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Prediction of Liquid Petroleum Gas for Domestic Consumption in Odisha

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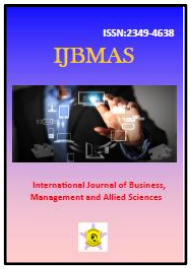

ABSTRACT
Time series modeling and forecasting has importance to various practical domains. Thus a lot of active research works is going on in this subject during several years. Several important models have been proposed in literature for accuracy and efficiency of time series modeling. The aim of this article is to present a statistical time series forecasting models. We have explained here different statistical methods of time series models. Here we have collected historical data of Liquid Petroleum Gas (LPG) domestic consumption in Odisha from year 2008 to 2015 of every month's data. Fitting a model to a dataset is used fitted trained equation. To evaluate forecast accuracy models fitted to a time series. We have shown the obtained forecast diagram, which graphically describes the forecasted observations. To have authenticity as well as clarity in our discussion about different methods of time series modeling and forecasting, we have gone through of various published research works from reputed journals and some standard books.
Keywords: Time series, forecasting, Liquid Petroleum Gas (LPG)

INTRODUCTION

Liquefied petroleum gas (LPG) is a hydrocarbon which is produced during processing of crude oil and natural gas production. It is a clean form of energy which is used in various applications. Along with this LPG environment friendly as produce 50% less carbon dioxide than coal and 20% less carbon dioxide than heating oil. The global LPG industry has increased rapidly over the past decade and experienced several significant changes such as improvement in channel of distribution, development of new light-weight metal and/or composite cylinders coupled with development of telemetry (remote management systems), constitute significant improvements in terms of safety, and facility of use. Emergence of LPG for various applications around the world has contributed to the growth of its demand in the past. Application of LPG as fuel in commercial and

residential market is booming in many developing countries owing to government relaxation and subsidy grant.

Time series modeling is a dynamic research area, which has attracted attentions of researchers. The main aim of time series modeling is to carefully collect and rigorously study the past observations of a time series to develop an appropriate model, which describes the inherent structure of the series. This model is then used to generate future values for the series, i.e. to make forecasts. Time series forecasting thus can be termed as the act of predicting the future by understanding the past. Due to the indispensable importance of time series forecasting in numerous practical fields such as business, economics, finance, science and engineering, etc. proper care should be taken to fit an adequate model to the underlying time series. It is obvious that a successful time series forecasting depends on an appropriate model fitting. Over many years the researchers tryto develop efficient models to improve the forecasting accuracy. As a result, various important time series forecasting models have been evolved in literature. Here we used time series models in statistical model. The basic assumption made to implement this model is that the considered time series is linear and follows known statistical methods, such as the Trend Analysis and Single Exponential Smoothing. In practice a suitable model is fitted to a given time series and the corresponding parameters are estimated using the known data values. The procedure of fitting a time series to a proper model is termed as Time Series Analysis.

Liquefied Petroleum Gas (LPG)

Liquefied Petroleum Gas(LPG), also referred to as simply propane or butane, are flammable mixtures of hydrocarbon gases used as fuel in heating appliances, cooking equipment, and vehicles.It is increasingly used as an aerosol propellant and a refrigerant, replacing chlorofluorocarbons in an effort to reduce damage to the ozone layer. When specifically used as a vehicle fuel it is often referred to as auto gas.Varieties of LPG bought and sold include mixes that are mostly propane (C_3H_8), mostly butane (C_4H_{10}) and, most commonly, mixes including both propane and butane. In the northern hemisphere winter, the mixes contain more propane, while in summer, they contain more butane. In the United States, mainly two grades of LPG are sold: commercial propane and HD-5. These specifications are published by the Gas Processors Association (GPA) and the American Society of Testing and Materials (ASTM).Propane/butane blends are also listed in these specifications.

LPG is prepared by refining petroleum or "wet" natural gas, and is almost entirely derived from fossil fuel sources, being manufactured during the refining of petroleum (crude oil), or extracted from petroleum or natural gas streams as they emerge from the ground. It was first produced in 1910 by Dr. Walter Snelling, and the first commercial products appeared in 1912. It currently provides about 3% of all energy consumed, and burns relatively cleanly with no soot and very few sulfur emissions. As it is a gas, it does not pose ground or water pollution hazards, but it can cause air pollution. LPG has a typical specific calorific value of 46.1 MJ/kg compared with 42.5 MJ/kg for fuel oil and 43.5 MJ/kg for premium grade petrol (gasoline).[8] However, its energy density per volume unit of 26 MJ/L is lower than either that of petrol or fuel oil, as its relative density is lower (about 0.5–0.58 kg/L, compared to 0.71–0.77 kg/L for gasoline).

Methodology

In practice a suitable model is fitted to a given time series and the corresponding parameters are estimated using the known data values. The procedure of fitting a time series to a proper model is termed as Time Series Analysis. It comprises methods that attempt to understand the nature of the series and is often useful for future forecasting and simulation. In time series forecasting, past observations are collected and analyzed to develop a suitable mathematical model which captures the underlying data generating process for the series. The future events are then predicted using the model. This approach is particularly useful when there is not much knowledge about the statistical pattern followed by the successive observations or when there is a lack of a satisfactory explanatory model. Time series forecasting has important applications in various fields. Often valuable strategic

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decisions and precautionary measures are taken based on the forecast results. Thus making a good forecast, i.e. fitting an adequate model to a time series vary important. Over the past several decades, researchers for the development and improvement of suitable time series forecasting models have made so many efforts.

Data Processing

We have presented the forecasting results of the experiments done by us. From the performance measures obtained for historical dataset, one can have a relative idea about the effectiveness and accuracy of the fitted models. The time series datasets, we have considered are taken from non-confidential sources and each of them is freely available for analysis. We have collected data from year 2008 to 2015 monthly Liquid Petroleum Gas (LPG) Domestic sales in Odisha (in Metric ton).

Analysis and Finding

In this article we analyze the Liquid Petroleum Gas (LPG) domestic consumption in Odisha. We have collected data of seven years from 2008 to 2015 month wise consumption. The data series are obtained from the National Petroleum Analysis. The said data has analyzed in different statistical methods for forecasting of time series data. The methods, which we are using time series analysis, Trend Analysis, Exponential Smoothing and Normal Probability. After analysis of different methods we got the results, which are shows in different figures. The Summary of Statistics N=84 (Number of months in 7 years), Mean=15989 Metric Ton, Standard Deviation=3209, Minimum = 10896 Metric Ton and Maximum Consumption = 25350 Metric Ton of LPG. The Trend Analysis Method is Model Type: Linear, Fitted Trend Equation and Accuracy measures: MAPE, MAD, MSD statistics to compare the fits of different forecasting and smoothing methods and Exponential Smoothing Constant= 0.2. The Forecast of month wise year 2016 for Liquid Petroleum Gas (LPG) domestic consumption in Odisha are showing in figure:4, where we can observe the consumption is gradually increasing form 21181 Metric Ton to 22525 Metric Ton

LPG Domestic Consumption

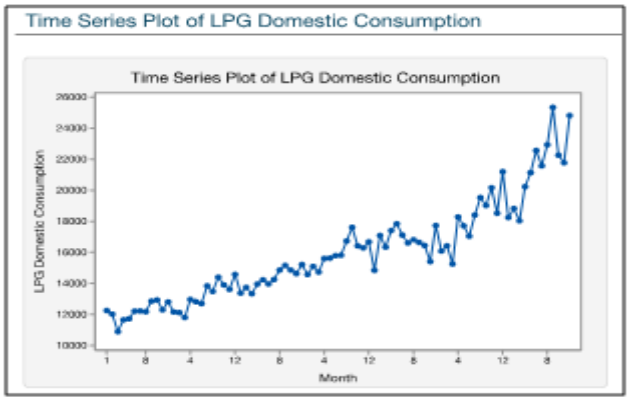

Figure 1: Time Series Plot of LGP Domestic Consumption in Odisha

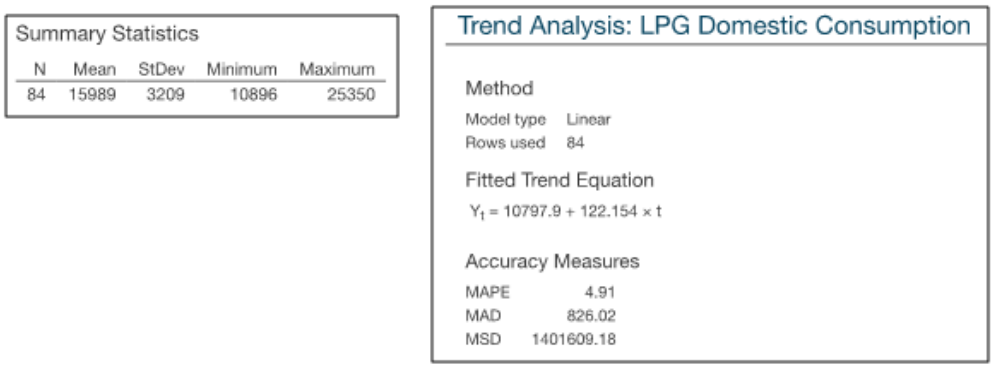

Figure 2: The Trend Analysis of LPG Domestic Consumption

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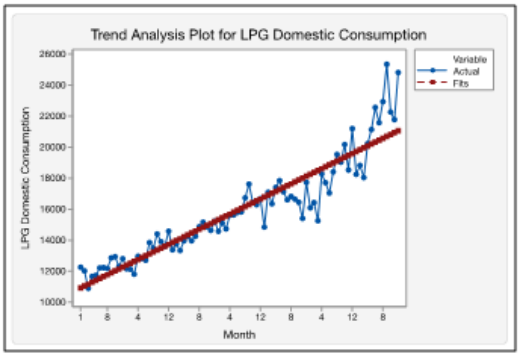


Single Exponential Smoothing: LPG Domestic Consumption

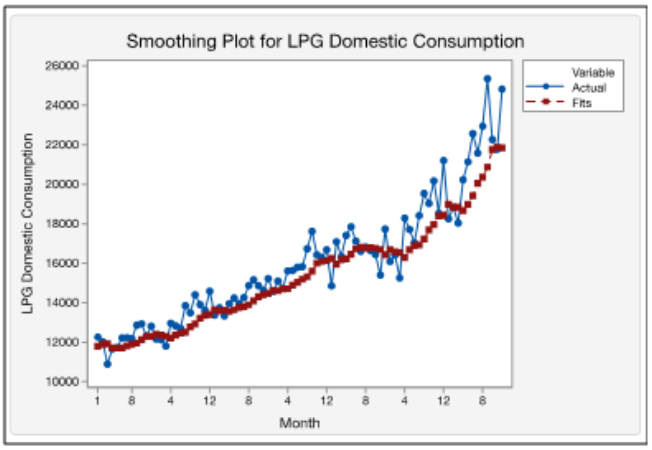
Method

Smoothing constant	0.2
Rows used	84

Accuracy Measures

MAPE	5.00
MAD	861.97
MSD	1430546.89

Figure 3: Single Exponential Smoothing of LPG Domestic Consumption



Trend Analysis: LPG Domestic Consumption

Method

Model type	Linear
Rows used	84

Fitted Trend Equation

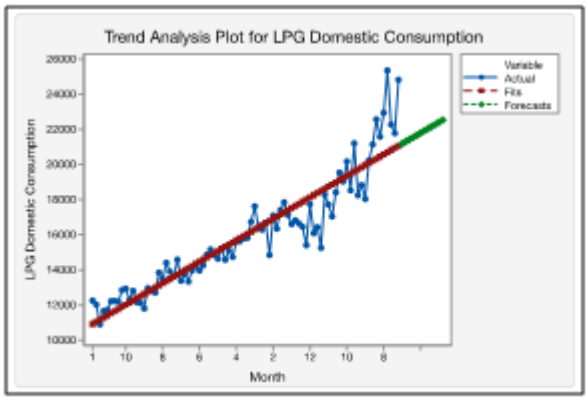
$Y_t = 10797.9 + 122.154 \times t$

Accuracy Measures

MAPE	4.91
MAD	826.02
MSD	1401609.18

Forecasts

Period	Forecast
85	21181
86	21303
87	21425
88	21547
89	21670
90	21792
91	21914
92	22036
93	22158
94	22280
95	22403
96	22525



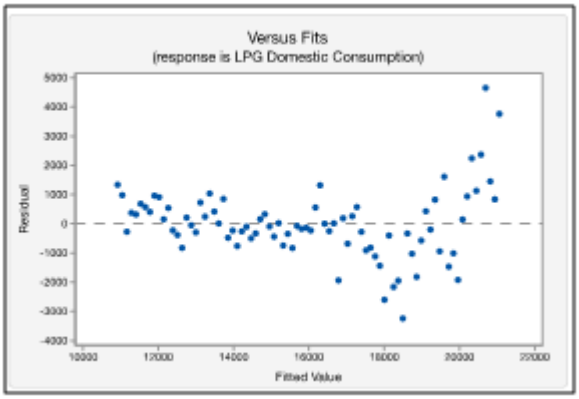


Figure 4: ***Forecast of LPG Domestic Consumption*** **Figure 5: Versus Fits** ***of LPG Domestic Consumption***

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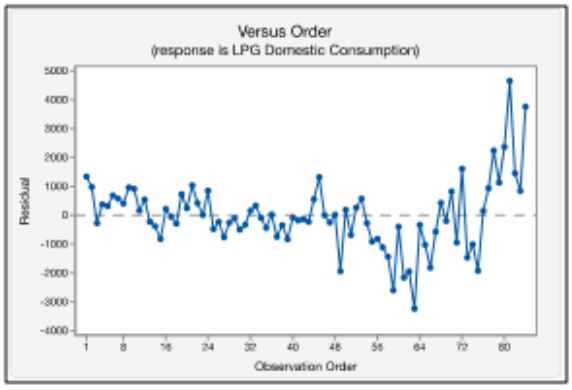

Figure 6: *Versus Order*

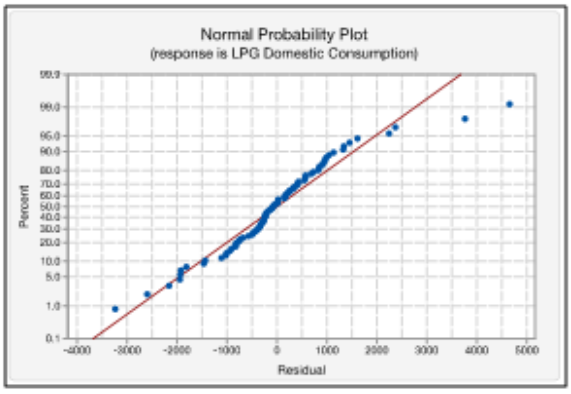

Figure 7: *Normal Probability*

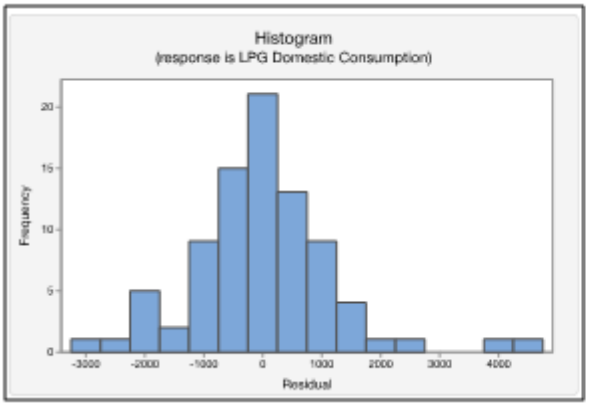

Figure 8: *Histogram*

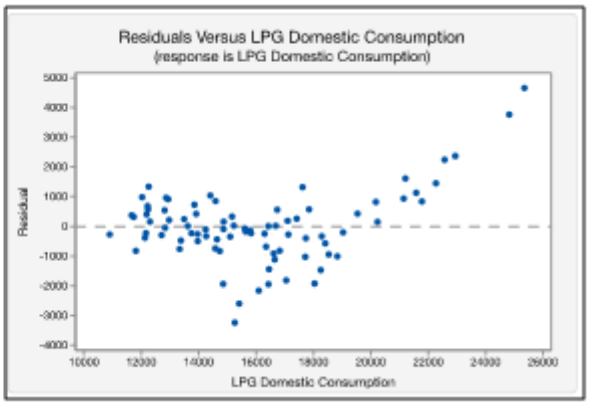

Figure 9: *Residual Versus*

Conclusions

Forecasting time series is a difficult problem. In this article we compared the performances of different statistical analysis and algorithms for predicting the Liquid Petroleum Gas (LPG) Domestic Consumption in Odisha. We used data series of monthly consumption (in Metric Ton)of Seven years form 2008 to 2015, which is available in National Petroleum Analysis website. Here we used different Statistical methods to predict or forecast of LPG domestic consumption for month wise consumption for year 2016. We can observe in figure:4our prediction of LPG consumption is gradually increasing from 21181 Metric Ton to 22525 Metric Ton and the other figures are showing different statistical methods output of our analysis. The output showing, our analysis is robust and the forecast is also accurate.

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