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AUTHOR	Benson, Martin T., Ed.
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ABSTRACT

This study compares college student-athlete graduation rates before and after implementation of National Collegiate Athletic Association Proposition 48, which reformed initial-eligibility rules for college athletes, requiring that they have achieved minimum high school grade point averages (at least 2.0 on a 4.0 scale) in core courses and minimum college entrance examination test scores (700 on the SAT or 15 on the ACT) to be eligible for college athletics during their first year. The study analyzed data covering the college careers of 3,380 student-athletes admitted to Division I schools in 1984-85 (before the reforms were implemented) and 2,435 student-athletes in a 1986 cohort. Comparison of the two cohorts found that overall graduation rates for student-athletes significantly increased between the 1984-85 and 1986 cohorts. Test scores, core-course grade point averages, and other indicators of high school academic performance also showed significant increases between 1984-85 and 1986. When high school academic performance variables were included as covariates, there remained no direct effect of cohort groups. Results are also analyzed in terms of gender and race. Overall the significant graduation-rate differences between cohorts can be considered a direct function of higher initial test scores and grade point averages. Several tables and figures displaying study data are appended. (Contains 23 references.) (JB)

NCAA Research Report

Report 92-02

A Statistical Comparison of College Graduation of Freshman Student-Athletes Before and After Proposition 48

FOREWORD

This report is the sixth in a series that we shall be publishing to inform our member institutions and others about our study of student-athletes' academic performance under Bylaw 14.3.

The results presented here are preliminary. This study was begun in 1985 and still has several years before completion.

We welcome your comments and suggestions on this report.

RICHARD D. SCHULTZ
NCAA Executive Director
July 1993

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THE NATIONAL COLLEGIATE ATHLETIC ASSOCIATION

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Overland Park, Kansas 66211-2422
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Distributed to CEOs, athletics directors, senior woman administrators and faculty athletics representatives at all Division I institutions.

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INTRODUCTION

Selective admissions to college has become a mainstay of the American collegiate system. Acceptance to or rejection from a particular college can have effects on the individual and the school for many years (Manski & Wise, 1983; Pascarella & Terenzini, 1991). These pressures also have led to an increased importance of accuracy in the initial admissions decision-making and in the tools used in these processes. Nationally standardized tests, such as the SAT and ACT, initially were designed to measure academic preparation for college, but these tests are routinely used as critical screening devices for access to higher education (Hargadon, 1984; Crouse & Trusheim, 1989). Any large-scale or national entrance requirements using such tools are of broad interest to students, faculty and administrators at all schools.

In 1986, the NCAA enacted an initial-eligibility rule, Bylaw 5-1-(j), which is now Bylaw 14.3. This eligibility rule is commonly called "Prop 48," after its original label at the 1983 NCAA Convention. In order to compete in NCAA Division I-sponsored events, all freshman student-athletes were required to demonstrate: (1) a high-school grade-point average of at least 2.0 (on a 4.0 scale) in 11 predefined "core courses" and (2) a minimum total test score of 700 on the SAT or 15 on the ACT (comparable to a 17 on the 1990 version of the ACT). If these academic-performance minimums are not met, the high-school student forfeits the first full year of college athletics eligibility.

These specific cutoff values (of 2.0 and 700 or 15) were selected by various committees during 1983, using methods that have not been documented. Controversy was generated from the inclusion of a minimum test score as an eligibility requirement (e.g., Williams, 1983; Ervin, Saunders & Gillis, 1984; Hargadon, 1984; Jenifer, 1984). Nevertheless, these national rules were approved by a vote of the membership of the NCAA Convention in 1983, gradually phased in during 1986 and 1987, and fully carried out in 1988. In 1991, amendments, such as the removal of athletically related financial aid, were added to the original rule (as "Prop 42"). Recent changes in these requirements were approved at the 1992 Convention, and these new requirements are set to be implemented in 1995.

The Academic Performance Study (APS) was started in 1984 by the NCAA Research Committee. This study of the academic-performance patterns of selected Division I student-athletes is a major research project of the NCAA staff (for an overview, see NCAA Research Report No. 90-01). This research has provided positive evidence for the use of precollege achievement measures, such as core grade-point average (core gpa) and national test scores, as predictors of college graduation for student-athletes (see NCAA Research Report Nos. 91-01 and 91-02). These results are relatively new, but they are consistent with previous work that focuses mainly on predictors of freshman grades (e.g., Braun, Broudy, Flaugher, Robertson, Maxey, Kane, & Sawyer, 1984; Donlan, 1984; Walter, Smith, Hoey & Wilhelm, 1987; Willingham, Lewis, Morgan & Ramist, 1990; Sawyer, 1986).

In related NCAA research reports (Nos. 91-

03, 91-04, 91-05), we also studied the specific effects of various rules using the 1984-1985 data. We have presented specific variable and cutoff combinations as well as the effects of entire families of initial-eligibility rules. We also have studied decision-analysis models, including explicit utility weights, for the selection of specific cutpoints on specific rules. In all cases, we have presented the effects of such rules separately for white and black student-athlete groups.

In this report, we continue to examine the possible effects of the initial-eligibility rules. We present an analysis of the predictors of graduation rate of almost 6,000 student-athletes who entered Division I colleges either: (1) before the rule went into effect (1984 and 1985 freshmen) or (2) after the rule (1986 freshmen). We focus all statistical analyses on the direct comparison of these two cohorts.

We also recognize that these two cohorts are not equivalent groups. The 1984 and 1985 freshmen of this study entered college before the current restrictive rules were enacted. Thus, some of these student-athletes were declared eligible to play in NCAA events even though they did not have a minimum score on their high-school grades (i.e., core gpa > = 2.0) or a precollege test-score minimum (i.e., SAT > = 700 or ACT > = 15). In contrast, the 1986 freshmen of this study are different students from different schools who entered college under a mixed version of the current rules, and they were the first group of students performing under the pressures of the national test-score requirements. Careful attention will be paid to these experimental design confounds in any subsequent statistical or substantive comparisons (e.g., Cook & Campbell, 1979; Beaton, Hilton & Schrader, 1992). We hope the current statistical comparisons will provide a unique look at some impacts of the current initial-eligibility rule.

METHODS

Subjects

The NCAA-APS database covers aspects of the college careers of five cohorts of almost N=12,000 student-athletes. Included are freshman classes from 1984 to 1989 in Division I schools that responded to the NCAA-APS questionnaire. (For more details, see NCAA Research Report No. 90-01).

The APS data form was sent to a college representative at a stratified random sample of 57 Division I institutions in each of the five years 1984-89. The college representative often was an academic advisor or a staff person in the athletics department. This person was asked to provide data on each student-athlete in the current freshman class. In 1984, we obtained usable responses from 47 of the 57 institutions, and in 1985, we obtained usable responses from 39 of an independent set of 57 institutions (a response rate of 75.4 percent). In 1986, we obtained usable responses from 55 of a new set of 56 schools (a 98.2-percent response rate).

The same student-athletes also were reported on for each of the subsequent four years using a similar coding form (see NCAA Research Report No. 90-01). For the purposes of the analyses to follow, we used only selected individual records. In sequence, we eliminated persons with: (1) implausible data, (2) incomplete longitudinal records, (3) non-U.S. citizens, (4) not reported as either white (Caucasian) or black (of African-American decent) or (5) missing both high-school gpa and a standardized SAT or ACT score. The biggest loss of data comes from incomplete longitudinal records. Using these selection criteria, we obtained N = 3,380 student-athletes in the 1984-1985 cohort and 2,435 student-athletes in the 1986 cohort.

Variables

Five-Year Graduation as a Dependent Variable

College graduation is a variable scored as a unit value if the student graduated with a degree from the school in which he or she enrolled as a freshman. This variable is scored as a zero if the student did not graduate from the first school within five years of initial entry. In this variable, we do not distinguish the reasons for nongraduation: that is, students who drop out in bad standing (dropouts), drop out in good standing (stopouts), transfer to another school (transfers) or continuing into the sixth year (continuers), are all considered to be the same status.

An adjusted graduation rate has been used in previous research, and it will be mentioned here as well. This adjusted rate does not include students who were in good standing when they either continued at another school (transfers) or when they left school (stopouts). Separate analyses of these adjusted rates will be described in this text and given in detail in the Appendix. Other academic-performance outcomes will be considered in additional reports.

Precollege Variables as Independent Predictors

A high-school core gpa was based on the 11 high-school core courses as required by NCAA rules. The scores were obtained from complete records for about 86 percent of the individuals in the study. For incomplete records, approximately 12 percent of the missing core gpas were created from the complete high-school gpa score, and another two percent were imputed from the available test score. The core gpa was computed as a standardized Z-score for high-school grades (based on national averages for 1984 entering freshmen).

Student-athletes in 1984 had taken either (1) the SAT, (2) the ACT, (3) both the SAT and the ACT or (4) neither test. To deal with this problem, we defined a variable labeled "test" as a Z-score from either the SAT total score, the ACT composite score or the average of both national Z-scores. This test score was missing for less than two percent of these students; in these cases, the test score was imputed from the available core gpa.

We also created an equally weighted average score as a simple numerical average of the core gpa Z-Score and the test Z-Score. This variable is equivalent to a linear-combination model, where both variables are used in raw-score form with equal weights. (That is, the variance of this average variable is the sum of the two raw-score variances plus twice the covariance of these two variables.)

Class rank was calculated as the percentage of the numerical rank of the individual divided by the size of the high-school graduating class. (Later, for comparison, we divide this variable by five so each unit represents a 20-percent shift in class rank.) About 18 percent of students were missing class rank, and it was imputed from core gpa.

Student Groups as Moderator Variables

Student-athletes in the original survey were reported as members of one of several cohorts: sex, racial and sport groups (see questionnaire in NCAA Research Report No. 90-01). Specific combinations of these independent groups will be used as potential moderator variables in our prediction analyses. A detailed summary of these codes is listed in Appendix 1.

In all models to follow, the cohort variable is scored 1 if the student was a member of the 1986 cohort (i.e., after the rule) and 0 if not (1984-1985, before the rule). This allows us to directly interpret the regression parameter associated with cohort as the increase in graduation rate for the 1986 cohort. This coding allows interaction variables to be created by multiplication to examine more complex hypotheses. For example, the cohort-by-core-gpa product variable will be used to examine the differences between regression slopes for core gpa between the two cohorts.

Other group variables were binary-coded in this way for similar ease of interpretation (see the middle column of Appendix 1). A sex variable was coded 1 if the student is male and 0 if female. A race variable was coded 1 if the student is black and 0 if white. A sport-revenue variable was coded 1 if the student's main college sport is men's basketball or football and 0 otherwise (all other men's sports and all women's sports). A travel-team variable was coded 1 if the student made the traveling team in his or her sport during the freshman year. Finally, a tutor variable was coded 1 if the student received tutoring during his or her freshman year.

A more complex set of group codes is used in the latter sections of this report (in Tables [5] to [8]; see the last column of Appendix 1). In these latter sections, we use five orthogonal codes to represent specific hypotheses about the differences between six specific groups: (1) sex, comparing all males vs. all females, (2) race, comparing all Blacks vs. all Whites, (3) revenue, comparing all males in revenue sports vs. all males in nonrevenue sports, (4) female-race, comparing white females vs. black females and (5) male-race, white males in revenue sports vs. black males in revenue sports.

School-Level Variables as Potential Covariates

Information about student-athletes from different Division I schools is combined in these analyses. However, variables reflecting differences in the colleges will be used as covariates in the equations for the individual graduation rates as potential controls for school selectivity (as in Manski & Wise, 1983; Crouse & Trusheim, 1988).

We selected four variables to index the academic strength of the college: (1) student-body six-year graduation rate (obtained from the NCAA Academic Reporting Compilation, 1989), (2) student-athlete six-year graduation rate (also from the NCAA), (3) school average on the precollege test Z-score (ACT or SAT as obtained from the College Board Handbook, 1987) and (4) a top 50-percent academic rating (from Gourman, 1989).

We also selected a few variables to represent other potentially important classifications of different schools. These variables include: (5) number of undergraduates enrolled, (6) Division I-A vs. others, (7) private vs. public schools, (8) urban vs. rural area schools and (9) a top 50-percent athletics rating (also from Gourman, 1989). These school variables are used mainly in initial descriptive analyses of the two cohorts.

Methods of Analysis

The purpose of the current report is to examine the predictors of college graduation. The current data represent five-year graduation results from the NCAA-APS database. These results are relatively new: The determination of a five-year graduation occurred in the fall of 1989 for the 1984 cohort, in the fall of 1990 for the 1985 cohort, and in the fall of 1991 for the 1986 cohort. We use logit-regression models to predict graduation rates from high-school grades, test scores and other continuous and categorical measures. We display these data and models, give mathematical and statistical results, and compare alternative models in various ways.

Logit models are commonly used to represent the prediction of an outcome that is a probability or rate (see Manski & Wise, 1983; also Hosmer & Lemeshow, 1989). Here we are interested in the prediction of academic performance as indicated by persistence in the same college. In this case, as in many others, we define persistence as a binary outcome (i.e., either "yes" or "no"). This binary measurement creates some problems for standard parametric statistics such as linear regression (for additional examples see NCAA Research Report No. 91-02).

Figure [3a] presents a path diagram to illustrate our basic regression approach. In this model we predict graduation rates (R) using a parameter for the intercept, Bo, the direct effect of core gpa, B_g, and the direct effect of test, B_t. This model will be compared for the significance of the parameters and the overall goodness-of-fit to the data. The log-odds transformation of the original binary (zero-one) scores is highlighted in Figure [3a] by the relationship between the square and the circle. This transformation of the log-odds back into the probability permits a direct interpretation of the B-weights in terms of rates-of-change (R) in the probability of graduation.

Figure [3b] presents a second path diagram for the inclusion of moderator and other interaction effects. First we show the intercept, core gpa, and test variables as predictors. We also add variables termed group, group-by-core-gpa, and group-by-test. The added group predictor allows us to simultaneously estimate the main effect of the grouping variable—the difference between groups at the intercept in the probability of graduation. The added group-by-core-gpa predictor allows us to simultaneously estimate the interaction effect of the grouping variable or the difference between groups in the regression slope for core gpa on the probability of graduation. The added group-by-test predictor allows us to simultaneously estimate the interaction effect of the grouping variable or the difference between groups in the regression slope for test on the probability of graduation. All three of these questions are important when the grouping variables are cohort, race, sex, revenue or any number of other groupings.

RESULTS

Initial-Group Differences

Table [1] gives a comparative breakdown of these two groups of student-athletes by several key variables and subgroups. (Specific details on the scoring systems used are presented in previous reports; see NCAA Research Report No. 91-02). The 1986 group appears significantly higher on all high-school academic-performance variables. The 1984-1985 cohort is listed with a mean CORE-GPA Z = -.385, a mean TEST score Z = -.152 and a mean class rank = +.343. In raw units, this is approximately equivalent to a group with a raw core gpa = 2.85, an SAT = 874 or an ACT = 18.7, and a class rank in the top 34.3 percent. In contrast, the 1986 cohort is listed with a mean core gpa Z = -.112, a mean test score Z = +.244, and a mean class rank = +.302.

In raw units, these are approximately equivalent to a group with a core gpa = 3.11, an SAT = 957 or an ACT = 21.0, and a class rank in the top 30.2 percent. The average Z-score shows the 1984-1985 cohort to be about one-fourth standard deviation units below zero (Z = -.269), while the 1986 cohort is almost exactly at the center point (Z = +.066).

Figure [1] presents some of these results in graphic form. In Figure [1a], we display the frequency histograms of the core gpas for both 1984-1985 and 1986 groups. In Figure [1b] we display the frequency histograms of the national test score for both 1984-1985 and 1986 groups. As these pictures illustrate, the 1986 cohort has slightly higher core gpas and higher test scores.

Table [1] also shows other group characteristics are slightly different. The percentage of males is lower in 1986 (71.1 percent down to 67.7 percent). The percentage of black students is lower in 1986 (25.2 percent down to 17.9 percent). These two summary statistics may reflect changes in the composition of Division I student-athletes in 1986. However, the percentage of males in revenue sports also is lower in 1986 (40.7 percent down to 34.3 percent). So these sample statistics may not reflect Division I population differences.

The last few rows of Table [1] list characteristics of the graduation rate for both groups. Here we find an increased graduation rate for the 1986 cohort. The 1984-1985 group shows a graduation rate of 48.0 percent (1,622/3,380), while the 1986 group shows a five-year graduation rate of 56.5 percent (1,288/2,435). Comparable adjusted graduation-rate figures show a larger increase from 68.2 percent to 78.6 percent. These same results are broken down by the six subgroups described earlier. Here we find increases for the white males in nonrevenue sports (up from 47.6 percent to 56.8 percent), the white females (up from 59.9 percent to 69.6 percent) and the black females (up from 35.6 percent to 63.8 percent). Other differences are not statistically significant.

School-Level Differences

Missing data and response bias also were considered at the school level. Initially, the 114 schools for 1984 and 1985 were randomly selected from all Division I schools.

Pre-existing differences among the 86 participating schools and the 28 nonresponding colleges were studied, and no significant differences were found. In 1986, a different set of 56 schools was asked to participate in this study. A statistical comparison of possible school-level differences is examined in Table [2] and Figure [2].

Table [2a] lists means (and standard deviations) for four variables on two groups: Included are: (1) student-body five-year graduation rate (obtained from the NCAA Academic Reporting Compilation, 1989), (2) student-athlete five-year graduation rate (also from the NCAA), (3) school average on the precollege test Z-score (ACT or SAT as obtained from the College Board Handbook 1987) and (4) number of undergraduates enrolled. The third and fourth columns of the same table give statistical information for variables (1), (2) and (3) above, but now weighted by (4) the number of undergraduates enrolled. Statistical comparisons of unweighted means (column one vs. column two) or weighted means (column three vs. column four) show no significant differences between the 1984 and 1985 schools represented and the 1986 schools represented. Figure [2] displays this same information in terms of frequency box-plots for both institutional graduation rate (Figure [2a]) and for school-test scores (Figure [2b]).

Table [2b] provides the same kind of comparison for variables that are largely categorical. This includes: (5) study participation, (6) Division I-A vs. others, (7) private vs. public schools, (8) rural-area schools, (9) top 50 percent academic rating (from Gourman, 1989) and (10) top 50 percent athletics rating (also from Gourman, 1989). Statistical comparisons again show only two significant differences between the 1984-1985 and 1986 cohorts: (1) fewer schools participated in the 1984 and 1985 cohort survey, and (2) fewer private schools participated in the 1984 and 1985 cohort survey. These effects are small, but they may need to be considered in further comparisons among cohorts.

The most important result of Table [2] is that we do not find many notable differences between the groups. There are never any significant differences between groups on college-level graduation rates or test scores, and the few differences found are small. These results suggest there is only minor school-level bias in either 1984-1985 or 1986, so the two cohorts of schools are not different from one another.

Predicting Graduation Rate for 1986 Student-Athletes

The results presented in Table [3] illustrate single-variable prediction models for the new graduation rates of the 1986 student-athletes. This table is identical in format to one presented earlier for the 1984-1985 sample (see Table 3, NCAA Research Report No. 91-02). These results include the logit coefficients, hazard-rate transformations and goodness-of-fit indices for 10 different independent variable models. In all equations, a single asterisk indicates a coefficient is significantly different from chance at the 95-percent level of confidence (i.e., $p < .05$) and a double asterisk indicates a coefficient is significantly different from chance at the 99-percent level of confidence (i.e., $p < .01$). The last column, labeled "Fit Index", gives a gross index of the increase in the amount of data accounted for in this model compared with the baseline model. Most effects noted are similar to those reported in our previous analyses of the 1984-1985 sample.

The first model, labeled "Baseline", gives the results where no independent variable is used. The logit coefficient of $B_0 = .262$ is transformed into a base rate of 56.5 percent using the equations described earlier. The second model, labeled "Core GPA", adds this variable to the prediction of graduation rate. The logit coefficients $B_0 = .372$ and $B_1 = .662$ are back transformed (by the exponential equation) into "one-unit change rates," where $R_0 = 59.2$ percent and $R_1 = 14.6$ percent. (The standardized coefficients given in parentheses are $\beta_1 = .422$ with a standardized rate $r_1 = 9.7$ percent.) By adding core-gpa information to this model, we obtain a 9.2-percent improvement in fit (this statistic is often considered as a "pseudo Rsquare"). We also note that a similar analysis on the adjusted graduation rate yields a much stronger improvement in fit to 16.9 percent. More detailed analyses of adjusted rates are listed in the Appendix.

The third model uses the "student test" score (the "student test" is either the ACT, the SAT, or a weighted average of both) to predict the graduation rate. These results show a significant rate of change of 19.1 percent per unit change on the test score, a 9.1 percent improvement over the baseline model. The standardized coefficient of 10.4 percent is correspondingly larger as well. In general, the result for test scores is almost identical to the corresponding results for core gpa. The test score is a slightly better predictor of the adjusted rate (at 11.9 percent).

The fourth model uses the average variable as a predictor of the graduation rate. In this model, we observe a significant raw rate-of-change of 20.1 percent with an 11.3 percent improvement over the baseline. This is a slight improvement over all other models, and the average variable is the strongest single predictor of all variables listed in Table [3]. The fifth model shows that percent rank accounts for a 9.0 percent improvement in the baseline. This is close to the other measures, so rank could be used in place of either core gpa or test.

The last five models in Table [3] describe specific group effects. Model No. 6 includes the race variable and predicts that Whites have an $R_0 = 60.2$ percent chance of graduating while Blacks' chances are $R_1 = -20.8$ less. This white-black difference accounts for 1.9 percent of the unknown variation. Model No. 7 shows that females have an $R_0 = 69.0$ percent chance of graduating while males' probabilities are $R_1 = -18.4$ less. The female-male difference accounts for 2.2 percent of the unknown variation. Model No. 8 shows that males in nonrevenue sports (i.e., those other than men's basketball and football) and females have an $R_0 = 62.1$ percent probability of graduating, while males in revenue sports' probabilities are $R_1 = -16.2$ less. The revenue- vs. nonrevenue-sport difference accounts for only 1.8 percent of the unknown variation. The travel team has a small but positive rate ($R_1 = 20.3$ percent), and the tutor use has a small negative effect ($R_1 = -9.3$).

Comparing Cohorts on Graduation Rate

The results presented in Table [4] give a direct comparison of graduation rates between the two cohorts. The first baseline model is fitted to the total sample of N = 5,815 student-athletes from both cohorts. This model shows the marginal value of the overall graduation rate is $B_0 = .064$ or $R_0 = 51.6$ percent. The second model, labeled "Cohort", adds the binary cohort variable as a predictor. The intercept in Model 2 implies that the 1984-1985 students have a graduation rate of $R_0 = 48.1$ percent. The cohort rate of $R_1 = 8.4$ percent represents the size of the significant increase in graduation rate for the 1986 cohort. The simple model accounts for only a small amount of overall information (LIP = .5 percent) and only a small increase in prediction accuracy (ACC = 53.9 percent).

The third model adds the core-gpa and the cohort-by-core-gpa interactions and has several notable aspects:

The intercept in Model 3 (B_0 = .169) is significant. This is interpreted as the expected graduation when the other scores are zero. In this equation R_0 = 54.2 percent is the graduation rate for the 1984-1985 students who have approximately a "B average" (core gpa = 3.05).

The main effect of cohort (B_1 = .204) in this model is significant. This is interpreted as the change in the expected graduation for the 1986 group at the average core gpa. In this equation, R_1 = 5.0 percent is the increase in graduation rate for the 1986 cohort for students who have approximately a "B average" (core gpa = 3.05). This may be considered as one of the main differences between cohorts.

The main effect of core gpa (B_2 = .670) in this model is significant. This is interpreted as the change in the expected graduation rate for the 1984-1985 group for each one-unit change in core gpa. In this equation, R_2 = 15.6 percent is the increase in graduation rate for students who have approximately a raw core gpa = 2.5 to students who have a raw core gpa = 3.0.

The interaction effect of cohort-by-core-gpa (B_3 = -.008, R_3 = -.2) is not significant. In this equation, the interaction coefficient reflects cohort differences in the prediction-regression weights (number 3 above). This effect will not be interpreted here, but it could be important in other models.

The overall predictor equation accounts for a significant increase in information (LIP = 10.4 percent), and the accuracy of classification (ACC) of graduates increases by 15 percent (from 51.7 percent to 66.6 percent) at the median predictor score.

Figure [4] is a graphic representation of Equation 3 from Table [3]. This is a plot of the observed and predicted graduation rates as a function of the core-gpa Z-score for both cohorts. The raw data for the 1984-1985 cohorts are highlighted with a circle ("o"), while the raw data for the 1986 cohort are highlighted with an asterisk (" * "). The expected value of the score is written as a function of the core gpa for each group; the upper line is 1986 (using asterisks) and the lower line is 1984-1985 (using circles). The two cross-hashed lines highlight the means for both variables for both groups.

The most obvious feature of this plot is the increasing probability of graduation for increasing high-school core gpa. This increase is linear in the logit (log odds) variable so it is nonlinear (sigmoid-shaped) in terms of the probability variable (see Hosmer & Lemeshow, 1989). At the next level, the comparison of academic performance before and after the rule is relatively clear — there are only small visible differences between the cohorts. As Model No. 3 suggested, the 1986 cohort graduates at a slightly higher rate given the same core gpas, but the two lines are almost identical.

In Model No. 4 we examine test scores in this cohort equation. We find a significant effect of the test score only (the weight B_2 = .920 so the rate R_2 = 21.4 percent). The model also accounts for an increase in fit (by LIP = 12.0 percent and ACC = 65.6 percent). There are no significant effects of cohort or of the cohort-by-test interaction. These results are displayed in Figure 5, where we see the two curves have no differences at the central (zero) point and possibly only minor differences earlier. This last interpretation is important — if test-score differences are held constant, then no other effects of cohort are apparent.

Similar results apply to Model No. 5, where the equal or average score is used. Here, as with the test score above, the only significant effect is the main effect of the average score. Once again, the cohort effect on graduation is rendered nonsignificant when the entering academic performance of the students is taken into account. Also as before, the average variable is the single best predictor of graduation rate (LIP = 13.5 percent and ACC = 67.7 percent).

The last two models of Table [4] show the impact of group differences. Here race or sex are combined together with the cohort variable. The cohort-race equation shows a significant positive effect of cohort (R_2 = +5.8 percent) and a negative effect for the black group (R_3 = -25.1 percent) but no significant interaction. The cohort-sex equation shows a significant positive effect of cohort (R_2 = 12.8 percent), a negative effect for the male group (R_3 = -11.5 percent) and also a significant interaction (R_4 = -7.8 percent). This last result suggests that the male-female differences may be changing over cohorts as well. More formal statistical models are next fitted to clarify group differences and refine these simple interpretations.

Multiple Variable Cohort Comparisons

A more complex prediction model is presented in Table [5]. The graduation rate is predicted from five sets of variables: (1) two constants (the intercept and cohort variable), (2) three precollege academic variables (core gpa, test score, and school-test score), (3) five student-group variables (sex, race, revenue, race-female, race-revenue), (4) three cohort-by-academic interaction variables and (5) five cohort-by-group interaction variables. This table gives the results of a logistic model fitted to all graduation rates from these 18 predictors. This model fitted to these data accounts for approximately 17.1 percent of the observed score distribution. For each parameter we have listed the associated B-weight, the standard error, the significance level, the one-unit rate of change and the upper and lower 95-percent confidence boundaries around this rate. A comparable model for the adjusted rate is given in Appendix 2. A few summary statements can be made about each set of variables:

The intercept gives a prediction of a base rate of 45.6 percent when all other variables are set to zero. The likely range of this intercept rate is between 42.1 percent and 49.1 percent (i.e., the 95-percent confidence range). The cohort intercept is not significant when all of the other variables in this model are taken into account.

The strongest predictors of graduation are the academic variables: (a) a one-unit increase in core gpa (from a 2.5 to 3.0) accounts for a 6.6-percent increase in graduation, (b) a one-unit increase in test score (an SAT change from 700 to 900, or an ACT change from 13 to 18) accounts for a 13.4-percent increase in graduation and (c) a one-unit increase in school-test score (from SAT 1025 to 1175 or from ACT 23 to ACT 27) accounts for a 16.8-percent increase in student graduation rate.

The student group effects are smaller, but we do find two significant results: (a) We predict significantly lower than expected graduation rates for males (-5.2 percent) and this difference is between -9.9 percent and -1.2 percent (or, conversely, significantly higher than expected graduation rates for females; 5.2 percent) and (b) We predict significantly higher-than-expected graduation rates for males in revenue sports compared with other males (3.4 percent) with 95-percent confidence that this estimate is between .1 percent and 6.8 percent. All other group effects are not significant.

Two cohort-by-academic interactions are present. There is a negative effect of cohort-by-test (-7.9 percent), and this suggests that the test score is significantly less predictive in 1986. There is also a positive effect of cohort-by-school-test (6.7 percent), and this suggests that the school-test score is significantly more predictive in 1986.

The cohort-by-group interactions are also small, except for a small negative effect of cohort-by-sex (-7.9 percent). This effect suggests that the small female group gain (listed as 3 above) is significantly lower in 1986.

Figure [6] illustrates some aspects of the model results obtained. The first figure [6a] is a display of the 1984-1985 cohort predictions: On the Y-axis we plot increasing graduation rate, on the X-axis we plot increasing core gpa and on the Z-axis we plot increasing test scores. The second figure [6b] shows the difference between the two response surfaces of the predicted equations — the 1984-1985 cohort predictions compared with the 1986 cohort predictions. On the Y-axis we plot increasing graduation rate, on the X-axis we plot increasing core gpa and on the Z-axis we plot increasing test scores. If we look carefully, we can see a slightly higher graduation rate for the 1986 cohort (most easily seen at the lowest core gpa). However, in contrast to Figure [6a], the plane of Figure [6b] is nearly flat, and this means the response surfaces are not very different. Thus, the most striking aspect of these two separate prediction models is the overall similarity of the two response surfaces for the two different cohorts.

The model of Table [5] assumes all 18 variables have been used in the prediction equation. In Table [6], however, we present the results for the variables entered in a strict hierarchy. The main effects are added first and the interactions are added later. Because there are so many models and variables fitted, we simply present measures of goodness-of-fit and highlight the direction of the significant coefficients.

The main-effects models of Table [6] start with the cohort variable as a baseline Model No. 1, which is identical to Equation 2 of Table 4. Cohort by itself is significant and positive, but it does not add much beyond the baseline information (LIP=.4 percent). In the Model No. 2, core gpa, test score and school-test score all have significant and positive effects. In this model, the cohort effect is no longer significant, and the equation accounts for a larger portion of variance in the outcome variable (LIP = 15.9 percent). Model No. 3 adds the group-difference information as five orthogonal codes (see Appendix 1 for details). These group effects add a small but significant amount to the equation (+.9 percent) but only the sex difference is significant; here, the females are significantly higher than the males even after accounting for variation in all of the other variables, but the male-revenue positive effect is not yet apparent. (The "- - -" in Table [6] means this effect is large and in the negative direction from the orthogonal-coded variable.) Model No. 4 adds the cohort-by-academic interactions, and while cohort-by-school-test score is significant, the added variables do not add much to the prediction (+.1 percent). The same is true for Model No. 5, where five predictors add only a small amount (+0.2 percent). It is in the last model, however, that the male-revenue increase appears as a positive effect on graduation, and the cohort-by-school-test variable is significant. In general, the interaction models do not account for a significant amount of information beyond that found in the main effect models, so the simpler models may be chosen without much loss of information.

The same sequence of models also was fitted to the adjusted graduation-rate data. The numerical results of these models are given in detail in Appendices [2] and [3]. The results are basically the same, but the models generally fit the data better (i.e., Pseudo R^2= 24.9 percent). Consequently, most direct effects are stronger. In the adjusted analyses, the effects of core gpa are as large or larger than the corresponding test-score effects.

Comparisons for Selected Student-Athletes

The clear interpretation of the previous comparisons is clouded by one main sampling issue — the 1984-1985 cohort and the 1986 cohort are not comparable because the 1986 cohort was "censored" by the regulations of "Prop 48." That is, an unknown number of student-athletes who did not achieve the minimum test score (i.e., SAT = 700 or ACT = 15) were not admitted into these schools in 1986. Of course, the 1986 group does include many partial qualifiers, and these students form an interesting subgroup for further analyses. Since the distribution of test scores was markedly censored in 1986 (see Figure [1]), a clear understanding of these phenomena may require more sophisticated analyses (e.g., Manski & Wise, 1983).

The equations of Table [7] examine some of these selection effects in a simple and straightforward way. Here, we reanalyzed all previous models using only those students-athletes in both cohorts who met the "Prop" 48 requirements. To select these students, we used the self-report item listed on the original questionnaire (i.e., "Would this student have been eligible under the regulations of Proposition 48 as applied in 1986?"; see Appendix, NCAA Research Report No. 90-01.) These subgroup analyses reduced the total sample size from N = 5,616 to N = 4,447 (79.2 percent). In these two selected groups, the background distribution of the test scores are approximately equal.

Table [7] presents a final set of coefficients that summarizes all our results for the selected groups. First, the model accounts for only 14.2 percent of the observed proportions. The model applied to the selected sample has similarly strong effects for the school-test (R = 17.9 percent), student-test (9.1 percent) and for core gpa (5.8 percent). Once again, the main effect of cohort is not significant when these other variables are taken into account. Most other effects are diminished in size or are no longer significant. The only exceptions are a significant cohort-by-test effect (-5.8 percent and a significant cohort-by-sex effect (-10.1 percent).

The subsample results of all hierarchical logit models are presented in Table [8]. These results show: (1) The cohort variable is not significant, even in the first equation; (2) We can obtain a small but significant sex effect (in Models No. 3 and 4), but this can be accounted for by noting that the female increase in graduation rate is enhanced in the 1986 group; and (3) There are no other notable cohort interactions in any model under any hierarchy. The results of Tables [7] and [8] show that many of the small effects of Table [5] and [6] are differences due to initial selection.

The comparable subsample models fitted to the adjusted graduation rate are presented in Appendices [4] and [5]. These results are similar to our previous reports; while the adjusted rates are more predictable, the pattern of results is about the same. The only notable difference is that in the subsample the student-test does not seem to be an independent predictive factor for the adjusted rate.

DISCUSSION

We have presented a comparative statistical analysis of the five-year graduation rates for student-athletes who entered college before and after the implementation of Bylaw 14.3. The student-athletes are a stratified random sample of schools in Division I. The 1984-1985 sample consisted of N = 3,380 student-athletes from 86 Division I Schools, and the 1986 sample consisted of N = 2,435 student-athletes from 55 Division I schools. Further group breakdowns include black-white, male-female, and sport groups. The prediction of individual graduation rates using logit regression models was described in detail. Models are fit to each group with high-school grades (core gpa), precollege SAT or ACT scores (test), high-school rank, school selectivity (school-test) and other group variables as predictors.

These comparative statistical results show: (1) The summary statistics for 1986 graduation rate are similar to other recent national statistics, including positive effects for females and negative effects for black students; (2) The overall graduation rate for student-athletes significantly increases between the 1984-1985 and 1986 cohorts; (3) The test scores, core gpas, and other indicators of high-school academic performance also show significant increases between 1984-1985 and 1986; (4) The differences between the two independent sets of schools sampled are not large, so school selection effects are unlikely to account for these cohort differences in graduation rate; (5) Graduation rate in both groups is moderately well-predicted from both core gpa, test scores and other variables. An equally weighted average of core gpa and test scores predicts as well as any other single- or multiple-student variable examined here. The school-test score remains the best overall predictor of student graduation rate; (6) When high-school academic performance variables are included as covariates, there remains no direct effect of cohort groups. Cohort increases in graduation rates appear to be a direct result of cohort increases in initial test scores and core gpas. The initial-eligibility regulations of 1986 created censoring effects that are seen to have an indirect effect on graduation rate; (7) There are group differences between the black and white student-athletes; the Blacks are lower on both core gpa, test scores and graduation rate. However, these differences are subsumed by the academic variables, so there is little or no evidence for differential validity of prediction between racial groups or across cohorts; (8) There are group differences in the graduation rate between the sexes. The females graduate at a higher rate than the males, but there is no strong evidence for differential validity between the sexes, and only a small effect of differences between cohorts; (9) There are group differences in the graduation rate between the male revenue and nonrevenue sports. Given all other academic variables, the males in revenue sports graduate at a slightly higher rate than the other males, and there is a small effect of differences between cohorts; (10) The group that has been eliminated, the 1984-1985 student-athletes who would have been ineligible, appear to be different from the other student-athletes in several important ways. The effects of selection of student-athletes above the "Prop 48" requirements have clear effects, and the further studies of the "ineligible group" may be potentially valuable.

In summary, cohort differences in graduation rate exist, but these can be accounted for by the other academic variables. These results are obtained in analyses of both selected and unselected samples. The significant graduation-rate differences between the 1984-1985 and 1986 cohorts can be considered a direct function of the higher initial-test and core gpas. Since the higher test and core gpas are themselves a direct function of the eligibility rule, the increased graduation rate is best considered as an indirect function of the initial-eligibility rules.

These conclusions are necessarily limited by the possibility of nonequivalent cohort groups. Although the sampling of schools appears to be similar in both cohorts, the students themselves are likely to reflect different selection pressures. The academic pressures on the student-athlete before the initial-eligibility rule (1984-1985) were not the same as the academic pressures placed on those entering after the rules were in place (1986). Thus, conclusions such as those listed above need to be carefully considered in the context of a rapidly changing social system (see Marini & Greenberger, 1978; Temple & Polk, 1986).

We also need to recognize that these models are only moderate in prediction accuracy. Variables such as core gpa and test scores can cut down on the uncertainty about college-level preparation. The additional information about the school entered can add to the accuracy of our prediction of some academic outcomes. However, these predictions are far from perfect and much work needs to be done to improve the measurement and validity of these constructs. Also, the use of five-year college graduation is only one measure of academic performance, and graduation may be unrelated to other important aspects of cognitive development. Other cognitive and noncognitive measures are essential to a further understanding of the progress of a college student through the college experience (see Tracey & Sedlacek, 1987; Kanoy, Wester, & Latta, 1989; Pascarella & Terenzini, 1991). We hope aspects of this initial study can help us pursue these intriguing contemporary questions.

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TABLE 1

COMPARISON OF UNIVARIATE SUMMARY STATISTICS FOR SELECTED VARIABLES FROM 1984-85 AND 1986 COHORTS

COHORTS COMPARISONS SUBJECTS	LABELS	CODING	COHORT 1984-85 N=3,380		COHORT 1986 N=2,435		
ACADEMIC VARIABLES			**MEAN**	**(STD)**	**MEAN**	**(STD)**	
1. CORE GPA	(CGPA)	Z-SCORE	-.385	(1.24)	.112	(1.155)	*
2. STUDENT TEST	(TEST)	Z-SCORE	-.152	(1.05)	.244	(.938)	*
3. CLASS RANK	(RANK)	UNITS of 20%	.343	(1.23)	.302	(.222)	*
4. AVERAGE	(AVEGT)	Z-SCORE	-.269	(1.04)	.066	(.945)	*
GROUP VARIABLES			**MEAN**	**(STD)**	**MEAN**	**(STD)**	
5. MALE SUBJECT	(SEX)	1=MALE, 0=NOT	710	(.454)	.677	(.468)	*
6. BLACK SUBJECT	(RACE)	1=BLACK, 0=NOT	.252	(.434)	.179	(.383)	*
7. SPORT REVENUE	(REVENUE)	1=YES, 0=NO	.407	(.491)	.344	(.475)	*
8. TRAVEL TEAM	(TRAVEL)	1=YES, 0=NO	.698	(.459)	.704	(.457)	
9. TUTOR USE	(TUTOR)	1=YES, 0=NO	.356	(.479)	.354	(.478)	
DEPENDENT VARIABLES			**MEAN**	**(STD)**	**MEAN**	**(STD)**	
1. OVERALL RATE	(OVERRATE)	1=GRAD, 0=NOT	.480	(.500)	.565	(.496)	*
2. ADJUSTED RATE	(ADJRATE)	1=GRAD. 0=NOT	.682	(.466)	.786	(.410)	*
OVERRATE SUBGROUPS			**MEAN**	**(STD)**	**MEAN**	**(STD)**	
1. WHITE MALE REVENUE		1=GRAD, 0=NOT	.565	(.496)	.528	(.500)	
2. WHITE MALE OTHER		1=GRAD, 0=NOT	.476	(.500)	.568	(.496)	*
3. WHITE FEMALE		1=GRAD, 0=NOT	.599	(.490)	.696	(.461)	*
4. BLACK MALE REVENUE		1=GRAD, 0=NOT	.284	(.451)	.334	(.473)	
5. BLACK-MALE OTHER		1=GRAD, 0=NOT	.258	(.439)	.368	(.487)	
6. BLACK FEMALE		1=GRAD, 0=NOT	.356	(.481)	.638	(.484)	*

Note: Missing scores imputed by simple linear regression. Asterisk designates statistical significance between cohorts based upon independent groups t-test (i.e., * = p < .01). Z-Score refers to a variable transformed by subtracting a mean and dividing by a standard deviation. The means and standard deviations used were based on National Norms for all students. (see NCAA Research Report 91-02).

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TABLE 2

STATISTICAL COMPARISON OF FRESHMAN COHORTS FOR ALL PARTICIPATING INSTITUTIONS

COHORTS COMPARISONS	UNWEIGHTED			WEIGHTED		
COLLEGES	1984-85 MEAN (STD) [N]	1986 MEAN (STD) [N]		1984-85 W-MEAN (W-STD) [N]	1986 W-MEAN (W-STD) [N]	
2A: CONTINUOUS VARIABLES						
1. 1992 REPORTED SIX-YEAR GRADUATION RATE	53.7 (18.9) [79]	52.2 (21.0) [49]		53.4 (41.8) [79]	50.7 (50.7) [49]	
2. 1992 REPORTED SIX-YEAR ATHLETICS GRADUATION RATE	52.7 (19.2) [78]	49.3 (19.2) [52]		51.7 (38.5) [78]	47.0 (44.7) [51]	
3. ACADEMIC PRECOLLEGE Z-TEST (COLLEGE BOARD)	.421 (.607) [86]	.359 (.684) [54]		.405 (.607) [82]	50.7 (50.7) [49]	
4. NUMBER OF UNDERGRADUATES (COLLEGE BOARD)	9200 (6227) [86]	8927 (7715) [54]		== == ==	== == ==	
2B: CATEGORICAL VARIABLES **						
5. INSTITUTION PARTICIPATION IN APS STUDY	75.4% (43.2) [114]	98.2% (13.3) [56]	*	84.3% (79.9) [112]	100.0% (92.3) [55]	*
6. DIVISION I-A VS. DIVISION I AA AND I-AAA	45.3% (50.0) [86]	34.5% (47.9) [55]		68.0% (86.4) [86]	62.1% (102) [54]	
7. PRIVATE INSTITUTION VS. PUBLIC INSTITUTION	25.5% (43.8) [86]	41.8% (49.7) [55]	*	14.2% (31.7) [86]	23.1% (43.9) [54]	
8. INSTITUTION LOCATED IN RURAL AREA	15.1% (36.0) [86]	20.0% (40.3) [55]		15.1% (39.7) [86]	19.1% (49.9) [54]	
9. TOP 50% ACADEMIC RATING (GOURMAN REPORT)	55.8% (49.9) [86]	43.6% (50.0) [55]		71.8% (84.3) [86]	59.5% (95.5) [54]	
10. TOP 50% ATHLETICS RATING (GOURMAN REPORT)	46.8% (50.2) [64]	57.1% (50.2) [35]		45.4% (60.1) [64]	57.8% (80.8) [35]	

NOTES: '*' represents a significant coefficient at $p < .05$; '**' All Categorical variables were tested with both a linear regression model and a logistic-regression model; '***' Weights are defined by the number of total enrolled undergraduates as defined by the College Board 1985-86.

1: J. Gourman (1989). The Gourman Report: A rating of undergraduate programs in America and International Universities.

2: The College Handbook 1985-86: The College Board. College Board Publication, New York.

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TABLE 3

OVERALL GRADUATION RATE AS A PROBABILISTIC FUNCTION OF SINGLE-PREDICTOR VARIABLES FOR 1986 COHORT

MODELS FITTED	INTERCEPT		B-WEIGHT (STAND)		BASE RATE	PROPORTION OF CHANGE (STAND)	FIT INDEX OVERALL (N=2,435)	FIT INDEX ADJUSTED (N=1,750)
M1. BASELINE	.262	**	.000 (.000)		56.5	0.0 (0.0)	0.0%	0.0%
M2. CGPA	.372	**	.662 (.422)	**	59.2	14.6 (9.7)	9.2%	16.9%
M3. TEST	.102	*	.824 (.426)	**	52.5	19.1 (10.4)	9.1%	11.9%
M4. AVEGT	.251	**	.920 (.480)	**	56.2	20.1 (11.3)	11.3%	18.2%
M5. RANK	1.308	**	-.682 (-.416)	**	78.7	-13.5 (-7.8)	9.0%	16.0%
M6. RACE	.415	**	-.844 (-.178)	**	60.2	-20.8 (4.3)	1.9%	5.3%
M7. SEX	.798	**	-.775 (.200)	**	69.0	-18.4 (-4.5)	2.2%	3.4%
M8. REVENUE	.493	**	-.685 (-.172)	**	62.1	-16.2 (-4.1)	1.8%	3.8%
M9. TRAVEL	-.310	**	.824 (.207)	**	42.3	20.3 (5.1)	2.5%	4.1%
M10. TUTOR	.321	**	-.373 (-.098)	**	58.0	-9.3 (-2.4)	0.6%	0.8%

NOTES: Logit coefficient calculated using SAS PROC LOGISTIC. Rates-of-change are calculated from standard exponential formulas (see NCAA Research Report 91-02, Table 4). Rates-of-change represent the change in probability of graduation from a baseline for a one-unit change in the predictor variable. Standardized rates-of-change are calculated from standardized logit values. These hazard rates represent the change in probability of graduation for a one standard deviation statistical change in the predictor variable. Fit index defines improvement in fit over the baseline Asterisk designates statistical significance (i.e., '*' = p < .05, '**' = p < .01).

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TABLE 4

1984-85 VERSUS 1986 COHORT COMPARISONS INCLUDING SINGLE VARIABLES (OVERALL GRADUATION RATE ONLY)

MODELS FITTED	PARAMETER ESTIMATES								FIT INDICES	
	INTERCEPT (RATE)		COHORT (RATE)		VARIABLE (RATE)		COHORT BY VARIABLE (RATE)		LIP	ACC
M1. BASELINE	.064 (51.6)	*	— —		— —		— —		0.0%	51.6%
M2. COHORT	-.078 (48.1)	*	.340 (8.4)	**	— —		— —		0.5%	53.9%
M3. CGPA	.169 (54.2)	**	.204 (5.0)	**	.670 (15.6)	**	-.008 (-0.2)		10.4%	66.6%
M4. TEST	.042 (51.0)		.060 (1.5)		.920 (21.4)	**	-.096 (-2.3)		12.0%	65.6%
M5. AVEGT	.167 (54.2)	**	.085 (2.1)		.965 (21.4)	**	-.044 (-1.1)		13.5%	67.7%
M6. RACE	.175 (54.2)	**	.240 (5.8)	**	-1.058 (-25.1)	**	.215 (5.2)		3.3%	59.2%
M7. SEX	.250 (54.2)	**	.548 (12.8)	**	-.462 (-11.5)	**	-.313 (-7.8)	**	1.9%	56.0%

NOTES: Asterisk designates statistical significance (i.e., '*' = $p < .05$, '**' $p < .01$); LIP is the Likelihood Improvement as a Percentage; ACC refers to the Accuracy of Classification of expectations refitted to observations at the median. RATE = rate-of-change in overall graduation for a one unit change in the independent variable.

TABLE 5

LOGISTIC REGRESSION PREDICTING GRADUATION RATE FOR ALL STUDENT-ATHLETES (N=5616)

MODEL COMPARISONS	(VARIABLE)	B-W	(SE)	SIG.	LOW-R	RATE	UP-R
1. COHORT VARIABLES							
INTERCEPT	(UNIT)	-.176	(.072)	+	42.1	45.6	49.1
1984-85 vs 1986	(COHORT)	.118	(.169)	NS	-5.2	2.9	11.2
2. ACADEMIC VARIABLES							
CORE HIGH-SCHOOL GPA	(CGPA)	.264	(.044)	+++	4.4	6.6	8.7
STUDENT TEST SCORE	(TEST)	.539	(.061)	+++	10.4	13.4	16.2
COLLEGE-TEST SCORE	(CTEST)	.685	(.075)	+++	13.4	16.8	20.2
3. STUDENT GROUP EFFECTS							
SEX	(SEX)	-.213	(.083)	-	-9.9	-5.2	-1.2
MALE-REVENUE SPORT	(MALE-REV)	.138	(.068)	+	0.1	3.4	6.8
RACE	(RACE)	.117	(.121)	NS	-2.9	2.9	8.9
RACE-SEX	(RACE-SEX)	-.162	(.156)	NS	-11.2	-4.0	2.9
RACE-MALE-REVENUE-SPORT	(RACE-REV)	-.149	(.135)	NS	-9.9	-3.7	2.9
4. COHORT-ACADEMIC DIFFERENCES							
COHORT CGPA	(COH-CGPA)	.080	(.069)	NS	-1.4	2.0	5.4
COHORT TEST	(COH-TEST)	-.356	(.098)	- - -	-13.0	-7.9	-1.6
COHORT COLLEGE-TEST	(COH-CTEST)	.267	(.114)	+	1.1	6.7	12.2
5. COHORT-GROUP DIFFERENCES							
COHORT SEX	(COH-SEX)	-.327	(.134)	-	-13.9	-7.9	-1.6
COHORT MALE-REVENUE	(COH-MREV)	-.181	(.109)	NS	-9.5	-4.5	0.8
COHORT RACE	(COH-RACE)	-.249	(.388)	NS	-22.2	-6.1	12.7
COHORT RACE-SEX	(COH-RSEX)	.399	(.253)	NS	-2.4	9.9	21.6
COHORT RACE-MALE-REVENUE	(COH-RREV)	.108	(.217)	NS	-7.7	2.7	13.2

Notes: '+++' or '- - -' denotes significant parameter at $p < .001$; '++' or '- -' denotes a significant parameter at $p < .01$; '+' or '-' denotes a significant parameter at $p < .05$; 'LOW-R' represents the lower 95% confidence interval for the hazard rate; 'UP-R' represents the upper 95% confidence interval for the hazard rate. The Model LRT = 1329 with 17 degrees of freedom and the Model LIP = 17.1%.

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TABLE 6

MODEL SUMMARIES PREDICTING GRADUATION RATE FOR ALL STUDENT-ATHLETES (N=5616)

ALTERNATIVE MODELS	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
B-WEIGHTS					
INTERCEPT	NS	+++	++	++	+
COHORT	+++	NS	NS	NS	NS
CGPA		+++	+++	+++	+++
TEST		+++	+++	+++	+++
CTEST		+++	+++	+++	+++
SEX			- - -	- - -	-
MALE REVENUE			NS	NS	+
RACE			NS	NS	NS
RACE-SEX			NS	NS	NS
RACE-REV			NS	NS	NS
COHORT * CGPA				NS	NS
COHORT * TEST				- - -	- - -
COHORT * CTEST				NS	+
COHORT * SEX					-
COHORT * REV					NS
COHORT * RACE					NS
COHORT * RACE-SEX					NS
COHORT * RACE-REV					NS
FIT INDICES					
LRT	30	1239	1300	1313	1329
DF	1	4	9	12	17
NORMAL Z-VALUE	4.9	24.6	27.1	27.9	28.7
d-LRT	30	1209	61	13	16
d-DF	1	3	5	3	5
d-NORMAL Z-VALUE	4.9	23.7	6.4	2.6	2.5
LIP	0.4%	15.9%	16.8%	16.9%	17.1%

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TABLE 7

LOGISTIC REGRESSION PREDICTING GRADUATION RATE FOR ELIGIBLE STUDENT-ATHLETES (N=4447)

MODEL COMPARISONS	(VARIABLE)	B-W	(SE)	SIG.	LOW-R	RATE	UP-R
1. COHORT VARIABLES							
INTERCEPT	(UNIT)	.287	(.095)	NS	52.5	57.1	61.6
1984-85 vs 1986	(COHORT)	.152	(.197)	NS	-5.8	3.7	12.4
2. ACADEMIC VARIABLES							
CORE HIGH-SCHOOL GPA	(CGPA)	.243	(.053)	+++	3.4	5.8	8.2
STUDENT TEST SCORE	(TEST)	.389	(.083)	+++	5.4	9.1	12.7
COLLEGE-TEST SCORE	(CTEST)	.813	(.089)	+++	14.5	17.9	21.0
3. STUDENT GROUP EFFECTS							
SEX	(SEX)	-.136	(.127)	NS	-9.5	-3.3	2.7
MALE-REVENUE SPORT	(MALE-REV)	.073	(.097)	NS	-2.9	1.8	6.3
RACE	(RACE)	.243	(.167)	NS	-2.1	5.8	13.1
RACE-SEX	(RACE-SEX)	-.306	(.231)	NS	-18.7	-7.6	3.6
RACE-MALE-REVENUE-SPORT	(RACE-REV)	-.289	(.193)	NS	-16.5	-7.2	2.2
4. COHORT-ACADEMIC DIFFERENCES							
COHORT CGPA	(COH-CGPA)	.097	(.075)	NS	-1.2	2.4	5.9
COHORT TEST	(COH-TEST)	-.234	(.115)	+	-11.4	-5.8	-0.2
COHORT COLLEGE-TEST	(COH-CTEST)	.141	(.125)	NS	-2.5	3.4	9.1
5. COHORT-GROUP DIFFERENCES							
COHORT SEX	(COH-SEX)	-.406	(.166)	-	-18.1	-10.1	-2.0
COHORT MALE-REVENUE	(COH MREV)	-.132	(.131)	NS	-9.7	-3.3	3.0
COHORT RACE	(COH-RACE)	.461	(.454)	NS	-31.5	-11.5	10.0
COHORT RACE-SEX	(COH-RSEX)	.546	(.307)	NS	-1.4	12.6	23.6
COHORT RACE-MALE-REVENUE	(COH-RREV)	.222	(.260)	NS	-7.1	5.3	16.4

Notes: '+++' or '- - -' denotes significant parameter at $p < .001$; '++' or '- -' denotes a significant parameter at $p < .01$; '+' or '-' denotes a significant parameter at $p < .05$; 'LOW-R' represents the lower 95% confidence interval for the hazard rate; 'UP-R' represents the upper 95% confidence interval for the hazard rate. The Model LRT = 855 with 17 degrees of freedom and the Model LIP = 14.2%.

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TABLE 8

MODEL SUMMARIES PREDICTING GRADUATION RATE FOR ELIGIBLE STUDENT-ATHLETES (N=4447)

ALTERNATIVE MODELS	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
B-WEIGHTS					
INTERCEPT	+++	NS	NS	NS	NS
COHORT	NS	NS	NS	NS	NS
CGPA		+++	+++	+++	+++
TEST		+++	+++	+++	+++
CTEST		+++	+++	+++	+++
SEX			- - -	- - -	NS
MALE REVENUE			NS	NS	NS
RACE			NS	NS	NS
RACE-SEX			NS	NS	NS
RACE-REV			NS	NS	NS
COHORT * CGPA				NS	NS
COHORT * TEST				NS	-
COHORT * CTEST				NS	NS
COHORT * SEX					-
COHORT * REV					NS
COHORT * RACE					NS
COHORT * RACE-SEX					NS
COHORT * RACE-REV					NS
FIT INDICES					
LRT	3	786	837	841	855
DF	1	4	9	12	17
NORMAL Z-VALUE	1.4	20.6	22.6	23.0	23.6
d-LRT	3	783	51	4	14
d-DF	1	3	5	3	5
d-NORMAL Z-VALUE	1.4	20.0	5.7	0.6	2.2
LIP	0.0%	13.1%	13.9%	14.0%	14.2%

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APPENDIX 1

CODING SUMMARIES FOR TABLES

VARIABLE	GROUP	BINARY CODES	COMPLEX CODES
COHORT	COHORT 1984-85	0	0
	COHORT 1986	+1	+1
RACE	BLACK	+1	+1
	WHITE	0	-1
SEX	FEMALE	0	-1
	MALE-REVENUE SPORTS	+1	+.5
	MALE-NONREVENUE SPORTS	+1	+.5
MALE REVENUE	FEMALE	0	0
	MALE-REVENUE SPORTS	+1	+1
	MALE-NONREVENUE SPORTS	0	-1
RACE WITHIN FEMALE	BLACK FEMALE		+1
	BLACK MALE-REVENUE SPORTS		0
	BLACK MALE-NONREVENUE SPORTS		0
	WHITE FEMALE		-1
	WHITE MALE-REVENUE SPORTS		0
	WHITE MALE-NONREVENUE SPORTS		0
RACE WITHIN REVENUE	BLACK FEMALE		0
	BLACK MALE-REVENUE SPORTS		+1
	BLACK MALE-NONREVENUE SPORTS		0
	WHITE FEMALE		0
	WHITE MALE-REVENUE SPORTS		-1
	WHITE MALE-NONREVENUE SPORTS		0

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APPENDIX 2

LOGISTIC REGRESSION PREDICTING ADJUSTED GRADUATION RATE FOR ALL STUDENT-ATHLETES (N=4008)

MODEL COMPARISONS	(VARIABLE)	B-W	(SE)	SIG.	LOW-R	RATE	UP-R
1. COHORT VARIABLES							
INTERCEPT	(UNIT)	1.012	(.099)	+++	69.4	73.3	76.9
1984-85 vs 1986	(COHORT)	.344	(.223)	NS	-1.8	6.2	12.4
2. ACADEMIC VARIABLES							
CORE HIGH-SCHOOL GPA	(CGPA)	.562	(.063)	+++	7.7	9.5	11.2
STUDENT TEST SCORE	(TEST)	.583	(.083)	+++	7.4	9.8	11.9
COLLEGE-TEST SCORE	(CTEST)	.499	(.104)	+++	5.4	8.6	11.4
3. STUDENT GROUP EFFECTS							
SEX	(SEX)	-.292	(.104)	- -	-10.7	-6.1	-1.7
MALE-REVENUE SPORT	(MALE-REV)	.181	(.080)	+	0.4	3.4	6.1
RACE	(RACE)	-.036	(.140)	NS	-6.5	-0.7	4.4
RACE-SEX	(RACE-SEX)	-.254	(.189)	NS	-13.8	-5.3	2.2
RACE-MALE-REVENUE-SPORT	(RACE-REV)	-.069	(.159)	NS	-8.1	-1.4	4.5
4. COHORT-ACADEMIC DIFFERENCES							
COHORT CGPA	(COH-CGPA)	.137	(.102)	NS	-1.2	2.6	6.0
COHORT TEST	(COH-TEST)	-.471	(.140)	- - -	-16.7	-10.1	-4.0
COHORT COLLEGE-TEST	(COH-CTEST)	.245	(.167)	NS	-1.7	4.5	9.6
5. COHORT-GROUP DIFFERENCES							
COHORT SEX	(COH-SEX)	-.311	(.182)	NS	-14.8	-6.5	0.9
COHORT MALE-REVENUE	(COH-MREV)	-.233	(.132)	NS	-10.6	-4.8	0.5
COHORT RACE	(COH-RACE)	-.528	(.464)	NS	-33.8	-11.5	6.8
COHORT RACE-SEX	(COH-RSEX)	.667	(.327)	+	0.5	10.9	17.7
COHORT RACE-MALE-REVENUE	(COH-RREV)	.094	(.262)	NS	-9.0	1.8	10.1

Notes: '+++' or '- - -' denotes significant parameter at $p < .001$, '++' or '- -' denotes a significant parameter at $p < .01$; '+' or '-' denotes a significant parameter at $p < .05$; 'LOW-R' represents the lower 95% confidence interval for the hazard rate; 'UP-R' represents the upper 95% confidence interval for the hazard rate. The Model LRT = 1151 with 17 degrees of freedom and the Model LIP = 24.9%.

APPENDIX 3

MODEL SUMMARIES PREDICTING ADJUSTED GRADUATION RATE FOR ALL STUDENT-ATHLETES (N=4008)

ALTERNATIVE MODELS	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
B-WEIGHTS					
INTERCEPT	+++	+++	+++	+++	+++
COHORT	+++	NS	NS	NS	NS
CGPA		+++	+++	+++	+++
TEST		+++	+++	+++	+++
CTEST		+++	+++	+++	+++
SEX			- - -	- - -	- -
MALE REVENUE			NS	NS	+
RACE			NS	NS	NS
RACE-SEX			NS	NS	NS
RACE-REV			NS	NS	NS
COHORT * CGPA				NS	NS
COHORT * TEST				- -	- - -
COHORT * CTEST				NS	NS
COHORT * SEX					NS
COHORT * REV					NS
COHORT * RACE					NS
COHORT * RACE-SEX					+
COHORT * RACE-REV					NS
FIT INDICES					
LRT	43	1077	1128	1136	1151
DF	1	4	9	12	17
NORMAL Z-VALUE	5.8	23.3	25.6	26.2	27.0
d LRT	43	1034	51	8	15
d-DF	1	3	5	3	5
d-NORMAL Z-VALUE	5.8	22.3	5.7	1.7	2.3
LIP	0.9%	23.3%	24.4%	24.6%	24.9%

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APPENDIX 4

LOGISTIC REGRESSION PREDICTING ADJUSTED GRADUATION RATE FOR ELIGIBLE STUDENT-ATHLETES (N=3258)

MODEL COMPARISONS	(VARIABLE)	B-W	(SE)	SIG.	LOW-R	RATE	UP-R
1. COHORT VARIABLES							
INTERCEPT	(UNIT)	1.445	(.131)	+++	76.6	80.9	84.6
1984-85 vs 1986	(COHORT)	.470	(.263)	NS	-0.7	6.2	10.9
2. ACADEMIC VARIABLES							
CORE HIGH-SCHOOL GPA	(CGPA)	.626	(.083)	+++	6.1	7.9	9.4
STUDENT TEST SCORE	(TEST)	.294	(.127)	+	0.7	4.1	7.0
COLLEGE-TEST SCORE	(CTEST)	.666	(.137)	+++	5.4	8.3	10.6
3. STUDENT GROUP EFFECTS							
SEX	(SEX)	-.116	(.160)	NS	-7.5	-1.9	2.9
MALE-REVENUE SPORT	(MALE-REV)	.040	(.123)	NS	-3.3	0.6	4.0
RACE	(RACE)	.130	(.210)	NS	-4.7	1.9	7.0
RACE-SEX	(RACE-SEX)	-.572	(.290)	-	-23.4	-10.4	-0.5
RACE MALE REVENUE SPORT	(RACE-REV)	-.362	(.244)	NS	-16.3	-6.2	1.7
4. COHORT-ACADEMIC DIFFERENCES							
COHORT CGPA	(COH-CGPA)	.061	(.116)	NS	-2.7	0.9	4.1
COHORT TEST	(COH-TEST)	-.190	(.173)	NS	-9.5	-3.1	2.2
COHORT COLLEGE-TEST	(COH-CTEST)	.040	(.192)	NS	-5.7	0.6	5.6
5. COHORT-GROUP DIFFERENCES							
COHORT SEX	(COH SEX)	-.499	(.222)		-18.4	-8.9	-1.0
COHORT MALE-REVENUE	(COH-MREV)	-.098	(.163)	NS	-7.3	-1.5	3.2
COHORT RACE	(COH-RACE)	-.872	(.562)	NS	-43.9	-17.0	3.3
COHORT RACE-SEX	(COH-RSEX)	1.024	(.399)	+	3.5	11.3	15.4
COHORT RACE-MALE-REVENUE	(COH-RREV)	.389	(.324)	NS	-4.1	5.3	11.3

Notes: '+++' or '- - -' denotes significant parameter at $p < .001$; '++' or '- -' denotes a significant parameter at $p < .01$; '+' or '-' denotes a significant parameter at $p < .05$; 'LOW-R' represents the lower 95% confidence interval for the hazard rate; 'UP-R' represents the upper 95% confidence interval for the hazard rate. The Model LRT = 612 with 17 degrees of freedom and the Model LIP = 19.2%.

APPENDIX 5

MODEL SUMMARIES PREDICTING GRADUATION RATE ELIGIBLE STUDENT-ATHLETES (N=3258)

ALTERNATIVE MODELS	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
B-WEIGHTS					
INTERCEPT	+++	+++	+++	+++	+++
COHORT	NS	NS	NS	NS	NS
CGPA		+++	+++	+++	+++
TEST		++	+	+	+
CTEST		+++	+++	+++	+++
SEX			---	---	NS
MALE REVENUE			NS	NS	NS
RACE			NS	NS	NS
RACE-SEX			NS	NS	-
RACE-REV			NS	NS	NS
COHORT * CGPA				NS	NS
COHORT * TEST				NS	NS
COHORT * CTEST				NS	NS
COHORT * SEX					-
COHORT * REV					NS
COHORT * RACE					NS
COHORT * RACE-SEX					+
COHORT * RACE-REV					NS
FIT INDICES					
LRT	1	559	560	599	612
DF	1	4	9	12	17
NORMAL Z-VALUE	0	17.8	19.0	19.8	20.2
d-LRT	1	558	1	39	13
d DF	1	3	5	3	5
d-NORMAL Z-VALUE	0	17.5	-1.8	5.2	2.0
LIP	0.0%	17.5%	17 5%	18.8%	19.2%

FIGURE 1

COMPARATIVE FREQUENCY DISTRIBUTION FOR 1984-85 (N=3380) AND 1986 (N=2435) STUDENT-ATHLETE COHORTS

Fig. [1a]

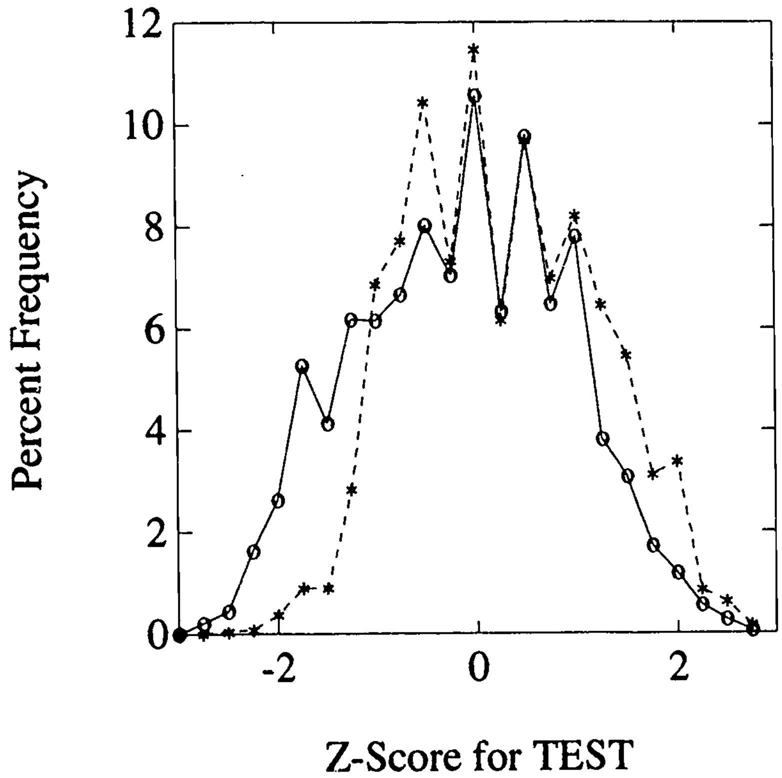
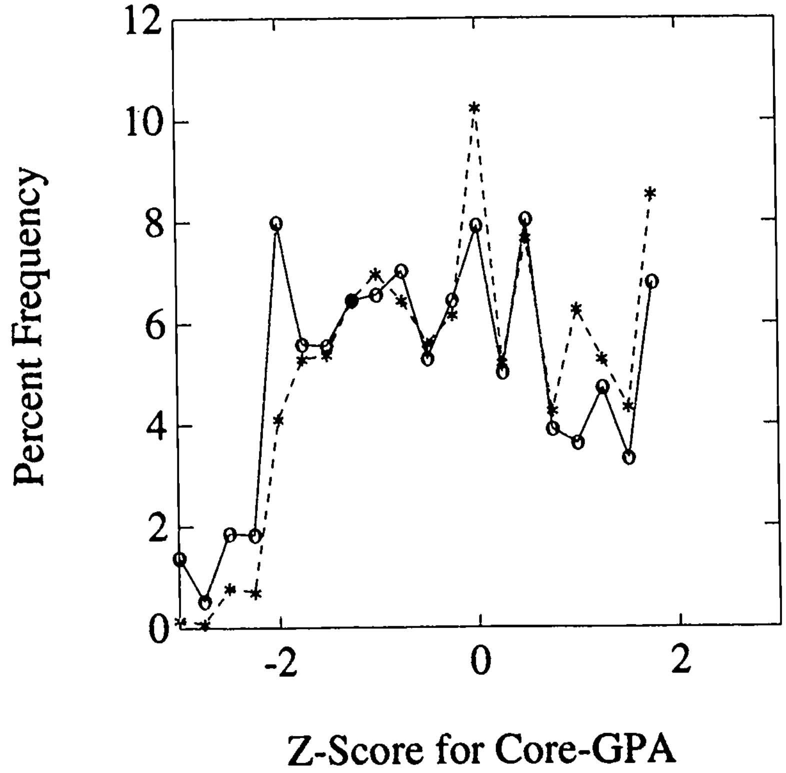


Fig. [1b]



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'O'=COHORT 1984-85
'*'=COHORT 1986

FIGURE 2

COMPARATIVE BOX-PLOT DISTRIBUTIONS FOR 1984-85 (N=86) AND 1986 (N=55) PARTICIPATING COLLEGES

Fig. [2a]

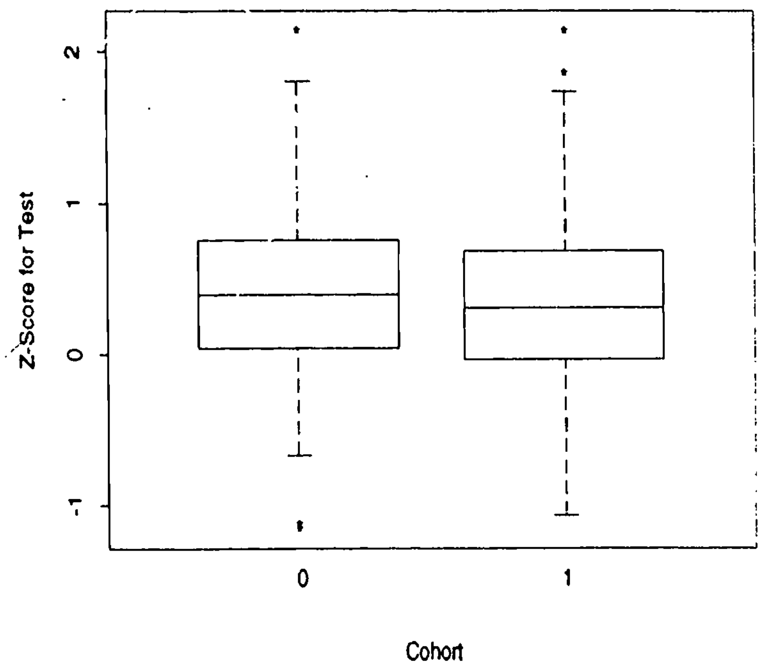

Fig. [2b]

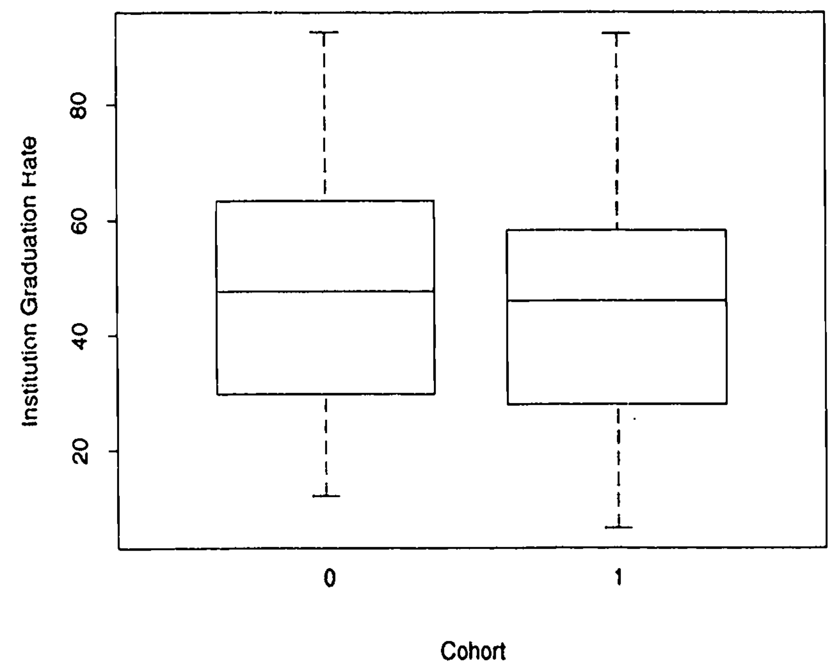

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FIGURE 3

LOGISTIC-REGRESSION PATH DIAGRAMS

Fig. [3a]

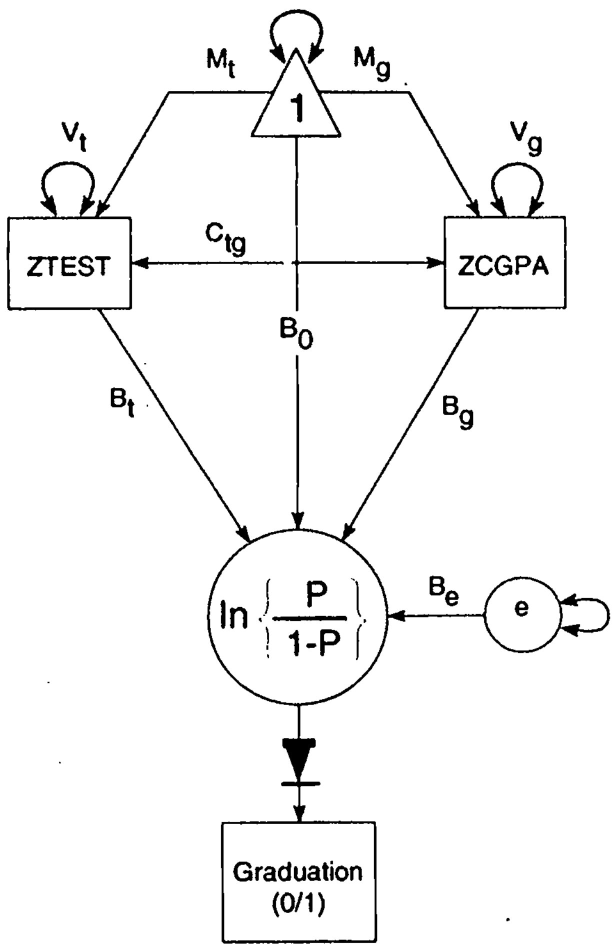


Fig. [3b]

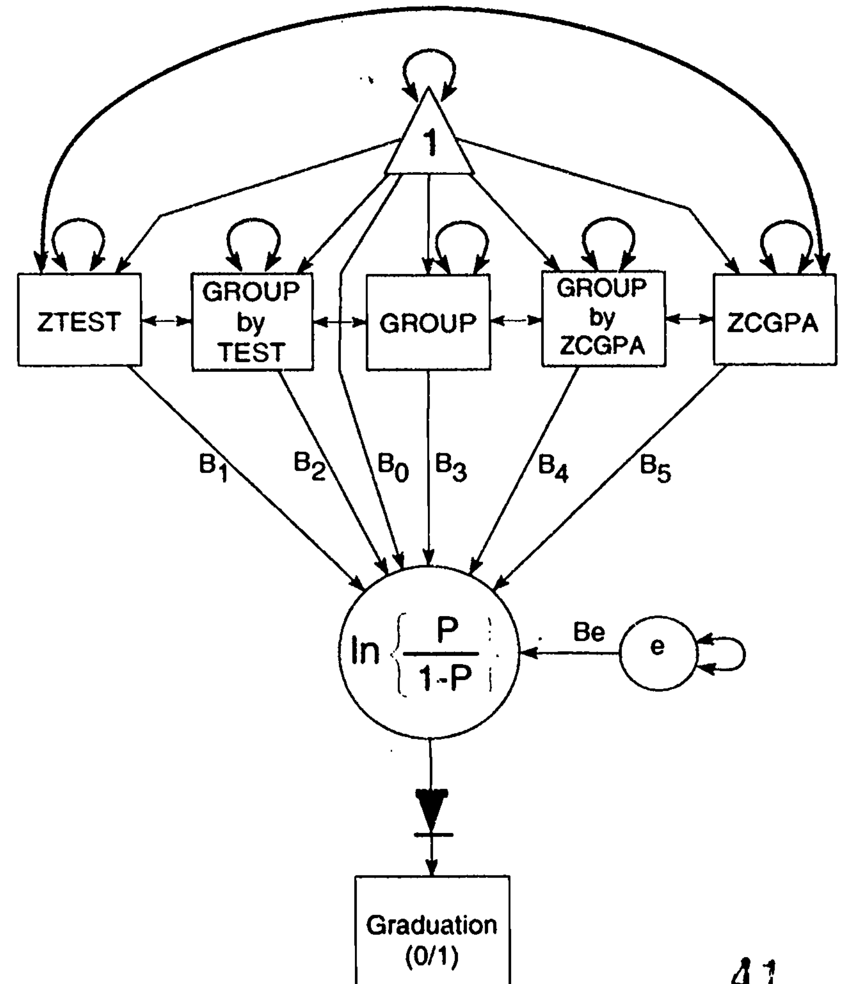


FIGURE 4

PREDICTING COLLEGE GRADUATION FROM HIGH-SCHOOL CORE GRADE-POINT AVERAGE

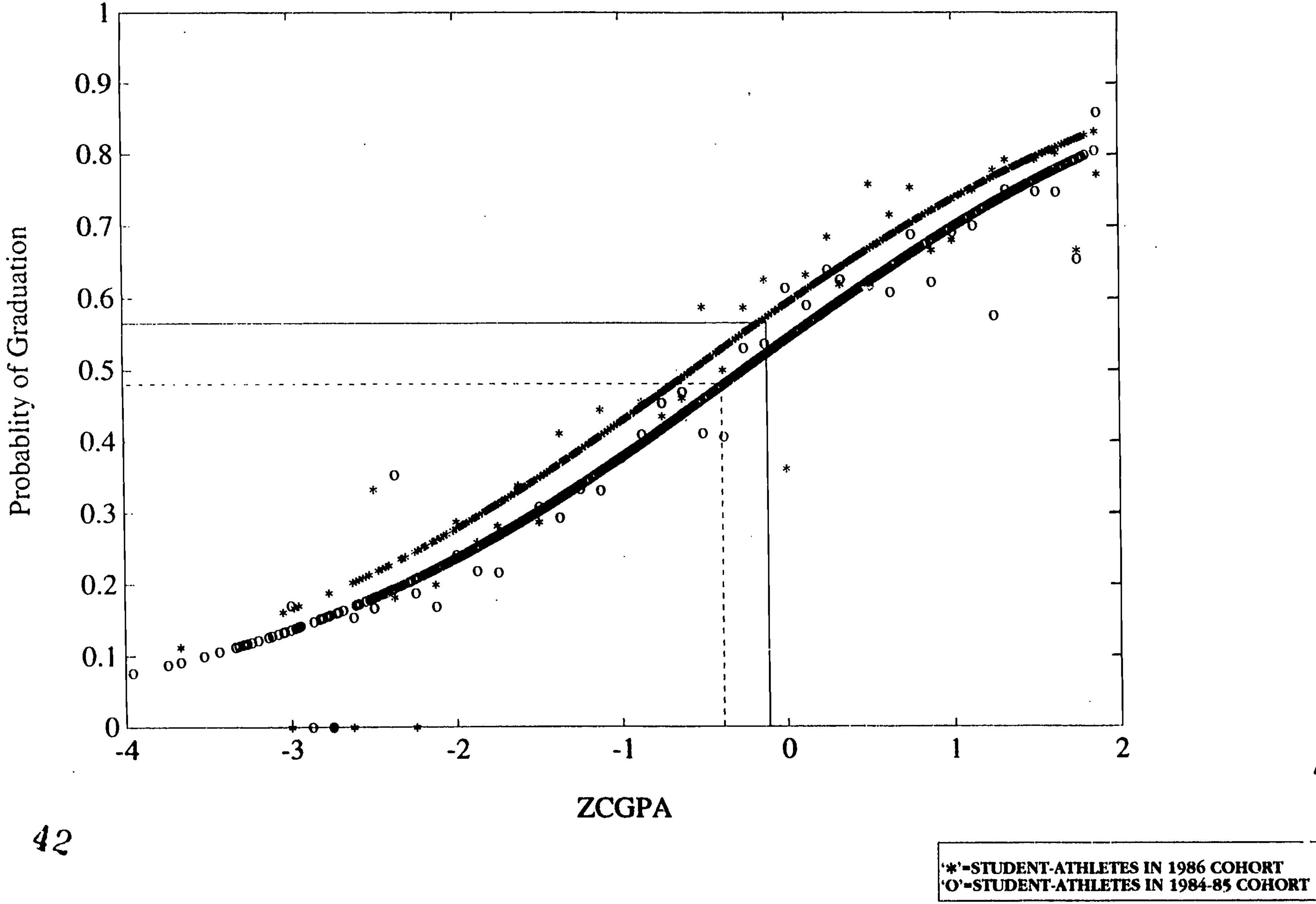
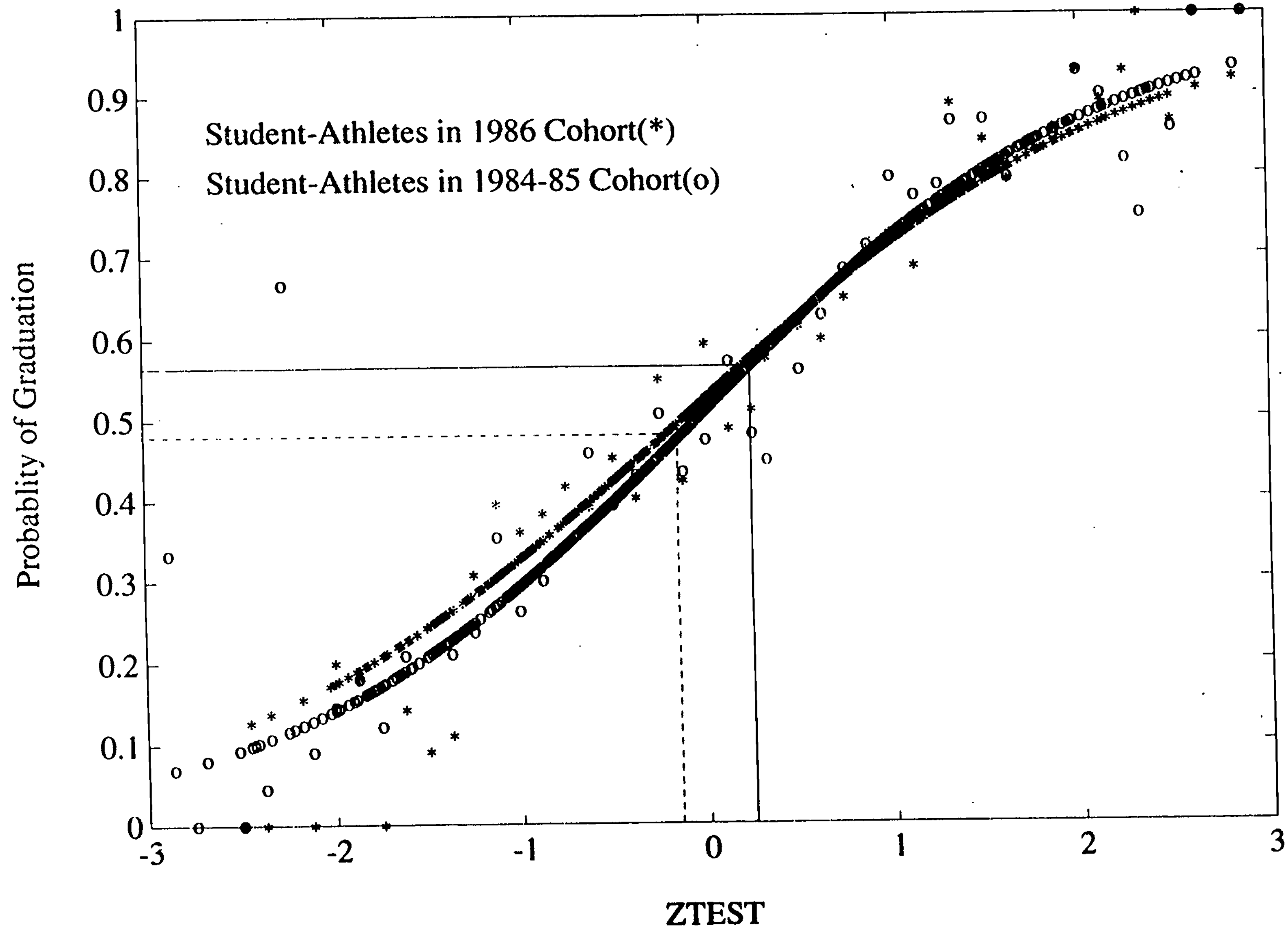


FIGURE 5

PREDICTING COLLEGE GRADUATION FROM HIGH-SCHOOL TEST SCORES



'*'=STUDENT-ATHLETES IN 1986 COHORT
'O'=STUDENT-ATHLETES IN 1984-85 COHORT

FIGURE 6

THE LOGISTIC PREDICTED SURFACE FOR 1984-85 (N=3380) AND 1986 (N=2435) STUDENT-ATHLETE COHORTS

Fig. [6a] Probability of graduation for 1984-85 freshmen as a function of Core GPA and TEST scores

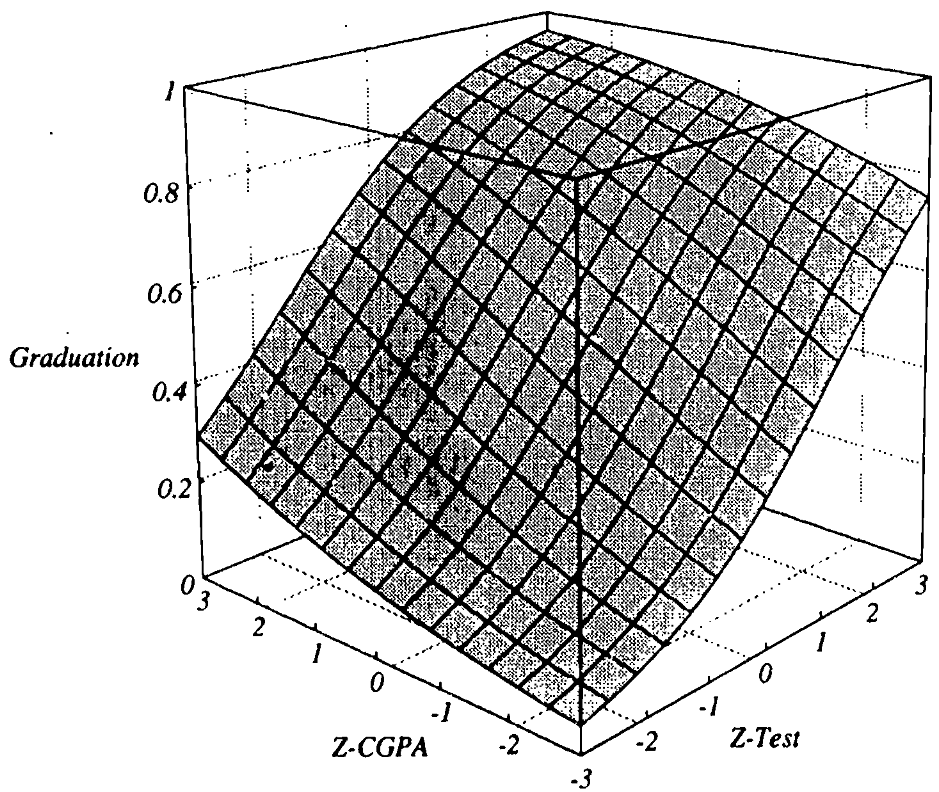
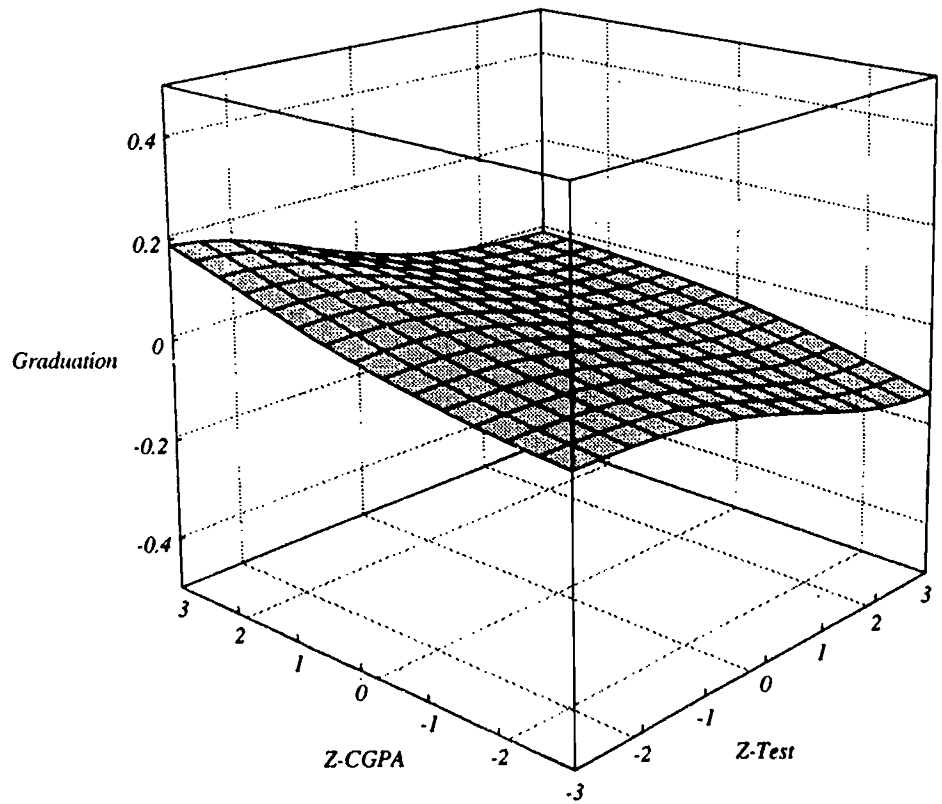


Fig. [6b] Difference in probability of graduation for 1984-85 freshmen versus 1986 freshmen as a function of Core GPA and TEST scores



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