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# Analyses and forecasting evaluation of GDP of India using ARIMA model

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***Abstract***

*This paper has attempted to forecast the Gross Domestic Product (GDP) with applying the Box Jenkins forecasting method. We have taken the historical data of GDP and to anticipate India's Gross Domestic Product while utilizing period arrangement information for the period from 1980 till 2017. The data has been collected for the Thirty-seven years and effort has been made to construct a forecast model for GDP using Autoregressive Integrated Moving Average Model (ARIMA) to construct the hypothetical model which is ARIMA for evaluating the India's GDP. Out of an assortment of determining models ARIMA (1, 1, 7) model has been applied to figure the GDP for thirty-seven years running from 1980 to 2017. The outcome proliferated that the wellness of AR (1) I (1) MA (7) parameters for making future forecasts. It is deciphered that the GDP of India would be rising ceaselessly over the assessed period. The model has been validated through diagnostic checking using the correlogram of the residual.*

***Keywords:*** *GDP, Forecasting, AR, MA, ARIMA, Correlogram*

## 1. Introduction

Gross Domestic Product is the method for measuring the value of finished goods produced in a country during a specific year and it provides the estimation of country's economic growth and size. The subject of GDP was the fate of high significance among large scale economy factors. Information on GDP is viewed as a significant marker for assessing the national financial advancement and development of whole macro economy (Ahmad and Harnhirun, 1996) Most well known meanings of GDP thoughtfully indistinguishable and can be arranged in three angles: Primarily, it is equivalent to the all out consumptions for every single last great and administrations delivered inside the nation in a predefined period (a monetary year). Optionally, it is equivalent to the total of the worth included at each period of creation by all the businesses in a nation, in addition to charges less awards on items in a facial year. Tertiary, it is equivalent to the entirety of the pay created by creation in the nation in the financial year, which is the pay of workers, imposes on creation and imports less awards, and benefits (Ahmad and Harnhirun, 1996). Gross domestic product totals the whole financial movement. It is much of the time utilized as the best proportion of how is the exhibition of the economy. Gross domestic product is commonly estimated in one of three methodologies. First approach is Expenditure approach which includes the values of market of every residential use made up on definite products and enterprises of the year them including speculation consumptions, government uses and any other net values. Second approach is Production approach, in this approach it is the summation of all worth of each period of creation by all enterprises inside the nation and last approach is Income approach which is the summation of all part of the salary made by creation inside en economy as compensation of workers, capital pay and gross working expenses.

## 2. Review of Literature

(Maity, B. and Chatterjee, 2012) read the comparable investigation for a period till 2020 while utilizing ARIMA Model. (Reynolds et al. 1995) created programmed techniques to distinguish the different criteria's of ARIMA model by using various periods' arrangement information for solitary trends. (Reilly, D.P. 1980) planned a comparable technique to display macroeconomic factors like GDP and the investigations limited themselves just on non-occasional time arrangement information and controlled to estimate the variable later on. (Wei, Bian, and Yuan, 2010) utilized ARIMA model for GDP information arrangement from 1952 to 2007 to anticipate the GDP of the Shanxi region in China, they proliferated that blunder between the genuine GDP esteem and the anticipated worth is inside 5%

territory. (Mei, Q., Liu, Y., & Jing, X, 2011) developed a multifaceted unique framework VAR forecast model of GDP by choosing six principle financial pointers, utilizing time arrangement information separated from the Shanghai locale in China. (Wang, Z. & Wang. H, 2011) sent ARIMA for foreseeing the GDP of China dependent on time arrangement information. In anticipating period arrangement information of GDP as a macroeconomic variable, ARIMA model has been demonstrated to be solid and a precise model. (Tsay, R.S., & Tiao, 1985) has propagated ARIMA model and they fitted non regular information by knowing autoregressive and movements of normal trends with the help of incomplete autocorrelation and capacities. (Abonazel and Ahmed Ibrahim, 2019) anticipated the Egyptian GDP and has been discovered that GDP will keep on ascending as per the estimated qualities from model. (Chaido, 2015) has been found that the results will help the administrative business officials for actualizing the task or choices which are worried about the extension of the current business. (Maniha Zakai, 2014) anticipated the estimations of Pakistan's GDP and has been discovered the best outcomes while utilizing ARIMA displaying. (Miah, Mimma and Shohel,2019) inspected that the estimate estimations of GDP in Bangladesh are consistently improving throughout the following thirteen years.

## 3. Research Objectives

To gauge and examine the India's Gross Domestic Product and its development rate from the year 1980 to 2017 utilizing the ARIMA Model by using Time-arrangement for forecasting.

## 4. Research Methodology

Information will be gathered from auxiliary sources to anticipate the India's Gross Domestic Product from the year 1980 to 2017. The necessary data was likewise gathered from Website Reserve Bank of India.

## 5. Data Analysis and Discussion

Box Jenkins technique which is commonly known as ARIMA modeling has been used as forecasting method. In this technique there is only one dependent variable which is regressed on its own past or lag values and the error term. If Yt variable is the variable where Y is the dependent variable and t is time element for number of years and the error term ut is normally distributed ut~ ii d N (0, σ2 ε), and if dependent variable follows the first order it will be termed as AR (1) MA(1) and this will mean that current value of dependent variable is dependent on one lag variable (AR) and stochastic error term (MA). If the dependent variable is hit by some shock or disturbance it will revert back to its mean value. The variables has been differences at first level i.e. I (1) as usually the time series variable are non stationary and even we have checked for GDP. In ARIMA modeling p denote the AR term and q denoted the MA terms and I denote the difference level for making variable stationary

5.1 Unit Root Test

Table-1:

| | | | | |
|---|---|---|---|---|
| Null Hypothesis: RETURN has a unit root | | | | |
| Exogenous: Constant | | | | |
| Lag Length: 0 (Automatic - based on SIC, maxlag=9) | | | | |
| | | | | |
| | | | t-Statistic | Prob.* |
| Augmented Dickey-Fuller test | | | -5.46021 | 0.000 |
| Test | 1% level | | -3.62678 | |
| critical | 5% level | | -2.94584 | |
| values: | 10% level | | -2.61153 | |
| | | | | |
| *MacKinnon (1996) one-sided p-values. | | | | |

The GDP arrangement was changed over into log arrangement and distinction at the First level as taken. In this manner, the stationary was accomplished by differencing the GDP arrangement from the start level. The series has become stationary at first difference as we have rejected the null hypothesis. i.e. Series has a unit root using augmented dickey fuller test. The series has become stationary at first level and now the series has becomes I (1) which means stationarity at first difference

5.2 Correlogram for ACF and PACF Values
Table-2:

Sample: 1980 2019
Included observations: 37

| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|---|---|
| | | 1 | -0.08... | -0.08... | 0.3040 | 0.581 |
| | | 2 | 0.050 | 0.043 | 0.4073 | 0.816 |
| | | 3 | 0.116 | 0.126 | 0.9832 | 0.805 |
| | | 4 | -0.07... | -0.06... | 1.2505 | 0.870 |
| | | 5 | -0.10... | -0.13... | 1.7169 | 0.887 |
| | | 6 | -0.08... | -0.11... | 2.0732 | 0.913 |
| | | 7 | -0.00... | 0.010 | 2.0736 | 0.956 |
| | | 8 | -0.23... | -0.20... | 4.7423 | 0.785 |
| | | 9 | -0.14... | -0.20... | 5.8777 | 0.752 |
| | | 1... | -0.10... | -0.17... | 6.4607 | 0.775 |
| | | 1... | -0.08... | -0.09... | 6.8428 | 0.812 |
| | | 1... | -0.04... | -0.08... | 6.9377 | 0.862 |
| | | 1... | 0.075 | -0.00... | 7.2793 | 0.887 |
| | | 1... | 0.038 | -0.06... | 7.3706 | 0.919 |
| | | 1... | -0.06... | -0.17... | 7.6156 | 0.938 |
| | | 1... | 0.441 | 0.345 | 20.976 | 0.179 |

Identification of AR (p) and MA (q) terms: Subsequent to making the GDP arrangement writing material the autocorrelation and incomplete autocorrelation capacities were contemplated. By watching the PACF (Table-2) values and correlogram term AR (1) was seen as fit for forecasts. So also, MA (1) and (2) terms were advocated by watching the ACF (figure-2) values and correlograms. The MA (1) was dismissed as it was seen as inconsequential. In this way, the ARMA (1, 7) parameters were recognized utilizing Autocorrelation and Partial Autocorrelation Functions.

5.3 ARIMA Model
Table-3:

Included observations: 37
Convergence achieved after 15 iterations
Coefficient covariance computed using outer product of gradients

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.066771 | 0.022843 | 2.922997 | 0.0062 |
| AR(1) | 0.177648 | 0.208784 | 0.850868 | 0.4010 |
| MA(7) | 0.613431 | 0.286662 | 2.139907 | 0.0398 |
| SIGMASQ | 0.004432 | 0.001382 | 3.208249 | 0.0030 |

| | | | |
|---|---|---|---|
| R-squared | 0.235700 | Mean dependent var | 0.071759 |
| Adjusted R-squared | 0.166218 | S.D. dependent var | 0.077204 |
| S.E. of regression | 0.070496 | Akaike info criterion | -2.274972 |
| Sum squared resid | 0.164001 | Schwarz criterion | -2.100819 |
| Log likelihood | 46.08699 | Hannan-Quinn criter. | -2.213575 |
| F-statistic | 3.392248 | Durbin-Watson stat | 2.068093 |
| Prob(F-statistic) | 0.029292 | | |

The ARIMA (1, 1, 7) parameters (Table-2) were found significant at 5% level of significance. The coefficient of AR (1) was estimated as 0.17 and that of MA (7) as 0.61. The t-test confirms the significance of these coefficients for predicting the GDP. A model ARIMA (1, 1, 1) was rejected due to insignificance of its AR (1) term while testing. The model fitness was confirmed by lower AIC values and lower values of root mean squared error. The R-square is merely 24%.

5.4 Residual ACF and PACF
Table-4:

Sample: 1980 2019
Included observations: 37
Q-statistic probabilities adjusted for 2 ARMA terms

| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|---|---|
| | | 1 | -0.03... | -0.03... | 0.0531 | |
| | | 2 | 0.235 | 0.234 | 2.3392 | |
| | | 3 | -0.00... | 0.007 | 2.3423 | 0.126 |
| | | 4 | -0.00... | -0.06... | 2.3432 | 0.310 |
| | | 5 | -0.17... | -0.18... | 3.6737 | 0.299 |
| | | 6 | -0.12... | -0.13... | 4.3675 | 0.359 |
| | | 7 | -0.02... | 0.052 | 4.4033 | 0.493 |
| | | 8 | -0.07... | -0.01... | 4.7124 | 0.581 |
| | | 9 | 0.031 | 0.021 | 4.7618 | 0.689 |
| | | 1... | -0.00... | -0.01... | 4.7627 | 0.783 |
| | | 1... | 0.123 | 0.075 | 5.6027 | 0.779 |
| | | 1... | -0.02... | -0.02... | 5.6290 | 0.845 |
| | | 1... | -0.00... | -0.07... | 5.6309 | 0.897 |
| | | 1... | -0.22... | -0.25... | 8.7522 | 0.724 |
| | | 1... | -0.00... | -0.00... | 8.7556 | 0.791 |
| | | 1... | -0.25... | -0.12... | 13.102 | 0.518 |

Model Validity: In above table we can see that there is no substantial spike that has crosses the bars in case auto correlation and partial correlation so we can conclude that the all the information has been captured and the error terms has become white noise error. It thus validates the model as no further information is available

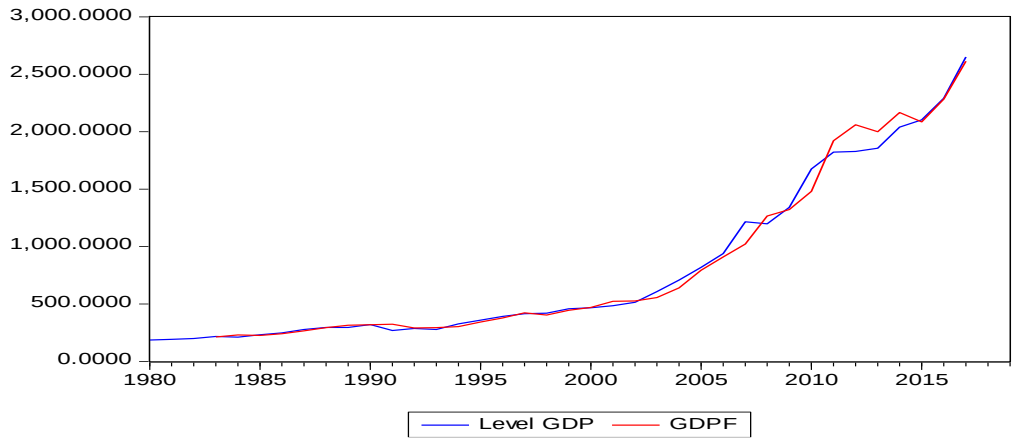
5.5 Ljung Box Test for Autocorrelation Correlogram of Residual squared
Table-5:

Sample: 1980 2019
Included observations: 37

| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|---|---|
| | | 1 | -0.08... | -0.08... | 0.3040 | 0.581 |
| | | 2 | 0.050 | 0.043 | 0.4073 | 0.816 |
| | | 3 | 0.116 | 0.126 | 0.9832 | 0.805 |
| | | 4 | -0.07... | -0.06... | 1.2505 | 0.870 |
| | | 5 | -0.10... | -0.13... | 1.7169 | 0.887 |
| | | 6 | -0.08... | -0.11... | 2.0732 | 0.913 |
| | | 7 | -0.00... | 0.010 | 2.0736 | 0.956 |
| | | 8 | -0.23... | -0.20... | 4.7423 | 0.785 |
| | | 9 | -0.14... | -0.20... | 5.8777 | 0.752 |
| | | 1... | -0.10... | -0.17... | 6.4607 | 0.775 |
| | | 1... | -0.08... | -0.09... | 6.8428 | 0.812 |
| | | 1... | -0.04... | -0.08... | 6.9377 | 0.862 |
| | | 1... | 0.075 | -0.00... | 7.2793 | 0.887 |
| | | 1... | 0.038 | -0.06... | 7.3706 | 0.919 |
| | | 1... | -0.06... | -0.17... | 7.6156 | 0.938 |
| | | 1... | 0.441 | 0.345 | 20.976 | 0.179 |

To test the model legitimacy factually a portmanteau trial of Independence was applied. The Ljung Box Test was led to check the lingering indicative utilizing excessively squared. It was utilized for testing against an assortment of potential deviations from autonomy including direct reliance, non-straight reliance, or confusion. The test can be applied to a progression of evaluated residuals to check whether the residuals are free and indistinguishably dispersed (iid).

5.6 FORECAST MODEL of GDP
Figure-6:




## 6. Conclusion and Implication

In this paper, utilizing Box-Jenkins strategy, we are attempting to investigations and gauge the India's GDP for the following decade with the assistance of ARIMA model, however is showing a slanting pattern ostensibly yet the development rate is declining over the period. It implies the job of RBI to take fitting measures with respect to the financial strategy and credit arrangement so the development isn't ruined later on. At present reports from United Nations are neglecting China's development rate and foresee the Indian economy would overwhelm the Chinese development in the Asian markets, yet the outcomes according to the a-hypothetical model created by Box-Jenkins is unveiling the small development rates for the following decade. The ARIMA (1, 1, 7) model was seen as a superior fit model in estimating India's GDP.

## 7. Implications of the Study

The consequences of this examination would be extremely valuable for policymakers and directors managing large scale factors, for example, remote direct speculation (FDI), outside institutional venture (FII), and so forth. The discoveries of the examination will be useful for the definition of better strategies. Directors who want to put resources into the development of existing business or the new undertaking will be profited significantly as the discoveries will give them an image of the monetary states of India well ahead of time. Further, the discoveries experience the ill effects of certain restrictions since the analysts have not mulled over the models, for example, Regression Analysis, VAR, ECM, and so on to conjecture GDP and its development rates in India.

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