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Predicting Motivation among GKP Recipients using Regression Techniques in Machine Learning: An Implementation of Rapid Miner

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ABSTRACT

Recently, predictive analytics has found a place in many research areas. From business to healthcare, the revolutions of predictive analytics studies are constantly evolving to help decision makers identify the problem and make a wise decision. While a bigger impact has been reported on the development of predictive models in business studies, there has been very little effort that investigates the deployment of predictive models by using machine learning approaches specifically involving SMEs. Small business entrepreneurs (SMEs) are among the entities most affected because of the COVID-19 pandemic. Hence, this study aims to develop a model that could predict the motivation score of GKP recipients based on three factors: satisfaction, perceived value, and perceived expectation. Four different regression models, namely Linear, Ridge, Lasso, and SVR, were developed and evaluated as the best model by using Rapid Miner machine learning software tools. The GKIPP grant dataset has been used as a case study for estimating the motive of the GKP grant to evaluate the outcomes of various regression models. The findings indicate that linear and SVR models have produced highly accurate predictions about the motivation of GKP recipients. They have also produced a high proportion of R-square scores across all regression models, which is highly encouraging.

1. Introduction

The use of machine learning (ML) has become more popular in recent years among academics from several domains. Machine learning is a method that uses a computer or algorithm to infer knowledge or make decisions, continually improving its performance on tasks requiring intelligence like that of a human. In only the last few years, machine learning has grown much more effective, widely accessible, and applied across several sectors, including business based on study by [1]. Four problems that are commonly used in machine learning techniques are prediction, classification, clustering, and profiling. Even though ML always gets attention in terms of the application of ML algorithm model development, training, and testing on different datasets, it is still less explored by

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researchers. Most of the methods that are usually used by researchers in predictive analytics are by using Structural Equation Modelling (SEM).

A prior study had looked at the ways in which female entrepreneurs share their knowledge with employees, business partners, or other entrepreneurs to increase business performance, as well as the antecedent elements that affect these factors, entrepreneurial motivation, and mutual trust based on study by [2]. Prior to now, much of the research had a narrow focus on the analysis tools that were employed with structural equation modelling to calculate the maximum likelihood estimate (SEM). It is the same as study by [3] who carried out an empirical investigation into the growth of small and medium-sized businesses and looked at how international orientation, growth motivation, and performance are related. This is different from this work, which tries to create a model that can anticipate what will happen using regression analysis and machine learning.

Motivation plays a crucial role in sustaining Small and Medium Enterprise (SME) businesses, as without adequate incentives, owners may face challenges leading to potential closure. Particularly during challenging times, such as the COVID-19 pandemic and Movement Control Order (MCO) implementation, entrepreneurs rely on personalized customer experiences, product suggestions, buzz monitoring, and sentiment analyses for business survival. Recognizing the impact of the pandemic on SMEs, the government introduced the GKP program to provide essential financial assistance, supporting entrepreneurs in establishing and growing their businesses.

The Geran Khas Prihatin (GKP) motivation prediction model has sparked interest in this work. This methodology is thought to be capable of determining the efficiency of the GKP award to SME entrepreneurs in assisting them to sustain their businesses. Numerous recent researches in [4-6] have showed promising results using the machine learning technique. Yet, as compared to other machine learning approaches, regression algorithms are best suited for predicting continuous numerical outcomes by study by [7]. While regression techniques are a current trend in terms of their applicability, this study used them to predict SMEs' motivation towards GKP recipients.

The contribution of this paper is the development of the GKP motivation prediction model by using various ML algorithms. It provides the state-of-the-art machine learning approach that will be beneficial for inexpert machine learning users or data scientists. The structure of this paper is as follows. The literature review for the research done on machine learning and Geran Khas Prihatin (GKP) is presented in section two. The study's methodology is presented in section three, and the results are presented in section four. The final portion, number five, is where the findings are stated.

2. Research Background

2.1 Gerak Khas Prihatin (GKP)

The worldwide economy has been significantly impacted by the different containment measures that several nations have implemented to prevent the spread of the COVID-19 virus. Global GDP decreased by 1.75 percent during the pandemic's peak in the second half of 2020, with an average annual impact of 1.5 percent. Although China experienced most of the repercussions of this economic slowdown, the rest of Asia was swiftly affected by the virus's spread and its subsequent influence on world economies. Global trade is significantly lower, falling by approximately 3.75 percent in 2020, affecting all economies' exports.

Overall, the proliferation of Movement Control Orders (MCOs), such as Recovery Movement Control Order (RMCO) and Conditional Movement Control Orders (CMCO), has caused businesses and SMEs to struggle to stay solvent, resulting in the closure of several businesses and SMEs due to a sudden drop in revenues. Various surveys on the impact of the pandemic on SMEs reveal significant disruptions among small businesses. More than half of all SMEs are experiencing income losses.

The Malaysian government acted quickly and decisively, announcing the PRIHATIN Package on March 27, 2020, for a total of RM250 billion, to assist the entire citizenry in dealing with this ongoing pandemic, and cover people from all walks of life, whether students, families, or entrepreneurs [8]. According to a study conducted by SME Corp, the number of SMEs affected is approximately 170,000 out of approximately 850,000 SMEs across the country [9]. Recognizing that small and medium-sized enterprises require a unique strategy to grow and sustain their operations, the government established the Geran Khas Prihatin. Geran Khas Prihatin is a one-time financial assistance programme for qualified SMEs that aim to reduce their financial burden while increasing the productivity of their production and services.

According to Malaysian Finance Minister Tengku Datuk Seri Zafrul Tengku Abdul Aziz, as of June 2, 2020, the grant had been awarded to 488,857 candidates. It is believed that this aid and support would continue to promote small and medium-sized enterprises (SMEs), enabling entrepreneurs' earnings to increase and the economy to recover.

2.2 Evaluation of GKP Recipient Model

Motivation is an effective tool in the hands of managers to maximise the effectiveness of the company's operations and production. Study by [10] stated that motivation is defined as a set of internal processes that influence the direction, intensity, and persistence of thoughts and behaviours over time. However, he points out that even though a lot of study has been done on motives, the relationship between motivations and interests has not received as much attention. Additionally, study by [10] revealed that the primary theme of tourism is a link between motivation and satisfaction.

By examining the direct and indirect interactions that influence them, researchers can better understand motivation and content. However, [10] has not clarified the relationship between motivational and satisfaction-related factors. Motivation is one of the important elements that can propel business owners to find a way to continue operating their company in the face of adversity. Therefore, it is crucial that the relationship between motivation and satisfaction be better understood to promote the circumstances for sustainable business.

On the other hand, it has also been discovered by previous study [11] that motivation and perceived value are related. This relationship has been proven where motivation has a relationship with perceived value according to study by [12]. Research that could link these two elements together, though, was discovered. Therefore, this study will predict motivation and its relationship with satisfaction, perceived value, and perceived expectancy. According to logic, the SME owner will be more motivated to continue their business if they believe they have acquired the perceived value.

2.3 Predictive Method in Machine Learning

In line with the current circulation of technology, the study of existing predictive models based on machine learning methods is widely used in various fields. For example, in healthcare area, machine learning been used to various scope of study, for example the study by [14] predicts COVID-19 severity at admission while predict and classify the lung cancer using image processing. Meanwhile in manufacturing area, while study by Ayvaz and Alpay [15] utilized the data generated from IoT sensors in real-time, the system aims to detect signals for potential failures before they occur by using machine learning methods. Thus, predictive analytics' foundation is the discovery and exploitation of correlations between explanatory variables and predicted variables from earlier

events to forecast the future. Developing accurate predictive modelling techniques is essential to take full advantage of predictive analytics solutions and leverage data to make accurate decisions.

Generally, machine learning and deep learning are the two main categories of predictive analytics algorithms. Machine learning includes structured data that can be seen in tables, which are more realistic and organised. The algorithm for this consists of linear and nonlinear types. Nonlinear algorithms are more suited to the difficulties they may face, although linear algorithms are more efficient. Meanwhile, a subset of the more popular machine learning for dealing with audio, video, text, and images is known as deep learning.

There are many different algorithms that can be employed with machine learning prediction modelling by previous study by [16]. Van Lissa [17] By locating predictors according to their relative importance, finding key drivers or links, specific outcomes, and exposing knowledge gaps, machine learning can supplement a theory-driven approach. Instead, machine learning calculates the predicted performance and, thus, the generalizability of outcomes in fresh data sets. Additionally, it has checks and balances to prevent inaccurate results based on the study by [18].

In machine learning, evaluation measures are used to assess the performance of regression models. The choice of evaluation measure in machine learning depends on the specific problem, the characteristics of the data, and the goals of the model and the expertise of domain expert in the study by [19]. The following are some commonly used evaluation measures for regression model:

i. Mean Squared Error (MSE): MSE is the average of the squared differences between the predicted and actual values. It is calculated by taking the sum of the squared errors and dividing by the number of observations. MSE gives an indication of how close the predicted values are to the actual values.
ii. Root Mean Squared Error (RMSE): RMSE is the square root of the MSE. It is a measure of the average magnitude of the error, and is often used to express the error in the same units as the output variable. A model that is more accurately fitted has lower RMSE values. RMSE is a more reliable measurement if the model's main goal is prediction [20].
iii. Mean Absolute Error (MAE): MAE is the average of the absolute differences between the predicted and actual values. It is calculated by taking the sum of the absolute errors and dividing by the number of observations. MAE is less sensitive to outliers than MSE and RMSE.
iv. R-squared (R2): R-squared is a measure of how well the regression model fits the data. It is the proportion of the variance in the output variable that can be explained by the input variables. R2 ranges from 0 to 1, with a higher value indicating a better fit.
v. Adjusted R2: Adjusted R2 is a modified version of R2 that takes into account the number of input variables in the model. It penalizes the use of additional variables that do not contribute significantly to the fit of the model.
vi. Mean Absolute Percentage Error (MAPE): MAPE is a measure of the percentage difference between the predicted and actual values. It is calculated by taking the absolute percentage error and averaging over all observations. MAPE is useful when the output variable has a non-linear relationship with the input variables.
vii. Explained Variance Score: The Explained Variance Score is a measure of how much variance in the output variable is explained by the input variables.
viii. Coefficient of Correlation(R): The coefficient of correlation describes the strength of the relationship between variables. It ranges from -1 to 1 to represent a negative relationship to a positive relationship.

3. Methodology

This study's methodological approach consists of collecting data on Geran Khas Prihatin (GKP) recipients. The motivation score may be predicted based on satisfaction, perceived value, and perceived expectations for the GKP grant. Next, the process of building regression models to predict the motivation of GKP recipients and the performance evaluation metrics are applied to determine the best predictive model.

3.1 Dataset

As the case study is to demonstrate supervised machine learning, this paper focuses on the Motivation score regression modelling of the GKP recipient around Bagan Datoh area. The sample for this study consists of 180 GKP recipients in the Hilir Perak District, chosen through the convenience sampling method. Respondents were selected based on their willingness to participate in the data collection process, and all 180 participants underwent interviews using the prepared survey questions. All data collected were treated confidentially and carefully, ensuring that the data were not shared beyond the scope of this study. The variables of the dataset are outlined in Table 1.

Table 1
GKP Dataset

Variable	Description
Total_Perceived	Perceived value of GKP grant
Total_satisfaction	Satisfaction value of GKP grant
Total_perceived value	Perceived value of GKP grant
Total_Motivation	Motivation value of GKP grant

The dataset consists of four rows, where three rows were used as independent variables (IVs) to predict motivation score as the dependent variable (DV). The features “label” is studied, which show the results of the Motivation score: a continuous quantitative value.

3.2 Data Understanding and Exploratory

The aim is to develop a model that can forecast the receiver of the GKP's motivation score. The data collection is separated into functions and variable labels. This part aims to grasp an outline of the actual data collection and all its distinctive qualities. After that, the exploratory study of the data set was conducted to draw some valuable conclusions. The 108 records in the training data set have four explanatory factors. Meanwhile, there were roughly 72 records with four variables in the test data set. To validate the questionnaire's quality, a reliability and validity test was performed. Four variables involved in this study will be examined by using Reliability and Validity analysis. The composite reliability (CR) and the average variance extracted (AVE) must be 0.6 and 0.5, respectively, to fulfil the reliability measurements according to previous studies by [12,21,22].

3.3 Technical Architecture RapidMiner

A data science software platform named RapidMiner provides a quick and easy way to use different machine learning models. In this study, several regression models will be used, and the results will then be compared using accepted regression measures.

3.4 The Development of Regression Models

Linear regression is one of the most widely recognized algorithms in statistics and machine learning. The objective of a linear regression model is to establish a link between one or more characteristics, e.g., independent, explanatory, or predictor variables, and a continuous target variable, e.g., dependent or response. If the model has only one feature, it is called simple linear regression. If it has more than one feature, the according to the study by [23] it been called as multiple linear regression.

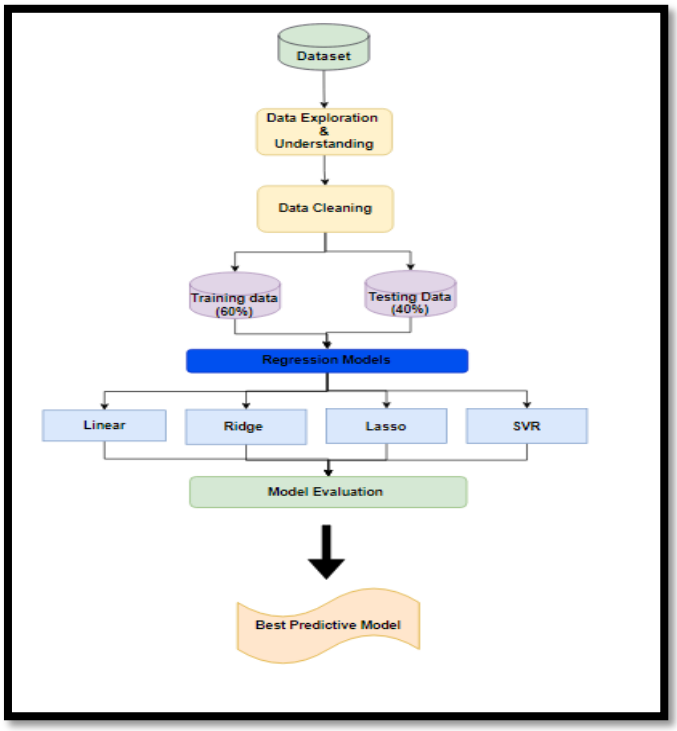


Fig. 1. Research Process Diagram

3.5 The Structure of Regression Process

3.5.1 Linear regression

The formulation for multiple regression model is:

$$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + \cdots + a_pX_p \quad (1)$$

where;
$Y =$ dependent variable (Motivation)
$\alpha =$ regression coefficient
$X_1, X_2, \ldots, X_p =$ independent variables (Perceived Value,Satisfaction,Perceived Use)

The assumptions in the model are:

i. The error terms are normally distributed
ii. The error terms have constant variance

iii. The model carries out a linear relationship between the target variable and the linear function

In this study, multiple regression models were developed using the least squares approach, often known as ordinary least squares (OLS). It is impossible to figure out how accurate the model is without looking at both the training and test data sets.

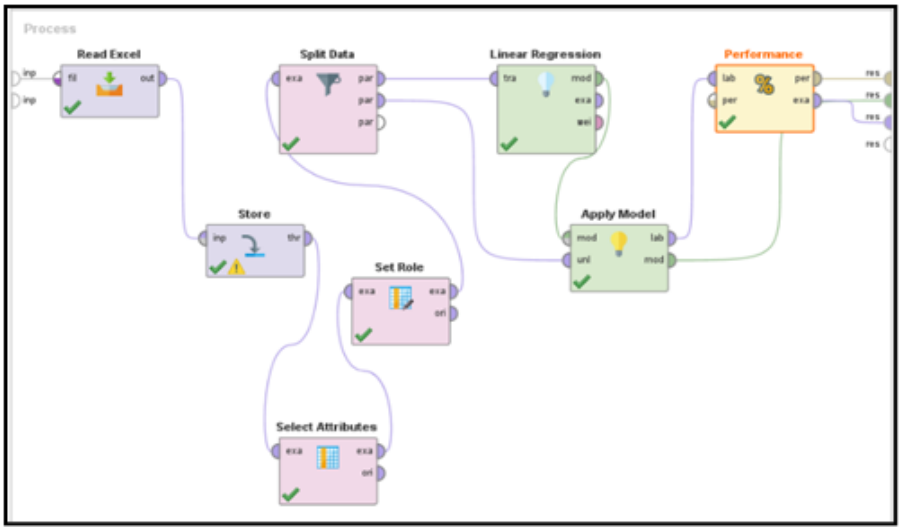


Fig. 2. Structure of The OLS Process in RapidMiner

3.5.2 Ridge regression

The Ridge regression model is a regularisation technique that adds and improves an extra variable (the tuning parameter) to find the effects of many variables on linear regression, which are often called statistical noise. The model can be stated mathematically as:

$$y = xb + e \tag{2}$$

where;

$y =$ dependent variable
$x =$ features in matrix form
$b =$ regression coefficient
$e =$ error term (residuals)

As a result, the variables are normalized by taking away the relevant elements and dividing the results by their standard deviations. The ridge regression model then illustrates the tuning function, abbreviated as a regularisation component. The squares' residual sum seems to be 0 if the value is big. The solutions follow the least squares approach if it is less than. Cross-validation is a method used to determine ƛ. The coefficients are reduced using ridge regression to arbitrarily low values, but not to zero. To fine-tune the regularization hyper parameter, study by [24] used ƛ as grid search cross-validation. A large range was selected for the hyper parameter, and the ideal value of 0.001 was established.

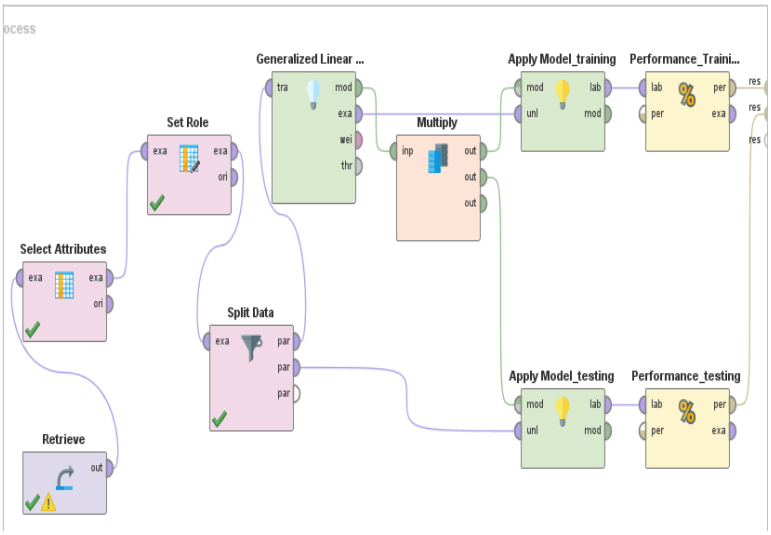


Fig. 3. Structure of the Ridge Regression Process in RapidMiner

3.5.3 Lasso regression

The selection operator is an LR approach that also regularises functionality, and LASSO stands for least absolute shrinkage. Apart from the regularisation values, it is the same as ridge regression. The total of the absolute values of the regression coefficients is taken into consideration. To entirely remove the errors, it even sets the coefficients to zero. Therefore, lasso regression produces a selection of features. The component "e" in the aforementioned ridge equation contains absolute values rather than squared values as mentioned in the study by [24]. It should be noted that the Lasso regression technique requires significantly more computing power than the Ridge regression technique. Grid-search cross-validation has been done to adjust the regularisation hyperparameter λ.

3.5.4 Support vector regression

SVR aims to fit the error inside a predetermined range, whereas ordinary linear regression aims to reduce the error. It is a regression algorithm that does regression analysis using a methodology like Support Vector Machines (SVM) [23]. The data from the regression is made up of continuous real numbers. Figure 4 shows that the SVR model takes model complexity and margin of error into account while estimating the optimal values with a predetermined margin known as the "ε-tube" (epsilon-tube; a tube width is provided).

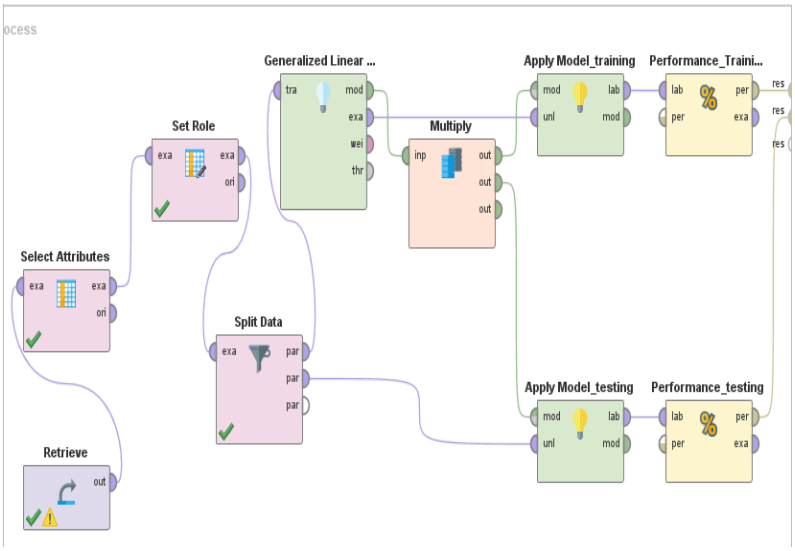


Fig. 4. Structure of the Lasso Regression Process in RapidMiner

3.6 The Evaluation of Regression Models

Evaluation measures provide useful information about the performance of a regression model and can help in comparing different models. It is important to choose the appropriate evaluation measure based on the specific requirements of the problem at hand. As a basis, three model assessment criteria will be used in this study to identify which regression models in machine learning are optimal for predicting Motivation among GKP recipients: Coefficient of Correlation (R), Coefficient of Determination (R2), and Root Mean Square Error (RMSE).

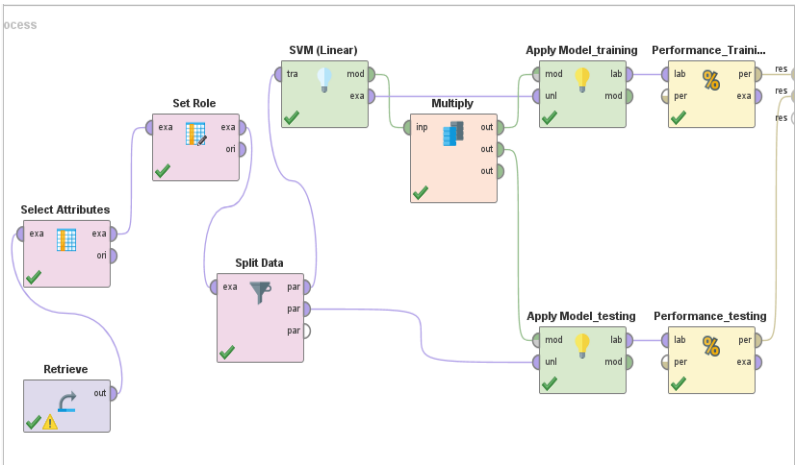


Fig. 5. Structure of the Lasso Regression Process in RapidMiner

4. Result and Discussion

4.1 Descriptive Statistics

Table 2 below showed the total average scores and standard deviation values for four variables involved in this study. Using the questionnaire developed based on scored on a Likert type scale ranging from 1 (strongly disagree) to 5 (strongly agree). It found that GKP recipients having highest score in Motivation on GKP grant with (Average Total =40.228; SD=9.115) and lowest score Satisfaction on GKP grant (Average Total =19.533; SD=4.381). The remaining for Perceived Expectation and Perceived Value found to be (Average Total =38.489; SD=5.753) and (Average Total

=31.739; SD=8.118) respectively. This means that GKP recipients felt motivates with GKP grant in order to sustain their business during post Covid situation however, due to the shortcoming of its implementation, they found to be dissatisfied towards this program.

Table 2
Descriptive Measures of Variables

Variable	Average Total Score	Standard Deviation
Total_Perceived Expectation	38.489	5.753
Total_Satisfaction	19.533	4.381
Total_Perceived value	31.739	8.118
Total_Motivation	40.228	9.115

4.2 Assessing the Assumptions of the Regression Model

All the assumptions have been measured previously to ensure the stability of the regression model. Linearity assumption had been checked by using matrix scatter plot in order to see the linear relationship between dependent variable (Motivation) and three independent variables (Perceived Value, Satisfaction and Perceived Expectation). Findings illustrated in Figure 7 below shows that there is a linear relationship between dependent and independent variables. The other assumptions such as normality, homoscedasticity and independence also found met the assumption given.

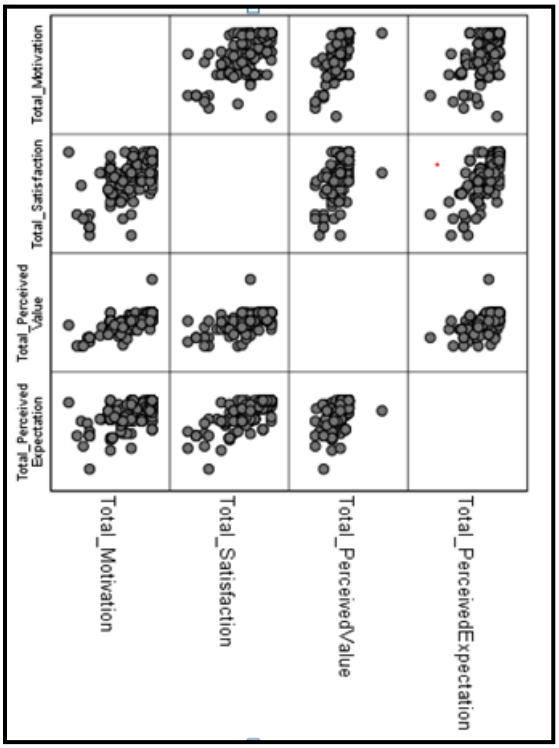
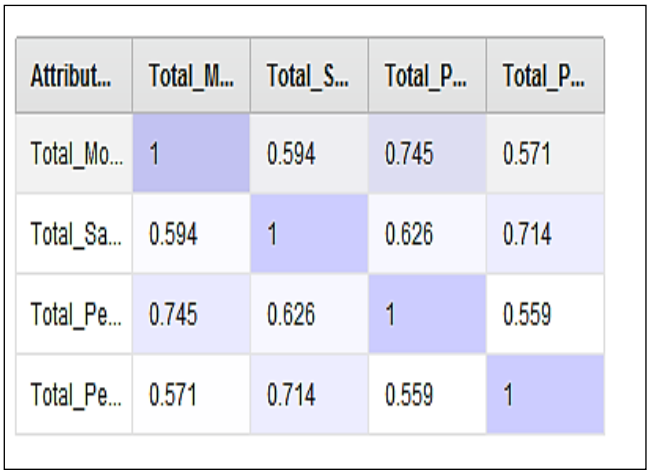


Fig. 7. Scatter Plot for All Variables

The attempt at building a regression model might expose the existence of a multicollinearity problem. Multicollinearity is found when there are highly correlated independent variables. Therefore, based on Figure 8 below, it is found the correlation between four variables shows a moderate relationship since the R value ranges from 0.594 to 0.745. Hence, it shows that there is no multicollinearity problem.



Attribut...	Total_M...	Total_S...	Total_P...	Total_P...
Total_Mo...	1	0.594	0.745	0.571
Total_Sa...	0.594	1	0.626	0.714
Total_Pe...	0.745	0.626	1	0.559
Total_Pe...	0.571	0.714	0.559	1

Fig. 8. Correlation Analysis among our Variables

4.3 The Evaluation of the Regression Models

The performance results of four regression models are nicely presented in Table 3 below. Based on Table 3, all four regression models found there to be a difference between training and testing for all three performance measures. The linear regression model found a reduction for test data for R and R^2 compared to training data by 0.138 and 0.206, while there was an increase for RMSE by 2.307 from training data to testing data.

Table 3
The Summary of Model Evaluation

Type of Regression	Data type	Type of evaluation metrics		
		R	R^2	RMSE
Linear	Train	0.818	0.669	4.906
	Test	0.680	0.463	7.213
Ridge	Train	0.811	0.658	8.531
	Test	0.628	0.395	9.983
Lasso	Train	0.000	0.000	8.531
	Test	0.000	0.000	9.984
SVR	Train	0.818	0.699	4.939
	Test	0.673	0.453	7.280

This observation is also the same as the Ridge regression model, where a reduction of 0.183, 0.263 for R and R^2 is measured between training and testing data. However, the RMSE value increased from 9.983 to 8.531. Lasso regression has yielded a result of no value for R and R^2 values but slightly increased the value of RMSE from training to testing data by 1.453. The last regression model, the SVR model, shows a reduction of 0.145 and 0.246 for R and R^2. The RMSE value was found to increase by 2.341 from training data to testing data. The evaluation performance for training data for these four regression models is presented in Figure 10 below. It shows that for training data, the SVR model is the best model among those that fit the data since it has the highest value for R^2. However, for RMSE, the linear model is found to be a better fit model since it has the lowest value.

Furthermore, for testing data, it is found that linear and SVR models are better models for predicting the motivation of GKP recipients. The same is true for R^2, where the linear and SVR models are found to be better fit models than the other two models (Ridge and Lasso). Figure 9 and 10 shows the comparison of the performance for training and testing data.

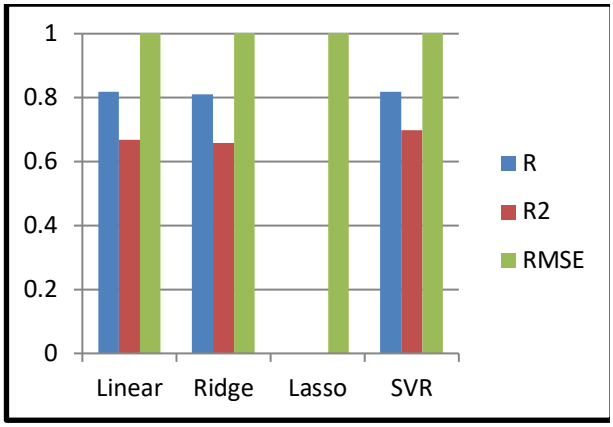


Fig. 9. Performance Evaluation for Training Data

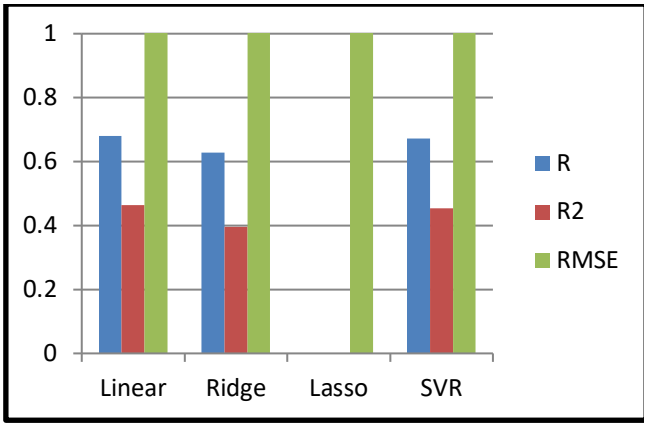


Fig. 10. Performance Evaluation for Testing Data

5. Conclusion

The purpose of this research was to develop a model that could predict the motivation score of GKP recipients based on three factors: satisfaction, perceived value, and perceived expectation. After evaluating various regression models, it was determined that four models adequately met the data requirements, and among them, the Support Vector Regression (SVR) model emerged as the most fitting for predicting the motivation scores of GKP recipients. This choice was made based on the model's superior performance in capturing the underlying patterns within the dataset. The significance of predicting motivation among GKP recipients is paramount, as it serves as a crucial factor in understanding and enhancing the effectiveness of the GKP program. The insights gained from such predictions can contribute to informed decision-making processes, ensuring that the support provided aligns optimally with the motivational factors influencing GKP recipients. Due to the fact that this dataset only comprises a limited number of samples, it could experience noise on occasion according to study by [25]. Future study might be conducted by evaluating more regression models such as Polynomial, Random Forest Regression and Neural Network regression to predict Motivation of GKP recipients in order to develop more robust predictive model.

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