Logistic Regression on the Data of Lecturer Performance Index on IAIN Purwokerto

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Abstract: This paper concerns to analyze the relationship between independent variables, including age, categories of lecturer, assessment components which they are each related, and a dependent variable lecturer performance index (LPI) using logistic regression. The background led this research is the exposure of LPI stated that the young lecturers, internal lecturers of Not State Civil Apparatus (NSCA), obtain small values of LPI and IAIN Purwokerto makes groups of LPI are not fine and fine performance. The steps in data analysis i.e. make simple graphs to plotting data, make tables, calculate data, model the logistic regression and interpret the result. There are three categories of lecturers i.e. State Civil Apparatus (SCA), Internal Lecturer Not SCA (NSCA), and External Lecturer (EL) with ages between 26.00 and 65.58 years old. The assessment component of LPI consists of Department's Assessment and Student's Assessment. The results show that, using binary logistic regression, the effect of age of lecturer is not significant, the effect of the lecturer category is significant with the 95% confidence interval is (0.3168, 1.0772), the department assessment is significant with the 95% confidence interval is (0.9008, 2.7432), and the student assessment is significant with the 95% confidence interval is (0.0770, 3.0130).

1 INTRODUCTION

Lecturer Performance Index abbreviated as LPI is a score obtained by the lecturer after carrying out a number of tasks that must be carried out as an institutional task. One of the interests of the LPI is a monitor to develop lecturers' professional and careers, besides that the LPI functions to realize the work culture of the lecturers in improving the quality of their institutions. On the basis of these interests, the lecturer is required to refer the conducted performance results on one semester in the implementation of the main activities and functions in the institution of higher education. IAIN Purwokerto as an institution providing higher education also conducts an assessment of the LPI to ensure the implementation of the main duties of the lecturer to run according to the legislation.

The exposure of the LPI of IAIN Purwokerto lecturers stated the young lecturers obtain small values of LPI on the odd semester in 2017, Internal lecturers of Not State Civil Apparatus (NSCA) also obtain small values of LPI, and IAIN Purwokerto make group of LPI into the two groups that are a not fine LPI and a fine LPI or the other word that IAIN Purwokerto has two categories of LPI. While age of lecturers is found the youngest is 26.00 years and the oldest is 65.58 years.

Logistic regression model has become one of any data analysis concerned with describing the relationship between a response (outcome or dependent) variable and one or more predictor (explanatory or independent) variables. The predictor variables are often called covariates. A binary logistic regression model is that binary or dichotomous in response's variable (Hosmer, 2000). The goal of an analysis by using binary logistic regression is to describe the relationship between a response variable and a set of predictor variables which the response variable includes two categories.

A data set will lead to analyze the relationship between one predictor variable and one response variable. They are age, category of lecturer, lecturer performance index for 220 subjects, also the department's assessment and student's assessment for 201 subjects in 2018. The data is taken from IAIN Purwokerto. The data also is found ages of lecturer are 26.00-65.58 years, three categories of

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lecturer are State Civil Apparatus (SCA), Internal Lecturer Not SCA (NSCA), and External Lecturer (EL), assessment components of LPI consist of Department's Assessment and Student's Assessment.

A data set also lists categories of lecturers in IAIN Purwokerto that number of State Civil Apparatus (SCA) are 131 lecturers included 26 no fine and 105 fine, Internal Lecturer Not SCA (NSCA) are 50 lecturers included 7 no fine and 43 fine, and External Lecturer (EL) are 39 lecturers included 22 no fine and 17 fine. As for data of 201 lecturers for the department's assessment and student's assessment that each includes 22 lecturers in no fine category and 179 are fine.

Finally, this paper organize by the second section is the basic theories and later, analyze the data set by binary logistic regression. Data representation and visualization are presented, also the interpretation of data analysis is done. Conclusion will finish in the analysis of the IAIN Purwokerto lecturer's data.

2 THE BASIC THEORIES

2.1 Logistic Regression

The specific form of the logistic regression model uses as below

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

where $\pi(x) = E(Y|x)$ represent the conditional mean of Y given x when the logistic distribution is used (Hyeoun-Ae, 2013).

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

$$g(x) = \ln\left(\frac{\pi(x)}{1 - \pi(x)}\right) = \beta_0 + \beta_1 x \quad (2)$$

The importance of this transformation is that $g(x)$ has many of the desirable properties of a linear regression model (Tranmer and Elliot, 2008; Thomsen and Lundbeck, n.d.). The endpoints of a 100(1 - α)% confidence interval for slope coefficient are

$$\hat{\beta}_1 \pm z_{1-\alpha/2} \widehat{SE}(\hat{\beta}_1) \quad (3)$$

where $z_{1-\frac{\alpha}{2}}$ is upper 100(1-α/2)% point from the standard normal distribution.

The reason to use the logistic regression in this data analysis are logistic regression do not require a linear relationship between independent and dependent variables, the independent variable does not require the multivariate normality assumptions, the independent variable can be in terms of continue and category data, dependent variable must be dichotomy that is two categories, and samples required in relatively large quantities, minimum required up to 50 data samples for an independent variable. In this research use more than 50 data to be analyzed.

2.2 Performance

The person's performance can be influenced by internal and external factors. Internal factors included psychic and physical. Physical component for example health, gender, age, and external factors included salary, working conditions, work relationship, position (Handoko, 2002). IAIN Purwokerto has done an assessment of LPI five times from 2015 until 2018, only once in 2018. IAIN Purwokerto also declares that LPI < 3.00 is no fine and LPI ≥ 3.00 is fine. IAIN Purwokerto has three categories of lecturer since 2017 that is State Civil Apparatus (SCA), Internal Lecturer Not SCA (NSCA), and External Lecturer (EL) (Tim, 2016). Department's Assessment includes four components in IAIN Purwokerto. A way to evaluate based on the time interval, when 1) lecturer give the planning of learning, 2) lecturer give the question of final exam of the semester, 3) lecturer give the final exam score, and 4) how many lecturers teach students in one semester. Department's assessment score is made in scale 0 - 4 (Tim, 2016). Student's assessment is obtained from the evaluation of the lecturer learning in each course class by students. A way to evaluate based on the results of a questionnaire given to students. The score of the student's assessments is also made in scale 0 - 4 too.

3 RESULTS OF THE DATA ANALYSIS

When faced with a set of data, a person will play around with them, an activity called (explanatory) data analysis. The activity is elementary calculation will be made, simple graphs will be plotted, and also table will be made (Dennis, 2001). Based on the

definition as Dennis (2001), this research will analyze a data set of IAIN Purwokerto's lecturers by making scatter plot, calculating the coefficient of logistic regression, modelling the logistic regression and interpreting this model.

3.1 Scatter Plot

This subsection will present the scatter plot of data analysis of IAIN Purwokerto's lecturers show relationship between age and lecturer performance index (LPI), category of lecturer and lecturer performance index (LPI), department's assessment and lecturer performance index (LPI), also student's assessment and lecturer performance index (LPI).

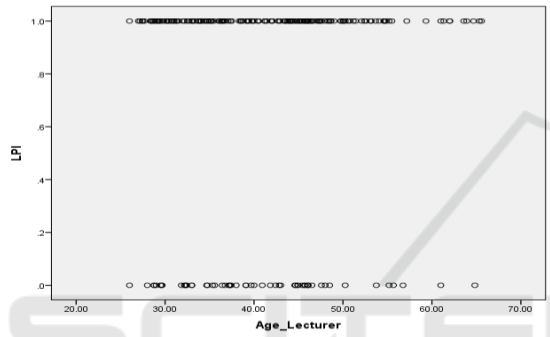

Figure 1: Scatter plot for lecturer's age versus LPI for 220 lecturers.

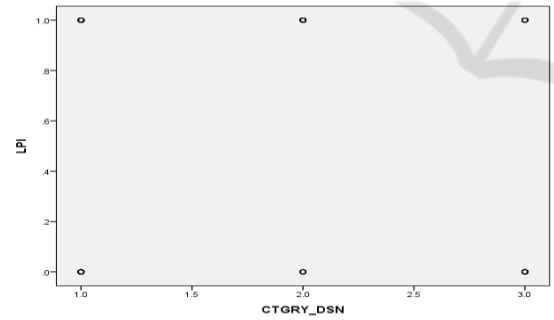

Figure 2: Scatter plot for lecturer's categories versus LPI for 220 lecturers.

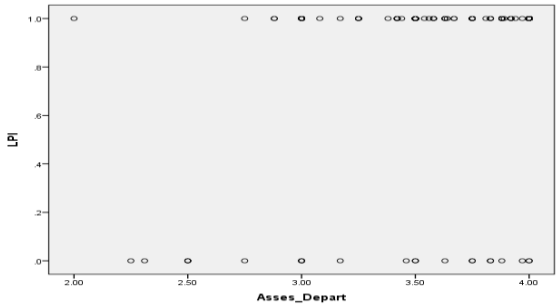

Figure 3: Scatter plot for department's assessment versus LPI for 201 lecturers.

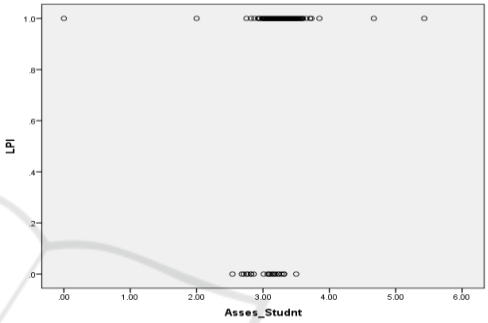

Figure 4: Scatter plot of LPI by the student assessment for 201 lecturers.

Figure 1 - 4 describe the variability in ages, lecturer category, assessment component at all LPIs are large. This is difficult to describe the functional relationship between age and LPI, lecturer category and LPI, also assessment component and LPI. One common method of removing some variation while still maintaining the structure of the relationship between outcome and the independent variable is to create intervals for the independent variable and compute the mean of the outcome variable within each group by the logistic regression analysis.

3.2 The Coefficient Calculation of Logistic Regression Model

This subsection will present the coefficient calculation of logistic regression model using an applied of binary logistic regression. The calculation will be used to make the logistic regression showed the relationship between age and lecturer performance index (LPI), the category of lecturer and lecturer performance index (LPI), department's assessment and lecturer performance index (LPI),

also student's assessment and lecturer performance index (LPI).

Table 1: The coefficient of the logistic regression for the lecturer age variable.

Variable	Coeff.	Std. Error	Sig.
Age of Lecturer	.015	.017	.377
Constant	.457	.710	.520

Table 1 shows that p-value for the age is 0.377. It can be said that it is not enough evidence to reject the hypothesis that there is no relationship between age of lecturer and LPI. Therefore, the age of lecturers is not affected LPI's no fine or fine with 95 % confidence.

Table 2: The coefficient of the logistic regression for the lecturer category.

Variable	Coeff.	Std. Error	Sig.	Exp (Coeff.)
Category of Lecturer	.697	.194	.000	2.007
Constant	-.544	.463	.241	.581

Table 2 talks that it is enough evidence to reject the hypothesis that there is no relationship between the category of lecturer and LPI. The other words, the category of lecturer's influence LPI's no fine or fine with the 95% confidence interval (0.3168, 1.0772).

Table 2 also talks that if category of lecturer is 1 then probability of category affect LPI's fine equal to exp(-0.544 + 0.697(1))/(1+ exp(-0.544 + 0.697(1))) = 0.5382 or other means that EL will affect LPI's fine as much as 58.82 percent, if category of lecturer is 2 then probability of category influence LPI's fine equal to exp(-0.544 + 0.697(2))/(1+ exp(-0.544 + 0.697(2))) = 0.7006 or other means that NSCA will influence LPI's fine as much as 70.06 percent, and if category of lecturer is 3 then probability of category influence LPI's fine equal to exp(-0.544 + 0.697(3))/(1+ exp(-0.544 + 0.697(3))) = 0.8245 or other means that SCA will influence LPI's fine as much as 82.45%.

Table 3: The coefficient of the logistic regression for department's assessment variable.

Variable	Coeff.	Std. Err	Sig.	Exp (Coeff.)
Department's assessment	1.822	.470	.000	6.186
Constant	-4.301	1.606	.007	.014

Table 3 explain that it is enough evidence to reject hypothesis that there is not relationship between the department's assessment and LPI. The other words, department's assessment effect LPI's no fine or fine with the 95% confidence interval is (0.9008, 2.7432).

Table 3 also explain that if department's assessment is exactly 0 then probability of category influence LPI's fine equal to exp(-4.301 + 1.822(0)) / (1+ exp(-4.301 + 1.822(0))) = 0.0138 or other means that department's assessment will influence LPI's fine as much as 1.38 percent, if department's assessment is exactly 1 then probability of department's assessment influence LPI's fine equal to exp(-4.301 + 1.822(1)) / (1+ exp(-4.301 + 1.822(1))) = 0.773 or other means that department's assessment will influence LPI's fine as much as 7.73 percent, if department's assessment is exactly 2 then probability of department's assessment influence LPI's fine equal to exp(-4.301 + 1.822(2)) / (1+ exp(-4.301 + 1.822(2))) = 0.3414 or other means that department's assessment will influence LPI's fine as much as 34.14 percent, if department's assessment is exactly 3 then probability of department's assessment influence LPI's fine equal to exp(-4.301 + 1.822(3)) / (1+ exp(-4.301 + 1.822(3))) = 0.7622 or other means that department's assessment will influence LPI's fine as much as 76.22 percent, and if department's assessment is exactly 4 then probability of department's assessment influence LPI's fine equal to exp(-4.301 + 1.822(4)) / (1+ exp(-4.301 + 1.822(4))) = 0.9520 or other means that department's assessment will influence LPI's fine as much as 95.20%.

Table 4: The coefficient of the logistic regression for the student's assessment variable.

Variable	Coeff.	Std. Err	Sig.	Exp (Coeff.)
Student's Assessment	1.545	.749	.039	4.686
Constant	-2.840	2.393	.235	.058

Table 4 talks that it is enough evidence to reject hypothesis that there is no relationship between the student's assessment and LPI. The other words, student's assessment influence LPI's no fine or fine with the 95% confidence interval is (0.0770, 3.0130).

Table 4 also explain that if student's assessment is exactly 0 then probability of category influence LPI's fine equal to exp(-2.840 + 1.545(0)) / (1+ exp(-2.840 + 1.545(0))) = 0.0552 or other means that department's assessment will influence LPI's fine as much as 5.52 percent, if department's

assessment is exactly 1 then probability of department's assessment influence LPI's fine equal to exp(-2.840 + 1.545(1)) / (1+ exp(-2.840 + 1.545(1))) = 0.2150 or other means that department's assessment will influence LPI's fine as much as 21.50 percent, if department's assessment is exactly 2 then probability of department's assessment influence LPI's fine equal to exp(-2.840 + 1.545(2)) / (1+ exp(-2.840 + 1.545(2))) = 0.5622 or other means that department's assessment will influence LPI's fine as much as 56.22 percent, if department's assessment is exactly 3 then probability of department's assessment influence LPI's fine equal to exp(-4.301 + 1.822(3)) / (1+ exp(-2.840 + 1.545(3))) = 0.8575 or other means that department's assessment will influence LPI's fine as much as 85.75 percent, and if department's assessment is exactly 4 then probability of department's assessment influence LPI's fine equal to exp(-2.840 + 1.545(4)) / (1+ exp(-2.840 + 1.545(4))) = 96.58 or other means that department's assessment will affect LPI's fine as much as 96.58%.

3.3 Logistic Regression Model and Its Interpretation

This subsection will present the logistic regression model from the calculation as in section III point B TABLE I-TABLE IV showed the analysis results of the relationship between age and lecturer performance index (LPI), category of lecturer and lecturer performance index (LPI), department's assessment and lecturer performance index (LPI), also student's assessment and lecturer performance index (LPI).

Binary logistic regression model that show the relationship between age and LPI is:

$$g(x) = 0.457 + 0.015X \quad (4)$$

where X is the age variable and $g(x)$ as in The Basic Theories, with the p-values is 0,377. It means the model is not significant.

Binary logistic regression model that show the relationship between lecturer categories and LPI is:

$$g(x) = 0.544 + 0.697X \quad (5)$$

where X is the independent variable of THE lecturer category and the p-values is 0.000. It means the model is significant with 95% confidence interval is (0.3168, 1.0772).

Binary logistic regression model that show the relationship between department's assessment and LPI is:

$$g(x) = -4.301 + 1.822X \quad (6)$$

where X is the independent variable of the department's assessment and the p-values is 0.000. It means the model is significant with 95% confidence interval is (0.9008, 2.7432**)**.

Binary logistic regression model that show the relationship between student's assessment and LPI is:

$$g(x) = -2.840 + 1.545X \quad (7)$$

where X is the independent variable of the student's assessment and the p-values is 0.000. It means the model is significant with 95% confidence interval is (0.0770, 3.0130).

Based on the all of results (equation (4) – (7)) that the Lecturer Performance Index (LPI) of IAIN Purwokerto is not affected by the lecturer's age but it is affected by the lecturer category, the department's assessment, and the student's assessment.

4 CONCLUSIONS

Based on the binary logistic regression can be found that three relationship between the independent (predictor or explanatory) variable and the dependent (response or outcome) variable i.e. the first, the lecturer category variable influence the IAIN Purwokerto lecturer's LPI; the second, the department's assessment variable influence the IAIN Purwokerto lecturer's LPI and the third is the student's assessment variable also influence the IAIN Purwokerto lecturer's LPI. While the lecturer age variable is not influencing the IAIN Purwokerto lecturer's LPI. The student's assessment variable influences greater than the department's assessment variable in the IAIN Purwokerto lecturer's LPI.

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