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Web-Based Sales Prediction at PT Menara Kudus Indonesia Using the Double Exponential Smoothing Method

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ABSTRACT

PT Menara Kudus Indonesia is a printing, publishing, and bookstore company that still relies on manual sales and paper-based transaction recording, causing inefficiencies and dead stock due to unbalanced production and demand. This study develops a responsive web-based sales prediction system that integrates the Double Exponential Smoothing (DES) method to improve accuracy in forecasting sales trends. The system was developed using the PHP programming language, MySQL database, and the Waterfall SDLC model. The novelty of this research lies in the direct integration of the DES forecasting algorithm into a web-based system, enabling real-time predictions and automated reporting. The implementation results show that the system can process historical sales data, generate accurate forecasts, and provide tabular and graphical reports. The forecast for the 11th month resulted in 174 units, which can serve as a production planning reference. This system improves efficiency, reduces the risk of overstock and understock, and accelerates managerial decision-making.

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1. INTRODUCTION

PT Menara Kudus Indonesia is a company engaged in the printing, publishing, and distribution of Islamic religious books. The company's main products include the Qur'an, yellow books, student textbooks, Yasin, and annual calendars. These products are widely known, especially among Islamic boarding schools (pesantren) spread across Indonesia.

However, in its operational implementation, the company still carries out manual sales processes, from sales visits to stores to recording transactions still using Excel and paper forms.

The use of a manual system in sales management certainly poses many problems. The risk of data loss, inefficient reporting, and minimal integration between departments are major obstacles in the company's business activities. One real impact of these problems is the occurrence of dead stock , namely the accumulation of unsold goods in large quantities due to production not being balanced with market demand. In addition, the company also experiences difficulties in carrying out production planning according to customer needs in the field.

This situation indicates that companies need a system capable of analyzing sales trends and providing accurate predictions for the future. Forecasting methods are the primary solution to address this issue. One suitable forecasting method for sales data with an upward or downward trend and non-seasonal nature is the Double Exponential Smoothing (DES) method [1], [2]. This method combines two important components of forecasting, namely level and trend , to produce a more accurate estimate of sales data for the upcoming period. Various previous studies have also proven the effectiveness of the DES method in assisting the business decision- making process. Research by Putro et al. [3] implemented this method to predict sales of paper raw materials in the printing industry. The results showed a high level of prediction accuracy with a fairly low Mean Absolute Percentage Error (MAPE) value . Lieberty and Imbar [4] also applied this method to a sales prediction information system for retail companies, and the results were able to improve the company's operational efficiency. Another study by Sudiantara et al. [5] even built a web-based revenue prediction system using the DES method with prediction accuracy ranging from 95% to 99%.

Although there has been much research on the use of the Double Exponential Smoothing method, in general, this method has not been directly integrated into web-based systems that can be used by companies in real time. Most previous research has focused only on manual calculations, desktop application implementations, or has not been integrated with actual company data. However, integrating forecasting methods with web-based systems can help companies access data anytime and anywhere, as well as generate prediction reports automatically [6]. In this context, this study proposes a new solution in the form of developing a web-based sales forecasting information system using the Double Exponential Smoothing method, implemented directly in the case study of PT Menara Kudus Indonesia. This system is designed to process existing sales data, process it using the DES algorithm, and display sales forecast results for the coming months. Furthermore, this system also features sales data import from Excel files, transaction recording, and forecasting results reporting in tables and graphs. The system was developed using the PHP programming language and MySQL database, using the Waterfall SDLC methodology. The

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process began with requirements analysis, system design, implementation, and testing using black box methods to ensure the system's functionality met requirements. The objectives of this research are:

1) Building a web-based information system to predict product sales at PT Menara Kudus Indonesia.
2) Implementing the Double Exponential Smoothing method automatically on the system.
3) Provide accurate predictive information as a basis for production decision making.
4) Minimize the occurrence of product overstock and understock .

With this system, it is hoped that company management can plan production more effectively and efficiently based on historical sales data. Furthermore, this research is also expected to contribute academically to the development of web-based information systems integrated with statistical methods for sales forecasting.

2. RESEARCH METHOD

2.1. Stage Study

This research uses a user-needs-based software engineering approach to build a web-based sales prediction information system using the Double Exponential Smoothing method. The system development process refers to the Software Development Life Cycle (SDLC) Waterfall model, which consists of five stages: (1) Needs analysis, (2) System design, (3) Program code implementation, (4) Testing, and (5) Maintenance.

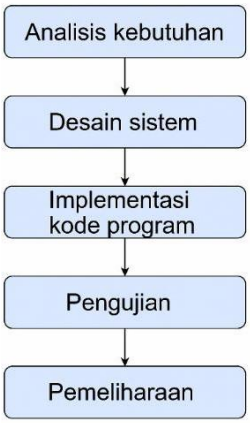


Figure 1. Stage Development Waterfall Model System

2.2. Method of Collecting Data

Data collection methods are divided into two main sources:

2.2.1 Primary Data

Primary data collection was conducted through:

1) Direct observation at the location of PT Menara Kudus Indonesia to understand the ongoing business processes and sales systems.
2) Interviews with the sales admin (Mrs. Thina) to obtain in-depth information regarding the distribution flow, transaction recording, and obstacles encountered in the sales process.

2.2.2. Data Secondary

Secondary data is obtained from internal documentation, sales records in Excel format, as well as references to scientific journals and literature related to sales forecasting methods

2.3. Design System

The system is designed using **the Unified Modeling Language (UML) approach** which consists of several diagrams, including:

1) **Use Case Diagram** : describes the interaction between actors (Admin and Director) with the system.
2) **Class Diagram** : describes the structure of objects and attributes in the system.
3) **Sequence Diagram** : describes the logical flow per transaction.
4) **Activity Diagram** : shows the flow of system activities from login to the prediction process.
5) **Statechart Diagram** : describes the status and changes of the system according to user commands.

The interface is designed using HTML and CSS, while the server side is developed using **PHP. MySQL is used** as the primary database for data management.

2.4. Implementation of the Double Exponential Smoothing Method

Double Exponential Smoothing (DES) method is used because it is able to take into account trends in the data. sales. The two main parameters in DES are:

Level **(ℓ_t):** current average sales estimate.
Trend **(b_t)**: the rate of change in sales over time The formula used :
Level (ℓ) : current average value

$$\ell t = \alpha y t + (1-\alpha)(\ell t - 1 + b_t - 1) \quad \textbf{(i)}$$

Trend (b): the rate of change in data over time

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$$b_t = \beta(\ell_t - \ell_{t-1}) + (1-\beta) b_{t-1} \quad \textbf{(ii)}$$

Double Exponential Smoothing Forecast Formula:

$$F_{t+m} = \ell_t + m b_t \quad \textit{(iii)}$$

Flowchart of DES Algorithm:

1) Input sales data (historical)
2) Initialize parameters α and β
3) Calculate Level (ℓ_t) using formula (i)
4) Calculate Trend (b_t) using formula (ii)
5) Generate Forecast (F_{t+m}) using formula (iii)
6) Output forecast results in tables and graphs

This workflow is implemented in the system so that forecasting runs automatically when sales data is entered or imported

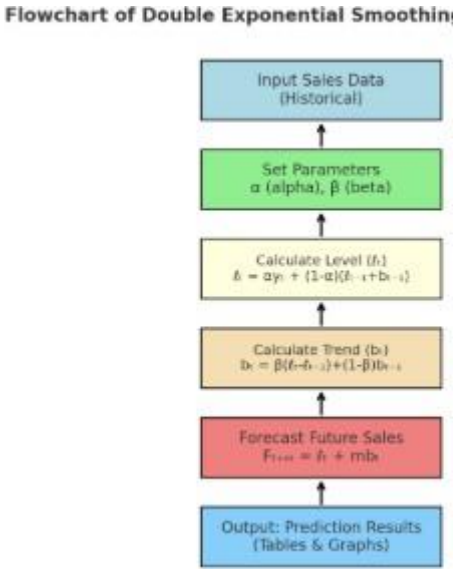


Figure 2. Flowchart DES Algorithm

2.5. Architecture System

The system is built as a responsive web application using a combination of the following technologies:

Table 1. Flowchart DES Algorithm

Component	Technology
Programming language	PHP, HTML, JavaScript
Database	MySQL

Tools	XAMPP, Visual Studio Code
Web Server Diagram	Apache (via XAMPP) UML (Use Case, Class, Activity)

2.6. Testing Method System

System testing is conducted using **black-box testing methods** to ensure each system feature functions as intended. Testing is performed on the following modules:

1) Import sales data
2) Prediction process using the DES method
3) Validation of prediction output (tables and graphs)
4) Sales forecast results report

If the system provides output that matches the input and calculation formula, it is considered to have successfully passed the functionality test.

3. RESULTS AND DISCUSSION

The system integrates product data management, sales data import, DES-based forecasting, and reporting. Historical sales of Al Ibriz Juz 30 were analyzed, showing a downward trend over three years. Using parameters $\alpha = 0.8$ and $\beta = 0.2$, the forecast for the 11th month resulted in 174 units. Visualization demonstrated that DES closely followed actual sales patterns. Compared to manual recording and desktop-based systems [2], [3], this web-based approach offers real-time access, automated reporting, and better scalability for business decision-making.

3.1. Implementation System

A web-based sales forecasting information system was successfully developed and implemented at PT Menara Kudus Indonesia. The system has the following key features:

1) Category and product data management
2) Input and import sales transaction data
3) The forecasting process uses the Double Exponential Smoothing (DES) method.
4) Prediction results report in the form of tables and graphs

The system interface is designed to *be responsive* so it can be accessed from various devices, including computers and smartphones. The system was implemented using the PHP programming language and MySQL database, and tested using *black-box methods* to ensure functionality meets user requirements.

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3.2. Sales Data Analysis Historical

Study using historical data sale of one product main , namely *Al Ibriz Juz 30 CD Green Cover* , during three year last . The following table serve amount product sold :

Table 2. Sales Data Annual Al Ibriz Juz 30 Products

Year	Sold
2022	50,208
2023	26,369
2024	23,207

From the data above seen that trend sale experience decline significant, so that needed method prediction For help management in make decision strategic production.

3.3. Simulation Forecasting with Monthly Data

To test the DES algorithm, a simulation was performed using monthly data as follows:

Table 3. Sales Data Monthly (Simulation)

Month	Sold
1	120
2	130
3	128
4	135
5	140
6	145
7	150
8	158
9	160
10	168

Parameters used in forecasting:

1) Alpha **(α)** = 0.8
2) Beta **(β)** = 0.2

Based on the DES formula (1)–(3), the following calculations are obtained:

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Table 4. Results of Level and Trend Calculations

Month	Y_t	ℓ_t	b_t	Forecast
1	120	120.00	10.00	-
2	130	130.00	10.00	130.00
3	128	130.40	8.08	140.00
4	135	135.70	7.52	138.48
5	140	140.64	7.01	143.22
6	145	145.53	6.58	147.65
7	150	150.42	6.25	152.11
8	158	157.73	6.46	156.67
9	160	160.84	5.79	164.19
10	160	167.73	6.01	166.63

Formula :

1) Level: $\ell t = \alpha y t + (1-\alpha)(\ell t - 1 + b_t - 1)$
2) Trend $b_t = \beta(\ell t - \ell t - 1) + (1-\beta) b t - 1$
3) Forencast $F_t + m = \ell t + m b_t$

Prediction Sales in the 11th month were :

$$F_{11} = \ell\, 10 + 1\,.\, b_{10} = 167.73 + 6.01 = 173.73$$

Result value rounded become ***174 units*** *as reference production For 11th month.*

3.4. Visualization of Forecast Result

The graph below shows a comparison between actual sales over 10 months with the predicted results from the Double Exponential Smoothing method.

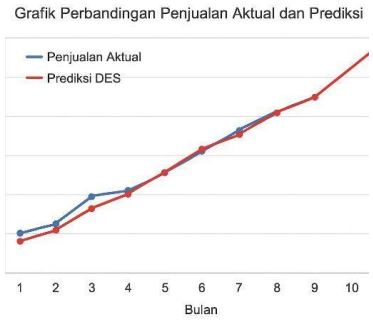


Figure 3. Graph Comparison Sale Actual and Prediction

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The graph shows that the predicted trend closely follows the actual sales movement pattern. This demonstrates that the DES method is quite accurate in predicting fluctuating data trends without any seasonality.

3.5. Testing System

Testing was carried out on several system modules, including:

1) **Data Input and Import Testing** : The system successfully imported data from an Excel file with the standard format provided.
2) **DES Algorithm Testing** : The forecast calculation results are in accordance with the manual and there are no formula errors.
3) **Visual Output Testing** : Report graphs and tables appear automatically according to the forecast results.
4) **Testing Report** : Report files can be downloaded in PDF format by admin or director.

The test results using the black-box method show that all the main features run according to specifications.

3.6. Compared and Comparison

Compared to research by Lieberty & Imbar [2] who implemented DES in a C#-based desktop system, this system has the advantage of flexible access because it is web-based. In addition, this system is also capable of processing transaction data automatically and producing real-time reports, which is not found in manual approaches such as those used by Putro et al. [3]. Overall, this system provides a modern solution for printing and publishing companies in addressing market dynamics and production planning. The system not only helps with sales forecasting but also accelerates managerial decision-making and increases product distribution efficiency.

4. CONCLUSION

This study successfully developed a web-based sales forecasting system for PT Menara Kudus Indonesia using the Double Exponential Smoothing method. The novelty lies in integrating DES directly into a responsive web application, enabling automated and real-time forecasting. The system improves production planning accuracy, reduces risks of overstock and understock, and enhances decision-making efficiency. Limitations remain in the manual determination of α and β parameters, which could be improved in future work by adding automatic parameter optimization and ERP integration.

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