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Forecasting Sales: A Comprehensive Analysis of Forecasting Techniques for Sales Budget Determination

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ABSTRACT

This research endeavors to employ sales forecasting techniques on historical sales data for the purpose of determining the sales budget. The application of forecasting is based on sales data from the preceding period, utilizing a descriptive qualitative method. The analysis employs the half-average trend method, generating an estimated sales figure for the upcoming period. This estimate serves as a reference for both inventory planning and the formulation of the sales budget. Within this research, the half-average trend method involves the selection of two X parameter values, namely 0.5 and 0. To determine the superior value, a calculation of SKF (Standard Error of Forecasting) is executed. The analysis results reveal that utilizing the value 0 yields an SKF value of 4,166.6, while the value 0.5 produces a lower SKF value of 3,941.6. This implies that the estimated sales number with the X value of 0.5 is smaller than that with the X value of 0. Conclusively, the application of the half-average trend method in this research provides sales estimates for the next three months, contributing valuable insights for effective planning and budgeting processes.

Keywords Forecasting, Semi average method, Standard Error of Forecasting, Parameter X value

INTRODUCTION

A company, as an organization driven by the pursuit of profit, executes management functions incorporating planning, actuating, and controlling elements. In the current era of globalization, companies are compelled to continually enhance and discover innovative ways to attract consumers to achieve sales targets. The escalating level of business competition and evolving, diverse, and daily-changing consumer demands place a demand on companies to produce offerings that align with consumer preferences (1).

The success of a company is measurable through its sales performance. Each company sets daily, monthly, and yearly sales targets, necessitating detailed planning and strategic sales forecasting due to the variability and daily fluctuations in consumer demand (2).

Forecasting, as an essential element in the management decision-making process, plays a pivotal role in business development (3). Sales forecasting is integral to sales budget formulation, and meticulous, precise, and accurate forecasting is crucial as it significantly impacts sales budget planning (4,5)

The forecasting technique involves systematically and pragmatically estimating future occurrences based on relevant historical data, aiming for greater objectivity (6). Sales forecasting is deemed the "core" of overall company planning, determining future sales potential and market share (7). Various

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forecasting techniques, including error standardization checks, are employed in sales forecasting to ensure accountability (8).

Against this backdrop, this research aims to calculate sales forecasts using the semi-average trend method and SKF analysis based on the X parameter value (9). The study seeks to determine which method is more effective in sales budget formulation (10,11)

METHODS

The research employs a descriptive method with a qualitative approach to delve into trend analysis using the semi-average trend method (12). Descriptive research, aims to ascertain the values of a variable, where each variable is independent, indicating no interdependence between them. The qualitative approach, involves a research and understanding process grounded in methodology that investigates social phenomena and human issues. Data for this study are derived from case study findings.

The Semi-Average Trend Method involves expressing a straight line in mathematics through an equation or linear function formulated as:

$Y = a + bX$ ..... [1]

In this method, all historical data are grouped into two sets, each with an equal number of members (13). The determination of the semi-average trend value is calculated using the formula Y = a + bX, where:

Y = represents the sought value (specific trend value),

A = is the base period trend value (constant),

b = is the average annual trend increment.

This research aims to provide insights into trend analysis using the semi-average trend method, offering a nuanced understanding of the historical data and trends (14). The utilization of a descriptive and qualitative approach ensures a comprehensive exploration of the subject matter, enriching the research with valuable perspectives and interpretations (15).

The value of bb can be determined using the following formula:

$b = \frac{X2 - X1}{N}$ ..... [2]

where:

X1 = the mean of Group I

X2 = the mean of Group II

N = the number of periods between X1 and X2

X = the total number of desired units from the base period

As explained above, in the semi-average trend method, the data are grouped into two sets, namely Group I and Group II, where each group has an equal number of data (16). The identified groups or data sets are as follows:

a. Even data count and even data group components

b. Even data count and odd data group components

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c. Odd data count and odd data group components

The parameter value X serves as an auxiliary tool or measure with a consistent interval value from one data point to another. In determining the value of X, two values can be used: starting from half (0.5) or starting from zero (0). Whether starting from half or zero, the interval from one value to the next is consistently one. The determination of the X value's location in the semi-average trend method begins with Group I. The X value or parameter X assists in determining the value of the linear function, forming a directed (straight) line or future sales estimation.

The Standard Error of Forecasting (SKF) is employed to ascertain the deviation or error present in the sales forecasting method by comparing the actual sales figures with the forecasted ones. This helps company leaders analyze decision-making regarding the use of quadratic methods in calculating sales forecasts for the upcoming periods (17). The smallest SKF value indicates a forecasting result that closely approximates reality (18).

RESULTS AND DISCUSSION

In this section, we delve into the analysis and calculation of sales forecasts using a single method, namely the semi-average trend method, employing 2 (two) parameters in its calculation: the X parameter values of (0.5) and (0). Both parameters are applied with the same time and sales quantity. The results from these two parameters will be compared to determine which one is more effective as the basis for sales budget formulation, utilizing the Standard Error of Forecasting (SKF) formula (19).

The sales data utilized in this analysis spanned 12 months in the year 2019. From this dataset, the sales budget for the next 3 years, covering the period from January to March 2020, will be determined (20).

Table 1: Year Sales Data 2019

Period	Sales quantity (Pcs)
Jan-19	1.850
Feb-19	1.800
Mar-19	1.900
Apr-19	2.000
May-19	1.950
Jun-19	2.020
Jul-19	1.980
Agu-19	1.960
Sep-19	2.000
Oct-19	2.200
Nov-19	2.240
Dec-19	2.220
Amount	**24.120**

Source: Author Processed Data, 2023

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Year of Sales (unit) Value (X) Semi Total
Semi Grade Average Trend (Y).

A. Use of the X value parameter starting from (0,5)

Table 2: Calculation of the semi trend method of average values X (0,5)

Year	Sales (unit)	Value (X)	Semi Total	Semi Average	Value Trend (Y')
Jan-19	1.850	-2,5			1.845
Feb-19	1.800	-1,5		Kel. I	1.875
Mar-19	1.900	**-0,5**	11.520		1.905
Apr-19	2.000	**0,5**		1.920	1.935
May-19	1.950	1,5			1.965
Jun-19	2.020	2,5			1.995
Jul-19	1.980	3,5	N = 6	Kel. II	2.025
Agu-19	1.960	4,5			2.055
Sep-19	2.000	5,5	12.600	2.100	2.085
Oct-19	2.200	6,5			2.115
Nov-19	2.240	7,5			2.145
Dec-19	2.220	8,5			2.175
Jan-20	?	2.205			
Feb-20	?	2.235			
Mar-20	?	2.265			

Source: Author Processed Data, 2023

The equation for the trend line.

$Y' = a + bxY' = a + bx$ …… [3]

Where Y represents the sought trend value, is calculated based on the results above, with a=1.920 and b=X2−X1/N, which is 2.100−1.920 / 6=30. Therefore, the obtained equation for the linear function is: Y' = a + b x become Y' = 1.920 + 30 X

Hence, to determine the trend values from Jan-19 to Dec-19 and the estimated months until Mar-20, one needs to substitute the X values (parameter X). To predict future values, continue the X values with the same interval as in the table.

Explanation of the calculation in the table:

a. The total number of data is 12 (Jan-19 to Dec-19), then the data is divided into two groups (Group I and Group II), with each group having 6 data points.
b. As the method used is semi-average, the data components for each group are further divided into 3 data points. Thus, Group I has 3 data components, and Group II has 3 data components.
c. The X values used in this calculation start from (0.5) with an interval of 1 (one) between

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each consecutive value.

d. The semi-total is the sum of data for each Group I and Group II, which are 11,520 and 12,600, respectively.
e. The semi-average is obtained by dividing the total sum of data for each Group I or Group II by the number of data points in each group. The value obtained in Group I automatically becomes the constant value.
f. N value is 6, obtained from the total number of data points between the average of Group I and Group II.
g. Calculation of trend values and estimated values.

$$Y\ Jan - 19 = 1.920 + 30\ (-2{,}5) = 1.845$$

$$Y\ Feb - 19 = 1.920 + 30\ (-1{,}5) = 1.875$$

$$Y\ Mar - 19 = 1.920 + 30\ (-0{,}5) = 1.905$$

$$Y\ Apr - 19 = 1.920 + 30\ (0{,}5) = 1.935$$

$$Y\ Mei - 19 = 1.920 + 30\ (1{,}5) = 1.965$$

$$Y\ Jun - 19 = 1.920 + 30\ (2{,}5) = 1.995$$

$$Y\ Jul - 19 = 1.920 + 30\ (3{,}5) = 2.025$$

$$Y\ Aug - 19 = 1.920 + 30\ (4{,}5) = 2.055$$

$$Y\ Sept - 19 = 1.920 + 30\ (5{,}5) = 2.085$$

$$Y\ Oct - 19 = 1.920 + 30\ (6{,}5) = 2.115$$

$$Y\ Nov - 19 = 1.920 + 30\ (7{,}5) = 2.145$$

$$Y\ Dec - 19 = 1.920 + 30\ (8{,}5) = 2.175$$

The next 3 months are:

Y Jan-20= 1.920 + 30 (9,5)= 2.205

Y Feb-20= 1.920 + 30 (10,5)= 2.235

Y Mar-20= 1.920 + 30 (11,5)= 2.265

The values obtained from Jan-19 to Dec-19 represent the trend values and are input into the trend value column (Y′Y′), while the values obtained from Jan-20 to Mar-20 are the desired sales estimates by the company and are entered into the sales unit column.

B. Use of the X value parameter starting from (0)

Tabel 3: Calculation of the semi trend method of average values X (0)

Year	Sales (unit)	Value (X)	Semi Total	Semi Average	Value Trend (Y')
Jan-19	1850	-3			1830
Feb-19	1800	-2		Kel. I	1860
Mar-19	1900	-1	11.520		1890
Apr-19	2000	0		1.920	1920
May-19	1950	1			1950
Jun-19	2020	2			1980
Jul-19	1980	3	N = 6	Kel. II	2010
Agu-19	1960	4			2040
Sep-19	2000	5	12.600	2.100	2070
Okt-19	2200	6			2100
Nov-19	2240	7			2130
Des-19	2220	8			2160

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Year	Sales (unit)	Value (X)	Semi Total	Semi Average	Value Trend (Y')
Jan-20	?	2.190			
Feb-20	?	2.220			
Mar-20	?	2.250			

Source: Author Processed Data, 2023

The calculation method used is the same as the utilization of the X parameter (0.5), with the only difference being that in this case, the use of the X parameter is modified to start from (0). The calculation of trend values and estimated values remains consistent with the given parameter adjustment.

Y Jan-19= 1.920 +30 (-3)= 1.830

Y Feb-19= 1.920 + 30 (-2)= 1.860

Y Mar-19= 1.920 + 30 (-1)= 1.890

Y Apr-19= 1.920 + 30 (0)= 1.920

Y May-19= 1.920 + 30 (1)= 1.950

Y Jun-19= 1.920 + 30 (2)= 1.980

Y Jul-19= 1.920 + 30 (3)= 2.010

Y Aug-19= 1.920 + 30 (4)= 2.040

Y Sept-19= 1.920 + 30 (5)= 2.070

Y Oct-19= 1.920 + 30 (6)= 2.100

Y Nov-19= 1.920 + 30 (7)= 2.130

Y Dec-19= 1.920 + 30 (8)= 2.160

The next 3 months are:

Y Jan-20= 1.920 + 30 (9)= 2.190

Y Feb-20= 1.920 + 30 (10)= 2.220

Y Mar-20= 1.920 + 30 (11)= 2.250

Half-average trend method with X values starting from (0,5)

Standard Error of Forecasting

Based on the calculations above, we will determine which method is more suitable to be chosen and applied as the basis for sales budget formulation. To ascertain this, we will use the Standard Error of Forecasting (SKF). The comparison can be made by calculating the SKF values for each method. A method with a lower SKF value tends to provide more accurate forecasting results. Let's calculate the SKF values for both methods and determine which method is more optimal for use in sales budget formulation.

Formula SKF:

$$SKF = \sqrt{\frac{\sum (X-Y)^2}{N}} \quad \text{.....[4]}$$

Description:

X = Sales forecast (estimated result)

Y = Actual sales (realization)

N = Number of periods

Table 4: Calculation of SKF value X (0,5)

Period	Real sales (Y)	Sales Forecast (X)	X-Y	$(X-Y)^2$
Jan-19	1.850	1.845	- 5	25
Feb-19	1.800	1.875	75	5.625

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Period	Real sales (Y)	Sales Forecast (X)	X-Y	$(X-Y)^2$
Mar-19	1.900	1.905	5	25
Apr-19	2.000	1.935	- 65	4.225
May-19	1.950	1.965	15	225
Jun-19	2.020	1.995	-25	625
Jul-19	1.980	2.025	45	2.025
Agu-19	1.960	2.055	95	9.025
Sep-19	2.000	2.085	85	7.225
Okt-19	2.200	2.115	- 85	7.225
Nov-19	2.240	2.145	- 95	9.025
Des-19	2.220	2.175	- 45	2.025
Amount	**24.120**			**47.300**

Source: Author Processed Data, 2023

SKF = $\sqrt{\frac{\sum (X-Y)^2}{N}} = \sqrt{\frac{47.300}{12}}$ = **3.941,6**

Half-average trend method with X values starting from (0)

Tabel 5 : SKF calculation of X value (0)

Period	Real sales (Y)	Sales Forecast (X)	X-Y	$(X-Y)^2$
Jan-19	1.850	1.830	- 20	400
Feb-19	1.800	1.860	60	3.600
Mar-19	1.900	1.890	- 10	100
Apr-19	2.000	1.920	- 80	6.400
May-19	1.950	1.950	0	0
Jun-19	2.020	1.980	- 40	1.600
Jul-19	1.980	2.010	30	900
Agu-19	1.960	2.040	80	6.400
Sep-19	2.000	2.070	70	4.900
Oct-19	2.200	2.100	- 100	10.000
Nov-19	2.240	2.130	- 110	12.100
Dec-19	2.220	2.160	- 60	3.600
Jumlah	24.120			50.000

Source: Data Olahan Penulis, 2023

SKF = $\sqrt{\frac{\sum (X-Y)^2}{N}} = \sqrt{\frac{50.000}{12}}$ = **4.166,6**

From the calculations above, it can be observed that the SKF value for using the parameter value (0.5) is 3,941.6, while for using the parameter value (0) it is 4,166.6. This means that the SKF value for (0.5) is smaller than the SKF value for (0). Therefore, we can conclude that the parameter value starting from (0.5) is more optimal for use in this method.

CONCLUSIONS

Based on the discussions above, it can be concluded that sales forecasting is a crucial aspect of business operations. One of the methods analyzed in this research is the semi-average trend method, which utilizes the value X as its calculation parameter. The magnitude of the X value is determined by each company's management. In this study, there are two types of X values used: starting from the value (0.5) with forecasted sales data for the Jan-20 period being 2,205 units, for Feb-20 period 2,235 units, and for Mar-20 period 2,265 units. Meanwhile, the X value starting from (0) results in forecasted sales for the Jan-20 period being 2,190 units, for Feb-20 period 2,220 units, and for Mar-20 period 2,250 units. A comparison using the Standard Error of Forecasting (SKF) technique has been conducted for both parameters, and the results indicate that the use of the X value starting from (0.5) yields a smaller SKF value compared to the use of the X value starting from (0). This implies that the X value starting from (0.5) provides results that are closer to reality.

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