

Analysis of Detergent Inventory Stock at Luch Laundry Using the Linear Regression Method

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ABSTRACT

Inventory stock management is an important aspect in the laundry business to ensure smooth operations and minimize costs. Laundry Detergent shortages or overstocks can cause service disruptions and unnecessary additional costs. Therefore, a method is needed that can help predict stock needs accurately, one of which is the linear regression method. The data used includes historical data on detergent use and other factors that influence demand over several time periods. Through linear regression analysis, a predictive model can be built to estimate detergent needs in the future, so that stocks can be managed more efficiently. Research Method, namely the survey research method, is a research method carried out using surveys or direct data collection from Laundry Luch. The method/algorithm used to analyze the data is the linear regression method. The aim of this research is to apply the linear regression method in detergent inventory stock and to carry out analysis using the linear regression method in detergent inventory stock. The research results from the data that have been collected show that the predicted stock of detergent supplies for Laundry Luch in January 2025, with an estimated total usage of 111 boxes of detergent and a target usage of 95 boxes of detergent, is 129 boxes of detergent. The research conclusion is that the linear regression method provides real benefits in supporting data-based decision making.

Keywords: Prediction, Availability, Linear regression methods.

INTRODUCTION

Current technological developments have brought significant changes in various industrial sectors, including the service industry such as the laundry business. In the last few decades, technology has not only made business operations easier, but also opened up new opportunities in terms of efficiency, accessibility and service innovation. The laundry business, which previously only relied on manual processes, has now transformed to become more modern and integrated with digital technology, starting from machine automation, use of applications, to online-based stock management and customer service systems.

Luch Laundry is one of the laundry businesses operating in Sawit Rejo, Kec. Kutalimbaru, Deli Serdang Regency with quite a large number of customers. For some time now, Luch Laundry managers have experienced challenges in managing the optimal amount of detergent stock, which has resulted in an imbalance between existing stock and real needs. Manually determining stock amounts based on estimates is often inaccurate, so an analytical approach is needed to assist in making decisions regarding inventory.

In the laundry service industry, the availability of stock of raw materials such as detergent plays an important role in maintaining smooth operations and customer satisfaction. Inadequate inventory stock can cause service delays and even losses, while excess stock has the potential to add unnecessary storage costs. Therefore, we need a method that can help laundry business managers manage detergent stocks more efficiently.

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Linear regression analysis is often used to make predictions or forecasting (Ababil et al., 2022). This method is a quantitative technique in time series analysis, where time is used as the basis for making predictions (Almumtazah et al., 2021). The linear regression method can be a solution in predicting detergent stock needs based on historical usage data and factors that influence demand. Linear regression is able to produce predictive models that enable businesses to predict future detergent needs more accurately, so that managers can determine optimal stock amounts.

Research by (Hasibuan & Musthofa, 2022) which discusses rice price predictions. Prediction accuracy test results were carried out using RMSE, with a value of 0.126. Rice price predictions using the linear regression method are categorized as very good. Research by (Harsiti et al., 2022) on predictions of tablet drug supplies. The calculation analysis carried out is able to overcome the problem of predicting drug supplies in the process of selling tablet type drugs. Based on calculations using the linear regression method, an accuracy of 98.505% was obtained, which shows that this method can be implemented to predict stock of tablet type drugs. Research by (Miftahuljannah et al., 2023) regarding sales predictions. The research results show that the variables or attributes used, namely product, actual and plan, do not influence the prediction results. The Root Mean Squared Error value is $36,241.241 \pm 0.000$, and the Squared Error is $1,313,427,569.481 \pm 5,882,150,128.134$. This shows that the Squared Error value is much higher than the Root Mean Squared Error.

This research aims to analyze the detergent stock at Luch Laundry using the linear regression method, with the hope of providing useful information in planning and managing inventory. By using this method, it is hoped that efficiency will be created in detergent stock management which can support smooth operations and minimize unnecessary costs.

LITERATURE REVIEW

In supporting the research carried out, the research that has been carried out related to this research is used as reference material/research reference. The following previous research was used, namely:

Table 1. Previous studies

No.	Researcher Name (year)	Method	Data	Results
1.	(Almumtazah et al., 2021)	Linear regression method	New Student Data 2016 – 2020.	Based on the results of data analysis, the MAPE values for mathematics, marine science, biology, information systems, architecture and environmental engineering study programs were 7.2%, 8.76%, 5.84%, 6.46%, 7 respectively. .98%, and 7.52%. With accuracy rates of 92.8%, 91.24%, 94.16%, 93.54%, 92.02%, and 92.48% respectively.
2.	(Azahra, 2022)	Linear regression method	New Student Data 2015-2019.	Based on calculations, the MAPE value for the Accounting study program can be obtained at 6.02%.
3.	(Sinaga et al., 2022)	Linear regression method	Population 2016-2020.	Based on research conducted using the Multiple Linear Regression method, the results showed a population growth of 40,078 people. This means that there is an additional population of 469 people in Gunung Malela District. The results of this research can be used as input to the Gunung Malela Subdistrict Office to anticipate population growth

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No.	Researcher Name (year)	Method	Data	Results
				rates and it can be concluded based on this research that the Multiple Linear Regression method can be used to estimate population numbers.
4.	(Harsiti et al., 2022)	Linear regression method	Drug Use Transaction Data for the January-August 2020 Period	Based on calculations using the linear regression method, an accuracy of 98.505% was obtained, which means that this method can be implemented in making stock predictions for tablet type drugs (ibu profen).
5.	(Rusdy, 2022)	Linear regression method	Pharmacy transaction data for a period of 3 months from January to March 2021.	Based on the test results using the Mean Absolute Percentage Error, Mean Square Error and Root Mean Square Error approaches and each shows results of 4,914%, 1,065 and 1,032 so that predictions of drug supply and demand using the Point of Sales application with the Linear Regression algorithm approach can be applied to case study of this research.
6.	(Fitri, 2023)	Linear regression method	The dataset is 2011 records (80% training data and 20% testing data), and has 6 attributes including house price, land area, building area, number of bathrooms, number of bedrooms and number of garages.	The results of this research are that in Random Forest Regression the RMSE value was 0.440, in the Linear Regression model the RMSE value was 0.515 and in Gradient Boosted Trees Regression the RMSE value was 0.508. Prediction results using the Random Forest Regression method produce the highest accuracy of 81.5% compared to the Linear Regression and Gradient Boosted Trees Regression methods.
7.	(Miftahuljannah et al., 2023)	Linear regression method	301 company usage data.	The Root Mean Squared Error is 36241.241 +/- 0.000, and the Squared Error is 1313427569.481 +/- 5882150128.134. This shows that squared error produces a high value of Root Mean Squared Error.
8.	(Sebastian Rudi et al., 2023)	Linear regression method	The data used was taken from cake usage data for 2021-2023.	The linear regression method works well and effectively, this can be proven by tests that have been carried out using MAPE (Mean Absolute Percentage) which shows an error value of 2-3%, based on the criteria from MAPE if the error value is not more than 10%, then it is said to be a process forecasting is accurate. So it can be concluded that the

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No.	Researcher Name (year)	Method	Data	Results
				Linear Regression method is very efficient for predicting the use of cakes in the future, namely 2024.
9.	(Husdi & Dalai, 2023)	Linear regression on method	Data on pineapple raw materials for the Bilfagi Jam Production House 2021.	With this simple linear regression method, the Mean Absolute Percentage Error (MAPE) obtained in trials with 2021 data was 18.897%. From the accuracy results, it can be concluded that the prediction system is effective to use.
10.	(Yusuf Alwy et al., 2024)	Linear regression on method	Questionnaire Data.	Based on the results of the coefficient of determination test (R2) in multiple regression analysis research, in the Model Summary table it can be seen that the R Square value reached 0.407, indicating that the influence of the education and promiscuity variables on the early marriage variable reached 40.7%. while the remainder, namely 59.3%, is influenced by other variables that are not in this study.

In accordance with the results of previous research described in the State of the Art table above, the research carried out is very suitable for applying the linear regression method, where the linear regression method has been widely used in terms of prediction.

Inventory is very important in carrying out the company's business goals because it concerns the smooth use of products, profits and the smooth achievement of company goals (Givan et al., 2022). Inventory is the stock of an item or resource used in a company organization (Hidayat et al., 2020). Inventory is an asset of a company, whether in raw form (raw materials), or in the form being processed, or in the form of finished goods (Juwari et al., 2018).

From the definitions above, the author can draw the opinion that inventory is the stock of goods in storage before the goods are distributed to meet customer demand.

According to (Huda et al., 2020) Prediction is a process of systematically estimating something that is most likely to happen in the future based on past and present information that is available so that errors (the difference between something that happens and the estimated results) can be minimized. Predictions are used to provide a clear view of the times with and connect big data to make work easier.

In a company, stock of goods is one of the important factors that the company must pay attention to. The number of incoming and outgoing goods needs to be paid attention to, the aim is to keep the stock available in the warehouse stable. Stable stock referred to in a warehouse is goods that are not overstocked or goods that are not out of stock. The problem faced when using goods is that each item has different purchasing interests. Goods with high buying interest will run out more quickly compared to goods with low buying interest (Syahputra et al., 2020).

Inventory is something that is always present in a large or small company, whatever the value of the inventory. Inventory is stored materials or goods that will be used to fulfill a specific purpose, for example for use in the production or assembly process, for resale, or for spare parts for equipment or machines (Tech et al., 2021).

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METHOD

Research methods are important for a researcher to achieve a goal and be able to find answers to the problems posed. The research stages start from identifying the problem to publishing scientific articles, as in the following fishbone diagram:

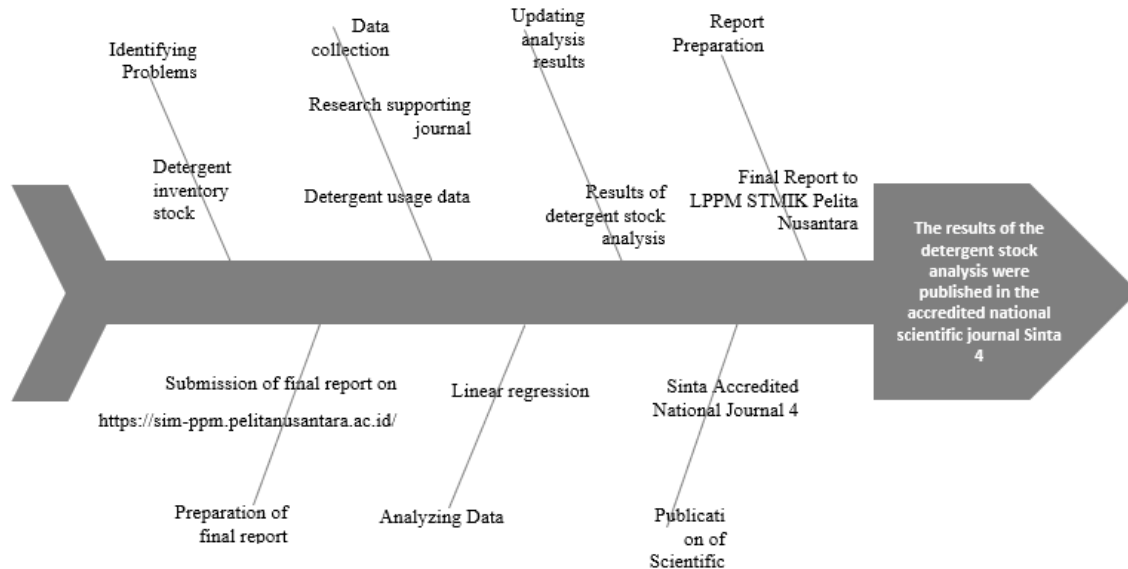


Figure 1. Research Flow

1. Identify the Problem

The first step in this research is identifying the problem to find out what problems exist in the detergent stock, so that the researcher better understands the problem to be studied. From the observations made by researchers so far, laundry companies in stocking detergents still only use estimates when stocking detergents.

2. Preparation of the final report

After the researchers identified the problem, the research team then prepared a final report and research RAB to be submitted to LPPM STMIK Pelita Nusantara for funding in implementing the tridharma of higher education, one of which was Odd Semester TA research. 2024/2025. In preparing the final research report, all teams were involved to provide input. Both from the lecturer team and the student team.

3. Data Collection

The steps taken in data collection are research data sources which are divided into 2, namely primary data sources and secondary data sources (Sugiyono, 2015). The primary data in this research is stock data and detergent use according to the criteria data that will be used in detergent stock analysis. The secondary data used is by searching for journals that support the research to be conducted and are in accordance with the research topic.

4. Analyzing Data

In analyzing the data that has been obtained, the researcher then analyzes the data using linear regression method calculations in order to get the RT head according to the criteria.

5. Update of analysis results

Data updating was carried out so that the results of data analysis using the linear regression method carried out could be synchronized with the understanding of Laundry Luch as the manager.

6. Accredited National Journal Publication

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In the final stage, the research output is the publication of the Accredited National Journal Sinta 4.

7. Preparation of Reports

At this stage the researcher prepares a final research report to be submitted to LPMM STMIK Pelita Nusantara as a final accountability report in accordance with the schedule determined by LPMM STMIK Pelita Nusantara.

RESULT

Data analysis

Data analysis is carried out in the interests of the success of a research, the data in research is analyzed to see whether the data can help research or is even suitable for use as research data. This research focuses on the application of the linear regression method. Data analysis was taken from detergent stock data and detergent use at Luch Laundry in the last three years.

Linear Regression Method Analysis

Analysis of the data obtained uses the linear regression method, namely analyzing the relationship between independent variables and dependent variables related to detergent stock.

Linear regression is used for its ability to identify trends and provide simple but accurate prediction results. The analysis process involves data processing, testing regression assumptions, and evaluating the model to ensure its reliability in supporting business decisions.

The steps of the linear regression method are explained as follows:

1. Enter the variables for x_1x_1 , x_2x_2 , and yyy values to be analyzed.
2. Calculate the regression coefficient.
3. Process elimination of linear equations.
4. Produce a linear equation to predict detergent stock.

The initial step begins by determining the variables that will serve as a reference in predicting detergent stock for the coming period. These variables will be the basis for algorithm calculations. The research result variables used are as follows:

Table 2. Variables Used

No	Variable	Information
1	Y	Detergent Inventory Stock
2	X1	Use
3	X2	Target Usage

Then enter the variables that have been determined into the research data as follows:

Table 3. Detergent inventory stock variable data

No	Detergent Inventory Stock (Y)	Use (X1)	Target Usage (X2)
1	115	102	110
2	115	109	110
3	110	107	105
4	110	112	105
5	113	98	110
6	110	95	100
7	110	90	100
8	95	103	90
9	118	117	105
10	108	102	105

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No	Detergent Inventory Stock (Y)	Use (X1)	Target Usage (X2)
...	...	...	...
34	105	118	100
35	100	105	95
36	100	111	95

Calculating Regression Coefficients

Regression coefficients are an important element in regression analysis. This coefficient functions to form a regression equation model that is used to solve the problem under study. Regression coefficient calculations can be done in two ways, namely through manual calculations using ordinary mathematical methods or with the help of statistical software such as SPSS. However, the calculation results of the two methods must be the same or at least close. The results of the regression coefficients for variables Y, X1, X2, and $X1 * Y$ can be seen in the table below:

Table 4. Regression Coefficients for Variables $X_1, X_2, X_3, Y, X_1 * Y, X_2 * Y$

No	Y	X1	X2	$X1 * Y$	$X2 * Y$
1	115	102	110	11730	12650
2	115	109	110	12535	12650
3	110	107	105	11770	11550
4	110	112	105	12320	11550
5	113	98	110	11074	12430
6	110	95	100	10450	11000
7	110	90	100	9900	11000
8	95	103	90	9785	8550
9	118	117	105	13806	12390
10	108	102	105	11016	11340
...	...	...	...	...	...
34	105	118	100	12390	10500
35	100	105	95	10500	9500
36	100	111	95	11100	9500
Σ	3921	3816	3748	416224	409838

The results of the regression coefficients for variables $X_1^2, X_2^2, X1.X2$ can be seen in the following table:

Tabel 5. Koefisien Regresi Untuk Variabel $X_1^2, X_2^2, X1.X2$

No	X_1^2	X_2^2	$X1.X2$
1	10404	12100	11220
2	11881	12100	11990
3	11449	11025	11235
4	12544	11025	11760
5	9604	12100	10780
6	9025	10000	9500
7	8100	10000	9000
8	10609	8100	9270

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No	X_1^2	X_2^2	$X_1.X_2$
9	13689	11025	12285
10	10404	11025	10710
...	...	...	...
34	13924	10000	11800
35	11025	9025	9975
36	12321	9025	10545
Σ	406366	391882	397852

Simplifying Linear Regression Equations

From the calculation of the regression coefficient above, the next step in creating a linear equation is as follows:

1. For the equation $\Sigma Y = a_n + b_1 \Sigma X_1 + b_2 \Sigma X_2$ and the regression coefficient, the results are as follows:

$$3921 = 36a + 3816b_1 + 3748b_2 \quad (1)$$

2. For the equation $\Sigma YX_1 = a \Sigma X_1 + b_1 \Sigma X_1^2 + b_2 \Sigma X_1 X_2$ and the regression coefficient, the results are as follows:

$$416224 = 3816a + 406366b_1 + 397852b_2 \quad (2)$$

3. For the equation $\Sigma YX_2 = a \Sigma X_2 + b_1 \Sigma X_1 X_2 + b_2 \Sigma X_2^2$ and the regression coefficient, the results are as follows:

$$409838 = 3748a + 397852b_1 + 391882b_2 \quad (3)$$

Next, carry out the elimination process between equations (1) and (2):

$$3921 = 36a + 3816b_1 + 3748b_2 \quad (1)$$

$$416224 = 3816a + 406366b_1 + 397852b_2 \quad (2)$$

$$3921 = 36a + 3816b_1 + 3748b_2 \quad \text{X 3816}$$

$$416224 = 3816a + 406366b_1 + 397852b_2 \quad \text{X 36}$$

$$14962536 = 137376a + 14561856b_1 + 14302368b_2$$

$$14984064 = 137376a + 14629176b_1 + 14322672b_2$$

$$-21528 = 0 - 67320b_1 - 20304b_2 \quad (4)$$

Kemudian melakukan proses eliminasi antara persamaan (1) dengan (3):

$$3921 = 36a + 3816b_1 + 3748b_2 \quad (1)$$

$$409838 = 3748a + 397852b_1 + 391882b_2 \quad (3)$$

$$3921 = 36a + 3816b_1 + 3748b_2 \quad \text{X 3748}$$

$$409838 = 3748a + 397852b_1 + 391882b_2 \quad \text{X 36}$$

$$14695908 = 134928a + 14302368b_1 + 14047504b_2 \quad (1)$$

$$14754168 = 134928a + 14322672b_1 + 14107752b_2 \quad (3)$$

$$-58260 = 0 - 20304b_1 - 60248b_2 \quad (5)$$

After carrying out the elimination process between equations (1) to (3), a new equation is obtained which is as follows:

$$-21528 = 0 - 67320b_1 - 20304b_2 \quad (4)$$

$$-58260 = 0 - 20304b_1 - 60248b_2 \quad (5)$$

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Then carry out an elimination process between equations (4) and (5):

$$\begin{array}{rcl}
 -21528 & = & 0 - 67320b_1 - 20304b_2 & (4) \quad X-20304b_1 \\
 -58260 & = & 0 - 20304b_1 - 60248b_2 & (5) \quad X-67320 \\
 \hline
 437104512 & = & 1366865280b_1 + 412252416b_2 & (4) \\
 3922063200 & = & 1366865280b_1 + 1366865280b_2 & (5) \\
 \hline
 -3484958688 & = & 0 - 954612864b_2 & (6)
 \end{array}$$

From equation (6), the value of b2 can be obtained in the following way:

$$\begin{aligned}
 -3484958688 &= 0 - 954612864b_2 \\
 -954612864b_2 &= -3484958688 \\
 b_2 &= -3484958688 / -954612864 \\
 &= 3,650651295 \text{ (become } \mathbf{0,65})
 \end{aligned}$$

Then to get the value of b1, the result of b2 is entered into equation (4) or equation (5), in this case using equation (4) as follows:

For $b_2 = 0,25$ and equation (4):

$$\begin{aligned}
 -21528 &= 67320b_1 - 20304b_2 & (4) \\
 -21528 &= 67320b_1 - (20304 * \mathbf{0,65}) & (4) \\
 -21528 &= 67320b_1 - 13197,6 & (4) \\
 -21528 + 13197,6 &= 67320b_1 & (4) \\
 8330,4 &= 67320b_1 & (4) \\
 67320b_1 &= 8330,4 & (4) \\
 b_1 &= 8330,4 / 67320 & (4) \\
 b_1 &= -0,123743316 \text{ (} \mathbf{0,12})
 \end{aligned}$$

Then to get the value of a, the results of b1, b2 are entered into equation (1) or (2) or (3), in this case using equation (1) as follows:

For $b_1 = 0,78$, $b_2 = 0,65$ and equation (1) then:

$$\begin{aligned}
 3921 &= 36a + 3816b_1 + 3748b_2 & (1) \\
 3921 &= 36a + (3816 * \mathbf{0,12}) + (3748 * \mathbf{0,65}) & (1) \\
 3921 &= 36a + 472,204492 + 2436,2 & (1) \\
 3921 &= 36a + 1963,995508 & (1) \\
 3921 - 1963,995508 &= 36a & (1) \\
 1957,004492 &= 36a & (1) \\
 a &= 1957,004492 / 36 & (1) \\
 a &= 54,36123589
 \end{aligned}$$

From the results of the calculations a, b1, b2 above, if the results are entered into the following equation:

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3$$

So it will produce the equation below:

$$Y = 54,36123589 + 0,12X_1 + 0,65X_2$$

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DISCUSSIONS

Case Testing based on equation results:

Laundry Luch wants to predict the amount of detergent stock based on the number of uses and usage targets for January 2025 with existing data from previous years, namely the estimated number of uses is 111 boxes of detergent with a sales target of 95 boxes of detergent.

Known:

X_1 (Use) = 111

X_2 (Target Usage) = 95

Asked

Y (Detergent inventory stock) = ?

Analysis results:

the formula is as follows:

$$Y = a + b_1 X_1 + b_2 X_2$$

$$Y = 54,36123589 + 0,12X_1 + 0,65X_2$$

$$Y = 54,36123589 + (0,12 * 111) + (0,65 * 95)$$

$$Y = 54,36123589 + 13,32 + 61,75$$

$$Y = 129,4312359 \text{ rounded } 129$$

Based on the calculations above, the predicted detergent stock for Laundry Luch in January 2025, with an estimated total usage of 111 boxes of detergent and a target usage of 95 boxes of detergent, is 129 boxes of detergent.

CONCLUSION

The research entitled "Detergent Stock Analysis at Luch Laundry Using the Linear Regression Method" aims to predict the amount of detergent stock needed based on historical usage data. Based on the results of the analysis using the linear regression method, a prediction model was obtained which was able to provide a more accurate estimate of stock requirements.

From the calculation results, it was found that the linear regression method was effective in analyzing the relationship between the independent variable (number of previous uses) and the dependent variable (inventory stock). With this model, Laundry Luch can manage detergent stocks more optimally, reduce the risk of excess or shortage of inventory, and increase operational efficiency.

In conclusion, the application of the linear regression method provides real benefits in supporting data-based decision making, especially in planning inventory for Luch Laundry operational needs.

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