

Sales Forecasting Analysis of Kirana Photocopy Using the Semi-Average and Least Squares Methods

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Abstract: This study aims to analyze sales forecasting for Kirana Photocopy, a micro-enterprise engaged in photocopy services, which often faces fluctuating demand influenced by seasonal cycles, academic activities, administrative needs, and digital service developments. Accurate forecasting is essential to support inventory management and reduce the risks of overstocking or stock shortages. This research applies two quantitative forecasting methods, the Semi Average method and the Least Square method to estimate future photocopy paper sales based on historical data. Data were collected through interviews, direct observation, and monthly sales records provided by the business owner. The analysis shows that both methods produce relatively consistent forecasting trends for the projected dates of June 20–22, although the Semi Average method generated slightly higher forecasts compared to the Least Square method. Overall, the results indicate that both forecasting techniques are simple, practical, and suitable for use by small businesses, provided that calculations are conducted carefully to avoid errors. The findings are expected to assist Kirana Photocopy in planning inventory, improving service efficiency, and supporting sustainable business operations.

INTRODUCTION

In an increasingly competitive business environment, the ability to forecast future sales has become an essential skill for companies. Sales forecasting assists businesses in anticipating production needs and market demand, thereby minimizing the gap between the production volume and actual sales, which ultimately supports companies in maximizing profits (Awaluddin et al., 2021). One of the business sectors that particularly requires sales forecasting is micro, small, and medium enterprises (MSMEs) engaged in photocopy services.

Photocopy-based MSMEs often experience fluctuating demand due to various influencing factors such as seasonal cycles, academic activities, public administrative needs, and the development of digital document services (Lestari et al., 2024). These fluctuations may create challenges for business owners in preparing sufficient supplies of raw materials such as paper and ink. Consequently, inaccurate demand estimation can lead to financial losses or a decline in service quality.

Kirana Photocopy is one of the MSMEs operating in the photocopy service sector. The business has been established since 2017 and is located in Sumbermanjungkulon Village, Pagak District. In its operational activities, Kirana Photocopy faces challenges related to demand uncertainty, which affects inventory management and service optimization for customers. This demand uncertainty may result in excess inventory—leading to increased storage costs—or insufficient inventory, which can cause lost sales opportunities (Wardah & Iskandar, 2017). Therefore, an appropriate and accurate sales forecasting method is needed to support more effective decision-making for the business.

This study employs two sales forecasting methods, namely the Semi Average method and the Least Square method. The Semi Average method is a simple forecasting technique that uses the average values of two divided data sets to predict future sales. Meanwhile, the Least Square method is a statistical approach aimed at constructing the best-fit trend line by minimizing the sum of squared errors between actual and forecasted values. Both methods were selected due to their relative ease of application and their ability to identify sales trend patterns within a specific time period.

Thus, the purpose of this study is to analyze and compare the sales forecasting results generated by the Semi Average and Least Square methods at Kirana Photocopy. The findings of this research are expected to assist the business owner in planning business strategies, managing inventory, and improving service quality, enabling the business to operate more optimally and sustainably.

Literature review

Forecasting

Forecasting is a systematic process used to estimate future events based on an analysis of historical data patterns. In the field of business and economics, forecasting is essential for organizational planning, resource allocation, and strategic decision-making. Makridakis and Bakas (2016) define forecasting as both an art and a science of predicting future occurrences, emphasizing that forecasting supports firms in estimating sales volume and product utilization so that resources and production outputs can be aligned with expected market needs. This indicates that forecasting integrates analytical techniques and managerial judgment, reflecting its dual epistemological nature.

The primary objective of forecasting is to reduce the level of uncertainty associated with future market conditions (Subagyo, 1986). Forecasting strives to produce reliable demand estimates so that business entities can optimize operational efficiency, determine

inventory policies, and manage financial planning. The accuracy of forecasting is typically evaluated through error measurement indicators, including Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and Mean Absolute Percentage Error (MAPE). These indicators allow analysts to evaluate the deviation between forecasted and actual data, providing a basis for model improvement and methodological selection.

According to Assauri (1984), developing a sound forecasting model requires a structured process consisting of three essential stages:

1. Historical Data Analysis

Data from previous periods are examined to identify deterministic and stochastic patterns, including linearity, seasonality, cyclicity, irregular fluctuations, and trend movements. This step assumes that past behavior tends to influence future conditions.

2. Determination of Forecasting Method

The appropriate forecasting technique must be chosen based on the nature of the data, forecasting horizon, cost considerations, and desired accuracy. Methods may include qualitative approaches (e.g., Delphi, expert judgment) or quantitative approaches (e.g., time series, causal/regression models).

3. Projection and Adjustment of Forecast

Historical patterns are extrapolated into the future, taking into account exogenous factors such as government policy changes, technological developments, competitor behavior, demographic dynamics, and market disruptions.

Principles of Forecasting

Scholars highlight several fundamental principles that guide forecasting:

- a. All forecasts contain errors, and forecasting aims to reduce uncertainty, not eliminate it completely.
- b. Error measurements are necessary so that decision-makers know the probability range of forecasting deviations.
- c. Forecasting for product families or aggregated data generally yields higher accuracy than forecasting for a single product (due to risk pooling).
- d. Short-term forecasts are generally more reliable than long-term forecasts, as external conditions are less likely to shift drastically.
- e. When feasible, organizations should prioritize direct demand measurement rather than prediction-based approximations.

Characteristics of an Effective Forecasting System

A robust forecasting system should feature:

1. High statistical accuracy, supported by appropriate validation methods;

2. Low implementation and operational cost;
3. Efficient computational time and minimal storage requirements;
4. Real-time or online analysis capability;
5. Clear interpretability for managerial usage;
6. Capacity for periodic model evaluation and recalibration.

Thus, forecasting becomes not only a calculation process but a core managerial capability, supporting organizations in navigating dynamic business environments.

Semi Average Method

The Semi Average Method is a basic quantitative forecasting technique used to identify linear trend patterns in time series data. It reduces subjectivity by constructing a trend line based on the average values of divided historical data segments. Although categorized as a relatively simple method, it remains conceptually relevant in analyzing long-term movement when minimal data is available.

The technique involves splitting time series data into two groups of equal or nearly equal size. If the number of data points is even, the dataset is divided into two halves. If it is odd, the central observation may be excluded or duplicated to maintain symmetrical grouping. The central rationale is that each group's mean (semi-average) reflects the representative level of data in that specific sub-period.

Procedural Steps of the Semi Average Method

1. Group the data into two segments.
2. Determine the mid-period (base period) for each group.
3. Calculate total values for each segment (semi total).
4. Compute the semi-average values by dividing semi total by the number of observations.
5. Identify the intercept a and slope b of the trend line:
 - a. For odd-numbered observations, slope is computed as the difference of semi-averages divided by the difference in mid-periods.
 - b. For even-numbered observations, slope is computed by dividing the semi-average difference by the number of observations per group.
6. Formulate the linear trend equation:
$$Y = a + bX$$
7. Forecast future values by substituting the projected time period into the equation.

This method is particularly useful when patterns are linear and data variation is minimal. However, for complex fluctuation patterns, more advanced forecasting methods

may be required.

Least Square Method

The Least Square Method is one of the most widely applied statistical techniques for estimating linear trend equations in time series forecasting. Maryati (2010:129) defines a trend as a long-term directional movement—upward or downward—representing average change over time. A positive trend reflects sustained growth, while a negative trend indicates systematic decline.

The theoretical foundation of least squares is to produce a regression line that minimizes the sum of squared errors (SSE) between actual data points and estimated values. The method is grounded in classical regression theory and is often preferred due to its strong statistical properties, including unbiased estimation and minimum variance among linear estimators under standard assumptions.

The linear trend model takes the form:

$$Y=a+bX$$

where:

Y = forecasted value,

a = intercept (predicted value when X=0),

b = slope, representing the change in Y for each incremental time period,

X = coded time index,

n = total number of observations.

The parameter estimation for a and b is given by:

$$a = \frac{\sum Y}{n} - b \left(\frac{\sum X}{n} \right)$$

The Least Square Method is applicable to annual, semi-annual, quarterly, monthly, weekly, or daily time series depending on the data frequency. It is commonly used in forecasting population growth, production volumes, financial indicators, consumer demand, and technological diffusion.

METHOD

This research was conducted at Fotokopi Kirana, located on Raya Sumbermanjungkulon Street, RT 23 RW 06, Pagak District, Malang Regency, with the main research object being the sales forecasting analysis of Fotokopi Kirana's photocopy business. The study employed both primary and secondary data to support the forecasting analysis using the Semi Average and Least Square methods. Primary data were obtained directly from the business owner and employees through interviews and on-site observations related to the operational activities of the photocopy business, while

secondary data consisted of historical sales records, specifically monthly paper sales data provided by the business owner. The collected data were then processed and analyzed to generate forecasting results that could support future sales planning and inventory management for Fotokopi Kirana.

FINDINGS AND DISCUSSION

Findings

Forecasting Analysis Using the Semi Average Method

According to this method, a straight trend line is constructed as a substitute for the broken or fluctuating line formed by historical data. This trend line is derived through specific statistical and mathematical calculations, thereby eliminating subjective elements in the forecasting process.

Table 1. Forecasting Using the Semi Average Method

Kelompok	Tanggal	Y	X	Semi Total	Semi rata-rata
I	10 Juni	500	-2	1.600	1.600/5 = 320
	11 Juni	250	-1		
	12 Juni	400	0		
	13 Juni	200	1		
	14 Juni	250	2		
II	15 Juni	350	3	1.800	1.800/5 = 360
	16 Juni	200	4		
	17 Juni	500	5		
	18 Juni	300	6		
	19 Juni	450	7		

Forecasting Calculations

Given:

$$a = 320$$

$$b = \frac{360-320}{5} = \frac{40}{5}$$

Thus, $b = 8$

The linear forecasting equation is:

$$Y = a + bX$$

$$Y = 320 + 8X$$

Sales Forecast for Fotokopi Kirana on June 20, June 21, and June 22

1. Forecast for June 20

$$Y_{20 \text{ June}} = 320 + 8(8)$$

$$= 320 + 8(8)$$

$$= 320 + 64 = 384$$

2. Forecast for June 21

$$Y_{21 \text{ June}} = 320 + 8(9)$$

$$= 320 + 8(9)$$

$$=320+72= 392$$

3. Forecast for June 22

$$Y_{22 \text{ June}}=320+8(10)$$

$$= 320 + 8(10)$$

$$= 320+80=400$$

Thus, based on the calculation results above, it can be predicted that the sales of photocopy paper at Kirana Photocopy on June 20 will reach 384 sheets, on June 21 will reach 392 sheets, and on June 22 will reach 400 sheets. To provide a clearer illustration of the results, the author presents a graph that compares the actual sales data with the forecasted sales of Kirana Photocopy. The blue points represent the actual sales, while the orange points represent the forecasted values. The following graph illustrates the forecasting results using the Semi Average Method:

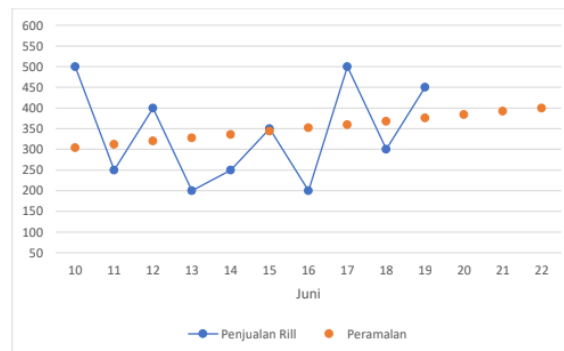


Figure 1. semi-average method graph

Forecasting Analysis Using the Least Square Method

The Least Squares/trend method is a long-term upward or downward movement (tendency), obtained from the average change over time. This average change can increase or decrease. If the average change increases, it is called a positive trend, or a trend with an upward tendency. Conversely, if the average change decreases, it is called a negative trend, or a trend with a downward tendency.

Table 2. Forecasting Using the Least Square Method

Tanggal	Y	X	XY	X ²	Trend
10 Juni	500	-9	-4.500	81	326.41
11 Juni	250	-7	-1.750	49	329.43
12 Juni	400	-5	-2.000	25	332.45
13 Juni	200	-3	-600	9	335.47
14 Juni	250	-1	-250	1	338.49
15 Juni	350	1	350	1	341.51
16 Juni	200	3	600	9	344.53
17 Juni	500	5	2.500	25	347.55
18 Juni	300	7	2.100	49	350.57
19 Juni	450	9	4.050	81	353.59
Jumlah	3.400	0	500	330	

So, : Value a = $\sum Y / n = 3.400 / 10$

Value a = 340

Value b = $\sum xy / \sum x^2 = 500 / 330$

Value b = 1.51

Jadi, $Y = a + bx$

$Y = 340 + 1.51 (x)$

Kirana Photocopy Sales Forecast for June 20, 21, and 22, 2024

$Y_{20 \text{ June}} = 340 + 1.51(11) = 340 + 16.61 = 356.61$

$Y_{21 \text{ June}} = 340 + 1.51(13) = 340 + 19.63 = 359.63$

$Y_{22 \text{ June}} = 340 + 1.51(15) = 340 + 22.65 = 362.65$

So, from the calculation results above, it can be predicted that Kirana Photocopy paper sales on June 20th were 357 sheets, June 21st were 360 sheets, and June 22nd were 363 sheets. To clarify the results of the calculations above, the author has attached a graph of the results of the calculation of Kirana Photocopy's real sales and forecasts. The blue dots are real sales and the orange dots are the forecasts. Below is a graph for the Least Square method:



Figure 2. Least Square Method

Discussion

Based on the results of the table and graph calculations above, the author found a relatively small difference between the two methods used in calculating sales forecasts for the next three days. Using the Semi-Average method, the revenue forecast calculation showed a significant increase : on June 20, the forecasted paper sales were 384 sheets, on June 22, the forecasted paper sales were 392 sheets, and on June 22, the forecasted paper sales were 400 sheets. Using the Least Squares method, the author obtained results for June 20-22 with similar differences. On June 20, the forecasted paper sales were 357 sheets, on June 22, the forecasted paper sales were 360 sheets, and on June 22, the forecasted paper sales were 363 sheets.

Conclusion

The author's conclusion from this research is that the forecasting results from the Semi-Average and Least Square methods are not significantly different. The advantage of these two methods is that their calculations are not overly complicated and tend to be simple, making them easy to use, even for small businesses. However, calculating with these two methods requires precision and strong focus. This is because the steps in these methods are interconnected. Therefore, if a miscalculation occurs in just one step, the calculation will likely have to be repeated from the beginning.

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