# Selection Of Forecasting Methods For Baby Products To Accurately Predict Sales
# (Case Study at PT ABPI Jakarta Branch)

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## ABSTRACT

*Rapid business growth faces the main challenge of adjusting production to fluctuating market demand. The mismatch between production volume and demand can cause various problems, such as overproduction resulting in waste of resources, underproduction causing the inability to meet market demand on time. This study aims to determine the most accurate forecasting method for the NSP-1006 Sumo Round Bottle Bpa Free 240 ml, NSP-3006 Sumo Round Bottle Bpa Free 50 ml, 3-2103-Mh Bottle 3 Function 150 cc, TS-3S Accessories 3-tier milk container, and F-338 Baby Training Cup 3 in 1 Accessories. The research method uses descriptive quantitative. The analysis method used is naive approach, simple moving average, linear regression, simple exponential smoothing. The accuracy benchmark uses Mean Absolute Deviation (MAD), Mean Square Error (MSE), Mean Absolute Percentage Error (MAPE). Data collection techniques use primary data and secondary data. The results of the study show that the NSP-1006 Sumo Round Bottle Bpa Free 240 ml has an accurate forecasting method which is the linear regression method, the NSP-3006 Sumo Round Bottle Bpa Free 50 ml has an accurate forecasting method which is the linear regression method, the 3-2103-Mh Bottle 3 Function 150 cc has an accurate forecasting method which is the naive method, the TS-3S 3-tier milk container accessories have an accurate forecasting method which is the naive method, and the F-338 Baby Training Cup 3 in 1 accessories have an accurate forecasting method which is the linear regression method.*

*Keywords: Forecasting; Sales; Accuracy benchmark; Naive approach; Simple Moving Average; Linear Regressio;, Simple Exponential Smoothing.*

## INTRODUCTION

The Indonesian manufacturing industry is a key pillar of the national economy, despite facing complex global challenges. The Indonesian Ministry of Industry explains that the manufacturing sector experienced an increase in GDP from 18.67% in 2023 to 18.98% in 2024 (ikpi, 2024). One of the contributors to GDP is the non-oil and gas management industry, namely the baby bottle industry. This industry in Indonesia is showing a positive trend in 2024. This increase indicates that the baby bottle industry plays a significant role in national economic growth (machinevision, 2024).

PT ABPI is one of the manufacturers established in 1992, located in Tangerang, producing various baby care products including baby bottles and accessories. Rapid business growth promises profits but also presents major challenges for the company, namely adjusting production to fluctuating market demand. Mismatches between production volume and demand can lead to various issues, such as overproduction resulting in resource wastage, or underproduction causing an inability to meet market demand on time. Such conditions negatively impact operational efficiency and company profitability (Audinasyah & Solehudin, 2024).

Forecasting is an effective measure to overcome this problem (Lusiana & Yuliarty, 2020). Forecasting is a process step of estimating future product sales within a certain period of time based on historical data (Ahmad, 2020). The long-term impact of forecasting is to increase sales profits and customer trust (Yulian, Anggraeni, & Aini, 2020). According to research in South Korea, forecasting is necessary as an accurate prediction of the future with a focus on efficiency (Choi, Zhang, & Nadzri, 2022).

PT ABPI produces high-quality products that can compete with similar products. The company faces several challenges, including stock shortages due to high demand, such as during Harbonas events and twin dates on e-commerce platforms. High customer demand for certain bottle colors makes it impossible for branches to meet customer demand when it increases due to limited supply in the Jakarta warehouse. This has resulted in the company not achieving optimal profits.



**DATA PENJUALAN DAN PERMINTAAN PT ABPI**

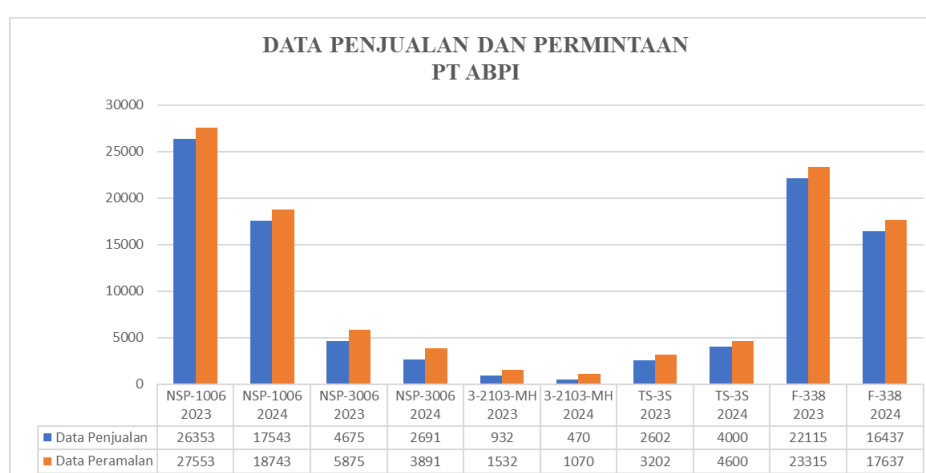| | NSP-1006 2023 | NSP-1006 2024 | NSP-3006 2023 | NSP-3006 2024 | 3-2103-MH 2023 | 3-2103-MH 2024 | TS-3S 2023 | TS-3S 2024 | F-338 2023 | F-338 2024 |
|---|---|---|---|---|---|---|---|---|---|---|
| Data Penjualan | 26353 | 17543 | 4675 | 2691 | 932 | 470 | 2602 | 4000 | 22115 | 16437 |
| Data Peramalan | 27553 | 18743 | 5875 | 3891 | 1532 | 1070 | 3202 | 4600 | 23315 | 17637 |

Figure 1 : Sales and Demand Data of PT ABPI

Based on the figure above, the sales data is still below the demand data.

Forecasting in this study uses the time series data processing method. This method works by calculating the weighted average of old and new data. Old data refers to the production usage level in the previous period, while new data refers to the production usage level in the most recent period (Laksono, Santi, & Chulkamdi, 2023).

Based on the processed data, as shown in Figure 1, it can be seen that PT ABPI's sales data is still below the demand figure (forecasting). This means that the company has not been able to optimally meet all market demand. The following are the stock conditions and the level of suitability to demand:

Table 1: Stock Condition Data and Level of Conformity

| KODE PRODUK | TAHUN | FORECAST | PENJUALAN | KETERSEDIAAN STOK | TINGKAT KESESUAIAN (%) |
|---|---|---|---|---|---|
| NSP-1006 | 2023 | 27,553 | 26,353 | 26,353 | 95,6% |
| NSP-1006 | 2024 | 18,743 | 17,543 | 17,543 | 93,6% |
| NSP-3006 | 2023 | 5,875 | 4,675 | 4,675 | 79,6% |
| NSP-3006 | 2024 | 3,891 | 2,691 | 2,691 | 69,1% |
| 3-2103-MH | 2023 | 1,532 | 932 | 932 | 60,8% |
| 3-2103-MH | 2024 | 1,070 | 470 | 470 | 43,9% |
| TS-3S | 2023 | 3,202 | 2,602 | 2,602 | 81,2% |
| TS-3S | 2024 | 4,600 | 4,000 | 4,000 | 87,0% |
| F-338 | 2023 | 23,315 | 22,115 | 22,115 | 94,8% |
| F-338 | 2024 | 17,637 | 16,437 | 16,437 | 93,2% |

Based on Table 1, the average level of compliance with demand is only around 79.9%, which means that around 20% of market demand is not being met due to limited stock. This mismatch is particularly significant for products such as 3-2103-MH 2024 (43.9%) and NSP- 3006 2024 (69.1%), indicating potential lost sales. This also impacts unmet customer demand and a decline in consumer confidence in the brand. This situation underscores the importance of conducting forecasting research, particularly using time series methods, which can dynamically analyze historical data and trends. As a result, companies can make more accurate production decisions, improve supply chain efficiency, and maximize profits amid competitive market dynamics.

## LITERATURE REVIEW

### Management

Management is the process of organizing something by a group of people or an organization to achieve the organization's goals (Gesi, Laan, & Lamaya, 2020). Management is something that is done effectively and efficiently through other people (Robbins & Judge, 2020). Management is the planning, organizing, directing, and controlling of a company's resources to achieve its objectives (Kaehler & Grundei, 2019). Management can be summarized as a company's efforts to achieve its objectives effectively and efficiently.

### Operational Management

Operational management is an activity related to the creation of goods and services through the transformation of inputs into outputs (Heizer, Render, & Munson, 2021). Operations management is the optimal use of various resources within a company, including labor, machinery, equipment, raw materials, and so on, in the process of transforming resources into

products in the form of goods or services. Thus, the process of change or transformation in operational management consists of input, process, and output (Suganda & Purnamasari, 2022).

## Forecasting

### Definition of Forecasting

Forecasting is the art and science of predicting future events. Forecasting may involve collecting historical data (such as previous sales) and projecting it into the future using mathematical models (Heizer, Render, & Munson, 2021). Forecasting is necessary in many situations to effectively and efficiently estimate future demand planning (Hyndman & Athanasopoulos, 2019). Forecasting is a method of estimating a future value using past data (Hamirsa & Rumita, 2022). It can be concluded that forecasting is a method of estimating or projecting the future effectively and efficiently.

### Accuracy Metrics

Accuracy metrics are used to measure the performance or effectiveness of forecasting based on forecasting errors. The performance metric for forecasting is that the smaller the error, the more accurate the forecasting results. This metric is crucial for selecting or evaluating the optimal forecasting model. Forecasting accuracy metrics include (Herawati, Prastiti, & Imamah, 2024)

1) Mean Absolute Deviation (MAD)

   MAD contains values calculated by taking the sum of the absolute values of each forecasting error divided by the number of data periods (n).

   The MAD formula is as follows :

   $$MAD = \frac{1}{n}\sum_{t=1}^{n}\left|A_t - F_t\right| \quad \text{……..………………………} (2.1)$$

2) Mean Square Error (MSE)

   MSE is the average difference between the actual value and the squared prediction result. The general formula for MSE is as follows:

   $$MSE = \frac{\sum_{t=1}^{n}(A_t - F_t)^2}{n} \quad \text{………………………….} (2.2)$$

3) Mean Absolute Percentage Error (MAPE)

   MAPE is the mean absolute error of the forecast as a percentage of the actual data. The smaller the percentage error in MAPE, the more accurate the forecast results. The general formula for MAPE is as follows:

   $$MAPE = \frac{100}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right| \quad \text{………….………………....} (2.3)$$

The forecasting model can still be used as long as it is no more than 50%. If the percentage value is above 50%, then the model can no longer be used. The MAPE value category can be seen

Table 2: MAPE Value Categories

| No | MAPE | Kategori |
|----|-----------|--------------|
| 1 | < 10% | Sangat baik |
| 2 | 10 % - 20% | Baik |
| 3 | 20 % - 50% | Layak |
| 4 | > 50% | Tidak akurat |

Source: (Herawati, Prastiti, & Imamah, 2024)

**Forecasting Methods**

Forecasting methods in this study

1) Naive approach

   The simplest forecasting model assumes that observations from the recent past (last year, last month, and so on) are the best forecasting tools for predicting future conditions. (Taifur & Imaroh, 2020).

$$Y\ t + 1 = Yt \quad \text{…….………..……………………………….…….……} \quad (2.4)$$

2) Linear Regression

   Linear regression is used in production to make predictions about quantity and quality. This allows companies to estimate the right amount of production and maximize profits. (Bilaffayza, Wahyudin, & Herwanto, 2023)

$$r = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{(n\Sigma x^2 - (\Sigma x))^2((n)\Sigma y^2 - \Sigma y)_+^2}} \quad \text{…………………...} \quad (2.5)$$

3) Simple Moving Average

   Representing (n) current data for forecasting periods using the average future figures forecasting method. (Taifur & Imaroh, 2020).

$$Mt = Yt + 1 = \frac{(Y1 + Yt - 1 + yt - 2 + \cdots + Yt - n + 1)}{n} \quad \text{……...} \quad (2.6)$$

4) Simple Exponential Smoothing.

   The simple Exponential Smoothing method is used to estimate short distances, usually only one month ahead. (Taifur & Imaroh, 2020).

$$St = \alpha.Xt + (1-\alpha).\ S\ t\text{-}1 \quad \text{.............................................} (2.7)$$

### Characteristics of Forecasting

Good forecasting has several important criteria, including (Rahma & Winursito, 2024)

1) Accuracy, which is measured by the bias and consistency of the forecast. A forecast is considered biased if it is too high or too low compared to the actual outcome. A forecast result is considered consistent if the magnitude of the forecasting error is relatively small.

2) Cost, which is required for creating a forecast depends on the number of items being forecasted, the length of the forecasting period, and the forecasting method used.

3) The use of simple, easy-to-create, and easy-to-apply forecasting methods will provide benefits for the company.

### METHOD

#### Research Time

The research period runs from September 2023 to February 2025. The research location is PT ABPI, located in Tangerang.

#### Research Design

The research design employs a quantitative descriptive approach. Quantitative research involves the collection and analysis of numerical data using statistical methods (Nunan, Briks, & Malhotra, 2020), while descriptive research focuses on formulating questions related to the existence of independent variables, whether involving a single variable or multiple variables (Sugiyono, 2024).

#### Research Population and Sample

According to (Sugiyono, 2022), the population is the entirety of the research subjects. Thus, the population can be defined as all individuals or units with the same characteristics that will be used as research subjects. The population in this study consists of bottles and accessories, totaling 3 types of bottles and 2 types of accessories. The sampling technique used in this study is purposive sampling, where the specific characteristic is bottles and accessories that are out of stock. The samples in this study are the NSP-1006 Sumo Round Bottle BPA Free 240 ml, NSP-3006 Sumo Round Bottle BPA Free 50 ml, 3-2103-Mh Btl 3 Funct 150 cc, Ts- 3s 3-Tier Milk Holder, and F-338 Baby Training Cup 3-in-1 (obtained from PT ABPI sales data).

#### Data Collection Technique

Data collection techniques using secondary data (Sugiyono, 2024). Secondary data is existing data. Secondary data in this study consists of journals, books, and production volume data.

### RESULTS AND DISCUSSION

#### Results
The focus of this study is on the volume and quantity of orders, specifically for the following products: NSP-1006 Sumo Round Bottle BPA-Free 240 ml, NSP-3006 Sumo Round Bottle BPA-Free 50 ml, 3-2103-Mh Btl 3 Funct 150 cc, Accessories Ts-3s Milk Holder 3 Layers, F-

338 Baby Training Cup 3 in 1. Using forecasting methods such as: naive approach, moving average, linear regression, and exponential smoothing for the period from January 2023 to December 2024.

Table 3: Results of Accuracy Measurements for All Forecasting Methods

| MAD | NSP-1006 | NSP-3006 | 3-2103-MH | TS-3S | F-338 |
|---|---|---|---|---|---|
| Naïve Approach | 532.74 | 127.48 | 23.96 | 119.09 | 697.7 |
| Moving Average (3 Bulan) | 413.78 | 107.43 | 26.22 | 163.14 | 741.33 |
| Moving Average (5 Bulan) | 431.22 | 109.87 | 25.13 | 213.41 | 834.15 |
| Exponential Smoothing (0,1) | 512.95 | 133.79 | 31.29 | 202.36 | 951.59 |
| Exponential Smoothing (0,5) | 436.37 | 107.46 | 25.06 | 142.12 | 757.6 |
| Exponential Smoothing (0,9) | 508.21 | 121.91 | 24.2 | 119.7 | 698.25 |
| Regresi Linier | 374.82 | 83.77 | 20.79 | 195.81 | 619.86 |
| **Error Terkecil** | **374.82** | **83.77** | **20.79** | **119.09** | **619.86** |

| MSE | NSP-1006 | NSP-3006 | 3-2103-MH | TS-3S | F-338 |
|---|---|---|---|---|---|
| Naïve Approach | 421103.3 | 27679.83 | 858.3 | 27895.7 | 814099.3 |
| Moving Average (3 Bulan) | 251649 | 21174.18 | 1017.09 | 57724.26 | 980344.7 |
| Moving Average (5 Bulan) | 260584.5 | 21733.79 | 893.37 | 89684.02 | 1092110 |
| Exponential Smoothing (0,1) | 363118.5 | 23287.24 | 1283.38 | 77110.4 | 1195375 |
| Exponential Smoothing (0,5) | 296078.8 | 19468.18 | 833.77 | 42463.53 | 867486.4 |
| Exponential Smoothing (0,9) | 382667.6 | 24938.38 | 848.76 | 29254.2 | 818862.9 |
| Regresi Linier | 217061.4 | 15462.76 | 615.48 | 69393.53 | 654023.4 |
| **Error Terkecil** | **217061.4** | **15462.76** | **615.48** | **27895.7** | **654023.4** |

| MAPE | NSP-1006 | NSP-3006 | 3-2103-MH | TS-3S | F-338 |
|---|---|---|---|---|---|
| Naïve Approach | 26.94% | 40.46% | 45.41% | 47.76% | 48.38% |
| Moving Average (3 Bulan) | 24.19% | 36.93% | 61.70% | 81.62% | 56.44% |
| Moving Average (5 Bulan) | 26.12% | 38.72% | 64.04% | 159.48% | 70.44% |
| Exponential Smoothing (0,1) | 29.37% | 55.29% | 91.37% | 179.75% | 90.89% |
| Exponential Smoothing (0,5) | 23.47% | 36.58% | 55.31% | 82.59% | 57.27% |
| Exponential Smoothing (0,9) | 25.97% | 39.08% | 46.71% | 49.75% | 49.24% |
| Regresi Linier | 20.47% | 27.56% | 47.08% | 164.71% | 46.93% |
| **Error Terkecil** | **20.47%** | **27.56%** | **45.41%** | **47.76%** | **46.93%** |

Based on Table 3, the following conclusions can be drawn:
The smallest MAD (Mean Absolute Deviation) value for the NSP-1006 Sumo Round BPA-Free 240 ml bottle is in the Linear Regression method with a value of 374.82. The NSP-3006 Sumo Round Bottle BPA-Free 50 ml bottle is in the Linear Regression method with a value of 83.77. The 3-2103-Mh Btl 3 Funct 150 cc bottle is in the Linear Regression method with a value of 20.79. And the F-338 Baby Training Cup 3 in 1 accessory is in the Linear Regression method with a value of 619.86. In contrast, the Ts-3s 3-Tier Milk Container accessory has the smallest MAD value in the Naïve Approach method with a value of 119.09.
a.  The smallest MSE (Mean Square Error) value for the NSP-1006 Sumo Round BPA- Free 240 ml Bottle is in the Linear Regression method with a value of 217,061.4. The NSP-3006 Sumo Round BPA-Free 50 ml Bottle is in the Linear Regression method with a value of 15,462.76. The 3-2103-Mh Btl 3 Funct 150 cc bottle is in the Linear Regression method with a value of 615.48. And the F-338 Baby Training Cup 3 in 1 accessory is in the Linear Regression method with a value of 654,023.4. In contrast, the

Ts-3s 3-Tier Milk Container accessory has the smallest MAD value in the Naïve Approach method with a value of 27,895.7.

b. The smallest MAPE (Mean Absolute Percentage Error) value for the NSP-1006 Sumo Round BPA-Free 240 ml bottle was found in the Linear Regression method with a value of 20.47%. The NSP-3006 Sumo Round Bottle BPA Free 50 ml has the smallest MAPE value in the Linear Regression method, with a value of 27.56%. The F-338 Baby Training Cup 3 in 1 accessory has the smallest MAPE value in the Linear Regression method, with a value of 46.93%. In contrast, the 3-2103-Mh Btl 3 Funct 150 cc bottle has the smallest MAPE value in the Naïve Approach method at 45.41%. The Ts-3s 3-Tier Milk Container accessory is in the Naïve Approach method with a value of 47.76%.

**Discussion**

1. NSP-1006 Sumo Round Bottle Bpa Free 240 ml

   The NSP-1006 Sumo Round Bottle BPA Free 240 ml product has the smallest MAPE percentage of 20.47% in the linear regression method forecasting results. This study is supported by (Rudi, Pranoto, & Ariwibisono, 2023), whose research findings indicate that the linear regression method performs well when applied to company sales data for forecasting future stock levels. Linear regression forecasting is an effort to predict future outcomes or events based on past data and then use a mathematical model to calculate future events.

2. NSP-3006 Sumo Round Bottle Bpa Free 50 ml

   The NSP-3006 Sumo Round Bottle BPA Free 50 ml product has the smallest MAPE percentage of 27.56% in the linear regression forecasting method results. This study is supported by (Ahmad, 2020), who states that using production forecasting through the linear regression approach is the recommended forecasting method because it has the lowest MAPE value. This is because, through the processing of forecasts using this method, it is known that the MAPE value with this method is the smallest, thereby reducing or avoiding the risk of errors in production forecasting and the losses caused by forecasting method errors.

3. Bottle 3-2103-Mh Btl 3 Funct 150 cc.

   The 3-2103-Mh Btl 3 Funct 150 cc bottle product has the smallest MAPE percentage of 45.41% in the naive method forecast results. This research is supported by (Ramdani & Azizah, 2019) that the naive method is used by companies because it is simple and easy to implement. This method assumes that future values will be the same as past values, so it does not require complex data or calculations.

4. Ts-3s Accessories 3-Tier Milk Holder

   The Ts-3s Milk Container 3-Tier Accessory Product has the smallest MAPE percentage of 47.76% in the Naive Method forecast results. This study is supported by (Kumila, Sholihah, Evizia, Safitri, & Fitri, 2019), which states that the naive method is the most accurate forecasting method. The Naive method is a very simple forecasting method, often used as a benchmark due to its ease in obtaining forecasting results.

5. F-338 Baby Training Cup 3-in-1 Accessories

   The F-338 Baby Training Cup 3-in-1 accessory product has the smallest MAPE percentage of 46.93% in the linear regression method forecast results. This study is supported by (Komansilan, Tarigan, & Yusupa, 2024), which states that the linear regression method produces better accuracy with a low MAPE accuracy rate. Linear regression is a prediction or forecasting method that uses a straight line to describe the relationship between two or more variables. This method is used to predict a target value based on several input

variables through the formation of a numerical relationship model. The regression method is chosen in forecasting because of its ability to model the relationship between independent and dependent variables, as well as its ability to make accurate predictions.

## CONCLUSION

1. The NSP-1006 Sumo Round Bottle BPA Free 240 ml has an accurate forecasting method, which is linear regression. Linear regression forecasting is an effort to predict future outcomes or events based on past data and then use a mathematical model to calculate future events.
2. The NSP-3006 Sumo Round Bottle BPA Free 50 ml has an accurate forecasting method, which is the linear regression method. This is because, through forecasting processing using this method, it is known that the MAPE value with this method is the smallest, thereby reducing or avoiding the risk of errors in production forecasting and losses caused by forecasting method errors.
3. The 3-2103-Mh Btl 3 Funct 150 cc bottle has an accurate forecasting method, which is the naive method. This method assumes that future values will be the same as past values, so it does not require complex data or calculations.
4. The Ts-3s Milk Holder 3-Tier accessory has an accurate forecasting method, which is the naive method. The naive method is a very simple forecasting method, often used as a benchmark due to its ease in obtaining forecasting results.
5. The F-338 Baby Training Cup 3-in-1 accessory uses the linear regression method as its accurate forecasting method. The regression method is chosen for forecasting due to its ability to model the relationship between independent variables.

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