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Predicting Secondary School Students' Mathematics Performance: The Role of Attitude, Motivation and Anxiety Using a Logistic Regression Model

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ABSTRACT

Predicting students' performance in mathematics subject which is a critical component of Science, Technology, Engineering and Mathematics (STEM) education has consistently been an important research topic across various academic fields as this subject is prerequisite for all career paths. However, in secondary school in Malaysia there is not much research done in this field. This study aimed to examine the relationship between students' attitude, motivation, anxiety towards mathematics and their academic performance. A total of 380 data were collected from form four students around Kemaman, Terengganu schools using a 5-point Likert scale questionnaire. A logistic regression model was developed to predict students' likelihood of passing and failing in mathematics. Model performance was evaluated using various metrics such as Mean Square Error (MSE), Mean Absolute Error (MAE), Root Mean Square Error (RMSE), accuracy, confusion matrix and Area Under the Curve (AUC). The findings revealed that students' attitude and students' motivation were significant predictors of academic performance in mathematics. Even though students' anxiety has been identified as non-significant factor, there were only minimal changes in model fit and explanatory power when this variable was removed. Therefore, both the full model and the reduced model were developed for comparison. The results shows that the full model of logistic regression outperformed the other model with the highest predictive accuracy of 78.29% and AUC of 0.824. These results suggest the model provides a valuable tool for educators and policymakers to identify students at risk and an early intervention can be done to improve their performance.

1. Introduction

In most countries, Science, Technology, Engineering and Mathematics (STEM) education which emphasizes critical thinking, problem solving, creativity and innovation is among the most crucial subjects in school as this interdisciplinary approach can prepare students for the challenges of the

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modern world. Nowadays, technology growth fast and continues to drive global economics. By developing a strong foundation in STEM, it will equip students with skills that are needed in their future career path. One of the fields in STEM discipline is mathematics and it is the foundation of all STEM disciplines [1].

According to Maamin et al. [2], students' achievements in mathematics give a big effect especially in determining their future jobs as well as on the economic growth of a country. The low level of mathematics performance can give a devastating effect of students' future career in STEM fields [3]. Despite its importance, students always feel mathematics is difficult and challenging [4]. As a result, their performance in mathematics is not convincing and they struggle to achieve satisfactory performance. This can be seen in a declining result through international students assessment such as Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) [5]. Students in Malaysia achieved a score below the average of Organisation for Economic Co-operation and Development (OECD) in mathematics and the achievement of TIMSS 2023 in mathematics also showed a significant decline in the average score compared to TIMSS 2019, with a decrease of 50 points [6], [7]. However, there is still not much information regarding the factors that influence the students to score well in mathematics [2]. This has prompted the researchers to investigate the factors that contribute to students' mathematics achievements so that the early intervention can be done.

Among the numerous factors that affect mathematics performance, the psychological and emotional elements have garnered the researcher's attention. According to Minano, unlike the impact of cognitive factors, the emotional or motivational factors has received less intention in the previous research [8]. Moreover, over the past years, the studies has concentrated on instructional techniques and pedagogical approach and they ignore the potential influence on emotional or motivational factors [9]. According to Barrosso, mathematics anxiety is one of the affective factor that has been found associated with the mathematics achievement where the students feel fear and worry with mathematics stimuli and situations [10]. While Julaihi, discovered that students' attitude, self-efficacy, motivation and anxiety as factors affecting students' achievement in mathematics among undergraduate students [11]. In prior studies, there have been limited research focusing on Malaysian secondary school students to identify the factors influencing their performance in mathematics, particularly psychological attributes. Thus, based on the earlier studies in literature, students' attitude, motivation and anxiety towards mathematics have garnered attention in this study to determine the relationship with the mathematics achievements.

A robust approach that can be used to investigate the relationship between independent and one or more dependent variables is predictive modelling. This approach has emerged as a critical technique as it offers significant insights and foresight across various fields. In the educational field, this approach can predict students' performance as it provides an early detection system. Early prediction not only can offer assistance to students at risk but also can minimize the learning expenses [12], [13]. Logistic regression analysis in particular is suitable in this study as it allows for the prediction in binary outcome.

This study aims to develop a predictive model to examine the relationships between students' attitude, motivation and anxiety towards mathematics and mathematics performance. The urgency of this research is highlighted by recent reports in Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS), showing mathematics performance has declined over the years [6], [7]. The research objectives include investigating the relationship of students' performance in mathematics with students' attitude, motivations and anxiety, to develop the predictive modelling on students' performance in

mathematics subjects using predictive modelling and to investigate the performance of the proposed model developed using various evaluation metrics.

This study holds significant importance in the Malaysian education system, aiming to provide crucial insights through predictive model among secondary school students and inform educators and policymakers. Students can gain personal insights on the effect of their own attitudes and feelings towards mathematics which can directly impact their performance in mathematics. This will lead them to better self-management technique. Educators can give early intervention to the targeted students based on the model prediction and raise awareness for the collaboration among teachers to change their teaching technique of mathematics to attract students' interest and attention. More holistic education such as incorporating the students' mental health and their motivation enhancement along with the current traditional academic skills can be integrated by policy makers in developing educational policies.

2. Related Works

Mathematics is a critical component in overall STEM education as it involves problem solving and decision making. Being proficient in Mathematics is a prerequisite for all career paths which highlight its essential in the contribution to the advancement of science, industry, technology and social progress of society [14]. Therefore, students must have a good fundamental of mathematics at the school level, as it is widely used not only in the fields of accounting, science, economics, technology and but also in their daily life [15]. The achievement of mathematics is measured by score test in mathematics [16]. There are many studies revealed the factors that contribute to the mathematics achievement. Study by Park et al. [17], in Bulgaria examined the impact of psychological attributes on mathematical achievement among school students. The relationship between psychological factors such as anxiety, motivation, and attitude and student performance has been extensively studied across various domains.

According to Hwang and Son [18], attitude is portrayed as emotion, behaviour or thought that represent one's disposition or viewpoint towards the subject. He revealed positive relationship between students' attitudes in mathematics and how well they do in mathematics. One study conducted by Hidayatullah and Csíkos [19] in Surabaya, East Java found that attitude gave significant impact to the students' mathematics achievement. By comprehensively understand the components of students' attitudes, educators can customize actions to improve students' attitudes towards mathematics. A positive influences in both the classroom and home settings also can contribute in shaping students' attitudes [20]. Even though attitudes towards Mathematics cannot be changed in a short period of time [21], students' experiences can change students attitude towards mathematics since attitude is not inherent [22].

Motivation is another crucial factor that influencing students' performance. Pekrun [23] defines motivation as the important parts in obtaining knowledge and skills and are driven by the students themselves. Motivated persons are more likely to finish a task or activity to the end and succeed in it with ease no matter of how tough or challenging it is without expecting external encouragements [24]. The study underscored that individual motivations significantly influence academic performance. By elevating emotional intelligence and mindfulness levels, it can reduce academic stress and enhanced students' motivation [25].

A comprehensive review by Konwar, examined the impact of anxiety on academic achievement [26]. They highlighted that the anxiety levels can impair cognitive functions like memory and concentration which lead to deteriorating in academic outcomes. To help free up cognitive resources, students can address and process their anxieties by expressive writing so that the

resources are available for use during the examination [20]. Study by Khasawneh et al. [27] describes mathematics anxiety as a feeling of stress, fear, nervousness and worry that can arouse or cause nervousness in a student's ability to solve mathematics problems. By reducing the elements of anxiety in students, we can potentially enhance motivation and positive attitudes towards mathematics which indirectly improve academic performance in the subject

Predictive modelling has gained traction in recent years to predict academic performance. Logistic regressions are commonly employed to evaluate the effects of psychological and demographic factors on binary outcomes such as pass or fail in examination. For example, Noel used logistic regression and linear regression modelling to model the academic achievement of university students, using demographic and past achievement data as predictors [28]. In addition, the study conducted by Owusu et al. [29] also used the logistic regression model to find the main factors that effects the students' academic success. However, the inclusion of insignificant predictors in these models has been debated, as it may introduce noise and reduce model generalizability. The method has also been used in assessing dropout risks. A recent study demonstrated that the integration of logistic regression with longitudinal data can identify at-risk students and develop early intervention strategies. This highlighted the ability of logistic regression to handle complex relationships and interactions among predictors. Therefore, it is suitable to analyse the multi-faceted educational phenomena.

Evaluation metrics are essential to assess the performance of predictive models particularly in binary classification tasks such as logistic regression. Arifin by employing key measures such as Root Mean Squared Error (RMSE) and Mean Absolute Error (MAE) to assess the accuracy and precision of different regression model [30]. A study by Chicco highlighted that relying on a single metric, such as accuracy, might lead to overly optimistic evaluations of model performance [31]. The combination of error-based metrics such as RMSE and MSE with classification metrics such as AUC which measure accuracy to ensure a more comprehensive assessment. The selection and application of evaluation metrics remains important in predictive modelling. It is also to make sure that the predicting models work and confidently be used to support decision making processes in the real-world setting.

3. Methodology

This study adopted a quantitative approach, employing a logistic regression model to predict students' performance in mathematics. A survey was done in three secondary schools in Kemaman district Terengganu from May 2024 to November 2024 among four students of science and art streams. This study focuses on psychological factors such as students' attitude, motivation and anxiety towards mathematics. A non-probability sampling known as judgmental sampling was used as the participants selection and a sample of 380 students were selected.

The data was collected through a questionnaire that has been adopted and adapted from previous research studies. There are four sections in the questionnaire. Data on demographic respondents such as gender, race, class stream, school name and mathematics score during mid-year examination were obtained in the pilot study. Students' attitude towards mathematics was assessed in the second section with 10 items. The third section of the questionnaire evaluated the students' motivation towards mathematics, which consists of 8 items while the fourth section of the questionnaire assessed the students' anxiety towards mathematics with 15 items. A 5-point Likert scale (strongly disagree, disagree, neutral, agree, strongly agree) was used to assess all the 33 items in the questionnaire. The developed questionnaire for this research is given upon request.

The data were analysed using IBM Statistical Package for Social Sciences (SPSS) version 26. A descriptive analysis was performed as part of the preliminary analysis. To determine the significant factors that influenced students' performance the logistic regression analysis was used. The general model is given by Equation 1.

$$\log it(\pi) = \beta_0 + \beta_1 x_1 + \dots + \beta_p x_p \quad (1)$$

where

x_1 : students' attitude towards mathematics

x_2 : students' motivation towards mathematics

x_3 : students' anxiety towards mathematics

while the regression coefficients are denoted by $b_1, b_2, \dots, b_p$ with b_0 is the intercept. In this study, we use a 5% level of significance to identify which independent variables statistically significant on students' performance. Once the significant variables identified, the predictive modelling were developed by employing logistic regression. The aim of logistic regression is to find the best parameter estimate by maximizing the function. This will examine the influence of attitude, motivation, and anxiety on students' likelihood of passing or failing mathematics.

The evaluation is a critical step in methodology as it can assess the reliability and performance of a model while identifying the areas for improvements. In this study, the performance of the models was evaluated using various evaluation metrics such as mean squared error (MSE), mean absolute error (MAE) and root mean squared error (RSME). These three common metrics were used to measure the accuracy of regression models. Mean squared error (MSE) calculates the average of the squares of the prediction errors which are the differences within predicted values and actual observed values. It is defined mathematically as in Equation 2.

$$MSE = \frac{1}{n} \sum_{i=1}^n (\hat{y}_i - y_i)^2 \quad (2)$$

where $\hat{y}_i$ is the predicted value, y_i is the observed actual value, and n is the number of observations.

Mean Absolute Error (MAE) computes the average magnitude of the errors in a set of predictions regardless of their direction. It is less sensitive to outliers than MSE and is defined as in Equation 3,

$$MAE = \frac{1}{n} \sum_{i=1}^n |\hat{y}_i - y_i| \quad (3)$$

Root Mean Squared Error (RMSE) is the square root of the MSE. The metric in RMSE have similar units as in the response variable. It is computed as in Equation 4,

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (\hat{y}_i - y_i)^2} \quad (4)$$

To evaluate the classification, metrics such as confusion matrix and area under the curve (AUC) were employed. These metrics were chosen to provide a thorough overview of the model performance. The confusion matrix, measures such as accuracy, precision, recall and F1-Score. Accuracy is a measure that calculates the proportion of the total correct prediction to the total number of samples examined. Precision measures the proportion of true positive predictions out of all the positive predictions made by the model, whereas recall measures the proportion of true positives out of all the actual positive instances in the dataset. Furthermore, since F1-score is a harmonic mean of the two metrics, it offers a balance within precision and recall. A good model performance is indicated by a higher F1-score. Following are the calculations of the evaluation metrics as in Equation 5, Equation 6, Equation 7 and Equation 8. The overall analysis coding for this research is given upon request.

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN} \quad (5)$$

$$\text{Precision} = \frac{TP}{TP + FP} \quad (6)$$

$$\text{Recall} = \frac{TP}{TP + FN} \quad (7)$$

$$\text{F1 - Score} = 2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}} \quad (8)$$

3. Results and Discussion

A total of 380 questionnaires were returned making the response rate 98%. There was no missing value in the data. The frequency analysis shown in Table 1 indicates the frequency and percentage of demographic profiles of the respondents. Out of 380 respondents, 261 (68.7%) are females and the remaining 119 (31.3%) are male respondents. All participants are from the Malay ethnic group (100%), as there are no Chinese or Indian respondents. In terms of class stream, 99 participants (26.1%) are from the Science stream, while 281 (73.9%) belong to other streams. Regarding academic achievement in mathematics subject, 132 participants (34.7%) passed, while 248 participants (65.3%) failed the mathematics subject.

Table 2 shows the descriptive data for independent and dependent variables. The students' performance which appears to be a binary measure had a mean of 0.35 (standard deviation, SD=0.48, range 0 – 1). The mean score for items in students' attitude towards mathematics was 2.40 (standard deviation, SD=0.75, range 1 – 4.6). The mean score for items in students' motivation toward mathematics showed a slightly higher mean of 2.46 (standard deviation, SD=0.74, range 1 – 5). The mean score for items in students' anxiety toward mathematics demonstrated the highest mean among three independent variables at 3.42 (standard deviation, SD=0.71, range 1 – 5).

Table 1
Demographic Profile of Respondents

Demographic Profile	Variable	Frequency	Percent (%)
Gender	Male	119	31.3
	Female	261	68.7
Race	Chinese	0	0
	Indian	0	0
	Malay	280	100
Class Stream	Science	99	26.1
	Others	281	73.9
Achievement	Passed	132	34.7
	Failed	248	65.3

Table 2
Descriptive Statistics

Variable	Mean	Std. Deviation	Minimum	Maximum
Students' performance in mathematics subject (y)	0.35	0.48	0.00	1.00
Students' attitude towards mathematics (x_1)	2.40	0.75	1.00	4.60
Students' motivations towards mathematics (x_2)	2.46	0.74	1.00	5.00
Students' anxiety towards mathematics (x_3)	3.42	0.71	1.00	5.00

Before conducting the logistic regression analysis, several key assumptions were examined to ensure the validity of the model. First, the dependent variable which is the students' performance in mathematics was binary (pass = 1, fail = 0). This fulfills the fundamental requirement for logistic regression. To address multicollinearity, Variance Inflation Factor (VIF) values were calculated and found to be below the threshold of 5, indicating that multicollinearity was not a concern. The relationship between the predictors and the logit of the dependent variable was also linear. Additionally, the assumption of independence of observations was satisfied, as each student represented a unique data point. Finally, the sample size of 380 respondents, with only three predictors, exceeded the recommended 10:1 ratio, ensuring sufficient power and stability for the analysis. These findings confirmed that the assumptions for logistic regression were met and that the model was appropriate for further analysis.

Table 3 presents the model summary of logistic regression that provides an overview of the result generated from the analysis to predict students' performance based on their attitude, motivation and anxiety towards mathematics. The value of -2 Log Likelihood is 368.311 indicates that the model provides a reasonable fit to the data. The Cox & Snell R Square and Nagelkerke R Square values were examined to assess the model fit for the logistic regression analysis. These pseudo R^2 used for comparing the relative fit of different models rather than for making absolute evaluations. The range for these two values is 0 to 1. In this study, the Cox & Snell R Square obtained is 0.276, meaning 27.6% variation from students' performance can be explained by their attitude, motivation, and anxiety toward mathematics. The Nagelkerke R Square value, which is 0.380 suggests that the model explains approximately 38% of the variance in student performance. These values indicate that the model possesses a moderate level of explanatory power.

Table 3

Model summary of logistic regression analysis between all predictor variables and students' performance in mathematics

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	368.311 ^a	0.276	0.380

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table 4 shows students' attitude and motivation variables have p-value of 0.000 and 0.011 respectively which are less than or equal to the 0.05 level of significance. This indicates that these two variables are significant with $p < 0.05$. This indicates that these two variables have a statistically significant effect on students' performance ($p < 0.05$). In contrast, the variable students' anxiety toward mathematics has p-value of 0.401 which is greater than 0.05. This indicates that it does not have a significant impact on students' performance. These findings are in line with previous research by Hwang and Arthur, who found attitude and motivations are the key factors influencing students' mathematics performance [18], [32]. Differences in findings from other studies such as those by Alias could be attributed to various factors including study populations and measurement instruments [33].

Table 4

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)
StepAttitude	-1.299	0.301	18.606	1	0.000	0.273
1 ^a Motivation	-0.749	0.293	6.512	1	0.011	0.473
Anxiety	-0.180	.215	0.704	1	0.401	0.835
Constant	4.655	0.734	40.208	1	0.000	105.126

While students' anxiety towards mathematics may not reach statistical significance in the current analysis, its theoretical importance and potential influence on students' performance cannot be neglected. Therefore, the model relating to students' performance, attitude, motivation and anxiety is fitted and can be written correspond to Equation 9 as given in Equation 10,

$$\hat{g}(x) = 4.655 - 1.299x_1 - 0.749x_2 - 0.180x_3 \quad (9)$$

The fitted values are given as in Equation 10,

$$\hat{\pi}(x) = \frac{e^{4.655 - 1.299x_1 - 0.749x_2 - 0.180x_3}}{1 + e^{4.655 - 1.299x_1 - 0.749x_2 - 0.180x_3}} \quad (10)$$

The coefficient β and odds ratio $\text{Exp}(\beta)$ for students' attitude is -1.299 and 0.273 respectively. This indicate that, when students have more negative attitude towards mathematics, they are less likely to pass the examination. Similarly, the coefficient β and odds ratio $\text{Exp}(\beta)$ for students' motivation is -0.749 and 0.473, respectively which indicate that, a student with lower motivation is less likely to pass the exam. For the students' anxiety variable, the coefficient β and odds ratio $\text{Exp}(\beta)$ are 0.835 and -0.180 respectively. The odds ratio of 0.835 suggests that for every unit increase in anxiety, the odds of passing are reduced by a factor of 0.180.

As our goal is to obtain the best fitting model, the reduced model with the significant predictors was developed and evaluated. Table 5 shows the model summary when the variable students' anxiety was not included in the model. There was only slightly small affected to the model performance. The new value of -2 Log likelihood increasing to 369.017. This suggest that the exclusion of students' anxiety variable does not enhance the model explanatory power. However, the change is very minimal which is less than one. Furthermore, when students' anxiety is excluded, the value of the Cox & Snell R Square and Nagelkerke R Square decreased marginally to 0.274 and 0.378, respectively. The change is very small which is a drop of 0.002 for both values and suggest that the explanatory power of the model is almost identical with or without anxiety variable. These also suggest that only minimal change in model fit and explanatory power when students' anxiety is removed.

Table 5

Summary of standard regression analysis between significant predictor variables and students' performance in mathematics

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	369.017 ^a	0.274	0.378

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Table 6 presents the model is refitted without anxiety variable. The coefficient for students' attitude and students' motivation remained highly significant and very similar with the initial model. Both predictors also show odd ratios less than 1 which is -1.357 for attitude and -0.782 for motivation. Similar with the initial model, the higher level of negative attitude and lower level of motivation are associated with reduced likelihood of passing in a mathematics examination.

Table 6

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 ^a Attitude	-1.357	0.292	21.620	1	0.000	0.257
Motivation	-0.782	0.290	7.287	1	0.007	0.457
Constant	4.257	0.546	60.837	1	0.000	70.625

The reduced model relating students' performance, students' attitude and students' motivation is fitted and can be written corresponding to Equation 11 as given in Equation 12,

$$\hat{g}(x) = 4.257 - 1.357x_1 - 0.782x_2 \quad (11)$$

The fitted values are given as in Equation 12,

$$\hat{\pi}(x) = \frac{e^{4.257 - 1.357x_1 - 0.782x_2}}{1 + e^{4.257 - 1.357x_1 - 0.782x_2}} \quad (12)$$

The developed models were then evaluated using various key performance metrics such as mean square error (MSE), mean absolute error (MAE), root mean square error (RMSE), area under the curve (AUC) and accuracy. Table 7 shows the logistic regression with full model demonstrated superior performance across most metrics. It achieved a lower value of MSE, MAE and RMSE which indicates this the model's prediction is closer to the actual values. In terms of classification

performance, the full model achieves higher accuracy of 78.29% compared to 77.63% for the reduced model. On the other hand, both models shared the same AUC values which indicate that both models have equivalent classification capabilities.

Table 7
Evaluation results between models

Metrics	Full Model	Reduced Model
MSE	0.1530	0.1536
MAE	0.3123	0.3133
RMSE	0.3123	0.3919
Accuracy	78.29	77.63
AUC	0.824	0.824

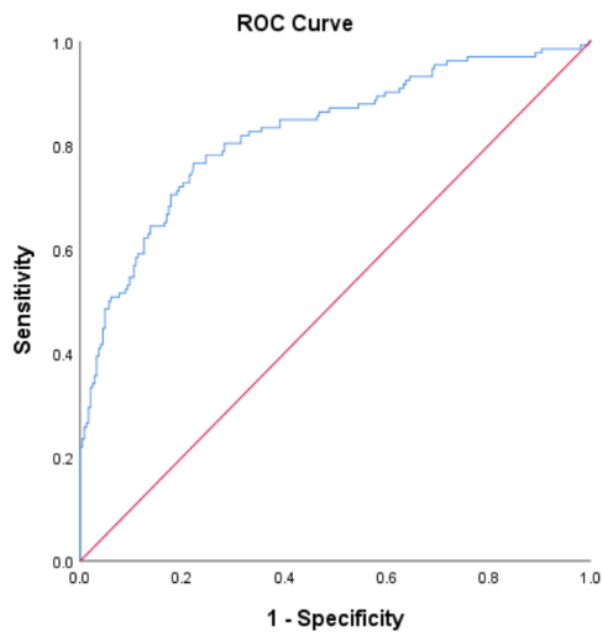


Fig. 1. ROC Curve for full model of logistic regression model

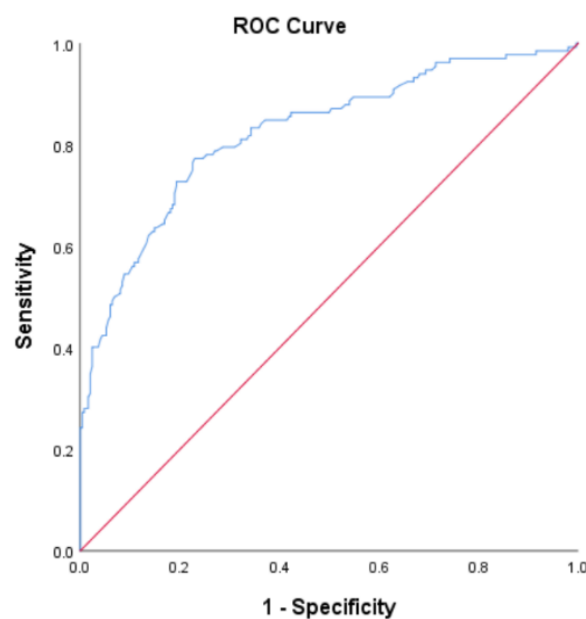


Fig. 2. ROC Curve for reduced model of logistic regression model

Overall, the full model shows slight advantage in predictive accuracy and error minimization. The reduced model provides an alternative option for practical applications with comparable accuracy and classification ability.

5. Conclusion

Generally, the purpose of this study was to identify the key factors that influenced students' performance in mathematics. This study focused on the involvement of emotional or motivational factors such as students' attitude, motivation and anxiety towards mathematics that affected the students' mathematics performance in school. The predictive models were also developed and evaluated to predict the students' performance in mathematics. The results showed that students' attitude and motivations had a notable impact on students' performance in comparison to students' anxiety towards mathematics. The predictive model has successfully developed, and the proposed model performs effectively which provide a good predictive capability. The full model of logistic regression demonstrated the highest predictive accuracy. Students' anxiety towards mathematics did not significantly affect the model performance. The study noted that this finding is in line with theoretical framework or prior research.

These findings emphasize the importance of considering psychological factors towards mathematics. It also highlights the potential of predictive modelling as a valuable tool in predicting students' performance, offering an early intervention towards a risk targeted students that have poor performance in mathematics. Educators can utilize these models to design data driven interventions such as targeted remedial sessions for the students. By identifying students with moderate motivation but weak mathematics skills, these students can be paired with the high performing students for tutoring. This structured peer tutoring program not only strengthens academic understanding but also fosters a supportive social environment that enhances both confidence and motivation. Beyond academic support, personalized learning plans can address students' specific learning preferences and emotional needs. These may include the use of visual aids, short video tutorials, interactive tools such as kahoot quizzes and mathematics journaling to reflect on learning. Such strategies can improve comprehension and reduce mathematics anxiety by creating a more engaging and interesting learning environment. Students with particularly exhibiting high anxiety or low motivation can be assisted through counseling support because academic intervention alone may be insufficient. School counselors play a vital role by providing psychological support through individual or small group sessions. These sessions can help students unpack their emotional triggers, negative perceptions about mathematics and past academic experiences. This target strategy can help students manage their mathematics anxiety or low self-confidence.

By integrating these insights into classroom practices, counseling interventions or early support programs, teachers and school counselors can implement targeted strategies to improve student outcomes in real school settings. This underscores the need for education systems to allocate more educational resources towards programs that can foster positive attitudes and reduce anxiety in learning environments to ensure students are interested and ready with this subject. By doing so, the education system can move beyond generic interventions and toward a more targeted, responsive approach that ensures all students, especially those most vulnerable, are equipped to succeed in mathematics.

While the attribute for this study is limited, they pave the way for future study. Future studies aim to explore more factors that influence students' performance to provide a more comprehensive understanding of the long-term impacts of psychological factors on students' performance in

mathematics. To provide a more complete picture, a broader range of variables, including psychosocial factors and comorbidities, should be considered.

In conclusion, this study marks a significant step towards improving students' performance in mathematics. By understanding the factors that influence students' performance, educators can raise awareness for the collaboration among teachers to change their teaching technique of mathematics to attract students' interest and attention. By predicting students' performance, students can gain personal insights on how their own attitudes and feelings towards mathematics can directly impact their performance and inform parents about the importance of fostering positive attitudes and motivations towards mathematics from an early age.

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