

# Demand Forecasting Automated External Defibrilator (AED) at Pt. Zoll Medical Indonesia

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**Abstract:-** Automated External Defibrillator (AED) is a medical device that functions to provide dc electrical shock therapy with the aim of stimulating a heartbeat that has stopped suddenly. According to the provisions of the American Heart Association (AHA), AED devices can be used in the IHCA (Internal Hospitality Cardiac Arrest) category, namely treatment in the hospital or in OHCA (Out Hospitality Cardiac Arrest), namely in the environment outside the hospital. The development of this portable defibrillator or commonly known as AED is very helpful in its use and users do not require that only medical personnel be allowed to use it. Therefore, demand forecasting is very necessary to be able to meet demand for Automated External Defibrillator (AED) products in various regions of Indonesia. Time Series forecasting methods, namely Moving Average, Exponential Smoothing, and trend projections will be used in this research. Forecasting error calculations use the smallest error criteria MAD, MSE and MAPE. From the results of the analysis, distributor 1 experienced conditions where the data was running in stages both from the top and bottom from time to time. To maintain the best running data from bottom to top, it is possible to carry out mitigation by holding a market monitoring pattern by holding an evaluation report every week so that if at any time practitioners may have problems in the market that can be immediately detected and the best solution can be found; Distributor 2 has a seasonal demand pattern where distributor 2 experiences changing data conditions if there are factors that influence it repeatedly both in the time period and sectoral factors owned by distributor 2, this needs to be immediately carried out monitoring evaluation or monitoring and evaluation with the product principal. so that progress in handling obstacles can be overcome immediately; For distributors 3 & 4, if the market analysis occurs, there is a random demand pattern which cannot be described from the other three demand patterns, so that in evaluating this pattern, it is necessary to study the time interval of the pattern when the market decline occurs, so that by combining time it is hoped to get evaluation results at that

time. This is an assessment of the inhibiting factors or obstacles that occur so that they can be corrected immediately.

**Keywords:-** AED, AHA, IHCA, DEFIBRILLATOR.

## I. INTRODUCTION

Automated External Defibrillator (AED) is an electronic medical device in the medical device category with a life support classification. Functionally, AED plays a role in supporting basic life support (BHD) facilities according to the treatment of heart problems with the American Heart Association (AHA) 2020 reference.

The use of AED equipment is situational in nature, which in support of this problem may occur in a health service facility environment (FASYANKES) which is termed IHCA/Intra Hospital Cardiac Arrest or in public facilities or OHCA/Out Hospital; Cardiac Arrest. With the possibility of using this tool without seeing the location, the AED tool is designed in such a way that users are not encouraged, only medical personnel are permitted to use it. Because the AED has a very directed usage guide from the point of use to the end. The guide for each type of AED product is in the form of an indicator light or sound indication guide.

However, the Automated External Defibrillator (AED), both in public facilities and even in health care facilities, is not really considered for its existence to support basic life support measures.

The AED is a tool that can be used by all groups, it is not recommended that only medical personnel be used, such as a defibrillator unit. This is because the AED device has a safety function that can guide operations, both functional stages which technically provide automatic defibrillation at the right time and button presses which will be instructed by the device via voice guidance.

And the following is a report on the availability of AEDs at one of the public facilities:

Table 1: Population Data Availability of Zoll brand AEDs in Public Facilities

No.	Nama Instansi	Ketersediaan AED ZOLL
1	Kedutaan	30 Unit
2	Lembaga/KCI	25 Unit
3	KAI	40 Unit
4	Bandara	20 Unit
5	BCA	45 Unit
6	AGD	50 Unit

From the presentation of data on AED availability in Health Service Facilities in table 1 and Public Facilities in table 2, the Zoll brand AED product is a choice that is superior to the 3 other brands of AED products that are the choice in health service facilities at 21 Regional Hospitals in DKI Jakarta. The sales aspect is greatly influenced by the company's readiness to anticipate consumer demand. For this reason, companies need to make optimal demand planning.

In general, demand planning is better known as forecasting. Forecasting is an objective calculation and uses past data to determine something in the future (Sumayang, 2019).

According to Lapide (2006), forecasting is useful for companies to find out what products will be most needed by consumers in the future, thus helping the sales department in developing strategies to increase sales.

Table 2: Data on demand for AED products

NO	YEAR	REQUEST	PRODUCT AVAILABILITY
1	2020	300	350
2	2021	500	450
3	2022	430	500

The table shows a comparison between demand and availability of Automated External Defibrillator/AED devices. Forecasting can also help with the fluctuating conditions that many companies often experience. Fluctuating conditions occur if consumer demand for products is high but the company cannot meet the needs or if low demand results in products that have been produced not being sold and having to be stored in warehouses so that storage costs increase. The manual forecasting that has been carried out so far is often inaccurate, so that production quantities are not appropriate, sometimes shortages sometimes exceed consumer demand. Shortages in production result in delays in the delivery of goods to consumers, while excess production results in a buildup of goods in warehouses that require maintenance costs. Demand forecasting is also closely related to the amount of raw materials required. So, by forecasting demand for a product, the company can find out the amount of raw materials needed.

last year's sales). Forecasting can also be used as a basis to help make decisions that are not fixed or uncertain, for example in decision making, in control policies for inventory systems, production planning decisions, scheduling needs for machines, equipment, materials, and can determine the level of labor during a period. production process. Forecasting techniques are carried out using historical data which is projected into the future through various mathematical models or combinations adjusted to the company's considerations.

Forecasting with a future horizon is classified into 3 categories as follows: 1) Short term forecasting; 2) Medium term forecasting; 3) Long term forecasting.

*C. Forecasting Method*

According to Daniel, et al (2016: 185), qualitative forecasting methods are subjective, based on consumer opinions and assessments. This method is usually applied to medium or long term forecasting. Examples of qualitative forecasting methods are informed by opinion and judgment, the Delphi method, market research, and historical life cycle analogies. Meanwhile, quantitative forecasting models are used to predict future data as a function of past data. This method is usually applied to short or medium range forecasting. Examples of quantitative forecasting methods are last period demand, simple and weighted N-Period moving averages, simple exponential smoothing, and multiplicative seasonal indexes.

Forecasting techniques have modeling that is implemented in research as follows; 1) Moving Average (Average movement); 2) Smoothing method (single exponential smoothing); 3) Double exponential smoothing (holt's method); 4) Winter method.

*D. Forecasting Accuracy*

In an analysis of forecasting techniques, a study of the accuracy of the data values in the data is required and the following is a study of the forecasting accuracy used in the research:

➤ *Mean Reference Deviation (MAD)*

Mean Absolute Deviation (MAD) is a technique used to find the absolute average error value. Mean Absolute Deviation (MAD) is the absolute total value of the error of a forecast divided by the data or the average absolute error during a certain period regardless of whether the forecast results are greater or smaller than the actual.

**II. LITERATURE REVIEW**

*A. Operational Management*

According to Rosdiana (2014; 18) "Operations management is a field of management that specializes in the production of goods, and uses special tools and techniques to solve production problems".

According to Eddy Herjanto (2007; 2) states that "Production and operations management is a process that continuously and effectively uses management functions to integrate various resources efficiently in order to achieve goals.

*B. Forecasting Techniques ( Forecasting )*

Forecasting is an art and science that can predict future events. Forecasting will involve taking historical data (such as

➤ *Mean Square Error (MSE)*

Mean Square Error (MSE) is a technique for finding the average value of the square error. Mean Square Error (MSE) is calculated by adding up the squares of all forecast errors in each period and dividing it by the number of forecasting periods. MSE amplifies the influence of large error rates, but reduces forecast error rates smaller than one unit.

➤ *Mean Absolute Percentage Error (MAPE)*

Mean Absolute Percentage Error (MAPE) is a technique for finding the average value of the absolute percentage error. Mean Absolute Percentage Error (MAPE) is a measure of relative accuracy used to determine the percentage deviation of forecasting results.

*E. Sales Theory*

According to Warren Reeve Fee (2010) "Sales are amounts charged to customers for merchandise sold well in cash and credit." According to Philip Kotler (2008) "Sales are informal social processes where individuals and groups get what they need and want, create, offer and exchange products that are valuable to others." According to Rudianto (2009), "sales is an activity that results in the flow of goods out of the company so that the company receives money from customers. Sale". According to Kusnadi (2009) "explains that sales is the amount of money charged to the buyer for the goods or services sold". According to Basu Swasta (2012)

"Selling is the science and art of personal influence carried out by sellers to persuade people to be willing to buy the goods and services offered." Based on this understanding, sales can be defined as one of the activities carried out by a company to maintain business activities with the aim of obtaining the desired profit or profits.

*F. Production Theory*

According to Assauri (2011:75) production is the means, methods and techniques for creating or increasing the usefulness of a good or service using existing resources (labor, machines, materials, funds).

According to Miller (2009), the definition of production is as follows: "Production is the use or resource of changing one commodity into another of the same commodity." According to Murti Sumarti and Jhon Soeprihanto (2012) "activities in creating or increasing the use of goods or services, where these activities require production factors.

*G. Introduction to the POM QM Application*

The POM program is an application that can be used to help solve problems in data processing in quantitative production and operations research.

Based on these theories, the framework for this research is as follows:

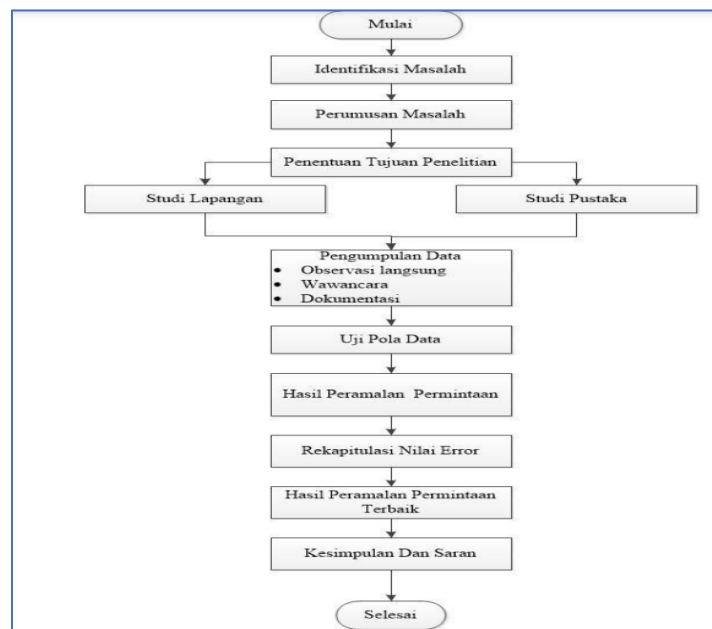


Fig. 1: Framework of Thought

**III. RESEARCH METHODOLOGY**

The method used is a quantitative method of causality statistical inference.

This research uses quantitative methods with Moving Average (MA), Exponential Smoothing, Trend Analysis forecasting techniques. The statistical tool used for testing in this research is POM QM .

The data collection technique in this research is nonprobability sampling with the technique taken, namely saturated sampling (sensus).

**IV. RESULTS**

*A. Data Testing*

Demand forecasting results are obtained by processing past demand data that has been collected. Starting from April 2022 to March 2023. And analyzed using POM QM5 software. The results of demand forecasting can be seen in the following table:

Table 3: Results of demand forecasting using the Time Series method

<b>Periode</b>	<b>Linear Trend</b>	<b>Single Eksponential Smoothing</b>	<b>Moving Average</b>
Distributor 1	10.479	9.546	10
Distributor 2	10.453	9.522	10
Distributor 3	10.53	9.447	10
Distributor 4	10.412	9.595	10

From the results of testing the data measuring pattern, it produces a dynamic predictive value using the moving average method, namely 10 units, hence the demand forecasting method which will be used to obtain the predictive value of data analysis studies in the next period will use the moving average method.

*B. Error Value Validation Recapitulation Results*

In carrying out predictive calculations based on the theoretical basis of the research, validation measurements were carried out on the error values for the 4 distributors and the following were the evaluation results:

➤ *Recapitulation of Error Values for Distributor 1*

Recapitulation of error values is used to determine the validity of the method used in demand forecasting. The results of the recapitulation of error values can be seen in the following table:

Table 4: Results of recapitulation of error values for distributor 1

<b>Error Analisis</b>	<b>Linear Trend</b>	<b>Single Eksponential Smoothing</b>	<b>Moving Average</b>
MAPE	63.048%	77.228%	79.25%
MAD	1.693	2.133	2.05
MSE	6.575	8.52	8.825

In determining the best forecasting method for distributor 1, namely by looking at the magnitude of the error value in that method. The smaller the error value in a method, the better the forecasting results. From the results of this forecasting, the Linear Trend method has the smallest error value with a MAPE value of 63,048%, MAD of 1,693 and MSE of 6,575. Thus, it can be said that linear trend is the best

time series method for forecasting demand for Zoll products at PT. Zoll Medical Indonesia.

➤ *Recapitulation of Error Values for Distributor 2*

Recapitulation of error values is used to determine the validity of the method used in demand forecasting.

The results of the recapitulation of error values can be seen in the following table:

Table 5: Results of recapitulation of error values for distributor 2

<b>Error Analisis</b>	<b>Linear Trend</b>	<b>Single Eksponential Smoothing</b>	<b>Moving Average</b>
MAPE	60.049%	62.2%	65%
MAD	1.769	2.078	2
MSE	8.341	8.791	9.95

In determining the best forecasting method for distributor 2, namely by looking at the magnitude of the error value in the method. The smaller the error value in a method, the better the forecasting results. From the results of this forecasting, the Linear Trend method has the smallest error

value with a MAPE value of 60,049%, MAD of 1,769 and MSE of 8,341. Thus, it can be said that linear trend is the best time series method for forecasting demand for Zoll products at PT. Zoll Medical Indonesia.

➤ *Recapitulation of Error Values for Distributors 3*

Recapitulation of error values is used to determine the validity of the method used in demand forecasting. The

results of the recapitulation of error values can be seen in the following table:

Table 6: Results of recapitulation of error values for distributor 3

<b>Error Analisis</b>	<b>Linear Trend</b>	<b>Single Eksponential Smoothing</b>	<b>Moving Average</b>
MAPE	46.879%	71.325%	58.5%
MAD	1.603	2.206	1.95
MSE	9.355	11.016	11.675

In determining the best forecasting method for distributor 3, namely by looking at the magnitude of the error value in the method. The smaller the error value in a method, the better the forecasting results. From the results of this forecasting, the Linear Trend method has the smallest error value with a MAPE value of 46,879%, MAD of 1,603 and MSE of 9,355. Thus, it can be said that linear trend is the best

time series method for forecasting demand for Zoll products at PT. Zoll Medical Indonesia.

➤ *Recapitulation of Error Values for Distributors 4*

Recapitulation of error values is used to determine the validity of the method used in demand forecasting. The results of the recapitulation of error values can be seen in the following table:

Table 7: Results of recapitulation of error values for distributor 4

<b>Error Analisis</b>	<b>Linear Trend</b>	<b>Single Eksponential Smoothing</b>	<b>Moving Average</b>
MAPE	88.6525%	85.972%	104.119%
MAD	2.287	2.455	2.6
MSE	9.596	9.704	10.3

In determining the best forecasting method for distributor 4, namely by looking at the magnitude of the error value in the method. The smaller the error value in a method, the better the forecasting results. From the results of this forecasting, the Linear Trend method has the smallest error value with a MAPE value of 88.6525%, MAD of 2,287 and MSE of 9,596. Thus, it can be said that linear trend is the best time series method for forecasting demand for Zoll products at PT. Zoll Medical Indonesia.

C. Demand Forecasting Value Processing

From the previous discussion, the assessment of the demand forecasting value of the predictive value of the 4 distributors for the next period can be presented in the following results:

➤ *Data Analysis on Distributor 1*

Recapitulation of error values is used to determine the validity of the method used in demand forecasting. The results of the recapitulation of error values can be seen in the following table:

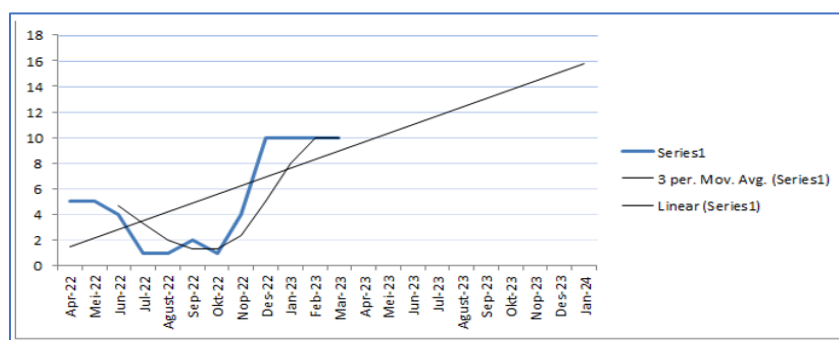


Fig. 2: Data analysis on distributors 1



In the forecasting curve for distributor 1, the maximum achievement value obtained in the January 2024 period was 16 units even though there had been a decline in marketing in the October 2022 period cycle.

➤ *Data Analysis on Distributors 2*

Recapitulation of error values is used to determine the validity of the method used in demand forecasting.

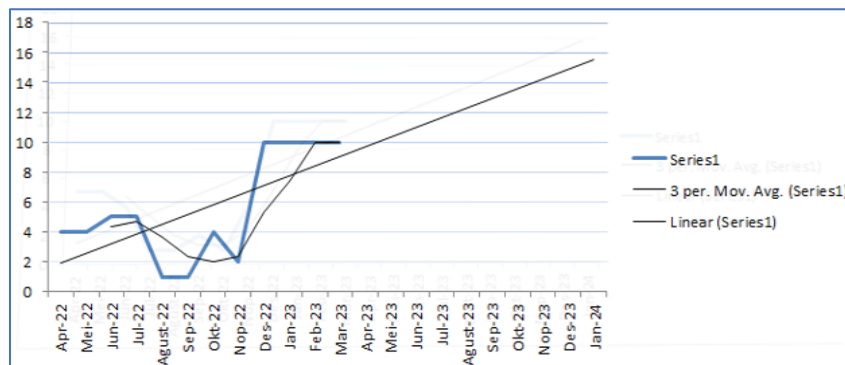


Fig. 3: Results of recapitulation of error values for distributor 2

For the forecasting curve for distributor 2, it was obtained that the maximum achievement value in the January 2024 period was almost close to that of distributor 1, which amounted to 16 units, however, distributor 2 had an upward fluctuation of 2 cycles after a decline in marketing occurred, namely in the period July 2022 and November 2022.

➤ *Data Analysis on Distributors 3*

Recapitulation of error values is used to determine the validity of the method used in demand forecasting. The results of the recapitulation of error values can be seen in the following table:

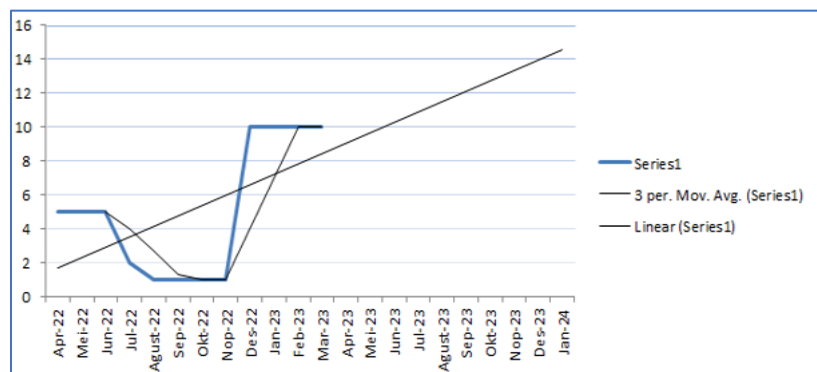


Fig. 4: Data analysis on distributors 3

Marketing at distributor 3 has a market decline from the period June 2022 to October 2022 and then there is stability until November 2022. The maximum marketing achievement

value at distributor 3 is that the predictive demand value is only 14 units.

➤ *Data Analysis on Distributors 4*

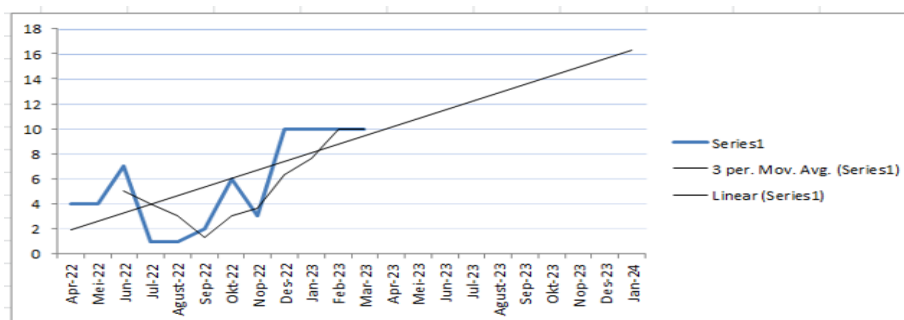


Fig. 5: Forecasting Results for distributors 4

Among the 4 distributors in AED distribution in the public safety division at PT. Zoll Medical Indonesia is only the 4th distributor that has a demand forecasting value that

exceeds 16 units, even though it has downward fluctuations from the period June 2022 to September 2022 but then experiences an ever-increasing marketing cycle.

**V. DISCUSSION**

The best demand forecasting results are determined based on the smallest error value. Based on the recapitulation of the smallest error value, linear trend is obtained as the best

demand forecasting method. The results of demand forecasting using the linear trend method can be seen in the following table:

Table 8: Best forecasting results

<b>Distributor</b>	<b>Hasil Peramalan Permintaan Terbaik (Linear Trend)</b>	<b>MAPE</b>	<b>MAD</b>	<b>MSE</b>
Disributor 1	10.479 unit	63.048%	1.693	6.575
Disributor 2	10.453 unit	60.049%	1.769	8.341
Disributor 3	10.53 unit	46.879%	1.603	9.355
Disributor 4	10.412 unit	88.6525%	2.287	9.596

**VI. CONCLUSION**

**A. Conclusion**

The conclusions from this research are:

- The best demand forecasting method based on historical demand data for Zoll AED products at PT. Zoll Medical Indonesia is a linear trend, at 1) Distributor 1 with a Mean Absolute Percentage Error (MAPE) value of 63,048%, a Mean Absolute Deviation (MAD) value of 1,693 and a Mean Square Error (MSE) value of 6,575; 2) Distributor 2 with a Mean Absolute Percentage Error (MAPE) value of 60,049%, a Mean Absolute Deviation (MAD) value of 1,769 and a Mean Square Error (MSE) value of 8,341; 3) Distributor 3 with a Mean Absolute Percentage Error (MAPE) value of 46,879%, a Mean Absolute Deviation (MAD) value of 1,603 and a Mean Square Error (MSE) value of 9,355; 4) distributor 4 with a Mean Absolute Percentage Error (MAPE) value of 88.6525%, a Mean Absolute Deviation (MAD) value of 2,287 and a Mean Square Error (MSE) value of 9,596.
- Based on the best forecasting method, a demand forecast for Zoll AED products at PT was produced. Zoll Medical Indonesia for the next period is 1) Distributor 1 is 10; 2) Distributor 2 is 10;3) Distributor 3 is 10; 4) Distributor 4 is 10; (in units).
- Of the 4 AED distributors in the *public safety division* at PT. Zoll Medical Indonesia evaluation value and *demand forecasting* until January 2024 from distributor 4
- From the results of research studies through evaluation of marketing data for the 4 distributors, it was found that demand forecasting values in the coming year will increase, so hopefully this can be a positive factor in reducing the death rate in Indonesia due to heart failure.
- PT. Zoll Medical Indonesia can find out the results of the marketing evaluation of the 4 AED product distributors in their public safety division, so that the best distributors can be used as regional placement options for markets that are not yet dominated and also distributors with small marketing value to immediately be evaluated more intensely and periodically.

**B. Suggestion**

- Future research is expected to provide more data from various regional areas and products as data sources.
- As time goes by and research always increases demandIt is hoped that related parties can provide forecasting, especially for AED products These supporting facilities can reduce deaths by improving themmore optimal availability of demand.

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