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Forecasting Inflation in India Using Arima Modelling

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ABSTRACT

In India, Inflation is one of the key economic indicators that influence the businesses, organization, public lives and also policy makers. The decision is to determine the inflation rate for the future and accordingly formulate the policies is the most essential part. With all the uncertainty and the challenges that are being faced with respect to the Indian context the paper aims to make forecasting of the inflation using the time series modeling.

There are many factors which influence forecasting Inflation in India such as global trends, government policies and economic conditions. Many researchers and policy maker use different models, statistical tools and time series analysis to predict the future inflation. The formulation of the policies curbs the inflation rate not exceed beyond the tolerance level of crossing 6 percent and above. These policies are formulated by the regulatory body that is RBI [Reserve Bank of India].

This paper provides insights about ARIMA modeling, used for forecasting inflation in India. It is a Statistical tool used for forecasting time series data, particularly for forecasting inflation. Because, its ability to capture temporal patterns and trends. This model provides accurate results for short and medium term inflation forecast. The ARIMA Modeling in JMP with time series analysis helps in forecasting of inflation rate in India.

KEYWORDS

Inflation

India

ARIMA

RBI

INTRODUCTION

Inflation means declining of purchasing power over period of time, due to rise in prices. Fluctuation in the prices of goods and services relative changes in productivity or demand and also supplies conditions. It can be measured in different ways depending upon types of goods and services. Deflation, it is the opposite of inflation where the prices of goods and services fall below 0 percent.

CAUSES OF INFLATION

There are some key causes of Inflation in India are

DEMAND PULL INFLATION

It happens when a spike in the quantity of credit and cash causes consumer demand for products and services to rise faster than the economy's capacity to produce them. It leads to increase in price due to increase demand.

COST PUSH EFFECT

Increase in the price of production process cost leads to increase in price of products and service for consumers. It is caused due to increase in cost of raw materials, high labour costs and also supplies chain disruptions.

BUILT IN INFLATION

In this the people think that the current inflation rates will continue in future due to increase in the price of goods and services. In further days, workers can demand more wages to maintain their living.

SIGNIFICANCE OF FORECASTING THE INFLATION

For a country's monetary environment, Inflation is a complicated economic trend with severe consequences. Keeping stable rates of inflation is crucial to guaranteeing both economic and social stability in India, since a significant section of the people is price sensitive.

Increase in rate of inflation leads to decrease the people's purchasing power and it can cause economic imbalances. In contrast, exceptionally low rate of inflation may stifle economic development and discourage investments.

As a result, it is important to forecast future trends for politicians, organizations, and businesses to make prior decisions to avoid risk.

THE ARIMA MODEL

ARIMA is an acronym for Autoregressive Integrated Moving Average, which is a popular time-series analysis approach. In this method there are 3 important components such as moving average (MA), auto regression (AR) and Integration (I). The relation between observed values to its lagged value called as Auto regression. Using differencing component, we can convert the nonstationary data into stationary data and the MA component represents the relationship between an observation and a moving average model's residual error.

ARIMA modeling is particularly effective in predicting since it accounts for time-series data's trend, seasonality, and other trends. ARIMA models can estimate future values with a fair degree of accuracy by detecting and analysing historical data. Based on these, this modeling considers as valuable tool for forecasting inflation

LITERATURE REVIEW

(**Tim Callen and Dongkoo Chang, 1999**)

The authors identify the most important indicators using inflation model and estimate the series of bivariate VARs. They presume that while the expansive cash target has been de-stressed, improvements in the money related totals stay a significant mark of future expansion. It provides valuable insights about the challenges faced by them while preparing the models and forecasting inflation, particularly the price of the products drastically change due to climate changes.

(**Muneesh Kapur, 2012)**

In this paper the author uses various models such as time series models, VARs models and phillips curve and explains the challenges faced by him during inflation forecasting such as lack of data, transition and impact of global atmosphere. This paper provides the overview of inflation rate in India at the time of 2012.

(**Deepak Mohanty**)

The author discussed about the various measures of inflation briefly and also explains about difference between wholesale price index and consumer price index. Further, he discussed about derived measures i.e core inflation.

(**Gour Sundar Mitra Thakur et.al, 2016**)

The authors discussed about recession at the time of 2008 and whole world started to pay attention to inflation and try to predict inflation more precisely. Many researchers used many models to forecast, however accuracy is major limitation for this. So they collected monthly economic data from 2000 January to 2012 December. Using this data they constructed a model based on back propagation neural network and identified the some of the factors influence the inflation.

(**Deepak Mohanty, Joice John, 2015**)

In this paper, the authors try to identify the determinants of inflation using quarterly data and they found some factors which influence on inflation such as policies, prices of crude oil and monetary policy using structural vector auto regression model. They found that inflation changes continuously over a period of time with different factors which shows the significant variation which is particularly after financial crisis in world.

OBJECTIVES

- The main objective of this study is to forecast inflation rate in India using ARIMA modeling, which helps organization, policymakers and other stakeholders in making decision.
- Also, this study helps to develop a framework to predict the trend patterns in India economy by analyzing previous year's data using ARIMA modeling.

METHODOLOGY

Scope:

The data set is collected from 1960 to 2022 to forecast the inflation rate in India using arima technique and the predicted outcome from arima model with the right (p,d,q) values can determine the accuracy of the rate of variation of the inflation from the actual and the predicted. The mape value is used for the determination of the model, based on the least mape value that model is chosen for the prediction.

Data collection

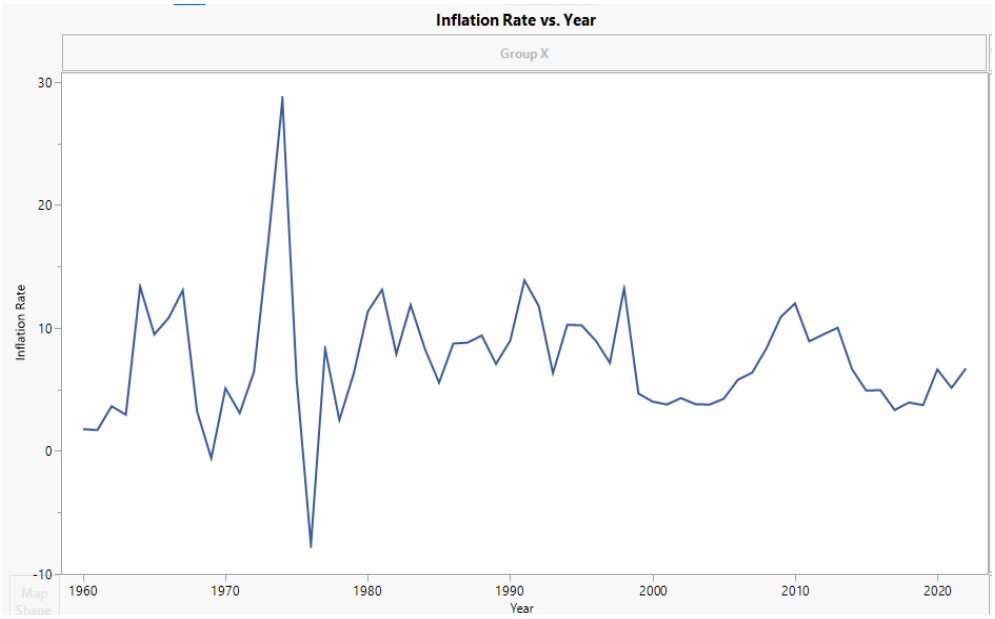
In this study, Secondary data is been collected from the website "Inflation, consumer prices (annual %) - India | Data (worldbank.org)".

The world bank allows the data set for anyone like researchers, policymakers, business or data analysts, businesses, and the organization to analyse the data and to make in decision like to forecast or to analyse the trend in the upwards or downwards trend.

It is a repository that holds data of the entire dimension related to various sector of the fields of education, health, infrastructural development, finance and many more.

With the above data set downloaded for the research on the forecasting of the inflation rate using the arima modelling we can predict the changes that could happen in the future which can help the government on the formulation of the policies for the better living of the nation.

RESULTS AND DISCUSSION



Source: Author

Graph: Inflation rate vs Years

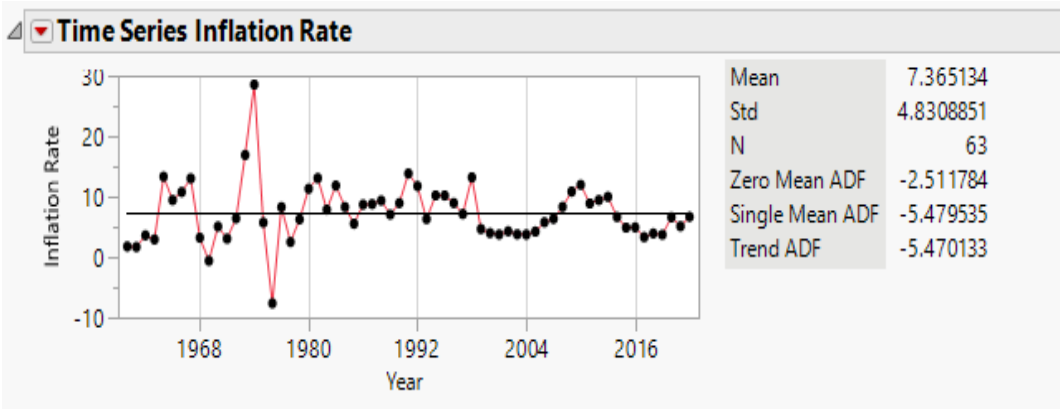
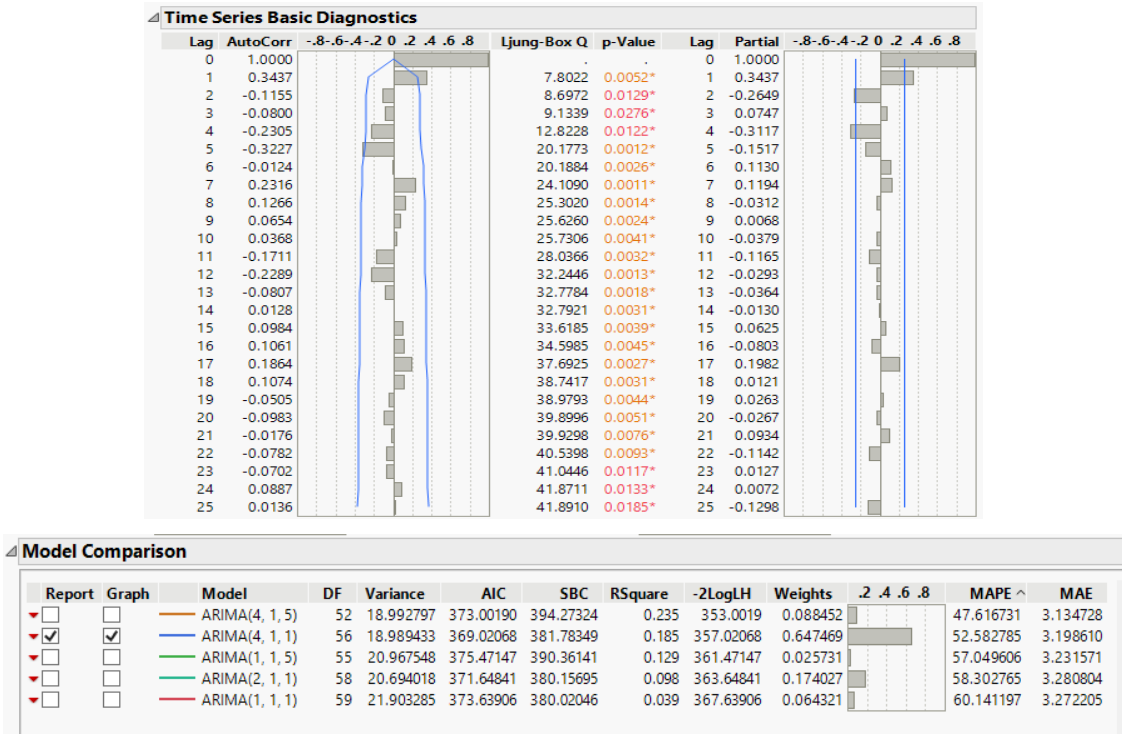


Fig: Points showing the graph plot.



Time Series Basic Diagnostics

Lag	AutoCorr	Ljung-Box Q	p-Value	Lag	Partial
0	1.0000	.	.	0	1.0000
1	0.3437	7.8022	0.0052*	1	0.3437
2	-0.1155	8.6972	0.0129*	2	-0.2649
3	-0.0800	9.1339	0.0276*	3	0.0747
4	-0.2305	12.8228	0.0122*	4	-0.3117
5	-0.3227	20.1773	0.0012*	5	-0.1517
6	-0.0124	20.1884	0.0026*	6	0.1130
7	0.2316	24.1090	0.0011*	7	0.1194
8	0.1266	25.3020	0.0014*	8	-0.0312
9	0.0654	25.6260	0.0024*	9	0.0068
10	0.0368	25.7306	0.0041*	10	-0.0379
11	-0.1711	28.0366	0.0032*	11	-0.1165
12	-0.2289	32.2446	0.0013*	12	-0.0293
13	-0.0807	32.7784	0.0018*	13	-0.0364
14	0.0128	32.7921	0.0031*	14	-0.0130
15	0.0984	33.6185	0.0039*	15	0.0625
16	0.1061	34.5985	0.0045*	16	-0.0803
17	0.1864	37.6925	0.0027*	17	0.1982
18	0.1074	38.7417	0.0031*	18	0.0121
19	-0.0505	38.9793	0.0044*	19	0.0263
20	-0.0983	39.8996	0.0051*	20	-0.0267
21	-0.0176	39.9298	0.0076*	21	0.0934
22	-0.0782	40.5398	0.0093*	22	-0.1142
23	-0.0702	41.0446	0.0117*	23	0.0127
24	0.0887	41.8711	0.0133*	24	0.0072
25	0.0136	41.8910	0.0185*	25	-0.1298

Model Comparison

Report	Graph	Model	DF	Variance	AIC	SBC	RSquare	-2LogLH	Weights	MAPE	MAE
☐	☐	ARIMA(4, 1, 5)	52	18.992797	373.00190	394.27324	0.235	353.0019	0.088452	47.616731	3.134728
☑	☑	ARIMA(4, 1, 1)	56	18.989433	369.02068	381.78349	0.185	357.02068	0.647469	52.582785	3.198610
☐	☐	ARIMA(1, 1, 5)	55	20.967548	375.47147	390.36141	0.129	361.47147	0.025731	57.049606	3.231571
☐	☐	ARIMA(2, 1, 1)	58	20.694018	371.64841	380.15695	0.098	363.64841	0.174027	58.302765	3.280804
☐	☐	ARIMA(1, 1, 1)	59	21.903285	373.63906	380.02046	0.039	367.63906	0.064321	60.141197	3.272205

Fig: Comparison table comparing the table with all range of mape values.

Model: ARIMA(4, 1, 1)

Model Summary

DF	56	Stable	Yes
Sum of Squared Innovations	1063.40827	Invertible	Yes
Sum of Squared Residuals	1172.5134		
Variance Estimate	18.9894335		
Standard Deviation	4.35768671		
Akaike's 'A' Information Criterion	369.020685		
Schwarz's Bayesian Criterion	381.783491		
RSquare	0.1849402		
RSquare Adj	0.112167		
MAPE	52.5827845		
MAE	3.19860965		
-2LogLikelihood	357.020685		

Parameter Estimates

Term	Lag	Estimate	Std Error	t Ratio	Prob>|t|	Constant Estimate	Mu
AR1	1	0.4770802	0.1207410	3.95	0.0002*	-0.0195778	-0.0191737
AR2	2	-0.3920157	0.1327666	-2.95	0.0046*		
AR3	3	0.2082275	0.1299713	1.60	0.1148		
AR4	4	-0.3143709	0.1215401	-2.59	0.0123*		
MA1	1	0.9999904	0.0639084	15.65	<.0001*		
Intercept	0	-0.0191737	0.0295044	-0.65	0.5184		

Fig: Summary statistics of the model(p,d,q)

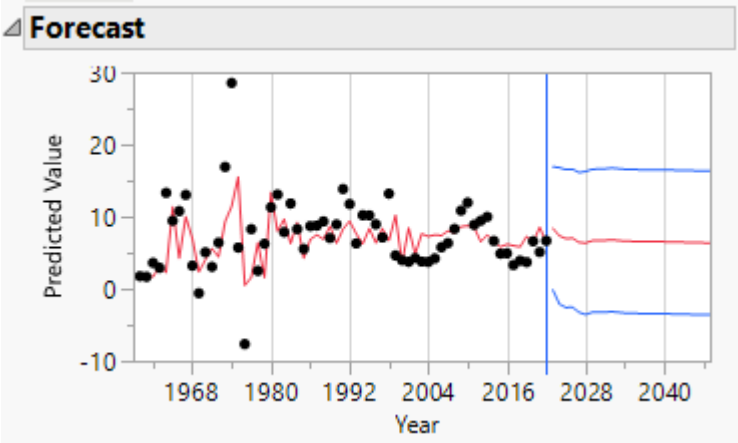


Fig: Graph showing what would be the prediction range.

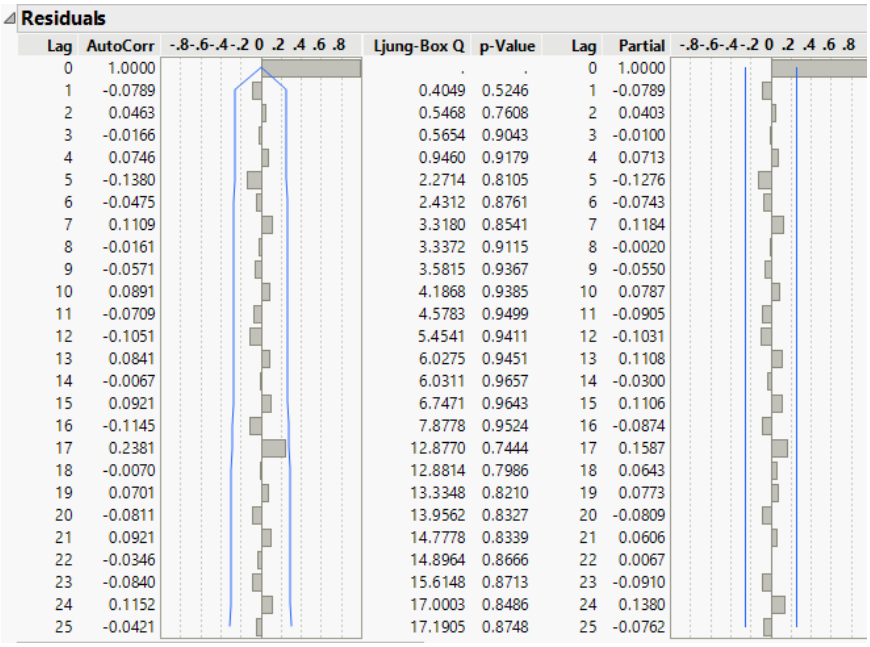


Fig: Residual to check the white noise.

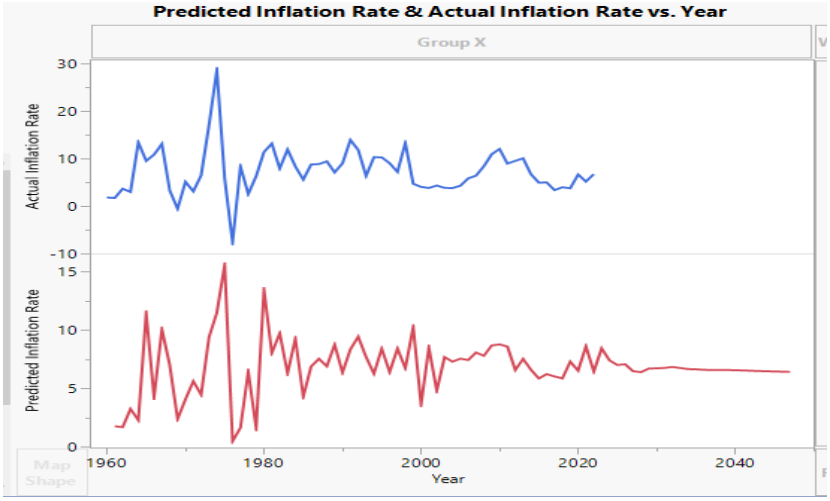


Fig: Graph plotting actual inflation rate and predicted inflation rate

CONCLUSION

To conclude the inflation rate forecasting is forecasted using a model (4,1,1) which has the least mape value when compared among all the other models. This model when used for prediction helps the government to formulate the policies, making the investment decisions and also maintain economic stability in the nation.

With the model (4,1,1) we could find out the predicted output being stable with the dataset taken from the Worldbank website but there could be variations if any uncertainty in market conditions, pandemic or natural disasters occurs.

This model helps in to maintain the risk and rewards of the government and this should be taken as a reference so as to mitigate the inflation.

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