

# Logistic Regression Versus Linear and One Way Anova

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## 8 Logistic Regression Versus Linear and One Way ANOVA on the Lecturer Performance Index (LPI) IAIN Purwokerto

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### ABSTRACT

This paper compares the statistical analysis on the LPI data of IAIN Purwokerto. We analyze them based on the type of the LPI data and analyze the significance of the relationship. We do the analysis as follows; compares the analysis results of the significance using the linear regression and One Way ANOVA with the logistic regression. We compared significance of the relationship analysis between linear and logistic regression in independent variables of either age, the department assessment, the student assessment with the dependent variable of the LPI. We also compare the analysis results of the significance using One Way ANOVA with the logistic regression. We determine that there is a relationship if the average of the LPI gives the same results. They include the analysis of relationship between either the lecturer category, the assessment component category and the LPI. The analysis of linear regression showed the relationship between age and the LPI was not significant, the relationship between the department assessment and the LPI was significant, and the relationship between the student assessment and the LPI was significant. This showed the same results as previous research using the logistic regression. The analysis results using One Way ANOVA that the relationship between the lecturer category and the LPI was significant. This means that the average of the LPI was not the same for all the lecturer categories. In other words, the lecturer category has no relationship with the LPI. This is contrary as previous research using the logistic regression. The analysis result by One Way ANOVA for the assessment component category was not significant, this is also contrary using the logistic regression that the assessment component category has no the relationship with the LPI.

**Keywords:** logistic; linear; one way ANOVA; lpi

### 1 INTRODUCTION

We can use the statistical tools to analyze the data. The statistical analysis tools can use the logistic regression, the linear regression or the one-way ANOVA. The logistic regression analysis is used to analyze data if the data for the dependent variable is a category data, while the linear regression analysis can be used if the data for the dependent variable is continuous data. The one-way ANOVA is used if the variable is divided into two or more category and the data values for every category are continuous. The regression analysis aims to analyze the relationship between the independent variables and the dependent variable. It can be used if the dependent variable is in the form of a category. The linear regression analysis aims to analyze the relationship between the independent variables and the dependent variable. It can also be done if the data of the dependent variable is continuous data. The one-way ANOVA aims to analyze the average similarity of a variable dividing in the category if the data values of the variable is continuous data. In this study, the one-way ANOVA also be used to analyze the relationship between the independent variables and the dependent variable of the LPI by provisions if the average among the independent variable categories is the same, so that it is stated to have a relationship, but if the average among the independent variable categories is different so it is declared to have no a relationship.

This study will analyze data taken from the IAIN Purwokerto. The data includes age, the lecturer category, the assessment component of the LPI, and the main data from this study, namely the data of the LPI. The data of ages, the lecturer category, and the assessment component are the data for the independent variables and the data of the LPI is the data for the dependent variable. We find the data are the lecturer age of IAIN Purwokerto were 26,00-65,58 years, the lecturers

of IAIN Purwokerto included State Civil Aparatus (SCA), the internal lecturer of Non State Civil Aparatus (NSCA), and External Lecturers (EL), the assessment component of the LPI consisted the department and student assessment, while the data values of the LPI was in intervals 0-4. The IAIN Purwokerto has made the category of the LPI in two categories. They are the  $LPI \geq 3,00$  called fine and the  $LPI < 3,00$  called no fine. In this case, the difference among the lecturer category appears in its salary which it greatly affects the lecturer performance Index for the lecturers of IAIN Purwokerto. Whereas the assessment components of the LPI are important in determining whether fine or not fine in the LPI of IAIN Purwokerto. The department assessment is determined by the factors themselves but for the student assessment depends on the others.

Based on the exposure of the LPI results of the IAIN Purwokerto in 2017, we find the low LPI or the no fine LPI in the young lecturers and the lecturers in the category of External Lecturers (EL). Based on this problem, we also suspect that there is a significant of the relationship between each age, the lecturer category, and the assessment component and the LPI of IAIN Purwokerto. Therefore, to prove the hypothesis, we try to analyze the data by using the logistic and linear regression, and also the one-way ANOVA. In the case of the one-way ANOVA, we determine if the average is the same so there is a relationship, but if the average is not the same, then there is no relationship.

In detail, based on the LPI category then we analyze the relationship between each the independent variable age, the lecturer category, the department assessment, the student assessment and the LPI of IAIN Purwokerto by using the logistic regression. This data analysis has been carried out by Mutijah (2018). An idea that the LPI value is only an interval among 0-4, the small number value will very

determine the results of the analysis, therefore is important to compare the results of the analysis if the data type of the LPI of IAIN Purwokerto is continuous. Based on this condition, we perform a regression analysis for each the independent variable age, the lecturer category, and the assessment component and the LPI of IAIN Purwokerto. We propose an idea, it comes from the lecturer category data and the assessment component of the LPI which consists of two types, namely the department and student assessment. The idea is "if the average of the LPI in the category is the same then we declare there is a relationship and vice versa".

We compare the significance is the main part of using the logistic and linear regression, and also one-way ANOVA in this paper. We compare the significance of the data analysis between the linear and logistics regression in each the independent variable age, the department and student assessment. We also compare between one-way ANOVA and the logistic regression in each the independent variable in either the lecturer category, the assessment component and the LPI of IAIN Purwokerto as a dependent variable.

## 2 LOGISTIC REGRESSION VERSUS LINEAR ON THE LPI OF IAIN PURWOKERTO

The modeling the relationship between a dependent variable and the independent variables is one the most widely used of all statistical techniques. We refer to this type of modeling as regression analysis. A regression model provides the user with a functional relationship between the dependent variables and the independent variable that allows the user to determine which of the independent variables have an effect on the dependent variable. The regression model allows the user to explore what happen to the dependent variable for specified changes in the independent variables.

The basic idea of the regression analysis is to obtain a model for the functional relationship between a dependent variable and one or more the independent variables. Regression model have a number of uses that the model provides a description of the major features of the data set, the equation relating the dependent variable to the independent variables produced from the regression analysis provides estimates of the dependent variable for values of the independent variables are not observed in the study, and in some applications of the regression analysis, the researcher is seeking a model which can accurately estimate the values of a variable that is difficult or expensive to measure the independent variables that inexpensive to measure and obtain.

We would like to write an equation in the linear regression as shown in (1)

$$y = a + bx \quad (1)$$

The equation in (1) stated that y as a linear function of x and a, b are constant.

To begin the linear regression analysis, we present description of variables and types of data as in table 1.

**Table 1. Variables and types of data to analyze linear regression**

| Variables             | Number of Lecturer | Type of Data |            |
|-----------------------|--------------------|--------------|------------|
|                       |                    | Logistic     | Linear     |
| Lecturer Age          | 220                | Continuous   | Continuous |
| Department Assessment | 201                | Continuous   | Continuous |
| Student Assessment    | 201                | Continuous   | Continuous |
| LPI                   | 220                | Category     | Continuous |

Furthermore, we analyze the relationship between the lecturer age and the LPI, the department assessment and the LPI, the student assessment and the LPI resulting the linear regression model respectively are

$$y = 3,182 + 0,001X \quad (2)$$

$$y = 6,623 + 0,250X \quad (3)$$

$$y = 6,623 + 0,250X \quad (4)$$

The significance analysis the linear regression results as in equation (2), (3), and (4) showed that the regression model in equation (2) is not significant p-value 0.765, equation (3) is significant by p-value <0.001, and equation (4) is also significant by p-value <0.001. The significance results are the same for the logistic regression analysis as previous research by Mutijah (2018).

## 3 ONE-WAY ANOVA ON THE LPI OF IAIN PURWOKERTO

In this research, analysis of variance (ANOVA) concern the interest of comparison of treatment means where the focus is on the evaluation of the effects of two or more independent variables on a dependent variable rather than on comparison of treatment means as in designs. Particular attention is given to focus on either comparison of treatment means or examination of the effects of the dependent variable.

Beginner to analyze the data using one-way ANOVA, we present types of data of the lecturer category and the assessment component as in table 2.

**Table 2. Variables the lecturer category, the assessment component, and the data types of the LPI**

| Variables            | Category              | Coding | Number of Lecturer | The Data Type of the LPI |
|----------------------|-----------------------|--------|--------------------|--------------------------|
| Lecturer Category    | SCA                   | 1      | 131                | Continuous               |
|                      | NSCA                  | 2      | 50                 | Continuous               |
|                      | EL                    | 3      | 39                 | Continuous               |
| Assessment Component | Department Assessment | 1      | 201                | Continuous               |
|                      | Student Assessment    | 2      | 201                | Continuous               |

Based on table 2, we analyze the average or mean among the lecturer category and the assessment component by one-way ANOVA. Relating with this, we determine that the mean among the lecturer category and among the assessment component is the same so we stated that there is relationship and vice versa.

The analysis of the lecturer category by one-way ANOVA result that it is significant by p-value 0,002. It means that the mean of the LPI among the category of SCA, NSCA, and EL are not the same, it also means between the lecturer category and LPI is no the relationship. This is contrary in previous research using the analysis of the logistic regression by Mutijah (2018).

The analysis of the assessment component by one-way ANOVA result that it is not significant by p-value 1,00. It means that the mean of the LPI between the department and student assessment are the same so this means that there is relationship. This result will be compared with the analysis using the logistic regression which the department and student assessment are analyzed together related by the LPI in fine and no fine category. This analysis has been done by Mutijah (2018).

As for the specific form of the logistic regression model use as below

$$\pi(x) = \frac{e^{\beta_0 + \beta_1 x}}{1 + e^{\beta_0 + \beta_1 x}} \quad (5)$$

with  $\pi(x) = E(Y|x)$  represent the conditional mean of Y given x when the logistic distribution is used.

A transformation of  $\pi(x)$  that is central to study the logistic regression is the logit transformation. This transformation is defined in terms of  $\pi(x)$  as

$$g(x) = \ln\left(\frac{\pi(x)}{1 - \pi(x)}\right) = \beta_0 + \beta_1 x \quad (6)$$

The importance of this transformation is that  $g(x)$  has many of the desirable properties of a linear regression model as in (6).

To begin the logistic regression analysis, we present the data as in table 3.

**Table 3. The data to analyze the logistic regression**

| Variables            | Category              | Coding |
|----------------------|-----------------------|--------|
| Lecturer Category    | SCA                   | 1      |
|                      | NSCA                  | 2      |
|                      | EL                    | 3      |
| Assessment Component | Department Assessment | 1      |
|                      | Student Assessment    | 2      |
| LPI                  | No Fine               | 0      |
|                      | Fine                  | 1      |

The results of analysis of the logistic regression from the data in table 3 are obtained the analysis of result is not significance by p-value 0.872. It means that there is no relationship between assessment component and LPI. This is also contrary with one-way ANOVA.

#### 4 CONCLUSIONS

Based on the above description, it can be concluded that

1. The significance of the analysis results using the linear regression equal to the logistic regression. The results of this analysis illustrate that there is not a relationship between the lecturer ages and the Lecturer Performance Index (LPI), there is relationship between the department assessment and the Lecturer Performance Index (LPI), and there is also the relationship between the student assessment and the Lecturer Performance Index (LPI) in the IAIN Purwokerto.
2. The significance of the analysis results by one-way ANOVA shows that there is no relationship between the lecturer category and the Lecturer Performance Index (LPI) and this is contrary with the analysis by the logistic regression in Mutjah (2018), and there is a relationship between the assessment components and the Lecturer Performance Index (LPI) with a note that in one-way ANOVA if among the treatment means are the same then it is determined that there is a relationship. The two of the significance analyzed by one-way ANOVA are contrary to the results of the analysis by the logistic regression.

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