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Elaboration of Electricity Energy for Production-Consumption Relation of Northern-Iraq for the Future Expectations

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Abstract

Balance between electricity production and consumption plays an important role for future strategic plan of a region. From this point of view, the concerning region should be aware of and forecast future production-consumption cycle and balance them. In this research, Northern-Iraq situation is taken into consideration to elaborate electricity energy consumption and compare with the generation. Competitive models such as Winters Additive and Box-Jenkins are considered to choose best model for the elaboration.

Keywords: Electricity Energy, forecasting, Northern-Iraq

Introduction

"Energy is one of the most important inputs required to maintain social and economic improvement in a country". (Akkurt, Demirel, Zaim, 2010). However, it is one of the welfare parameters of a state. Electricity energy is a kind of energy which is used at service facilities, manufacturing companies, residential…etc. all over the world. From this point, it is not hard to estimate the importance of electricity energy for any region.

Northern-Iraq is located at Middle East where rich raw petroleum energy exists. As a possible result of this, Northern-Iraq may become an important petroleum exporting region from Middle East. On the other hand, there is lack of academic information about electricity energy production and consumption of Northern-Iraq.

It is blatant by looking at historical data; consumption of electricity is increasing day by day in Northern-Iraq. It means that the welfare level of Northern-Iraq is increasing, too. But on the other hand, it is obvious that electricity load is not enough to satisfy the need of consumption in the market. Considering this point, an elaboration on this field is required to create a strategic plan for the future expectations.

Literature Review

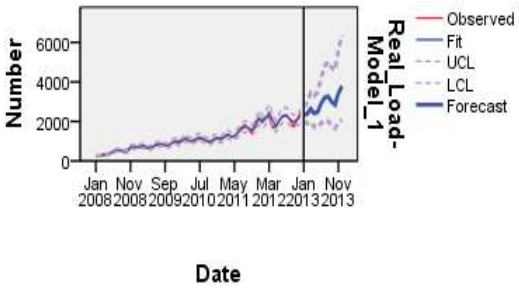
Forecasting techniques are widely used at energy field in the literature. From the oldest techniques to the state of art ones, projections are reflected at energy field. For example,

Brown and Matin (1995) used feed-forward artificial neural network models to forecast daily gas consumption in Wisconsin. Ramakrishna, Boiroju, and Reddy,(2011) used comparatively artificial neural networks and box-jenkins models to forecast the monthly electricity demand in Andhra Pradesh. Myint Myint Yi, et.al. (2008) forecasted the short term load of electricity using neural network, time series and wavelet transform. Hippert et. al. (2001) reviewed the methodology for forecasting short-term load using artificial neural networks. Ediger and Akar (2007) used ARIMA and SARIMA methods to estimate the future primary energy demand of Turkey between 2005 and 2020. R. Ramakrishna et.al. (2011) presents modeling of daily electricity load in Andhra Pradesh using neural networks

Accuracy is also important as well as forecasting. Mean absolute percentage error (MAPE) might be considered as one of the common used error measurement proposing type in researches. P. Arumugam, V. Anithakumari (2013) has used MAPE at their research called "Fuzzy Time Series Method for Forecasting Taiwan Export Data". Furthermore, Jeh-Nan Pana, Pin Kunga, Abraham Bretholtb, and Jia-Xiang Lua, (2013), also used MAPE as one of the error measuring parameters when they forecast energy's environmental impact using a three variable time series models. A. Azadeh, M. Taghipour, S.M. Asadzadeh, M. Abdollahi, (2013), measured error of prediction of electricity consumption with random variations using MAPE. Finally ,Benyamin Khoshnevisan, Shahin Rafiee, Mahmoud Omid, Hossein Mousazadeh (2013) have used MAPE as one of the error measuring parameters for their research called as "Prediction of potato yield based on energy inputs using multi-layer adaptive neuro-fuzzy inference system"

Finding Model

Winters' additive model is used initially to perform testing. Natural log transformation is preferred to reduce the fluctuation and smooth the data. Results of the model are;

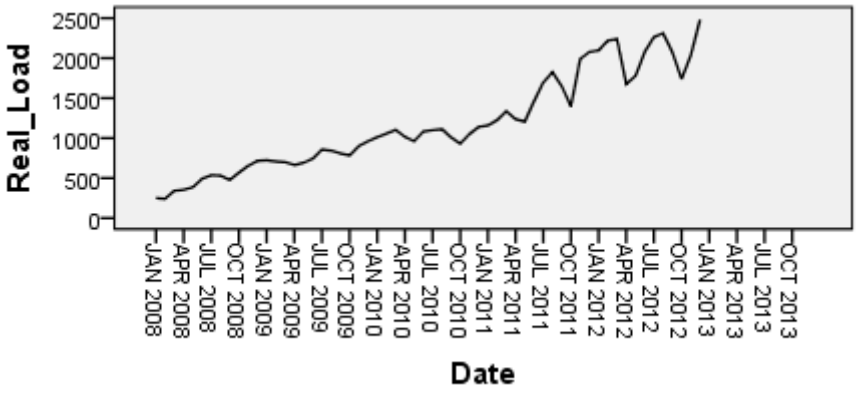


Winters' Additive

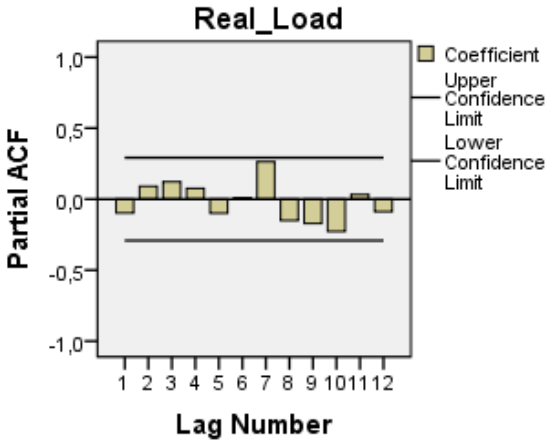
Fit Statistic	Mean
RMSE	101,105
MAPE	5,684

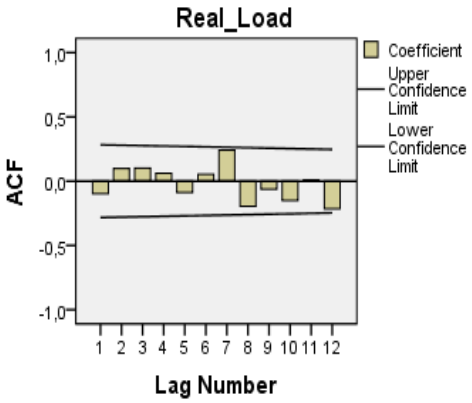
Winters' additive gave result as 5.7% of MAPE and 101,105 level of RMSE. These results will be compared with the results of SARIMA model and the best model will be selected.

In order to start the SARIMA test, diagnostic will be perform to keep the data stationary because box-jenkins model can be applied to stationary data. First of all, data is sequenced simply to see the distribution behavior of numbers. It is shown below;



Trend and seasonality is seen at data behavior. it means a transformation is needed. Difference and seasonal difference may help to turn data into stationary form. However, it is obvious that data has fluctuation and natural log transformation is widely used in these kinds of situations. There is autocorrelation and partial autocorrelation function table below after stationary form.

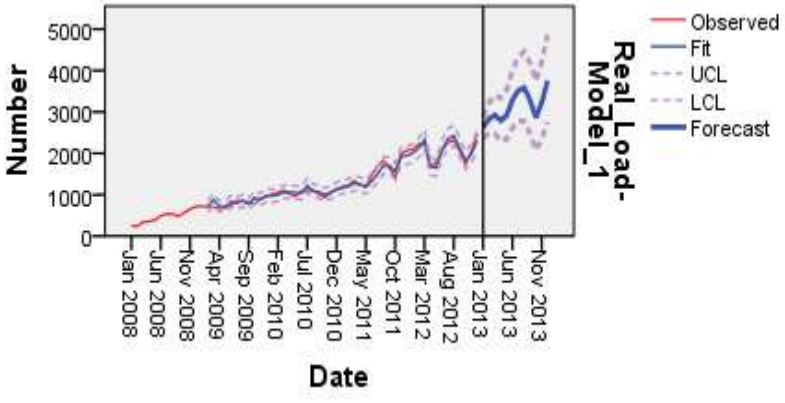




After stationary data form, it can be seen from both ACF and PACF that the model is not autoregressive. On the other hand, normal and seasonal differences are taken and this will be shown at the model. Moving average 1 will be tested and as result $(0, 1, 0)*(0, 1, 1)_{12}$ model will be used to see if error level is lower than winters' additive. Results are shown below;

(0,1,0)(0,1,1)

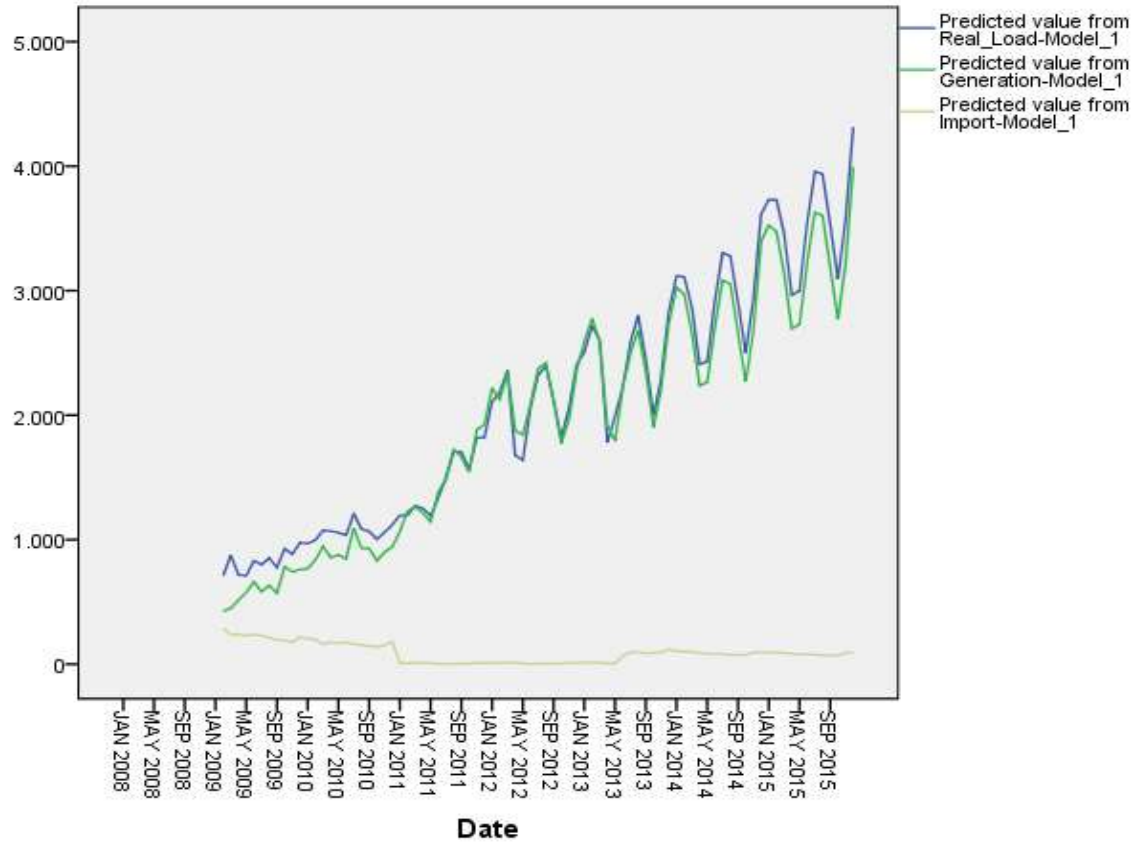
Fit Statistic	Mean
RMSE	90,392
MAPE	5,406



It can be seen both from RMSE and MAPE levels that SARIMA model is better performing than the winters' additive model. The elaboration will be performed by using SARIMA model.

Elaboration

Consumption (Load), generation, and import parameters will be considered to plan the electricity future. The data distributions of those parameters are as;



Future predictions are reflected to the graph above. It can be seen from the graph that before 2011, generation of electricity was lower than load. But after 2011, Northern-Iraq has afforded to equalize the generation-load balance and succeeded until 2013. But there might be some problems occurring after 2013 for the load of electricity if the government doesn't increase the import level or generation level. It can be seen easily from the graph that after 2013 and at the beginning of 2014 on, the gap between generation-load is increasing. On the other hand, import seems to be decreasing for the future. At the end of 2013, load seems above 3000 MW but at the same time generation was 2900. This gap holds on half year increasingly especially in the winter and summer times.

Conclusion and Suggestions

Gap seems to be increasing in the summer and winter times. From this point, Northern-Iraq government should invest either on generation or on import. Somehow the government should plan a strategy to close this gap between generation and consumption. Furthermore, it is seen that the consumption and load are sometimes equal to each other but sometimes load is lower than the consumption especially in the summer and winter times. Consumption does not mean "demand". In order to understand the "demand" exactly and not from the predictions, the government should load more than the society demands. By that way,

demand within a year might be known and compensated every year accordingly. From this point, two strategies might be followed;

1- Increase the import for one year above the demand to check the level of demand during a year.
2- Invest on the generation to increase the load above the demand in order to see the exact demand during a year.

It seems the electricity generation is not so easy for the government in these years. From this point of view, educating consumer plays an important role. In summer times, most of the residences are using the air conditioners. The hour and the level of air conditioners must be set to the optimum. Overuse of the air conditioners may cause increase at demand and this is a waste. Society must be educated to use electricity energy carefully.

At the end of 2015, the load is predicted to increase over 4000 MW. But at the same time, the generation is predicted to be lower than 4000 MW. From this point of view, equalizing the load and generation will not be enough. It means the government should be ready to provide 1000 MW more than the estimated consumption. This means that the government should provide 4500-5000 MW of electricity energy to see the real demand during a year. This provision might be import or investment for the generation.

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