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Modeling Consumer Price Index: An Empirical Analysis Using Expert Modeler

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Abstract

Consumer price index (CPI) a popular economic indicator for India that represents the prices paid by customers for goods and services consumedby them.CPI is often used as an economic indicator that reflects the change in prices of goods and services over a period of time. In this work an attempt has been made to develop a forecasting model for India's CPI for the period of May to December 2018. The data used in this work is the all-India CPI data for the period January 2013 - April 2018. SPSS Expert Modeler method has been used to fit the models and analyzing the data.

Key Words: *Consumer price index, Time series forecasting, Expert modeler, ARIMA model*

INTRODUCTION

Time series forecasting has a great importance in future planning and business decision making. It is an important tool for economic analysis. Starting from weather forecasting, stock market prediction, sales forecasting etc. everywhere the historical data needs to be analyzed. It not only gives a future value for that that but also helps the higher management to take timely decision. Many researches have been conducted to analyze the applicability of various time series methods in different dimensions. One such area is forecasting consumer price index. Singh & Sarangi (2009), Sarangi & Singh (2009), Sarangi & Sarangi (2010), Sarangi & Sarangi (2010) , Gupta & Sarangi (2012), Singh & Sarangi (2014), Sarangi & Pant (2014), Sarangi (2010).

CPI is often used as an economic indicator that reflects the change in prices of goods and servicesfor a specific period of time. CPI reflects the change in prices over a period of time and a key measure for inflation. It can be said that CPI acts a very critical performance grade of the government of the day Singh *et al.* (2018). It not only provides information about the inflation in the country but also is used to adjust pensions and social security benefits. Nobert *et al.* (2016). The CPI data mainly consists of historical data over a long period and contains many variables related to consumer goods and services. A large number of researchers have worked on it and still working on it to present better and better models & methods for time series forecasting. Some of them

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are cited here. Cryer and Chan (2008), Brocwell and Davis (2002), Box and Jenkins (1976), Montgomery *et al.* (2008).

The main components in the CPI in India are food and beverages (45.86%) and miscellaneous categories account for 28.32% which include transportation and communication health and education, housing sector, fuel and light, clothing and footwear etc. Iqbal and Naveed (2016).

LITERATURE REVIEW

There are a number of forecasting methods exist. Some of them which are very popular are moving average method, Exponential smoothing method, Holt's linear trend and seasonal method, ARIMA method and Neural network method. Here we present some research works where similar techniques have been reported.

Habimana Norbert *et al.* (2016) presents a paper on Modeling and Forecasting Consumer Price Index. The fundamental target of their experiment was to model the dynamic of CPI and to estimate its future qualities in short term. The authors have used Box and Jenkins method utilizing three steps like Model Identification, Parameter Estimation and Diagnostic Checking and using ARIMA (4,1,6) they have made precise prediction for one year in advance i.e 2016.

The study conducted by Iqbal *et al.* (2016) using time series dataanalyze the future prediction of various ARIMA models with Box-Jenkins approach is used for forecasting. The authors have used the quarterly data for empirical analysis for the period of 1970 to 2006 for Pakistan.

In another experiment, Weng Dongdong (2010) has performed an experiment on the correlation function and the partial correlation function of consumer price index. The author has used ARIMA (12,1,12) model to test residual serial autocorrelation. Finally,the author has made a short-term estimation on monthly CPI.

In their work, Admas *et al.* (2014) present a time series model to fit the CPI in Nigeria's Inflation rate between 1980 and 2010. The authors have provided five years forecasted value for the expected CPI in Nigeria. The authors have used ARIMA models.

A detailed study on the advantages and disadvantages of various forecasting methods is done by Qizhi *et al.* (2012). The authors have made anempirical comparison between various methods like ARIMA-GARCH, ARIMA, neural networks, median method of autoregressive model, least squares method of autoregressive model and exponential smoothing.

Another model to forecast CPI through ANN is reported by M. Akin (1999). The author has used leading economic indicator data like Producer

Price Index (PPI) and change in money supply M2 were used for developing the neural network.

Salzano and Colander (2007) proposed two models: one is a linear model and another one is a non-linear model. The authors have made acomparison of these two models to forecast the CPI.

In another work, the power of artificial neural network models as forecasting tools for monthly inflation rates for 28 OECD countries was verified by Choudhary and Haider (2008).

Linear and neural network-based models is applied by McAdam and McNelis (2005). The authors have forecasted inflation based on Phillips–curve formulations in the USA, Japan and the euro area.

OBJECTIVE

The objective of this work is to forecast the India's CPI (for eight products: Cereals and products, Meat and fish, Egg, Milk and Products, Oils and fats, Fruits, Vegetables, Pulses and products) for the period May to December 2018.

DATA

The data used in this work is the all India CPI data of India for the period of January 2013 to April 2018.

IMPLEMENTATION DESIGN AND MODEL SUMMARY

The forecasting has been done using the Expert Modeler of SPSS. The software has automatically taken care of the nature of data and has selected the appropriate model. The model type selected by the software based on the nature of the data is given in Table 1.

Table 1: Model description

			Model Type
Model ID	Cereals and products	Model_1	Holt
	Meat and fish	Model_2	Winters' Additive
	Egg	Model_3	Winters' Additive
	Milk and products	Model_4	Holt
	Oils and fats	Model_5	Winters' Additive
	Fruits	Model_6	Winters' Additive
	Vegetables	Model_7	Simple Seasonal
	Pulses and products	Model_8	ARIMA(1,1,0)(0,0,0)

Table 2: Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum
Stationary R-squared	.492	.224	.133	.677
R-squared	.976	.038	.887	.999
RMSE	1.772	2.100	.302	6.589
MAPE	.958	1.125	.196	3.606
MaxAPE	4.021	4.360	.584	13.524
MAE	1.317	1.657	.248	5.233
MaxAE	5.776	6.611	.657	19.664
Normalized BIC	.257	2.144	-2.267	3.901

Table 3: Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)			Number of Outliers
		Stationary R-squared	Statistics	DF	Sig.	
Cereals and products-Model_1	0	.144	16.220	16	.438	0
Meat and fish-Model_2	0	.639	21.521	15	.121	0
Egg-Model_3	0	.551	12.958	15	.606	0
Milk and products-Model_4	0	.133	16.357	16	.428	0
Oils and fats-Model_5	0	.677	35.027	15	.002	0
Fruits-Model_6	0	.639	30.663	15	.010	0
Vegetables-Model_7	0	.626	24.786	16	.074	0
Pulses and products-Model_8	0	.526	18.669	17	.348	0

Table 4(a): Exponential Smoothing Model Parameters

Model			Estimate	SE	t	Sig.
Cereals and products-Model_1	No Transformation	Alpha (Level)	1.000	.116	8.591	.000
		Gamma (Trend)	.400	.134	2.994	.004
Meat and fish-Model_2	No Transformation	Alpha (Level)	.999	.124	8.084	.000
		Gamma (Trend)	1.222E-5	.046	.000	1.000
		Delta (Season)	.999	92.121	.011	.991
Egg-Model_3	No Transformation	Alpha (Level)	1.000	.130	7.709	.000
		Gamma (Trend)	.001	.037	.017	.986
		Delta (Season)	.001	8605.314	1.162E-7	1.000
Milk and products-Model_4	No Transformation	Alpha (Level)	1.000	.123	8.148	.000
		Gamma (Trend)	.500	.160	3.118	.003

Table 4(b): Exponential Smoothing Model Parameters

Model			Estimate	SE	t	Sig.
		Gamma (Trend)	.500	.160	3.118	.003
Oils and fats-Model_5	No Transformation	Alpha (Level)	1.000	.129	7.730	.000
		Gamma (Trend)	.001	.017	.060	.952
		Delta (Season)	.001	992.672	1.007E-6	1.000
Fruits-Model_6	No Transformation	Alpha (Level)	1.000	.130	7.677	.000
		Gamma (Trend)	.001	.016	.061	.952
		Delta (Season)	.001	5738.845	1.743E-7	1.000
Vegetables-Model_7	No Transformation	Alpha (Level)	.999	.128	7.832	.000
		Delta (Season)	1.000	130.574	.008	.994

Table 5: ARIMA Model Parameters

					Estimate	SE	t	Sig.
Pulses and products-Model_8	Pulses and products	Natural Logarithm	AR	Lag 1	.720	.087	8.282	.000
			Difference		1			

Table 6: Forecast

Model	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018
Cereals and products-Model_1	136.6	136.8	137.0	137.2	137.4	137.6	137.8	138.0
Meat and fish-Model_2	146.6	149.4	150.2	149.4	148.5	148.3	148.2	148.7
Egg-Model_3	134.0	137.3	139.1	138.6	138.4	138.9	143.8	146.6
Milk and products-Model_4	141.9	142.2	142.4	142.7	143.0	143.3	143.5	143.8
Oils and fats-Model_5	121.1	121.6	121.8	122.0	122.4	123.0	123.6	124.1
Fruits-Model_6	153.2	154.0	155.6	155.9	152.9	152.8	153.3	152.5
Vegetables-Model_7	136.2	146.5	161.8	169.4	166.8	168.7	170.2	152.2
Pulses and products-Model_8	122.7	122.2	121.9	121.7	121.6	121.6	121.7	121.8

The graphs produced by SPSS for each item showing the observed values, fit values and forecasted values are given in Figure 1.

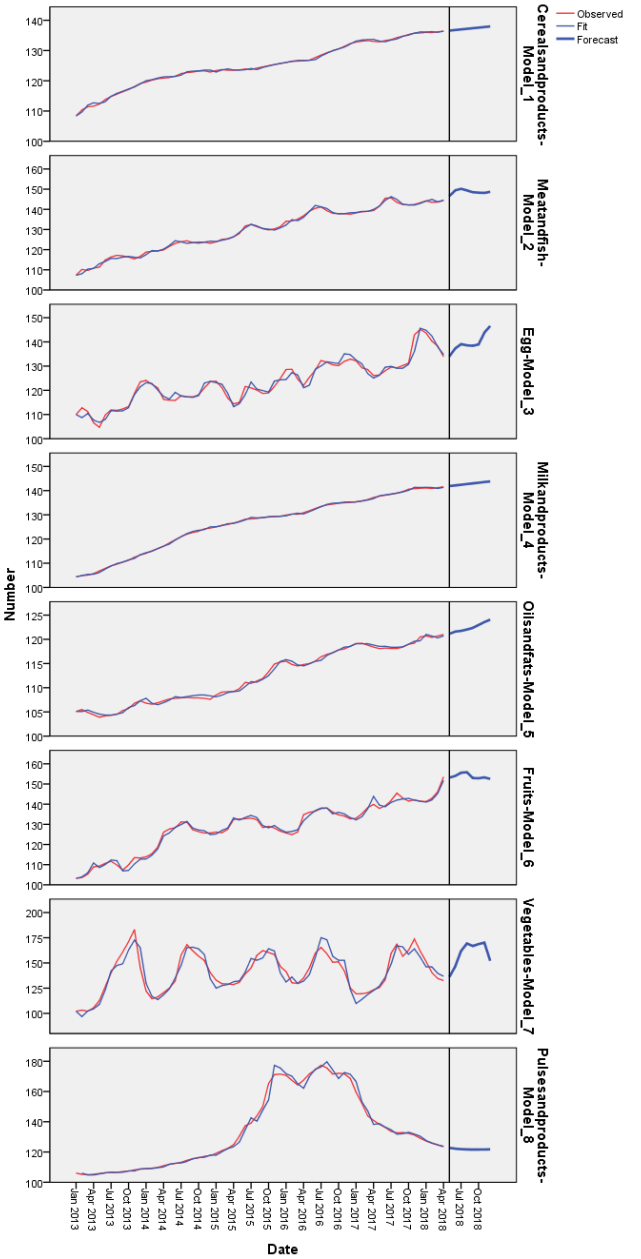

Figure 1: Graphical representation of observed, fit and forecasted values

From the graphs above, the following interpretations are drawn:

(i) The CPI for Cereals and products will increase by 1.024% in December in comparison to May 2018.
(ii) The CPI for Meat & Fish will increase by 1.432% in December in comparison to May 2018.
(iii) The CPI for Egg will increase by 9.402% in December in comparison to May 2018.
(iv) The CPI for Milk and products will increase by 1.338% in December in comparison to May 2018.
(v) The CPI for Oils and fats will increase by 2.477% in December in comparison to May 2018.
(vi) The CPI for Fruits will decrease by 0.456% in December in comparison to May 2018.
(vii) The CPI for Vegetables will increase by 11.747% in December in comparison to May 2018.
(viii) The CPI for Pulses and products will decrease by 0.733% in December in comparison to May 2018.

CONCLUSION

This study concludes that in the near future (till December 2018) there will be a slight increase in some of the products under study such as Cereals and products, Meat & Fish, Egg, Milk and products, Oils and fats and Vegetables. Whereas prices for products like Fruits and Pulses will likely to decrease.

An increase in CPI indicates that there will be an increase in the prices of these items resulting a house hold will have to pay more to maintain the same standard of living and the decrease in CPI will result in a decrease in price for the other items like fruits and pulses.

DECLARATION

The outcome of this study is purely academic and may only be considered for study and research purposes. The actual situation can only be verified with time.

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