Forecasting Electricity Consumption with Neural Networks and Regression

S.Jayashree
Assistant Professor
Department Mathematics and Statistics

Abstract

Energy strategy is extremely important for developing countries. As the economy of the countries grow rapidly, their energy consumption increase substantially. Data about electricity consumption were analysed by using the sector LT domestic data. Policy makers should give critical decisions and develop new strategies for meeting this growing energy demand. Apparently, accurate predictions of the future energy consumption are vital for developing such strategies. The analysis of power consumption is neutral within practically nine months in order to find out some significant information that allows us to predict the future demand with the certain degree of accuracy. In this study, we have used the computation methods to forecast the electricity consumption. The forecast results are compared with real consumption values to measure the performance of the methods.

Index terms: Artificial neural networks, Electricity consumption, Forecasting, Regression.

1. Introduction

Energy demand forecasting is one of the most important tools that decision makers use (Ediger and Akar, 2007). It is a very attractive area for researchers and there are various models generated for energy demand forecasting[1]. Techniques used in energy demand forecasting studies are mainly composed of Box- Jenkins models, regression models, econometric models and neural networks (Jebaraj and Iniyan, 2006).

Electricity demand forecast will provide guidance in strategic management and future demands will give a road map during strategy formulation and implementation processes. Deciding on the forecasting model and methodology for demand prediction is a valuable asset for companies in the energy sector. Based on this research, companies acting in the energy market can set their strategic goals and have the chance to achieve better performance.

Electrical energy is not storable therefore it is a vital need to make a good electricity demand forecast. The main purpose of this study using monthly based consumption data is to develop an accurate forecasting model for predicting electricity consumption.

2. Methodology

Artificial Neural Networks

Artificial neural networks (ANN) are computational techniques modeled on the learning processes of the human cognitive system and the neurological functions of the brain.There has been considerable interest in the development of artificial neural networks for solving a wide range of problems from different fields. Neural networks are distributed information processing systems composed of many simple computational elements interacting across weighted

connections[2]. Inspired by the architecture of the human brain, neural networks exhibit certain features such as the ability to learn complex patterns of information and generalize the learned information. Neural networks are simply parameterized non-linear functions that can be fitted to data for prediction purposes.

The main appeal of neural networks is their flexibility in approximating a wide range of functional relationships between inputs and output. Indeed, sufficiently complex neural networks are able to approximate arbitrary functions arbitrarily well. One of the most interesting properties of neural networks is their ability to work and forecast even on the basis of incomplete, noisy, and fuzzy data. Furthermore, they do not require a priori hypothesis and do not impose any functional form between inputs and output. For this reason, neural networks are quite practical to use in the cases where knowledge of the functional form relating inputs and output is lacking, or when a prior assumption about such a relationship should be avoided.

The success of the NN models depends on properly selected parameters such as the number of nodes (neurons) and layers, the nonlinear function used in the nodes, learning algorithm, initial weights of the inputs and layers, and the number of epochs that the model is iterated

In ANN methodology, the sample data often is divided into two main sub-samples which are named as training and test sets. During the training process, the neural network learns the relationship between output and input criteria, while in the testing process; test set is used to assess the performance of the model.

Forecasting Monthly Electric Energy Consumption

Our objectives is to check whether

- To know the variation between the different months of Tandur in different mandals.
- To analyse the power consumption of domestic people.

Southern Power Distribution Company of TG Limited
Energy Billing System, ERO: 319 TANDUR
STATEMENT SHOWING COLLECTION FIGURE (In Lakhs)

TANDUR

MONTH	March	April	May	June	July	August	September	October	November
X(Collection)	88.85	113.31	141.88	162.6	113.73	112.83	122.5	126.68	75.95
Y(Demand)	98.29	139.29	142.67	163.21	129.22	114.16	120.02	126.17	121.51

PEDDAMUL

MONTH	March	April	May	June	July	August	September	October	November
X(Collection)	14.64	14.86	21.9	23.14	12.45	19.03	23.27	22.07	12.43
Y(Demand)	17.98	22.22	22.27	24.15	22.56	23.42	25.28	23.56	23.99

BASHEERABAD

MONTH	March	April	May	June	July	August	September	October	November
X(Collection)	14.35	16.45	20.06	22.99	13.71	20	24.39	23.3	10.97
Y(Demand)	17.9	22.38	22.01	24	20.85	20.54	25.67	24.82	22.47

TANDUR- RURAL

MONTH	March	April	May	June	July	August	September	October	November
X(Collection)	11.6	12.44	16.06	17.73	12.44	15.65	16.78	18.82	10.16
Y(Demand)	13.52	17.61	17.62	19.02	16.73	16.02	17.04	19.66	16.99

KODANGAL

MONTH	March	April	May	June	July	August	September	October	November
X(Collection)	12.26	12.54	19.14	20.13	16.09	14.3	19.27	15.77	8.93
Y(Demand)	16.54	18.98	21.75	19.78	20.2	15.94	18.92	16.61	21.4

BOMRASPET

MONTH	March	April	May	June	July	August	September	October	November
X(Collection)	6.21	4.89	8.48	9.08	8.24	7.75	9.01	8.43	4.57
Y(Demand)	8.12	8.17	9.63	9.2	9.95	8.73	9.93	8.96	10.76

DOULATABAD

MONTH	March	April	May	June	July	August	September	October	November
X(Collection)	4.09	3.27	6.03	5.88	2.73	5.18	8.5	6.05	3.17
Y(Demand)	6.61	5.28	7.86	5.61	8.3	5.58	9.07	6.72	8.19

Analysis:

For **TANDUR** :

9 pairs of observations of the months March-November for collection and demand of power consumption are taken. Obtain the regression line of Y on X and Estimate the value of Y if X=99.49.

To Obtain the regression lines on power consumption of TANDUR Area

$$\bar{x} = \frac{1}{n}\sum x$$

$$\bar{y} = \frac{1}{n}\sum y$$

$$\sigma_x = \sqrt{\frac{1}{n}\sum x^2 - (\bar{x})^2}$$

$$\sigma_y = \sqrt{\frac{1}{n}\sum y^2 - (\bar{y})^2}$$

$$Cov(x\ ,y) = \frac{1}{n}\sum xy - \bar{x}\bar{y}$$

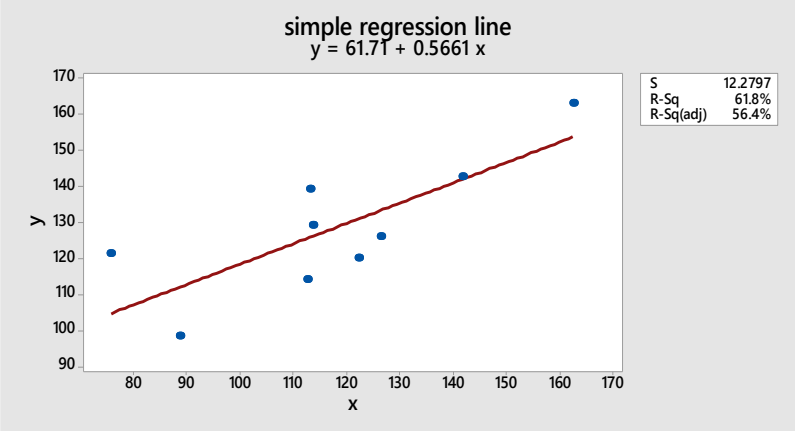
$$r = \frac{cov(x,y)}{\sigma_{x\sigma_y}}$$

Using MINITAB Worksheet values of X and Y should be entered .

Go to Stat>Regression>Fitted Line Plot. Select X value as Predictor and Y value as Response.

Select type of Regression model as linear and title as simple regression line.

Click Ok and hence we get the following result.



CONCLUSION:

Estimate of Y

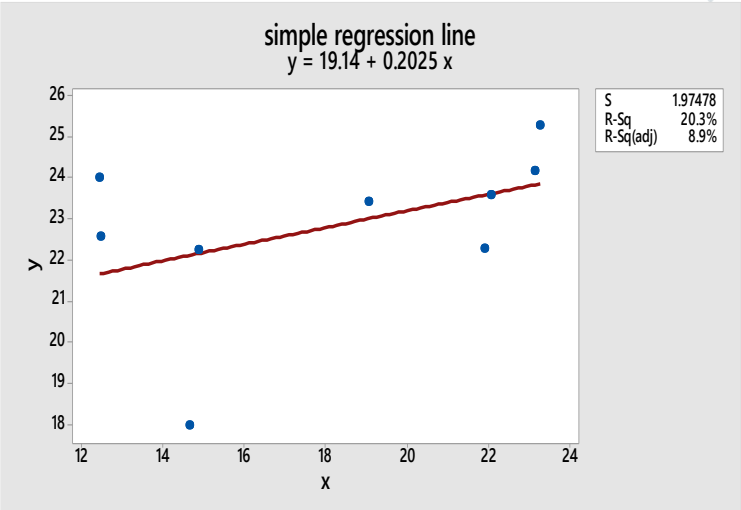
If X=99.49, by using Regression line of Y on X.

$\hat{y} = 118.031289$

PEDDAMUL :

9 pairs of observations of the months March-November for collection and demand of power consumption are taken. Obtain the regression line of Y on X and Estimate the value of Y if X=20.01

To obtain the regression lines on power consumption of PEDDAMUL Area.

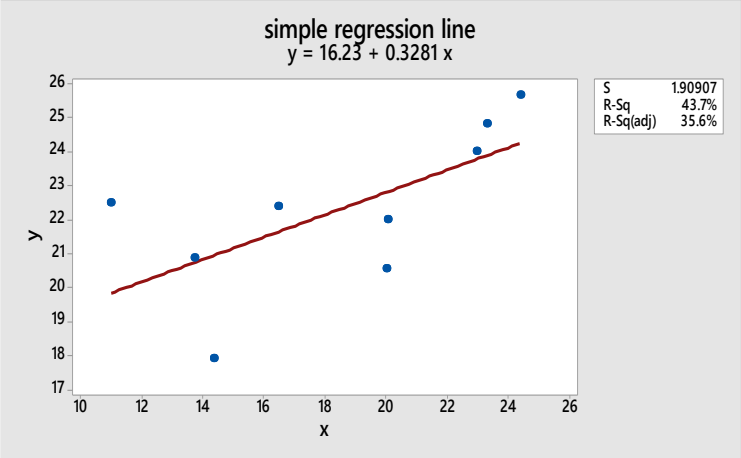


CONCLUSION:

Estimate of Y
If X=20.01, by using Regression line of Y on X.
$\hat{y} = 23.19224$

BASHEERABAD :

9 pairs of observations of the months March-November for collection and demand of power consumption are taken. Obtain the regression line of Y on X and Estimate the value of Y if X=20.12

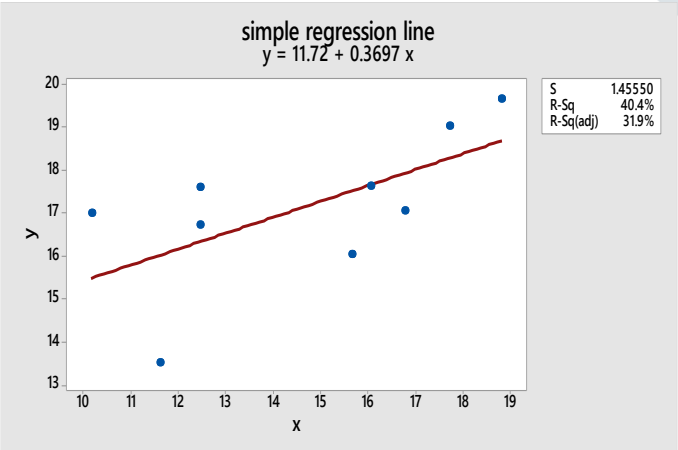


CONCLUSION:

Estimate of Y
If X=20.12, by using Regression line of Y on X.
$\hat{y} = 22.83511$

TANDUR- RURAL :

9 pairs of observations of the months March-November for collection and demand of power consumption are taken. Obtain the regression line of Y on X and Estimate the value of Y if X=13.91



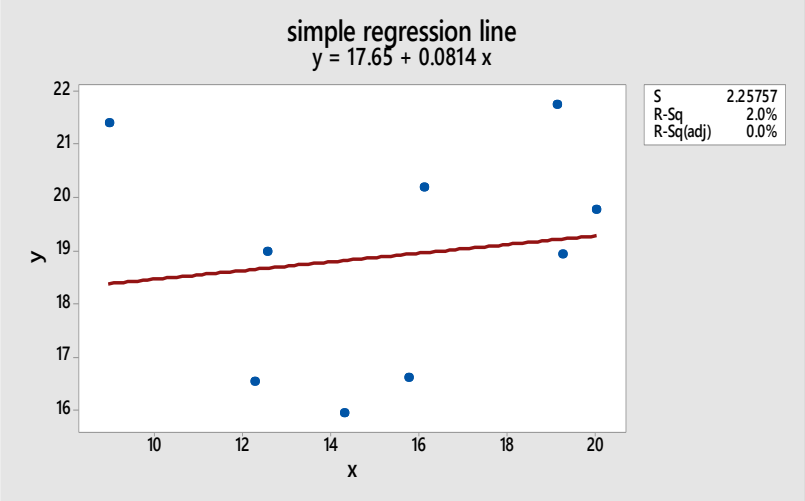
CONCLUSION:

Estimate of Y

If X=13.91 , by using Regression line of Y on X.
$\hat{y} = 16.862527$

KODANGAL :

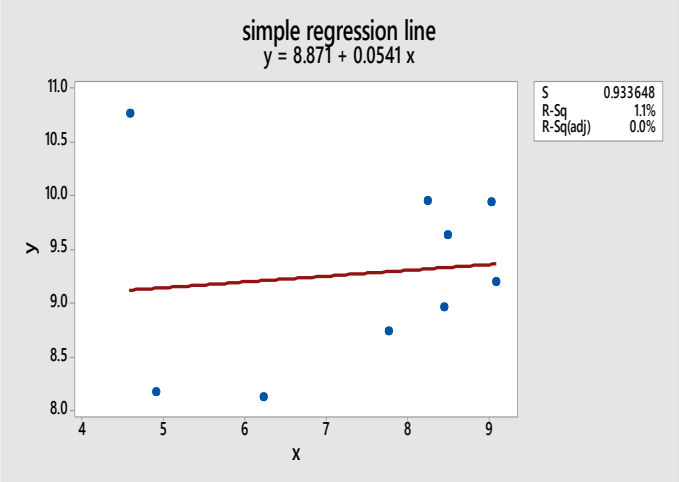
9 pairs of observations of the months March-November for collection and demand of power consumption are taken. Obtain the regression line of Y on X and Estimate the value of Y if X=17.86



CONCLUSION:

Estimate of Y
If X=17.86, by using Regression line of Y on X.
$\hat{y} = 19.10409$

BOMRASPET Data:
9 pairs of observations of the months March-November for collection and demand of power consumption are taken. Obtain the regression line of Y on X and Estimate the value of Y if X=8.977



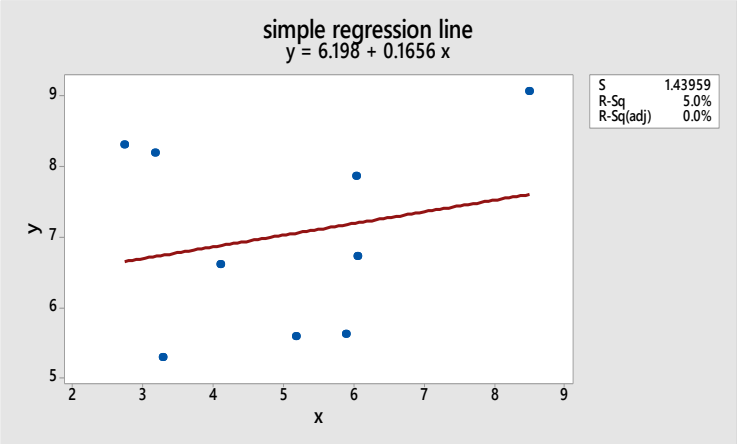
CONCLUSION:

Estimate of Y
If X=8.97, by using Regression line of Y on X.

$\hat{y} = 9.35715547$

DOULATABAD Data:

9 pairs of observations of the months March-November for collection and demand of power consumption are taken. Obtain the regression line of Y on X and Estimate the value of Y if X=86.55



CONCLUSION:

Estimate of Y
If X=6.55, by using Regression line of Y on X.
$\hat{y} = 7.28304$

REPORT:

1. Estimated value for Y on X for TANDUR area is $\hat{Y} = 118.031289$

   Estimated value for Y on X for PEDDAMUL area is $\hat{Y} = 23.19224$

   Estimated value for Y on X for BASHEERABAD area is $\hat{Y} = 22.83511$

   Estimated value for Y on X for TANDUR-RURAL area is $\hat{Y} = 16.862527$

   Estimated value for Y on X for KODANGAL area is $\hat{Y} = 19.10409$

   Estimated value for Y on X for BOMRASPET area is $\hat{Y} = 9.35715547$

   Estimated value for Y on X for DOULATABAD area is $\hat{Y} = 7.28304$

2. **AREA WISE:** According to the estimated values, the TANDUR area has more Power Consumption compare to other areas.

3. **MONTH WISE:** Power consumption is more in the month of June -261.55 and less in the month of March-152.00

References

[1] Abdel-Aal , R.E., Al-Garni, A.Z. (1997), Forecasting monthly electric energy consumption in eastern Saudi Arabia using univariate time-series analysis, Energy, 22 (11), pp. 1059-1069.

[2] Azadeh, A., Ghaderi, S.F., Sohrabkhani, S. (2007), Forecasting electrical consumption by integration of Neural Network, time series and ANOVA, Applied Mathematics and Computation, 186, 1753-1761.