# Cost Estimate Modelling of PrestressedConcrete Bridge at the Public Worksand Housing Department of Bina MargaEast JavaProvince Indonesia

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***Abstract;*This research is a modeling of cost estimation of prestressed bridge project in Public Works and HousingDepartmentof Bina Marga East Java ProvinceIndonesia. The purpose of this research is to get an accurate initial cost estimation taking into account the time series data of project cost budget and the inflation value that prevailed in the previous years. Data collection is taken from the contractor and the Public Works and Housing Department ofBinaMarga East JavaProvinceIndonesia from 2011-2016. Data analysis using Cost Significant Modelling (CSM) and multiple linear regression with the help of SPSS version 22 software. The results concluded that 97,90% of the work affecting the cost of the prestress bridge project consists of : pavement and asphalt work ($X_3$), top material building ($X_7$) and masonry work ($X_9$). The equation model of cost estimation of prestige bridge structure construction with Cost Significant Model is in the form of regression equation, $Y = 26{,}217{,}681.38 + 2{,}108\ X_3 + 1{,}513\ X_7 + 1{,}161\ X_9$. The estimated model accuracy ranges from -10,20% to + 6,75%, with an average of + 8,48% accuracy. The estimation result of this study is better when compared with the estimation using long road parameters used by the Public Works and Housing Department of Bina MargaEast Java Province Indonesia whose accuracy ranges from -38,68%to + 38,05%, with an average accuracy of 14,47%.**

**Keywords:**estimate, cost model, bridge, prestress, CSM.

## I. INTRODUCTION

Government project budget planning, particularly in technical offices throughout Indonesia's provinces and districts is often constrained on the required budget size and the lack of information provided on each of the same jobs. The Road Maintenance and Improvement Project at the Public Works and Housing Department of East Java Province is one of the budget spots in the Budget Implementation List (DIPA) in East Java Province Indonesia using unit price contracts. In the budget planning of the project is always made based on experience without any special methods, so it takes certain methods to know and compare what work is influential, how the accuracy of existing budgetary planning costs to reduce the cost overrun of pre-construction calculations and for calculates its Own Estimated Price (HPS) before the work is conducted (Akhsa et al., 2015)[1].

At the planning stage each construction project requires an initial cost estimate. This initial cost estimation is required by the Project Owner to estimate the project owner's budget. Often, when the project is at an early stage, the information to estimate the cost is not too detailed, so the estimation results tend to be less accurate. Therefore, an accurate cost estimation model is needed which can explain most projects based on the least information possible (Falahis et al., 2015)[2]. In general, the accuracy of cost estimates depends on the progress of the project, materials, labor, equipment, direct and indirect costs as well as the expected benefits of the contractor. In the early stages of the project, data and information are still incomplete, so the cost estimation can not be detailed yet. As the planning process, design data will be more detailed and can produce more accurate estimates (Sugiyarto et al., 2016)[3].

In addition, in the early stages of planning, such as at the time of budget planning, estimates are not possible based on quantity calculations of work because the specifications and job descriptions have not been planned. For contractors this is a problem because in general in Indonesia the basic planning of construction work is often done simultaneously with the bidding offer. Therefore it takes time to quickly estimate the price of a construction work. Though the time available to participate in the bidding is very limited. Therefore, the cost estimation model is needed quickly, accurate, effective, reliable, simple and generally accepted (Kaming et al., 2009)[4].

According to the National Estimating Society (USA), Cost estimation is a cost analysis job that involves the cost assessment of activities of past project activities that will be used as materials to develop cost engineering development is basically an activity based on analysis of various aspects to achieve the goals and objectives certain with optimal results (Aptiyasa, 2015)[5]. In Indonesia many cost models are commonly used in the calculation of construction projects. Each cost model has its advantages and disadvantages in determining the estimated initial cost of the project cost budget. The following are the types of estimates based on the development stage of the project, namely: quantity list and unit price, Preliminary Estimate (PE), Semi-Detailed Estimate (SE), Definitive Estimate (DE), Element Cost Analysis (ECA), Quantity Take Off ( QTO) and Cost Significant Model (CSM) (Handayani et al., 2015;Azmi&Huda, 2017; Bari, 2012; Vijaya&Shinde)[6][7][8][9]

Cost estimation method with Cost Significant Model was first introduced by Poh and Horner (Azmi& Huda, 2017)[7]. The Cost Significant Model is one of the total construction cost forecasting models based on past bidding data, which relies more on the most significant price in affecting the total project cost as the basis for forecasting, which translates into multiple regression formulation. The Cost Significant Model relies on well-documented findings of previous project data and information with similar types of work. Data and information can be obtained by collecting an archive of previous offers for similar projects that win the tender or the projects that have been implemented (Fikri&Sekarsari, 2015)[10]. This method has been widely used in previous studies to estimate the costs of some construction project activities such as buildings (Sugiyarto et al, 2016)[3], hospitals (Aptiyasa, 2015)[5], irrigation and irrigation channels (Kaming et al., 2009; Akhsa et al , 2015)[4][1], residential (Azmi& Huda, 2017)[7], construction of reinforced concrete and steel bridges (Falahis et al., 2015; Bakar, 2014)[2][10], upgrading of roads (Handayani et al., 2015; Fikri&Sekarsari, 2015)[6][11], maintenance of airport facilities, and others (Soemardi& Reni, 2010; Dewita et al., 2013; Indrawan, 2011) [12][13][14]

This study aims to develop cost estimation model budget in the early stages of project planning quickly, easily with sufficient accurate results and can be used as forecasting in the following years. The research object is road improvement and maintenance project in East Java Province Indonesia. The development method uses the principle of "Cost Significant Model" and multiple linear regression equation. The data are taken from several packages of workers using *BoQ* (Bill of Quantity) method which has been implemented from 2011 until 2017 by contractor and Public Works Department of East Java Province Indonesia. This study aims to analyze the estimated cost of prestressed bridge construction in East Java Province Indonesia as well as to strengthen the accuracy of project cost estimation in previous studies. The results of this study are expected to provide benefits for the project owner in determining the initial project cost estimation and also useful for contractors who will arrange an offer to participate in the tender.

## II. METHODOLOGY

### *A. Research Concept*

This research is a quantitative research because it uses numerical data using budget cost of similar projects at certain time. This study is also a comparative study because it compares the magnitude of the project budget and the influence of the inflation rate in 2011 to 2016. The data population in this study are all bridge prestress projects using girder beams that were done in East Java Province Indonesia from 2011 to year 2016. Sample research is conducted by considering different project sites implemented at intervals in accordance with the limited in the scope of the study. Technique of collecting data using sampling technique with purposive sampling method based on criteria of project name, location, year and work item appropriate with research purpose.

### *B. Data analysis*

Data analysis techniques, initially data grouped by year, location and influence inflation. Then after the results grouped the feasibility of data analysis techniques in this study carried out based on the classical assumption test consisting of the normality test. In the normality test, the data will be considered normal if its probability value is greater than 0.05 which can be seen with the Kolmogorov-Smirnov test statistic

### *C. Calculation of influence time value*

The influence of time value can be calculated due to the reduced value of money due to the inflation factorevery year. Calculation using Future Value (FV) with equation 1, (Faza& Huda, 2017)[7]

$$F = P\,(1+i)^{N} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where :

F: The price value on the specified projection

P: Price before projected

i: Inflation factor

N: Year of projection

*D. Determine the cost-significant items*

By looking at the description of the research results, the proportion of each cost component (independent variable) to the total cost (dependent variable). The proportion is sorted from the largest to the smallest. Host-significant items are identified as the largest items whose percentage is the same or greater of 80% of total cost. The independent variables identified as cost-significant items will then be analyzed using the SPSS program (Ghozali, 2015)[15].

*E. Identify Variables*

This study uses total cost of work (Y) as independent variables consisting of dependent variables include: mobilization work (X1), drainage and soil work (X2), pavement and asphalt work (X3), concrete work (X4), work reinforcement (X5), foundation work (X6), top building materials (X7), installation of top building materials (X8), masonry work (X9), and other work (X10).

*F. Model Analysis*

The relationship between the dependent variable and the independent variable is analyzed based on the correlation coefficient and the determination coefficient. The resulting correlation coefficient (r) is used to describe the strength of the relationship between the dependent variable and the independent variable. The correlation coefficient that approaches 1, both in the positive and negative directions, indicates that the relationship between the dependent variable and the free variable is stronger. In addition, the accuracy of the regression model can be seen based on the coefficient of determination (R) which is getting closer to 1, meaning more accurate. To determine the feasibility to be used in estimating the value of the dependent variable, the regression model needs to be tested by F test and t test. The regression model is considered to be eligible if the probability of t is less than the 0.05 significance.

*G. Multiple linear regression analysis.*

Multiple linear regression analysis is a regression analysis to describe a problem (dependent variable) that is influenced by more than one factor (independent variable). The purpose of multiple linear regression analysis is to measure the intensity of the relationship between two or more variables and make predictions of the estimated value of Y over X (Ghozali, 2015)[15]. Multiple linear regression model is formulated as follows:

$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8 + a_9X_9 + a_{10} X_{10}$…….(2)

Where :

Y = dependent variable

X1 through X11 = Independent variable

a0 to a11 = coefficient of the regression equation

*H. Model Accuracy Analysis*

Poh and Horner (Faza& Huda, 2017)[7] stated that the model test is done by dividing the estimated cost based on the regression model with the Cost Model Factor (CMF). CMF is the ratio between model estimation cost and actual cost. Accuracy is indicated by the percentage of margin between the estimated price and the actual price. The equations used to calculate accuracy are:

Accuracy = $\frac{EV-AV}{AV}$…………………………………………………………………….(3)

Where :

EV = estimated bill value

AV = actual bill value

## III. RESULTS AND DISCUSSION

*A. Research Data*

The research data used is secondary data in the form of time-historical data of unit price of the prestress bridge project. The data is obtained from 6 Bill of Quantity of Prestressed concrete bridge construction work pack held by Public Works Department of Bina Marga of East Java Province from fiscal year 2011 to 2016. The data is budget cost without Value Added Tax (VAT) ). Recapitulation of the six work packages is shown in Table 1.

Table 1 shows that the cost of constructing a bridge for each project package differs according to the length of the bridge. While the width of the bridge is considered the same as the standards determined by government regulations. For data uniformity, the existing data is adjusted to the cost per meter of bridge length. Each variable cost is divided by the length of the bridge and the results are shown in Table 2.

TABLE 1.Preliminary Budget Data of Bridge 2011-2016

| Var | Description | Details of Bridge Cost / Year (x Rp 1000) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 |
| | **Bridge Data** | **Bridge 1** | **Bridge 2** | **Bridge 3** | **Bridge 4** | **Bridge 5** | **Bridge 6** |
| | **Area (m2)** | **50** | **21** | **40** | **23,6** | **38** | **34** |
| Y | Total Budget | 11.351.384 | 2.416.128 | 6.397.518 | 5.248.284 | 3.960.100 | 3.226.797 |
| $X_1$ | Mobilization | 100.000 | 24.165 | 75.625 | 314.095 | 21.095 | 21.550 |
| $X_2$ | Drainage and soil | 29.996 | 97.993 | 140.845 | 414.190 | 142.282 | 74.477 |
| $X_3$ | Pavement and asphalt | 668.988 | 281.451 | 578.463 | 822.492 | 710.304 | 388.777 |
| $X_4$ | Concrete | 1.278.252 | 283.518 | 499.054 | 249.763 | 364.473 | 300.286 |
| $X_5$ | Reinforcement | 334.344 | 365.098 | 839.438 | 439.874 | 689.279 | 456.828 |
| $X_6$ | Foundation | 1.668.348 | 144.582 | 413.880 | 411.115 | 334.306 | 458.665 |
| $X_7$ | Top building materials | 3.780.000 | 525.000 | 2.400.000 | 1.487.044 | 950.000 | 806.728 |
| $X_8$ | Install top building materials | 716.345 | 165.298 | 402.282 | 440.241 | 213.982 | 499.204 |
| $X_9$ | Masonry work | 2.411.978 | 518.285 | 950.749 | 606.611 | 471.049 | 163.873 |
| $X_{10}$ | Others | 101.164 | 17.738 | 97.182 | 62.859 | 63.331 | 56.408 |

Source: Secondary data

TABLE 2.Budget Data of Bridge per M2, 2011-2016

| Var | Description | Details of Bridge Cost per m2 / Year (x Rp 1000) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 |
| | **Bridge Data** | **Bridge 1** | **Bridge 2** | **Bridge 3** | **Bridge 4** | **Bridge 5** | **Bridge 6** |
| | **Area (m2)** | **50** | **21** | **40** | **23,6** | **38** | **34** |
| Y | Total Budget | 227.028 | 115.054 | 159.938 | 222.385 | 104.213 | 94.906 |
| $X_1$ | Mobilization | 2.000 | 1.151 | 1.891 | 13.309 | 555 | 633 |
| $X_2$ | Drainage and soil | 5.840 | 4.666 | 3.521 | 17.550 | 3.744 | 2.191 |
| $X_3$ | Pavement and asphalt | 13.380 | 13.402 | 14.462 | 34.851 | 18.692 | 11.435 |
| $X_4$ | Concrete | 25.565 | 13.500 | 12.478 | 10.583 | 9.591 | 8.832 |
| $X_5$ | Reinforcement | 6.687 | 17.052 | 20.986 | 18.639 | 18.139 | 13.436 |
| $X_6$ | Foundation | 33.367 | 6.885 | 10.347 | 17.420 | 8.798 | 13.490 |
| $X_7$ | Top building materials | 75.000 | 25.000 | 60.000 | 63.010 | 25.000 | 23.727 |
| $X_8$ | Install top building materials | 14.327 | 7.871 | 10.057 | 18.654 | 5.631 | 14.682 |
| $X_9$ | Masonry work | 48.239 | 24.680 | 23.769 | 25.704 | 12.396 | 4.820 |
| $X_{10}$ | Others | 2.023 | 845 | 2.430 | 2.664 | 1.667 | 1.659 |

Source: Secondary data

### *B. Calculation of influence of time value*

Calculation of the effect of time value due to inflation, each variable can be calculated by calculating the index of each bridge price per meter variable length multiplied by the inflation value in 2011 to 2016. Data magnitude value inflation in the province of East Java-Indonesia starting in 2011 -2016 (BPS, 2017)[14] can be seen in Table 3. Then the influence of time value on the index of permeter square work unit price can be seen in Table 4

TABLE 3.Inflation in East Java Province, 2011-2016

| No | Year | Inflation (%) |
|---|---|---|
| 1 | 2011 | 4,09 |
| 2 | 2012 | 4,50 |
| 3 | 2013 | 7,59 |
| 4 | 2014 | 7,77 |
| 5 | 2015 | 3,08 |
| 6 | 2016 | 2,74 |

Source: Statistics Indonesia East Java Province (2017)[16]

TABLE 4.Inflation Calculation at Bridge Budget Year 2011-2016

| Var | Description | Details of Bridge Cost per m2 / Year (x Rp 1000) | | | | | |
|---|---|---|---|---|---|---|---|
| | | **2016** | **2015** | **2014** | **2013** | **2012** | **2011** |
| | **Bridge Data** | **Bridge 1** | **Bridge 2** | **Bridge 3** | **Bridge 4** | **Bridge 5** | **Bridge 6** |
| | **Area (m2)** | **50** | **21** | **40** | **23,6** | **38** | **34** |
| Y | Total Budget | 259.114 | 141.281 | 196.397 | 285.368 | 139.198 | 126.766 |
| $X_1$ | Mobilization | 2.283 | 1.413 | 2.322 | 17.078 | 741 | 847 |
| $X_2$ | Drainage and soil | 6.665 | 5.730 | 4.324 | 22.520 | 5.001 | 2.926 |
| $X_3$ | Pavement and asphalt | 15.271 | 16.458 | 17.758 | 44.722 | 24.967 | 15.273 |
| $X_4$ | Concrete | 29.178 | 16.578 | 15.320 | 13.581 | 12.811 | 11.797 |
| $X_5$ | Reinforcement | 7.632 | 20.939 | 25.770 | 23.918 | 24.228 | 17.947 |
| $X_6$ | Foundation | 38.083 | 8.454 | 12.706 | 22.354 | 11.751 | 18.019 |
| $X_7$ | Top building materials | 86.285 | 30.699 | 73.678 | 80.856 | 33.393 | 31.693 |
| $X_8$ | Install top building materials | 16.352 | 9.666 | 12.350 | 23.938 | 7.521 | 19.611 |
| $X_9$ | Masonry work | 55.057 | 30.306 | 29.187 | 32.984 | 16.557 | 6.438 |
| $X_{10}$ | Others | 2.309 | 1.037 | 2.983 | 3.418 | 2.226 | 2.216 |

Source: Secondary data

*C. Determining the Cost Significant Model*

Determination of Cost Significant Items by first calculating the mean and standard deviation values of each item variable as shown in Table 5. Then sort the job cost variables from the largest to the smallest value to get the percentage of each work item. Cost Significant Items are identified as the largest items whose percentage is = 80%

TABLE 5.Calculation of Mean and Standard Deviation (x Rp 1000)

| Variable | Description | Mean (Rp) | Std.DeviasiRp) | % |
|---|---|---|---|---|
| Y | Total Budget | 191.353 | 67.609 | 100,00 |
| $X_1$ | Mobilization | 4.114 | 6.387 | 2,15 |
| $X_2$ | Drainage and soil | 7.861 | 7.293 | 4,11 |
| $X_3$ | Pavement and asphalt | 22.408 | 11.518 | 11,71 |
| $X_4$ | Concrete | 16.544 | 6.425 | 8,65 |
| $X_5$ | Reinforcement | 20.072 | 6.702 | 10,49 |
| $X_6$ | Foundation | 18.561 | 10.757 | 9,70 |
| $X_7$ | Top building materials | 56.100 | 26.794 | 29,32 |
| $X_8$ | Install top building materials | 14.906 | 6.234 | 7,79 |
| $X_9$ | Masonry work | 28.421 | 16.483 | 14,85 |
| $X_{10}$ | Others | 2.364 | 812 | 1,24 |

Source: Results of SPSS Analysis

Based on Table 6 then work items are sorted by the largest percentage value as follows:

1. Top building materials (X7) = 29,32%
2. Masonry work (X9) = 14,85%
3. Pavement & Asphalt (X3) = 11,71%
4. Reinforcement (X5) = 10,49%
5. Foundation (X6) = 9,70%
6. Concrete (X4) = 8,65%

Total= 84,72%

*D. Normality Analysis*

Since the sample size is less than or equal to 50 then the data normality test using Shapirow Wilk method. The test is conducted based on the comparison of probability value with significance value ($\alpha = 0,05$). The data requirement is called normal if probability or p> 0,05 or (p> α) (Ulwan, 2017)[17]. The summary of normality test results based on Shapirow Wilk value can be seen in Table 6.

TABLE 6.Normality Test Based on Kolmogorov Value - Smirnov

| Variable | Description | Significant | Remark |
|---|---|---|---|
| Y | Total budget | 0.715 | Normal |
| $X_3$ | Pavement & Asphalt | 0.127 | Normal |
| $X_4$ | Concrete | 0.837 | Normal |
| $X_5$ | Reinforcement | 0.994 | Normal |
| $X_6$ | Foundation | 0.765 | Normal |
| $X_7$ | Top building materials | 0.756 | Normal |
| $X_9$ | Masonry work | 0.810 | Normal |

Source: Results of SPSS Analysis

*E. Multiple linear regression analysis*

Regression analysis using six variables in Table 6 above is done to get the most influential variable to the cost. Based on the results of partial regression analysis on each independent variable using SPSS program obtained the most powerful regression and used for this research that is for the Top Building Materials ($X_7$). It states that the relationship between cost (Y) and Top Building materials ($X_7$) is very strong and positively correlated, which means the increase and decrease in the value of Top Building materials ($X_7$) will be followed by the increase and decrease in cost (Y). The significance value $p = 0.044 < 0.05$ indicates that the Top Building materials ($X_7$) most significantly affects the cost (Y) at the 5% confidence level. From the calculation result using SPSS program got the result shown in Table 7

TABLE 7.Summary of Model Influence (Model Summary)

| Model | R | $R^2$ | Adjusted $R^2$ | Std Error of the Estimate |
|---|---|---|---|---|
| 1 | 0,990 | 0,979 | 0,948 | 15.379.657,10 |

Source: Results of SPSS Analysis

From table 8 the model summary got the standard number error of the estimate = Rp 15.379.657 < standard deviation = Rp 67.608.733. This suggests that the regression model is feasible to use. Furthermore, based on the result of SPSS analysis, the regression model equation for prestressed bridge pricing in East Java Indonesia can be made by considering the regression equation constant values shown in Table 8.

TABLE 8.Coefficient of Regression Equation

| Model | | *Unstandardized Coefficients* | *Standardized Coefficients* | T | Sig. |
|---|---|---|---|---|---|
| | | B | Beta | | |
| 1 | (*constant*) | 26.217.681,380 | | 1,390 | 0,299 |
| | $X_7$ | 1,513 | 0,600 | 3,299 | 0,081 |
| | $X_9$ | 1,161 | 0,283 | 1,654 | 0,240 |
| | $X_3$ | 2,108 | 0,359 | 3,064 | 0,092 |

Source: Results of SPSS Analysis

Table 8.explains that the value of B constant = 26.217.681,380; B $X_7$ = 1,513; B $X_9$ = 1.161 and B $X_3$ = 2,108 so that regression equation can be made as follows:

$Y = 26,217,681,380 + 2,108\ X_3 + 1,513\ X_7 + 1,161\ X_9$..................... (4)

Where :

Y = The cost of building a prestressed bridge beam per m bridge length

$X_3$ = Pavement and asphalt cost per m of bridge length

$X_7$ = Cost of Procurement of top building materials per m length of bridge

$X_9$ = Cost of Couple pair per m length of bridge

*F. Cost Model Model Testing (CMF)*

In this study the cost of model estimation is calculated by entering the unit price of the independent variables $X_7$, $X_9$ and $X_3$ per m, into equation (4). The result of cost estimation with Cost Significant Model is obtained by dividing model estimation cost with Cost Model Factor (CMF). CMF is the average ratio of the estimated cost model to the actual cost. Next the calculation of Cost Model Factor (CMF) can be seen in Table 9.

TABLE 9.Summary of CMF Calculation Results

| Var | Description | Cost of Bridge per m2 (x Rp 1000) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Bridge 1 | Bridge 2 | Bridge 3 | Bridge 4 | Bridge 5 | Bridge 6 |
| $X_3$ | Pavement and asphalt | 15.271 | 16.458 | 17.758 | 44.722 | 24.967 | 15.273 |
| $X_7$ | Top building materials | 86.285 | 30.699 | 73.678 | 80.856 | 33.392 | 31.693 |
| $X_9$ | Masonry works | 55.057 | 30.306 | 29.187 | 32.984 | 16.557 | 6.438 |
| Y | Cost Estimate per M ' | 252.878 | 152.543 | 209..012 | 281.120 | 148.594 | 113.839 |
| | Actual Cost per M ' | 259.114 | 141.281 | 196.397 | 285.368 | 139.198 | 126.766 |
| | CMF | 0,976 | 1,009 | 1,064 | 0,985 | 1,068 | 0,898 |

Source: Results of Analysis

The result of the Cost Significant Model estimation obtained from the calculation is compared to the actual cost of the project being reviewed. The level of accuracy is to calculate the difference between the Cost Significant Model estimation and the implementation cost, divided by the implementation cost (%). In comparison, calculated also the method of accuracy that has been used is the method of road length parameters to the cost of implementation. The comparative estimation model of prestress bridge works can be seen in Table 10.

TABLE10.Comparison of Bridge Cost Estimation Model

| No | Bridge | Total Cost (x Rp1000) | Cost Significan Model | | Conventional Method | |
|---|---|---|---|---|---|---|
| | | | Cost Estimation | Acuration | Cost Estimation | Acuration |
| 1 | Bridge 1 | 12.955.693 | 12,643,893 | -2.41% | 8,750,000 | -32.46% |
| 2 | Bridge 2 | 2.966.905 | 2,993,415 | 0.89% | 3,675,000 | 23.87% |
| 3 | Bridge 3 | 7.855.888 | 8,360,487 | 6.42% | 7,000,000 | -10.89% |
| 4 | Bridge 4 | 6.734.687 | 6,634,439 | -1.49% | 4,130,000 | -38.68% |
| 5 | Bridge 5 | 5.289.508 | 5,646,591 | 6.75% | 6,650,000 | 25.72% |
| 6 | Bridge 6 | 4.310.034 | 3,870,517 | -10.20% | 5,950,000 | 38.05% |
| | | | Maximum | 6,75 % | | 38.05% |
| | | | Minimum | -10,20 % | | -38.68% |
| | | | Average | 8,475 % | | 0.93% |

Source: Results of Analysis

## IV.CONCLUSION

From this research can be concluded as follows:

1. Procurement of top building materials ,masonry work, pavement work and asphalt, are three jobs that significantly influence 97.9% of the overall cost of prestressed bridge construction in East Java Province Indonesia.
2. Model of cost estimation of prestress bridge construction with "Cost Significant Model" is: $Y = 26.217.681,38 + 2,108\ X_3 + 1,513\ X_7 + 1,161\ X_9$
3. Accuracy model of cost estimation of prestress bridge construction with method "Cost Significant Model" is ranged from -10,20% until + 6,75% with average accuracy 8,475%.
4. Estimates with the "Cost Significant Model" resulted in better estimates when compared to estimates using long road parameters that have been used in the Department of Public Works of Bina Marga East Java Province whose accuracy ranges from -38.68% to + 38.05 % with average accuracy +0,93 %

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