# Can We Predict Student Success in Agricultural Economics Graduate Programs?

**Don Ethridge and Darren Hudson**

***Abstract:*** *Criteria for admission to graduate programs are used by departments and graduate schools to identify characteristics assumed to be associated with "success." They allow for more uniformity in student ability and preparation so graduate education is more efficient. This study analyzes the relationship between selected student characteristics and experience and two proxies for "success"—graduate GPA and the probability of completing an Agricultural Economics graduate program. Data are from past students in the Department of Agricultural Economics at Texas Tech University. Statistical differences among the means of student characteristics were evaluated, a regression model was estimated to predict graduate GPA, and a logistical regression was estimated to examine the probability of not completing a graduate program. Results show some differences in characteristics between those who complete and do not complete. Graduate GPA is significantly related to citizenship, degree program, quantitative GRE scores, and previous program GPA. However, only above-average prior GPA and existence of financial assistance are significantly related to the probability of not completing a graduate program.*

***Key Words and Phrases:*** *Graduate admissions, GRE scores, GPA, Logistical regression.*

Universities, colleges and academic departments develop procedures and standards for admission of students into graduate programs. Reasons for engaging in these practices are to increase the probability of student success in graduate programs and maintain a degree of uniformity in student ability and preparation, thereby making graduate education more efficient and less expensive for both students and universities. The most widely used procedures for screening applicants include a combination of standardized test scores and prior academic achievement. Also, letters of recommendation are often used as a more subjective part of the evaluation process.

Another use of the standardized tests, or the test scores of those accepted into programs, is as an indicator of the program quality, with the presumption that aggregated student test scores automatically result in a better graduate program.

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Perry uses the Graduate Record Exam (GRE) scores and undergraduate grade point average (GPA) as part of a ranking system for agricultural economics Ph.D. programs. The causal link between "quality programs" and standardized test scores is not clear because other factors such as student self selection, research opportunities, and quality of faculty and facilities, also contribute to the quality of the program. Some still use the GRE scores as the sole or primary determinant for admissions and program quality evaluation, although specifically admonished by the Educational Testing Service.

The literature on Agricultural Economics/Agribusiness programs and curricula covers a diverse set of issues. There have been studies addressing teaching methods and evaluation. For example, Broder and Taylor analyze the applicability of, and reliance on, student evaluations as a means of evaluating teachers. Roberts and Lee evaluate the disparities between student and faculty personality characteristics and how these might affect the teaching process. Some literature also addresses curriculum. For example, Kropp outlines a framework for curriculum development, considering the key elements of the curriculum within the framework of the activity demands placed on the faculty. Extending that idea, Manderscheid discusses changes in the curriculum once it has been developed. Demand for education and post graduate performance have also been recent topics. Thompson et al. use several models from the higher education literature to analyze the demand for undergraduates in agricultural sciences. Preston et al. analyze the income earned by agricultural graduates, finding that labor market dynamics could have important implications for curriculum design.

Little literature, however, is available on the relationship between admissions standards and criteria and student "success." In the more general literature, i.e., not specific to agricultural economics, there has been some association reported between GRE general test scores and *first* year program GPA (Boldt). However, there is little evidence on the association between GRE scores and completion of a graduate degree. The lack of reliable evidence on this question led to an evaluation of quantifiable factors that may help in understanding how to better use various indicators for admitting applicants to the graduate programs in the Agricultural Economics Department at Texas Tech University. The objective of this paper is to present the findings of an analysis of graduate program "success," i.e., GPA and graduate program completion.

The paper is presented in the following format: First, a basic description of the Agricultural Economics (AECO) graduate programs is provided, along with some descriptive data on the students who have entered them. This is followed by a description of the analyses, empirical results, and selected interpretations. The third section provides a summary and some implications, and the final section presents conclusions.

### *Description of Programs and Student Body Characteristics*

A Ph.D. program in Agricultural Economics has been offered at Texas Tech since 1981. Masters programs, which have been offered since 1947, include a traditional M.S. program in Agricultural Economics (thesis and non-thesis options) and a Master of Agriculture (M.Ag.) program with an emphasis in Agribusiness Management. The department cooperates with the College of Business Administration on an M.B.A. with an emphasis in Agricultural Business Management, but data from that program were not used in this study.[1]

Admission *guidelines* have varied slightly over time, but generally specify a minimum score of 1,000 on the sum of the verbal and quantitative portions of the GRE and a 3.00 grade point average (GPA) on a 4.0 scale on prior coursework for Ph.D. program applicants. Guidelines for the Masters programs are the same except the GRE minimum is 900. Additionally, three letters of recommendation addressing the probability of success in graduate school are required for the evaluation of each applicant. The GRE and GPA minimums may be waived if recommendations appear to warrant. Alternatively, students who meet the minimum GRE and GPA guidelines may also be rejected if references indicate low probability of success. As another deviation, the verbal portion of the GRE is treated more liberally with applicants whose native language is not English. However, the Test of English as a Foreign Language (TOEFL), with a minimum score of 550, is required of those students.

Records have been compiled on all graduate students who entered (admitted and began) a graduate program since the fall semester, 1981, and their programs have been resolved as of August, 1995. Resolution may have been from graduating, being terminated or voluntarily leaving the program. The data set contains information on 137 students, although all information on each student is not necessarily complete. Before presenting descriptive data on students, the necessary variable definitions are presented below:

| | | |
|---|---|---|
| COMP | = | dummy variable indicating completion of the program; if COMP=1, student graduated (completed), otherwise COMP=0; |
| DOM | = | dummy variable for domestic students; if DOM=1, student is a U.S. citizen, otherwise DOM=0; |
| FIN | = | dummy variable for financial assistance; if FIN=1, student received financial support (research assistantship, teaching assistantship, international agency, home government), otherwise FIN=0; |
| GPA | = | grade point average over the student's graduate program (4.00 scale); |

| | | |
|---|---|---|
| GRE-AN | = | graduate record examination score on the analytical portion of the test; |
| GRE-Q | = | graduate record examination score on the quantitative portion of the test; |
| GRE-V | = | graduate record examination score on the verbal portion of the test; |
| LGPA | = | GPA on leveling[2] work taken upon entering the program; |
| LH | = | hours of leveling work taken upon entering the graduate program; |
| PGPA | = | GPA on the student's prior program (GPA in Bachelor program for Masters students, GPA in Masters program for Ph.D. students); |
| PHD | = | dummy variable for Ph.D. students; if PHD=1, student is in Ph.D. program, otherwise student is in a Masters program. |

Means, ranges and standard deviations of these variables are shown in Table 1.

Overall, 20 percent have been Ph.D. students and 80 percent Masters students; 63 percent have been U.S. citizens and 37 percent of foreign citizenship. The overall mean GRE scores have been 428 on verbal (V), 542 on quantitative (Q), and 486 on analytical (AN). The average GPA while in the program has been 3.40, with an average GPA in prior Bachelors or Masters programs (PGPA)[3] of 3.08. About 74 percent of the students entering a graduate program in the department have completed, and students entering the program took one leveling course, on average.

### *Empirical Analyses*

Empirical analyses of the data on 137 students consisted of three components. First, data on specific groupings of students were constructed and statistical tests performed to see if there were significant differences in mean characteristics. This provided an indication of which characteristics have been different between, for example, students who completed and who did not complete. Next, statistical models were formed to attempt to predict "success" of students in graduate programs. One indicator of success used was GPA while in the program. A multiple linear regression model was used in this analysis. A second indicator of success was whether or not the student completed his/her degree program. A logistical regression model was used to address that question. The empirical results and interpretations are presented below.

Table 1.
*Means and Ranges of Variables in the Analysis*

| Variable | Number of Observations | Mean | Minimum Value | Maximum Value | Standard Deviation |
|---|---|---|---|---|---|
| COMP | 137 | 0.740 | 0.0 | 1.0 | 0.440 |
| DOM | 137 | 0.630 | 0.0 | 1.0 | 0.490 |
| FIN | 137 | 0.800 | 0.0 | 1.0 | 0.400 |
| GPA | 114 | 3.400 | 1.7 | 4.0 | 0.420 |
| GRE-AN | 75 | 486.3 | 230 | 800 | 137.09 |
| GRE-Q | 108 | 541.9 | 350 | 740 | 84.98 |
| GRE-V | 108 | 427.6 | 220 | 600 | 79.66 |
| PGPA | 86 | 3.080 | 2.0 | 4.0 | 0.460 |
| PHD | 137 | 0.200 | 0.0 | 1.0 | 0.400 |
| LGPA | 128 | 1.300 | 0.0 | 4.0 | 0.620 |
| LH | 137 | 3.200 | 0.0 | 21.0 | 4.800 |

***Mean Differences.*** The data were divided — Masters versus Ph.D., those who completed versus those who did not, etc. — in order to determine the variables that differ between groupings. The means and standard deviations for each of these divisions are presented in Tables 2a and 2b. A t-test for mean differences, with unequal means and distributions, was used (Steel and Torrie). It is important to note that the mean differences do not *explain* the differences between groups; they merely identify the characteristics on which the groups differ significantly.

To interpret Tables 2a and 2b, consider the first line of data in Table 2a: 102 students completed their program and 35 did not complete. Of the 102 students who completed, 67.6 percent were U.S. citizens, which is significantly different (at the 0.10 level of significance) from the 48.6 percent of U.S. citizens who did not complete their program. Alternatively, the average GRE analytical score of the 54 students who completed (on which scores were available) was 497, which was not significantly different from the average 458 score of the 21 students who did not complete.

Overall, Tables 2a and 2b provide information on the characteristics on which there are, or are not, differences between groupings of students in the data set. Concentrating on the differences between those who completed and did not complete, the following general results are revealed:

1. The groups differ in terms of proportion of domestic students when Masters and Ph.D. students are combined, but do not differ within either group individually.

Table 2a.

*Characteristics Population Means for Students in Graduate Programs in Agricultural Economics, Texas Tech University, Fall 1981 - Summer 1995*

| Variable | Completed Program | | | Did Not Complete | | |
|---|---|---|---|---|---|---|
| | No. Obs. | Mean | Std. Dev. | No. Obs. | Mean | Std. Dev. |
| | | | *All Students* | | | |
| DOM* | 102 | 0.676 | 0.470 | 35 | 0.486 | 0.507 |
| FIN** | 102 | 0.853 | 0.356 | 35 | 0.657 | 0.482 |
| PHD | 102 | 0.186 | 0.391 | 35 | 0.257 | 0.443 |
| Masters | 102 | 0.814 | 0.391 | 35 | 0.743 | 0.443 |
| GPA*** | 88 | 3.500 | 0.260 | 26 | 3.040 | 0.610 |
| LH | 102 | 2.850 | 4.540 | 35 | 4.170 | 5.420 |
| LGPA** | 35 | 3.570 | 0.510 | 13 | 2.980 | 0.670 |
| GRE-V | 80 | 426.6 | 73.20 | 28 | 430.4 | 97.20 |
| GRE-Q | 80 | 544.3 | 83.10 | 28 | 535.0 | 91.40 |
| GRE-AN | 54 | 497.4 | 134.6 | 21 | 457.6 | 142.7 |
| PGPA** | 65 | 3.140 | 0.450 | 21 | 2.900 | 0.470 |
| | | | *Ph.D. Students* | | | |
| DOM | 19 | 0.211 | 0.420 | 9 | 0.110 | 0.330 |
| FIN** | 19 | 1.000 | 0.000 | 9 | 0.556 | 0.527 |
| GPA** | 18 | 3.650 | 0.210 | 8 | 3.210 | 0.360 |
| LH | 19 | 1.100 | 2.100 | 9 | 2.800 | 4.500 |
| LGPA* | 4 | 3.880 | 0.250 | 1 | 3.500 | 0.000 |
| GRE-V | 17 | 388.8 | 83.70 | 7 | 417.1 | 139.1 |
| GRE-Q | 17 | 547.7 | 87.60 | 7 | 534.3 | 117.3 |
| GRE-AN | 16 | 475.0 | 123.6 | 6 | 366.7 | 125.8 |
| PGPA** | 11 | 3.390 | 0.540 | 4 | 3.480 | 0.430 |
| | | | *Masters Students* | | | |
| DOM | 83 | 0.783 | 0.414 | 26 | 0.615 | 0.496 |
| FIN | 83 | 0.819 | 0.387 | 26 | 0.692 | 0.471 |
| GPA*** | 70 | 3.470 | 0.260 | 18 | 2.960 | 0.690 |
| LH | 83 | 3.300 | 4.900 | 26 | 4.700 | 5.700 |
| LGPA** | 31 | 3.530 | 0.520 | 12 | 2.940 | 0.670 |
| GRE-V | 63 | 436.8 | 67.30 | 21 | 434.8 | 82.80 |
| GRE-Q | 63 | 536.0 | 80.60 | 21 | 535.2 | 84.50 |
| GRE-AN | 38 | 527.9 | 128.6 | 15 | 494.0 | 135.9 |
| PGPA*** | 54 | 3.090 | 0.420 | 17 | 2.770 | 0.370 |

* Statistically different at the 0.10 level of significance.
** Statistically different at the 0. 05 level of significance.
*** Statistically different at the 0.01 level of significance.

Table 2b.
*Characteristics Population Means for Students in Graduate Programs in Agricultural Economics, Texas Tech University, Fall 1981 - Summer 1995*

| | Ph.D. Students | | | Masters | | |
|---|---|---|---|---|---|---|
| Variable | No. Obs. | Mean | Std. Dev. | No. Obs. | Mean | Std. Dev. |
| DOM*** | 28 | 0.179 | 0.390 | 109 | 0.743 | 0.440 |
| FIN | 28 | 0.857 | 0.356 | 109 | 0.789 | 0.410 |
| COMP | 28 | 0.679 | 0.476 | 109 | 0.761 | 0.430 |
| GPA* | 26 | 3.510 | 0.330 | 88 | 3.360 | 0.440 |
| LH | 28 | 1.600 | 3.100 | 109 | 3.600 | 5.100 |
| LGPA** | 5 | 3.800 | 0.270 | 43 | 3.370 | 0.620 |
| GRE-V | 24 | 397.1 | 100.4 | 84 | 436.3 | 71.00 |
| GRE-Q | 24 | 562.9 | 96.30 | 84 | 535.8 | 81.10 |
| GRE-AN | 22 | 409.1 | 124.0 | 53 | 518.3 | 130.3 |
| PGPA** | 15 | 3.410 | 0.500 | 71 | 3.010 | 0.430 |

* Statistically different at the 0.10 level of significance.
** Statistically different at the 0.05 level significance.
*** Statistically different at the 0.01 level of significance.

2. The groups differ in terms of proportion of students receiving financial assistance when considered collectively, but the differences lie primarily in the Ph.D. group.
3. The groups differ in GPA while in the program in all instances.
4. The groups differ in leveling GPA in all instances.
5. The groups differ in GPA in prior academic programs, but the differences are more significant for the Masters group.[4]

Note that *none* of the GRE scores in any group differed between those who completed and those who did not.

***Models to Predict "Success."*** Models were used to predict both grade point average and program completion. In predicting grade point average, two multiple linear regression models were used to evaluate variables that may explain differences in graduate program GPA (GPA while in program). The first model represents the GPA of students in the Masters program and is specified as follows:

$$GPA_M = f(DOM, FIN, GRE\ Scores, PGPA), \quad (1)$$

where $GPA_M$ is the program GPA while in the Masters program. A linear additive model was used for estimation. Initially, all three components of the GRE score

were used, but collinearity problems prevented all variables from being used simultaneously. Models were estimated using the individual portions of the GRE score and the verbal and quantitative scores combined. The various results indicated that Equation 1 using the quantitative portion of the GRE was the best specification based on t-values, F and t probability levels, and $R^2$s. Table 3 shows the results for those in the Masters program. Those of U.S. citizenship (DOM=1) were found to have a significantly higher program GPA. The quantitative portion of the GRE appeared to have some predictive power, while prior program GPA did not. Whether or not the student had financial assistance had no significant effect on graduate program GPA. Overall, only 37 percent of the variation in program GPA could be explained by the objective measures available for admissions criteria.

A second model was used to analyze the program GPA for those in the Ph.D. program, which is specified as:

$$GPA_D = g\,(DOM,\ GRE\ Scores,\ PGPA), \tag{2}$$

where $GPA_D$ is the GPA while in the Ph.D. program. This model does not contain the variable FIN because all Ph.D. students in the sample received financial aid. The GRE score went through a similar process of elimination discussed above, and this final model took a linear additive form. Table 4 shows the results for the Ph.D. model. Note that none of the variables are statistically different from zero, and only 11 percent of the variation is explained. This indicates that, at least in terms of the objective measures, Ph.D. program GPA was not predictable.

The differences between the results found for the Masters and Ph.D. programs might be explained in two ways. First, the smaller number of observations in the Ph.D. group may be limiting the capability of the model to identify recognizable patterns in the data. Second, and what may seem more likely, is that students in the Masters program are likely to exhibit more variation in characteristics than students in the Ph.D. program. That is, the population entering the Ph.D. program is likely more homogeneous than the population entering the Masters. How much effect this had on the current results is not known.

Another model with the sum of quantitative and verbal GRE scores (GRE-VQ) as the GRE measure was estimated for both the Masters and Ph.D. groups to be consistent with the common practice of viewing these scores together as the admissions standard. Neither model performed better than the specification with quantitative GRE scores alone, and the combined GRE score had a higher p-value (less significant) associated with the t-statistic in both cases. This is interesting from an admissions criteria standpoint because the sum of the verbal and quantitative scores was not significantly related to graduate program GPA.[5] This may be indicating that the criteria of minimum scores on the overall GRE are restrictive, and serve to exclude, on the basis of low verbal scores, students who may otherwise

Table 3.
*Regression Results for Masters Students*

| Variable | Parameter Estimate | Standard Error | t-value | Variance[a] Inflation Factor |
|---|---|---|---|---|
| Intercept | 1.0726 | 0.5208 | 2.06** | 0.00 |
| DOM | 1.0457 | 0.2074 | 5.04*** | 1.07 |
| FIN | 0.0994 | 0.1264 | 0.79 | 1.03 |
| GRE-Q | 0.0012 | 0.0006 | 1.82* | 1.04 |
| PGPA | 0.1840 | 0.1203 | 1.53 | 1.08 |
| F-value = 9.86*** | Adjusted $R^2$ = 0.37 | | n = 37 | |

[a] VIF<10 indicates no significant multicollinearity (Pindyk and Rubinfeld)
* Statistically significant at the 0.10 level.
** Statistically significant at the 0.05 level.
*** Statistically significant at the 0.01 level.

Table 4.
*Regression Results for Ph.D. Students*

| Variable | Parameter Estimate | Standard Error | t-value | Variance[a] Inflation Factor |
|---|---|---|---|---|
| Intercept | 2.5730 | 0.5123 | 5.02** | 0.00 |
| DOM | -0.0125 | 0.1844 | -0.07 | 1.02 |
| GRE-Q | 0.0005 | 0.0008 | 0.06 | 1.20 |
| PGPA | 0.2278 | 0.1438 | 1.58 | 1.21 |
| F-value = 1.47*** | Adjusted $R^2$ = 0.11 | | n = 13 | |

[a] VIF<10 indicates no significant multicollinearity (Pindyk and Rubinfeld)
* Statistically significant at the 0.10 level
** Statistically significant at the 0.05 level
*** Statistically significant at the 0.01 level

be "successful" in graduate school, at least within the range of GRE scores that have been accepted. Alternatively, this could also indicate that the admissions standard of a minimum GRE score is successfully screening applicants so that once they are admitted to the program, there is essentially no significant variation in the graduate GPA. It is difficult to tell the true nature of this relationship since data

Table 5.
*Results of Logit Analysis of Characteristics on COMP*[a]

| Variable | Parameter Estimate | Standard Error | Wald Chi-Square | Probability> Chi-Square |
|---|---|---|---|---|
| Intercept | 0.3349 | 0.5389 | 0.3864 | 0.5342 |
| DOM | -0.5857 | 0.4814 | 1.4802 | 0.2237 |
| PHD | 0.4369 | 0.5826 | 0.5623 | 0.4533 |
| GREQ1 | -0.1622 | 0.4589 | 0.1249 | 0.7238 |
| GREQ2 | -0.0426 | 0.7971 | 0.0029 | 0.9574 |
| GPA1 | -1.2334 | 0.6084 | 4.1092* | 0.0427 |
| FIN | -1.0893 | 0.4893 | 4.9553* | 0.0260 |
| Log-Likelihood = 15.549 | degrees of freedom = 6 | | n = 77 | |

[a] The dependent variable is COMP. The logistical regression is measuring the probability of not completing the program.
* Statistically significant at the 0.05 level

on students who were not accepted or did not start a program were not available, but this result does indicate the need for further analysis on this point.

In predicting completion of program, a logistical regression model similar to Equation 1 was formulated, i.e., the same independent variables, to measure the probability of not completing a degree program in Agricultural Economics (a zero-one dummy variable). However, the correlation between GRE scores found in the multiple regression constituted a problem in the logistical regression as well. Thus, the logistical regression was run using the individual GRE scores as in the linear regression. Additionally, the continuous variables (GRE scores and PGPA) were transformed into categorical variables because they tend to be more powerful explanatory variables in logistical regression (Maddala). The categories were chosen by a cross-tabulation of GRE scores and PGPA against the dependent variable (COMP) and calculating a chi-square. None of the categories of any *individual* portion of the GRE or the *sum* of the verbal and quantitative showed any significant results. Therefore, to be consistent in terms of variables with the linear regression, only results from the following model are presented:

$$COMP = f(DOM, PHD, FIN, GREQ1, GREQ2, GPA1), \quad (3)$$

where:

GREQ1 = dummy variable for the GRE quantitative score, GREQ1=1 if GRE-Q is between 500 and 650, GREQ1=0 otherwise (corresponds to quantitative GRE scores about the mean; mean GREQ1 = 0.4453 and the standard deviation = 0.4988);

GREQ2 = dummy variable for the GRE quantitative score, GREQ2=1 if GRE-Q is greater than 650, GREQ2=0 otherwise (corresponds to those quantitative scores above the mean; mean GREQ2 = 0.0803 and the standard deviation = 0.2727);

GPA1 = dummy variable for the previous program GPA, GPA1=1 if PGPA is greater than 3.08, GPA1=0 otherwise (corresponds with those previous GPA values above the mean; mean GPA1 = 0.3211 and the standard deviation = 0.4686).

The rest of the variables are as previously defined. The other portions of the GRE were broken down in a similar manner, but showed not to be significant as well. Also, the model was run separately for the Masters and Ph.D. programs, but the model with combined data presented here gave the best empirical results.

Results of the logistical regression are presented in Table 5.[6] The log-likelihood ratio was 15.549, which indicates the overall model was significant at the .03 level (the interpretation is similar to an F-value in an ordinary least squares model). Note that the model is measuring the probability of not completing the graduate program. Thus, a negative sign indicates that increases in that variable are associated with a decreasing probability of not completing the graduate program, and *vice versa*. All signs are consistent with *a priori* expectations. The McFadden $R^2$ for the model was 0.12, which indicates that the variables included do not have substantial explanatory power.

Listing the marginal changes associated with each variable becomes a labyrinth of marginal probabilities. For present purposes, two alternatives are considered. For both scenarios, all the variables not significantly different from zero in Table 5 were set at their mean levels. With financial assistance, the probability of completing the degree program is increased by 16.01 percent when moving from a below-average previous program GPA to an above-average GPA. The same probability when the student does not have financial assistance is 27.27 percent. Thus, the above-average GPA has a more significant impact when the student does not have financial assistance.

When a student has a below-average previous program GPA, giving financial assistance will increase the probability of completion by 24.69 percent, compared to an increase in probability of completion of 13.43 percent when the student has an above-average GPA. This result corresponds to the one presented above, and indicates that financial assistance is more beneficial when the student is below average in previous program GPA. This may suggest that the beneficial impacts

of financial assistance are not as pronounced with students who are already above average academically because those students already have a higher probability of completion.

Analysis of the results of the logistical regression point to some general relationships. First, the variable for domestic students (DOM) is not significant, indicating that there is no statistical difference in probability of not completing the program between domestic and foreign students. This is not surprising given that there is no statistical difference in the proportion of domestic students who completed and did not complete in both the Ph.D. and Masters categories (Table 1). Also, there appears to be no significant difference in probability of program completion between Masters and Ph.D. students as indicated by the PHD variable (Table 5).

Financial assistance was associated with a significantly lower probability of not completing the program. This does not imply causation; rather, it points to an association between financial assistance and "success" (completion). There may be several reasons for the existence of that association. Financial assistance may mitigate enough financial burden to facilitate more attention to the program. Alternatively, it may be that financial assistance tends to be awarded to students who are judged to have a higher probability of completing.

Above-average previous program GPA also appears to significantly reduce the probability of not completing (increase the probability of completing) the program relative to below-average previous program GPA. This may suggest that previous academic achievement carries over into the graduate program. However, the results of this analysis indicate that only above-*average* previous GPA is an effective explanatory variable (other smaller groupings were tried, but were not significant). Thus, predictions based on specific GPA values does not appear to be meaningful; that is, whether the student has above- or below-average previous GPA appears to be the germane issue. When a student has an above-average GPA in his/her previous degree program, he/she had a higher probability of completing the current program.

An important result from the perspective of graduate admissions is the quantitative GRE score. These results indicate that above-average quantitative GRE scores do not significantly affect the probability of not completing relative to below-average scores.[7] This indicates that one cannot effectively predict whether an applicant will successfully complete the graduate program on the basis of the quantitative GRE score alone. This result could have implications for how the department (and possibly the discipline) views graduate admissions criteria. The lack of association between GRE scores and GPA beyond the first year (Boldt) and the lack of predictability of student "success" based on GRE scores found here suggest a more limited role for the GRE scores in the admissions process. Note, however, that this analysis deals only with those students who have been *admitted*

and *start* a graduate program. Since data on students who were not admitted or did not begin a program were not available, extending the results beyond the range of the data should be done with caution. Additionally, reasons for leaving a program vary. Some students may have been terminated, some leave voluntarily because of financial concerns, family problems or change in interests to name a few. Thus, it cannot be said definitively that those who leave a program do so because of lack of ability. This may bias the results to some extent, although to what degree is not known.

### *Summary and Conclusions*

To synthesize the results presented, there are differences in mean characteristics between those students who complete and do not complete graduate programs in agricultural economics at Texas Tech, most notably in citizenship (U.S. or foreign), financial assistance, program GPA, and previous program GPA. Regression analyses give some indication of which quantifiable variables are correlated with graduate program GPA and the magnitude of the correlation. Citizenship and quantitative GRE scores appeared to play a role in determining the graduate program GPA for Masters students, but none of the quantifiable factors appeared to influence the GPA of Ph.D. students. The logistical regression indicated that the score on the quantitative portion of the GRE does not have an impact on the probability of completing a graduate program. The previous program GPA and whether the student received financial assistance did have an impact on the probability of completing.

In general, "success" by a student in the programs analyzed is not very predictable by any combination of objective indicators. The traditional measures of potential success (previous GPA, GRE scores) appear to be related to student attainment, but do not appear reliable as admission criteria. This does not suggest that the previous GPA and GRE scores are not useful measures. Rather, it suggests that they are only *partial* indicators, insufficient by themselves. The fact that bias may be introduced by non-completion because of uncontrollable circumstances appears to be insignificant. That is, these factors are not controlled by GRE scores and previous GPA, and thus, add to the unpredictability of student success. These factors should be random across the student population and, thus, have no effect on the regression results except that we can identify one of the possible sources of random variation.

To the extent that these programs may be typical, the findings raise questions about interdepartmental comparisons largely or exclusively on these indicators. More specifically, decisions and comparisons based solely on GRE scores appear to be based on a measure whose validity in predicting student success has not been

established. The larger portion of success is probably made up of intangibles such as self-motivation, determination, innate aptitudes and other factors of personal character.

The extent to which these empirical results and conclusions apply beyond the agricultural economics programs at Texas Tech is not known. Individual departments and programs have some unique characteristics. However, there are also many common characteristics, which make the analysis reported here useful to some degree in other programs.

## *Notes*

*The authors are Professor and Research Assistant, respectively, Department of Agricultural and Applied Economics, Texas Tech University, Lubbock, TX 79409-2132. Phone: (806) 742-2025. Fax: (806) 742-1099.* *The authors thank Changping Chen, Clay Carr, Sukant Misra, Monty Strauss, Marvin Cepica, and three anonymous reviewers for their assistance on the paper, as well as Niki Ryan and Melissa Toombs for compiling and maintaining the data set. Texas Tech University College of Agricultural Sciences and Natural Resources manuscript number T-1-423.*

1. The reason for this exclusion is that the program is new and different admissions criteria are used, i.e., the GMAT is used instead of the GRE, and admissions are controlled by the College of Business Administration.
2. Leveling work is courses recommended by the admissions committee or major advisor to supplement or address deficiencies in the previous degree program.
3. The fewer number of observations for prior program GPA is due to missing records or the difficulty in translating foreign transcripts into U.S. GPA measures.
4. This is likely due to the larger inherent variation in the GPA of a Bachelors program, which constitutes the previous program GPA for the Masters students.
5. The mean combined GRE score was 969.44 and the standard deviation was 129.74. The variation appears large enough that the results cannot be dismissed as lack of variation in the data set.
6. The sample statistics for the categorical variables are included with the results in Table 5.
7. In fact, no portion of the GRE examined had a significant impact on the probability of not completing the program.

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