Predicting College Academic Performance from Precollege Measures of Academic Ability for Twelve Freshman Admitting Colleges at the University of Minnesota

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In the past, only a minority of students admitted to the General College (GC) had taken a college entrance examination such as the SAT or ACT. This year, however, about half of the students entering General College for the first time had ACT scores. Given that all Minnesota high school students will be required to take the ACT in their junior or senior year, the General College can expect an even higher percentage of applicants and admits who will submit ACT scores upon application. The fairly large number of admits with ACT scores for this past year provides an excellent opportunity to investigate the utility of the ACT for predicting academic success in General College. However, it should be kept in mind that the ACT is being revised this year and it is difficult to anticipate what effects (if any) the revision will have on the relationship between ACT scores and college academic success.

This report is less formal than ORE's usual fare. Although statistics and statistical tests are presented, there are many instances where the practical or apparent significance of differences is addressed without reference to the results of a statistical test. While this is in line with the practical nature of the admissions process, it does not detract from the importance of the findings.

Predicting College Academic Performance in the General College

Typical measures of precollege academic ability are high school math course grades, high school English course grades, high school percentile rank, high school GPA, and scores on standardized tests such as the PSAT, SAT, and ACT. Two of the measures, namely high school GPA and high school percentile rank, are typically available for GC freshmen. Given that half the Fall, 1988, entering GC freshmen also had ACT scores, it was of interest to look at the relationship between these three measures and a measure of college academic performance. Spring, 1989, cumulative GPA was chosen as the latter measure.

In all, 910 students were identified as having registered in GC for the first time in Fall, 1988. The correlation between ACT composite scores and cumulative GPA was close to zero ($r = .112$, $N = 461$). Cumulative GPA also had low correlations with high school percentile rank ($r = .266$, $N = 821$) and high school GPA ($r = .259$, $N = 864$). These are very low correlations, especially for the high school indicators which are usually the best predictors of academic performance in college.

These findings raised the question of whether the low correlations are characteristic of all freshmen entering the University of Minnesota, or particular to the General College. This was considered a worthwhile question to pursue since the answer would help to further define the General College student population, as well as assess the utility of the ACT, in its current form, as an admissions tool.

Comparison of Precollege Academic Ability Measures

Twelve University of Minnesota colleges which admit freshmen were chosen for comparison to General College freshmen. The colleges were the College of Liberal Arts (CLA), the Institute of Technology (IT), Science and Engineering (Sci & Eng), Business and Economics (Bus & Econ), Agriculture, Forestry, Home Economics, Fine Arts, Education and Human Services, and the Morris, Crookston, and Waseca campuses. The colleges of Agriculture, Forestry, and Home Economics were combined into one group (Ag-For-HomeEc) which represents the Saint Paul campus. Similarly, the Morris, Crookston, and Waseca campuses were combined into a single group (Mor-Crook-Was) to represent satellite campuses of the University. All other colleges remained as distinct groups.

Table 1 presents the number of freshmen whose first quarter of registration at the University was Fall, 1988, for each of the nine groups defined above. The groups are arranged in rank order according to the number of students each group represents. As can be seen, the range is from less than one hundred (Fine Arts) to almost 4,000 (CLA) admits, with GC just above the middle rank (rank of 4 out of 9).

Tables 2 through 8 present rank orderings of the nine entering freshmen groups for mean scores on high school percentile rank, high school GPA, the four subscores of the ACT, and ACT composite scores. Although this is a lot of information, it provides a base for comparing the nine groups on precollege academic performance. One observation which jumps out from the tables is that IT is always on top, and that the students entering IT typically have less variation among their scores than do students entering the other colleges. A second observation is that GC is always ranked last, with scores that are typically lower and depart significantly from scores of the other groups.

Table 9 presents a rank ordering based on the average ranks for each group across Tables 2 through 7. IT and GC appear to be at opposite ends of the spectrum with respect to precollege academic measures, which is probably of no surprise given their respective admissions requirements. Both of these colleges stand apart from the remaining seven groups. Of the remaining groups, Education & Human Services comes closest to GC, followed by Fine Arts, although average scores for these two groups appear to be higher than those of GC, on the whole.

Given this comparison of the nine groups, it was of interest to look at the correlations between precollege measures of academic performance and college academic performance for each group.

Are Precollege and College Academic Performance Related?

Table 10 presents the correlations of high school percentile rank, high school GPA, and ACT composite scores with Spring, 1989, cumulative GPA for each of the nine groups. The order of the groups was determined as follows. The nine groups were rank ordered for each of the three precollege academic performance measures. For each group, the three rank orders were averaged, and the groups ordered from highest to lowest according to their average rank. Fine Arts and Business & Economics tied for first place. These two colleges along with the Morris-Waseca-Crookston group tend to have correlations that are somewhat higher than the correlations obtained for all groups combined. Agriculture-Forestry-Home Economics, Science & Engineering, IT, and CLA have correlations which are similar to the total group correlations. Education & Human Services and GC fill the bottom two ranks, respectively. Yet, even though the correlations for Education & Human Services are lower than those for all groups combined, GC still stands apart from all the other colleges with significantly low correlations. While the high school measures and the ACT show some degree of association with college performance, this is clearly not the case for General College freshmen.

A final set of analyses was performed to determine the degree of prediction obtained when the high school measures and ACT composite scores were combined to predict Spring, 1989, cumulative GPA. High school percentile rank and GPA are highly correlated ($r = .892$ for the entire group, $N = 6185$) so that it would not be informative to enter both into a multiple regression equation to predict cumulative GPA. Two separate multiple regression runs were conducted for each freshmen group. The first analysis regressed high school percentile rank and ACT composite score onto Spring, 1989, GPA. High school percentile rank was entered into the equation first, followed by ACT composite score. This produced two multiple Rs, one for high school GPA alone, and one for high school percentile rank and ACT composite scores both entered into the equation. (Anyone who is not familiar with mulitple regression or has difficulty interpreting Tables 11 and 12 can refer to the appendix.)

Table 11 presents a summary of results for high school percentile ranks and ACT composite scores regressed onto Spring, 1989, cumulative GPA. Multiple Rs were used to arrange the nine groups in rank order (Note: The multiple R used for ranking is underlined). There is one case (Educ/Human Serv) where the F statistic was not significant, indicating that ACT scores did not significantly increase the amount of variance accounted for. Therefore, the multiple R for high school percentile rank alone is used and indicated by an underscore. Note that the same ordering would have obtained if multiple Rs for both precollege variables were used for all groups.

The multiple R for the entire group is .431, and the multiple Rs for most of the nine groups come close to this same value. Fine Arts is extremely high, since the multiple R of .630 accounts for 21% more variance than is possible for the group as a whole. The multiple R of .514 for Business & Economics is higher than .431, and represents an 8% increase in accountable variance. Similarly, the multiple R of .341 for Education & Human Services accounts for 7% less variance in cumulative GPA, while the General College multiple R of .283 (8% variance accounted for) is 10% less. The results presented in Tables 10 and 11 are quite similar. In both tables, Fine Arts is ranked first, followed by Business & Economics, while General College is ranked last and preceded by Education and Human Services.

Table 12 presents the results for a similar multiple regression analysis, but with high school GPA substituted for high school percentile rank as a predictor variable. Again, the results are similar to Tables 10 and 11, with Fine Arts and Business & Economics in top ranks while General College is ranked last and preceded by Education & Human Services. Although there are fewer students with scores on all three variables, the multiple R for the entire group (.454) comes out a little higher than when high school percentile rank was entered first. If the General College is not included, the spread of multiple Rs across the nine groups is also a little tighter in Table 12. The highest multiple R of .599 for Fine Arts only accounts for 15% more variance, while the multiple R of .384 for Education & Human Services only accounts for 6% less. When General College is considered, again we find about 8% of the variance in cumulative GPA accounted for, which is 13% less than for the entire group. In addition, knowing ACT composite scores in addition to high school GPA does not significantly reduce the prediction error.

Conclusions

High school percentile rank, high school GPA, and ACT composite scores were not found to be reliable predictors of General College academic performance. Even in the case where high school percentile rank and ACT scores could be combined to predict college GPA, they only accounted for 8% of the variance. It would be impossible to make informed admissions decisions for General College admits based on these precollege indicators of academic performance and ability alone.

General College students have much lower scores on the precollege measures than all other entering freshmen used for this report. Some might be inclined to point to this characteristic as the reason for the low correlations. A review of the findings does not support this conclusion. The College of Education and Human Services looks the most like GC in terms of the precollege measures. Although the correlations are also low for Education and Human Services, they are significantly higher than those of GC. In addition, correlations for the College of Fine Arts were always ranked the highest despite and overall ranking of 7 based on the precollege measures. This

is also surprising given that the small number of students entering Fine Arts would cause one to expect lower correlations due to restriction of range. Finally, colleges which ranked high in terms of precollege measures (i.e., IT, Science & Engineering, and CLA) had correlations that were about average when compared to the entire group. Therefore, the low academic standing of General College students may be involved, but may not be directly responsible for the low correlations.

What does all this add up to? Mainly, that although it is clear that the precollege measures explored in this report cannot reliably predict academic performance in GC, it is not clear as to why? Given the present structure of the General College, we will have to seek other forms of pre-admissions information if we are to separate those who are likely to succeed from those who are not before they begin at GC. However, this does not mean the precollege academic measures are not useful admissions tools. The precollege measures do provide some ability to predict academic success for most other freshmen entering the University. This is exactly what is done by setting minimums for PAR, AAR, and SAR scores. Reasonable cutoff scores could be set for most colleges that would reliably identify applicants with a low likelihood of success.

Most notably, the reliability of these predictions are not dependent on level of prior academic success or achievement. It is not the fault of the precollege measures. It could be due to differences between the GC curriculum and that of other colleges. It could be due to differences in grading practices. Whatever the reason, the question is still one of how best to predict what results when a General College admit interacts with the General College. Hopefully, we will look to internal as well as external sources as we explore this question.

Appendix

The discussion which follows makes use of Table 11 for illustration. The multiple R is the counterpart for the Pearson product moment correlation in simple linear regression. The multiple R indicates the degree of association between a linear combination of the predictor variables (i.e., high school percentile rank and ACT composite scores) and the dependent variable, or the variable to be predicted (i.e., Spring, 1989, GPA). When R is squared, it represents the proportion of variance in the dependent variable which is accounted for by the linear combination of the predictor variables. Since R^2 is a proportion, it can be translated to a percentage through multiplication by 100.

To explain this further, take the situation where you know nothing other than the distribution of cumulative GPAs for a group. Given a particular individual, and no other information about the individual, your best bet is to predict that the student's cumulative GPA is equal to the mean cumulative GPA. It can be argued that the least amount of error in prediction is produced if you simply predict the mean for every individual in the group (under these circumstances). However, if an equation produced by multiple regression is used to predict cumulative GPAs, the error in prediction is reduced, and the reduction is equal to $R^2 \times 100$.

The second column represents the number of students who had values for all three measures, and is presented for comparison with Table 1. The third column presents the multiple R when only high school percentile rank is entered. This is the same as the simple correlation between high school percentile rank and cumulative GPA. R^2 is given in column four, and indicates the proportion of variance in Spring, 1989, cumulative GPAs accounted for by knowing high school percentile ranks. Column five indicates the multiple R when both precollege measures are used to predict cumulative GPA.

Column six differs from column four in that it represents an additional proportion of variance accounted for by the addition of ACT composite scores to the prediction equation. The results for the entire group will be used to illustrate the difference. The multiple R is .406 (column 3) which indicates a .165 (column 4), or 16.5%, reduction in variance. When ACT composite scores are added, the multiple R increases to .431 (column 5) which explains an additional .021 (column 6), or 2.1%, of variance in cumulative GPA. The test statistic in the seventh column indicates whether the R^2 change is significantly greater than zero (0). In other words, it asks the question of whether ACT scores significantly reduce the error of prediction beyond the reduction already produced by knowing high school percentile ranks. When the entire group of students is considered, the probability is less than .001 (one in a thousand) that the change in R^2 due to ACT scores is equal to zero. Therefore, the multiple R is taken to be .431 for all groups combined, with a total reduction in error of 18.6% (16.5% + 2.1% = 18.6%).

Table 1. Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988.†

College	Frequency	Percent
CLA	3763	40.7
Mor-Crook-Was	1736	18.8
IT	1036	11.2
GC	910	9.8
Sci & Eng	562	6.1
Bus - Econ	456	4.9
Ag-For-HomeEc	381	4.1
Educ-Hum Services	323	3.5
Fine Arts	75	0.8
Entire Group	9242	100.0

Table 2. Rank Ordering of Mean High School Percentile Ranks for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988.†

College	N	Mean	Std Dev
IT	730	88.9	9.11
Sci & Engineering	501	76.9	17.73
Ag-For-HomeEc	179	75.1	15.42
CLA	2637	74.8	16.89
Fine Arts	59	67.2	20.10
Bus-Economics	399	66.2	18.95
Educ-Human Serv.	223	66.1	20.38
Mor-Crook-Was	1037	65.6	27.00
GC	821	33.4	17.61
Entire Group	6586	69.0	23.88

† The colleges of Agriculture, Forestry and Home Economics were combined into one group. The Morris, Crookston, and Waseca campuses were also combined to form a single group.

Table 3. Rank Ordering of Mean High School GPA for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988.†

College	N	Mean	Std Deviation
IT	722	3.56	0.371
Mor-Crook-Was	120	3.29	0.56
Sci & Engineering	494	3.12	0.583
CLA	2547	3.08	0.522
Ag-For-HomeEc	168	3.03	0.563
Bus-Economics	385	2.80	0.536
Educ-Human Serv.	208	2.80	0.567
Fine Arts	58	2.75	0.686
GC	864	1.99	0.481
Entire Group	5566	2.94	0.685

Table 4. Rank Ordering of Mean ACT English Subscore for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988.†

College	N	Mean	Std Deviation
IT	503	22.7	3.50
CLA	1998	21.3	3.79
Sci & Engineering	500	20.2	4.19
Ag-For-HomeEc	122	20.1	4.33
Fine Arts	59	20.1	4.64
Mor-Crook-Was	644	19.7	4.82
Bus-Economics	394	18.5	3.85
Educ-Human Serv.	223	18.4	4.33
GC	461	16.5	4.53
Entire Group	4575	20.2	4.44

† The colleges of Agriculture, Forestry and Home Economics were combined into one group. The Morris, Crookston, and Waseca campuses were also combined to form a single group.

Table 5. Rank Ordering of Mean ACT Mathematics Subscore for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988.†

College	N	Mean	Std Deviation
IT	503	28.5	3.75
Sci & Engineering	500	23.6	5.84
CLA	1669	22.4	5.34
Ag-For-HomeEc	122	21.6	5.48
Mor-Crook-Was	644	20.8	7.12
Bus-Economics	394	19.4	6.35
Educ-Human Serv.	223	17.1	6.67
Fine Arts	59	16.5	7.33
GC	461	13.7	6.22
Entire Group	4575	21.5	6.91

Table 6. Rank Ordering of Mean ACT Social Sciences Subscore for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988.†

College	N	Mean	Std Deviation
IT	503	25.2	4.57
CLA	1669	22.0	5.54
Sci & Engineering	500	21.4	6.02
Ag-For-HomeEc	122	20.5	6.41
Mor-Crook-Was	644	20.2	6.70
Fine Arts	59	18.7	6.31
Bus-Economics	394	18.3	6.24
Educ-Human Serv.	223	17.1	6.33
GC	461	15.1	6.12
Entire Group	4575	20.7	6.46

† The colleges of Agriculture, Forestry and Home Economics were combined into one group. The Morris, Crookston, and Waseca campuses were also combined to form a single group.

Table 7. Rank Ordering of Mean ACT Natural Sciences Subscore for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988.†

College	N	Mean	Std Deviation
IT	503	29.7	3.47
Sci & Engineering	500	26.5	5.01
CLA	1669	25.5	4.94
Ag-For-HomeEc	122	24.5	5.10
Mor-Crook-Was	644	24.3	5.76
Bus-Economics	394	22.4	5.27
Fine Arts	59	21.8	4.95
Educ-Human Serv.	223	21.4	5.37
GC	461	19.0	5.22
Entire Group	4575	24.7	5.74

Table 8. Rank Ordering of Mean ACT Composite Score for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988.†

College	N	Mean	Std Deviation
IT	503	26.7	3.02
Sci & Engineering	500	23.0	4.34
CLA	1669	22.9	3.9
Ag-For-HomeEc	122	21.9	4.49
Mor-Crook-Was	644	21.4	5.24
Bus-Economics	394	19.8	4.68
Fine Arts	59	19.4	4.84
Educ-Human Serv.	223	18.6	4.77
GC	461	16.2	4.22
Entire Group	4575	21.9	5.02

† The colleges of Agriculture, Forestry and Home Economics were combined into one group. The Morris, Crookston, and Waseca campuses were also combined to form a single group.

Table 9. Rank Ordering of Mean Ranks from Tables 2 Through 7 for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988.†

College	Rank HS Perc Rank Table2	HS GPA Table 3	ACT English Table 4	ACT Math Table 5	ACT Soc Sci Table 6	ACT Nat Sci Table 7	Mean Rank
IT	1	1	1	1	1	1	1.0
Sci & Engineering	2	3	3	2	3	2	2.5
CLA	4	4	2	3	2	3	3.0
Ag-For-HomeEc	3	5	4	4	4	4	4.0
Mor-Crook-Was	8	2	6	5	5	5	5.2
Bus-Economics	6	6	7	6	7	6	6.3
Fine Arts	5	8	5	8	6	7	6.5
Educ-Human Serv.	7	7	8	7	8	8	7.5
GC	9	9	9	9	9	9	9.0

Table 10. Correlations of High School Percentile Rank, High School GPA, and ACT Composite Score with Spring, 1989, Cumulative GPA for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988.†

College	HS PR N	HS PR Corr	HS GPA N	HS GPA Corr	ACT Composite N	ACT Composite Corr
Fine Arts	59	.535	58	.442	59	.582
Bus - Econ	399	.469	385	.466	394	.427
Mor-Crook-Was	1037	.483	120	.463	644	.374
Ag-For-HomeEc	179	.389	168	.504	121	.360
Sci & Eng	501	.452	494	.495	500	.324
IT	730	.378	722	.453	503	.337
CLA	2637	.380	2547	.435	1669	.326
Educ-Hum Services	223	.344	208	.385	223	.283
GC	821	.266	864	.259	461	.112
Entire Group	7367	.410	6311	0.440	5334	0.357

† The colleges of Agriculture, Forestry and Home Economics were combined into one group. The Morris, Crookston, and Waseca campuses were also combined to form a single group.

Table 11. Results of Mulitple Regression Runs to Predict Cumulative GPA after Spring Quarter, 1989, Using High School Percentile Rank and ACT Composite Score as Predictor Variables for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988 †

COLLEGE	N	HS PR Multiple R	HS PR Multiple R^2	HS PR & ACT Comp Multiple R	ACT Comp R^2 Change	F Value for R^2 Change
All Colleges	5184	.406	.165	.431	.021	134.308***
Fine Arts	57	.543	.295	.630	.103	9.177**
Bus/Econ	390	.471	.222	.514	.042	22.249***
Science/Engineering	495	.454	.206	.462	.007	4.481*
CLA	1608	.410	.168	.458	.041	84.098***
Mor/Crook/Was	609	.398	.158	.437	.032	24.183***
IT	495	.349	.122	.427	.060	36.100***
Ag/For/Home Ec	119	.354	.125	.405	.039	5.455*
Educ/Hum Serv	213	.341	.117	.363	.015	3.648
GC	453	.263	.069	.283	.011	5.283*

† The colleges of Agriculture, Forestry and Home Economics were combined into one group. The Morris, Crookston, and Waseca campuses were also combined to form a single group.

* $p < .05$

** $p < .01$

*** $p < .001$

Table 12. Results of Mulitple Regression Runs to Predict Cumulative GPA after Spring Quarter, 1989, Using High School GPA and ACT Composite Score as Predictor Variables for for Nine Groups of Freshmen Who Entered the University of Minnesota Fall, 1988 †

COLLEGE	N	HS GPA Multiple R	HS GPA Multiple R^2	HS GPA & ACT Comp Multiple R	ACT Comp R^2 Change	F Value for R^2 Change
All Colleges	4609	.440	.193	.454	.013	75.258***
Fine Arts	58	.442	.196	.599	.163	14.025***
Mor/Crook/Was	103	.480	.230	.517	.037	5.098*
Bus/Econ	385	.466	.217	.503	.036	18.194***
Ag/For/Home Ec	491	.497	.247	.500	.003	1.638
IT	495	.437	.191	.479	.039	24.881***
CLA	1568	.435	.189	.467	.029	58.149***
Science/Engineering	113	.441	.195	.469	.025	3.574
Educ/Hum Serv	206	.384	.148	.394	.007	1.796
GC	457	.276	.076	.289	.007	3.578

† The colleges of Agriculture, Forestry and Home Economics were combined into one group. The Morris, Crookston, and Waseca campuses were also combined to form a single group.

* $p < .05$

** $p < .01$

*** $p < .001$