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ANALYSIS OF PRODUCTION PERFORMANCE OF TAMILNADU NEWSPRINT AND PAPERS LTD – CASE STUDY

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Abstract: Every day, Tamilnadu Newsprint and Papers Ltd managers must make decisions about Production delivery without knowing what will happen in the future. Forecasts enable them to anticipate the future and plan, many forecasting methods are available to Tamilnadu Newsprint and Papers Ltd managers for planning, to estimate future demand or any other issues at hand. However, for any type of forecast to bring about later success, it must follow a step-by-step process comprising five major steps: 1) goal of the forecast and the identification of resources for conducting it; 2) time horizon; 3) selection of a forecasting technique; 4) conducting and completing the forecast; and 5) monitoring the accuracy of the forecast. Accordingly Linear Regression method is a widely used to predict this kind of demand. In this paper, we forecast the Production of Papers in TamilNadu Newsprint and Papers Ltd from the past 15 years of Production using the Linear Regression method
Keywords: Trend analysis; Linear Regression; Forecast Accuracy

1. INTRODUCTION

A time series is a sequence of evenly spaced observations taken at regular intervals over a period of time (such as daily, hourly, weekly, monthly, or yearly). An example of a time series is the Annual production to Tamilnadu Newsprint and Papers Ltd. Forecasts from time-series data assume that future values of the series can be predicted from past values. Analysis of a time series can identify the behavior of the series in terms of trend, seasonality, cycles, irregular variations, or random variations. A trend is a gradual, long-term, upward or downward movement in data. Seasonality refers to short-term, relatively frequent variations generally related to factors such as Shortage of raw material, high cost of production; Sales often experience quarterly and Yearly "seasonal" variations. Cycles are patterns in the data that occur every several years, often in relation to current economic conditions. Such cycles often exhibit wave like characteristics that mimic the business cycle. Irregular variations are "spikes" in the data caused by chance or unusual circumstances (examples: severe weather, labor strike, Water Problem, use of a new high-technology service); they do not reflect typical behavior and should be identified and removed from the data whenever possible. Random variations are residual variations that remain after all other behaviors have been accounted for. Graphing the data provides clues to a manager for selecting the right forecasting method.

Tamil Nadu Newsprint and papers (TNPL) Ltd. was established by the Government of Tamil Nadu in the Year 1976. The company produces Newsprint, Printing and Writing paper using bagasse, a sugarcane residue, as the primary raw material. Their manufacturing facility is located at Kagithapuram in Karur District of Tamil Nadu. Commencing production in 1984 at a modest 90,000 tonnes per annum, the company has made rapid strides and has emerged today as the largest paper mill in India at a single location with a total installed capacity of 400,000 tonnes per annum. TNPL's paper comes from three high end machines of Beloit Walmsley, Voith Paper with a total production capacity of 245,000 tonnes per annum and a third state-of-the-art paper machine with a production capacity of 155,000 tonnes per annum.

In this Paper forecast the next 15 years of production in Tamil Nadu Newsprint and papers (TNPL) Ltd using Linear Regression Method. The method is evaluated with different accuracy measures; variance (MSE and MAD), a numerical example shows the next 15 years of production.

2. TIME SERIES METHOD

2.1 Techniques for Trend

A trend is a gradual, long-term movement caused by changes in population, income, or culture. Assuming that there is a trend present in a data set, it can be analyzed by finding an equation that correlates to the trend in question. The trend may or may not be linear in its behavior. Plotting the data can give a Tamilnadu Newsprint and Papers Ltd manager insight into whether a trend is linear or nonlinear. Forecasting Techniques Based on Linear Regression. By minimizing the sum of the squared errors, which is called the least squares method, regression analysis can be used to create a representative line that has the form:

$$y = a + b * x \qquad (1)$$

where
y = the predicted (dependent) variable
x = the predictor (independent) variable
b = the slope (rise/run) of the data line
a = the value of y when x is equal to zero.

Consider the regression equation example y = 20 + 5x. The value of y when x = 0 is 20, and the slope of the line is 5. Therefore, the value of y will increase by five units for each one-unit increase in x. If x = 15, the forecast (y) will be 20 =5(15), or 95 units. This equation could be plotted on a graph by finding two points on the line. One of those points can be found in the way just mentioned; putting in a value for x. The other point on the graph would be a (i.e. y_x at x = 0). The coefficients of the line, a and b, can be found (using historical data) with the following equations:

$$b = \frac{n\left(\sum xy\right) - \left(\sum x\right)\left(\sum y\right)}{n\left(\sum x^2\right) - \left(\sum x\right)^2}$$

$$a = \frac{\sum y - b\sum x}{n}.$$

3. NUMERICAL EXAMPLE

Table 1 gives an example about the Production data in Tamilnadu Newsprint and Papers Ltd.

Table 1. Production data

YEAR	PRODUCTION INMETRIC TONNES (Y)	X	X^2	XY
1997-98	170618	-7	49	-1194326
1998-99	176075	-6	36	-1056450
1999-2000	178871	-5	25	-894355
2000-01	191106	-4	16	-764424
2001-02	184267	-3	9	-552801
2002-03	167878	-2	4	-335756
2003-04	182215	-1	1	-182215
2004-05	196241	0	0	0
2005-06	230079	1	1	230079
2006-07	231161	2	4	462322
2007-08	245471	3	9	736413
2008-09	254903	4	16	1019612
2009-10	245008	5	25	1225040
2010-11	265044	6	36	1590264
2011-12	343306	7	49	2403142

After calculating ∑x=0, ∑ y= 3262243, ∑xy=2686545, ∑x2=280, n=14 substitute into the Equations [2] for a and b, respectively

$$b = \frac{14(2686545) - 0(3262243)}{14(280) - 0} = 9594.804$$

$$a = \frac{3262243 - 9594.804\,(0)}{14} = 217482.9$$

Hence, the regression line is:

$$Y_x = 217482.9 + 9594.804) * 8$$

$$Y = 309775.8$$

Table 2 give the results of the Linear Regression method computed based on the above data.

Table 2. The Forecasting Production of Linear Regression Method

YEAR	PREDICTED PRODUCTION INMETRIC TONNES
2012-13	309775.832
2013-14	319370.636
2014-15	328965.44
2015-16	338560.244
2016-17	348155.048
2017-18	357749.852
2018-19	367344.656
2019-20	376939.46
2020-21	386534.264
2021-22	396129.068
2022-23	405723.872
2023-24	415318.676
2024-25	424913.48
2025-26	434508.284
2026-27	444103.088

4. FORECAST ACCURACY

4.1 Mean Square Error(MSE)

In this section we present and discuss the different measures we use in the forthcoming analyses. Common measures for forecasting errors and its variability are MSE and also Mean Absolute Deviation (MAD). Silver et al (1998) recommend the use of MSE, because MSE is related to standard variation of forecast errors. However MSE is more sensitive to outliers and errors smaller than one due to the squared Function. Which mean that in an evaluation of different forecasting methods MSE and
MAD sometimes presents a different result:

$$MSE = \frac{1}{T}\sum_{t=1}^{T}\left(X_t - \hat{X}_t\right)^2, \quad (2)$$

$$MAD = \frac{1}{T}\sum_{t=1}^{T}\left|X_t - \hat{X}_t\right|. \quad (3)$$

5. TEST RESULT

The data comes from Tamilnadu Newsprint and Papers Ltd; the data covers 15 Years. For an overlook the demand data are also shown in diagrams. Below the result of 15 years of forecast production is shown.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.887351052
R Square	0.78739189
Adjusted R Square	0.77103742
Standard Error	23138.64232
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	25776871561	25776871561	48.145	1.02391E-05
Residual	13	6960157989	535396768.4		
Total	14	32737029550			

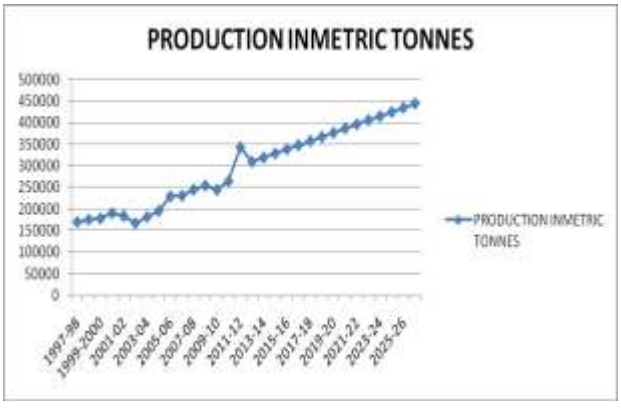
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	217482.87	5974.37	36.40	0.00	204576.02	230389.71	204576.02	230389.71
X Variable 1	9594.80	1382.80	6.94	0.00	6607.45	12582.16	6607.45	12582.16

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	150319.24	20298.76
2	159914.05	16160.95
3	169508.85	9362.15
4	179103.65	12002.35
5	188698.46	-4431.46
6	198293.26	-30415.26
7	207888.06	-25673.06
8	217482.87	-21241.87
9	227077.67	3001.33
10	236672.47	-5511.47
11	246267.28	-796.28
12	255862.08	-959.08
13	265456.88	-20448.88
14	275051.69	-10007.69
15	284646.49	58659.51

PROBABILITY OUTPUT

Percentile	*Y*
3.3	167878
10.0	170618
16.7	176075
23.3	178871
30.0	182215
36.7	184267
43.3	191106
50.0	196241
56.7	230079
63.3	231161
70.0	245008
76.7	245471
83.3	254903
90.0	265044
96.7	343306



6. CONCLUSION

In this paper, we analyze a Linear Regression Method in forecasting approach to deal with the production data in Tamilnadu Newsprint and papers Ltd. Numerical experiments show that the next 15 years forecasting production in that company. For further studies, to predict the sales, net profit and working capital in TNPL.

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