequate for the distribution of funds but has not been demonstrated as having any other utility. This study has produced a multiple regression equation which can now use the subjective assignment of aid to students in an objective manner, thereby producing as the main by-product the best possible combination of aid which is capable of increasing a predicted grade-point average.

From the population of 360 students, data were used on 198. These 198 students were selected based on their profile cards having all critical determinants for computation. Determinants used were such as full-time student, CGPA, a financial aid award and socioeconomic status. Students omitted were those whose profile lacked a critical determinant such as full-time student, CGPA, sex (not reported), and socioeconomic (non-need scholarships).

The BMDP stepwise regression program produced the following stepwise regression coefficients:

GPA" = 2.8629 -0.0004BEOG -0.0004SEOG +0.0005NDSL +0.0000CWSP +0.0005SCHOLARS +0.1090 0/FEMALE 1 -0.0000SOCIOECO -0.0271INDEP 0/DEP 1 +0.0001MSG +0.2134 FRES 0/SOPH 1.

This multiple regression equation can now be used mathematically to answer the following hypothesis:

Hypothesis I. Students' socioeconomic status is not related to their academic success.

A male dependent freshman who is from a low socioeconomic strata and receives a large financial aid package of BEOG $800, SEOG $200, NDSL $500, MSG $100 produces a predicted grade-point average of 2.6958. This same male dependent freshman from a high socioeconomic strata would probably not be eligible for any financial aid other than that based on academic record. A scholarship of $300 results in a predicted grade-point average of 2.9858. This obvious difference in GPA's suggests that socioeconomic status and type of financial aid received is related to academic success.

TABLE 1
MEAN AND STANDARD DEVIATIONS

NO.	VARIABLE NAME	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION	SKEWNESS	KURTOSIS
1	GPA	2.7775	0.7073	0.2546	-0.6591	3.2004
2	BEOG	462.9747	412.3071	0.8906	-0.0649	1.1903
3	SEOG	48.3535	117.9221	2.4387	3.1187	15.5141
4	NDSL	26.5152	125.5100	4.7335	5.1372	30.4561
5	CWSP	180.1465	434.1434	2.4099	3.9585	24.5715
6	SCHOLARS	145.7929	182.0679	1.2488	1.1753	3.9054
7	SEX	0.6010	0.4909	0.8168	-0.4094	1.1584
8	SOCIOECO	11709.3182	6298.7097	0.5379	0.2410	2.2493
9	STUDSTA	0.8030	0.3987	0.4965	-1.5123	3.2887
10	MSG	62.9394	62.3279	0.9903	0.3954	2.2067
11	FRESSOPH	0.4141	0.4938	1.1924	0.3460	1.1102

NO.	VARIABLE NAME	SMALLEST VALUE	LARGEST VALUE	SMALLEST STD. SCORE	LARGEST STD. SCORE
1	GPA	0.60000	4.0000	-3.0788	1.7286
2	BEOG	0.	1162.0000	-1.1229	1.6954
3	SEOG	0.	850.0000	-0.4100	6.7981
4	NDSL	0.	900.0000	-0.2113	6.9595
5	CWSP	0.	3577.0000	-0.4149	7.8243
6	SCHOLARS	0.	760.0000	-0.8008	3.3735
7	SEX	0.	1.0000	-1.2242	0.8127
8	SOCIOECO	100.0000	27856.0000	-1.8431	2.5635
9	STUDSTA	0.	1.0000	-2.0140	0.4940
10	MSG	0.	205.0000	-1.0098	2.2792
11	FRESSOPH	0.	1.0000	-0.8386	1.1864

TABLE 2
CORRELATION MATRIX

		GPA 1	BEOG 2	SEOG 3	NDSL 4	CWSP 5	SCHOLARS 6
GPA	1	1.0000					
BEOG	2	-0.2745	1.0000				
SEOG	3	-0.1166	0.3108	1.0000			
NDSL	4	0.0753	-0.0432	0.2062	1.0000		
CWSP	5	-0.0005	0.0160	-0.0190	-0.0196	1.0000	
SCHOLARS	6	0.1766	-0.3119	-0.1707	-0.1617	-0.0932	1.0000
SEX	7	0.1273	-0.1685	0.1052	0.1520	0.1322	-0.0139
SOCIOECO	8	0.1103	-0.5810	-0.2737	-0.1113	-0.0679	0.2791
STUDSTA	9	-0.0390	-0.0523	-0.0890	-0.4276	-0.1719	0.2497
MSG	10	-0.0976	0.3328	0.2745	0.0876	-0.1134	-0.2353
FRESSOPH	11	0.1033	0.1447	0.0383	-0.1371	-0.0621	0.0240

		SEX 7	SOCIOECO 8	STUDSTA 9	MSG 10	FRESSOPH 11
SEX	7	1.0000				
SOCIOECO	8	-0.0011	1.0000			
STUDSTA	9	-0.1701	0.4525	1.0000		
MSG	10	0.0015	-0.1398	0.0122	1.0000	
FRESSOPH	11	-0.0059	-0.0866	0.0555	0.0826	1.0000

TABLE 3
STEPWISE REGRESSION COEFICIENTS

VARIABLES STEP	0 Y-IN TC	2 BEOG	3 SEOG	4 NDSL	5 CWSP	6 SCHOLAR
0	2.7775*	-0.0005	-0.0007	0.0004	-0.0000	0.0007
1	2.9955*	-0.0005*	-0.0002	0.0004	0.0000	0.0004
2	2.9256*	-0.0005*	-0.0002	0.0005	0.0000	0.0003
3	2.8553*	-0.0005*	-0.0002	0.0006	0.0000	0.0003*
4	2.8151*	-0.0004*	-0.0003	0.0006*	0.0000	0.0004*
5	2.7409*	-0.0004*	-0.0004	0.0005*	0.0000	0.0004*
6	2.7342*	-0.0004*	-0.0004*	0.0006*	0.0000	0.0004*
7	2.8588*	-0.0004*	-0.0004*	0.0006*	0.0000	0.0005*
8	2.8676*	-0.0004*	-0.0004*	0.0005*	0.0000	0.0005*
9	2.8637*	-0.0004*	-0.0004*	0.0005*	0.0000*	0.0005*
10	2.8629*	-0.0004*	-0.0004*	0.0005*	0.0000*	0.0005*
11	2.8637*	-0.0004*	-0.0004*	0.0005*	0.0000*	0.0005*

VARIABLES STEP	7 SEX	8 SOCIOECO	9 STUDSTA	10 MSG	11 FRESSOPH
0	0.1835	0.0000	-0.0692	-0.0011	0.1479
1	0.1202	-0.0000	-0.0950	-0.0001	0.2092
2	0.1163	-0.0000	-0.1118	-0.0001	0.2092*
3	0.1260	-0.0000	-0.1579	0.0000	0.2001*
4	0.1075	-0.0000	-0.1003	-0.0001	0.2178*
5	0.1075*	-0.0000	-0.0832	-0.0001	0.2134*
6	0.1196*	-0.0000	-0.0771	-0.0000	0.2152*
7	0.1125*	-0.0000*	-0.0299	0.0001	0.2132*
8	0.1105*	-0.0000*	-0.0299*	0.0001	0.2135*
9	0.1091*	-0.0000*	-0.0271*	0.0001	0.2143*
10	0.1090*	-0.0000*	-0.0281*	0.0001*	0.2138*
11	0.1091*	-0.0000*	-0.0271*	0.0001	0.2143*

NOTE - 1) Regression coefficients for variables in the equation are indicated by an asterisk
2) The remaining coefficients are those which would be obtained if that work variable were to enter the next step

TABLE 4
PARTIAL CORRELATIONS

VARIABLES STEP	2 BEOG	3 SEOG	4 NDSL	5 CWSP	6 SCHOLARS	7 SEX
0	-0.2745	-0.1166	0.0753	-0.0005	0.1766	0.1273
1	-0.2745*	-0.0342	0.0661	0.0040	0.0996	0.0856
2	-0.2941*	-0.0336	0.0877	0.0140	0.0898	0.0837
3	-0.2553*	-0.0264	0.1057	0.0221	0.0898*	0.0908
4	-0.2482*	-0.0515	0.1057*	0.0270	0.1074*	0.0771
5	-0.2331*	-0.0628	0.0942*	0.0164	0.1112*	0.0771*
6	-0.2040*	-0.0628*	0.1051*	0.0136	0.1091*	0.0851*
7	-0.2042*	-0.0668*	0.0976*	0.0102	0.1142*	0.0800*
8	-0.1954*	-0.0651*	0.0850*	0.0081	0.1149*	0.0781*
9	-0.1956*	-0.0648*	0.0854*	0.0081*	0.1152*	0.0765*
10	-0.1917*	-0.0648*	0.0844*	0.0073*	0.1148*	0.0764*
11	-0.1956*	-0.0648*	0.0854*	0.0081*	0.1152*	0.0765*

VARIABLES STEP	8 SOCIOECO	9 STUDSTA	10 MSG	11 FRESSOPH
0	0.1103	-0.0390	-0.0976	0.1033
1	-0.0629	-0.0556	-0.0069	0.1503
2	-0.0631	-0.0661	-0.0126	0.1503*
3	-0.0755	-0.0909	0.0009	0.1441*
4	-0.0605	-0.0531	-0.0087	0.1563*
5	-0.0535	-0.0439	-0.0118	0.1535*
6	-0.0581	-0.0407	-0.0016	0.1551*
7	-0.0581*	-0.0138	-0.0057	0.1538*
8	-0.0437*	-0.0138*	0.0065	0.1540*
9	-0.0439*	-0.0123*	0.0055	0.1542*
10	-0.0442*	-0.0127*	0.0055*	0.1535*
11	-0.0439*	-0.0123*	0.0055	0.1542*

TABLE 5
SUMMARY TABLE

STEP NO.	VARIABLE ENTERED	MULTIPLE R	RSQ	INCRESAE IN RSQ
1	2 BEOG	0.2745	0.0754	0.0754
2	11 FRESSOPH	0.3102	0.0962	0.0209
3	6 SCHOLARS	0.3218	0.1035	0.0073
4	4 NDSL	0.3370	0.1135	0.0100
5	7 SEX	0.3447	0.1188	0.0053
6	3 SEOG	0.3497	0.1223	0.0035
7	8 SOCIOECO	0.3539	0.1253	0.0030
8	9 STUDSTA	0.3542	0.1254	0.0002
9	5 CWSP	0.3542	0.1255	0.0001
10	10 MSG	0.3543	0.1255	0.0000

Hypothesis II is also satisfied with the above equation. To answer Hypothesis III, there is no relationship between sex and academic achievement. By entering female in the above equation the predicted grade-point averages would be 2.8048 and 3.0948 respectively. This suggests that academic achievement as measured by grade-point average is related to the sex of the aid recipient.

This study also produced a parsimonious equation, at step 3. This equation is as follows: GPA' = 2.8553 -0.0005BEOG +0.0003SCHOLAR +0.2001FRES 0/SOPH 1.

Some possible profiles and predicted GPA's are as follows:

BEOG $1000 Freshman = GPA' 2.3553
BEOG $1000 Sophomore = GPA' 2.5554
SCHOLAR $300 Freshman = GPA' 2.9453
SCHOLAR $300 Sophomore = GPA' 3.1454

Conclusions

It is suggested by this researcher from a study of literature on financial aid and grade-point averages that a linear trend exists between the variables of this study and that trend could have implications for predictability. The above equations do indeed produce predicted grade-point averages and by changing amounts and student's profiles one can increase predicted grade-point averages. This finding can now be used to determine if a more objective means of financial aid packaging can produce the optimum grade-point average given the best possible aid combinations.

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