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An Empirical Analysis of Hunan's Consumer Price Index Based on ARMA Model

Tingting Li, Fang Chen*
Department of Mathematics and Finance, Hunan University of Humanities Science and Technology Loudi, China

***Corresponding author**
Fang Chen

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Abstract: The resident consumer price index is a relative number that reflects the trend and degree of changes in the price of residential households purchasing consumer goods and expenditure service items. This article was downloaded to the monthly data of the CPI index of Hunan Province, China from January 2016 to April 2018. Eviews software was used for empirical analysis to predict the consumer price index of Hunan Province, China from May to July 2018, and to better analyze Future economic conditions. The model used is the time series ARMA model, and the data comes from the National Bureau of Statistics of China.
Keywords: CPI; ARMA model; consumer price index; forecast.

INTRODUCTION

The Consumer Price Index, or CPI for short, is an important indicator of inflation [1]. The CPI index affects everyone. When the CPI rises, it will increase the inflation rate. At the same time, people's real wages will decrease. At this time, consumers will often reduce purchasing power, which will lead to a decline in the national economy's speed of development. It has a close relationship with the masses and has a direct impact on people's quality of life. With the development of the economy, controlling the CPI in an appropriate range can effectively control the inflation rate and promote the stable development of the economy. People's consumption levels can rise and improve their living standards [2].

This article forecasts the future price changes based on the collected monthly CPI data of Hunan Province. It is of practical significance to use the ARMA model to conduct empirical analysis and take corresponding measures to make economic decisions.

ARMA theoretical model empirical analysis

Introduction to ARMA Model

The ARMA model is an important method for the study of time series. It consists of an autoregressive model (AR model) and a moving average model (MA model) based on a "mixed" basis. It was first proposed by the American statistician GE P Box and G. M. Jenkins in 1970 and is relative to a more sophisticated method of predicting the time series [3]. It can be used to predict the future economic development of a country or a region, and it can be applied to many practical problems. It is more accurate than the AR model and MA model spectrum estimation, and has better spectral resolution performance [4]. The mathematical formula is:

$$y_t = \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_p y_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + ... + \theta_q \varepsilon_{t-q} \quad (1)$$

SOURCES OF DATA

This article selects monthly consumer price index (CPI) data from January 2016 to April 2018 in Hunan Province and uses Eviews software to complete

Table-1. The data used for this article. (In the same month of last year = 100)

Table-1

years	1	2	3	4	5	6	7	8	9	10	11	12

2016	101.1	102.1	102.2	102.3	101.9	101.6	101.6	101.2	101.7	102.1	102.5	102.3
2017	102.8	101.2	101	101	101.4	101.4	101.5	101.6	101.5	101.3	101	101.4
2018	101.3	102.4	101.8	101.6								

Unit Root Test

First analyze the stability of CPI in Hunan Province. From Diagram 1 we can be seen that the data trend is relatively stable. The unit root test is analyzed from the three cases of Intercept, Trend and intercept, and none. According to the minimum AIC, SC, and HQ information criterion values, the Trend and intercept condition is confirmed Diagram 2. According to the ADF test, the consumer price index was initially determined to be a stable series.

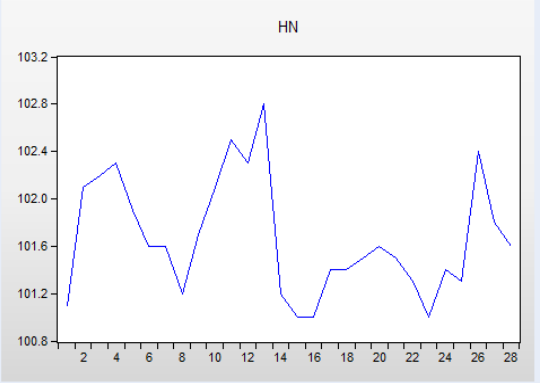


Diagram 1

Null Hypothesis: HN has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=6)

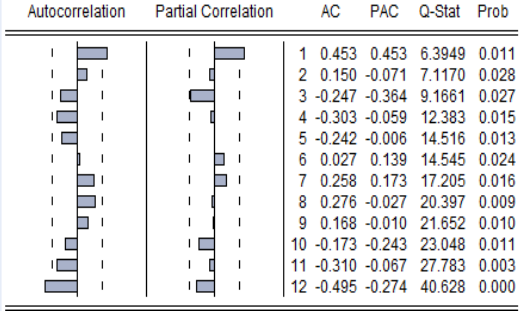
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.089228	0.0185
Test critical values:	1% level	-4.374307	
	5% level	-3.603202	
	10% level	-3.238054	

Diagram 2

Model form judgment

In order to further examine the stability of the sequence, the AC chart test and the PAC chart test are performed below. In Diagram-3, it can see the sample autocorrelation coefficient (AC) tailing, sample partial autocorrelation coefficient (PAC) tail. The initial judgment is the ARMA model [5].

Date: 05/17/18 Time: 19:25
Sample: 1 28
Included observations: 28



	AC	PAC	Q-Stat	Prob
1	0.453	0.453	6.3949	0.011
2	0.150	-0.071	7.1170	0.028
3	-0.247	-0.364	9.1661	0.027
4	-0.303	-0.059	12.383	0.015
5	-0.242	-0.006	14.516	0.013
6	0.027	0.139	14.545	0.024
7	0.258	0.173	17.205	0.016
8	0.276	-0.027	20.397	0.009
9	0.168	-0.010	21.652	0.010
10	-0.173	-0.243	23.048	0.011
11	-0.310	-0.067	27.783	0.003
12	-0.495	-0.274	40.628	0.000

Diagram-3

Determination of lag order

In order to determine the lag order of the ARMA model, the following attempts are made based on the lag order. For example: ARMA (1, 1), ARMA (1, 2), ARMA (2, 1), ARMA (2, 2). Get the following

Table-2 of the four situations. The significance of the coefficient corresponding to the largest lag variable in each model is summarized, and the minimum AIC, SC, and HQ information criterion values are used. The AIC information criterion value of the ARMA model (2, 2) and the SC, HQ information criterion value are the minimum, and the adjustment R The statistic has the largest value and the model is simpler. Therefore, select the ARMA (2, 2) model.

Table-2

(p, q)	(1,1)	(1,2)	(2,1)	(2,2)
AIC	1.346269	1.281132	1.158423	0.937443
SC	1.490251	1.473108	1.351976	1.179385
HQ	1.389083	1.338126	1.214159	1.007113
Adjusted Rsquared	0.171175	0.247533	0.345296	0.490799

Model regression and testing

Create an ARMA (2, 2) model and return it, such as Diagram 4. Residual sequence correlation test and heteroscedasticity test were performed.

Dependent Variable: HN
Method: Least Squares
Date: 05/17/18 Time: 21:43
Sample (adjusted): 3 28
Included observations: 26 after adjustments
Convergence achieved after 12 iterations
MA Backcast: 1 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	101.6146	0.093959	1081.475	0.0000
AR(1)	1.312726	0.066542	19.72764	0.0000
AR(2)	-0.938820	0.069701	-13.46917	0.0000
MA(1)	-1.107573	0.088342	-12.53736	0.0000
MA(2)	0.944150	0.040126	23.52939	0.0000

R-squared	0.572271	Mean dependent var	101.6769
Adjusted R-squared	0.490799	S.D. dependent var	0.497440
S.E. of regression	0.354964	Akaike info criterion	0.937443
Sum squared resid	2.645995	Schwarz criterion	1.179385
Log likelihood	-7.186759	Hannan-Quinn criter.	1.007113
F-statistic	7.024139	Durbin-Watson stat	1.909021
Prob(F-statistic)	0.000940		

Diagram 4

In the residual sequence correlation test (starting from the third-order lag of the lag to the first-order lag), the residual LS test is performed with the least-order AIC, SC, and HQ information criteria to determine the residual correlation test. The P value of the LM test statistic Obs*R-squared is 1.0000. Under the 5% significance level, the original hypothesis is not rejected, and there is no serial correlation between the tested residuals. Therefore, it is reasonable to choose the first order lag. Test the heteroscedasticity (ARCH test) in a similar way. Observe AIC, SC and HQ and other information to comprehensively judge the best lag of ARCH test, and finally select ARCH (1). At the 5% level, if the original hypothesis is not rejected, it means that there is no ARCH effect. Explain that there is no ARCH form of heteroscedasticity. So the expression for the ARMA (2, 2) model is:

$$Y_t = 101.6146 + 1.312726Y_{t-1} - 0.938820Y_{t-2} - 1.107573\varepsilon_{t-1} + 0.944150\varepsilon_{t-2} \quad (2)$$

Model Prediction and Analysis

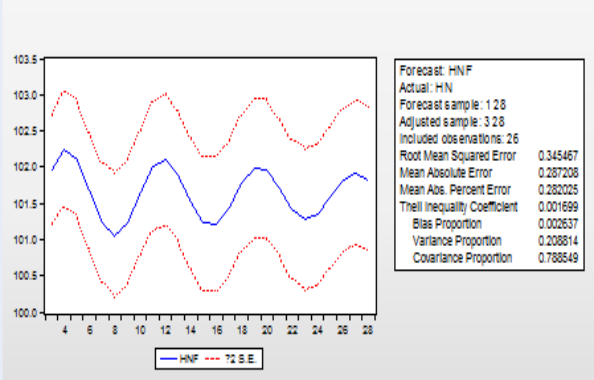


Diagram 5

The solid line in the graph represents the predicted value of HNF, and the two dotted lines provide the confidence interval of 2 times the standard deviation. It can be seen that the predicted value has been fluctuating with the increase of time. On the right are some criteria for evaluating the prediction, because the Theil inequality coefficient is 0.001699, indicating that the model has better prediction ability.

CONCLUSION

In this paper, the ARMA model is established based on the time series analysis of Hunan consumer price index changes over the past two years, and a reasonable price forecast is made. Without considering the impact of economic factors on CPI, it will reflect the future trend of market prices better and truly. The results show that CPI has a relatively stable fluctuation trend, and the inflation rate also fluctuates within a certain range. Hunan Province's economy shows a stable development trend, and the people's living standards tend to be stable. There are also some problems in using the time series method to predict. For example, it does not take into account the current complex and changeable real-time information, which may lead to a large deviation between the predicted value and the actual value. Therefore, the ARMA model needs to be continuously refined to make the prediction more accurate.

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