

FORECASTING SPOKE CAKE SALES AT ZAHRA SHOP WITH DOUBLE EXPONENTIAL SMOOTHING METHOD

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Abstract: Sales of sponge cakes at Zahra's shop have difficulty meeting customer demand when the demand for sponge cakes increases drastically at certain times. This is because the sales of sponge cakes at Zahra's shop are still calculated based on their own estimates, causing excess production to be made and even a shortage of sponge cake supplies. This problem has an impact on the supply control of sponge cake production which cannot be predicted properly by Zahra's shop. The purpose of this study is to build a forecasting system using the double exponential smoothing method to predict sales of sponge cake at Zahra's shop for the next period based on the data obtained. The research method used in this study is a quantitative method. The results in the calculation of sponge cake sales forecasting using the Double Exponential Smoothing method using alpha 0.5, the number of sponge cake sales for July 2023 on Banana Cake is 430 boxes, with a forecasting error rate of 2.75%, on Chiffon Mocca Sponge cake is 330 boxes, with a forecasting error rate of 2.75%. forecasting error of 4.50%, on Pandan Cake as many as 92 Boxes, with a forecasting error rate of 7.21%, on Ordinary Roll Cake as many as 77 Boxes, with a forecasting error rate of 4.78, So the error rate on Banana Cake, Bolu Chiffon Mocca, Pandan Cake, and Ordinary Roll Cake are in the very good category because they have an error value of less than 10%.

Keywords : double exponential smoothing; forecasting; spoke cake

Abstrak: Penjualan kue bolu pada toko zahra mengalami kesulitan untuk memenuhi permintaan pelanggan ketika permintaan kue bolu meningkat secara drastis diwaktu-waktu tertentu. Hal ini disebabkan karena penjualan kue bolu di toko zahra masih perhitungan berdasarkan perkiraan sendiri sehingga menyebabkan produksi yang dibuat sering kelebihan bahkan kekurangan persediaan kue bolu. Masalah tersebut berdampak pada pengendalian persediaan produksi kue bolu yang tidak dapat diprediksi dengan baik oleh toko zahra. Tujuan penelitian ini adalah membangun sistem peramalan dengan metode double exponential smoothing untuk meramalkan penjualan bolu pada Toko Zahra untuk periode berikutnya berdasarkan data yang diperoleh. Metode penelitian yang digunakan dalam penelitian ini adalah metode kuantitatif. Hasil dalam perhitungan peramalan penjualan kue bolu dengan metode Double Exponential Smoothing menggunakan alpha 0.5 jumlah penjualan kue bolu untuk bulan Juli 2023 pada Bolu Pisang sebanyak 430 Kotak, dengan tingkat kesalahan peramalan sebesar 2,75%, Pada Bolu Chiffon Mocca sebanyak 330 Kotak, dengan tingkat kesalahan peramalan sebesar 4,50%, pada Bolu Pandan sebanyak 92 Kotak, dengan tingkat kesalahan peramalan sebesar 7,21%, pada Bolu Gulung Biasa sebanyak 77 Kotak, dengan tingkat kesalahan peramalan sebesar 4,78, Sehingga tingkat kesalahan pada Bolu Pisang, Bolu Chiffon Mocca, Bolu Pandan, dan Bolu Gulung biasa tergolong kategori sangat baik karena memiliki nilai kesalahan kurang dari 10%.

Kata Kunci : peramalan; kue bolu; pemulusan eksponensial ganda

INTRODUCTION

Almost every company in the industry is currently facing the challenge of increasingly fierce competition. This requires that every company must be able to plan all production parameters properly and correctly including production capacity, in order to meet market demand in a timely and fast manner. This is done in order to increase company profits and reduce losses. On the other hand, developments in information technology affect data to produce information that is more accurate, fast and actual and relevant to increase the precision or accuracy in decision making.

Sponge cake is a food that is quite popular in Indonesia. The sweet and legit taste makes this cake very popular with all people. Especially when we are having a special celebration or event, sponge cake is often used as the main menu. Besides that, sponge cake is also suitable for serving during celebrations of religious holidays, such as Eid al-Fitr.

The Double Exponential Smoothing method for forecasting sponge cake sales for the next period is a good enough method so that the forecasting results can help Zahra Shop owners prepare sponge cake supplies to be sold in the next period.

Zahra's shop is a small and medium business that is starting to develop at this time. Zahra's shop produces sponge cakes using the best and quality selected ingredients. In the process of developing sponge cake sales at Zahra's shop, they experienced a problem, namely they often had difficulty meeting customer demand when the demand for sponge cake

increased drastically at certain times. This happens because the prediction method used by Toko Zahra is still conventional, that is, calculations are still based on their own estimates so that the results of sponge cake production can be excess or even lacking. Besides that, with these problems, the zahra shop must be able to predict or predict how many sponge cakes will be sold and how many must be provided in the coming period. This study only discusses the sales forecasting of Banana Sponge Cake, Chiffon Mocca Cake, Pandan Cake, and Ordinary Roll Cake.

The rationale for the Double Exponential Smoothing method is that the smoothing value will be present before the actual data if there is a trend component in the data. Therefore, for single smoothing values, it is necessary to add double smoothing values to adjust the trend. The Double Exponential Smoothing method that can be used to solve linear trends is the two-parameter method from Holt. In the Holt method the trend values are not smoothed by double smoothing directly, but the process of smoothing the trend is done using different parameters from the parameters used in the original data smoothing.

The Dasni Store Sales Forecasting System uses Double Exponential Smoothing "and the results are in the form of a period from the sales forecasting system for the next 3 months, Using MAPE (Mean Absolute Percentage Error) to calculate the level of forecasting accuracy by looking for minimum errors, because the smaller the error, the forecasting period sales Images then it will be more accurate [1].

The Double Exponential Smoothing Method in Forecasting the

Number of Passport Applicants” shows that the results obtained from forecasting applications for passports using the Double Exponential Smoothing Method with parameter $\alpha = 0.4$ (alpha selection using trial and error) obtain a MAPE value of 14.28% and are included in the GOOD category in predicting applications for passports in the future [2]

Forecasting Rice Sales at Bulog Sub-Division Medan Using the Double Exponential Smoothing Method "shows that the best parameter α for forecasting the amount of rice sales at Bulog Perum, Medan Sub-divre is $\alpha = 0.2$ with an error percentage of 0.27% and rice sales at Perum Bulog Sub Divre Medan in 2022 will experience a decline every month [3].

Application of the Double Exponential Smoothing Method in Forecasting Web-Based Dairy Stocks (Case Study: PT. Web-Based Dairy Stock Forecasting, PT. Beringin Suka Sehat Can Do Forecasting from Dairy Product Inventory Sales Data The system designed can provide output results that can help PT. Beringin Like Healthy. The Double Exponential Smoothing method can be applied to web-based forecasting of dairy products through web applications written in HTML, PHP and MySQL Inventory programming languages [4].

Forecasting of Users of Packaging Design Services Using the Double Exponential Smoothing Method The results of this study are that the Double Exponential Smoothing Method can be used to predict the number of Small and Medium Industries using UPTD IPOK West Java Province packaging design services in the next period. The smallest forecasting accuracy value is at $\alpha = 0.5$ with a

MAPE value = 10.23%, this indicates a fairly good level of accuracy [5].

Bread Sales Prediction Using Double Exponential Smoothing (Case Study: Harum Bakery). The results of this study are Double Exponential Smoothing and Triple Exponential Smoothing. Evaluation of prediction results is done by calculating the average error value using the Mean Absolute Percentage Error (MAPE) method. The smallest MAPE of the Single Exponential Smoothing method is obtained when the value of $\alpha = 0.1$ with a MAPE value of 27.4039%, the smallest MAPE of the Double Exponential Smoothing method is obtained when the value of $\alpha = 0.1$ with a MAPE value of 25.124%, and the smallest MAPE method Triple Exponential Smoothing is obtained when the value of $\alpha = 0.1$, $\beta = 0.1$, and $\gamma = 0.4$ with a MAPE value of 25.303%. It can be concluded that the Double Exponential smoothing method has better accuracy than the Single Exponential Smoothing and Triple Exponential Smoothing methods in the Prediction of Bread Sales in the Case Study of Harum Bakery [6].

Application of the Double Exponential Smoothing Forecasting Method on the Yogyakarta City Consumer Price Index. The results of this study are the CPI for the City of Yogyakarta for the period January 2014 to February 2022. The CPI data tends to increase because the data continues to increase until February 2022. However, within a certain period of time, namely January 2020, the CPI value for the City of Yogyakarta has experienced a serious decline due to the Covid-19 pandemic. Furthermore, predictions are made using double exponential smoothing which is then searched for the

prediction error value using the Mean Absolute Percentage Error (MAPE) calculation. The CPI forecast value for March 2022 is 109.2964, with a MAPE value of 0.76%. The MAPE value is less than 10%, meaning that the prediction with the double exponential smoothing method can be said to be good [7].

Goods Sales Forecasting Information System Using the Double Exponential Smoothing Method at the Sayur Palace. The results of this study are using the mean absolute error as a percentage, the value of broccoli 15.05%, eggs 15.78%, green peppers 12.45%, beans 22.22%, cloves 34.69%, garlic 19.53 %, Tempeh with a value of 20.60% Potatoes with a value of 17.58%. Therefore, Caisim broccoli, chicken eggs, green peppers, garlic and potatoes are classified appropriately because their value is between 10% and 20%. And beans, cloves, tempeh just enough because the value is 20% to 50% [8].

Pontianak Equator Bingke Production Forecasting System Using Web-Based Double Exponential Smoothing Method. The results of this study include the prediction of bingke production at the Bingke Equator factory, the method used is DoubleExponential Smoothing (DES). Based on the results of this study, the correct alpha value was used to predict next month's bingke production by using alpha 0.3 and the prediction results obtained from alpha 0.3 were 16,057.68 cents next month. , and the results of MAPE (The Mean Absolute Percentage Error) is 8.13 with the smallest error, namely very good criteria [9].

The purpose of this research is to design The forecasting system uses

the Double Exponential Smoothing method which can be used to predict sponge cake sales at Zahra's shop. So that the owner can use it in determining sales planning and supply of sponge cakes in the following week. As well as to make it easier to know sales predictions and stock predictions that must be provided, stores can use the application system automatically without calculating sales with manual calculations.

METHOD

The framework in this study is a step that will be taken by the author to solve the problem to be compiled. The framework in research requires a clear arrangement at each stage. The framework that the author does can be seen in the image below:

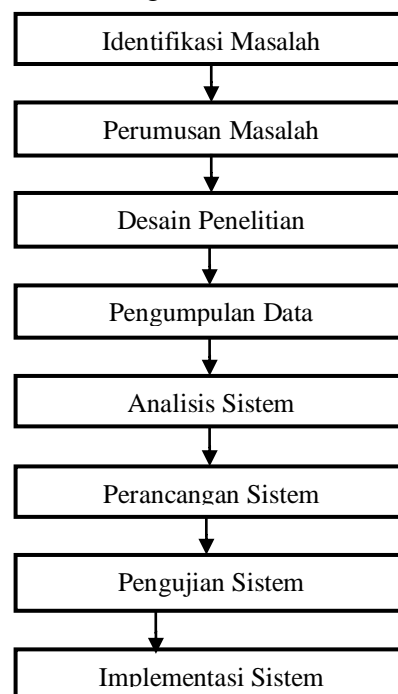


Image 1. Research Framework

Double Exponential Smoothing Method Formula:

a. Determining the First Smoothing Value: (St') $St' = \alpha X_t + (1-\alpha)St-1'$ (1)

b. Determining the Second Smoothing Value: (St'') $St'' = \alpha St' + (1-\alpha)St-1''$

c. Determining Constant Values (at): $at = 2St' - St''$

d. Determining the Slope Value (bt): $bt = \alpha (1-\alpha) (St' - St'')$

e. Determining Forecasting Value: $Ft+m = at + bt m$

Where:

St' : Single exponential smoothed value

X_t : The actual value of the t-period

St'' : Double exponential smoothed value

α : Exponential smoothing parameter $0 < \alpha < 1$

The value of the double exponential smoothing forecasting error can be found using the following formula:

$$MAD = \frac{\sum_{t=1}^n |X_t - Ft|}{n} \quad (2)$$

Where:

Ft = Forecast (Forecast) in the t-period

X_t = actual disclosure in the period

Table 1. Sponge cake sales data at Zahra's shop for the period January 2022 to June 2023

| No | Period | Actual Data | | | |
|-----|----------|-------------|--------------------|-------------|-------------------|
| | | Banana Cake | Mocca Chiffon Cake | Pandan Cake | Regular Roll Cake |
| 1 | Jan-2022 | 370 | 170 | 63 | 98 |
| 2 | Feb-2022 | 398 | 198 | 65 | 106 |
| 3 | Mar-2022 | 415 | 205 | 68 | 125 |
| 4 | Apr-2022 | 590 | 390 | 92 | 157 |
| 5 | May-2022 | 410 | 310 | 76 | 110 |
| 6 | Jun-2022 | 395 | 215 | 64 | 107 |
| 7 | Jul-2022 | 425 | 305 | 67 | 125 |
| ... | | | | | |
| 16 | Apr-2023 | 553 | 431 | 73 | 120 |
| 17 | May-2023 | 430 | 330 | 64 | 82 |
| 18 | Jun-2023 | 433 | 330 | 62 | 84 |

n = number of forecasting periods involved

$$MSE = \frac{\sum_{t=1}^n |X_t - Ft|^2}{n} \quad (3)$$

Where:

Ft = Forecast (Forecast) in the t-period

X_t = Actual demand in the period

n = Number of forecasting periods involved

$$MAPE = \frac{\sum_{t=1}^n |(\frac{At - Ft}{At})| 100}{n} \quad (4)$$

Where:

At = Actual request to t

Ft = forecasting results to t

n = amount of forecasting data

RESULTS AND DISCUSSION

In table 1, the sales data that will be used to forecast sponge cake sales is banana cake. Forecasting is done using the Double Exponential Smoothing method with a value of $\alpha = 0.5$. The following is the calculation using $\alpha = 0.5$

First Smoothing Calculation

S'_1 = Because at $t=1$ the value of S'_1 (smoothing of the first period) is not yet available, so this problem can be solved by setting the value of S'_1 equal to the value of the first period data (X_1) of 370

$$S'_2 = (0.5 \times 398) + (1 - 0.5) \\ * 370,00 = 384,00$$

Second Smoothing Calculation

S''_1 = Because at the time $S=1$ the value of S''_1 (smoothing of the second period) is not yet available, then this problem can be solved by setting the value of S''_1 equal to the value of the first Smoothing data (S'_t) of 370

$$S''_2 = (0.5 \times 384,00) + (1 - 0.5) \\ * 370,00 = 377,00$$

Table 2. Calculation Results For The First Smoothing And The Second Smoothing For Banana Cake

| Period | Actual Data | S'_t | S''_t |
|---------------|-------------|--------|---------|
| Januari 2022 | 370 | 370,00 | 370,00 |
| Februari 2022 | 398 | 384,00 | 377,00 |
| Maret 2022 | 415 | 399,50 | 388,25 |
| April 2022 | 590 | 494,75 | 441,50 |
| | | | |
| Maret 2023 | 420 | 431,34 | 442,93 |
| April 2023 | 553 | 492,17 | 467,55 |
| Mei 2023 | 430 | 461,08 | 464,32 |
| Juni 2023 | 433 | 447,04 | 455,68 |

Calculation of A_t

$a_1 = 0,00$ Because the S'_1 and S''_1 values are not yet available)

$$a_2 = (2 \times 384,00) - 377,00 \\ = 391,00$$

Calculation of b_t

$b_1 = 0,00$ Because the S'_1 and S''_1 values are not yet available)

$$b_2 = \left(\frac{0,5}{(1-0,5)} \right) \times (384,00 - \\ 377,00) = 7,00$$

Table 3. Calculation Results For The Magnitude Of The Constant (A_t) Slope (B_t) Of Banana Cake

| Period | Actual Data | A_t | b_t |
|---------------|-------------|--------|--------|
| Januari 2022 | 370 | 0,00 | 0,00 |
| Februari 2022 | 398 | 391,00 | 7,00 |
| Maret 2022 | 415 | 410,75 | 11,25 |
| April 2022 | 590 | 548,00 | 53,25 |
| | | | |
| Maret 2023 | 420 | 419,75 | -11,59 |
| April 2023 | 553 | 516,79 | 24,62 |
| Mei 2023 | 430 | 457,85 | -3,23 |
| Juni 2023 | 433 | 438,41 | -8,64 |

Table 4. Result of Banana Sponge Sales Forecasting Error Value

| Period | Actual Data | ft | MAD | MSE | MAPE |
|---------------|-------------|--------|-------|--------|--------|
| Januari 2022 | 370 | 0,00 | 0,00 | 0,00 | 0,00 % |
| Februari 2022 | 398 | 398,00 | 0,00 | 0,00 | 0 % |
| Maret 2022 | 415 | 422,00 | 7,00 | 49,00 | 2 % |
| April 2022 | 590 | 601,25 | 11,25 | 126,56 | 2 % |
| | | | | | |
| Maret 2023 | 420 | 408,16 | 11,84 | 140,22 | 3 % |
| April 2023 | 553 | 541,41 | 11,59 | 134,31 | 2 % |
| Mei 2023 | 430 | 454,62 | 24,62 | 606,20 | 6 % |
| Juni 2023 | 433 | 429,77 | 3,23 | 10,44 | 1 % |
| Juli 2023 | | 429,77 | 12,05 | 333,64 | 2,75 % |

Table 5. Forecasting Results for All Sponge Cake Categories

| Category Name | Forecasting Period | ft | MAD | MSE | MAPE |
|--------------------|--------------------|--------|-------|--------|--------|
| Banana Cake | Juli 2023 | 429,77 | 12,05 | 333,64 | 2,75 % |
| Chiffon Mocca Cake | Juli 2023 | 92,09 | 11,76 | 204,87 | 7,21 % |
| Pandan Cake | Juli 2023 | 68,77 | 3,68 | 20,48 | 4,26 % |
| Regular Roll Cake | Juli 2023 | 77,37 | 5.01 | 48,76 | 4,78 % |

Implementation of the system interface in forecasting the number of sponge cake sales using the Double Exponential Smoothing method.

Main Menu Page

The main menu page is the page that will appear after a successful login. The main page will display the dashboard page, forecasting category page, period page, category page, change password page, and logout page.



Image 2. Main Menu Page Display

Forecasting Calculation Process page

The forecasting page is a page that contains a form for entering data for the sponge cake category found at the Zahra Store, the Alpha value for the calculation process and the calculate button.

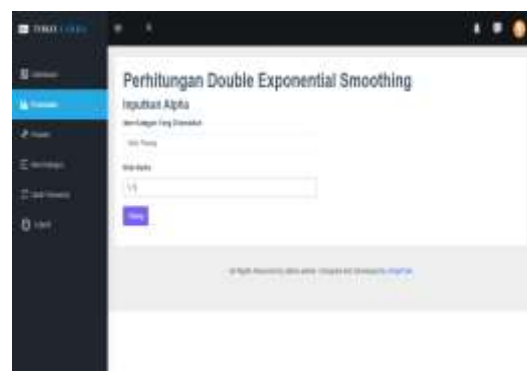


Image 3. Display Forecasting Calculation Page

Period Page

The period page is a page that contains sponge cake sales data for each

period at Zahra's Store, on this page there are 3 buttons that aim to add, edit and delete period data.

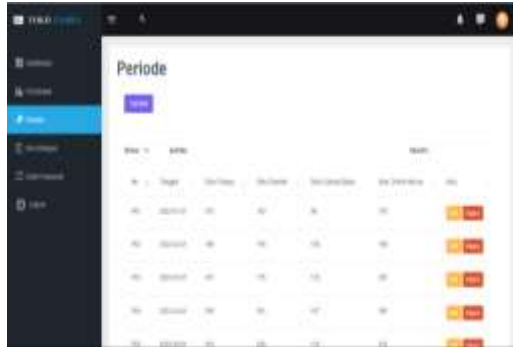


Image 4. Period Page Display

Category item page

The category item page is a page that contains sponge cake category data found at Zahra's Store, on this category page there are 3 buttons that aim to add, change and delete category data.

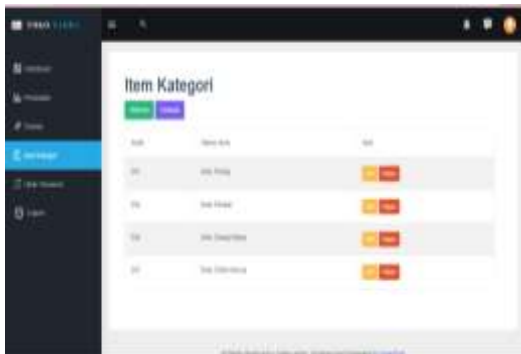


Image 5. Page Display Category Items

Print Results Page

The display of the printed forecasting results page is the page that will display the output of the sponge cake sales forecasting process for the next period at Zahra's Store.



Image 6. Display of Results Print Pages

CONCLUSION

By applying the Sponge Cake Sales Forecasting application with the Double Exponential Smoothing Method at Zahra's Store, it can make it easier to forecast sponge cake sales for the next period. Double Exponential Smoothing is a fairly good method so that the forecasting results can help Zahra Shop owners prepare sponge cake supplies to be sold in the next period.

The application of Double Exponential Smoothing has stages in the forecasting process, namely using sponge cake sales data in the months previous month as well as smoothing. In the smoothing process, you have to do an alpha calculation of 0.1 to 0.9 to find out the level of forecasting error.

The lower the error value, the better the forecasting ability. After the smoothing process has been carried out, the alpha has a low forecasting error rate of 0.5. Then the forecasting calculation of sponge cake sales using the double exponential smoothing method for all categories uses an alpha of 0.5, so the total sponge cake sales for July 2023 are obtained for 430 boxes of Banana Sponge Cake, with a forecasting

error rate of 2.75%, for Chiffon Mocca Cake as many as 330 boxes, with a forecasting error rate of 4.50%, in Pandan cake as many as 92 boxes, with a forecasting error rate of 7.21%, in ordinary roll cake as many as 77 boxes, with a forecasting error rate of 4.78, so that the level The errors in Banana Cake, Chiffon Mocca Cake, Pandan Cake, and Ordinary Roll Cake belong to the very good category because they have an error value of less than 10%.

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