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Using Mathematical Models to Predict the Academic Performance of Students from Initial Courses in Engineering School

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Abstract : The Engineering School of the University of the Republic in Uruguay offers an Introductory Mathematical Course from the second semester of 2019. This course has been designed to assist students in preparing themselves for math courses that are essential for Engineering Degrees, namely Math1, Math2, and Math3 in this research. The research proposes to build a model that can accurately predict the student's activity and academic progress based on their performance in the three essential Mathematical courses. Additionally, there is a need for a model that can forecast the incidence of the Introductory Mathematical Course in the three essential courses approval during the first academic year. The techniques used are Principal Component Analysis and predictive modelling using the Generalised Linear Model. The dataset includes information from 5135 engineering students and 12 different characteristics based on activity and course performance. Two models are created for a type of data that follows a binomial distribution using the R programming language. Model 1 is based on a variable's p-value being less than 0.05, and Model 2 uses the stepAIC function to remove variables and get the lowest AIC score. After using Principal Component Analysis, the main components represented in the y-axis are the approval of the Introductory Mathematical Course, and the x-axis is the approval of Math1 and Math2 courses as well as student activity three years after taking the Introductory Mathematical Course. Model 2, which considered student’s activity, performed the best with an AUC of 0.81 and an accuracy of 84%. According to Model 2, the student's engagement in school activities will continue for three years after the approval of the Introductory Mathematical Course. This is because they have successfully completed the Math1 and Math2 courses. Passing the Math3 course does not have any effect on the student’s activity. Concerning academic progress, the best fit is Model 1. It has an AUC of 0.56 and an accuracy rate of 91%. The model says that if the student passes the three first-year courses, they will progress according to the timeline set by the curriculum. Both models show that the Introductory Mathematical Course does not directly affect the student’s activity and academic progress. The best model to explain the impact of the Introductory Mathematical Course on the three first-year courses was Model 1. It has an AUC of 0.76 and 98% accuracy. The model shows that if students pass the Introductory Mathematical Course, it will help them to pass Math1 and Math2 courses without affecting their performance on the Math3 course. Matching the three predictive models, if students pass Math1 and Math2 courses, they will stay active for three years after taking the Introductory Mathematical Course, and also, they will continue following the recommended engineering curriculum. Additionally, the Introductory Mathematical Course helps students to pass Math1 and Math2 when they start Engineering School. Models obtained in the research don't consider the time students took to pass the three Math courses, but they can successfully assess courses in the university curriculum.

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