MJI
Media Jurnal Informatika
Vol. 12, No. 2, December 2025
p-issn : 2088-2114, e-issn : 2477-2542

Development of A Sales Forecasting Application Using The Autoregressive Integrated Moving Average Method With External Input (ARIMAX)

Aulia Aziizah Fauziyyah [a,1,*], Jonanda Pantas Agitha Brahmana [a,2], Paulina Lestari Simatupang [a,3], Eddy B. Soewono [a,4], Hashri Hayati [a,5]

[a] Politeknik Negeri Bandung, Jl. Gegerkalong Hilir, Ciwaruga, Kabupaten Bandung Barat 40559, Indonesia
[1] auliaziizah@gmail.com*; [2] jonandapantas@gmail.com; [3]paulinalestarisimatupang@gmail.com; [4] ebang@polban.ac.id; [5] hashri.hayati@polban.ac.id
* corresponding author

ARTICLE INFO

Article history
Received
Revised
Accepted

Keywords
PT Selada Indonesia Produktif
Forecasting
Autoregressive Integrated Moving Average with Exogenous Input (ARIMAX)
Mean Absolute Error (MAE)
Waterfall

ABSTRACT

PT Selada Indonesia Produktif is an information technology company that also operates in the culinary industry through the Pempek Duo brand. In the operational business of the culinary sector, PT Selada has developed the Mireta Point of Sale (POS) system as a transactional and reporting tool. However, the existing system has not been equipped with a transaction history data analysis feature to predict sales trends. This condition makes it difficult for the company to identify which products are best-selling and which ones are less popular. This development aims to create a sales forecasting feature based on the Autoregressive Integrated Moving Average with Exogenous Input (ARIMAX) method in the Mireta POS system. The ARIMAX model was chosen because it can incorporate external variables into the prediction calculations, in this case, holiday factors. The development was carried out using a waterfall approach which includes the stages of requirements analysis, system design, model implementation, and accuracy testing. The data used consists of the sales transaction history of Pempek Duo products from January 2022 to February 2023, which has been grouped by week, as well as holiday data as an external variable. The model evaluation results show that the best parameter combination is ARIMAX(1,0,2) with a Mean Absolute Error (MAE) value of 4.3333. This value indicates an average prediction error of 4 sales packages per week. With this feature, Mireta POS can provide more accurate sales predictions, making it easier for the company to identify the best-selling and least popular products.

1. Introduction

PT Selada Indonesia Produktif (Selada) is an information technology company established in 2019. This company focuses on the development of web-based and mobile applications across various platforms. Along with its development, Selada also ventured into the culinary industry through the brand Pempek Duo. Direct experience in running this culinary business has encouraged the company to better understand the technological needs in this sector.

One of the technologies that plays an important role in the operations of the trade sector is the Point of Sale (POS) system. POS is a system that executes financial processes and transactions equipped with integrated management features, such as sales transactions and inventory or stock management. Each POS consists of hardware, such as terminals or computers, and software that includes inventory management,

reporting, purchasing, customer management, and return processing. These two components are used to support the entire transaction process [13].

Based on an interview with the Chief Technology Officer (CTO) of PT Selada Indonesia Produktif, the company currently has an application designed to support culinary business operations, namely Mireta Point of Sale (POS). However, the application still has shortcomings or limitations. The Mireta POS website only provides reporting of transaction results without any data processing that can be utilized to support business operations. As a result, the transaction history data and reports produced cannot help users understand sales trends.

As a consequence of these limitations, Selada is facing operational issues, particularly in terms of sales trend analysis. This results in a lack of understanding regarding the sales patterns of pempek products, making it difficult for the company to identify the best-selling and less popular products. One way to improve the efficiency of the POS system is through the use of forecasting.

Forecasting is a method used to predict possible situations in the future by analyzing data that has occurred in the past. This approach is very useful for business or organization owners in determining estimates of product sales in the future. Thus, owners can make more informed decisions regarding strategies for increasing or decreasing the production of goods [8].

In the developed application, the forecasting method used is time series. The time series method is a forecasting technique that analyzes the pattern of relationships between the predicted variable and the factor of time [1]. The time series method used is Autoregressive Integrated Moving Average With Exogenous Input (ARIMAX).

Several previous studies have proven the effectiveness of forecasting methods in supporting business decision making. One of them is the research by Syam [12] titled "Application of the Autoregressive Integrated Moving Average Exogenous (ARIMAX) with Calendar Variation Effect Method for Forecasting Chocolate Data in Indonesia and the United States". This study used Google Trends data related to the keywords "Cokelat" (Indonesia) and "Chocolate" (United States) during the period of 2012-2019. The ARIMAX model was applied by including dummy variables that represent celebration moments, such as Valentine's Day, Christmas, and Eid al-Fitr, as external variables. The results showed that the ARIMAX model with calendar variation was able to provide good prediction accuracy, with a Mean Absolute Percentage Error (MAPE) value below 10%, specifically 4.73% for Indonesia and 2.47% for the United States. This shows that the use of calendar-based external variables in the ARIMAX model can improve forecasting accuracy, especially in cases that contain seasonal patterns due to specific celebrations.

Based on the problems outlined and supported by previous research, the aim of this development is to add a sales forecasting feature to the Mireta web-based POS system using the ARIMAX method. ARIMAX was chosen because it has the additional advantage of allowing the inclusion of external variables that affect predictions. In the development, the external variable used is holidays. This makes ARIMAX more flexible and accurate in modeling sales data influenced by external factors. [2].

2. Method

2.1 Type and Approach of Research

This research falls into the category of Research and Development (R&D), which is an approach aimed at researching and simultaneously developing certain products or systems to provide solutions to real problems. This approach was chosen because this research aims not only to analyze transaction history data but also to generate a product in the form of a sales forecasting feature on Mireta POS. The development process is carried out based on the needs of the company.

The use of the ARIMAX forecasting method in this development is based on the need to model transaction history data influenced by certain external factors, such as holidays. With this approach, the results obtained are not only theoretical but can also be directly implemented in the systems used by the company. Thus, the R&D approach is considered most suitable for the research objectives, which are to produce an optimal forecasting model and provide useful predictive information in the company's operational decision-making process.

2.2 Object and Scope of Research

The main object of this research is forecasting feature in the Mireta POS system used by PT Selada Indonesia Produktif. Mireta POS is a Point of Sale application that functions to record and manage sales transactions. This research focuses on the development of a sales forecasting feature in the system by utilizing the ARIMAX method (Autoregressive Integrated Moving Average with Exogenous Input).

The scope of this research includes the design and implementation of a weekly sales forecasting feature using the ARIMAX (Autoregressive Integrated Moving Average with Exogenous Input) method. This feature is developed to support the short-term production needs of Micro, Small, and Medium Enterprises (MSMEs) in the culinary sector. The research is limited to the use of sales transaction data for pempek and only considers external variables such as holidays, without including other factors such as promotions or weather. In addition, the prediction scope only covers the quantity of products in packaged forms and item variants (variants within each package), without detailing raw material requirements or conducting other financial analyses.

2.3 Data Collection Techniques

The data sources in this research consist of transaction history data and product data stored in the database of the ongoing system. The transaction history data includes information such as ID, date and time of the transaction, products sold, and the quantity purchased in each transaction. This data is processed and grouped by weekly periods for each type of product, to facilitate analysis of sales volume and patterns that occur every week.

The product data includes product ID, product name, and description. The description column contains an explanation of the composition of the variants included in each product package. This data is used to support the calculation of product requirements based on sales forecast results. Thus, the system can identify the quantity of item needs more accurately.

2.4 Tools and Marials Used

A. Laravel

Laravel is an open-source PHP framework designed to facilitate use and ensure reliability. By using the MVC (Model-View-Controller) design pattern, Laravel integrates various elements from other frameworks to simplify the web application development process. This framework provides a neater structure and an efficient approach, incorporating the best features of CodeIgniter, Yii, and also the principles from Ruby on Rails. With its comprehensive features, Laravel significantly accelerates and simplifies the web development process [11]. In the development process of the Mireta Point of Sale application, a PHP framework is used as the backend.

B. Vue.js

Vue.js is one of the famous frameworks built using the JavaScript language. This framework's main purpose is to develop Single Page Applications (SPA) and User Interfaces (UI). With Vue.js, the user interface can be divided into several small parts known as components. These parts can be reused as needed without having to be created repeatedly. In addition, Vue.js is known for being easy to integrate with various applications and has very good performance [3]). In the process of developing the Mireta Point of Sale Application, Vue.js functions as the frontend.

C. PostgreSQL

PostgreSQL is an open-source database management system that is available for free under the BSD license. As one of the most well-known databases besides MySQL and Oracle, PostgreSQL provides a variety of outstanding features, including the ability to replicate data. Various features supporting the replication process in PostgreSQL include DB Mirror, PGPool, Slony, and PGCluster. After more than 15 years of active development, PostgreSQL is recognized as a reliable relational database system, with a strong structure, ensuring data integrity and accuracy [5]. In the process of developing the Mireta Point of Sale application, PostgreSQL is implemented as the database management system to store and manage the necessary data.

D. Google Colab

Google Colab is a cloud-based Jupyter Notebook service that can be accessed without the need for installation or configuration. This service offers free access to computing resources, including GPUs (Graphics Processing Units) and TPUs (Tensor Processing Units). Colab is particularly suitable for

machine learning, data science, and education. In the development process of the Mireta Point of Sale application, Google Colab is utilized to analyze and test transaction history data, as well as to conduct model forecasting experiments. Google Colab was chosen because it can run Python code without requiring additional installations or configurations, thus providing convenience in its use.

E. Python

Python is a high-level programming language designed with principles that emphasize code readability and clear syntax. Python is a commonly used programming language in web application development, software, data analysis, and machine learning (ML). Developers choose Python for its effectiveness, ease of learning, and ability to operate on various platforms. Python can be downloaded at no cost, integrates well with various types of systems, and accelerates the development process [6]. In the development process of the Mireta Point of Sale application, the programming language used is Python, which is operated through Google Colab.

F. Statsmodels

Statsmodels is a library in Python used for predicting statistical models and conducting statistical tests. This library supports various types of models such as linear regression, generalized linear models, time series analysis, and more. In the context of time series analysis, the SARIMAX function (Seasonal AutoRegressive Integrated Moving Average with eXogenous regressors) is one of the important classes in statsmodels used to model and forecast time series data with seasonal patterns and external variables..

2.5 Research Procedures or Stages

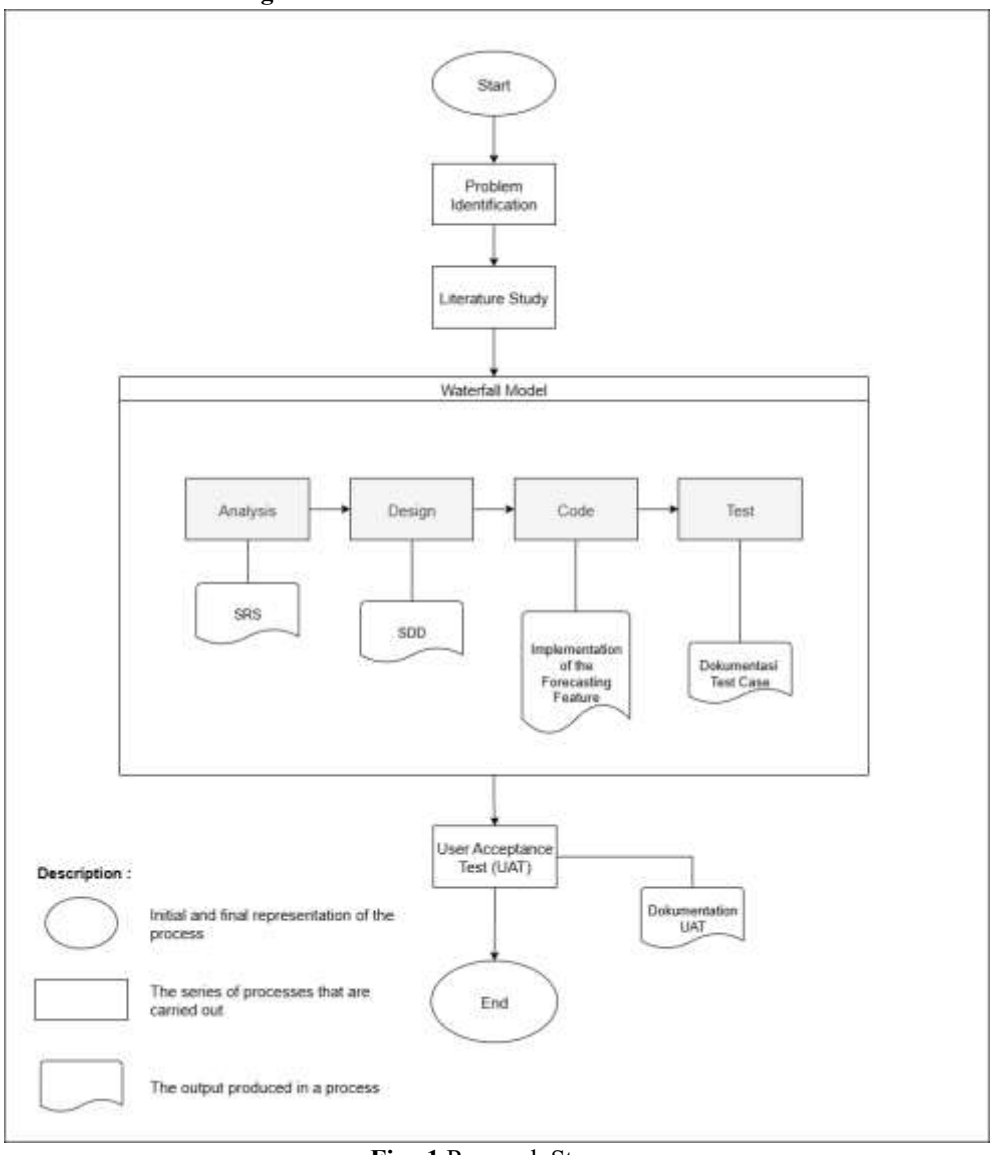

Fig. 1. Research Stages

A. Problem Identification

The initial stage of this development is problem identification to understand user needs and the limitations of the current system. The identification activities are carried out through:

1. Interviews with Relevant Parties
   Interviews are conducted directly with the CEO and CTO of PT Selada Indonesia Produktif. The purpose of this interview is to obtain information related to operational issues and system needs, especially concerning sales predictions and production requirements.
2. Analysis of Existing Systems
   Analysis of the Mireta Point of Sale application that has been used by the company. This analysis is conducted to identify the features that are already available.

B. Literature Study

To strengthen the theoretical framework, understand the supporting technologies, and examine methods relevant to the problems at hand. The scope of the literature study includes:

1. Exploration of Technology
   The exploration focuses on the technology used in the Mireta Point of Sale application. The main technologies used are Laravel as the backend, Vue.js as the frontend, and PostgreSQL as the database system. Additionally, to support the development of sales forecasting features, Python is added as the programming language used in data processing and forecasting model calculations.
2. Collection of Similar Scientific Works
   The collection of scientific references related to sales forecasting methods, specifically the application of the ARIMAX (Autoregressive Integrated Moving Average with Exogenous Input) model. This study aims to understand the principles of ARIMAX, its advantages, and its application in similar case studies.

C. Stages of System Development

The development of the forecasting system in this case uses the waterfall development model, which consists of four main stages: analysis, design, code, and test [10]. The following is an explanation of each stage:

1. Analysis
   This stage includes the analysis of system requirements as well as the analysis of process flow and features to be developed.
2. Design
   This stage involves the design of the system architecture, user interface design, as well as the database structure design used to store forecasting results.
3. Code
   This stage encompasses the implementation of programming code for the sales forecasting feature as well as the calculation of item variant needs based on prediction results.
4. Test
   This stage includes testing the functionality of the developed forecasting features.

2.6 Data Analysis Techniques

A. ARIMAX Method

The Autoregressive Integrated Moving Average With Exogenous Input (ARIMAX) model is a modification of the basic ARIMA model with the addition of external variables[2]. To apply this method, the following ARIMAX equation is used.

$$\emptyset_p(B)(1-B)^d y_t = \beta_o + \beta_1 D_{1,t} + \beta_2 D_{2,t} + \cdots + \beta_n D_{n,t} + \theta_q(B)\varepsilon_t$$

Where,

Table 1. Explanation of the ARIMAX

Variables	Keterangan
y_t	Value of observation at time t
β_o	Intercept or constant of the model
$D_{n,t}$	External variable n at time t
β_n	Coefficient of external variable n

ϕ_p	Autoregressive parameter
θ_q	Moving Average parameter
B	Backward shift operator
$(1-B)^d$	Differencing
ε_t	Error or residual of the model at time t
p	Degree of autoregressive(AR)
q	Degree of moving average(MA)

B. Measurement of Model Accuracy

Forecasting techniques that use quantitative data often involve data in the form of certain time series. Where there are usually errors made by forecasting techniques [4]. The Mean Absolute Error (MAE) is one of the methods used to measure the accuracy level of the forecasting model. The MAE value indicates the average absolute error between the forecasting results and the actual values [7]. The formula for calculating MAE is as follows:

$$MAE = \frac{1}{n}\sum_{t=1}^{n} |y_t - \hat{y}_t|$$

Where,

Table 2. Explanation of the MAE Formula

Variables	Keterangan
$\hat{y}_t$	Predicted Value at time t
y_t	Actual Value at time t
n	Number of Data ObservationsIn this research

In this research, MAE is used as the main indicator to determine the best parameters in the ARIMAX model. The model with the smallest MAE value is chosen because it is considered to have the best prediction accuracy.

3. Results and Discussion

3.1 Presentation of Research Results

A. System Needs Analysis

Based on user needs analysis, the developed system is designed with special access rights intended for the Production Manager. This access rights allow the Production Manager to obtain information on sales forecasting results and calculate the needs for item variants as a basis for production planning. The system needs analysis in the development of the forecasting feature in the Mireta Point of Sale application is illustrated using Unified Modeling Language (UML) diagrams. The analysis model is presented in the form of a Use Case Diagram as shown in Fig. 2.

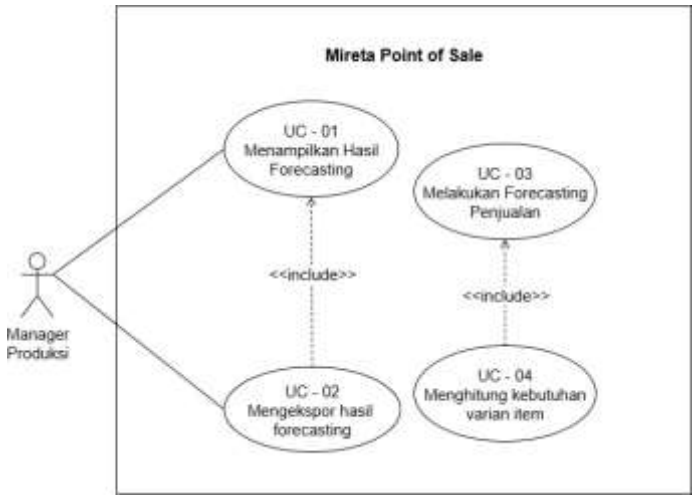

Fig. 2. Use Case Diagram

The use case scenario depicting the sales forecasting process flow and the calculation of item variant needs is presented in the following Table.

Table 3. Use Case Scenario of Building a Forecasting Model

Use Case Name	UC-03 : Building a Forecasting Model
Scope	Aplikasi Mireta Point of Sale
Level	Subfunction
Primary Actor	System
Stakeholder and Interests	The production manager requires forecasting results to plan production quantity needs.
Preconditions	1. The system has access to transaction history data. 2. The forecasting model has been stored in the system.
Success Guarantee	The forecasting results are successfully saved to the database.
Main Success Scenario	1. The system retrieves transaction history data from the existing database. 2. The system groups sales amounts for each product per week. 3. The system calculates the total holidays occurring each week in the data period. 4. For each product, the system performs the following process: 4.1. The system checks the stationarity of sales data. 4.2. If the data is stationary, then the parameter value d = 0. 4.3. The system analyzes the PACF plot to determine the value of p. 4.4. The system checks the lags in the PACF plot that have bars exceeding the significant threshold. 4.5. If there are no bars exceeding the significant threshold, then the system sets p = 0. 4.6. The system analyzes the ACF plot to determine the value of q. 4.7. The system checks the lags in the ACF plot that have bars exceeding the significant threshold. 4.8. If there are no bars exceeding the significant threshold, then the system sets q = 0. 4.9. The system builds several ARIMAX models based on the identified combinations of values for p, d, and q. 4.10. The system evaluates the performance of the models based on error metrics. 4.11. The system selects the best model that has the smallest error value. 4.12. The system calculates the sales forecasting results for the upcoming period using the best model. 4.13. The system stores the latest forecasting results in the database.
Extensions	4.1 a. If the data is non-stationary then 1. The system applies differencing to transform the data into stationary. 2. The system rechecks the stationarity of the data. 3. The system repeats steps 1 and 2 until the data becomes stationary. 4. The value of parameter d in the model is determined based on the number of

	differencing processes performed until the data becomes stationary. 4.5a. If there are bars crossing the significant limit 1. Possible values of p are in the range of 1 to n. 4.8a. If there are bars crossing the significant limit 1. Possible values of q are in the range of 1 to n.
Special Requirements	-
Technology and Data Variation List	The data used is transaction history data.
Frequency of Occurrence	This process runs automatically every 7 days.
Miscellaneous	-

Table 4. Use Case Scenario of Building a Forecasting Model

Use Case Name	UC-04 : Calculating Item Variant Requirements
Scope	Aplikasi Mireta Point of Sale
Level	Subfunction
Primary Actor	System
Stakeholder and Interests	The production manager wants to know the quantity of each type of pempek that needs to be produced based on the product package forecasting results.
Preconditions	1. UC-03 has been successfully executed. The forecasting data is available and stored in the system database. 2. Product data (containing product names, descriptions including item variants in each package) is already available in the system.
Success Guarantee	The item variant data is successfully stored in the system database.
Main Success Scenario	1. The system retrieves forecasting results data from the database. 2. The system retrieves product data from the existing database. 3. For each row of forecasting results data, the system performs the following processes: 3.1. Matching the package name in the forecasting results data with product data. 3.2. Retrieving the description from the product data. 3.3. Calculating the needs for each item variant by multiplying the amount of forecasting results by the quantity of each item variant in the package. 3.4. Storing the calculated needs of item variants into the database.
Extensions	-
Special Requirements	-
Technology and Data Variation List	The data used are forecasting results and product data.
Frequency of Occurrence	This process is automatically executed when UC-03 has been completed.
Miscellaneous	-

B. System Design

System design is conducted to ensure that the data structure used in the development of sales forecasting features on Mireta Point of Sale meets the needs for efficient and integrated data storage. At this stage, a Logical Data Model (LDM) is created to illustrate the logical data structure along with the relationships between relevant entities for the forecasting process and production needs.

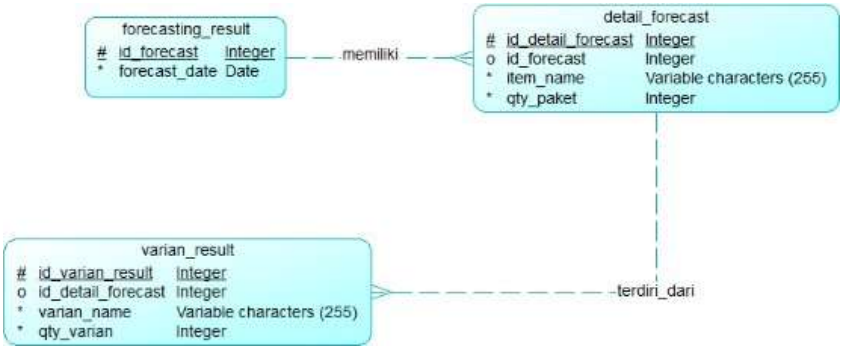

Fig. 3. Logical Data Model (LDM)

The main entities present in the Logical Data Model are as follows:

1. forecasting_result
   Stores information on the main results of the sales forecasting process, namely the prediction date as a reference for the forecast period.
2. detail_forecast
   Stores the required quantity of products for each package based on the forecasting results. This data indicates how many of each product package needs to be prepared according to the sales prediction results..
3. varian_result
   Storing the required quantity of each variant of the item calculated based on the composition of each product package and the quantity of packages needed from the forecasting results.

C. Implementation of the ARIMAX Method

In the development of a sales forecasting feature in the Mireta Point of Sale application, transaction history data is required as a basis for calculations using the ARIMAX method. The data used in this study consists of sales transaction history recorded from January 2022 to February 2023. This data is used to build a sales prediction model considering the influence of external factors.

The external variable used in the ARIMAX modeling is the holiday variable. Each holiday is converted into a binary variable, where a value of 1 indicates the presence of a holiday and a value of 0 indicates a regular day[9]. Thus, the holiday data can be integrated into the model as one of the factors affecting the forecasting results.

Because the data used has been grouped into weekly form, each week period will be examined to determine the existence of holidays. If there is one or more holidays within a single period, the value of the external variable will be weighted according to the number of holidays that occur in that period. Conversely, if there are no holidays, the value of the external variable will remain at 0.

Table 5. Sales Data

t	**Y_t**	**X_t**
1	5	0
2	28	0
3	14	0
…	…	…
72	17	0
73	5	2
74	0	1

Where, t is the t-th week, Y_t is the amount of sales at time t, and X_t is the number of holidays at time t.

The data used is divided into two parts, namely 80% as training data and 20% as testing data. From the total data, 59 data points were obtained for the model training process and 15 data points for the testing process. Then, an Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) analysis was performed to assist in determining the model parameters. The visualization of the ACF and PACF plot results is presented in Fig. 4 and Fig. 5.

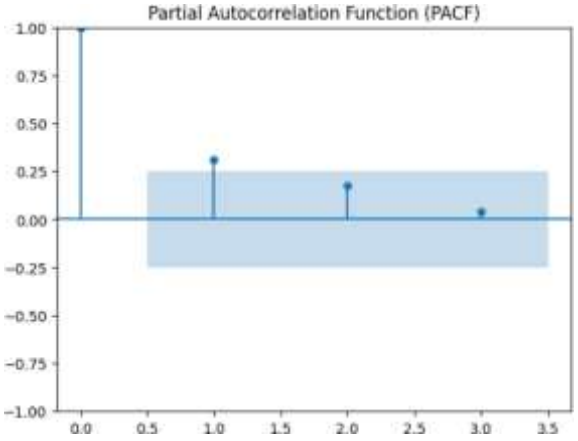

Fig. 4. Plot PACF

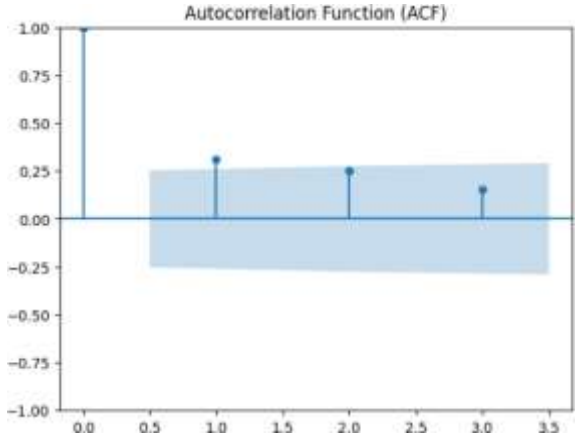

Fig. 5. Plot ACF

Based on the results of the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) analysis, ARIMAX modeling was conducted with various combinations of parameters (p,d,q). Subsequently, the performance of each model was evaluated using the Mean Absolute Error (MAE) indicator. The comparison of the MAE values from each parameter combination is presented in the following table.

Table 6. Evaluation Results of the ARIMAX Model Based on Parameter Combinations and MAE Values

Combination of Parameters (p, d, q)	Mean Absolute Error (MAE)
ARIMAX(0,0,0)	9.6667
ARIMAX(0,0,1)	8.7333
ARIMAX(0,0,2)	8.6667
ARIMAX(1,0,0)	7.8667
ARIMAX(1,0,1)	4.4000
ARIMAX(1,0,2)	4.3333

Based on the model evaluation results in Table 6, the best parameter combination was obtained in the ARIMAX(1,0,2) model because it produced the smallest Mean Absolute Error (MAE) value, which is 4.3333. The model with this parameter combination was then used to predict sales numbers for the next period, which is week 75. The forecasting process was carried out using the following ARIMAX equation.

$$\emptyset_1(B)(1-B)^0 y_t = \beta D_t + \theta_2(B)\varepsilon_t$$

Since the value of d = 0, the equation can be simplified to:

$$\emptyset_1(B) y_t = \beta D_t + \theta_2(B)\varepsilon_t$$

This equation can be derived to:

$$(1 - \emptyset_1 B)y_t = \beta D_t + (1 - \emptyset_1 B + 1 - \emptyset_2 B^2)\varepsilon_t$$

If we write it back in explicit form, we obtain:

$$y_t - \emptyset_1 y_{t-1} = \beta D_t + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2}$$

Thus, the final equation becomes:

$$y_t = \emptyset_1 y_{t-1} + \beta D_t + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2}$$

The estimation of the ARIMAX model parameters was obtained through a training process using the statsmodels library in the Python programming language. The results of the training showed the values of the model parameters as follows:

$$\emptyset_1 = 0.9980$$

$$\beta = -2.8563$$

$$\theta_1 = -0.6481$$

$$\theta_2 = -0.2264$$

The input values for the 75th period are as follows:

$$y_{t-1} = 0$$
$$D_t = 0$$
$$\varepsilon_{t-1} = -7.775479$$
$$\varepsilon_{t-2} = -2.579542$$

By substituting these values into the model equation, the following calculation is obtained:

$$y_{75} = (0{,}9980\ x\ 0) + (-2.8563 \times 0) + \varepsilon_t + (-0.6481 \times -7.775479) + (-0.2264 \times -2.579542)$$

Since the value of εt (the residual at the 75th period) is the result of the internal model estimation process and cannot be calculated manually, the sales prediction for the 75th period is obtained using the .forecast() function from the statsmodels library. The predicted result is 8.47 packages. This predicted value is then rounded up to 9 packages.

D. Hasil Implementasi Fitur

The result of this development is the implementation of a sales forecasting feature. The display of the implementation results is shown through several system interfaces as follows.

1. Visualization of Forecasting Results

   The system displays a visualization of the sales transaction history data in the form of a line chart, which is accompanied by the predicted sales figures for the next period. With this visualization, users can more easily understand past sales patterns while also gaining an estimate of sales figures for the upcoming period.

Fig. 6. Visualization of Forecasting Results

2. Visualization of Overall Product Sales Graph

   The system also provides sales visualization graphs for all available products. This visualization is useful for helping users identify which products have the highest sales levels and which products are less favored by customers.

Fig. 7. Visualization of Sales for All Product Packages

3. Forecasting Results Table by Product Package
   In addition to graphical form, the system also presents forecasting results in table form. This table contains a list of package names, the predicted sales quantity for each package, the details of the composition of item variants in the package, as well as the total needs for each item variant based on the calculated forecasting results.

Fig. 8. Forecasting Results Table by Product Package

4. Summary Table of Item Variant Requirements
   Additionally, the system displays a summary table of the total requirements for each variant of items that need to be produced. This requirement calculation is based on the forecasting results of the number of product packages as well as the composition of each package's contents.

Fig. 9. Recapitulation Table of Item Variant Needs

4. Conclusion

Based on the results of the development that has been carried out, it can be concluded that the sales forecasting feature development on the Mireta Point of Sale application has been successfully implemented using the ARIMAX method (Autoregressive Integrated Moving Average with Exogenous Input). The application of this method is supported by system needs analysis, integrated database design, as well as the implementation of a prediction model that utilizes historical sales transaction data and external variables in the form of holidays. The model testing results show that the best parameter combination is ARIMAX(1, 0, 2), which produces a Mean Absolute Error (MAE) value of 4.3333, the smallest value compared to other ARIMAX models. The MAE value of 4.3333 indicates that the average absolute error between the predicted sales results and actual sales data is about 4.33 sales packages per week. This means that in each week of the testing period, the predicted number of product packages made by the ARIMAX model can differ or deviate from the actual data by approximately 4 packages.

References

[1] M. Imam Baidowi and Edwin Agus Buniarto. 2020. ANALISIS RAMALAN PENJUALAN MENGGUNAKAN METODE TIME SERIES DALAM MENENTUKAN JUMLAH PRODUKSI M . Imam Baidowi Edwin Agus Buniarto Abstrak. *J. Ekononomi Manaj.* 1, 1 (2020), 33–41.

[2] Jonathan D. Cryer and Kung-Sik Chan. 1985. *Time series analysis*. https://doi.org/10.1016/0377-2217(85)90052-9

[3] Fikri Ahmad Fauzi and Fajar Darmawan. 2023. Pembangunan Aplikasi E-Commerce Berbasis Website Menggunakan Laravel. *J. Pas. Inform.* 2, 1 (2023), 1–7. https://doi.org/10.23969/pasinformatik.v2i1.7172

[4] John E. Hanke and Wichern Dean. 2019. *Business Forecasting*.

[5] Eka Juliantino. 2012. DESAIN DAN IMPLEMENTASI EMAIL SERVER DENGAN POSTGRESQL PADA SEKRETARIAT DPRD KABUPATEN BAYUASIN. *Kementeri. Pendidik. DAN Kebud. Sekol. TINGGI Manaj. Inform. DAN Komput. PALCOMTECH PALEMBANG SKRIPSI* (2012), 1–11.

[6] Guna Lucky Adi. 2014. Bahasa Pemrograman Python. *J. Ilmuti Ilmu Teknol. Inf.* 2, 11 (2014), 1–6.

[7] Ajeng Nurdina, Dyah Aryani, Ella Venita, and Sarah Astiti. 2022. Analisis Peramalan Permintaan Golang-Galing dalam Memaksimalkan Manajemen Rantai Pasok Menggunakan Metode Weighted Moving Average. *JURIKOM (Jurnal Ris. Komputer)* 9, 4 (2022), 1167. https://doi.org/10.30865/jurikom.v9i4.4551

[8] Alfian Nurlifa and Sri Kusumadewi. 2017. Sistem Peramalan Jumlah Penjualan Menggunakan Metode Moving Average Pada Rumah Jilbab Zaky. *INOVTEK Polbeng - Seri Inform.* 2, 1 (2017), 18. https://doi.org/10.35314/isi.v2i1.112

[9] Jeffri Prayitno, Bangkit Saputra, and Susheel Yadav. 2024. Modeling the Impact of Holidays and Events on Retail Demand Forecasting in Online Marketing Campaigns using Intervention Analysis. 1, 2 (2024), 144–164. https://doi.org/10.47738/jdmdc.v1i2.9

[10] Roger S Pressman. 2006. *Software engineering is software engineering*. https://doi.org/10.1049/ic:20040411

[11] Master Edison Siregar. 2022. Aplikasi web dwi Bahasa sebagai sarana promosi usaha UMKM menggunakan Framework Laravel. *J. Inov. Inform. Univ. Pradita* 7, September 2022 (2022), 1–8.

[12] Andy Rezky Pratama Syam. 2022. Application of the Autoregressive Integrated Moving Average Exogenous (ARIMAX) with Calendar Variation Effect Method for Forecasting Chocolate Data in Indonesia and the United States. *J. Mat. Stat. dan Komputasi* 18, 2 (2022), 224–236. https://doi.org/10.20956/j.v18i2.18460

[13] Tamus Bin Tahir, Muh. Rais, and Moch. Apriyadi HS. 2019. Aplikasi Point OF Sales Menggunakan Framework Laravel. *JIKO (Jurnal Inform. dan Komputer)* 2, 2 (2019), 55–59. https://doi.org/10.33387/jiko.v2i2.1313