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Student Performance in Pre-Calculus Courses: Unbolting Gate for Success in Differential Calculus

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Abstract

This study provided an answer why students should learn a two-part college calculus course and how calculus would be practical in their future jobs after graduation. Thus, the main objective is to determine the significance of certain pre-calculus courses in predicting success in Differential Calculus at ACLC Macau. Final grades of students in Communication Skills P-1, College Algebra, Trigonometry and Geometry were used to predict success in Differential Calculus. The best predictor was the final grades of students in College Algebra.

Keywords: Calculus, Logistic regression, Student performance, Final grades, Computer science, Information technology, Curricula.

Introduction

Calculus is a required course in most computer science or information technology curricula. However, many CS/IT students have much apprehension in taking up calculus. The general impression for many students is that "calculus" is synonymous with "difficult".

Majority of these students do not realize the relationship between calculus and their chosen field. They also complain that their curriculum is loaded with many mathematics subjects and fail to see the link between these two disciplines.

Many CS/IT students question why they should learn a two-part college calculus course and how calculus would be practical in their future jobs after graduation. The sufficient evidence that many students fail in calculus also reinforces this negative view.

Many college instructors would agree that the main reason why students are not successful in calculus is because they have weak foundations in algebra and other pre-calculus courses. A major difficulty that students have in calculus involves the lack of the so-called pre-calculus skills that should have been mastered in advance. A student with weak.

Pre-calculus

Skills is prone to making errors in algebraic manipulations while calculating limits, determining derivatives or solving applied problems such as optimization or related rates. Difficulty with mathematics courses at the high school level might also contribute to the overall weak background in calculus and may lead to performance difficulties among college students. The foundations of mathematics taken at the high school level may play a prominent role in college level mathematics achievement.

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The main objective of this study is to determine the significance of certain pre-calculus courses and some high school data in predicting success in Differential Calculus at ACLC Macau.

Related Literature

According to Moore et al. [1], linear regression is an approach for modeling the relationship between a scalar dependent variable y and one or more explanatory variables (or independent variables) denoted X. The case of one explanatory variable is called simple linear regression. For more than one explanatory variable, the process is called multiple linear regressions.

In linear regression, the relationships are modeled using linear predictor functions whose unknown model parameters are estimated from the data. Such models are called linear models. Most commonly, the conditional mean of y given the value of X is assumed to bean affine function of X; less commonly, the median or some other quantile of the conditional distribution of y given X is expressed as a linear function of X. Like all forms of regression analysis, linear regression focuses on the conditional probability distribution of y given X, rather than on the joint probability distribution of y and X, which is the domain of multivariate analysis.

Linear regression was the first type of regression analysis to be studied rigorously, and to be used extensively in practical applications. This is because models which depend linearly on their unknown parameters are easier to fit than models which are non-linearly related to their parameters and because the statistical properties of the resulting estimators are easier to determine.

Strickland [2], stated that the generalized linear model (GLM) is a flexible generalization of ordinary linear regression that allows for response variables that have error distribution models other than a normal distribution. The GLM generalizes linear regression by allowing the linear model to be related to the response variable via a link function and by allowing the magnitude of the variance of each measurement to be a function of its predicted value. Generalized linear models were formulated by Nelder and Wedderburn [3] as a way of unifying various other statistical models, including linear regression, logistic regression and Poisson regression. They proposed aniteratively re-weighted least squares method for maximum-likelihood estimation of the model parameters. Maximum-likelihood estimation remains popular and is the default method on many statistical computing packages.

According to Freedman [4], logistic regression, or logit regression, or logit model is a regression model where the dependent variable is categorical. The binary logistic model is used to estimate the probability of a binary response based on one or more predictor variables. As such it is not a classification method. It could be called a qualitative response/discrete choice model in the terminology of economics.

Logistic regression measures the relationship between the categorical dependent variable and one or more independent variables by estimating probabilities using a logistic function, which is the cumulative logistic distribution. Thus, it treats the same set of problems as probit regression using similar techniques, with the latter using a cumulative normal distribution curve instead. Equivalently, in the latent variable interpretations of these two methods, the first assumes a standard logistic distribution of errors and the second a standard normal distribution of errors.

Logistic regression can be seen as a special case of generalized linear model and thus analogous to linear regression. The model of logistic regression, however, is based on quite different assumptions from those of linear regression. In particular, the key differences of these two models can be seen in the following two features of logistic regression. First, the conditional distribution y \mid x is a Bernoulli distribution rather than a Gaussian distribution, because the dependent variable is binary. Second, the predicted values are probabilities and are therefore restricted to (0,1) through the logistic distribution function because logistic regression predicts the probability of particular outcomes.

Related Studies

Yushau and Omar [5] investigated the effect of the preparatory year program courses on the first calculus course at King Fahd University of Petroleum and Minerals (KFUPM). The data consists of more than 2,000 bilingual Arab university students in the English language, tracked over seen semesters. These students represent over 70% of all entering first year students into KFUPM degree programs. Using the software SAS 9.0, the multiple regression analyses found that at KFUPM the success in a Calculus I course depends mainly on the two preparatory year mathematics courses, and their interaction. Another variable that contributed significantly in the model is the preparatory year of English. The old mathematics placement requirement was found to produce higher predicted grades for performance in Calculus I compared to the new requirement.

Islam and Al-Ghassani [6] evaluated the performance of students of college of Science of Sultan Qaboos University (SQU) in Calculus I course, and examined the predictive validity of student's high school performance and gender for Calculus I success. The data for the study was extracted from students' database maintained by the Deanship of Admission and Registration Office of SQU. The study considered a sample of 615 students who took Calculus I course during 2014 spring semester. Both descriptive and inferential statistical techniques were used for data analysis. Predictive validity of selected factors was analyzed using hierarchical regression analysis. The analysis revealed that female students entered in SQU with a higher average high school scores than male students, and many boys with lesser high school scores than girls succeed in getting admission at SQU. The results indicate that female students obtained grades lower than C in Calculus I, of which 20% failed in the course. The proportion of students with F grade was found to be significantly higher among male students compared to female students (28% vs. 7%). The analysis revealed

that gender, high school math score and overall high school score are significant predictors of subsequent performance in Calculus course at college level. Thus differences among gender and high school performance should be taken into consideration during the admission process to allow for more equal opportunities to all applicants and have fairer admissions decisions.

Sule and Saporu [7] used a logistic regression model to investigate the factors that influence students in MTH101 (Element of Calculus) course. The data use were the grades of the (200-400) level students in MTH101 course which was collected from the department's examination record and also by questionnaire administered to the students. The data analysis shows that the factors that significantly influence academic performance in MTH101 course are GPA (student's academic performance), course challenge (student's attitude related to the course) and concept in the course related to real world experience (student's motivation). It was therefore recommended that intervention strategies to bring about improvement in the course should be focused on how to enhance academic performance, change course related attitudinal problems and provide sufficient motivation.

Post et al. [8] examined the impact of prior mathematics achievement on the relationship between high school mathematics curricula and student postsecondary mathematics performance. The sample (N=4,144 from 266 high schools) was partitioned into 3 strata by ACT mathematics scores. Students completing 3 or more years of a commercially developed curriculum, the University of Chicago School Mathematics Project curriculum, or National Science-funded curriculum comprised the sample. Of interest were comparisons of the difficulty level and grade in their initial and subsequent college mathematics courses, and the number of mathematics courses completed over 8 semesters of college work. In general, high school curriculum was not differentially related to the pattern of mathematics grades that students earned over time or to the difficulty levels of the students' mathematics course taking patterns.

There was no relationship between high school curricula and the number of college mathematics courses completed.

Amici [9] investigated the factors that predict success in AP Calculus. The factors investigated include student study habits, such as time spent doing homework, working with a study group or tutor, phoning a friend for help, or using the internet for help. The study also examined the classroom environment and structure and the effect of teacher knowledge and attitude in predicting success. Additionally, teacher teaching styles and teacher designed lessons that predicted success in AP calculus were investigated. Seventy-three (N=73) former students in the course participated in the study. An online survey was conducted to collect data for the study. The study used multiple regressions to analyze the student data. The results showed that, when taken together, student study habits and teacher teaching styles were two factors that were statistically significant predictors of success in AP Calculus. The study found that the internet was a factor that predicted success of AP Calculus which was important as students become more and more wired into cell phones, tablets, and other media devices.

Conversely, the results also showed that the classroom environment and structure, teaching knowledge, and attitude, and the teacher designed lessons were not statistically significant in predicting success in AP Calculus. However, even though these were not significant statistically, the students expressed that they were very important contributors to their success. Recommendations include the application of specific study habits, teaching styles, and increase use of the internet resources to students in school, including increased access to their various handheld devices such as cell phones and tablets. Additionally, it is recommended to continue the examination success factors in higher level math courses such as AP Calculus.

Methods and Techniques

This study used the descriptive method of research. According to Calderon and Gonzales [10], descriptive research is a purposive process of gathering, analyzing, classifying, and tabulating data about prevailing conditions, practices, beliefs, processes, trends, and cause-effect relationships and then making adequate and accurate interpretation about such data with or without the aid of statistical method.

Ariola [11] noted that descriptive research describes current events and that the research questions or problems raised are based on the appreciation of present phenomena, events, or state of affairs. The purpose of the descriptive method is to describe "what is." It deals with the prevailing conditions of objects, people and events.

Population and Sample of the Study

The forty (40) sample included in the study were selected among students (N=112) who have taken Differential Calculus at ACLC, Macau; the data were based from ACLC Macau Registrar records. Final grades of students in Communication Skills P-1, Differential Calculus and its pre-requisites College Algebra, Trigonometry, and Geometry were collected. The final grade in Differential Calculus as the dependent variable takes on values 1 (passed) or 0 (failed).

Findings

The backward elimination process of stepwise regression is presented in Table 1. The final grades of students in College Algebra with ap value of 0.00717 appears to have a significant effect for Differential Calculus success. The final grades of students in Communication Skills P-1, Plane and Spherical Trigonometry and Analytic Geometry do not appear to have a significant effect for Differential Calculus success.

The Analysis of Deviance table is shown in Table 2. The likelihood ratio test statistic is 7.4019 with a p-value of 0.006516. Thus, there is relatively strong evidence in favor of rejecting.

Conclusion and Recommendation

The findings of the study suggest that the students' performance in the College Algebra course have significant

Table 1: The backward elimination process of stepwise regression.

Deviance Residuals				
Min	1Q	Median	3Q	Max
-2.2379	-0.8140	0.1377	0.6940	1.5912
Coefficients				
Estimate Std. Error z value Pr(>IzI)				
(Intercept)	12.479	4.688	2.662	0.00777 **
Algebra	-4.471	1.663	-2.689	0.00717 **
Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Table 2: Analysis of deviance table.

>anova (mod.pop4, mod. pop 3, test = "Chisq"	
Analysis of Deviance table	
Model 1:	Calculus – Algebra
Model 2:	Calculus – Algebra + Trigonometry
Resid. Df Resid. Dev Df Deviance Pr (>Chi)	
1	38 37.101
2	37 29. 699 1 7.4019 0.006516 **
Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1	
> q( )	
>	

effect to the success of learning Differential Calculus. College Algebra course usually involves a large number of topics ranging from high school algebra to the more advanced algebraic lessons on functions and graphs, matrices and determinants, complex numbers and sequences and series. College instructors can help their students to become "calculus ready" by taking a "pre-calculus approach". That is, by letting their students to have a comfortable transition from basic mathematics to the more advanced courses and by avoiding the selection and presentation of material that are rather a bunch of disconnected topics or remotely associated with calculus.

References

1. Moore BR, Höhna S, May MR, Rannala B, Huelsenbeck JP, et al. (2016) Critically evaluating the theory and performance of Bayesian analysis of macro evolutionary mixtures. PNAS 113: 9569-9574.
2. Strickland J (2015) Predictive modeling and analytics. The rest of the story.
3. Nelder JA and Wedderbur RWM (1972) Generalized linear models. J R Statist Soc A 135: 370-384.
4. Freedman DA (2008) Randomization does not justify logistic regression. Statistical Science 23: 237-249.
5. Yushau B and Omar MH (2007) Investigating the role of the preparatory year program courses as predictors of first calculus course grade: a longitudinal study. King Fahd University of Petroleum & Minerals Technical Report Series pp: 1-23.
6. Islam MM and Al-Ghassani A (2015) Predicting college math success: do high school performance and gender matter? evidence from sultan Qaboos University in Oman. Int J Higher Edu 4: 67-80.
7. Sule BO and Saporu FWO (2015) A logistic regression model of students' academic performance in university of Maiduguri, Maiduguri, Nigeria. Mathematical Theory and Modeling 5: 124-136.
8. Post TR, Medhanie A, Harwell M, Norman KW, Dupuis DN, et al. (2010) The impact of prior mathematics achievement on the relationship between high school mathematics curricula and postsecondary mathematics performance, course-taking, and persistence. J Res Math Edu 41: 274-308.
9. Amici PG (2014) Factors that affect success in AP calculus. Pro Quest Dissertations Publishing.
10. Calderon JF and Gonzales EC (2005) Methods of research and thesis writing. Bookstore Publishing Corporation, Manila, Philippines.
11. Ariola M (2006) Principles and methods of research. Rex Book Store, Manila, Philippines.

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