Student profile of the incoming First Year Class of the College of Engineering at UPRM and their academic performance after their first year

González-Barreto, David R., González-Quevedo, Antonio A.

Office of Institutional Research and Planning
University of Puerto Rico at Mayagüez

Abstract

This work presents the student profile for the first year class of the College of Engineering at the University of Puerto Rico in Mayagüez (UPRM) during the period of 1990-2003. The profile includes variables such as: gender, school type (public or private), geographic location of high school, scores from five College Entrance Examination Board (CEEB) tests, high school grade point average (GPA), and the first year GPA (FYGPA). The execution of the students after the first year, as represented by the FYGPA, is related to the CEEB tests scores and the high school GPA. This model is stratified by gender and school type. A comparison between actual admission criteria and suggested alternative criteria is also presented. This longitudinal comparison is carried out to evaluate proposed changes in admission criteria in the future.

Profile of the First Year Engineering Classes

The entering class of the Engineering School from 1990 through 2003 is composed of an average of 761 students, for whom 62% are males and 38% females. The high school grade point average for these students is 3.79 of a possible 4.0. The students from public schools have a high school grade point average of 3.84, while those from private schools possess a GPA of 3.73. Figure 1 shows the GPA for private and public school students from 1990 through 2003. The graphs show that the high school GPA has increased throughout the 14 years of this study for both private and public schools. The average GPA has fluctuated from 3.67 to 3.86.

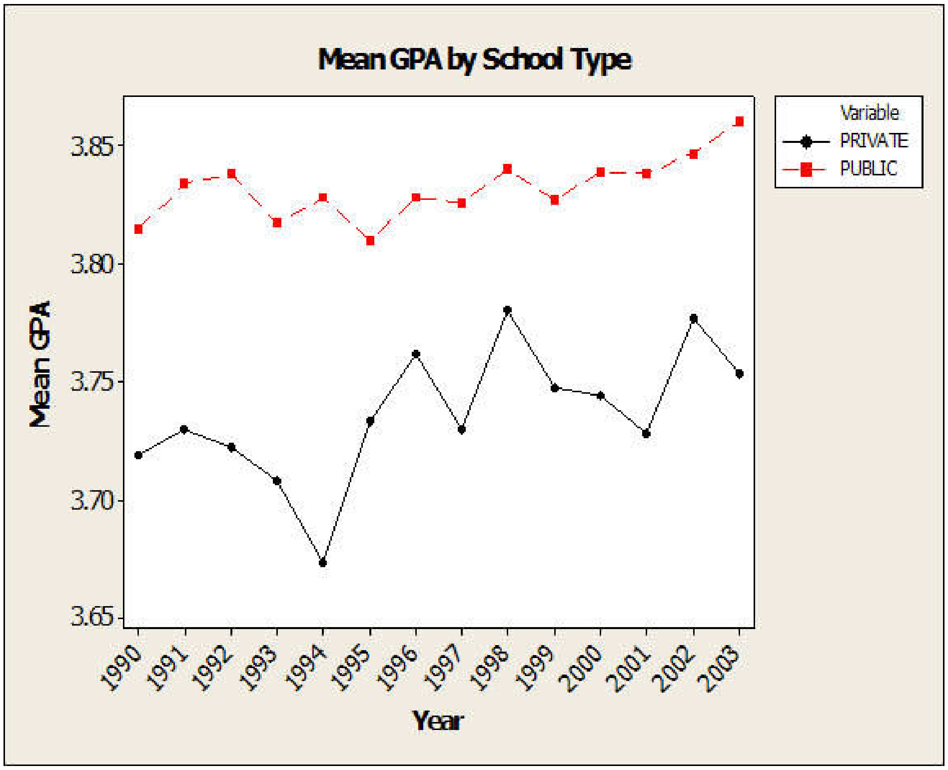

Figure 1.Mean High School GPA by School Type

These students are required to take the mathematics (APT_MAT) and verbal (APT_VER) (Spanish) aptitude tests prepared by the Puerto Rico and Latin America College Entrance Examination Board. Each of these tests has a possible maximum score of 800.

The results for the mathematics aptitude test, which are shown in Figure 2, demonstrate a decline throughout the 14 years of this study. Students from private schools have obtained scores that average 707 and students from public schools 689. The average score for all students is 697. In general, these graphs show a downward trend. The average score has fluctuated from 722 to 673.

The results for the verbal aptitude test, which are shown in Figure 3, show a decline throughout the 14 years of this study. Students from private schools have obtained scores that average 635 and students from public schools 620. The average score for all students is 626. In general, these graphs show a downward trend. The average score has fluctuated from 654 to 601.

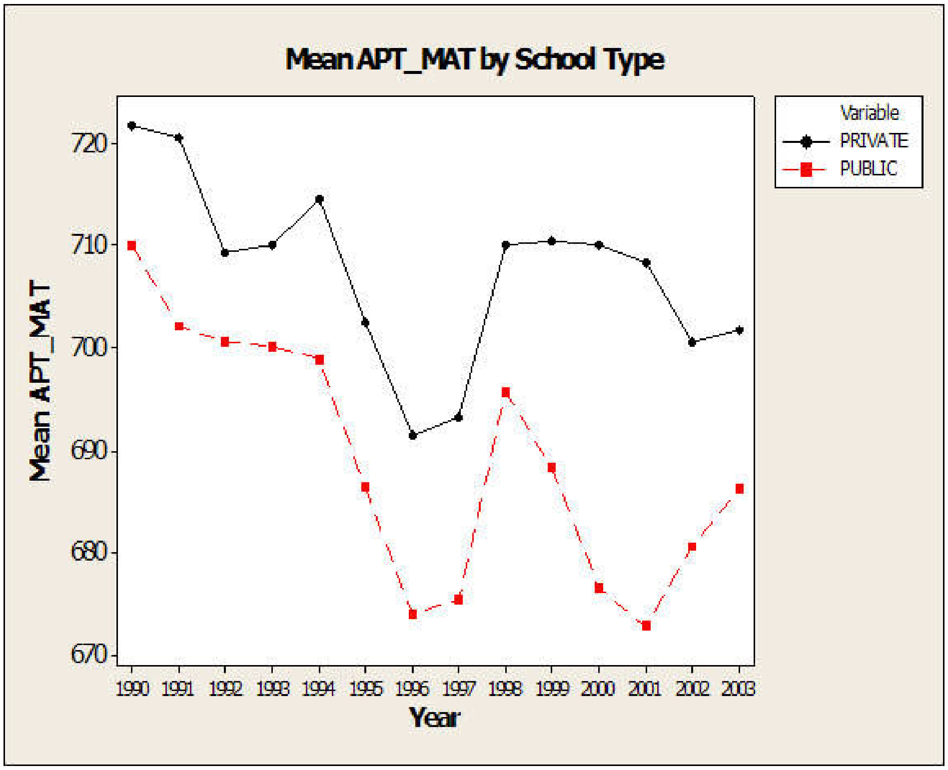

Figure 2. Mean Mathematical Aptitude by School Type

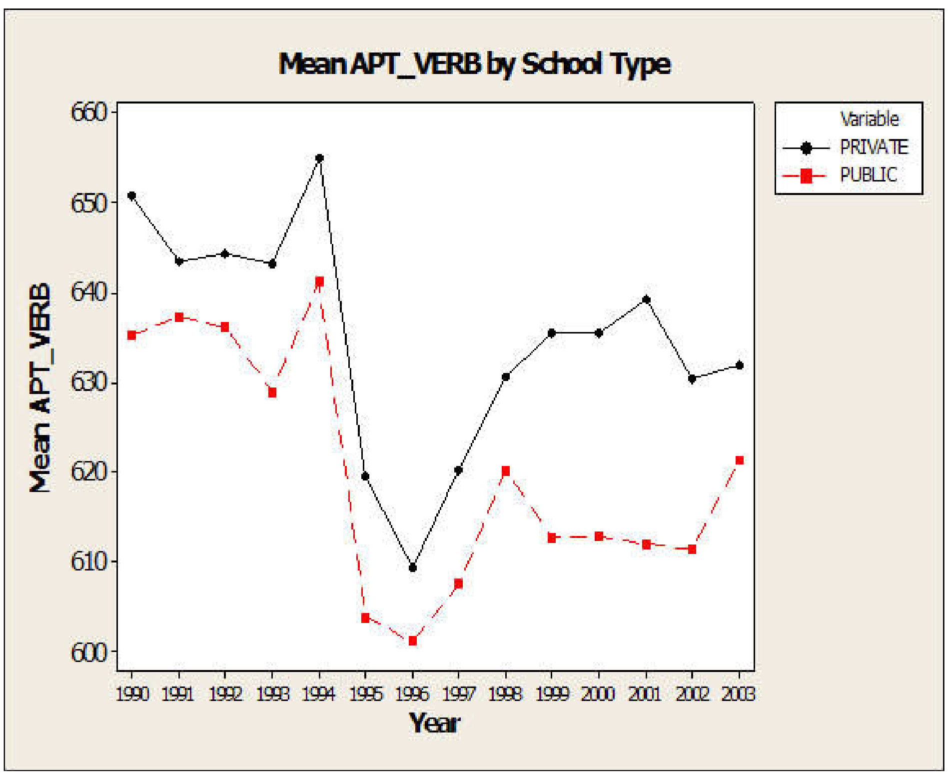

Figure 3. Mean Verbal Aptitude by School Type

In 2003, the College of Engineering of the University of Puerto Rico at Mayagüez had an undergraduate enrollment of 4,476. This enrollment places our college in the 13th position of United States of America Engineering Schools. Texas A&M ranked number 1 with 6.411 students (ASEE Prism, Summer 2004). Our college granted 680 bachelor's degrees in 2001-2002, ranking number 1 in the degrees granted to Hispanics. The second spot belonged to Polytechnic University of Puerto Rico with 305 degrees, and the third place belonged to Florida International University with 154 bachelor's degrees awarded (ASEE Prism, December 2003).

Description of Admission Criteria

The admission index, which is called the IGS, is composed of the high school grade point average, the verbal aptitude test score and the mathematics aptitude test score. The highest possible value of the IGS is 400. Each of these three components used to have the same weight in the index. The formula for the admission index was changed for the entering class of 1995. Since 1995, the weight of the GPA was increased to 50%, while the weight for each of the two aptitude tests was lowered to 25%. Figure 4 show the IGS for the 14 years of this study. It should be noted that the IGS experienced an increase when the formula was changed. The mean values of IGS for private and public school students are very close, 335 for private and 333 for public.

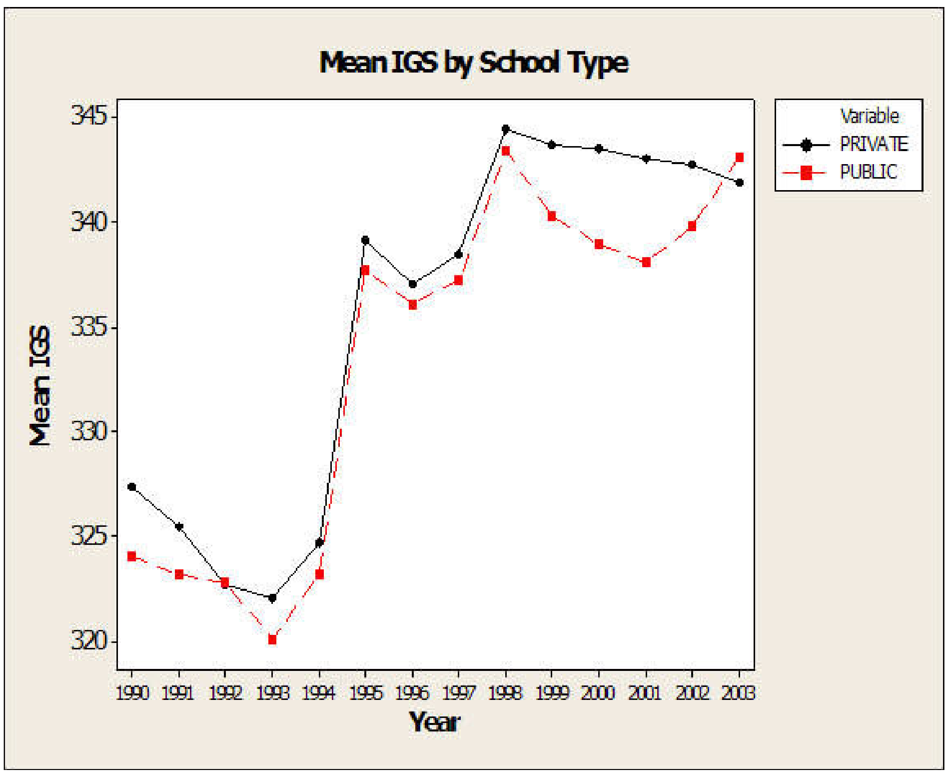

Figure 4. Mean IGS by School Type

The reason that the mean values of IGS are so similar between private and public schools is because the private schools outperform the public schools in the scores of the aptitude tests, while the private schools GPAs are lower than those of the public schools. The graph shows that the IGS fluctuates from 320 to 344.

Each academic department or program determines each year the minimum value of the IGS for the entering students. In general terms, no other measurement is used to admit a student in the first year of university studies. For the engineer class of 2004-2005, the minimum IGS fluctuated from to 313 (Surveying) to 342 for Computer Engineering.

Performance of Student after their First Year in College

A common measure used to evaluate the execution of students is their GPA after their first year at the college level (Wilson, 1983). In the model presented in the following section, this characteristic serves as the response or dependent variable of the model. Figure 5, shows the annual average of the 1st year GPA (FYGPA) during the 14 years included in the study. The graph is stratified by school type. As can be noticed from the graphs, student coming from private schools tend to outperform students from publics schools with a difference close to 0.14 on a 4.0 scale on the FYGPA. This result contrast with the incoming GPA in which students coming from public schools exhibited higher averages as depicted and showed in Figure 1. Also it is worth noting the drop in the FYGPA when compared with incoming GPA; this mean difference is around 1.1 on a 4.0 scale. The complete distribution of the gap between the two GPAs is presented in the marginal plot in Figure 6. The majority of the incoming students arrive with GPAs above 3.8, but after a year in college more than 50% of the students have FYGPA lower then 3.0.

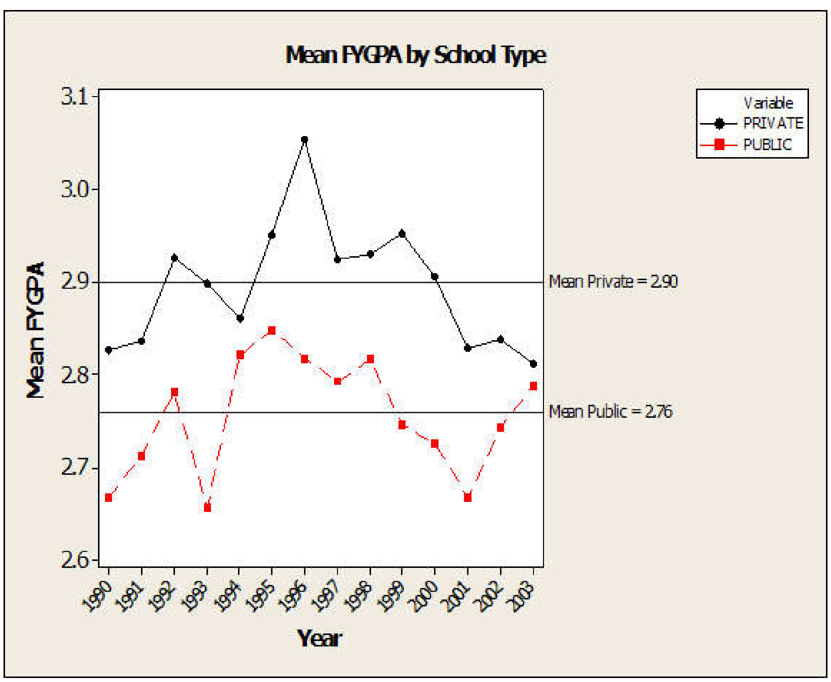

Figure 5. 1st Year GPA of Engineering Students by School Type

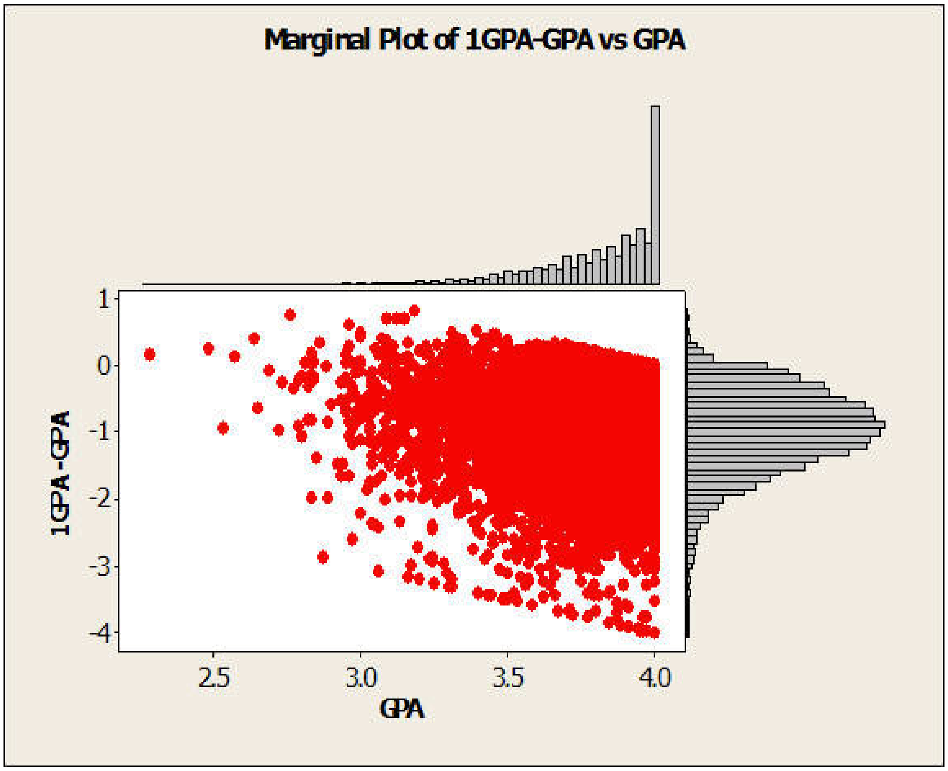

Figure 6. GPA and FYGPA-GPA Marginal Plot for Engineering Students

Suggested Admission Criteria

Since the inception in 1995 of the so called "new admission index", there has been some controversy at the Engineering College regarding the suitability of the model for admitting students to engineering. The admission index known as the IGS index considers three components as explained in a previous section of this work. The three components are: High School GPA (GPA), CEEB Math Aptitude Score (APT_MAT), and CEEB Verbal Aptitude Score (APT_VERB). Besides these three components the students are examined in three other areas. These are: Mathematical knowledge (APR_MAT), English Language knowledge (APR_ENG), and Spanish Language knowledge (APR_SPA). The six dependent variables have relationships among them. This being the case, it is difficult to understand the contribution of each variable by itself. Thus the model selection presents a challenge; in this study best models were selected according to minimum mean square error and best C_p Mallows statistic. This is often referred to as the best subsets selection criteria depending on the number of predictors (Montgomery, 2003). The correlations among these variables are presented in Figure 7.

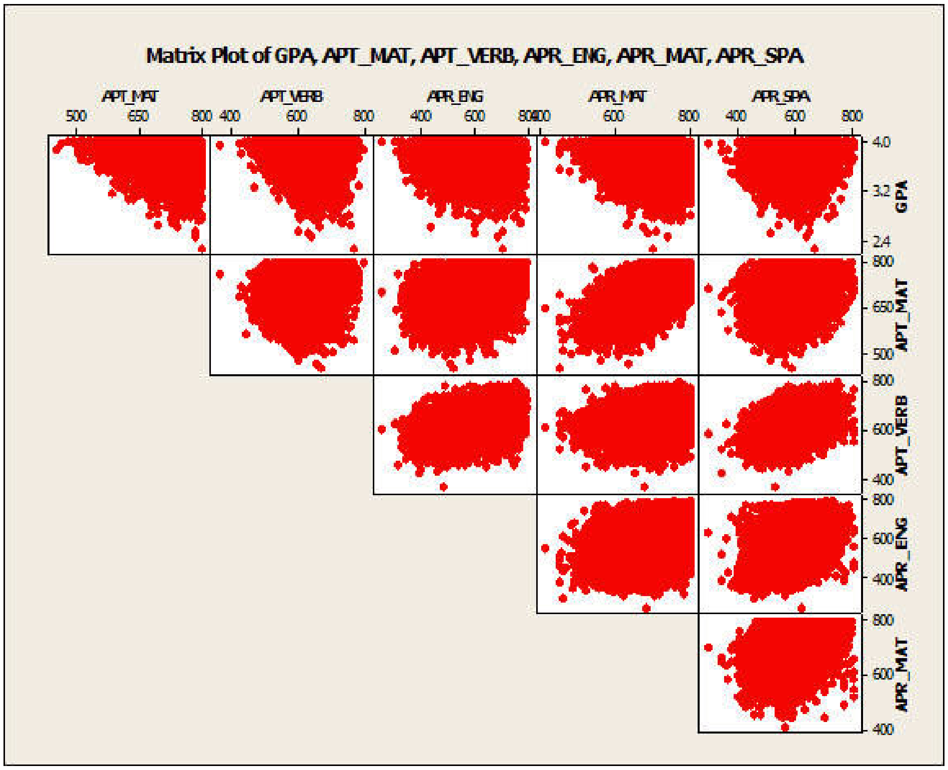

Figure 7. Scatter Diagrams for Six Dependent Variables

In this work, the FYGPA is modeled as a function of the six described dependent variables or predictors: the high school GPA and the scores from the five CEEB tests. The model is built using ordinary least squares method (OLS) to obtain linear models. Table 1 shows the results for best subsets models produced by MINITAB® (2004). The table shows the best model for each number of variables included; e.g. if only one variable is included in the model, the best one based on the minimum mean square error (MSE) is the model that only considers the high school GPA (Pike and Saupe, 2002). Similarly the best model with only two predictors is the one that includes GPA and APR_MAT.

Several other observations could be made from the table. First, the model for engineering students FYGPA with three predictors differs from the current admission criteria (last row of Table 1). This study suggests that for engineering FYGPA it is better to include GPA, APR_MAT,and APR_ENG CEEB scores as the predictors in a three dependent variable model. In fact, none of the best subset models from one to four predictors include the two scores used in the current index, i.e., APT_MAT, and APT_VERB. Second, based on the C_p Mallows criteria and the lowest MSE the best model will include all six predictors. Even this model is not sufficient to explain the FYGPA variability, since its R Square is close to 24%. Therefore, other predictors are needed to understand the FYGPA variable. Among those predictors the authors believe that the number of high school science and math credits, and the respective GPA in those courses may prove to be good predictors

Table 1. Best Subsets Models for Different Number of Predictors for FYGPA

Vars	R-Sq	R-Sq(adj)	C_p Mallows	S	GPA	APT_VERB	APT_MAT	APR_ENG	APR_MAT	APR_SPA
1	11.5	11.5	1743.4	0.62757	X					
2	19.5	19.5	618.1	0.5984	X				X	
3	21.7	21.6	324.2	0.59052	X			X	X	
4	22.8	22.8	165.9	0.58622	X			X	X	X
5	23.7	23.7	37.5	0.5827	X		X	X	X	X
6	24	23.9	7	0.58185	X	X	X	X	X	X
Current	**20.8**	**20.8**	**438.0**	**0.5936**	**X**	**X**	**X**			

Findings and Conclusion

The study showed that the high school GPA for public school students is higher by approximately 0.10 when compared to private school student averages. On the other hand, the aptitude test scores for private school students are higher that those of public school students. With the change of the formula to calculate the IGS, these differences balanced out as shown in the average values of IGS for both school types. Nevertheless, it is a reason for concern that test scores are declining independently of school type, while the GPAs are increasing.

After the first year of college engineering at UPRM students experienced a drop of approximately 1.1 out of a maximum 4.0 scale in their GPA's. Close to 50% of the incoming students showed this decline. The drop is around 0.14 larger for students coming from public schools.

The existing admission index, which considers three variables, is not a good predictor of success of our students in their first year in college. An alternative model, using a different set of three variables, proved to be superior to the existent one. In total, six models were analyzed, with one thru six variables considered. Out of these models, the one combining all the six variables showed an improvement in its prediction capability, but it is still not a strong model. Other variables not considered in the model are necessary to provide better predictions of success. A future study should identify such variables and perform an evaluation of the model containing them.

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Biographical Information

GONZÁLEZ-BARRETO, DAVID R., Ph.D. He is Associate Professor of Industrial Engineering and Coordinator of Institutional Research of the Office of Institutional Research and Planning of the University of Puerto Rico at Mayagüez. He is interested in institutional research, specifically in the areas of admissions and student success.

GONZÁLEZ-QUEVEDO, ANTONIO A., Ph.D. He is Professor of Civil Engineering and Director of the Office of Institutional Research and Planning of the University of Puerto Rico at Mayagüez. He is interested in physical planning and institutional research, specifically in the areas of assessment of student learning.