FINDING METHODS FOR FORECASTING STORAGE SPACE DEMAND OF WASTE RECYCLE COMPANY. CASE STUDY OF ABC WASTE RECYCLE COMPANY, SAMUTSAKHON PROVINCE

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ABSTRACT

The purpose of this research was to find a suitable forecasting method for the product category. There were seven time series forecasting methods, they are: Linear Trend, Multiplicative Decomposition, Additive Decomposition, Single Exponential Smoothing, Double Exponential Smoothing, Multiplicative Winters and Additive Winters. There were 6 types of product information: Copper, Steel, Plastic, Paper, Beer Crate and Glass. The population and the sample were the total number of employees of the company, 59 people. The data analyzed was from January-December 2021. The research procedures were 1) to study the general information of the company, 2) to find the results of the discrepancy of each method of forecasting, 3) to compare the forecast results. The results showed that 1) The suitable forecasting method for Copper was Multiplicative Decomposition. 2) The suitable forecasting method for Iron were Multiplicative Decomposition and Additive Decomposition. 3) The suitable forecasting method for Plastic were Linear Trend, Multiplicative Decomposition, Additive Decomposition and Single Exponential Smoothing. 4) The suitable forecasting method for Paper were Multiplicative Decomposition and Additive Decomposition. 5) The suitable forecasting method for Beer crate were Multiplicative Decomposition and Additive Decomposition. 6) The suitable forecasting method for Glass were Multiplicative Decomposition and Additive Decomposition.

Keywords— Forecasting, Decomposition, Storage Space.

INTRODUCTION

At present, the case study company did not have a clear division of space in product classification (Laphasrada Limsila, 2018), causing some groups of products to be damaged and the selling price falling according to the condition of the product. (Nalinthip Leesuksam, 2020) The damage of the product may cause decay, including placing too many products together, may cause some groups of products to rust and break. (Narueporn Ninnisai, 2021). In addition, the arrangement of products is not organized, resulting in the storage of products, causing delays in finding and picking products. (Piyamas Klakhaeng, 2021)

The researcher was therefore interested in time series forecasting by bringing the amount of sales in the past to use in forecasting to find a forecasting method that is suitable for each type of product and can predict how much sales volume of each type of product that will come in the future. The purpose of this research was to find a suitable forecasting method for the product category

LITERATURE REVIEWS

1. Trend Analysis Method

It is a mathematical method that considers the cause and the need. If there is a linear relationship, the linear trend method can be applied by looking at the relationship. (Chanpen Anuratnanon, 2020)

2. Multiplicative Decomposition Method

It is a way of forecasting data by separating different components of the time series. The components of the time series include trend, seasonal, cyclical, and irregular events. Then used them to create multiplicative relationship equation. (Rachanee Kositanon, 2021)

3. Additive Decomposition Method

It is a way of forecasting data by separating different components of the time series. The components of the time series include trend, seasonal, cyclical, and irregular events. Then use them to create a positive model relationship equation.

4. Single Exponential Smoothing Method

It is a method that uses the principle of averaging one method by giving great importance to new information. Forecast values are primarily responsive to new information, suitable data that is changing and unpredictable. In this regard, the weight. The most recent data is α, with α ranging from 0-1. If $\alpha = 1$, then the most recent data is highly weighted. The prediction value for the next time period is equal to the true data for the most recent time period that based on historical forecasts without regard to current information. (Thiraphong Thapporn, 2018)

5. Double Exponential Smoothing Method

It is an exponential smoothing method that is similar to single exponential smoothing, but single exponential smoothing is suitable for data with uncertainty. Therefore, there is only one smoothing constant, α, but Holt's method has two smoothing constants, α and γ. (Thanyathorn Aonmee, 2017)

6. Multiplicative Winters Method

It is a forecasting technique suitable for directional and seasonally trending data. Forecasting using the winter method yields better forecasts than with double exponential adjustment, but would have an advantage. In other words, it can forecast against seasonal or directional data or both. Then used them to create multiplicative relationship equation.

7. Additive Winters Method

It is a forecasting technique suitable for directional and seasonally trending data. Forecasting using the winter method yields better forecasts than with double exponential adjustment, but would have an advantage. In other words, it can forecast against seasonal or directional data or both. Then use them to create a positive model relationship equation. (Tassanee Akarapin, 2020)

8. Measuring the forecasting error

Mean Absolute Percent Error (MAPE) is a method of measuring accuracy by calculating percentage error in forecasting, regardless of the mark, low value, high accuracy. (Watcharachai Intipuk, 2018)

METHODS

The population and the sample were the total number of employees of the company, 59 people. There were 6 types of product information: Copper, Steel, Plastic, Paper, Beer Crate and Glass. The data analyzed was from January-December 2021. Data were analyzed using the program Minitab 17.

The data analysis steps were 1) collecting data on 6 types of product information: Copper, Steel, Plastic, Paper, Beer Crate and Glass from January-December 2021. (Worapol Aree, 2020) 2) Finding Mean Absolute Percent Error for each method and all products using program Minitab. There were seven time series forecasting methods, they are: Linear Trend, Multiplicative Decomposition, Additive Decomposition, Single Exponential Smoothing, Double Exponential Smoothing, Multiplicative Winters and Additive Winters. 3) Comparison Mean Absolute Percent Error for each method.

RESULTS

1. Result of data collection of 6 types of products.

Result of data collection of 6 types of products information: Copper, Steel, Plastic, Paper, Beer Crate and Glass. The data analyzed was from January-December 2021 shown in Table 1.

Table 1
Product information from January-December 2021

Month	Sales Volume (Kg.) Year 2021					
	Copper	Steel	Plastic	Paper	Beer Crate	Glass
1	585	4,520	54,960	64,615	26,580	8,981
2	632	5,344	57,641	52,000	25,000	10,301
3	731	5,052	56,300	61,538	26,316	10,192
4	527	5,331	60,333	43,590	22,368	9,900
5	679	4,919	53,619	66,667	25,526	10,595
6	574	5,384	61,662	71,795	26,842	12,109
7	627	5,318	60,322	64,103	26,316	10,090
8	523	4,653	54,000	38,513	21,276	9,082
9	679	5,331	64,343	71,795	27,632	10,949
10	627	5,345	54,569	73,099	28,421	9,591
11	736	4,654	65,025	75,406	23,910	10,281
12	531	5,424	56,311	53,095	26,002	10,295

2. Result of finding Mean Absolute Percent Error.

Result of finding Mean Absolute Percent Error (MAPE) for Copper, Steel, Plastic, Paper, Beer Crate and Glass, shown in Table 2.

Table 2
Mean Absolute Percent Error all products

Method	Copper	Iron	Plastic	Paper	Beer crate	Glass
Linear Trend	9.95	5.60	6.00	18.00	6.00	6.00
Multiplicative Decomposition	4.68	4.90	6.00	7.00	5.00	5.00
Additive Decomposition	4.80	4.90	6.00	7.00	5.00	5.00
Single Exponential Smoothing	11.01	6.00	6.00	19.00	7.00	6.00
Double Exponential Smoothing	12.89	6.00	7.00	19.00	8.00	7.00
Multiplicative Winters	6.90	8.00	7.00	23.00	11.00	7.00
Additive Winters	7.06	8.00	7.00	24.00	11.00	7.00

3. Result of comparison Mean Absolute Percent Error for each method.

From Table 2, the data shown that

3.1 Copper. The forecast method with the least MAPE value was Multiplicative Decomposition.

3.2 Iron. The forecast method with the least MAPE value were Multiplicative Decomposition and Additive Decomposition.

3.3 Plastic. The forecast method with the least MAPE value were Linear Trend, Multiplicative Decomposition, Additive Decomposition and Single Exponential Smoothing.

3.4 Paper. The forecast method with the least MAPE value were Multiplicative Decomposition and Additive Decomposition.

3.5 Beer crate. The forecast method with the least MAPE value was Multiplicative Decomposition and Additive Decomposition.

3.6 Glass. The forecast method with the least MAPE value was Multiplicative Decomposition and Additive Decomposition.

CONCLUSION AND FUTURE WORK

The purpose of this research was to find a suitable forecasting method for the product category. Therefore, the research can be summarized as follows. The suitable forecasting method for Copper was Multiplicative Decomposition. The suitable forecasting method for Iron were Multiplicative Decomposition and Additive Decomposition. The suitable forecasting method for Plastic were Linear Trend, Multiplicative Decomposition, Additive Decomposition and Single Exponential Smoothing. The suitable forecasting method for Paper were Multiplicative Decomposition and Additive Decomposition. The suitable forecasting method for Beer crate were Multiplicative Decomposition and Additive Decomposition. The suitable forecasting method for Glass were Multiplicative Decomposition and Additive Decomposition.

REFERENCES

Chanpen Anuratnanon (2020), Schedule of drug purchases in government hospitals: a case study of Sirindhorn Hospital. Master's thesis Department of Industrial Engineering and Management Faculty of Engineering and industrial technology, Silpakorn University. Nakhon Pathom.

Nalinthip Leesuksam (2020), Alloy Inventory Management by ABC Analysis Technique, Case Study of AC Alloy Shop, Mae Sot District, Tak Province. Master's Degree Thesis. Logistics Management Program, Kamphaeng Phet Rajabhat University, Mae Sot.

Narueporn Ninnisai (2021), Optimization of ready-made warehouse management: a case study of ABC Bird's Nest Beverage Co., Ltd. Master's thesis. Logistics Management Faculty of Business Services, University of the Thai Chamber of Commerce.

Laphasrada Limsila (2018), Reducing Inventory Costs Using ABC-VED Analysis, Case Study of a Cosmetic Factory. Master's thesis Engineering Academic Program, College of Technology and Engineering Innovation, Dhurakij Pundit University.

Piyamas Klakhaeng, Anuch Nampinyo, Phitphisut Thitart and Kittiampol Sudprasert (2021), Research Article Service Innovation Stimulus Inevitable For Marketing Performance of Retail Modern Trade in Thailand? Role of Service Innovation and Employee Engagement, Turkish Journal of Computer and Mathematics Education Vol.12 No.12 (2021), 289-299.

Rachanee Kositanon (2021), Forecasting demand for purchasing and managing raw materials inventory in a case study of an air purifier manufacturing company. Master's thesis Logistics and Supply Chain Management Program Faculty of Logistics, Burapha University.

Tassanee Akarapin (2020), Application of Time Series Analysis Techniques to forecast the volume of payments made through electronic systems Mobile banking application. Master's thesis, Ratchaphruek University.

Thanyathorn Aonmee (2017), Forecasting and stock building planning to reduce the problem of delayed product delivery A case study of an eyeglass lens factory. Master's thesis Department of Industrial Development, Faculty of Engineering, Thammasat University.

Thiraphong Thapporn (2018), Sales forecasting and inventory management of frozen octopus chin: Siam Makro Public Company Limited. Master's thesis. Department of Industrial Engineering Thonburi University, Rajamangala University of Technology Krungthep.

Watcharachai Intipuk (2018), Product Demand Forecasting and Production Planning: Case Study: Duck Meat Processing Factory. Master of Engineering Program Thesis, Management Program Engineering, College of Technology and Engineering Innovation, Dhurakij Pundit University.

Worapol Aree. (2020). Application of the ABC technique classification analysis for inventory management Seasonings and Dried Foods Group: A Case Study of XYZ Department Store. Master's Degree Thesis. Faculty of Science and Arts, Rajamangala University of Technology Isan.