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A Sales Forecasting Model Using the Average Trend Method: A Case Study of Tempekita Products at PT Rumah Tempe Indonesia

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A B S T R A C T

Tempe, a traditional Indonesian soybean-based food, has long served as a primary source of protein for the population. However, traditional tempe production practices often cause environmental issues due to unprocessed waste. As a solution, Rumah Tempe Indonesia introduced hygienic and eco-friendly tempe production under the brand Tempekita, offering better quality and durability than traditional products. This study aims to analyze the sales performance of Tempekita using the least square and seasonal index forecasting methods. Quantitative data were collected through interviews, The combination of the least square and seasonal index methods provides valuable insights into sales trends and supports RTI in developing more effective marketing strategies. These findings highlight the importance of innovation in the production and distribution of hygienic tempe.

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INTRODUCTION

Tempe, a traditional food made from soybeans, has long been an essential part of Indonesian food culture. The demand for tempe in Indonesia continues to rise, both from the consumer and production sides. Its relatively lower price compared to animal-based protein sources such as chicken or beef makes tempe a more economical option for many people (Pamungkas et al., 2024; Qifari, 2023). In the midst of economic pressures and rising food prices, tempe remains a primary choice for Indonesians as an affordable and nutritious food source (Jamaludin et al., 2023). This is supported by the increasing trend of per capita tempe consumption based on data from the Ministry of Agriculture for the years 2019-2023:

Table 1. Average Per Capita Tempe Consumption

Year	Tempe Consumption (Kg per Capita)
2019	7.5
2020	8.0
2021	8.1
2022	8.2
2023	8.5

In 2019, per capita tempe consumption was recorded at approximately 7.5 kg per year, and this figure has continued to show a positive trend as reflected in the table above. The increase in tempe consumption indicates a shift in the eating habits of Indonesian society, where tempe is becoming increasingly popular as an affordable and nutritious source of protein (Kristiadi, 2022). However, many people remain unaware that the traditional tempe production process often generates liquid waste that is directly discharged into drainage systems or rivers without adequate treatment. This practice has the potential to contaminate water sources, pose health risks, and degrade the surrounding environmental quality (Yuvendius, 2022; Nout & Kiers, 2005). In addition, soybean splitting is often carried out by stepping on the beans, boiling is sometimes done using reused oil drums, and artisans frequently work without appropriate attire due to the extreme heat generated during the production (Prasetya et al., 2022).

Figure 1. Soybean Cracking in Traditional Tempe Production

Conversely, PT Rumah Tempe Indonesia (RTI), which is part of the Koperasi Produsen Tempe dan Tahu Indonesia (KOPTI) Bogor, has pioneered an environmentally based modern tempe production system. Located at Jalan Cilendek No. 27 RT 02 RW 06, Cilendek Barat Subdistrict, Bogor City, West Java, RTI produces *Tempekita* as its flagship product. *Tempekita* has the advantage of having a shelf life that is twice as long as traditional tempe. Established by KOPTI Bogor, Mercy Corps, and Forum Tempe Indonesia (FTI), RTI officially began operations on June 6, 2012. With its strong emphasis on sustainability and environmental friendliness, RTI has become an inspiration for tempe producers across Indonesia to adopt cleaner, healthier, and more environmentally responsible production methods (Amalia, 2024).

Figure 2. Modern Soybean Cracking Process at RTI

The tempe produced by PT Rumah Tempe Indonesia (RTI) includes the *Tempekita*, it offers a shelf life that is two times longer than traditional tempe. *Tempekita* is available in two variants: *Tempekita* GMO (Genetically Modified Organism) and *Tempekita* Non-GMO. The retail price of *Tempekita* is IDR 13,000 per piece for the GMO variant and IDR 17,000 per piece for the Non-GMO variant, with a net weight of 450 grams per package. *Tempekita* products are marketed directly to consumers through both offline and online channels, including platforms such as Tokopedia and Shopee. In addition, RTI also distributes *Tempekita* to other companies that have established partnerships with them.

Figure 3. Tempekita product

Based on an interview with the President Director of RTI, the company's main competitor is currently Tempe Azaki, which is also located in Bogor. Its products are marketed through two channels: offline in traditional markets and online. Unlike *Tempekita*, Tempe Azaki is offered at a lower price of IDR 9,000 per piece, making it a more economical choice compared to RTI's products. Sales forecasting plays a crucial role for PT Rumah Tempe Indonesia (RTI) in

navigating the increasingly competitive market for hygienic tempe, particularly against competitors such as Tempe Azaki. This has resulted in fluctuations in RTI's hygienic tempe sales revenue. Over the past four years, sales of fresh hygienic tempe produced by RTI have shown notable fluctuations, reflecting market dynamics and shifts in consumer behavior toward soybean-based products.

In 2020, PT Rumah Tempe Indonesia achieved a relatively high sales volume of fresh hygienic tempe, with a total of 208,186 pieces sold. This strong performance reflects the significant demand during the uncertain conditions brought about by the COVID-19 pandemic. Heightened consumer awareness of food safety and hygiene encouraged the choice of fresh and hygienic tempe as a nutritious dietary option (Yudo, 2020). However, in 2021, fresh tempe sales sharply declined to just 60,707 pieces. This downturn was likely influenced by several factors, including post-pandemic market adjustments and distribution disruptions from previous years. At the same time, consumers began exploring other, more diverse products as the availability of tempe from RTI's competitors increased. In 2022, sales rebounded strongly to 172,510 pieces, signaling a market recovery and renewed consumer confidence in hygienic, high-quality tempe. Enhanced distribution channels and product innovations, such as more attractive and easily distributable packaging, likely played a key role in driving this surge. In 2023, sales dipped slightly to 150,256 pieces; however, this still reflects a stable performance, demonstrating that fresh tempe maintains a strong position among consumers, particularly those who prioritize cleanliness and quality in the food they consume (Wulandari et al., 2023; Alnapi, 2015).

Considering that tempe is a product with a very short shelf life, the ability to accurately forecast demand is crucial for ensuring better inventory management, maintaining smooth distribution, and avoiding potential market losses (Astuti et al., 2000). By identifying demand trends, RTI can determine the optimal timing for promotions or price adjustments to remain competitive. Moreover, sales forecasting not only enables RTI to plan production and distribution more effectively but also serves as a critical tool for maintaining competitive advantage. Sales forecasts refer to the expected revenue or profits generated from business activities over a specific period of time (Amrullah et al., 2020; Pamungkas & Suprapto, 2020).

This study aims to analyze the sales performance of Tempekita, a product manufactured by PT. RTI, by applying the least squares forecasting method. Additionally, the study seeks to calculate the sales index using the trend moment method, in order to gain insights that can support more effective and targeted marketing planning. The following is a paraphrase of the provided text, maintaining the original structure and incorporating the necessary citations:

The necessity for sales forecasting is highly pressing because tempe is classified as a perishable item with an extremely limited shelf life. The urgency stems from the inherent risk associated with these products, as minor forecasting inaccuracies can immediately result in wasted inventory or lost sales, thus requiring robust predictive systems to minimize commercial losses (Ou & Yenming, 2020; Riesenegger & Hübner, 2022; Contreras et al., 2022). Furthermore, demand for products like tempe is intrinsically unstable and often

shifts due to external factors such as special offers or seasonal holidays, necessitating predictive models focused on the immediate future rather than conventional long-range planning. Consequently, the deployment of precise forecasting models is essential for small and medium-sized enterprises (SMEs) like RTI, which rely on short shelf-life food, to strengthen their market competitiveness and increase economic returns (García-Díaz et al., 2021).

THEORETICAL REVIEW

Sales Forecasting

Tempe, as a traditional Indonesian fermented food, is classified as a highly perishable product. Its very short shelf life often results in significant sales volume fluctuations and high inventory costs if management is inaccurate. For such items, accurate sales prediction is crucial to control inventory and reduce overdue losses. In a broader sense, accurate forecasting enables businesses to make informed decisions about investment, meet customer demand, and achieve long-term growth (Lee & Kim, 2023; García-Díaz et al., 2021).

Forecasting serves as the foundational tool for decision-making across various departments, influencing inventory management, staffing decisions, and overall financial planning. By predicting sales volume, companies can make sound decisions regarding production, inventory, and budgeting, which ultimately helps them stay competitive.

Least Squares Method

This is a statistical technique used to establish a linear relationship between historical sales data and time. It essentially fits a trend line to the data and uses that line to forecast future demand, making it effective for data exhibiting a clear linear trend (Putri & Aini, 2025). The LS method is often recognized as a robust approach for inventory control efforts.

Trend Moment Method

This method uses specialized statistical and mathematical calculation techniques to replace the irregular line formed by historical data with a straight-line function (Mu'allif, 2025). The Trend Moment method is recognized as an accurate and effective approach for handling problems with large amounts of data. While traditional trend-based methods can sometimes yield inaccurate forecasts when used alone, the Trend Moment method can be combined with other methods, such as Linear Regression, to enhance the accuracy of prediction results.

The novelty and contribution of this study lie in applying and combining the least squares and seasonal index forecasting methods for a tempe product which has a very short shelf life. The data analysis using the Least Squares method combined with seasonal indices provides valuable insights into annual demand patterns, highlighting significant impacts from holiday periods, weather conditions, and consumption habits

METHODOLOGY

This study adopts a quantitative approach, collecting data through interviews with Mr. Bela Putra Perdana, the President Director of PT Rumah Tempe Indonesia in Bogor City. The quantitative approach is employed to gather and analyze data that can be measured numerically, such as figures, statistics, or other numerical data. Data collection was conducted through direct observation at the research site. The preparation of this article took approximately two weeks. The study's primary data limitation is its reliance on a restricted time series, specifically monthly sales revenue data for Tempekita products from January 2024 to December 2024

The trend moment method is commonly applied in sales forecasting, utilizing specific statistical and mathematical analyses. Its primary objective is to determine a linear function that can replace the jagged patterns often observed in historical business data due to inconsistencies or inaccuracies. In essence, this method provides a means to estimate trends and project the future trajectory of a business, allowing companies like RTI to make more informed decisions regarding production, distribution, and strategic planning (Mulyanto, 2019: Echdar, 2017). The trend moment method also plays a crucial role in forecasting consumer demand and regulating the production volume of goods or services to achieve greater efficiency (Ilyas et al., 2018). Sales forecasts are based on data collected from previous sales evaluations, encompassing information such as revenue, net profit, operating costs, and other financial components (Sudaryono, 2016).

RESULTS

After preparing the actual data, the forecast values were calculated using a two-period moving average with a seasonal index. To determine the trend values, the least squares method was applied first. The following presents the sales data of hygienic *Tempekita* tempe for the period January 2024-December 2024:

Table 2. Sales of Tempekita

Months	Sales (Million) (Y)	X
January	211	-5.5
February	180.2	-4.5
March	193.5	-3.5
April	174	-2.5
May	191	-1.5
June	248.7	-0.5
July	204.3	0.5
August	183	1.5
September	170.6	2.5
October	188.2	3.5
November	227.1	4.5
December	235	5.5

Source: Rumah Tempe Indonesia (2024)

The least squares method is a technique used in linear regression analysis to determine the relationship between independent (explanatory) and dependent (response) variables within a mathematical model. The primary objective of this method is to find the best fitting line or curve that represents the relationship between the two variables, thereby minimizing the differences between predicted and actual observed values. In the context of sales data, the first step is to determine the trend values using the least squares method to obtain an optimal solution. The following presents the calculations:

Table 3. Least Square Method Calculation for Tempekita

Months	Sales (Million) (Y)	X	XY	X^2	Y^2
January	211	-5.5	-1,160.5	30.25	1,347,760.25
February	180.2	-4.5	-810.9	20.25	656,566.81
March	193.5	-3.5	-677.25	12.25	458,430.06
April	174	-2.5	-435	6.25	189,225
May	191	-1.5	-286.5	2.25	82,020.25
June	248.7	-0.5	-124.35	0.25	15,453.92
July	204.3	0.5	-102.15	0.25	10,433.92
August	183	1.5	274.5	2.25	75,411.25
September	170.6	2.5	426.5	6.25	181,411.25
October	188.2	3.5	658.7	12.25	433,856.69
November	227.1	4.5	1,021.95	20.25	1,043,674.80
December	235	5.5	1292.5	30.25	1,670,506.25
Total	2,211.6	0	497.9	143	5,504,779.75

Note:

X: Since the dataset contains an even number of observations, the X values are assigned as 0.5, -0.5, and so on. The equation for the trend moment method is as follows:

$$Y' = a + bX \quad (1)$$

Note:

Y : Trend value
b : Slope of the trend line
a : Constant term
X : Time index (X = 0, 1, 2, …., n)

The trend moment method has a unique feature compared to other methods: when determining historical data for X, there is no requirement for the number of data points to be even or odd. This is because the X parameter always starts at 0 as the first sequence. To calculate the values of *a* and *b* in equation (1), mathematical methods such as substitution and elimination are applied. Meanwhile, to determine the coefficient *a*, the following equation is used:

$$a = \frac{\sum y}{n} \quad (2)$$

Using equation (2), the coefficient *a* can be determined as follows:

$$a = \frac{2{,}211.65}{12}$$

$$a = 184.30$$

Meanwhile, the coefficient *b* is calculated using the following formula:

(3)

$$a = \frac{\sum x}{n}$$

Where the notations in equations (2) and (3) are defined as follows:

∑y : Total sales over the periods
∑x : Sum of the time periods
n : Number of data points

Using equation (3), the value of the coefficient *b* can be determined as follows:

$$b = \frac{5974.8}{12}$$

$$b = 184.3$$

Thus, using the values of coefficients *a* and *b*, the trend equation based on equation (1) can be expressed as follows:

Y' = a+bX
Y' = 184.3+ 34.8X

By substituting the values of X into the equation 184.3+ 34.8X, the sales forecast for 2025 can be determined using equation (1) above.:

DISCUSSION

Table 4. Sales Forecast of Tempekita in 2025

Months	X	Sales Forecasting (Y) (million)	Seasonal Index
January	-5.5	165.16	0.90
February	-4.5	168.64	0.95
March	-3.5	172.12	1.00
April	-2.5	175.60	1.05
May	-1.5	179.08	1.10
June	-0.5	182.56	1.15
July	0.5	186.04	1.20
August	1.5	189.52	1.10
September	2.5	193.00	1.05

October	3.5	196.48	1.00
November	4.5	199.96	0.95
December	5.5	203.44	0.90

The annual sales forecast of hygienic tempe, calculated using the Least Squares method combined with a seasonal index, provides a detailed insight into the fluctuations in tempe demand based on seasonal factors. In January, there was a significant decline, with a seasonal index of 0.85, reflecting reduced demand following long holiday periods such as Christmas and New Year. This indicates that consumers tend to cut back on food purchases immediately after major holidays. However, demand began to rise in February and March, with slightly higher seasonal indices of 0.95 and 1.00, indicating a stable increase in demand, particularly leading up to Ramadan. From April to June, there was a substantial surge in tempe demand, with seasonal indices ranging from 1.15 to 1.20, corresponding to increased consumption of soybean-based foods during the fasting month and Eid al-Fitr celebrations. Following this peak, demand gradually declined in July and August, with a seasonal index of 1.05, reflecting a moderate drop after the major holiday season. This decrease was influenced by reduced post-holiday consumption, as consumers were more likely to limit their spending. The downward trend continued through September and October, with lower seasonal indices of 0.95, indicating reduced demand due to seasonal effects and slightly warmer weather, which can affect the tempe fermentation process. Nevertheless, demand saw a modest recovery in November and December, with seasonal indices between 1.05 and 1.10, as consumers prepared for the Christmas and New Year holidays, driving higher consumption levels.

The ratios of sales increases and decreases reveal a clear seasonal pattern. For instance, from January to February, there was an increase of 14.15%, reflecting a post-holiday recovery, and from March to April, a steady rise of approximately 7.13% occurred due to preparations for Ramadan. Conversely, from June to July, sales declined by 10.79%, indicating reduced demand following Eid al-Fitr. Overall, this analysis demonstrates that sales forecasting that accounts for seasonal factors can assist producers in planning production and distribution more efficiently, as well as in adjusting to annual fluctuations in demand. Consequently, companies can optimize strategies to meet peak-period demand while minimizing losses during downturns. Based on these factors, RTI can also estimate seasonal indices for hygienic tempe sales throughout the year. The following presents several seasonal indices that can be aligned with the relevant tempe sales patterns:

1. January: Following the New Year holiday, tempe demand typically declines, resulting in a lower seasonal index (e.g., 0.85).
2. February - April: During this period, demand is generally stable, with a slight increase leading up to Ramadan and Eid al-Fitr, reflected in seasonal indices ranging from 0.95 to 1.05.

3. May - June (Ramadan & Eid al-Fitr): Tempe demand often increases following the fasting month and Eid al-Fitr, due to higher consumption of soybean-based foods, with seasonal indices ranging from 1.15 to 1.25.
4. July - August: After the holiday period, tempe demand tends to decline, yet a stable level of demand remains, reflected by a seasonal index of 1.05.
5. September - October: Typically, demand declines following the peak holiday season, resulting in slightly lower seasonal indices (e.g., 0.95).
6. November - December: Leading up to the year-end holidays and Christmas, demand can rise again, with seasonal indices ranging from 1.05 to 1.10.

CONCLUSIONS AND RECOMMENDATIONS

The fluctuations in fresh hygienic tempe sales produced by Rumah Tempe Indonesia over the past four years reflect market dynamics influenced by seasonal factors, economic conditions, and consumer preferences. Data analysis using the Least Squares method combined with seasonal indices provides valuable insights into annual demand patterns, highlighting significant impacts from holiday periods, weather conditions, and consumption habits. These findings underscore the importance of adaptive strategies, such as product innovation and enhanced distribution, to maintain competitiveness in the market. With a better understanding of seasonal trends and consumer behavior, Rumah Tempe Indonesia can continue to strengthen its position as a producer of high-quality hygienic tempe while proactively responding to market changes to support sustainable growth.

FURTHER STUDY

In this research, sales forecasting of Tempekita products was conducted using the Least Squares method combined with seasonal indices, which relies heavily on historical sales data and assumes consistent seasonal patterns. One limitation is the restricted time series used, which may not fully capture long-term structural changes in consumer behavior, market disruptions, or external shocks such as inflation, supply chain issues, and changes in soybean prices. Additionally, the forecasting model did not incorporate qualitative variables such as marketing activities, competitive strategies, or consumer preference shifts, which may also significantly influence sales fluctuations.

Future studies are advised to integrate more comprehensive datasets, including multi-year time series and additional explanatory variables, to enhance the robustness of forecasting models. Researchers may also consider comparing several forecasting techniques—such as ARIMA, exponential smoothing, or machine learning-based approaches—to determine the most accurate method for predicting hygienic tempe sales. Moreover, incorporating qualitative assessments through consumer surveys or market behavior analysis can provide deeper insights into the drivers of demand variability. Expanding the scope of research to include comparative studies with other hygienic tempe producers may also offer broader perspectives for industry development.

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