Impact of Academic Support Strategies to Scholarship Students in Pre-calculus

Research Practise 1: Project Presentation

Mayra Bustamante[1], Pedro Vicente Esteban[2]

[1]Mathematical Engineering

[2]Tutor, Department of Mathematical Sciences

November 24, 2015

Our problem is to find the impact of the pre-calculus virtual course and the 20 hours of pre-calculus classes on the grade of the scholarship students in the subjects Mathematics 1 and Calculus 1, during these initiatives the students do three evaluations: self-diagnostic evaluation, academical training work in virtual course and follow-up evaluation.

These are the specific goals for this project:

- ▶ Process the data for the self-diagnostic evaluation, follow-up and the subjects notes Mathematics 1 and Calculus 1 for the semester 2015-1 and 2015-2.
- ▶ Find the correlation of data.
- ▶ Make a follow-up report to the three assessment strategies to support academic scholarship students and their possible effect on their academic performance.

- Linear regression model finds an estimate model that described a situation where there is a "y" variable that it dependent on some "x" variables, this model suppose the relationship between the variables is linear, and "ϵ" is the error.

- Linear regression model finds an estimate model that described a situation where there is a "*y*" variable that it dependent on some "*x*" variables, this model suppose the relationship between the variables is linear, and "ϵ" is the error.

- This is the model structure:

$$y_i = \beta_1 X_{i1} + ... + \beta_k X_{ik} + \epsilon_i$$

where *i* =1, 2, ..., *T* and *T* is the number of variables values that we have and *k* is the number of variables "*x*" that we have.

In this project linear regression model is used in the problem about the impact of virtual pre-calculus course and the 20 hours of contact sessions in the results of scholarship students.
The data processed were:

- ▶ Grade of self diagnostic evaluation.
- ▶ Grade of academical training work in virtual course.
- ▶ Grade of follow-up evaluation.
- ▶ Grade of the subject Mathematics 1 or Calculus 1.
- ▶ Number of students who took the subjects Mathematics 1 or Calculus 1.
- ▶ Number of students who passed the subjects Mathematics 1 or Calculus 1.

The variables used in the linear regression model are:

- **Grade of the subject Mathematics 1 or Calculus 1:** Dependent variable "y_i".
- **Grade of self diagnostic evaluation:** Independent variable "x_{i1}".
- **Grade of academical training work in virtual course:** Independent variable "x_{i2}".
- **Grade of follow-up evaluation:** Independent variable "x_{i3}". where $i = 1, 2, ..., T$, T is the number or students who took Mathematics 1 or Calculus 1 and in this case $k = 3$.

To have the linear regression model to our problem, we need to estimate the coefficients β_k, for that we used the following equation because with this we find the estimator of minimum variance (minimum error square).

$$\vec{\beta_k} = (\vec{x}'\,\vec{x})^{-1}\,\vec{x}'\,\vec{y}$$

$\vec{\epsilon}$ has an uniform distribution with average=0 and variance = $\sigma^2 I_i$. We can estimate σ^2 with the following equation:

$$\sigma^2 = \frac{\vec{y}'\,\vec{y} - \vec{\beta}'\,\vec{x}'\,\vec{y}}{T - k}$$

To know the variability of the data we searched the determination coefficient R^2. To find this coefficient we start with the equation $\epsilon = y_{real} - y_{estimate}$ so $y_{real} = y_{estimate} + \epsilon$. After we find the total sum of squares of each variable.
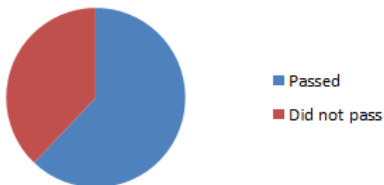
$$R^2 = 1 - \frac{CES}{CTS} = \frac{\vec{\beta}' \, \vec{x}' \, \vec{y} - T\bar{\bar{y}}^2}{\vec{y}' \, \vec{y} - T\bar{\bar{y}}^2}$$
$$0 \le R^2 \le 1$$

where CES=corrected error sum and CTS=corrected total sum.

Population are 448 scholarship students that start the university in the semester 2015-1. 285 students did the self-diagnostic evaluation, with an average grade of 62.91% and 108 students did not pass the exam.
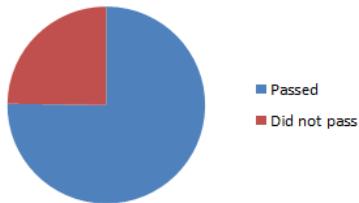
Self-diagnostic evaluation

- Passed
- Did not pass

Figure: Students that passed and students that did not pass self-diagnostic evaluation.

Number of students who did the academical training work in virtual course: 347.
Average grade of students who did the academical training work in virtual course: 69.3% and 86 students did not pass the exam.
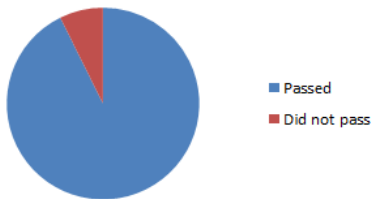
Work in virtual course

- Passed
- Did not pass

Figure: Students that passed and students that did not pass academical training work in course.

Number of students who did the follow-up exam: 314.
Average grade of students who did the follow-up evaluation: 79.86%
and 23 students did not pass the exam.
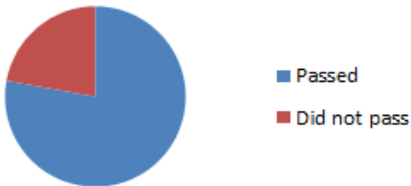
Follow-up evaluation

■ Passed
■ Did not pass

Figure: Students that passed and students that did not pass follow-up evaluation.

Number of students who took the subject Mathematics 1 or Calculus 1: 248.
Average grade of students who took the subject Mathematics 1 or Calculus 1: 66% and 55 students did not pass the subject.
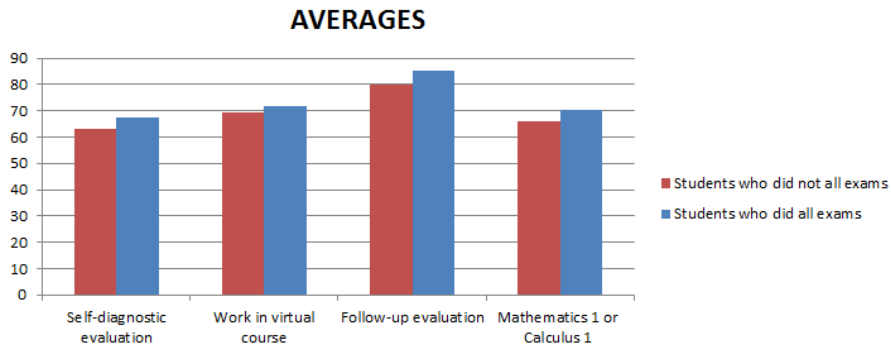

Figure: Students that passed and students that did not pass Mathematics or Calculus 1.

Results
Data

138 students did all exams, and they had better results than the group of all students.

AVERAGES

Figure: Comparison of averages between students who did and students who did not all exams.

Results with linear regression model were:

$$\beta_1 = 0.1718, \; \beta_2 = 0.1403 \; \text{y} \; \beta_3 = 0.5819$$
$$R^2 = 0.1758$$

Thanks for your attention!