JURTEKSI (Jurnal Teknologi dan Sistem Informasi) ISSN 2407-1811 (Print)
Vol. X No 2, Maret 2024, hlm. 403 - 410 ISSN 2550- 020 (Online)
DOI: http://dx.doi.org/10.33330/jurteksi.v10i2.3085
Available online at http://jurnal.stmikroyal.ac.id/index.php/jurteksi

FORECASTING METHOD SINGLE EXPONENTIAL SMOOTHING FOR DEMAND GROCERIES AT THE GUNTUR STORE

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Abstract: Guntur Store is located on Jl. Sisingamangaraja, Kisaran, Asahan Regency. It focuses on selling basic needs, but the store faces a problem in its sales. The main issue encountered is the uncertainty in forecasting the stock of basic needs, which can lead to imbalance between supply and demand, due to Guntur Store still relying on manual ledger entries for reporting and inputting data into Microsoft Excel. This research aims to predict the demand for basic needs at Guntur Store using the Single Exponential Smoothing Method and to enhance prediction accuracy through the application of time series analysis techniques on historical sales data. The Single Exponential Smoothing Method will be employed to model and forecast patterns of demand for staple goods. The findings of this research can provide insights into future demand for goods, thereby improving supply chain optimization and ensuring adequate stock levels to effectively meet customer demands. The conclusion of this study is to obtain more accurate estimates in anticipating the evolving data patterns of basic needs at Guntur Store, thus providing valuable information for the store and policymakers involved in the distribution of basic needs.

Keywords: basic food needs; forecasting; single exponential smoothing

Abstrak : Toko Guntur terletak di Jl. Sisingamangaraja, Kisaran, Kabupaten Asahan. Berfokus pada penjualan kebutuhan sembako, namun dalam penjualan toko tersebut mengalami sebuah permasalahan. Permasalahan utama yang dihadapi adalah ketidakpastian dalam meramalkan kebutuhan stok Sembako yang dapat mengakibatkan ketidakseimbangan antara pasokan dan permintaan, dikarenkan Toko Guntur masih menggunakan buku besar dalam pembuatan laporan dan di input ke dalam microsoft excel. Penelitian ini bertujuan untuk memprediksi permintaan Sembako di Toko Guntur menggunakan Metode Single Exponential Smoothing serta meningkatkan akurasi prediksi melalui penerapan teknik analisis deret waktu terhadap data penjualan historis. Metode Single Exponential Smoothing akan digunakan untuk memodelkan dan memprediksi pola permintaan barang pokok. Hasil penelitian ini dapat memberikan jumlah permintaan barang di masa mendatang sehingga optimalisasi rantai pasok menjadi g lebih baik dan memastikan tingkat stok yang memadai untuk memenuhi permintaan pelanggan secara efektif. Kesimpulan penelitian ini untuk mendapatkan perkiraan yang lebih akurat dalam mengantisipasi pola data yang sedang berkembang kebutuhan sembako pada Toko Guntur sehingga menghasilkan informasi yang akurat dapat menjadi sumber informasi berharga bagi Toko Guntur, dan pembuat kebijakan yang terlibat dalam distribusi Sembako.

Kata Kunci: kebutuhan sembako; single exponential smoothing; peramalan

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INTRODUCTION

Inventory is one of the most crucial estimates in a company's operations. For companies, inventory is not just an asset, but also a significant value [1].The prese nce of inventory in a company context has major implications, depending on its quantity and availability [2][3]. If the amount of inventory is large enough, this will have an impact on increasing the costs required to maintain and manage the inventory. On the other hand, if inventory is insufficient, the impact can disrupt the production and sales process. Apart from that, the existence of inven tory also has a direct influence on the company's balance sheet and profit and loss statement[4][5].

Guntur Shop is a shop that sells basic necessities, this shop was founded in 1990. The address is Jl. Sisingama ngaraja No.113, Kisaran Timur, Kec. East Kisaran City, Asahan Regency, North Sumatra 21221. In the context of the retail business, especially in the sale of basic necessities (nine basic commo dities) at the Guntur Store, accuracy in forecasting and managing demand is crucial to maintaining smooth operations and customer satisfaction. However, for the past 2 years, the Guntur store has experienced difficulties in estimating basic food supplies because it only relies on direct observation of stock conditions in the store without data processing. Fluctuating and difficult to predict demand can cause problems in inventory planning, which in turn can result in an imbalance between supply and demand [6][7].

The goods that experienced a drop were rice in June 2022 by 350 kg, cooking oil in March 2022 by 340 kg, sugar in September 2022 by 800 kg, eggs in September 2022 by 503, butter in May 2022 by 55. kg, salt in November 2022 as much as 45 kg and milk in March 2022 as much as 192 cans.

This research aims to increase the accuracy of predicting demand for basic necessities at the Guntur Store through the application of the Single Exponential Smoothing Method. By conducting time series analysis of historical sales data, this research is expected to make a significant contribution to improving inventory management efficiency and optimizing the supply chain. Apart from that, this research can also provide valuable insight for industry players in their efforts to improve services to custo mers and avoid inventory imbalances that can be detrimental both from a financial and operational perspective[8],[9]. Even though there have been many studies examining demand predictions in the retail sector, the use of the Single Exponential Smoothing Method in the context of specific basic food stores such as the Guntur Store is still relatively minimal[10],[11]. Some prediction metho ds that have been developed tend to pay less attention to the unique characteristics of demand for basic goods.

Previous studies discussing fore casting, in research, [12] The Single Exponential Smoothing method can be applied to predict demand for herbal medicines at DS Ria Sari Anggriani, enabling knowledge of the predicted value of demand in the next period. in line with research [13], explaining that by applying the Single Exponential Smoothing method the system created can predict the number of sales of building materials at UD. Karya Mandiri in the July 2022 period. In addition, the Mean Squared Error (MSE) method can be used to evaluate the error level for each alpha value, thereby making it possible to obtain a minimal error value.

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Therefore, it is necessary to carry out more in-depth research with a focus on implementing the Single Exponential Smoothing method at the Guntur shop by testing the best alpha value[14]. By using the Single Exponential Smoothing method, it is hoped that it can produce accurate predictions related to consumer demand to help Guntur Stores in stock planning, marketing strategies and more informational decision making.

METHOD

Research methodology refers to the systematic steps used in a study to collect, analyze and interpret data . The methodology contains a research frame work to explain the flow of the problem, analyze the problem, determine the objec tives of the research. The stages in the research method carried out are depicted in image 1.

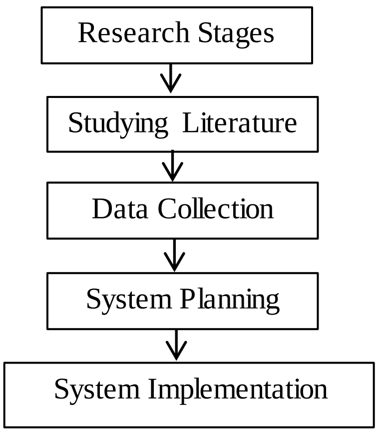

Image 1. Research Methodology

Research Stages

This stage it will The research stages and research methodology are described which contain the steps in solving problems at the Toko Guntur

Studying Literature

Search for reference information in the form of books, journals and study materials related to the topic of forecasting discussion.

Data collection

The data collection process was carried out in the form of direct interviews with the shop owner Mr. Ahyar S Pane and observations for data analysis of the process of predicting demand for basic necessities at the Guntur Shop so that the necessary data and information were obtained. Next, the data is analyzed for data processing in the system.

System planning

System design a critical stage in the software development cycle that involves transforming the results of system analysis into a detailed and implementable design. At this stage, the main focus is detailing how the information system will be organized and implemented to meet user needs and achieve business goals.

System Implementation

The software development cycle where the design that has been created is realized into code that can be run. This process involves building an application or system based on previously established specifications and designs.

In this research, the data collected is sales data Groceries at the Guntur Shop from Month December 2021 until November 2023 , which will later be processed using the SES method or desktop-based Single Exponential Smoothing. In application SES method uses formula as following :

$$Ft = \mathrm{Ft} - 1 + \alpha(\mathrm{At} - 1 - \mathrm{Ft} - 1) \quad (1)$$

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Description:

Ft : Forecast value for period t.
Ft-1 : Estimated forecast for the previous period.
At-1 : Observation Data for period t -1.
α : smoothing constant

To measure the forecasting error value, it can be searched using Mean Square Error is an alternative method in a forecasting method. The smaller the MSE value, the more accurate the prediction.

$$MSE = \frac{\sum(Yt - Ft)^2}{n} \quad (2)$$

Description:
Yt : Actual value in period t
Ft : Value Forecasting in period t
n : Number of data for the forecasting period

RESULTS AND DISCUSSION

Input requirements analysis invol ves collecting and assessing input data that will be processed through calcula tions using the Single Exponential Refinement Method (SES). In the context of this research, basic food sales data from the Guntur Store during the period January 2022 to December 2023 is the main input. The analysis process will lead to understanding sales patterns, trends and fluctuations contained in the data (table 1).

Table 1. Sales Data Groceries on the Moon January 2022 until December 2023

Month	Sales Data Groceries						
	Rice (Kg)	Cooking Oil (Kg)	Sugar Sand (Kg)	Eggs (Grains)	Butter (Kg)	Salt (Bgks)	Milk (Canned)
January 2022	398	375	810	540	82	57	215
February 2022	376	362	805	512	61	49	197
March 2022	362	354	808	530	74	55	206
April 2022	388	340	803	508	59	48	192
May 2022	354	361	802	522	67	52	203
June 2022	369	359	804	505	55	47	195
July 2022	350	363	801	525	76	54	210
August 2022	355	345	806	514	65	46	198
September 2022	370	349	807	518	72	50	201
October 2022	364	355	800	503	60	53	194
November 2022	358	346	809	520	78	51	212
December 2022	361	348	812	510	69	45	200
January 2023	554	542	1210	768	201	190	348
February 2023	627	598	1285	789	245	225	392
March 2023	490	677	1255	789	165	175	298
April 2023	579	504	1230	848	225	210	375
May 2023	612	628	1225	9 03	185	165	312
June 2023	542	569	1278	860	273	240	420
July 2023	596	459	1 41 0	780	155	155	255
August 2023	567	711	1290	865	280	220	408
September 2023	7 33	525	1260	6 15	210	185	350
October 2023	602	490	1 3 45	845	255	205	382
November 2023	519	609	9 35	9 05	195	160	335
December 2023	501	497	1268	825	240	235	410

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Table 2. Rice Demand Calculation Table with Single Exponential Smoothing Method with Alpha 0.9.

Periode	Yt	Alpha	Ft	Ft-Yt	MAD	MSE	MAPE
					|Ft-Yt|	(Ft-Yt)^2	|Ft-Yt|/Yt
1	398	-	-	-	-	-	-
2	376	0,4	398,00	22,00	22,00	484,00	0,06
3	362	0,4	389,20	27,20	27,20	739,84	0,08
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
23	519	0,4	621,92	102,92	102,92	10.592,06	0,20
24	501	0,4	580,75	79,75	79,75	6.360,16	0,16
25			548,85	-377,13	1.138,50	134.454,77	2,08
Total					49,50	5.845,86	9,02600554

Then the input data will be processed using the Single Exponential Smoothing method, with the formula equation (1). To measure the forecast error value, it can be searched using MSE (Mean Square Error) which is an alternative method in a forecasting method. The smaller the MSE value, the more accurate the prediction.

For calculating rice demand using the Single Exponential Smoothing method with Alpha 0.4, Calculation Request Oil Fry Method Single Exponential Smoothing With Alpha 0.3, Calculation Request Sugar Sand Meth od Single Exponential Smoothing With Alpha 0.6, Calculation Request Egg Method Single Exponential Smoothing With Alpha 0.6, Calculation Request Butter Method Single Exponential Smo othing With Alpha 0.4, Request Salt Method Single Exponential Smoothing With Use Alpha 0.5, and Calculation Request Milk Method Single Expone ntial Smoothing With Alpha 0.3.

Table 3. Oil Demand Calculation Table with Alpha 0.3.

Periode	Yt	Alpha	Ft	Ft-Yt	MAD	MSE	MAPE
					|Ft-Yt|	(Ft-Yt)^2	|Ft-Yt|/Yt
1	375	-	-	-	-	-	-
2	362	0,3	375,00	13,00	13,00	169,00	0,04
3	354	0,3	371,10	17,10	17,10	292,41	0,05
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
23	609	0,3	542,97	- 66,03	66,03	4.360,24	0,11
24	497	0,3	562,78	65,78	65,78	4.326,69	0,13
25			543,04	-560,15	1.385,68	192.449,66	2,49
Total					60,25	8.367,38	10,82

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Table 4. Sugar Demand Calculation Table with Alpha 0.6.

Periode	Yt	Alpha	Ft	Ft-Yt	MAD	MSE	MAPE
					|Ft-Yt|	(Ft-Yt)^2	|Ft-Yt|/Yt
1	810	-	-	-	-	-	-
2	805	0,6	810,00	5,00	5,00	25,00	0,01
3	808	0,6	807,00	-1,00	1,00	1,00	0,00
.	.	.	.	.	.	.	.
24	1268	0,6	1.088,83	-179,17	179,17	32.101,52	0,14
25			1.196,33	-643,89	1.689,95	436.048,06	1,46
		Total			73,48	18958,61144	6,335649

Table 5. Egg Demand Calculation Table with Alpha 0.6.

Periode	Yt	Alpha	Ft	Ft-Yt	MAD	MSE	MAPE
					|Ft-Yt|	(Ft-Yt)^2	|Ft-Yt|/Yt
1	540	-	-	-	-	-	-
2	512	0,6	540,00	28,00	28,00	784,00	0,05
3	530	0,6	523,20	- 6,80	6,80	46,24	0,01
.	.	.	.	.	.	.	.
24	825	0,6	858,88	33,88	33,88	1.147,69	0,04
25			838,55	-497,59	1.381,17	194.649,20	1,87
		Total			60,05	8463,008843	8,130136

Table 6. Calculation Table for Butter Demand with Alpha 0.6.

Periode	Yt	1-Alpha	Ft	Ft-Yt	MAD	MSE	MAPE
					|Ft-Yt|	(Ft-Yt)^2	|Ft-Yt|/Yt
1	82	-	-	-	-	-	-
2	61	0,6	82,00	21,00	21,00	441,00	0,34
3	74	0,6	73,60	- 0,40	0,40	0,16	0,01
.	.	.	.	.	.	.	.
24	240	0,6	218,97	- 21,03	21,03	442,42	0,09
25			227,38	-363,45	766,73	59.088,55	4,50
		Total			33,34	2569,067303	19,5756

Table 7. Salt Demand Calculation Table with Alpha 0.5.

Periode	Yt	Alpha	Ft	Ft-Yt	MAD	MSE	MAPE
					|Ft-Yt|	(Ft-Yt)^2	|Ft-Yt|/Yt
1	57	-	-	-	-	-	-
2	49	0,5	57,00	8,00	8,00	64,00	0,16
3	55	0,5	53,00	- 2,00	2,00	4,00	0,04
.	.	.	.	.	.	.	.
24	235	0,5	179,51	-55,49	55,49	3.079,60	0,24
25			207,25	-300,51	633,37	46.840,82	3,86
		Total			27,54	2.036,56	16,76463

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Table 8. Milk Demand Calculation Table with Alpha 0.3.

Periode	Yt	Alpha	Ft	Ft-Yt	MAD	MSE	MAPE
					|Ft-Yt|	(Ft-Yt)^2	|Ft-Yt|/Yt
1	215	-	-	-	-	-	-
2	197	0,3	215,00	18,00	18,00	324,00	0,09
3	206	0,3	209,60	3,60	3,60	12,96	0,02
.	.	.	.	.	.	.	.
23	335	0,3	357,60	22,60	22,60	510,83	0,07
24	410	0,3	350,82	- 59,18	59,18	3.502,15	0,14
25			368,57	- 511,92	879,85	83.020,19	2,63
		Total			38,25	3609,573637	11,43125

Image 1. Owner's Main Menu Page View

Image 1 shows the display of the owner's main menu page. In this system, there are several active menus on the main menu page, namely the forecast calculation menu, change password menu and logout.

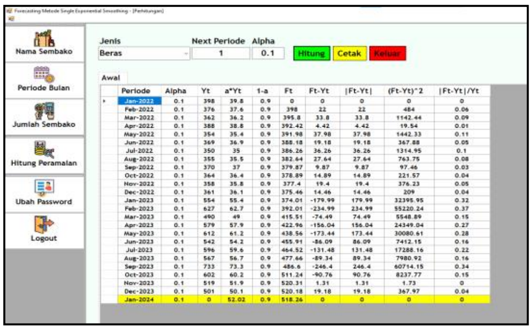

Image 2. Display the Forecast Calculation Form

Display of the forecast calcula tion form that will appear after the user selects the forecasting period and alpha. The forecast calculation form is equipped with a print forecast results button.

CONCLUSION

Forecasting system using the single exponential smoothing method for basic food demand at the Guntur Store provides benefits for the store . With this system, forecasting can be more accurate request groceries . The single exponential smoothing (SES) forecasting method is an important method in helping Guntur Shop to predict the number of requests basic necessities in the coming period. This method can be used as evaluation material and help in making more appropriate decisions regarding inventory goods For for sale.

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