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INTRODUCTION

REVIEW OF LITERATURE

NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

SCOPE FOR FURTHER RESEARCH

ACKNOWLEDGMENTS

REFERENCES

APPENDIX/ANNEXURE

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- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.
- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio" Ohio State University, Nigeria.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

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- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

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- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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WEBSITES

- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

ARIMA MODEL BUILDING AND FORECASTING OF GDP IN BANGLADESH: THE TIME SERIES ANALYSIS APPROACH

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ABSTRACT

GDP is defined as the total market value of all financial goods and services produced within the country in a given period of time. A good region's Gross Domestic Product (GDP) is one of the ways of measuring the size of its economy. A fore cast is a quantitative estimate about the likelihood of future event based on past and current information. This information is embodied in the form of a model. The study was based on secondary data during the period from 1984-1985 to 2010-2011. Data was collected from Bangladesh Bureau of Statistics (BBS). Here GDP was measured at constant price (Base year 1995-96). The primary objective of the research was to find an appropriate ARIMA Model for forecasting, GDP.Forecasting attempts had been made to achieve the target by developing Box-Jenkins type autoregressive integrated moving average (ARIMA) model; consider the minimum of biased corrected information criterion of Akaike and Schwarz criteria. Primarily several models for different values of p, d and q were estimated from the different ARIMA model. The AIC and SIC for the model ARIMA [0,2,0] were 20.11, 19.88respectively. and the adjusted $\bar{R}2 = (.503)$ was very high compared to others models. More over from the above forecasted part it was found that the percentage variation between actual and forecasted value was very less. Therefore the suggested model is appropriate to forecast for the future time.

KEYWORDS
Production, ARIMA model, Forecasting.

1.0 INTRODUCTION
GDP is defined as the total market value of all final goods and services produced within the country in a given period of time (Usually a Calendar Year). It is also considered the sum of a value added at every stage of production of all final goods and services within a given period of time. Business and finance dictionary defined GDP as follows "The monetary value of all the finished goods and services produced within a country's boarder in a specific time period. It includes all of private and public consumption, government outlays, invest and exports that occur within a defined territory.
GDP= C+I+G+NX
In recent years more and more attention has been given to modeling and forecasting the non- linearity in various macroeconomic seriessuch as GDP and unemployment rate. Forecasting is vital in economics and in economical time series analysis. It is an integral part of the decision making activities of management. The need for forecasting is increasing as management attempts to decrease its dependence on chance and becomes more scientific in dealing with its environment. So forecasting, GDP is quite necessary for making valid economic policy. A number of models have been applied, such as the ARCH, GARCH, ARIMA and so on. Among them ARIMA model is more popular. The main advantage of Box-Jenkins ARIMA method is, for immediate and short term forecasting. The study will use ARIMA model to analyze GDP fromBangladesh.

1.2 REVIEW OF LITERATURE
There is great interest among researches, on economic sectors performance analysis, based on comparison between different historic time intervals. One of the most important measures of the size of a country's economy is the Gross Domestic Product (GDP).
"Judi (2006) forecasted the non-oil GDP in the united Arab Emirate (UAE) by using Autoregressive Integrated Moving Average (ARIMA) models. The researcher divided the economic development in the United Arab Emirates into three eras. The researcher defined the most important sectors in the United Arab Emirates. Then she estimated the effect of the oil sector on the non-oil economy using ARIMA models, she showed the results of forecasting the non-oil Gross Domestic Product (GDP) up to the year 2020 by using ARIMA models.
Ediger and Akar (2006) used the Autoregressive Integrated Moving Average and seasonal ARIMA (SARIMA) methods to estimate the future primary energy demand of Turkey 2015 to 2020. The ARIMA forecasting of the total primary energy demand aprears to be more reliable than the summation of the individual forecasts. Another interpretation was that any decrease in energy demand will show down the economic growth during the forecasted period.
Rahman (2010) examined the best fitted ARIMA model that could be used to make efficient forecast boro rice production in Bangladesh ffrom 2008-09 to 2012-13 > It appeared from the study that the ARIMA (0,1,2) are the best for local, modern and total boro rice production respectively. It was observed from the analysis that short term forecasts are more efficient for ARIMA models.
Suleman and Sarpong (2012) examined the Box-Jenkins approach to model milled rice production using time series data from 1960 to 2010. The analysis revealed that ARIMA (2,1,0) was the best model for forecasting milled rice production. Although, a ten years forecast with the model shows an increasing trend in production, the forecast value at 2015 was not good enough to compare with the current production of Nigeria, the leading producer of rice in West Africa.

1.3 OBJECTIVES OF THE STUDY
The present study is carried out with the following objectives:
1)   To estimate the best fitted ARIMA model.
2)   To analyze the forecasting performances of the selected ARIMA models.
3)   To compare the predicted values of GDP in Bangladesh.

2.0 METHODOLOGY
2.1 Introduction*:* The study represents a fundamental discussion about Autoregressive Integrated Moving Average Models. ARIMA models have been studied extensively in time series analysis and forecasting. They were popularized by Box and Jenkins in the early 1970's and their names have frequently been used synonymously with general ARIMA models.
2.2ARIMA Model: Autoregressive (AR) models can be effectively coupled with Moving Average (AR) models to form a general and useful class of time series models called Autoregressive Integrated Moving Average (ARIMA) model (Makridakis, 1998). It is a combination of an Autoregressive process and a Moving Average process applied to a non- stationary data series. The general non-seasonal model is known as ARIMA (p, d, q).
Where,
AR (p) denotes the number of autoregressive terms
I (d) denotes the number of times the series has to be differenced before it becomes stationary.
MA (q) denotes the number of moving average terms.
The model is:
$Y_t = C + \emptyset_1 Y_{t-1} + \emptyset_2 Y_{t-2} + \ldots\ldots\ldots + \emptyset_p Y_{t-p} + e_t - \theta_1 e_{t-1} - \theta_2 e_{t-2} - \ldots\ldots - \theta_q e_{t-q}$.

C = constant term

d = difference

$\emptyset =i$ th autoregressive parameter, $i =1, 2, …………… , p$

$\theta_j = j$ th moving average parameter, $j= 1,2 …………..., q$

$e_{t =}$ error tie at time t .

2.3 Difference Operator for non-stationary time series: If a time series values $y_1, y_2, ……………, y_n$ indicate that these values are non stationary we can transform the non-stationary series values by taking the first difference of the non-stationary time series values. That is, the difference of time series values $y_1, y_2,$ ……………, y_n are $Z_t = y_t - y_{t-1}$, where, $t=2,……………n$ and the second difference of the time series values , $y_1, y_2, ……………, y_n$ are

$Z_t = (y_t - y_{t-1}) - (y_{t-1} - y_{t-2})$

$= y_t - 2y_{t-1} + y_{t-2}$ for $t= 3, 4…….. n$

2.4 Autocorrelation and partial Autocorrelation Function: The identification of the model involves the comparison of sample autocorrelation (r_k) and partial autocorrelation (r_{kk}) function derived from the stationary time series. Box-Jenkins forecasting models are tentatively identified by examining the behavior of the sample Autocorrelation function (SAC) and Sample Partial Autocorrelation Function (SPAC) for the values of a stationary time series $Z_b , Z_{b+1} ,…………. , Z_n$.

2.5 Box – Jenkins Methodology: To identify a perfect ARIMA model for a particular data series, Box – Jenkins proposed a methodology that consists of three phases which is known as Box - Jenkins methodology. The total process of selecting a model is nothing but an iteration process that contains the following processes:

2.5.1 Phase: 1: Identification:

In this phase a tentative model is usually obtained by using the following four steps:

Step 1: Stability of Variance:

At first the data series is transformed to achieve the stationarity in the varience.

Step 2: Checking the Stationary:

The time plot as well as the ACF (Autocorrelation Function) and the PACF (Partial Autocorrelation Function) of the possibility transformed data are considered. If the time plot shows that the data are scattered horizontally around a constant mean or equivalently, ACF and PACF drop to or near to zero quickly, and indicates that the data are stationary. If the time plot is not horizontal or ACF and PACF do not drop to zero, non-stationary is implied.

Step 3: Obtaining Stationary:

If the data appear non-stationary, it can be made stationary through differencing. The order of the difference is the value of the parameter in the model.

Step 4: Model Selection:

When stationary has been achieved the ACF and PACF of the stationary series and the resulting correlogram are observed to see if any pattern remains. A primary guess of the parameters p, d and q are so obtained and corresponding tentative ARIMA model can be identified.

2.5.2 Phase: 2: Estimation and Diagnostic checking: In this phase there are three steps.

Step 1: Estimating the parameters:

When a tentative model is identified, we want the best estimate of the AR and MA parameters to fit the time series that is being modeled. For ARIMA model, the method of least squares can be used.

Step 2: Selection of the best model:

To select the best model the following processes are mentioned bellow:

2.1 Unit Root Test: At the formal level, Stationary can be checked by finding out if the time series contains a unit root. The Dickey – Fuller (DF) and augmented Dickey – Fuller (ADF) tests can be used for this purpose.

2.2 Testing Goodness of fit: Several criteria that have used to compare the competing models for our forecasting purpose. The criterions are given as follows:

2.2.1 Adjusted R^2: Henry Theil developed the adjusted R^2 , denoted by $\overline{R^2}$, which is

Adjusted $R^2 = 1 - \frac{RSS/(n-k)}{TSS/(n-k)}$

$=1 - (1 - R^2)\frac{(n-k)}{(n-k)}$

Where,

K' is the number of regressors.

n' is the number of observations.

RSS' is the number of residential sum of squares.

TSS' is the number of total sum of squares.

As we can see from this formula, $\overline{R^2} \le R^2$, $\overline{R^2}$ is a better measure than R^2.

2.2.2 Error Sum of Squares:

$SSE = \sum (y_{t-} \hat{y}_t)^2$

The lowest value of SSE is preferred.

2.2.3 Akaike Information Criterion (AIC):

$e^{\frac{2k}{n}}\frac{\sum u_{i^2}}{n} = e^{\frac{2k}{n}}\frac{RSS}{n}$ Where , k is the number of regressors. n is the number of observevations.

RSS is the residual Sum of Square.With the lowest value of AIC is preferred.

2.2.4 Schwarz Information Criterion:

$SIC = n^{\frac{k}{n}}\frac{\sum u_{i^2}}{n} = n^{\frac{k}{n}}\frac{RSS}{n}$

Where,

k is the number of regressors.

n is the number of observation.

RSS is the residual sum of squares.

The lowest value of SIC is preferred

2.2.5 Test of Significance: Most ARIMA estimation routines automatically test the hypothesis that the true co-efficient is zero. An approximate *t-value* to test this hypothesis for each co-efficient is calculated in this way: $t = \frac{(\text{estimated co}-\text{efficient}) - (\text{hypothesized co}-\text{efficient value})}{(\text{estimated standard error of the co}-\text{efficient})}$

Step 3: *Diagnostic* checking: This is simply done by studying the residual to see if any pattern remains unaccounted for (Makridakis, 1998)

2.5.3 Phase: 3: Application: One of the popularity of the ARIMA modeling is it success in forecasting.

2.6 Measures of Forecast Error: The model that gives the minimum measures of error will be our desired model for forecasting. The following statistical summary measures of a model's forecast accuracy are defined using the absolute errors.

1) The Root mean Square Error (RMSE)

$RMSE = \sqrt{\frac{\sum_{t=1}^{n} e_{t^2}}{n}}$

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2) The Mean Absolute Error (MAE) :

$$MAE = \sum_{t=1}^{n} |e_t|$$

3) The mean of the Absolute Percentage Error (MAPE) :

$$MAPE = \frac{\sum_{t=1}^{n} \frac{|e_t|}{y_t}}{n}.$$

4) Theil's inequality Co-efficient:

$$U = \frac{(RMSE \ of \ the \ forecasting \ model)}{MMSE \ of \ the \ actual \ model}$$

The smaller values of MAE, RMSE and MAPE, the better the model is considered to be.

A theil's inequality co-efficient greater than 1.0 indicates that the forecast model is worse than the actual model, a value less than 1.0 indicates that it is better. The closer U is to 0 the better the model.

FIGURE: 2.6.1: STAGES IN THE BOX-JENKINS APPROACH
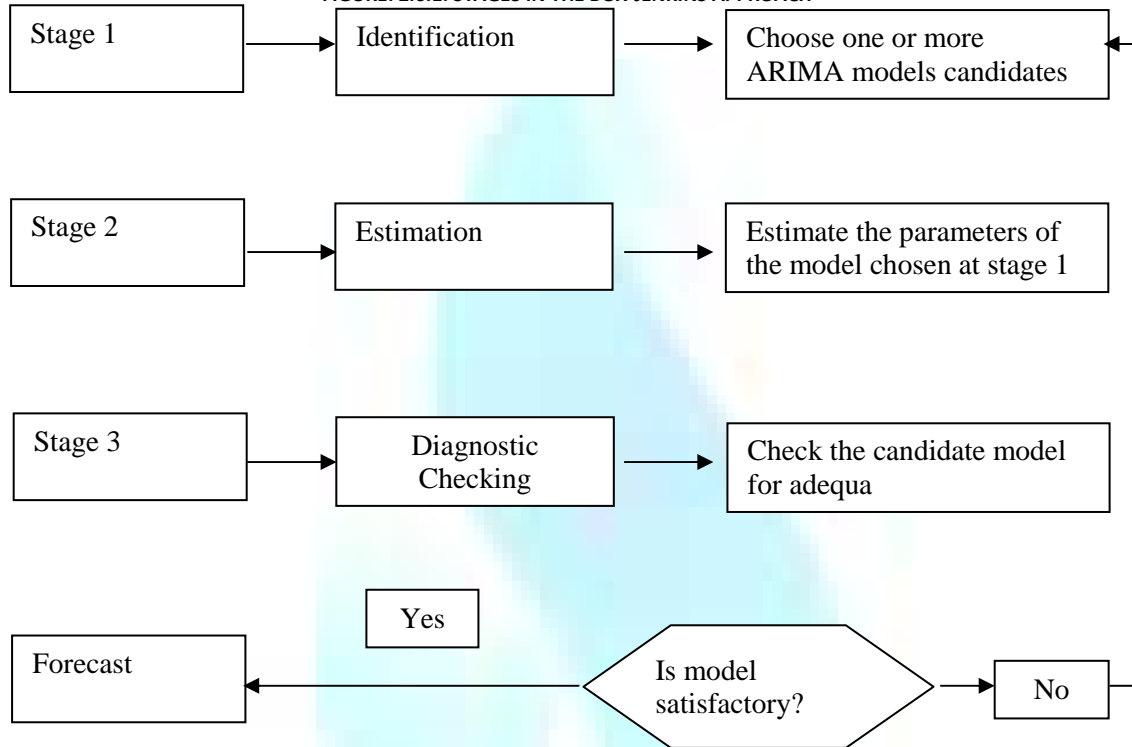
Source: Box-Jenkins, 1976, p.19

2.7 Statistical Software: Statisticalpackages:spss, Eviews-5 and Microsoft Excel are used for the analysis.

2.8 Data Sources:The secondary data were collected from *"NationalAccounts"* Statistics of Bangladesh *(2012*) published by Bangladesh Bureau of Statistics that covered the period *1984-85* to *2010-2011*. The data have been presented on a time series. Data related to production and expenditures accounts have been reflected both in current and constant prices. Here GDP is measured at constant price *(base year 1995-96).*

3.0 ANALYSIS OF DATA

3.1 Modeling Time Series of GDP: To select a best ARIMA model for GDP a routine test of identification is done before using Box-Jenkins methodology   Figure-3.1 showsthe ACF and PACF plots and their level. TheACF has five significant spikes at the beginning while the PACF has only one significant spike at the beginning. Figure shows ACF and PACF plots of GDP at the first difference level. First difference of the log of GDP data shows that the data is fluctuating and increasing trend. So, the data are non stationary. The time plot of second differenced series shows that the values differ around a constant mean. The second differ of log of GDP data is stationary.From the above test, we can conduce that the second difference of log of GDP data at lag 2 is stationary. Thus we will stop further test. The plot of ACF and PACF can give a primary guess about the parameter p and q for ARIMA model.

3.1: Checking and obtaining Stationary GDP A plot of the sample autocorrelation function, ACF and the sample partial autocorrelation functions, PACF of the series is shown in fig- 3.1

FIGURE-3.1 CORRELOGRAM FOR ACF AND PACF OF GDP

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*******|	. |*******|	1	0.873	0.873	22.930	0.000
. |****** |	. | . |	2	0.753	-0.035	40.686	0.000
. |***** |	. | . |	3	0.637	-0.051	53.932	0.000
. |**** |	. *| . |	4	0.524	-0.059	63.284	0.000
. |*** |	. | . |	5	0.416	-0.054	69.434	0.000
. |**. |	. | . |	6	0.315	-0.043	73.132	0.000
. |**. |	. | . |	7	0.221	-0.046	75.045	0.000
. |* . |	. | . |	8	0.134	-0.048	75.782	0.000
. | . |	. | . |	9	0.054	-0.045	75.908	0.000
. | . |	. | . |	10	-0.021	-0.055	75.929	0.000
. *| . |	. *| . |	11	-0.092	-0.061	76.343	0.000
. *| . |	. | . |	12	-0.157	-0.056	77.629	0.000

Six ARIMA models at different values of   p ,dand q such as, ARIMA (1,1,1), ARIMA (1,2,5), ARIMA [1,2,2], ARIMA [1,2,3], ARIMA [1,2,4], ARIMA [0,2,0]are estimated. All these models are estimated and their diagnostic checks are done. In addition the minimum value of RMSE, MSE, MAE, AIC, BIC, MAPPE, and high

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value of R^2 , $\overline{R}^2$ are used to select the best model which are presented in table 3.1.1 Hence it can be concluded that ARIMA (0,2,0) is comparatively the best fitted model for forecasting the GDP in Bangladesh. This justifies the selection of ARIMA (0, 2, 0)as the best model to represent the data generating process very precisely.

TABLE: 3.1.1: DIAGNOSTIC TOOLS AND MODEL SELECTION CRITERIA FOR GDP OF BEST FITTED MODELS

Model	Values of Selection Criteria							
	MAE	MSE	RMSE	AIC	BIC	MAPPE	R^2	$\overline{R}^2$
ARIMA (1,1,1)	12548.138	42080.709	17759.162	22.45512	20.071	.714	0.22037	0.146
ARIMA (1,2,5)	10264.925	31658.925	15008.684	22.33540	20.263	.572	0.50440	.229
ARIMA (1,2,2)	10328.906	30295.350	14501.609	22.49559	19.808	.556	0.161465	.0852
ARIMA (1,2,3)	10393.684	31871.519	14930.905	22.37800	19.995	.560	0.335945	0.236
ARIMA (1,2,4)	10362.155	27595.268	14783.874	22.11057	20.104	.575	0.532406	0.434
ARIMA (0,2,0)	14305.725	40164.662	17757.598	20.1120	19.875	.769	1.00	.503

Note: The value of the criterion for a model with asterisk show that the model is better than other models with respect to that criterion.

From the above table revealed that the model ARIMA [0,2, 0] is better than the other model in case of smaller AIC and BIC and higher $\overline{R}^2$. But the model ARIMA [1,2,4] is better than the other model in case of smaller MSE, RMSE. So we can conclude that ARIMA [0,2,0] is the best model.

3.2 Forecasting performance of GDP: Five year forecast is used to make with *95%* confidence interval of GDP production estimated by using the best selected model (Table3.2.1)*.*The production period extends from 2011-2012 to 2015-2016. An important limitation of making forecasts is that forecasting error increasing as the period of forecast increases. For this reason short-term forecast is more reliable compared to long term forecast.

TABLE: 3.2.1 FORECAST OF GDP IN BANGLADESH FOR THE PERIOD OF 2011-12 TO 2015-2016. [DATA USING ARIMA (0,2,0)]

Year	Forecast	UPL	LPL
2011-2012	415733	4152468	4078999
2012-2013	4401913	4484053	4319772
2013-2014	4708187	4845635	4570740
2014-2015	5035354	5236557	4834152
2015-2016	5384213	4834152	5111783

LPL: Lower Predicted Limit.   UPL: Upper Predicted Limit.

Table 3.2.1 would reveal that forecasting errors are sufficiently small and consequently the intervals are not too large. As shown in table the forecasted GDP in year 2011-2012 was 4115733 millions of taka. The analysis reveals that if the present growth rate continues the GDP of Bangladesh would be millions of taka in the year of 2015-2016, with a 95% confidence interval of 5384213 million respectively.

4.0 CONCLUSION

In this study, an attempt has been made to apply some of this lessons learned from the problems of model selection. To select the best model for a particular time series the latest available model selection criteria are used. They are efficient of determination (R^2) , adjusted co-efficient of determination $\left(\overline{R}^2\right)$. Root mean square error (RMSE), Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Mean Absolute Error (MAE), and mean Absolute Percent Prediction (MAPPE). From the different ARIMA models of GDP we see that the various information criterions such as AIC and SIC for the model ARIMA (0, 2, 0) are 20.112 and19.747respectively which are very less but adjusted $\overline{R}^2$ is very high compared to the other models. Moreover, from the above forecasted analysis it is found that the percentage variation between actual and forecasted value is very less. Therefore the suggested model is appropriate to forecast for the future time period. Empirical results suggest that ARIMA models fit well and they are capable for predicting the future trend of GDP movement. According to the minimum AIC and SIC criterion, ARIMA model was considered the best model for predicting GDP. But before use this, model are must verify the validation of the model in different time period, because a forecasting model may loss its validity and suitability as time changes.

Hence it can be concluded that ARIMA (0, 2, 0) is comparatively the best fitted model for forecasting the GDP in Bangladesh. This justifies the selection of ARIMA (0, 2, 0) as the best model to represent the data generating process very precisely.

The ARIMA model offers a good technique for predicting magnitude of any variable. The accuracy of the proposed ARIMA model is very important in model selection for evaluating the performance of GDP in Bangladesh. A time series model accounts for patterns in the past movement of a variable and uses that information for predicting its future movements. In a sense, a time series model is just a sophisticated model for extrapolation. The study tries to develop a forecasting model of GDP in Bangladesh.

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APPENDIX

APPENDIX 1

Model Type
ARIMA(0,2,0)

MODEL SUMMARY

MODEL FIT

Fit Statistics	Mean	SE	Minimum	Maximum
Stationary R-squared	.103	.	.103	.103
R-Squared	1.000	.	1.000	1.000
RMSE	17757.598	.	17757.598	17757.598
MAPE	.769	.	.769	.769
MaxAPE	3.132	.	3.132	3.132
MAE	14305.728	.	14305.728	14305.728
MaxAE	40164.662	.	40164.662	40164.662
Normalized BIC	19.827	.	19.827	19.827

MODEL STATISTICS

ARIMA [0,2,0]	Model Fit Statistics				
	Number of predictors	Stationary R squared	R-squared	RMSE	MAPE	MAE
	1	.103	1.000	17757.598	.769	14305.728

MODEL STATISTICS

ARIMA [0,2,0]	Model Fit Statistics			Ljung-Box Q(18)		
	MaxAPE	MaxAE	NormalizedBIC	Statistics	DF	Sig.
	3.132	40164.662	19.827	24.115	18	.151

FORECAST

Year	2011-12	2012-13	2013-14	2014-15	2015-16
Forecast	4115733	4401913	4708187	5035354	5384213
UCL	4152468	4484053	4845635	5236557	5656642
LCL	4078999	4319772	4570740	4834152	5111783

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