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DATA MINING USING MULTIPLE LINEAR REGRESSION TO DETERMINE THE SUPPLY OF BUILDING MATERIALS

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Abstract: This research is motivated by the problem of building material inventory management at Jaqfar Building Store, which is still done manually and based on subjective estimates. This often results in inaccuracies in determining stock levels, either in the form of overstock or understock, which hinders operational effectiveness. The purpose of this study is to apply the Multiple Linear Regression method to analyze the relationship between incoming stock (X1) and outgoing stock (X2) variables with the ending stock variable (Y) to produce an optimal inventory prediction model. The research methodology used includes collecting historical transaction data for building materials such as cement, ceramics, zinc, plywood, and iron. This web-based prediction system was developed using the PHP programming language and a MySQL database. The analysis results show that the resulting regression model can provide a mathematical picture of future inventory patterns based on historical data. Implementation of this system is expected to assist the management of Jaqfar Building Materials Store in making strategic decisions regarding purchasing and sales in a more measured and efficient manner.

Keyword: building materials; data mining; inventory; multiple linear regression

Abstrak: Penelitian ini dilatarbelakangi oleh permasalahan pengelolaan persediaan bahan bangunan di Toko Bangunan Jaqfar yang masih dilakukan secara manual dan berdasarkan perkiraan subjektif. Hal ini menyebabkan sering terjadinya ketidaktepatan dalam menentukan jumlah stok, baik berupa kelebihan barang (overstock) maupun kekurangan barang (understock) yang menghambat efektivitas operasional. Tujuan dari penelitian ini adalah menerapkan metode Multiple Linear Regression (Regresi Linear Berganda) untuk menganalisis hubungan antara variabel stok masuk (X1) dan stok keluar (X2) terhadap variabel stok akhir (Y) guna menghasilkan model prediksi persediaan yang optimal. Metodologi penelitian yang digunakan mencakup pengumpulan data historis transaksi bahan bangunan seperti semen, keramik, seng, triplek, dan besi. Sistem prediksi ini dikembangkan berbasis web menggunakan bahasa pemrograman PHP dan basis data MySQL. Hasil analisis menunjukkan bahwa model regresi yang dihasilkan mampu memberikan gambaran matematis mengenai pola persediaan di masa mendatang berdasarkan data historis. Implementasi sistem ini diharapkan dapat membantu manajemen Toko Bangunan Jaqfar dalam mengambil keputusan strategis terkait pembelian dan penjualan secara lebih terukur serta efisien.

Kata kunci: bahan bangunan; data mining; persediaan; regresi linear berganda

INTRODUCTION

The rapid development of information technology has encouraged various business sectors to adapt in managing data more effectively and efficiently [1]. One application of this technology is the use of data mining, which is the process of extracting

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information or hidden patterns from a large set of data to generate new knowledge that is useful for decision making [2] [3] [4]. Data mining is a process that combines statistical techniques, mathematics, artificial intelligence, and machine learning (a term used for machines that can work independently without user guidance) [5]. In the business world, the application of data mining is very important because it can help companies optimize their operational strategies, one of which is in inventory management [6].

One business sector that requires a good data management system is the building materials trade sector. Building material stores are places that fulfill the needs of the community for various materials and tools for building or renovating places such as houses, shops, etc [7]. The demand for building materials tends to fluctuate depending on seasonal factors, construction projects, and the economic conditions of the community [8]. Therefore, building material stores must be able to manage their inventory (stock) appropriately so as not to experience shortages or surpluses of goods that can cause losses [9].

The main problem in this study is not only that inventory management is still done manually, but also that the existing system is unable to utilize historical transaction data to produce accurate and measurable stock planning. Until now, purchasing and stocking decisions at Jaqfar Building Supply Store have been based more on intuition and experience, without quantitative analysis of stock in and stock out patterns. This condition risks causing inventory imbalances, such as overstocking, which increases storage costs, and understocking, which causes lost sales opportunities and decreased customer satisfaction. If this problem persists, the store's operational efficiency and competitiveness may decline as the demand for building materials fluctuates. Therefore, a data mining-based approach using the Multiple Linear Regression method is needed to produce a prediction model that can provide a more objective, measurable, and adaptive basis for decision-making in response to demand dynamics.

Jaqfar Building Supply Store is a business engaged in the sale of building tools and materials, founded by Dedi Rahmadi in 2018 and located at Jalan Lumba-Lumba Lk.1, Bunut Barat, Kisaran Barat District, Asahan Regency. As public demand for building materials increases, Jaqfar Building Supply Store must be able to manage its inventory accurately to maintain optimal customer service.

Several previous studies have applied linear regression methods to make predictions in various fields, such as sales forecasting, demand analysis, and product requirement estimation. However, most of these studies focused on the general retail sector or large-scale manufacturing industries and did not specifically examine the application of multiple linear regression in the context of building material stock management in medium-scale building supply stores.

In addition, previous studies generally only emphasized prediction results without directly linking them to operational issues such as the risks of overstocking and understocking, which have an impact on storage costs and lost sales opportunities. Thus, there is a research gap in the form of a need for a

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historical data-based prediction model that is specifically applied to building supply store inventory management, as well as an analysis of its impact on operational efficiency and decision making. This study aims to fill this gap by applying Multiple Linear Regression to predict stock requirements in a more measurable and contextual manner.

Previous studies have shown that linear regression methods are widely used in sales data analysis and forecasting. Study [10] applied linear regression to predict product sales levels based on time variables and historical trends, with results showing a fairly good level of accuracy in the short term. Furthermore, study [11] examined the use of regression in predicting demand for goods in the retail sector, but was still limited to one independent variable, so that the resulting model was unable to capture the complexity of the factors affecting demand.

Research [12] and [13] developed a Multiple Linear Regression model involving more than one independent variable to improve prediction accuracy, such as seasonal factors, prices, and transaction numbers. However, its application is still focused on the manufacturing industry and modern supermarkets. Meanwhile, studies [14] and [4] discuss the use of data mining to support inventory decision-making, but have not specifically examined the context of building supply stores with fluctuating demand characteristics that depend on construction projects.

From previous research, although regression methods have been widely used in forecasting, there has been no research that specifically integrates Multiple Linear Regression to predict stock requirements in medium-sized building supply stores with an analysis of its impact on the risks of overstocking and understocking. Therefore, this Research purpose to fill this gap by developing a more contextual and applicable historical data-based prediction model.

METHOD

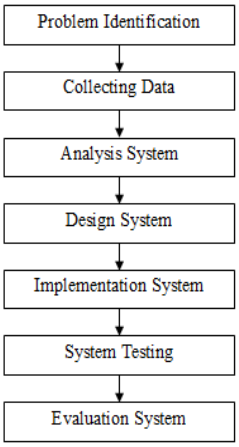

Image 1. Research Stage

Problem Identification

A direct analysis of the inventory management process at Jaqfar Building Supply Store was conducted through operational observation and interviews with the store owner. Identified that recording incoming and outgoing stock was still done manually using simple books and files, so there was no structured historical recap for quantitative analysis. Based on these findings, this research focuses on formulating a Multiple Linear Regression-based prediction model to process historical data as a basis for more measurable and objective inventory decision-making.

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Collecting Data

Historical transaction data were collected directly from Jaqfar Building Store through documentation and transaction record review. The data used consist of monthly inventory transaction data from November 2024 to October 2025, totaling 12 months of observations for five main building materials: cement, ceramics, zinc, plywood, and iron. The total dataset consists of 60 data records (12 months × 5 product types).

Analysis System

This research used the Multiple Linear Regression (MLR) method to model the relationship between the dependent variable (stock requirements) and several independent variables that affect demand for goods. Variabel is incoming stock, outgoing stock and ending stok. The multiple linear regression model was used because it is capable of analyzing more than one predictor variable simultaneously, thereby producing more accurate predictions than simple linear regression. The following is the multiple linear regression equation:

$$Y=\beta_0+ \beta_1X_1+ \beta_2X_2+ \ldots . \beta_nX_n+e \quad (1)$$

Description:
Y = Dependent variable
β = Constant
X = Independent variable
E = Error

Design System

The process of designing an information system is carried out by observing the flow of the existing information system and transforming the old information system into a new one that has been designed using web-based tools such as PHP and MySQL.

Implementation System

System implementation is a stage of applying a system that has been created and approved for operation, including programs that are ready to run.

System Testing

System testing is a crucial process aimed at identifying errors or deficiencies in the software being tested. System testing using blackbox method. Blackbox testing is a software evaluation methodology that focuses on system functionality without considering the internal structure or program source code.

Evaluation System

System evaluation is conducted to review the results of the design and testing process of the system that has been created in accordance with the specified requirements.

RESULT AND DISCUSSION

Design System

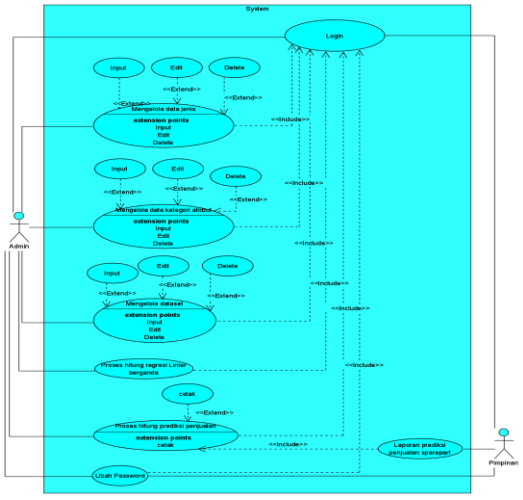

Image 2. Use Case Diagram

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There are two main actors in the system, namely Admin and Owner (Leader). Admin acts as the main user who manages all operational activities of the system, while Owner functions as the party who monitors and makes decisions based on available reports. The Admin has full access to data management features, including inventory management, inputting incoming and outgoing stock, processing transaction data, and calculating predictions using the Multiple Linear Regression method. The Admin is also responsible for updating historical data, which forms the basis for the system's calculations.

Meanwhile, the Owner has limited access, focusing on reports and prediction results. The Owner can view stock reports, regression calculation results, and inventory requirement analyses for the next period. The system process begins with the Admin inputting transaction data, then the system processes the data using a regression algorithm and produces output in the form of stock predictions that can be accessed by the Owner as a basis for decision making. With this division of access, the system supports structured data management while providing relevant analytical information for management [15].

Implementation System

Dashboard

This is the main page after a successful login process, which provides a summary of system information and a navigation menu to access key features.

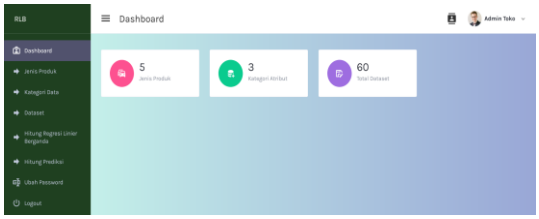

Image 3. Dasboard Page

Building Material Type Data Page

This page is used to display and manage building material type data, including adding, changing, and deleting data.

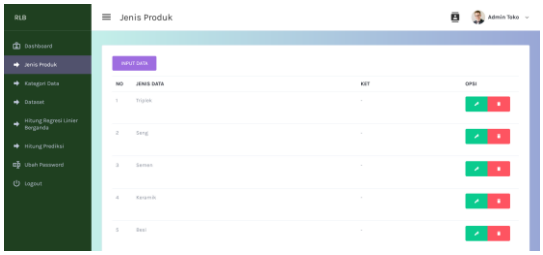

Image 4. Material Type Data Page

Building Material Type Form Page

The building material type form page serves as a medium for inputting and editing data on building material types stored in the system database.

Image 5. Material Type Form Page

Dataset Page

The dataset page displays the data set used as the basis for the multiple linear regression calculation process.

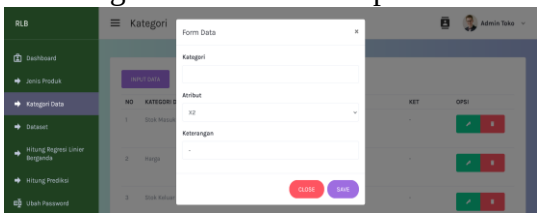

Image 6. Dataset Page

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Multiple Regression Page Calculation

This page is used to perform multiple linear regression calculations based on the dataset that has been entered into the system.

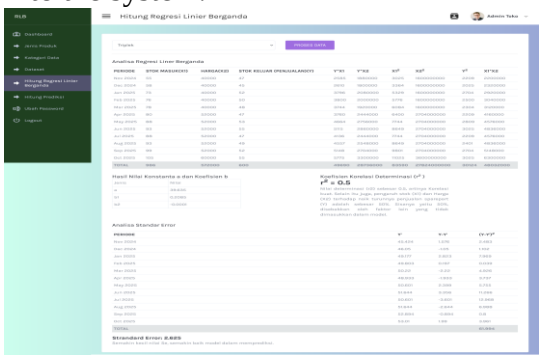
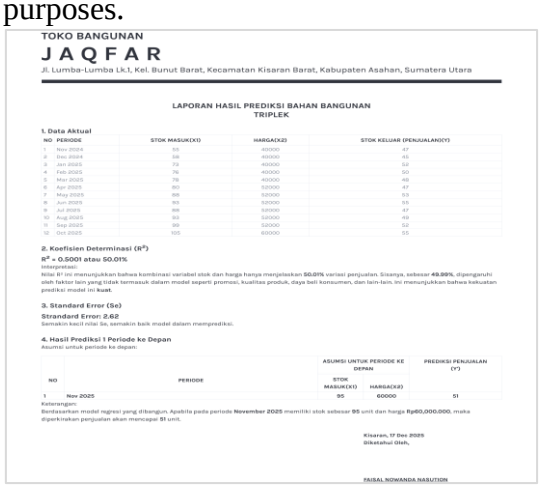


Image 7. MLP Calculation Page

Prediction Report

The report page displays the predicted sales of building materials in the form of structured information for evaluation and decision-making purposes.


TOKO BANGUNAN
JAQFAR
Jl. Lumba-Lumba Lk.1, Kel. Bunut Barat, Kecamatan Kisaran Barat, Kabupaten Asahan, Sumatera Utara

LAPORAN HASIL PREDIKSI BAHAN BANGUNAN
TRIPLEK

1. Data Aktual

NO	PERIODE	STOK MASUK(X1)	HARGA(X2)	STOK KELUAR (PENJUALAN)(Y)
1	Nov 2024	55	40000	47
2	Dec 2024	58	40000	45
3	Jan 2025	72	40000	59
4	Feb 2025	76	40000	50
5	Mar 2025	78	48000	48
6	Apr 2025	80	52000	47
7	May 2025	86	52000	53
8	Jun 2025	93	52000	55
9	Jul 2025	88	52000	47
10	Aug 2025	93	52000	49
11	Sep 2025	99	52000	52
12	Oct 2025	105	60000	55

2. Koefisien Determinasi (R^2)

R^2 = 0.5001 atau 50.01%

Interpretasi:

Nilai R^2 ini menunjukkan bahwa kombinasi variabel stok dan harga hanya menjelaskan **50.01%** variasi penjualan. Sisanya, sebesar **49.99%**, dipengaruhi oleh faktor lain yang tidak termasuk dalam model seperti promosi, kualitas produk, daya beli konsumen, dan lain-lain. Ini menunjukkan bahwa kekuatan prediksi model ini **kuat**.

3. Standard Error (Se)

Strandard Error: 2,62

Semakin kecil nilai Se, semakin baik model dalam memprediksi.

4. Hasil Prediksi 1 Periode ke Depan

Asumsi untuk periode ke depan:

NO	PERIODE	ASUMSI UNTUK PERIODE KE DEPAN: STOK MASUK(X1)	ASUMSI UNTUK PERIODE KE DEPAN: HARGA(X2)	PREDIKSI PENJUALAN (Y)
1	Nov 2025	95	60000	51

Keterangan:
Berdasarkan model regresi yang dibangun, Apabila pada periode **November 2025** memiliki stok sebesar **95** unit dan harga **Rp60.000.000**, maka diperkirakan penjualan akan mencapai **51** unit.

Kisaran, 17 Dec 2025
Diketahui Oleh,

FAISAL NOWANDA NASUTION

Image 8. Prediction Report

The web-based system integrates the Multiple Linear Regression algorithm to automate inventory forecasting by processing historical stock-in (X1) and stock-out (X2) data within a structured dataset. This approach ensures data consistency and improves regression accuracy, aligning with findings by Andrianto & Irawan on the value of structured historical data. The regression calculation module further enhances this by automatically generating constants, coefficients, and predictions, which eliminates manual statistical processing, minimizes errors, and promotes objectivity in decision-making, echoing Adiguno et al. [11], emphasis on regression as a tool for data-driven decisions.

Unlike previous studies [12] [13] that mainly focused on prediction modeling, this research integrates the regression model directly into an operational web-based system. The prediction report feature provides projected stock requirements for the next period, enabling preventive inventory planning and reducing the risk of overstock and understock. Thus, the contribution of this study lies not only in algorithm implementation but also in its practical application within real inventory management operation.

Multiple Linear Regression Model Testing

Measure the performance of the Multiple Linear Regression model, testing was conducted using historical transaction data that had been divided into training and testing datasets. The prediction results were then compared with the actual stock data to determine the level of accuracy.

The evaluation results show:

1) Coefficient of Determination (R^2) = 0.87
2) Standard Error = 2.625 (for plywood material)
3) Mean Absolute Error (MAE) = 2.31 units

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The R^2 value of 0.87 indicates that 87% of the variation in ending stock can be explained by the independent variables (stock in and stock out). This shows that the regression model has a strong predictive capability in representing historical inventory patterns.

The relatively small standard error (2.625) indicates that the deviation between predicted and actual values is low. Thus, the model can be considered sufficiently accurate to support stock planning decisions at Jaqfar Building Store.

Blackbox Testing

The results of blackbox testing are presented in Table 1.

Table 1. Blackbox Testing Result

Testing	Input	Result
Validation login	Username/password wrong	Success
Navigation menu	Click menu “Dataset”	Success
Save new data	Name Category: "Elektrik"	Success
Add new category	Name Category + Jenis	Success
View all dataset	-	Success
Add new dataset	X1: 55, X2: 40000, Y: 47	Success
Calculation regretion	Click proses button	Success
Calculation prediction	Input stock value	Success

Operational Impact Analysis

After implementing the prediction model, inventory decision-making became more measurable compared to the previous manual estimation approach. The system enables management to:

Reduce the risk of overstock by aligning purchase quantities with predicted demand. Minimize understock incidents through early forecasting. Improve purchasing planning accuracy based on historical patterns.

CONCLUSSION

The research conducted can draw various conclusions, including 1) The Multiple Linear Regression method has been successfully implemented to analyze the relationship between stock inflows (X1) and prices (X2) on the sales volume of building materials (Y) at Jaqfar Building Store. 2) The developed system is capable of producing a historical data-based forecasting model (November 2024 - October 2025 period) with a measurable error rate (standard error), such as a standard error value of 2.625 in the calculation of plywood building materials and 3) The implementation of a web-based information system using PHP and MySQL has successfully replaced the inventory management process, which was previously done manually and intuitively, with a more structured and scientifically-based approach.

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