



Optimizing The Preparation Of Work Plans Using Linear Regression

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Abstract

Effective and efficient work plan preparation is a crucial component in achieving the strategic goals of local governments. However, this process often faces challenges in budget management, particularly related to the increase of indicative ceilings that exceed limits. This study aims to optimize the work plan preparation at the Regional Secretariat of Langkat Regency using the linear regression method. This method is applied to evaluate the previous year's work plan and adjust it according to the region's financial capacity, so the budget can be utilized more efficiently and effectively. The study results show that using linear regression can provide more accurate predictions of budget needs, thereby minimizing the risk of excessive increases in indicative ceilings. The optimized forecast value for the 2025 plan, with 10 data points as the analysis, is 35,266,140,000, showing a Mean Absolute Percentage Error (MAPE) of 0.08%, which means the accuracy rate reaches 99.92%. Thus, this optimization of work plan preparation is expected to support the achievement of regional development goals in a more structured and measurable manner.

Keywords: Optimization, Preparation, Work Plans, Linear Regression

1. Introduction

The preparation of an efficient and effective work plan is a crucial aspect in supporting the government's success in achieving development goals. However, the government often faces challenges in managing the budget, especially when the increase in indicative ceilings exceeds the expected limits. There has been little research specifically discussing the application of linear regression in the context of optimizing work plan preparation to optimize indicative ceilings, making this research relevant. This study aims to fill that gap by identifying previous studies that are relevant and highlighting the unique position of this research. The difference between this study and previous ones is its specific focus on the application of linear regression in optimizing the preparation of government work plans, particularly in optimizing indicative ceilings. The novelty of this research lies in the use of linear regression methods for optimizing the preparation of government work plans, a topic that has not been extensively covered in previous studies. The purpose of this research is to develop a method that can be used to optimize work plan preparation by utilizing linear regression, thereby optimizing indicative ceilings and increasing budget efficiency [1], [2], [3].

2. Research methodology

2.1. Linear Regression Analysis

Regression analysis is a statistical calculation to test how closely the relationship between variables is. The simplest and most frequent regression analysis. Used is simple linear regression. In regression analysis there is one dependent variable which is usually written with the symbol y and one or more independent variables which are usually written with the symbol x [4]

Linear regression is a quantitative method of calculating time series where time is used as the basis for predictions. The following is the basic equation of the simple linear regression method:

$$Y = \alpha + bX \quad (1)$$

Where :

Y = Dependent variable
 α = Intercept
 b = Variable coefficient
 X = Independent variable

Next, use the following equation to find intercept and variable coefficients:

$$\alpha = \frac{(\sum Y) \cdot (\sum X^2) - (\sum X) (\sum XY)}{n (\sum X^2) - (\sum X)^2} \quad (2)$$

$$b = \frac{n (\sum XY) - (\sum X) \cdot (\sum Y)}{n (\sum X^2) - (\sum X)^2} \quad (3)$$

As for the description of the steps so that the research can be carried out in a structured manner, the research stages are arranged from the beginning to the achievement of the final results as follows:

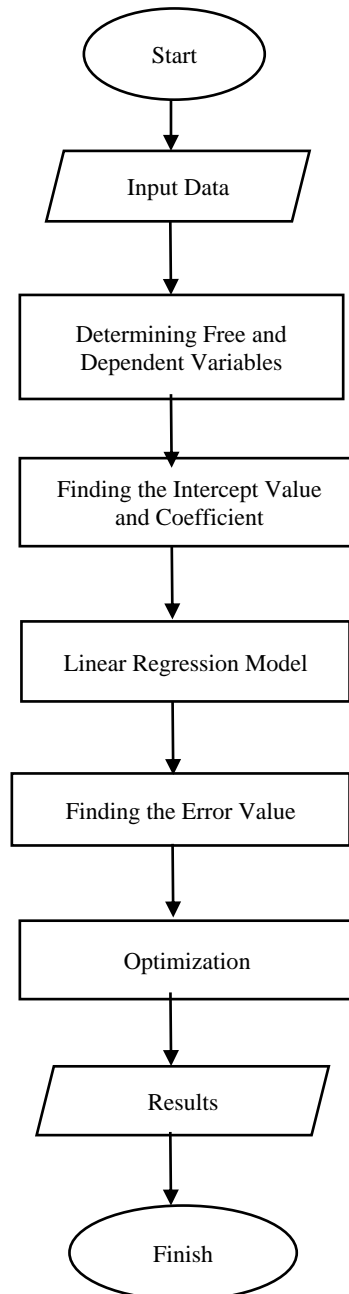


Figure 1: Flowchart of Research Stages

2.2. MAPE (Mean Absolute Percentage Error)

MAPE is a test of results according to a prediction model that has been carried out using past data [5], [6], [7] Explain that to determine the level of accuracy you can use the MAPE method by calculating the difference between actual data and predicted data. The smaller the MAPE value, the higher the level of accuracy. Linear Regression Model Start Data Input Results Finish Looking for Intercepts and Variable

Coefficients X Looking for Error Values Determining Independent and Dependent Variables Prediction 35 in other words, the method used has good ability to predict. Following MAPE calculation formula [8], [9], [10]:

$$MAPE = \frac{\sum \frac{|Y - Y'|}{Y} \times 100\%}{n} \quad (4)$$

Where :

Y = Actual data
 Y' = Prediction data
 n = Number of data

2.3. Optimization

Optimization can be achieved in two ways, namely maximization and minimization. Maximization is optimizing production by using or allocating certain inputs to obtain maximum profits. Meanwhile, minimization is the optimization of production to produce a certain level of output using the minimum input or costs. The introduction contains the following points [11], [12]:

2.4. Purpose of preparation

The purpose of preparation is to produce accurate, comprehensive and structured information, which is useful in an efficient and effective decision making process. The purpose of drafting can vary depending on the context and needs of the organizations or individuals involved.

In preparing a work plan, the aim of the preparation is to provide information that supports strategic and tactical decision making, such as selecting activities, sub-activities, budget allocation and setting targets. In preparing a budget, the aim is to support effective decision making and efficiency in managing resources and costs.

The preparation needs to be carried out carefully and systematically to ensure the correctness and accuracy of the conclusions. Preparation can be done differently, according to the situation and interests of the corporate organization or individual involved.

2.5. Work plan

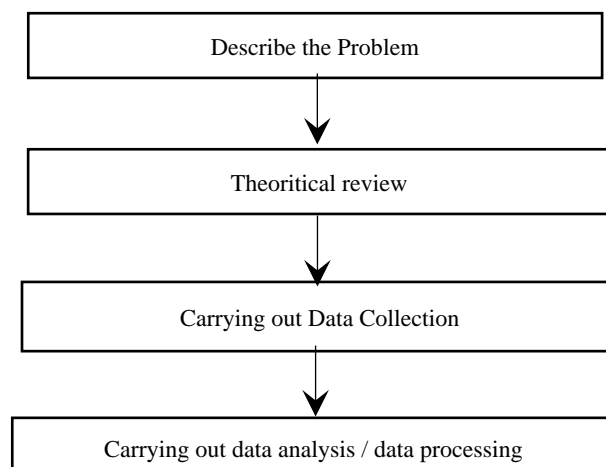
A work plan is a planning document that contains programs and activities needed to achieve development targets. The 2024 Langkat Regency regional secretariat work plan is a performance planning document for the regional secretariat for the fifth year of the 2019-2024 regional secretariat strategic plan period as an elaboration of the vision and mission of the Regent and Deputy Regent of Langkat as stipulated in the Langkat Regency Medium Term Development Plan (RPJMD) for the year period. 2019-2024, as well as serving as a guideline for preparing regional apparatus budget work plans (rka-pd) for 2024.

2.6. Python

Python is an interactive object-oriented programming language that provides high-level data structures. Python is a multipurpose interpretive programming language with a design that focuses on code readability so that the syntax used is easier to understand. Python is said to be a language that combines capabilities, capabilities, with very clear code syntax.

2.7 Research workflow

The research method is a description of the steps so that research can be carried out in a structured manner, so a framework is prepared from the beginning to achieving the final results as follows.



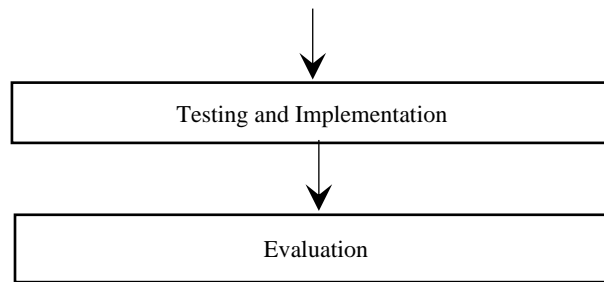


Fig. 1: Research workflow

2.8. Data sources and research variables

A research variable is a value/trait/attribute of an object, activity, or person with a specified variation. To clarify, the symbol X is given as the independent variable and the symbol Y as the dependent variable.

1. Independent variables or those that affect the dependent variable. In this study, it is played by the indicative ceiling.
2. The dependent variable is the effect variable or the one affected by the independent variable. In this research, it is played by the forward-looking 2025 plan.

2.9. Research supporting data

The data used to support research decisions are 10 sub-activities with variables used: indicative ceilings, forecast ahead of the plan 2025 as in table 1:

Stage 1.

processing research datasets using linear regression methods.

Table 1: Research Dataset

No	Sub-Activities	Indicative Ceiling (in millions)	Forecast ahead of the plan for 2025 (in million)
1	Provision of ASN Salary and Allowances	24.495	25.720
2	Provision of Administration for the Implementation of ASN Duties	983	1.032
3	Procurement of Official Clothes and Their Completeness Attributes	617	648
4	Provision of Components for Electrical/Office Building Lighting Agencies	191	200
5	Provision of Office Equipment and Supplies	319	334
6	Provision of household appliances	271	284
7	Provision of Office Logistics Materials	4.672	4.906
8	Provision of Printed Goods and Reproduction	139	146
9	Preparation of Reading Materials and Laws and Regulations	200	210
10	Implementation of the Skpd Coordination and Consultation Meeting	1.700	1.785

Stage 2.

formation of linear regression models which consists of:

- a. Calculate x^2 , xy and total from each column in table 2.

Table 2: Dataset To Be Processed

No	Sub-Activities	Indicative Ceiling (in millions)	Forecast ahead of the plan for 2025 (in million)	X.Y	X ²	Y ²
1	Provision of ASN Salary and Allowances	24.495	25.720	630,011,400	600,005,025	661,518,400
2	Provision of Administration for the Implementation of ASN Duties	983	1.032	1,014,456	966,289	1,065,024
3	Procurement of Official Clothes and Their Completeness Attributes	617	648	399,816	380,689	419,904
4	Provision of Components for Electrical/Office Building Lighting Agencies	191	200	38,200	36,481	40,000
5	Provision of Office Equipment and Supplies	319	334	106,546	101,761	111,556
6	Provision of household appliances	271	284	76,964	73,441	80,656
7	Provision of Office Logistics Materials	4.672	4.906	22,920,832	21,827,584	24,068,836
8	Provision of Printed Goods and Reproduction	139	146	20,294	19,321	21,316

9	Preparation of Reading Materials and Laws and Regulations	200	210	42,000	40,000	44,100
10	Implementation of the Skpd Coordination and Consultation Meeting	1.700	1.785	3,034,500	2,890,000	3,186,225
Σ		33587	35265	657665008	626340591	687369792

b. Find the coefficient values a and b

1) Find the value of a by using equation (2)

$$\alpha = \frac{35265 \cdot 626340591 - 33587 \cdot 657665008}{10(626340591) - (33587)^2}$$

$$\alpha = \frac{22087900941615 - 22088994623696}{6263405910 - 1128086569}$$

$$\alpha = \frac{-1093682081}{5135319341}$$

$$\alpha = -0.21$$

2) Find the value of b by using equation (3)

$$b = \frac{10(657665008) - (33587) \cdot (35265)}{10(626340591) - (33587)^2}$$

$$b = \frac{6576650080 - 1184445555}{6263405910 - 1128086569}$$

$$b = \frac{5392204525}{5135319341}$$

$$b = 1.05$$

a. Calculating linear regression equations

A simple linear regression model was used

$$\hat{Y} = a + bX$$

Optimizing the forward forecast for the 2025 plan with $X = 33.587.000.000$

$$\hat{Y} = a + bX$$

$$\hat{Y} = -0.21 + (1.05) \cdot 33587$$

$$= -0.21 + 35266.35$$

$$= 35266.14 \text{ (in millions)}$$

Simple linear regression optimization results 35.266.140.000

Stage 3.

Performance testing based on optimization that has been made with input testing data with MAPE output using equation (4) in table 3.

Table 3: Testing Using Mape

No	Sub-Activities	Indicative Ceiling (x)	Actual Data (y)	Prediction Data (y')	Difference (y-y')	Error MAPE (%)
1	Provision of ASN Salary and Allowances	24.495	25.720	25.719.54	0.46	0.001
2	Provision of Administration for the Implementation of ASN Duties	983	1.032	1031.94	0.06	0.005
3	Procurement of Official Clothes and Their Completeness Attributes	617	648	647.64	0.036	0.05
4	Provision of Components for Electrical/Office Building Lighting Agencies	191	200	200.34	-0.34	0.17
5	Provision of Office Equipment and Supplies	319	334	334.74	-0.74	0.22
6	Provision of household appliances	271	284	284.34	-0.34	0.11
7	Provision of Office Logistics Materials	4.672	4.906	4.905.39	0.61	0.01
8	Provision of Printed Goods and Reproduction	139	146	145.74	0.26	0.17
9	Preparation of Reading Materials and Laws and Regulations	200	210	209.79	0.21	0.10
10	Implementation of the Skpd Coordination and Consultation Meeting	1.700	1.785	1.784.79	0.21	0.01
					Total	0.846

$$MAPE = \frac{0.846 \times 100\%}{10} = 0.08\%$$

Based on the error level test results, the test results were 0.08% or an accuracy level of 99.92%.

3. Results and Discussion

3.1. Load Data

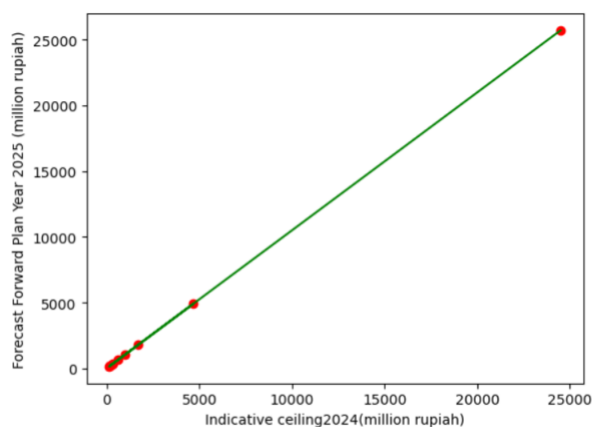
Supporting data here displays sub-activities, indicative ceiling 2024, and forward forecast 2025 plan.

No	Sub-Activity	Indicative Ceiling 2024	Forward Forecast 2025 Plan
0 1	Provision of ASN Salary and Allowances	24495	25720
1 2	Provision of Administration for the Implementa...	983	1032
2 3	Procurement of Official Clothes and Their Comp...	617	648
3 4	Provision of Components for Electrical/Office ...	191	200
4 5	Provision of Office Equipment and Supplies	319	334
5 6	Provision of household appliances	271	284
6 7	Provision of Office Logistics Materials	4672	4906
7 8	Provision of Printed Goods and Reproduction	139	146
8 9	Preparation of Reading Materials and Laws and ...	200	210
9 10	Implementation of the Skpd Coordination and Co...	1700	1785

Fig. 2: Supporting Data Display

3.2. Optimization Results Forward Forecast 2025 Plan

This graph shows the optimization results of the 2025 work plan forecast. The green line on the graph represents the linear regression line generated from the optimization model. The red dots on the graph show the actual data. The almost straight green line through the red dots shows that the linear regression model provides a very accurate prediction with an error rate (MAPE) of 0.08%. This means that the work plan forecast for 2025 has an accuracy rate of 99.92%. Thus, this work plan optimization has been carried out to the maximum extent and can be relied upon for future planning.



Then the results of the Langkat Regency Regional Secretariat Work Plan Optimization in 2025 with a MAPE Error rate of 0.08%. Then the plan in the future with a level of success accuracy of 99.92%

Fig. 3: Optimization Results Forward Forecast 2025 Plan

4. Conclusion

Based on the results of the analysis that has been carried out, the following conclusions can be drawn:

1. The use of Linear Regression as one of the methods for optimizing the preparation of work plans at the Regional Secretariat of Langkat Regency proved effective. Through analysis of historical data, this method enables more accurate optimization of future indicative ceilings, thereby helping to optimize indicative ceilings and ensure efficient resource allocation.
2. The results of testing the linear regression method in work plan preparation optimization by using linear regression and analyzing 10 sub-activities, the author managed to achieve a very low MAPE error rate of 0.08%. This shows that the linear regression model used has a very high level of accuracy reaching 99.92%. With this almost perfect level of accuracy, the linear regression method has proven to be effective in optimizing indicative ceiling requirements, so that it can significantly assist in the preparation of a more efficient work plan.

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