



APPLICATION OF THE FORECASTING METHOD TO THE DEMAND FOR PRINTING RECEIPTS WITH GTO 46 ENGINE

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ABSTRAK

Peramalan merupakan bagian penting dari setiap organisasi bisnis dan untuk setiap keputusan manajemen yang sangat signifikan. Tujuan dari peramalan adalah untuk mengurangi risiko atau ketidakpastian yang dihadapi suatu perusahaan dalam mengambil keputusan operasional jangka pendek dan dalam merencanakan pertumbuhan jangka panjang. Perusahaan yang menjadi objek penelitian ini adalah perusahaan yang bergerak di bidang percetakan. Fokus mengamati produk kuitansi karena permintaan kuitansi paling tinggi setiap bulannya. Upaya yang digunakan untuk menghilangkan/mengurangi kesenjangan antara produksi dan penjualan adalah dengan menggunakan metode peramalan yang bertujuan untuk menentukan penyesuaian kuantitas produk dan kapan diperlukan. Berdasarkan pengolahan data dengan menggunakan metode siklis dan linier, maka metode yang digunakan dalam menghitung ramalan bulan berikutnya adalah metode Linier. Metode linier mempunyai nilai error terkecil yaitu $SEE = 1100.57$, $MAD = 871$ dan $MAPE = 26.34$. Metode linier dapat membantu perusahaan percetakan dalam memprediksi jumlah penerimaan periode berikutnya dalam pemenuhan jumlah penerimaan dengan fungsi Linier $Y = 2980 + 169x$. Hasil penelitian menunjukkan prediksi jumlah permintaan kuitansi periode November 2023 sebanyak 4.839 lembar

ABSTRACT

Forecasting is an important part of every business organization and for every substantial management decision. The purpose of forecasting is to reduce the risk or uncertainty faced by a company in making short-term operational decisions and in planning for long-term growth. The object of this research is a company that handle the printing sector. Focus on observing receipt products because receipt orders are the highest every month. The effort used to eliminate/reduce the gap between production and sales is to use a forecasting method which aims to determine product quantity adjustments and when they are needed. Based on data processing using cyclical and linear methods, the method used in calculating the next month's forecast is the Linear method. The linear method has the smallest error values, namely $SEE = 1100.57$, $MAD = 871$ and $MAPE = 26.34$. The total forecast demand for receipt products in November is 4839 pieces. The linear method can help printing companies predict the number of receipts for the next period in fulfilling the number of receipts with the Linear function $Y = 2980 + 169x$. The research results show that the predicted number of requests for receipts for the November 2023 period is 4,839 sheets.

1. INTRODUCTION

Forecasting is an important part of every business organization and for every very significant management decision. The purpose of forecasting is to reduce the risk or uncertainty faced by a company in making short-term operational decisions and in planning for long-term growth (Rosnani, 2007). The forecasting method is used to adjust the number of products (how many) and when they are needed (when) (Rusdiana, 2014). In the marketing section, sales forecasting is needed to plan new products, production quantities, and several other important decisions. The effort used to

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eliminate/reduce the gap between production and sales is to use a forecasting method which aims to determine product quantity adjustments and when they are needed (Zainul, 2019).

The object of this research is a company that handle the printing sector. This company's printing products include books, monthly tabloids, calendars, agendas, stopmaps, business cards, envelopes, letterheads, labels, paper bags, office administrator notes, receipts, invitations and banners. The limitation of this research is receipt products because receipt orders are the higher every month. In the implementation of the production process, there are often shortages of raw materials such as NCR paper or Non Carbon Required Paper so that delivery times are late to reach consumers. The Company's hope is to deliver print results on time and in the right quantity.

Demand for receipt products is always changing due to many factors. Estimates of the influence of variables make the amount of demand always change and produce a gap between the amount of production and the amount of sales which causes a buildup of goods which can increase production costs. Apart from that, companies also cannot fulfill product orders that have been ordered by consumers if the gap between the sales amount is too high and the production amount. The effort used to eliminate/reduce the gap between production and sales is to use a forecasting method instead of which determine product quantity adjustments and when they are needed (Wardani et al., 2020).

Research conducted by Nindi Lisnawati concluded that applying the forecasting method helped the Asahan District Fisheries Service in preparing the number of fish in the next period (Lisnawati et al., 2022). Similar research conducted by Saiful concluded that by applying the forecasting method, it was possible to estimate the stock of Bimoli oil goods in the following month in an effort to prepare oil stocks in storage warehouses (Budiman, 2021).

The purpose of this research is to predict the sales of receipt products for the next period and understand and analyze the relationship between variables and sales of a product

2. METHOD

The type of research used in this research is a descriptive method. The data collection technique is to carry out direct observations to obtain actual data in the company, namely by observation, interviews and literature study methods (Sinambela, 2022). The steps in the research can be explained in Figure 1.

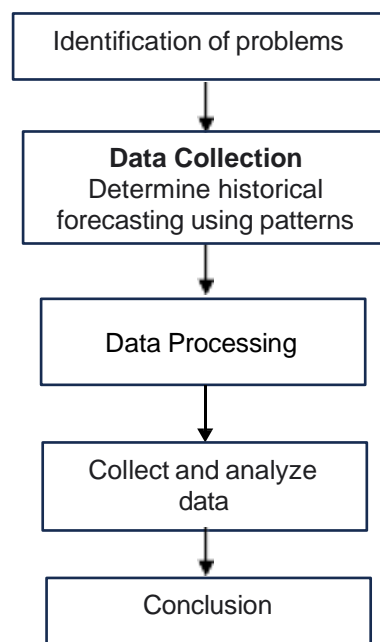


Figure 1. Research Process Steps

Identification of problems

Before conducting research, preliminary research was carried out to find out the problems that exist at CV.X. The item being predicted is a receipt which is the most requested product during the production process.

Data Collection

- a. Determine historical forecasting using patterns. The data collection stage in this research uses primary data and secondary data. Secondary data is data obtained directly from the company in the form of company documents or records. The secondary data needed in this research is as follows profile data, organizational structure, company location, number of employees and employee work schedules.
- b. Population is a group of research objects or a collection of some samples (Ahmad, 2020). In this research, The population for this research is the overall product demand at CV.X. The sampling technique uses a purposive technique sampling, where the sample in this study is the demand for receipt products from January 2023 to October 2023, so the total sample is 10 months

Data Processing

After the data is obtained, the next step is to process the data using the Microsoft Excel program. This data processing aims to ensure that the raw data obtained can be analyzed and make it easier to draw conclusions or answer the problem being researched using the specified method.

Collect and analyze data

The analysis carried out aims to study existing problems and draw conclusions from the research results (Sutisna & Hendy, 2019). For this purpose the author uses a quantitative method, namely by using formulas related to the methods used. Data Analysis Techniques Quantitative data analysis was carried out to predict demand for receipt materials using the time series forecasting method. The error rate calculation used is the MAD, MSE, and MAPE methods

Conclusion

From the results of data processing and analysis, conclusions can be drawn that can answer the problem formulation

3. RESULT AND DISCUSSION

RESULT

Data on requests for receipts from January to October 2023 can be seen in Table 1.

Month	Receipt Request Data
1	2.800
2	3.000
3	4.000
4	4.500
5	2.000
6	5.000
7	5.000
8	5.000
9	2.800
10	5.000

The forecasting steps taken consist of:

- a. Define the purpose of forecasting
The purpose of forecasting is to forecast the next month's demand data.
- b. Making scatter diagrams
From the data in Table 1, a scatter diagram will be created to see the data pattern.

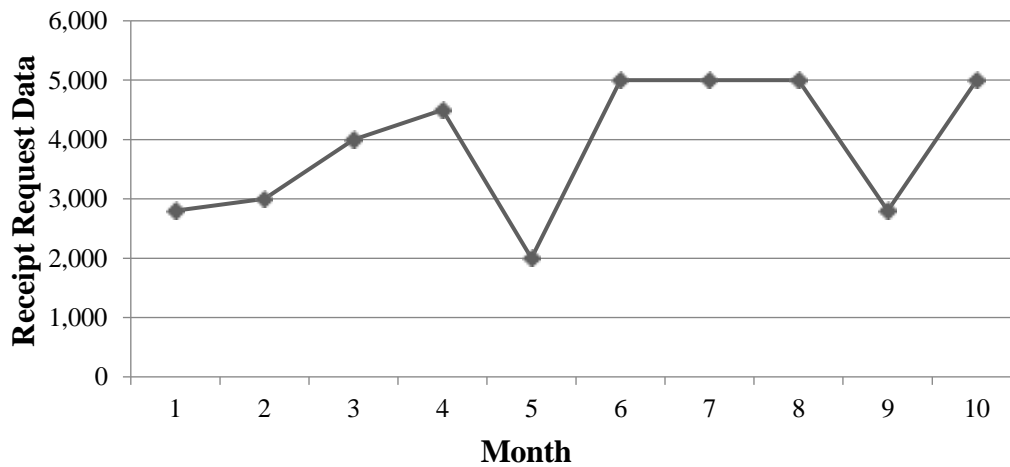


Figure 2. Scatter diagram

c. Selection of forecasting methods

The forecasting method used is:

1. Cyclical Method
2. Linear Method

d. Calculate forecasting parameters

To make calculations easier, let x be the year variable and Y be the economic growth variable.

1). Cyclical Method

Forecasting function: $Y = a + b \sin(2\pi x/n) + c \cos(2\pi x/n)$

Table 2. Cyclical Method Forecasting Calculations

x	Y	Sin(2πx/n)	Cos(2πx/n)	Y.sin(2πx/n)	Y.cos(2πx/n)	sin ² (2πx/n)	cos ² (2πx/n)	$\frac{\sin(2\pi x/n)}{\cos(2\pi x/n)}$
1	2800	0,5878	0,8090	1645,8400	2265,2476	0,3455	0,6545	0,4755
2	3000	0,9511	0,3090	2853,3000	927,0510	0,9046	0,0955	0,2939
3	4000	0,9511	-0,3090	3804,4000	-1236,0680	0,9046	0,0955	-0,2939
4	4500	0,5878	-0,8090	2645,1000	-3640,5765	0,3455	0,6545	-0,4755
5	2000	0,0000	-1,0000	0,0000	-2000,0000	0	1,0000	0,0000
6	5000	-0,5878	-0,8090	-2939,0000	-4045,0850	0,3455	0,6545	0,4755
7	5000	-0,9511	-0,3090	-4755,5000	-1545,0850	0,9046	0,0955	0,2939
8	5000	-0,9511	0,3090	-4755,5000	1545,0850	0,9046	0,0955	-0,2939
9	2800	-0,5878	0,8090	-1645,8400	2265,2476	0,3455	0,6545	-0,4755
10	5000	0,0000	1,0000	0,0000	5000,0000	0	1,0000	0,0000
55	39100	0	0	-3147,2	-464,1833	5,0004	5	0

Earned value a = 3910, b = -629,38, c = -92,83

The forecasting function is

$Y = 3910 - 629,38 \sin(2\pi x/n) - 92,83 \cos(2\pi x/n)$

2). Method Lines

The forecasting function is $Y = a + bx$

Table 3. Linear Method Forecasting Calculations

x	Y	x.Y	x ²
1	2800	2800	1
2	3000	6000	4
3	4000	12000	9
4	4500	18000	16
5	2000	10000	25
6	5000	30000	36
7	5000	35000	49
8	5000	40000	64
9	2800	25200	81
10	5000	50000	100
55	39100	229000	385

Earned Value $b = 169$, $a = 2980$

The forecasting function is $Y = 2980 + 169x$

e. Calculate each error for each forecasting method.

Error calculations use the SEE (Standard Error of Estimation) and PE (Percentage Error) methods.

$$SEE = \sqrt{\frac{\sum(Y-Y')^2}{n-f}}$$

$$PE = \left(\frac{Y-Y'}{Y}\right) \times 100\%$$

Y = actual value

Y' = forecasting value

n = number of periods

f = degrees of freedom (f = 3)

Table 4. SEE and PE Calculation for the Cyclic Method

x	Y	Y'	Y-Y'	e	(Y-Y') ²	PE
1	2800	3464,9476	-664,9476	664,9476	442155	23,74812857
2	3000	3282,7268	-282,7268	282,7268	79934	9,424226667
3	4000	3340,103	659,8970	659,897	435464	16,497425
4	4500	3615,1605	884,8395	884,8395	782941	19,6631
5	2000	4002,8367	-2002,8367	2002,8367	4011355	100,141835
6	5000	4355,0524	644,9476	644,9476	415957	12,898952
7	5000	4537,2732	462,7268	462,7268	214116	9,254536
8	5000	4479,897	520,1030	520,103	270507	10,40206
9	2800	4204,8395	-1404,8395	1404,8395	1973574	50,17283929
10	5000	3817,1633	1182,8367	1182,8367	1399103	23,656734
55	39100	39100	0	8710,7012	10025107	275,8598365

SEE = 1196,72
 MAD = 871
 MAPE = 27,58

The SEE and PE calculations for the Linear method Linear Method (f = 2)

Table 5. SEE and PE Calculation for the Linier Method

x	Y	Y'	Y-Y'	PE	(Y-Y') ²	E
1	2800	3149,091	-349,0910	12,4675	121865	349,091
2	3000	3318,1819	-318,1819	10,6061	101240	318,1819
3	4000	3487,2728	512,7272	12,8182	262889	512,7272
4	4500	3656,3637	843,6363	18,7475	711722	843,6363
5	2000	3825,4546	-1825,4546	91,2727	3332284	1825,4546
6	5000	3994,5455	1005,4545	20,1091	1010939	1005,4545
7	5000	4163,6364	836,3636	16,7273	699504	836,3636
8	5000	4332,7273	667,2727	13,3455	445253	667,2727
9	2800	4501,8182	-1701,8182	60,7792	2896185	1701,8182
10	5000	4670,9091	329,0909	6,5818	108301	329,0909
55	39100	39100,0005	-0,0005	263,4548	9690182	8389,0909

SEE = 1100,57
 MAD = 871
 MAPE = 26,34

f. Calculate the best forecasting pattern by calculating the F distribution

Ho : SEE Linier ≤ SEE cyclical

Hi : SEE Linier > SEE cyclical

: 0,05

$$\text{Test statistik } F = \frac{(\text{SEE Linier})^2}{(\text{SEE Siklis})^2} = \frac{1100,570^2}{1196,725^2} = 1,11$$

$$F_{\text{Tabel}} (0.05; 1.11) = 4,84$$

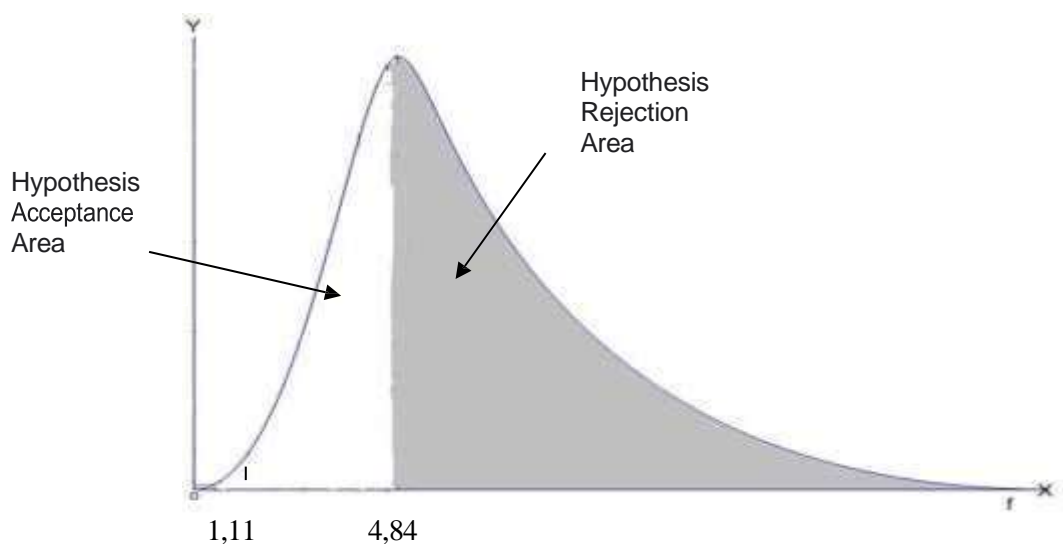


Figure 3. Hypothesis Test Graph with F Distribution

Because $F_{Count} < F_{Table}$, then H_0 is accepted. So, the test results state that the Linear method is better than the Cyclical method. The linear functions are

$$Y = 2980 + 169x$$

g. Verify Forecasting

The purpose of the verification process is to find out whether the function that has been determined can represent the predicted data (Sudarismiati & Sari, 2019)

Table 6. Verify Forecasting

x	Y	Y'	Y-Y'	MR
1	2800	3079,7386	-279,7386	-
2	3000	3214,7343	-214,7343	65,0043
3	4000	3355,6474	644,3526	859,0869
4	4500	3502,7372	997,2628	352,9102
5	2000	3656,2745	-1656,2745	2653,5373
6	5000	3816,5418	1183,4582	2839,7327
7	5000	3983,8342	1016,1658	167,2924
8	5000	4158,4596	841,5404	174,6254
9	2800	4340,7395	-1540,7395	2382,2799
10	5000	4531,0093	468,9907	2009,7302
55	39100	37639,7164	1460,2836	11504,1993

$$MR = \frac{\sum MR}{n - 1} = \frac{11504,1993}{10 - 1} = 1.278,24$$

$$UCL = 2,66MR = 2,66 \times 1.278,24 = 3.400,11$$

$$\frac{1}{3} \cdot UCL = \frac{1}{3} \times 3.400,11 = 1.133,37$$

$$\frac{2}{3} \cdot UCL = \frac{2}{3} \times 3.400,11 = 2.266,74$$

$$LCL = -2,66MR = -2,66 \times 1.278,24 = -3.400,11$$

$$\frac{1}{3} \cdot LCL = \frac{1}{3} \times (-3.400,11) = -1.133,37$$

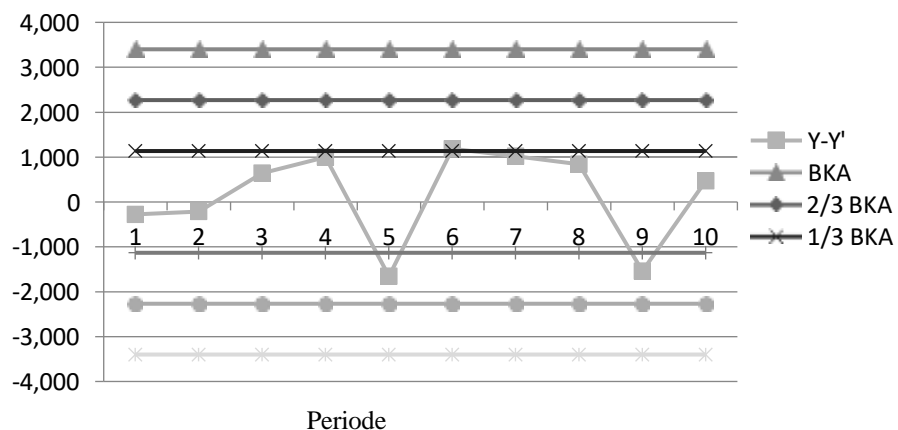


Figure 4. Moving Range Chart of Request for Receipts

It can be seen that all points are within the control limits, so forecasting using the Linear method is considered representative of the data. The forecasting formula is:

$$Y = 2980 + 169x$$

Until the demand forecast in November 2023 is as follows

$$\begin{aligned} Y &= 2980 + 169x \\ &= 2980 + 169(11) \\ &= 2980 + 1859 \\ &= 4839 \end{aligned}$$

3.2. DISCUSSION

The following is a table comparing the error percentage values between the two forecasting method approaches that have been carried out previously.

Table 7. Comparison of each error for each forecasting method

Method	SEE	MAD	MAPE
Linear	1100,57	871	26,34
Siklis	1196,72	871	27,58

From the table above it can be seen that the highest Percentage Error value is forecasting using the cyclical approach method with a percentage value of 27.58% and the lowest Percentage Error value is forecasting using the Linear approach method with a percentage value of 26.34%, so it can be concluded that from the two methods that have been used to predict Receipt production are the Linear Regression forecasting method, because the MAPE (Mean Absolute Percentage Error) value using the Linear Regression method is the smallest, so the researchers analyzed that the forecasting method using the Linear Regression approach is the best forecasting approach.

4. CONCLUSION

Based on data collection and processing as well as the analysis that has been carried out, we can do it compare that in terms of error rates as well Linear method ranking has levels smaller error compared to the method other. The linear method has a MAD value of 871, MAPE of.26,34 and standard error of 1100,57, can be concluded that the selected method is the Linear method. The linear method can help printing companies predict the number of receipts for the next period in fulfilling the number of receipts with the Linear function $Y = 2980 + 169x$. The research results show that the predicted number of requests for receipts for the November 2023 period is 4,839 sheets. . The sales forecast for receipts is 4,839, meaning that the company must provide 4,838 receipt products/month so that there is no shortage or excess of receipt product inventory, and can meet all consumer demand for receipt sales so that they can obtain profits as expected.

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