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ABSTRACT

The development of new admissions standards for freshmen entering the College of Liberal Arts, the College of Forestry, the Institute of Technology, and the University of Minnesota at Morris is described and supporting research presented. The new admissions standards, which are based on a multiple correlation and regression approach using first quarter freshman year GPA as the criterion, permit applicants to submit the Preliminary Scholastic Aptitude Test (PSAT) or the aptitude tests of the American College Testing Program (ACT) for both admissions and placement purposes. This research project was originally organized into three parts: (1) preliminary research on 1972 university freshmen; (2) the development of new admissions standards on 1973 freshmen (for whom some PSAT scores were available); and (3) the establishment of cutting scores on the new admissions standards. After cutting scores on the new admissions criteria were developed, a fourth stage of research, best described as a process of double-checking earlier results, was undertaken. Table 1 of this document summarizes each phase while the remainder of the document discusses the phases in more detail, presenting supporting data at each stage of research. (Author/KE)

office for student affairs RESEARCH BULLETIN

THE DEVELOPMENT OF NEW ADMISSIONS STANDARDS FOR FALL 1975 UNIVERSITY OF MINNESOTA FRESHMEN

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Abstract

The development of new admissions standards for freshmen entering the College of Liberal Arts, the College of Forestry, the Institute of Technology, and the University of Minnesota at Morris is described and supporting research presented. The new admissions standards, which are based on a multiple correlation and regression approach using first quarter freshman year GPA as the criterion, permit applicants to submit the results of either the Preliminary Scholastic Aptitude Test (PSAT) or the aptitude tests of the American College Testing Program (ACT) for both admissions and placement purposes. A discussion of followup research related to the equivalence and adequacy of the selected cut-off scores is also included.

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When the Minnesota Statewide Testing Program decided to replace the Minnesota Scholastic Aptitude Test (MSAT) with the Preliminary Scholastic Aptitude Test/National Merit Scholarship Qualifying Test (PSAT) in 1973-1974, many colleges which had previously used the MSAT for admissions purposes were suddenly faced with the difficult task of revising admissions standards for fall 1975 freshmen, the first group of applicants for whom substantial numbers of PSAT scores would be available. Several colleges at the University of Minnesota--the College of Liberal Arts (CLA), the College of Forestry, and the University of Minnesota at Morris--had been using MSAT scores as an admissions criterion, usually in combination with high school rank.

University personnel concerned with admissions agreed that every effort should be made to use the PSAT not only for admissions decisions, but for course placement purposes as well. Minnesota high school students could then submit only PSAT scores to the University for both purposes. Since the University had long followed a policy of announcing admissions standards well in advance of application deadlines to assist potential applicants in assessing their chances of admission, it was necessary to define the new admissions requirements early in 1974. Therefore, a re-

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search project was initiated in the fall of 1973 to identify the combination of variables which could best be used for admissions and placement.

This research project was originally organized into three parts: (1) preliminary research on 1972 University freshmen, (2) the development of new admissions standards on 1973 freshmen (for whom some PSAT scores were available), and (3) the establishment of cutting scores on the new admissions standards. After cutting scores on the new admissions criteria were developed, a fourth stage of research, best described as a process of double-checking earlier results, was undertaken. Table 1 summarizes each phase while the remainder of this paper discusses the phases in more detail, presenting supporting data at each stage of the research.

Preliminary Research on 1972 Freshmen

When this research project was begun in the fall of 1973, no criterion data were available for students entering that quarter, so a preliminary investigation of fall 1972 freshmen was initiated for several reasons. First, we wished to investigate the relationships among variables which were potential predictors of collegiate academic performance (e.g., test scores and various high school measures). Second, we wanted to explore possible criterion measures. Third, we had to identify the need for tests on a college-by-college basis. It was hoped that these initial studies would allow us to eliminate unproductive approaches and concentrate on areas which looked promising when criterion data

Table 1

Summary of Development of New Admissions Standards

Time	Research Phase	Key Events
Fall, 1973	Preliminary research on 1972 freshmen	1. Correlation and multiple regression selected as research strategy. 2. Criteria narrowed to fall GPA and fall completion ratio. 3. Predictors narrowed to ACT, PSAT, MSAT, SAT, HSR, and high school grades.
Winter and Spring, 1974	Research on 1973 freshmen (basic statistics, correlation and multiple regression and analyses); consultation with University colleges; analysis of possible weighting schemes	1. PSAT or ACT announced as new test requirements for fall 1975 applicants to CLA, Forestry, IT, and Morris. 2. PAR/AAR selected as admissions composites for CLA, Forestry, and Morris; ITAR-A/ITAR-P selected for IT.
Summer, 1974	Research related to establishing cutting scores	Cutting scores for admission on each composite were announced.
Fall, 1975 through Spring, 1975	Verification of new criteria in consultation with the Minnesota Statewide Testing Program; equating studies of AAR and PAR, ITAR-A and ITAR-P	PAR/AAR equivalence table circulated; ITAR-A/ITAR-P equivalence table circulated.

for the 1973 freshmen with PSAT scores became available early in the winter quarter of 1974.

A variety of potential predictors based on high school performance was considered: high school rank (HSR); high school academic GPA; high school average GPAs in English, mathematics, natural science, and social science; and number of high school units (years of study) in the same areas. A similar array of aptitude tests was explored: the Scholastic Aptitude Test (SAT verbal and math, very similar to the PSAT); the American College Testing Program aptitude tests (ACT English, math, social studies, natural science, and composite); and the MSAT. Criterion measures examined were: fall-quarter freshman-year grade point average (fall GPA), freshman year GPA (year GPA), number of ABC credits completed, ratio of credits satisfactorily completed to those attempted (completion ratio), and total credits completed. Basic statistics on every variable (means, standard deviations, number of cases available) were collected for each college and the University as a whole, and the intercorrelations among test, aptitude, and potential criterion variables were computed.

Analyses of the 1972 data led to several conclusions. First, fall GPA was the best criterion measure that would be available for the 1973 freshman group (i.e., it had the highest correlation with relevant predictor variables such as HSR). Fall completion ratio was also of some interest and warranted further investigation. Other criteria considered either could not be predicted

well or would not be available. Second, the best single predictor of fall GPA was HSR (r = .36 for all University freshmen, males and females combined); other high school performance measures also correlated well with fall GPA (e.g., high school English GPA, math GPA, social and natural science GPAs), with rs ranging from .28 to .34. The aptitude tests studied--SAT, ACT, and MSAT--correlated between .27 and .34 with fall GPA. Both SAT and ACT correlated well with the MSAT, suggesting that changing admissions requirements to substitute one or both of them for the MSAT would probably cause little, if any, loss in validity when compared with our previously used criteria. Since the SAT may be considered an estimate of PSAT scores (e.g., an SAT verbal score of 580 is equivalent to a PSAT score of 58 if both were taken at the same time), the results were encouraging and implied that the PSAT could be a useful test for admissions purposes. In addition, the fact that the tests under consideration (primarily the ACT and PSAT) had mathematical aptitude subtests suggested that, especially in technical programs, these tests might do a better job of prediction than the long-used MSAT, a test of verbal aptitude only.

In general, correlations of tests and high school variables with college performance in the 1972 group were relatively low. This can be attributed, at least in part, to the nature of the population; correlations are always lower in a group already selected on variables similar to those on which the correlations are based because of the restriction in range on the measures.

(Several colleges had been using high school and test data to select students and because of this tended to have few students in the lower aptitude range.) Some difficulties were also observed with the GPA criterion. In recent years, the GPA has been inflating somewhat in all the colleges, thus reducing the available range. In addition, GPAs do not necessarily mean the same across students owing to differential grading policies of individual colleges or instructors. It was also noted that performance in the colleges was differentially predictable (i.e., student grades could be predicted much better in some colleges of the University than in others, and in some cases variables that predicted well in one college were far less effective in others).

Results of the research on 1972 freshmen were widely discussed by University admissions staff members and college personnel. By the end of December 1973, several conclusions had been reached:

1. Further analyses would be made using data on fall 1973 freshmen for whom PSAT scores were available.

2. Criterion variables in these analyses would be fall GPA and fall completion ratio (the ratio of courses satisfactorily completed to those attempted in the fall quarter only).

3. Predictor variables to be investigated further would be HSR, SAT, PSAT, MSAT, ACT, high school GPAs in English, mathematics, social and natural science.

4. Further analyses would be of the correlation-regression type, the same model that had been used to establish previous ad-

missions criteria.

5. Additional information was needed before a decision could be made on which tests were acceptable for admissions purposes; this primarily involved obtaining validity information on the PSAT.

Research on Fall 1973 Freshmen

Early in the winter of 1974, analyses of the 1973 freshman group, who by then had completed their first quarter at the University, were begun. The first step was matching the PSAT scores obtained from the Educational Testing Service via the Minnesota Statewide Testing Program with freshman data. Of the 6,903 cases on the PSAT tape 1,873 matched with our fall 1973 applicants, and of that number slightly over 1,300 were for fall 1973 enrolled freshmen. Table 2 shows the relationships of a variety of high school performance and aptitude measures to fall GPA for this final group of enrolled freshmen. As in the 1972 group, HSR is the best single predictor of fall GPA, although none of the other variables is far behind. Clearly, there is no statistical basis for selecting one test or aptitude over another. All correlate at approximately the same level with fall GPA. (Early in this phase of the study it was decided to drop fall completion ratio from consideration. As a single variable, it was a less adequate measure of performance than fall GPA. Potentially it could have become part of a composite criterion also including GPA, but this type of analysis was considered too complex given the time pressure for the present study. Future research in this area might well investigate a canonical correlation approach to the

Table 2

Correlations of High School Academic Achievement Measures and Aptitude Tests with Fall GPA

Achievement/ Aptitude Measures	r	Mean	Standard Deviation	Number of Cases
HSR	.36	70.7	23.4	6709
High school GPAs:				
Academic	.28	2.9	.9	7475
English	.33	3.0	.7	7258
Mathematics	.32	2.7	.9	6861
Social science	.32	3.0	.8	7165
Natural science	.33	2.8	.9	6811
MSAT	.30	41.8	11.7	6506
ACT:				
English	.31	20.3	4.7	6775
Math	.31	23.2	6.7	6774
Social studies	.29	22.6	6.3	6775
Natural science	.28	24.7	5.9	6775
Composite	.35	22.8	5.0	6775
SAT:				
Verbal	.25	515.8	101.5	586
Math	.31	567.0	106.3	588
PSAT:				
Verbal	.32	48.2	8.9	1335
Math	.31	54.0	9.6	1335

Note. Fall 1973 freshmen, colleges and sexes combined.

criterion issue as one way of incorporating additional relevant variables.)

The next step in the research was a regression analysis for each college using various predictor sets, selected on the basis of earlier results and following consideration of data that might be available at the time of application. A step-wise regression using all variables was also used, as we were interested in determining the maximum relationship which could be obtained. Table 3 gives the results of these analyses. A combination of test data and high school achievement measures predicts fall GPA better than HSR (or other high school data) alone. In most colleges HSR plus PSAT is as good or better than HSR plus ACT or SAT in predicting GPA in the fall of the freshman year.

Following a review of these early results, CLA, Forestry, IT, and Morris decided to continue using tests as part of their admissions requirements. (Other colleges and campuses, while they might use tests for placement or counseling purposes, decided not to require them for admission.) PSAT and ACT were considered equally acceptable by these four colleges, and so the University announced early in March 1974 that fall 1975 applicants could submit either PSAT or ACT scores to those colleges for admission purposes, and that the same test would also be used for course placement in English, mathematics, and chemistry. (Some promising results were obtained from preliminary regression analyses using PSAT or ACT scores plus high school data to predict course grades in these areas. Research con-

Table 3

Multiple Correlations of Various Predictor Sets with Fall GPA

Predictor Set	College										
	All	CLA	IT	General College	Agri-culture	Forestry	Home Econ	Duluth	Morris	Crookston	Waseca
HSR only	.36	.34	.33	.27	.43	.16	.42	.41	.42	.58	.45
HSR, high school academic GPA	.40	.38	.38	.28	.47	.41	.47	.43	.52	.59	.45
HSR, high school GPAs (academic, math, English, social science, natural science)	.40	.40	.38	.30	.41	.50	.52	.42	.53	.58	.48
HSR, ACT English, math, social studies, natural science	.39	.41	.43	.46	.52	.53	.45	.44	.47	.62	.51
HSR, SAT verbal and math	.38	.40	.30	.48	---	---	---	---	---	---	---
HSR, PSAT verbal and math	.44	.44	.57	.53	.70	.47	.40	.41	.62	.54	.72

Note. Fall 1973 freshmen, sexes combined. Where the number of cases was too small to yield meaningful results, rs are omitted.

cerned with placement decisions will be discussed in a subsequent paper and, therefore, is not presented here.)

Since only four colleges planned to use tests, further analyses concentrated on students in these colleges. Three samples of fall 1973 freshmen who had high school and criterion data were used:

1. PSAT sample--955 students for whom PSAT data were available.

2. PSAT/ACT sample--about 859 students for whom both PSAT and ACT scores were available.

3. ACT sample--4,115 freshmen in these colleges for whom ACT data were available.

The PSAT sample consisted of students who had, on the average, performed better in high school and who obtained higher aptitude test scores and slightly higher University performance. The magnitude of these differences may be seen in Table 4, which compares the group of students for whom PSAT, HSR, ACT, and University grade data were available with a similar group for whom PSAT scores were not necessarily available. We planned to develop new standards including PSAT scores on the PSAT sample and standards including ACT scores on the ACT sample since this would permit the maximum number of cases for each analysis. However, we were concerned that regression analyses done with the PSAT on this relatively small, somewhat-biased sample would produce misleading results. The PSAT/ACT sample was used as one check on this. ACT regression analyses were done both for this group and the total ACT sample; the results were quite similar, both in terms of the correlations

Table 4

Comparison of Fall GPA, HSR, and ACT Scores for the PSAT Sample and the Total ACT Sample

	PSAT Sample (N=909)	ACT Sample (N=3,695)
Fall GPA	2.9	2.8
HSR	85.9	77.8
ACT:		
English	22.5	21.6
Math	27.2	25.3
Social studies	25.5	24.3
Natural science	27.5	26.3
Composite	25.8	24.5

Note. Fall 1973 freshmen; CLA, Forestry, IT, and Morris; sexes combined.

(shown in Table 5) and the B-weights, thus giving us some confidence that the PSAT correlations and regression analyses using the small sample would have adequate validity.

Several sets of predictors were used in these regression analyses:

1. HSR and ACT composite
2. HSR, ACT English, and ACT social studies
3. HSR, ACT math, and ACT natural science
4. HSR, PSAT verbal, and PSAT math
5. HSR and PSAT verbal
6. HSR and PSAT math

These sets were selected for a variety of reasons. Ultimately, of course, we wanted to have an admissions index similar to the old college aptitude rating (CAR) in computational simplicity (CAR = [HSR + MSAT college percentile]/2). We had also determined earlier that a combination of high school performance and test data was a better predictor than either alone. Further, we were trying to develop an index that would be available on almost all applicants, and high school rank is more readily available than a variety of separate high school GPAs.

The results of the regression analyses using these six sets of predictors are given in Table 6. Generally, the results are fairly good in terms of the magnitude of the correlations. There is some difference in the correlations obtained for each college, however. For example, regressions involving HSR and PSAT verbal or ACT English and social studies are best for Morris and CLA,

Table 5

Comparison of Intercorrelations of ACT, HSR, and Fall GPA for the Total ACT Sample and the PSAT/ACT Sample

Variable/sample	Fall GPA	HSR	ACT				
			English	Math	Social Studies	Natural Science	Composite
Fall GPA							
ACT	--	.37	.31	.30	.30	.27	.37
PSAT/ACT	--	.41	.39	.31	.34	.26	.40
HSR							
ACT		--	.34	.43	.27	.32	.43
PSAT/ACT		--	.35	.40	.27	.31	.42
ACT English							
ACT			--	.35	.54	.44	.69
PSAT/ACT			--	.38	.53	.47	.71
ACT Math							
ACT				--	.43	.60	.79
PSAT/ACT				--	.44	.58	.78
ACT Social Studies							
ACT					--	.60	.81
PSAT/ACT					--	.62	.81
ACT Natural Science							
ACT						--	.84
PSAT/ACT						--	.85
ACT Composite							
ACT							--
PSAT/ACT							--

Note. The total ACT sample (N≈3,695) consists of all CLA, IT, Forestry, and Morris fall 1973 freshmen for whom ACT scores were available. The PSAT/ACT sample (N≈894) is the subset of the total ACT sample for whom PSAT scores were also available.

Table 6

Multiple Correlations of HSR and PSAT or HSR and ACT with Fall GPA for CLA, Forestry, IT and Morris[a]

Predictor Set	CLA	Forestry[b]	IT	Morris	Colleges Combined
HSR, PSAT verbal, and PSAT math	.48	---	.59	.52	.49
HSR and PSAT verbal	.48	---	.41	.51	.47
HSR and PSAT math	.43	---	.59	.50	.45
HSR and ACT composite	.44	.48	.45	.46	.44
HSR, ACT English, and ACT social studies	.44	.46	.43	.45	.44
HSR, ACT math, and ACT natural science	.41	.53	.46	.45	.41

[a]Fall 1973 freshmen, males and females combined.

[b]Too few subjects were available to perform these analyses with HSR and PSAT combinations.

whereas similar regressions using HSR and PSAT math or ACT math and natural science are better for IT than for the other two colleges. This suggests that separate admissions indexes might be used for IT and the CLA/Morris students.

The next step in the analyses was to determine appropriate weights for each component of these predictor sets. The regression analysis yields a set of B-weights which are the optimal weights for these variables and when applied yield the highest relationship with the criterion; however, practical experience and research (Guilford, 1965) has shown that integral weights (single digit weights such as 1, .2, or 5 rather than .02356 or .5157) work very nearly as well. So, the ratios of the B-weights to one another within college were calculated, and integral weights reflecting these relationships were used. Other integral weighting schemes were tried because they were simple to calculate, looked reasonable, and so on. For each student, the new integral-weighted variable was calculated. Then these new variables were correlated with fall GPA to yield the correlations shown in Table 7 (HSR and ACT composites) and Table 8 (HSR and PSAT composites). (Each new variable name indicates its composition [e.g., H1C2 means 1 X HSR + 2 X ACT composite standard score].) Clearly, considerable violence can be done to the original B-weights before a significant loss in predictability occurs. For each college, many different admissions indexes could be selected but only two--one involving the PSAT, the other the ACT--were chosen for each college group. For

Table 7

Correlation of Various HSR and ACT Weighted Composites with Fall GPA

College	H1C1	H1C2	H1C3	H1C4	H1C5	H1E1S1	H1E2S1	H1E2S2	H1M1N1	H2M3N2	H2M3N3
CLA	.41	.43	.44	.44	.44	.43	.44	.44	.41	.41	.41
Forestry	.39	.43	.45	.47	.48	.41	.41	.44	.45	.46	.48
IT	.40	.42	.44	.44	.45	.42	.43	.42	.42	.43	.43
Morris	.45	.46	.46	.46	.45	.45	.45	.45	.45	.44	.45
Colleges combined	.41	.43	.44	.44	.44	.43	.44	.44	.41	.41	.41

Note. Abbreviations for composites are H = HSR, C = ACT composite, E = ACT English, S = ACT social studies, M = ACT math, and N = ACT natural science. Weights applied to each variable in the composite are given following the abbreviation; for example, H1C3 designates a composite consisting of HSR + 3(ACT composite score).

Table 8

Correlation of Various HSR and PSAT Weighted Composites with Fall GPA for CLA, IT, and Morris[a]

College	H4V4M1	H3V5M1	H1V1M4	H2V1M1	H2V2M1	H3V3M2	H1V1M1
CLA	.48	.48	.39	.46	.48	.48	.47
IT	.44	.45	.59	.47	.48	.50	.52
Morris	.51	.49	.43	.52	.51	.51	.50
Colleges combined	.48	.48	.43	.48	.49	.49	.48

College	H3V4	H2V3	H1V1	H3V2	H3M2	H1M4	H2M1	H1M1
CLA	.48	.48	.48	.47	.43	.36	.43	.42
IT	.41	.41	.40	.39	.47	.58	.45	.52
Morris	.49	.42	.50	.51	.50	.41	.50	.49
Colleges combined	.47	.47	.47	.46	.45	.40	.44	.45

Note. Abbreviations for composites are H = HSR, V = PSAT verbal, and M = PSAT math. Weights applied to each variable in the composite are given following the abbreviation; for example, H3M2 designates a composite consisting of 3(HSR) + 3(PSAT math score).

[a]These analyses could not be performed for Forestry because there were not enough cases available.

IT, the following indexes were selected:

ITAR-P = HSR + 4(PSAT math)

ITAR-A = HSR + 2(ACT math + ACT natural science)

For CLA and Morris, two other indexes were agreed upon:

PAR = HSR + PSAT verbal + PSAT math

AAR = HSR + 2(ACT composite)

The criteria for selecting indexes were primarily correlation with fall GPA in the colleges, ease of computation and communication to the educational community, and face validity (i.e., a composite was not selected for IT that appeared to weight verbal ability more highly than mathematical).

The next step--the most important from the point of view of high school students and counselors waiting to hear about new admissions standards--was to determine the cutoffs for admission.

Establishment of Admissions Cutting Scores

As a first step in determining cutoff scores, the research staff met with personnel in each college to discuss the criteria for selection of standards. The results of these meetings are summarized briefly below:

CLA described their philosophy as making the top 50% of high school seniors eligible for admission. Alternately they expressed a desire to admit the "same kinds" of students as were currently admissible under CAR of 50 or higher criterion.

Morris, which had previously used the same admissions standards as CLA, planned to continue this

practice.

Forestry, like Morris, planned to use the CLA admissions standard with the addition of some course prerequisites in mathematics.

IT had already been using the ITAR-A, a combination of HSR and ACT math and natural science scores, requiring a score of 180 or above on this index for admission. In addition, they believed that their target population could be described as somewhere within the top 20-25% of high school seniors. IT's admission requirements also included a fairly extensive background in mathematics and the sciences.

After these initial meetings with college personnel, the task of the research staff was to translate the philosophies of the colleges into cutoff scores. The discussion that follows is confined to CLA and IT because Morris and Forestry planned to use the CLA requirements.

Several sources of information were used to establish cutting scores on the PAR and AAR for the College of Liberal Arts. First, an attempt was made to determine what proportion of high school students had been eligible for admission in the past at various levels of the CAR. To do this, the CAR was calculated for a sample of approximately 43,784 high school juniors in 1971-72 for whom both HSR and MSAT scores were available. (At that time MSAT was taken by and HSR calculated for almost all Minnesota high school juniors.) A percentile distribution was prepared for this

group which suggested that about 51.9% of the students were eligible for admission under the old requirement. Since this figure was very similar to the philosophical standard mentioned by the College, it was decided to set standards making 50% of the high school population eligible. (Later research showed that the CAR distribution used here was in error, in part because there was some bias in the MSAT testing--some high schools tested only college-bound students rather than all juniors as instructed--and in part because there was something wrong with the magnetic tape data used to prepare the distributions. The effect of this problem on the College, and on Morris and Forestry as well, will be discussed in more detail in the following section.) Second, estimates of the average PAR for high school seniors were made using the normative/standardization data for the PSAT/NMSQT for Minnesota high school juniors (Perry, 1974). It was believed that the data on juniors would provide a close enough approximation of senior data for our purposes. For high school juniors, an average PAR, a composite of HSR plus PSAT verbal plus PSAT math, may be estimated by taking the sum of the averages for each component for the same group (Cf. Nunnally, 1967, pp. 142-143, for an explanation of the statistics used). Using this procedure, PAR (high school junior mean) ≐ HSR (high school junior mean) + PSAT verbal (high school junior mean) + PSAT math (high school junior mean). In actual score terms then, PAR = 50 + 35 + 40, or 125. It should be noted that the standardization data provided by Perry combine scores from the PSAT/NMSQT (the test

recommended for college-bound students) with SCAT scores (recommended for students who are planning a technical education or are undecided); thus, although we have used average PSAT scores of 35 and 40 respectively in the equation above, these are averages based on all high school students, not just on those who took the PSAT/NMSQT. Using this approach, the estimated cutoff value of 125 would make approximately 50% of all high school juniors eligible for admission.

Unfortunately, similar Minnesota norms for unselected high school students were not available for the ACT composite score. ACT norms are prepared each year by the testing program, but are based only on students who take the test battery, a typically college-bound group of students. Contacting the ACT research staff, we located a set of norms on an unselected high school sample thought to be representative of national high school students of about 10 years ago, which could be used as an estimate of an unselected group of Minnesota high school seniors. According to these norms, the median ACT composite score for unselected high school seniors was 15.6. Using the technique described above to estimate an average AAR, we get AAR (high school senior average) = HSR (high school senior mean)+ 2 x ACT composite (high school senior mean). Or, in actual score terms, AAR = 50 + 2 x 15.6, or 81.2. Based on experience with the Minnesota ACT college-bound norms compared with national norms and other test information that showed that the Minnesota students typically score a bit higher on aptitude tests such as this, the AAR value obtained above was adjusted,

somewhat arbitrarily, upward to 85.

The CLA staff approved the AAR cutoff of 85 and the PAR cutoff of 125 with the assumption that they would be admitting approximately the same type of student as was previously admitted with the CAR greater than or equal to 50. As will be seen in the next section, this was not exactly the case, which caused some problems for the College and necessitated a reevaluation of their standards for admission the following year. We also assumed that the two values were roughly equivalent since there was not enough time to initiate a formal equating study prior to the announcement of cutoffs.

For IT, the establishment of new standards was slightly simpler because they were already using a cutoff of 180 or above on the ITAR-A and wished to continue doing so. Thus, we simply needed to establish a roughly comparable value for ITAR-P. Since there was no way to determine what proportion of high school students achieved an ITAR-A score of 180 or above (as was done with the PAR described above) or to estimate an ITAR-P cutting off approximately the same proportion, we relied on IT's estimate that about 20-25% of the senior class should be eligible under the standard. A rough estimate of ITAR-P cutoffs at each percentage level could be made using the procedure described above for determining the average high school score on the PAR and AAR. This method is, however, less accurate as estimates are made further from the average since the variances of the individual components of the composite are not equal. Under the circumstances, it was

agreed that such estimates might work reasonably well since IT applicants could meet one of three standards for admission: HSR of 75 or above, ITAR-A of 180 or above, or the new cutoff score on the ITAR-P. These multiple criteria would guard against error. In addition, the IT staff was willing, as a further check, to review individually the application of students who came near the new cutoff scores. Estimates of ITAR-P at the 75th percentile (25% eligible) and 80th percentile (20% eligible) were then made, giving suggested cutoffs of 271 or 284 respectively. A cutoff of 280 was selected for this year, with the understanding that additional relevant data would be collected and the situation reviewed later in the year, with the possibility of modifying standards for fall 1976 applicants.

In Retrospect, or How Did We Do?

During the process of developing new admissions standards we were painfully aware of the inadequacy of some of our data as well as our need for haste and its undoubted effect on the research. Therefore, even as the new standards were being announced, plans were being made to check our conclusions against a variety of additional criteria, which are described below.

Revised CAR Distribution

The Minnesota Statewide Testing Program was asked to prepare as representative a CAR distribution as possible for 1972-73 juniors, the last class for whom MSAT scores were available, as a check on the proportion of high school seniors admissible under the old standards. If a distribution were prepared for all stu-

dents who had HSRs and MSAT scores, bias would be introduced since all high schools did not test all students. In some cases, only students who planned to attend college were tested, which would serve to bias the distribution in the direction of higher CARs since college-bound students tend to score higher. One way to eliminate this bias in the CAR distribution, then, was to eliminate all schools which did not test almost all their students. This was done by checking the number of tests taken against the number of HSRs for a given school and eliminating schools that did not have at least 90% as many MSATs as HSRs. (HSRs are generally available on virtually all students in a school because the school must report grade averages on all students before the Minnesota Statewide Testing Program will calculate HSR.) Using this proportion as our criterion, we eliminated 36 high schools from the sample, leaving almost 500 public and private high schools. Table 9 gives the unbiased distribution by sex for selected CAR values. CLA's old admission standard of a CAR of 50 made only about 40% of the high school population eligible for admission, not nearly the 50% we had estimated previously. (In practice, the CLA admissions staff had reviewed and often admitted a number of students in the CAR 40-49 range, but since this was not widely known, it is difficult to estimate the effect of this practice on total proportion of students eligible for admission.) Potentially, CLA could get many more freshmen than expected in fall 1975, a matter of considerable concern in this time of diminishing resources. Upon receiving this information,

Table 9

Unbiased CAR Distribution for 1972-73 Minnesota Juniors[a]

CAR	Cumulative Percentage			Percentage eligible for admission with CAR ≥ this value
	Female	Male	Total	
99	100.0	100.0	100.0	0.0
95	98.0	98.9	98.5	2.0
90	94.8	96.8	95.8	4.7
85	91.2	94.5	92.9	7.8
80	87.1	91.7	89.4	11.3
75	82.5	88.8	85.6	15.2
70	77.2	85.3	81.2	19.7
65	71.9	81.3	76.6	24.3
60	66.4	77.2	71.8	29.1
55	60.6	72.7	66.7	34.4
50	54.3	67.7	61.0	40.1
45	48.0	62.4	55.2	46.0
40	41.4	56.6	49.0	52.1
35	35.1	50.8	42.9	58.3
30	28.6	44.4	36.5	64.8
25	22.3	37.3	29.8	71.5
20	16.3	29.7	23.0	78.3
15	11.1	21.9	16.5	84.8
10	6.2	13.6	9.9	91.4
5	2.3	5.4	3.8	97.2

[a]N = 51,982; mean = 43.67; standard deviation = 25.78.

the CLA staff tightened admissions policies (e.g., by admitting fewer marginal students below the cutoffs). It was also decided to review more carefully the standards for 1976 admission.

Minnesota Normative Data on the PAR and the ITAR-P from the Minnesota Statewide Testing Program

As soon as high school rank and PSAT/NMSQT or SCAT scores were available for 1973-74 juniors, it was possible for the Minnesota Statewide Testing Program to prepare normative data on admissions indexes involving these elements. Only schools which tested all or virtually all of their juniors were included, so these distributions are comparable to the CAR distribution described above. Distributions were prepared for females, males, and females and males combined on:

HSR + V + M

HSR + (V + M) junior percentile

HSR + V junior percentile + M junior percentile

2 x HSR + V + M

2 x HSR + (V + M) junior percentile

2 x HSR + V junior percentile + M junior precentile

HSR + 4 x M

HSR + 4 x M junior percentile

The abbreviations "V" and "M" refer to Minnesota verbal and math scores respectively, the score scales which may be used with PSAT or SCAT scores. For students who had taken both tests, only PSAT was counted. Two of these distributions--HSR + V + M and HSR + 4 x M for the sexes combined--were of interest since they were essentially

the same as the PAR and ITAR-P respectively and as such could assist in determining whether our estimated cutoff scores were accurate. Tables10 and 11 give cumulative percentage distributions for selected values of these two indexes, as well as noting the percentage of students eligible for admission with an admission standard greater than or equal to the index value. The CLA cutoff of 125 on the PAR was slightly too generous because it made approximately 52.2% of the high school juniors eligible. The addition of this discrepancy to the earlier-noted errors on the CAR distribution created a potentially difficult situation for CLA. Even several months after the fact it is difficult to estimate how this problem could have been foreseen. The ITAR-P cutoff of 280 for IT, however arbitrarily selected, is quite near the 20% figure we sought.

Equating the PAR and AAR

A sample of 1,289 fall 1973 University freshmen for whom both PAR and AAR scores could be computed was selected. Two cumulative percentage distributions were prepared for this group, one each for PAR and AAR. These distributions were then graphed and a smooth curve was drawn to minimize sampling errors. Then, PAR and AAR scores sharing the same percentage points on these curves were read from the curves; these scores were considered equivalent. Table 12 gives the results of this equating process. Although slightly different sets of data were used for selecting the AAR and PAR cutoffs, respectively, the selected cutoffs are very nearly equal, with a PAR of 125 equivalent to an AAR of 84.

Table 10

Distribution of HSR + V + M (PAR)
for 1973-74 Minnesota High School Juniors
from Schools in Which Virtually All Students Were Tested[a]

HSR + V + M	Cumulative Percentage	Percentage eligible for admission with PAR ≥ this value
235	99.9	.1
225	99.4	.6
215	98.2	1.9
205	96.1	4.3
195	92.4	8.1
185	87.6	13.0
175	82.2	18.5
165	76.0	24.7
155	69.5	31.1
145	62.8	37.8
135	55.8	44.9
125	48.6	52.2
115	41.2	59.6
105	34.0	66.7
95	26.9	73.9
85	20.0	80.6
75	14.0	86.7
65	8.3	92.3
55	3.9	96.4
45	1.2	99.1
35	.1	99.9

[a] N = 43,491; mean = 128.74; standard deviation = 44.86.

Table 11

Distribution of HSR + 4(M) [ITAR-P]
for 1973-74 Minnesota High School Juniors
from Schools in Which Virtually All Students Were Tested[a]

HSR + 4(M)	Cumulative Percentage	Percentage eligible for admission with ITAR-P ≥ this value
380	99.8	.2
360	98.8	1.2
340	96.5	3.6
320	92.9	7.4
300	87.4	12.9
280	80.4	19.9
260	72.5	27.9
240	63.8	36.6
220	54.2	46.3
200	43.9	56.6
180	33.7	66.3
160	23.7	76.7
140	15.0	85.5
120	7.5	92.8
100	2.6	97.6
80	.5	99.6
60	.1	99.9

[a]N = 43,500; mean = 215.84; standard deviation = 67.60

Table 12

PAR/AAR[a] Equivalence Table

PAR	AAR	PAR	AAR	PAR	AAR	PAR	AAR
240 ↔	165	205 ↔	149	170 →	123	135	92
239 →	165	204 →	149	169 ↔	123	134	91
238 →	165	203 ↔	148	168	122	133	90
237	164	202 →	148	167	121	132 ↔	89
236 ↔	163	201	147	166	120	131 →	89
235 →	163	200 ↔	146	165	119	130	88
234 ↔	162	199 →	146	164	118	129	87
233 →	162	198 ↔	145	163	117	128 →	86
232 →	161	197 →	145	162	116	127 ↔	86
231 ↔	161	196	144	161	115	126	85
230 →	160	195	143	160	114	125	84
229 ↔	160	194 ↔	142	159	113	124	83
228 →	160	193 →	142	158	112	123 →	82
227 ↔	159	192	141	157	111	122 ↔	82
226 →	159	191	140	156	110	121	81
225 ↔	158	190 →	139	155	109	120	80
224 →	158	189 ↔	139	154	108	119	79
223 →	157	188	138	153 →	107	118	78
222 ↔	157	187	137	152 ↔	107	117 →	77
221 →	156	186 ↔	136	151	106	116 ↔	77
220 ↔	156	185 →	136	150	105	115	76
219 →	156	184	135	149	104	114	75
218 →	155	183 ↔	134	148 →	103	113	74
217 ↔	155	182 →	134	147 ↔	103	112	73
216 →	154	181	133	146	102	111	72
215 ↔	154	180	132	145	101	110	71
214 →	153	179 ↔	131	144	100	109	70
213 →	153	178 →	131	143	99	108	69
212 ↔	153	177	130	142	98	107	68
211 →	153	176	129	141	97	106	67
210	152	175	128	140	96	105	66
209 ↔	151	174	127	139 ↔	95	104	65
208 →	151	173	126	138 →	95	103	64
207	150	172	125	137	94	102	63
206 →	149	171	124	136	93	101	62
						100	61

Note. This equivalence table is based on 1289 1973 University freshmen who had HSR and both PSAT and ACT test scores available. Equivalence for low scores (i.e., below 125 for PAR and 85 for AAR) should be considered approximate because of the relatively small number of students in this range. The table is set up so that PAR equivalents of AAR scores may be obtained and vice versa; for example, the AAR equivalent of PAR scores of 178 and 179 is 131, but the closest PAR equivalent of an AAR of 131 is 179.

[a]PAR = PSAT Aptitude Rating = HSR + PSAT verbal score + PSAT math score
AAR = ACT Aptitude Rating = HSR + 2 x ACT composite score

Equating the ITAR-A and ITAR-P

A similar procedure was used to determine the ITAR-A and ITAR-P score equivalence. The results, based on the same sample as those for examining PAR/AAR relationships, are given in Table 13 Again we were pleasantly surprised to find that our somewhat arbitrarily selected cutoffs were nearly equivalent: An ITAR-A of 180 is the same as an ITAR-P of 278, only 2 points lower than the selected cutoff.

Table 13

ITAR-A/ITAR-P[a] Equivalence Table

ITAR-A	ITAR-P	ITAR-A	ITAR-P	ITAR-A	ITAR-P	ITAR-A	ITAR-P	ITAR-A	ITAR-P	ITAR-A	ITAR-P
239↔	398	222↔	360	206←	322	184	284	157	246	126←	209
239←	397	221←	359	206↔	321	183←	283	156←	245	126←	208
239←	396	221↔	358	205←	320	183↔	282	156↔	244	125	207
239←	395	220←	357	205↔	319	182	281	155	243	124	206
239←	394	220↔	356	204←	318	181	280	154	242	123↔	205
239←	393	220←	355	204↔	317	180←	279	153←	241	123←	204
239←	392	219←	354	203←	316	180↔	278	153↔	240	122	203
239←	391	219↔	353	203↔	315	179	277	152	239	121↔	202
238	390	218←	352	202←	314	178←	276	151	238	121←	201
237	389	218↔	351	202↔	313	178↔	275	150←	237	120	200
236↔	388	217←	350	201←	312	177	274	150↔	236	119↔	199
236←	387	217↔	349	201↔	311	176	273	149	235	119←	198
235↔	386	217←	348	200↔	310	175←	272	148	234	118	197
235←	385	216←	347	200←	309	175↔	271	147	233	117	196
234	384	216↔	346	199↔	308	174	270	146	232	116↔	195
233←	383	215←	345	199←	307	173←	269	145	231	116←	194
233↔	382	215↔	344	198↔	306	173↔	268	144	230	115←	193
232	381	214←	343	198←	305	172	267	143	229	115↔	192
232←	380	214↔	342	197←	304	171←	266	142	228	114	191
231	379	214←	341	197←	303	171↔	265	141	227	113	190
230←	378	213←	340	196←	302	170	264	140←	226	112↔	189
230↔	377	213↔	339	196←	301	169	263	140↔	225	112←	188
229	376	212←	338	195←	300	168←	262	139	224	111↔	187
228↔	375	212←	337	195↔	299	168↔	261	138	223	111←	186
228←	374	212↔	336	194	298	167	260	137	222	110	185
228←	373	211←	335	193←	297	166	259	136	221	109←	184
227↔	372	211←	334	193↔	296	165←	258	135←	220	109↔	183
227←	371	211↔	333	192←	295	165↔	257	135↔	219	108	182
226↔	370	210←	332	191←	294	164	256	134	218	107	181
226←	369	210↔	331	191↔	293	163←	255	133	217	106←	180
225←	368	210←	330	190↔	292	163↔	254	132	216	106↔	179
225↔	367	209←	329	189←	291	162↔	253	131	215	106←	178
224←	366	209↔	328	189↔	290	162←	252	130↔	214	105	177
224↔	365	208←	327	188	289	161	251	130←	213	104	176
224←	364	208↔	326	187	288	160↔	250	129	212	103	175
223↔	363	208←	325	186	287	160←	249	128→	211	102	174
223←	362	207↔	324	185←	286	159	248	127↔	211	101	173
222←	361	207←	323	185↔	285	158	247	126↔	210	100	172

Note. This equivalence table is based on 1289 University freshmen who had HSR and both PSAT and ACT test scores available. Equivalence for low scores (i.e., below about 125 for ITAR-A and 207 for ITAR-P) should be considered approximate because of the relatively small number of students in this range. The table is set up so that ITAR-A equivalents of ITAR-P scores may be obtained and vice versa; for example, the ITAR-A equivalent of ITAR-P scores of 360 and 361 is 222, but the closest ITAR-P equivalent of an ITAR-A of 222 is 360.

[a]ITAR-A = IT Aptitude Rating-ACT = HSR + 2 x (ACT Math + ACT Natural Science score)
ITAR-P = IT Aptitude Rating-PSAT = HSR + 4 x PSAT Math score

Reference List

Guilford, J. P. Fundamental statistics in psychology and education (4th edition). New York: McGraw-Hill, 1965.

Nunnally, J. C. Psychometric theory. New York: McGraw-Hill, 1967.

Perry, D. K. Standardization of scores on the SCAT and PSAT/NMSQT for Minnesota high school students. University of Minnesota, Office for Student Affairs Research Bulletin, 1974, 15 (6).