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Analysis of Classic assumption test and multiple linear regression coefficient test for employee structural office recommendation

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Abstrak

Pengadilan Tinggi Agama Bandar Lampung merupakan Lembaga Peradilan Agama yang bertugas melaksanakan penyelesaian perkara tingkat banding. Promosi jabatan merupakan salah satu pengembangan karier melalui penilaian kinerja pegawai. Saat ini proses penilaian kinerja masih belum dilakukan secara objektif adanya pegawai yang menduduki jabatan struktural tetapi tidak memenuhi kompetensi dan prinsip promosi yang masih mengedepankan unsur like and dislike sehingga berdampak kepada pemberian promosi jabatan di lingkungan peradilan. Pemanfaatan data mining menggunakan metode Regresi Linier Berganda memberikan hasil prediksi rekomendasi pegawai yang berhak untuk menempati jabatan pada instansi tersebut. Metode Regresi Linier Berganda merupakan teknik regresi yang menghasilkan persamaan dan akan menjelaskan keterkaitan pola hubungan dari variabel yang digunakan. Implementasi penggunaan metode Regresi Linier Berganda didapatkan dari 40 pegawai terdapat 26 pegawai yang layak diberikan rekomendasi promosi jabatan. Hasil pengujian performa regresi menggunakan 10-cross validation dengan tools WEKA yang menyajikan nilai error dari hasil prediksi menggunakan nilai korelasi koefisiennya (Correlation Coefficient) adalah 0.8066 atau 80.66% menghasilkan nilai Error MAE (Mean Absolute Eror) sebesar 2.24% dan RMSE (Root Mean Square Eror) 3.88%. Hasil ini menjelaskan metode regresi linier memiliki kinerja yang baik dengan tingkat eror yang kecil pada pengujian evaluasi performa regresinya. Hasil analisis uji asumsi klasik yaitu menyimpulkan bahwa data terdistribusi secara normal dan regresi dapat terpenuhi dengan baik dengan melakukan uji multikoinieritas, uji heterosledastisitas dan uji normalitas. Sedangkan untuk analisis uji koefisien regresi linier berganda yang dilakukan dengan uji T dan uji F yaitu menghasilkan pengujian yang mempunyai pengaruh yang signifikan terhadap variael kinerja pegawai sehingga penelitian ini layak untuk dilanjutkan.

Kata kunci*—Data Mining, Promosi Jabatan, Regresi Linier Berganda, Jabatan Struktural, Prediksi*

Abstract

Religious High Court Bandar Lampung is a Religious Courts Institution in charge of carrying out the settlement of cases at the appeal level. Promotion is one of the career development through employee performance appraisal. Currently, the performance appraisal process has not been carried out objectively, there are employees who occupy structural positions but do not meet the competencies and promotion principles that still prioritize the like and dislike element so that it has an impact on giving promotions to positions within the judiciary. Utilization of data mining using the Multiple Linear Regression method provides

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predictions of recommendations for employees who are entitled to occupy positions in the agency. Multiple Linear Regression Method is a regression technique that produces equations and will explain the relationship patterns of the variables used. Implementation of the use of the Multiple Linear Regression method obtained from 40 employees there are 26 employees who deserve to be given a promotion recommendation. The results of the regression performance test using 10-cross validation with the WEKA tools that present the error value of the prediction results using the correlation coefficient value (Correlation Coefficient) is 0.8066 or 80.66% resulting in an MAE Error (Mean Absolute Error) value of 2.24% and RMSE (Root Mean Square). Error) 3.88%. These results explain that the linear regression method has a good performance with a small error rate in the regression performance evaluation test. The results of the classical assumption test analysis concluded that the data were normally distributed and the regression could be met properly by performing multicoinierity tests, heteroscedasticity tests and normality tests. As for the analysis of the multiple linear regression coefficient test which was carried out with the T test and the F test, it resulted in a test that had a significant effect on employee performance variables so that this research was feasible to continue.

Keywords—*Data Mining; Job Promotion; Multiple Linear Regression; Structural Position; Prediction*

1. INTRODUCTION

The Religious High Court Bandar Lampung is one of the Religious Courts in charge of carrying out cases at the appeal level in the provincial capital. The successful completion of court cases at the appellate level will be influenced by the quality of the performance of human resources possessed by the court apparatus itself. In Government Regulation Number 30 of 2019 concerning Assessment in Employee Performance, it is carried out based on measurable, objective, participatory, transparent, accountable, and transparent principles to ensure the objectivity of Civil Servants. This assessment needs to be carried out to measure an institution's performance to achieve the goals of ASN (State Civil Code), namely as an implementer of services, public policies, glue, and unifier of the nation (Law No.5 / 2015 Article 10).

Rating is essential for various fields both in the world of education and in the world of work to measure the extent to which the achievement process has been carried out within a certain period[1], including determining employee performance to be able to see the employees professionalism in achieving maximum performance target. The performance appraisal process has not been carried out objectively, impacting the promotion of positions to employees within the Bandar Lampung Religious High Court. It can be seen that there are still some employees who hold structural positions but do not meet the competencies required to occupy those positions. The promotion principle has not been implemented optimally, which still prioritizes element closeness relationship. According to the National Personnel Board, the requirement for an employee to be entitled to promotion by having a performance appraisal for the last 2 years is of at least good value.

Based on the problem, a method is needed to produce precise and accurate data analysis. This work proposes using data mining for applied to data originating from various fields [2]. The data to be analyzed in this study is employee performance appraisal data for 2015-2019, with variable employee performance values (Orientation, Integrity, Commitment, Discipline, Cooperation, and Performance).

2. METHODS

2.1 Data Mining

Data mining is the process of searching for additional information and new value knowledge [3]. The approach makes it easy to find or dig up important new information from large amounts of databases. Data mining can produce unique patterns in information[4][5].

2.2 Regression

The management of the regression analysis method is used to find out how a dependent or dependent variable can be predicted using the independent variable or the independent variable [6]. Regression analysis analyzes two or more variables, which will explain the relationship between these variables [7]. Every regression correlates, but correlation does not always have a regression. The correlation that is not followed up by computational regression is the relationship between two variables with no causal or functional relationship.

a. The dependent variable or dependent variable is a variable that is influenced by other variables and is represented by Y.
b. The independent variable or independent variable that is not influenced by other variables is represented by X.

Based on the number of independent variables (X), there are two types of regression analysis: simple linear regression with only one independent variable (X) and multiple linear regression with several independent variables. (X1, X2,… Xn).

2.3 Multiple Linear Regression Method

Multiple linear regression analysis predicts changes in the value of certain variables when other variables change [8]. It can be said as various regression because the independent variable is used as a predictor of more than one. Multiple linear regression equations are used in combination with the following formulas.:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_n X_n \qquad (1)$$

Information:

$\boldsymbol{Y}$: *dependent variable*
$\boldsymbol{X_1, .., X_n}$: *independent* variable on observation to –i
$\boldsymbol{\beta_0 \ldots, \beta_n}$: Regression Coefficient

2.4 Classic Assumption Test

Classic hypothesis testing is a prerequisite for testing using multiple linear regression methods. The classical assumption test ensures that the data to be analyzed is usually distributed (normality test), and the model does not contain multicoinierity and heteroscedasticity. This test is carried out on scaled or serialized data and only on using the Multiple Linear Regression method [9].

2.4.1. Heterokesdasticity Test Error

This heteroscedasticity hypothesis test is needed to determine whether the absolute residual values of all regression model observations are the same. These observations qualify that the residuals from one observation to another have the same variance [9].

2.4.2. Multicoinierity Test

This test is carried out to see whether there is a linear relationship between one independent variable and other independent variables. Suppose there is a relationship / high correlation between the independent variables. In that case, the relationship between the independent and dependent variables will make it difficult to distinguish the effect of each

independent variable on the dependent variable. Using an excellent linear regression method will not show a correlation/relationship between independent variables [9].

2.4.3. Normality test

The data normality test is vital in using the normality test to test whether the dependent and independent variables are normally distributed. The test results have normally distributed data, or the regression model is close to normal [9].

2.5 Multiple Linear Regression Coefficient Test

2.5.1 T-Test

This test is called the regression coefficient test. T-test is used to determine whether the independent variable partially or individually affects the dependent variable. In other words, the T-test aims to test whether the expected parameters (regression coefficients and constants) can predict whether the multiple linear regression equation/model is the correct parameter. This test can explain the independent variables that affect the dependent variable. Estimated parameters include intercept (constant) and slope (coefficient)[10].

2.5.2 F Test

The purpose of this test is to determine whether the independent variable and the dependent variable affect. A simultaneous test is a combined test of all parameters in the regression model, which aims to test that the relationship between the independent and dependent variables affects the dependent variable simultaneously (collectively) [10].

2.6 Regression Performance Evaluation

Linear regression is a predictive method included in data mining; the success of this method is determined based on the small difference between the value obtained and the actual value when a calculation has been generated. Small error values generally indicate good or good model performance. Some of the methods commonly used to test the forecasting performance of Root Mean Square (RMSE) and Mean Absolute Error (MAE) [11].

2.6.1 Root Mean Square Error (RMSE)

Another option is the square root plot of MSE, or commonly called the Root Mean Square Error (RMSE). RMSE is a more viable option. It is more intuitive than MSE because its measurement range is the same as the currently evaluated data. The Root Mean Square Error (RMSE) value can be calculated using the following formula

$$RMSE = \frac{\sum_{t=1}^{n} (y - \acute{Y}t)^2}{n} \quad (2)$$

Infomation :

n = the amount of data (periode)
Y = the predicted value on the period (t)
Ýt = the actual value of the period (t)

The error value can be negative or positive if the sum is added directly, resulting in a small or even zero final value. The smaller the resulting RMSE value, the better the forecasting results will be

2.6.2 Mean Absolute Error (MAE)

Mean Absolute Error (MAE) is one of the test methods, and this method is used to see the results of the accuracy of the forecasting model. MAE value shows the average error (error) absolute between the results of the forecast/prediction with the real value [12]. The MAE formula is explained as follows**,**

$$\mathrm{MAE} = \frac{1}{n}\sum_{j=1}^{n}|y_j - \hat{y}_j| \qquad (3)$$

where,

$\hat{Y}_j$ = Forecasting Result Value
Y_j = True Value
n = Amount of data

The smaller the MAPE value, the more accurate the prediction technique is, and the greater the MAPE value, the less accurate the prediction technique will be. If the MAPE value is less than 10 then the predictive ability is very good. If the MAPE value is less than 20 then the predictive ability is also very good.

2.7 Research Framework

a. *Problems*
The stage begins with determining the research problem [13] [14], regarding the performance value data of employees that need to be predicted to know the employees who will be recommended to get a job promotion.

b. Opportunity
Opportunities to contribute to research on the application of data mining with the Multiple Linear Regression method to predict each employee's performance.

c. Approach
The approach is carried out by applying the multiple linear regression method to the employee performance value data to calculate the predicted value of employees who can be recommended for promotion.

d. Identification and Assessment
This research deals with the attributes that will be used in the study so that the results to be presented can be following the expected objectives, namely, showing the effects of predictive data on employee performance values.

e. Proposed
The proposals that will be submitted produce predictions for employees who will receive recommendations for promotion.

f. Validation
This test uses manual testing and data processing testing with SPSS, and performance testing will be carried out from the results of the calculation analysis that has been used.

g. Result
Implement the use of the Multiple Linear Regression method to produce predictions of employees who will get a promotion.

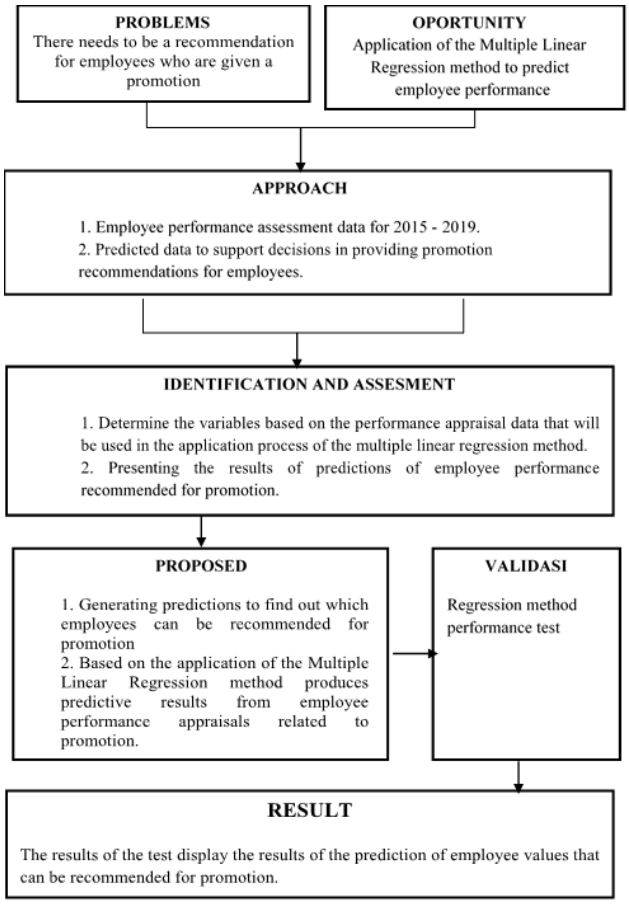

Figure 1 Research Framework

2.8 Data Collection Methods

a. Observation
   The collection is done by researching the field [15] by observing the existing business processes, the researcher made observations at the Religious High Court Bandar Lampung.
b. Interview
   Interviews are used to gather information in the form of data orally [16]. This study conducted interviews with the staff of the Religious High Court Bandar Lampung.
c. Documentation

By recording the data needed in the study, researchers obtain appropriate or valid data about the required information [17] by researchers, namely employee performance appraisal in 2015-2019.

3. RESULTS AND DISCUSSION

3.1 Research Variables

This study uses primary data. The data obtained is employee performance data for 2015-2019 in the personnel section with 2424 data. The independent variable (X) in this study consists of six variables along with one dependent variable (Y), namely

1. X1 = Orientation
2. X2 = Integrity
3. X3 = Commitment

4. X4 = Discipline
5. X5 = Cooperation
6. Y = Performance

Data cleaning or the cleaning process is carried out to clean data that has missing value and inconsistent data. The researcher obtained 2316 data at this stage, and the data was divided into two, namely training data (1836 data) and testing data (480 data). The software used to analyze the SPSS version 25.

3.2 Classic assumption test

3.2.1 Multicollinearity Test

A multicollinearity test is used to test whether the regression model finds a correlation between the independent variables. The linear relationship between the independent variables will make it difficult to distinguish the effect of each independent variable on the dependent variable. The results of the multicollinearity test are shown in Table 1.

Table 1. Multicollinearity Test

Variable	Collinearity Statistics	
	Telerance	VIF
Orientation (X1)	0.995	1.005
Integrity (X2)	0.993	1.007
Commitment (X3)	0.990	1.010
Discipline (X4)	0.993	1.007
Cooperation (X5)	0.998	1.002

Based on the results of the multicollinearity test, it can be seen that the value of "linearity statistic" shows that the VIF value is less than 10 and the tolerance is greater than 0.1. It can be concluded that there is no multicollinearity between the VIF values, the independent variable.

3.2.2Heteroscedasticity Test

This heteroscedasticity hypothesis test is to determine whether the absolute residuals of all observations are the same. Suppose the assumption that there is no heteroscedasticity is not fulfilled. In that case, the estimator is no longer effective, and it can be said that the accuracy of the estimation of the coefficient is poor. A good regression model is a purity.

Table 2. Heteroscedasticity Test

Variable	Sig. (2-Tailed)
Orientation (X1)	0.499
Integrity (X2)	0.212
Commitment (X3)	0.022
Discipline (X4)	0.013
Cooperation (X5)	0.609

The results of the heteroscedasticity test in Table 2 show that the Sig (2-tail) probability value of the relationship between the independent variable and its absolute residual (ABRESID) is much greater than 0.05, so it can be concluded that there are no problems or symptoms of heteroscedasticity, which means that the regression model used for research is worth doing.

3.2.3 Normality Test

The normality test in multiple linear regression is used to determine whether the residual value is normally distributed. A good normality test can be seen in the distribution of data or plot points close to the diagonal line, and no data is located far from the data distribution. The results of the normality test using the SPSS application are shown in Figure 2 below.

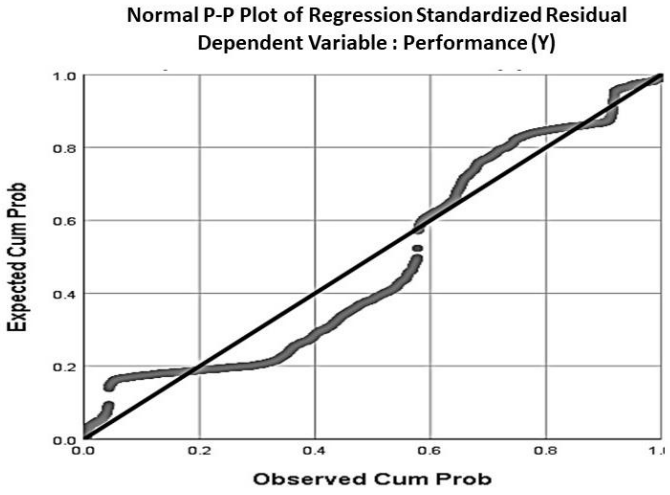

Figure 2 Normality Test

Figure 2 shows the results of the normality test using the graphic method, it is known that the plot points contained in the Normal PP Plot of Regression Standardized Residual image spread around the line and follow and approach the diagonal line in groups, so the normality assumption for the residual value in the regression analysis is fulfilled or data is normally distributed.

3.3 Multiple Linear Regression Coefficient Test

3.3.1 T-Test

As for some of the testing steps

a. Determine the formulation of the hypothesis
   - Ho: β = 0, meaning that the variables X1, X2, X3, X4, and X5 do not significantly affect variable Y.
   - H1: β = 0, meaning that the variables X1, X2, X3, X4, and X5 have a partially significant effect on variable Y.

b. Determine the degree of confidence 95% (α = 0.05)

c. Determine significance
   - The significance value (P-value) <0.05, then H0 is rejected, and H1 is accepted.
   - Significance value (P-value)> 0.05, then H0 is accepted, and H1 is rejected.

d. Make conclusions
   - If (P-value) <0.05, then H0 is rejected and H1 is accepted, it means that the independent variable partially affects the dependent variable.
   - If (P Value)> 0.05, then H0 is accepted and H1 is rejected, it means that the independent variable partially does not affect the dependent variable.

The following displays the results of the T-Test in Table 3 as follows:

Table 3. T-Test Result

Coefficients[a]		
Model	**t**	**Sig.**
(Constant)	15.017	0.000
Orientation (X1)	1.336	0.182
Integrity (X2)	0.766	0.444
Commitment (X3)	-1.043	0.297
Discipline (X4)	1.741	0.082
Cooperation (X5)	0.045	0.965

1. Effect of the Orientation variable (X1) on Performance (Y)
   In the orientation variable, the significance level of 95% (α = 0.05), the significance value of the orientation variable is 0.182> 0.05, so that H0 is accepted and H1 is rejected, or the orientation variable (X1) does not have a significant effect on the performance variable (Y).

2. The influence of the Integrity variable (X2) on Performance (Y)
   For the integrity variable, the significance level is 95% (α = 0.05), the significance level on the integrity variable is 0.444> 0.05 so that H0 is rejected and H1 is accepted, or it means that the integrity variable (X2) does not have a significant effect on the performance variable (Y).

3. Effect of Commitment variable (X3) on Performance (Y)
   In the commitment variable, the significance level is 95% (α = 0.05), the significance level on the integrity variable is 0.297> 0.05 so that H0 is accepted and H1 is rejected, or the commitment variable (X3) does not have a significant effect on the performance variable (Y).

4. Effect of Discipline variables (X4) on Performance (Y)
   In the discipline variable with a significance level of 95% (α = 0.05), the significance figure (P-value) on the integrity variable is 0.082> 0.05, so that H0 is accepted and H1 is rejected, or the discipline variable (X4) does not have a significant effect on the variable performance (Y).

5. The effect of the cooperation variable (X5) on performance (Y) on the cooperation variable with a significance level of 95% (α = 0.05), the significance value on the integrity variable is 0.965> 0.05, then H0 is accepted, and H1 is rejected or it means the cooperation variable (X5) has a significant influence on the employee performance variable (Y).

3.3.2 Simultaneous Test (Test F)

This test identifies a regression model that is estimated to be feasible or not.
The steps for testing the F Test are as follows:
a. Determine the formulation of the hypothesis

- Ho: β = 0, the variables X1, X2, X3, X4, and X5 mean that they do not have a significant effect simultaneously on variable Y.
- H1: β = 0, the variables X1, X2, X3, X4, and X5 mean that they do not have a significant effect simultaneously on variable Y.

b. Determine the 95% significance level (α = 0.05)
c. Determine significance
- Significance value (P-value) <0.05, then H0 is rejected, and H1 is accepted.
- Significance value (P-value)> 0.05, then H0 is accepted, and H1 is rejected.

d. Determine the conclusion
- If (P Value) <0.05 so that H0 is rejected and H1 is accepted, the independent variable simultaneously affects the dependent variable.
- If (P Value)> 0.05 so that H0 is accepted and H1 is rejected, the independent variable will not simultaneously affect the dependent variable.

The following shows the results of the F test using the SPSS application in Table 4.

Table 4. F Test Results

ANNOVA[a]			
Model	**df**	**F**	**Sig.**
Regression	5	1.327	0.250[b]
Residual	1830		
Total	1835		

Data from the results of the F test in Table 5 shows that the F value is calculated at 1.327 with a significance value (P-value) of 0.250> 0.05. variable Y.

4.4 Multiple Linear Regression Analysis

Testing with multiple linear regression methods and SPSS software with the following results.

Table 5. Results of Multiple Linear Regression Analysis

Variable	**Unstandardized B**
(Constant)	74.177
Orientation (X1)	0.035
Integrity (X2)	0.020
Commitment (X3)	-0.026
Discipline (X4)	0.045
Cooperation (X5)	0.001

Based on Table 5, the results of the multiple linear regression equation are as follows:

Y = 74,177 + 0,035*X1 + 0,020*X2 - 0,026*X3 + 0,045*X4 +0,001*X5

The multiple linear regression model is then applied to the testing data, and the results are as shown in the following table:

3.5 Evaluation of Repegression Performance

Regression performance testing was carried out using the Weka application based on the performance data of each employee from 2015-2019, totalling 2316 data. The test results are carried out using 10-cross validation, which presents the error value of the prediction using WEKA tools. The following is the result of the evaluation of the linear regression performance. The following is the result of the evaluation of the linear regression performance.

Table 6. Evaluation of Regression Performance Error Value

Performance Evaluation Method	***Error Rate***
Mean Absolute Error (MAE)	2,2488
Root Mean Squared Error (RMSE)	3.8861
Relative Absolute Error (RAE)	45.9516
Root Relative Squared Error (RRSE)	59.1447

The results of the cross-validation test (Cross Validation) in Table 6 testing the error value using the WEKA application produce an MAE (Mean Absolute Error) error value of 2.24% and an RMSE (Root Mean Square Error) of 3.88%. These results explain that the linear regression method has good performance with a small error rate in the regression performance evaluation test.

4. CONCLUSIONS

The Multiple Linear Regression can be used in predicting the performance of employees who are recommended for structural promotion. The data used is employee performance, including orientation, integrity, commitment, discipline, cooperation, and performance. Regression performance by testing using the WEKA application with an error value of Mean Absolute Error of 2.24% and Root Mean Square Error of 3.88%. These results explain that the linear regression method has good performance with a small error rate, indicating excellent prediction results.

The results of the classical assumption test analysis concluded that the data were normally distributed and the regression could be met properly by performing multicoinierity tests, heteroscedasticity tests and normality tests. As for the analysis of the multiple linear regression coefficient test which was carried out with the T test and the F test, it resulted in a test that had a significant effect on employee performance variables so that this research was feasible to continue.

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