

Utilizing SAS[®] Software in the Evaluation of Virginia Tech's Academic Eligibility Policy

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Abstract

Beginning in Fall of 1997, freshmen entering Virginia Tech were required to maintain a 2.00 grade point average to be considered eligible for continued enrollment in the University. This policy was adopted to promote a higher level of academic achievement for Virginia Tech students. However, it was expected that the policy would negatively impact student retention, especially freshmen retention. A study investigating the effects of the Academic Eligibility Policy on student retention was initiated.

The populations of interest were freshmen who entered the University prior to the implementation of the new policy and freshmen who entered after implementation of the new policy. The 1995 and 1996 freshmen were considered as samples of the first population and the 1997 freshmen were considered as samples of the second population. Two performance measures were identified: end of the second Fall semester GPA, and the percentage of students returning for their second fall semester. This report outlines the methodology that was used to complete the analysis and provides some results regarding the 1997 freshmen. SCT's[®] Strategic Enrollment Management software, and SAS[®] software were used in the analysis. The conclusion of the study was that the new academic eligibility policy did not adversely affect freshman retention.

Introduction

Beginning in the Fall of 1997, freshmen entering Virginia Tech were required to maintain a 2.00 grade point average (GPA) to be considered eligible for continued enrollment in the University. This policy was adopted to promote a higher level of academic achievement for Virginia Tech students. However, it was expected that the policy would negatively impact student retention, especially freshmen retention. Therefore, a study was initiated to investigate the effects of the Academic Eligibility Policy on the retention of students.

Given that the most recent change in the Academic Eligibility Policy occurred in 1997, the population of interest consisted of the first-time freshmen who were first enrolled at Virginia Tech during a summer session or the fall semester of 1997. Two performance measures were identified: end of the second Fall semester GPA, and the percentage of students returning for their second fall semester. This report outlines the methodology that was used to complete the analysis and provides some results regarding the 1997 Freshman cohort.

Methodology

First, the target population was identified as first-time freshmen who first enrolled at Virginia Tech during a summer or fall semester of 1997 and who were enrolled

for at least one semester credit hour during their first fall semester. In this study, these students are called collectively the 1997 Freshman cohort. The source of this data was the University's Student Longitudinal File.

The performance measures for this population were compared to the performance measures for students who were classified as being in the 1995 and 1996 Freshman cohorts.

For each student in the 1997 Freshman cohort, the grade point average (GPA) that the student received through the end of their first fall semester was obtained. These GPAs were averaged to get an overall semester average GPA for the target population. The overall semester average GPAs were calculated in similar fashion for the 1995 and 1996 Freshman cohorts.

The set of first fall semester GPAs for each cohort was tested for normality using the Kolmogorov-Smirnov goodness-of-fit test. Based on the results of the Kolmogorov-Smirnov test, a test comparing the means of the different populations was conducted (a parametric test if the hypothesis of normality was not rejected for all three cohorts or a non-parametric test if the hypothesis of normality was rejected.) Since the averages were calculated on non-equal numbers of observations, the Tukey test could not be used to determine significant differences in conjunction with an analysis of variance.

Likewise, the second fall semester GPAs were calculated for the 1995, 1996 and 1997 Freshman cohorts. Again, tests for normality were conducted and the means were compared. This provided a mechanism for determining if there were significant differences between average GPAs earned prior to the new eligibility policy and those earned since the new eligibility policy was put in place.

The second set of performance measures to be calculated and analyzed consisted of retention rates. Retention rates for each of the freshman groups were calculated. For example, the retention rate for the 1995 freshmen was the number of 1995 freshmen enrolled in Fall 1996/the number of freshmen in the 1995 Freshman cohort. The retention rates for each freshman cohort were calculated and compared.

Once overall retention rates (before and after the new policy was implemented) were compared, analysis was conducted to determine if the previous years' retention rates led to a reasonable predictive model for 1997 retention. The 1995 and 1996 students were combined into a single set. This set was sub-grouped by 0.1 increments of the first fall GPA. For example, students who achieved a first fall GPA of 3.9 or greater but less than 4.0, were grouped together. The retention rate for each of these sub-groups was calculated. A curve was fit to the data; the dependent variable was the retention rate in a particular GPA increment category while the GPA

increment and the square of the GPA increment were the independent variables. The equation of the resulting curve was considered the prediction equation for the 1997 freshmen. It was assumed that the predictions generated from the prediction equation would closely approximate the percentages of returning 1997 freshmen under the previous academic eligibility policy.

Results

The target population consisted of all first-time freshmen who first enrolled at Virginia Tech during the summer or fall semester of 1997 and who were carrying at least one semester credit hour during the fall of 1997. These students were identified using a DATA statement and a WHERE clause generated through SCT's Strategic Enrollment Management software (a GUI interface to the SAS system). The comparison populations were 1) all first-time freshmen who first enrolled at Virginia Tech during a summer or fall semester of 1996 and who were carrying at least one semester credit hour during the fall of 1996 (1996 Freshman cohort) and 2) all first-time freshmen who first enrolled at Virginia Tech during a summer or fall semester of 1995 and who were carrying at least one semester credit hour during the fall of 1995 (1995 Freshman cohort).

The overall semester average GPAs for the three populations are summarized in Table 1.

A cursory glance suggests that the average GPA at the end of the first fall term has been steadily increasing since 1995. From 1995 to 1996, the average GPA among first-time freshmen increased 1.34% and from 1996 to 1997, the average GPA increased 4.60%. However, there is insufficient data to conclude that this increase is due to some force other than the natural variation that is found in any process including grading processes.

Kolmogorov-Smirnov (K-S) goodness-of-fit tests were conducted to determine if the distribution of first fall semester GPAs among the students in each population was approximately normal (PROC UNIVARIATE). The results of these tests suggest that in all three instances, first fall semester GPAs appear to be approximately normally distributed. K-S tests also were conducted on second fall semester GPAs. Again, the data suggest that in all three instances, second fall semester GPAs appear to be approximately normally distributed.

Since the distribution of first fall semester GPAs appeared to be normal for all three populations, t-tests were conducted to determine if the differences in the averages were significant or not (PROC TTEST).

Test 1: $H_0: \mu_{1,1995} = \mu_{1,1996}$
 $H_1: \mu_{1,1995} < \mu_{1,1996}$

The first test compared the average first fall GPA earned by freshmen in 1995 with the average first fall GPA earned by freshmen in 1996. The variances in GPA in each of the two populations appeared to be equal ($p=0.5393$) and as mentioned before, the data appeared to come from approximately normal distributions. The test produced a p-value of 0.0284. Therefore, the null hypothesis would

be rejected at the $\alpha = 0.05$ confidence level and the average grades earned at the end of the first fall semester by 1996 freshmen appear to be significantly higher than those earned by 1995 freshmen.

Test 2: $H_0: \mu_{1,1995} = \mu_{1,1997}$
 $H_1: \mu_{1,1995} < \mu_{1,1997}$

The second test compared the average first fall GPA earned by freshmen in 1995 with the average first fall GPA earned by freshmen in 1997. As discussed earlier, the data appeared to come from approximately normal distributions. However, the data did not support the hypothesis that variances in GPA in each of the two populations were equal ($p=0.0028$). Therefore, the Cochran and Cox approximation of the probability level of the approximate t statistic for the case where variances are unequal was used for a p-value. The t-test produced a p-value of 0.0000. Therefore, the null hypothesis was rejected. The average GPA earned by freshmen in 1997 was significantly higher than the average GPA earned by freshmen in 1995.

Test 3: $H_0: \mu_{1,1996} = \mu_{1,1997}$
 $H_1: \mu_{1,1996} < \mu_{1,1997}$

The third test compared the average first fall GPA earned by freshmen in 1996 with the average first fall GPA earned by freshmen in 1997. As discussed earlier, the data appeared to come from approximately normal distributions. However, as in the second test, the data did not support the hypothesis that variances in GPA in each of the two populations were equal ($p=0.0150$). Again, the Cochran and Cox p-value was calculated. The t-test produced a p-value of 0.0000. Therefore, the null hypothesis was rejected. The average GPA earned by freshmen in 1997 was significantly higher than the average GPA earned by freshmen in 1996.

Similar tests were conducted on the second fall average GPA. Summary statistics are presented in Table 2.

As expected, the average GPAs improved for each freshman cohort analyzed. The reduction in the numbers of students in each cohort coupled with the improved average GPAs suggests that the students who left the University tended to have low GPAs.

Tests for normality were conducted on the second fall GPAs for each year, and in every test, the hypothesis that the data came from normal distributions failed to be rejected. Therefore, a series of t-tests were conducted to determine if significant differences in the average GPAs earned by each freshman group existed.

In this series of tests, the data suggests:

1. the average second fall GPA for 1995 freshmen was significantly less than the average second fall GPA for 1996 freshmen ($p = 0.0001$);
2. the average second fall GPA for 1996 freshmen was significantly less than the average second fall GPA for 1997 freshmen ($p=0.0000$); and
3. the average second fall GPA for 1997 freshmen was significantly greater than the average second fall GPA for 1995 freshmen ($p = 0.0000$).

In fact, it appears that the 1997 freshmen received higher grades on average through the second fall semester than the 1996 freshmen. Additionally, the 1996 freshmen seem to have received higher grades on average through their second fall semester than the 1995 freshmen. As the average grade increased, the variation in grades decreased. This would be expected because there is an upper bound on the GPA (4.00).

Retention Rates

For each freshman cohort, retention rates were calculated. The results are given in Table 3. Chi-Squared tests (PROC FREQ) were conducted to see if the proportion of students being retained through the second fall semester was significantly different from freshman group to freshman group. In all cases, the data did not support the rejection of the null hypothesis that all proportions were equal. Therefore, it would not appear that there were any significant differences in retention rates, and certainly none that could be attributed to the new academic eligibility policy.

Curve Fitting

The 1995 and 1996 data were used to develop a prediction equation for retention of 1997 freshmen. The 1995 and 1996 students were combined into a predictor single set. This set was sub-grouped by 0.1 increments of the first fall GPA. For example, students who earned less than a 0.1 GPA during their first fall semester a first fall semester were grouped together. The retention rate for each of these sub-groups was calculated and is presented in Table 4. The GPA increment category was the minimal GPA value allowed for a particular sub-group.

A curve was fit to the data (PROC REG) with the dependent variable being the retention rate in a particular GPA increment category and the GPA increment and the GPA increment squared being the independent variables. The two independent variables (GPA and GPA²) accounted for 91.6% of the variation in the number of returning students (adjusted R² = .916). The equation of the resulting curve is given as:

$$\% \text{ completing 2}^{\text{nd}} \text{ fall} = 0.31491 + 0.44917*(1^{\text{st}} \text{ Fall GPA Increment}) - 0.07662*(1^{\text{st}} \text{ Fall GPA Increment})^2.$$

This equation became the prediction equation for the 1997 freshmen. Given the large value of R², the predictions generated when the prediction equation was applied to the 1997 freshman cohort data were assumed to closely approximate the retention rates for 1997 freshmen had they been under the previous academic eligibility policy.

The retention rates predicted and the actual retention rates for each GPA are shown in Figure 1. The numbers of students that were expected to return for and complete the second fall semester were calculated from these predicted rates (Table 5). The prediction equations suggested that 4079 of the 4472 freshmen in the 1997 cohort would return. However, only 3933 of these freshmen were retained.

As can be seen in Figure 1, the differences in the predicted retention rates and the actual retention rates mainly occurred in the lower First Fall GPA increment

categories. This is largely due to the decreased number of 1997 freshman students in those lower categories as compared to the predictor set. When these rates were used to calculate the numbers of students retained, it is apparent that the predicted numbers of students retained closely approximate the actual numbers of students retained (Figure 2).

Conclusions

The analysis revealed that on average, freshmen entering Virginia Tech in either the summer or fall of 1997 earned higher grades than freshmen entering Virginia Tech in either the summer or fall of 1996 or 1995. There could be several reasons for this increase including:

1. Virginia Tech may be attracting higher quality incoming students;
2. The academic eligibility policy implemented in 1997 resulted in students taking classes more seriously and working harder to avoid application of the policy;
3. There is sufficient variation in grading practices that the differences in average GPAs would not warrant undue attention if more years of data were included in the study; or
4. Changes in teaching techniques or tutoring programs are helping students achieve and maintain higher grades.

However, this study did not establish causality. The data analyzed merely suggest that grades earned by first-time freshmen since the new academic policy was implemented (in 1997), were higher than grades earned by first-time freshmen in 1996 and 1995. This was true for the overall GPAs earned by the end of the cohort's first fall semester as well as for the overall GPAs posted at the end of the cohort's second fall semester.

Overall two-year retention rates of freshmen entering Virginia Tech in 1997 did not differ significantly from the retention rates of freshmen who entered Virginia Tech in 1995 or 1996. In fact, data from the 1995 and 1996 Freshman cohorts were used to predict the numbers of 1997 freshmen that would have been retained through the second fall semester (if the eligibility policy had not been changed) given each student's GPA at the end of their first fall semester. The predicted numbers of freshmen retained was very similar to the actual numbers of freshmen retained, again suggesting that there were no significant differences in retention that could be attributed to the academic eligibility policy.

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Table 1. Average freshman GPA at the end of the first fall term

Entering Year	Number of Freshmen	First Fall Average GPA	Standard Deviation in GPA
1995	4658	2.4930	0.868
1996	4998	2.5265	0.860
1997	4472	2.6427	0.830

Table 2. Average freshman GPA at the end of the second fall term

Entering Year	Number of Freshmen	Second Fall Average GPA	Standard Deviation in GPA
1995	4138	2.5909	0.692
1996	4454	2.6447	0.676
1997	3933	2.7400	0.626

Table 3. Retention rates for each freshman cohort

Entering Year	Number of Entering Freshmen	Number of Freshmen Enrolled in Second Fall Semester	Retention Rate
1995	4658	4138	88.84%
1996	4998	4454	89.12%
1997	4472	3933	87.95%

Table 4. 1995 and 1996 Freshman retention rates based on first fall GPA

1995 and 1996 Freshman Cohorts			
GPA at End of First Fall Semester	Percentage of Students Completing Second Fall Semester	GPA at End of First Fall Semester	Percentage of Students Completing Second Fall Semester
0.0<= GPA < 0.1	23.20%	2.1<= GPA < 2.2	90.73%
0.1<= GPA < 0.2	20.00%	2.2<= GPA < 2.3	92.17%
0.2<= GPA < 0.3	59.26%	2.3<= GPA < 2.4	93.27%
0.3<= GPA < 0.4	45.83%	2.4<= GPA < 2.5	93.59%
0.4<= GPA < 0.5	32.35%	2.5<= GPA < 2.6	93.83%
0.5<= GPA < 0.6	60.47%	2.6<= GPA < 2.7	94.58%
0.6<= GPA < 0.7	53.19%	2.7<= GPA < 2.8	93.83%
0.7<= GPA < 0.8	60.42%	2.8<= GPA < 2.9	94.11%
0.8<= GPA < 0.9	67.80%	2.9<= GPA < 3.0	92.57%
0.9<= GPA < 1.0	65.63%	3.0<= GPA < 3.1	94.33%
1.0<= GPA < 1.1	75.53%	3.1<= GPA < 3.2	95.06%
1.1<= GPA < 1.2	74.23%	3.2<= GPA < 3.3	93.99%
1.2<= GPA < 1.3	78.76%	3.3<= GPA < 3.4	93.71%
1.3<= GPA < 1.4	79.47%	3.4<= GPA < 3.5	97.00%
1.4<= GPA < 1.5	84.03%	3.5<= GPA < 3.6	92.96%
1.5<= GPA < 1.6	85.25%	3.6<= GPA < 3.7	93.95%
1.6<= GPA < 1.7	85.80%	3.7<= GPA < 3.8	92.63%
1.7<= GPA < 1.8	82.50%	3.8<= GPA < 3.9	93.26%
1.8<= GPA < 1.9	87.19%	3.9<= GPA < 4.0	94.57%
1.9<= GPA < 2.0	88.56%	GPA = 4.0	95.73%
2.0<= GPA < 2.1	92.69%		

Table 5. Predicted and actual numbers of retained students in 1997 Freshman cohort

First Fall GPA Increment	Predicted Number	Actual Number		First Fall GPA Increment	Predicted Number	Actual Number
0	28	17		2.1	179	167
0.1	3	2		2.2	158	151
0.2	4	0		2.3	188	187
0.3	4	1		2.4	214	209
0.4	4	4		2.5	211	199
0.5	5	4		2.6	218	212
0.6	7	4		2.7	183	178
0.7	8	4		2.8	223	212
0.8	8	5		2.9	234	226
0.9	12	5		3	231	225
1	22	20		3.1	189	187
1.1	17	16		3.2	196	189
1.2	32	26		3.3	181	178
1.3	35	30		3.4	164	167
1.4	45	42		3.5	139	136
1.5	44	39		3.6	106	102
1.6	60	56		3.7	107	107
1.7	80	79		3.8	118	123
1.8	67	63		3.9	68	75
1.9	79	79		4	55	58
2	153	149		Total	4079	3933

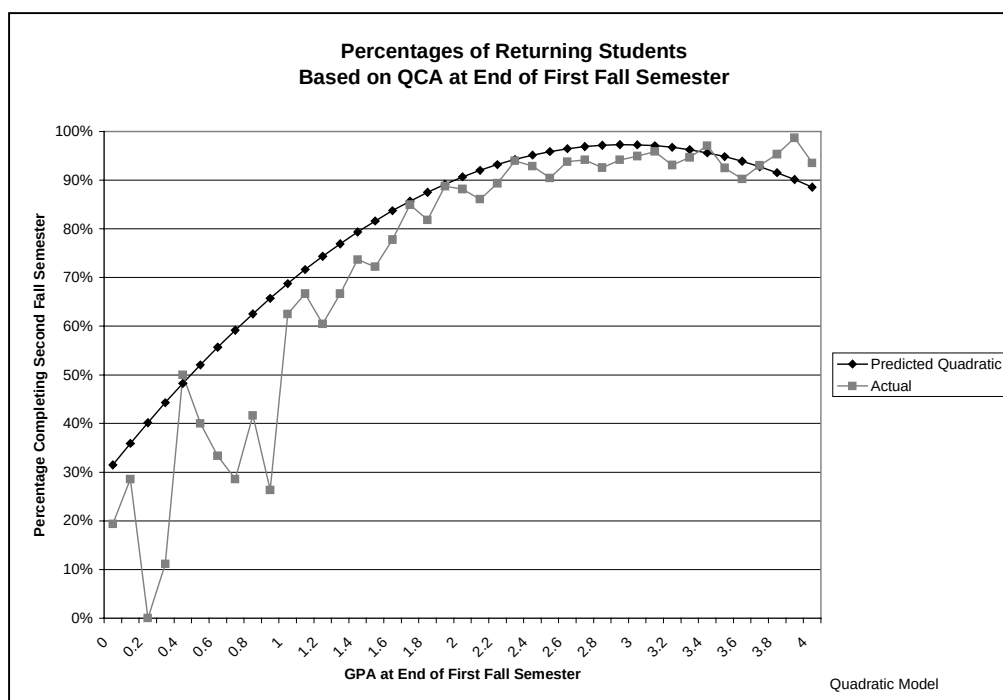


Figure 1. Comparison of predicted and actual retention rates for the 1997 freshman cohort

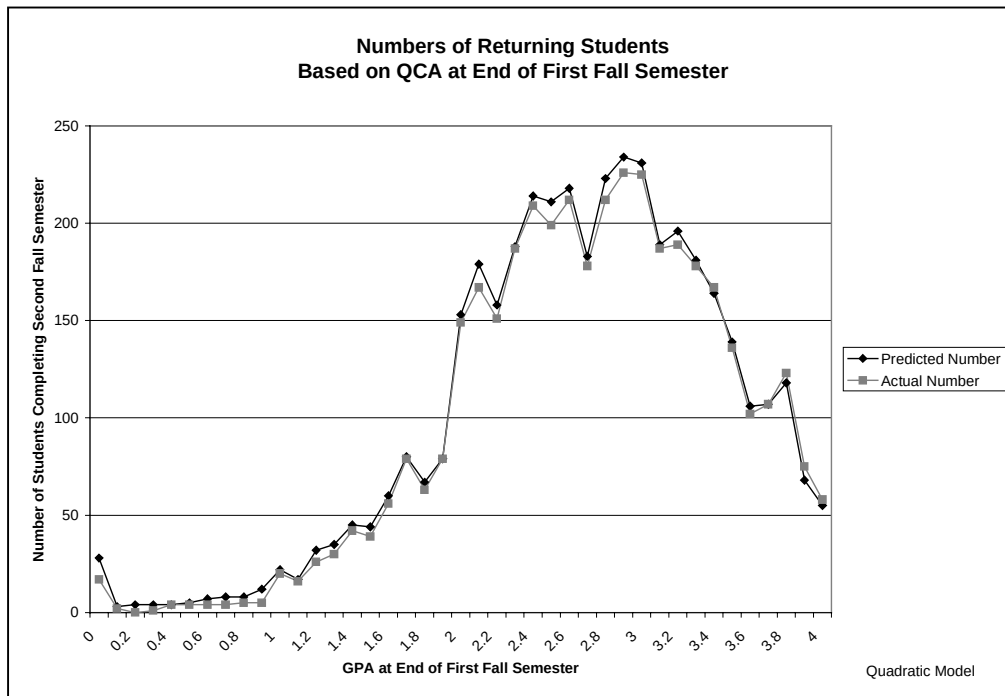


Figure 2. Comparison of predicted and actual students retained given first fall GPAs