

## **Periodic Consumer Price Index in the Philippines: A Time Progression Analysis**

Renato E. Apa-ap

Polytechnic University of the Philippines, Research Management Office, College of Science,  
Department of Mathematics and Statistics  
r\_apaap@yahoo.com;reapa-ap@pup.edu.ph

### **Abstract**

The core intention of this study is to analyze the behavior and formulate a safe estimation model of Consumer Price Index (CPI) in the Philippines. The researcher exploited the data came from the internet site of the PSA from 2000 to 2018. To apprehend the objective of this study, the researcher embraced the contemporary projecting system introduced by George Box and G. Jenkins, the Box-Jenkins method. This is a statistical tool to shape a scientific pattern devised to estimate a point in time sequence. The data was processed and analyze in pursuing to find the safest paradigm using the said projecting system after January 2018 towards December 2019. The outcomes show that the scheme of CPI of the Country is growing along with certain oscillation. In supplement, the typical CPI from year 2000 to year 2018 stands at 108.20 while the maximum CPI in that phase of time stays at 142.6 that occurred in trendy December 2018 and the lowermost CPI is 75.3 during January 2000. The process includes identifying the stationary and diagnostics evaluation of data for integrity. Entirely, the researcher arrived the safest statistical prototypical that can foresee the impending standards of the CPI founded on the Akaike Information Criterion as standards in selecting the finest model points to Periodic Auto-Regressive Integrated Moving Average  $(1,1,0)(1,0,0)[12]$  with drift. This design can help the government to enhance further the economic policies of the country..

**Keywords:** Consumer Price Index, Philippines, Philippine Statistical Authority, Box-Jenkins model, Time Progression Analysis

### **1. Introduction**

Everyone is perceiving the execution of the costs in the marketplace. This course can support the entity to have a scheme in judgment making for creating financial arrangements in the everyday expenses. Some of the markers to govern the costs of the product in the fairs is termed as the Consumer Price Index (CPI). Rendering to the assertion of Philippine Statistical Authority, CPI remains a point of the revolution in the middling merchandising values of an immobile bag of commodities and services frequently purchased by household's compared to a sordid year. Established on the website from a macro-basis, this container was comprised of several goods and essential services quantified at different loads that will ascertain the overall price level<sup>1</sup>. These loads are assigned in every commodity and facilities based upon the feeding significances of households and also on the way they allot their resources or income to meet their wants. CPI is a foremost numerical series used for economic evaluation and as a supervising gauge of administration economic dogma. Moreover, the CPI is more broadly used in the reckoning of the inflation percentage and procuring influence of the peso<sup>2</sup>.

Established on the learning of Zhang, et.al, 2013, that Box-Jenkins analysis<sup>3</sup> is a few of the leading Statistical tools employed by some researchers in estimating the CPI of China. They reflect in their report that the appropriate paradigm should meet the subsequent conditions: succinct, quantity shows to be stable, there is no lingering autocorrelation, reasonably great out of sample projected and so on. In supplement, they retrieved out that the ARIMA model that was established is legitimate and has reasonably elevated forecast exactitude.

## Periodic Consumer Price Index in the Philippines: A Time Progression Analysis

Yudie-Du (et. al, 2014) proposed<sup>4</sup> a new split-plus-dominant archetypal for foretelling consumer price index. They managed three simulations namely Propagation Neural Network (BPNN) model, Grey projecting model GM (1,1) and ARIMA or Auto Regressive Integrated Moving Average model<sup>5</sup>. In the result, they conclude that the dividing-integration method enhances the accurateness of predicting consumer price index. In the analysis, they transmute the projecting of the national CPI to the forecasting of the 8 sub-CPI and obtain the best estimated findings. Hence, they propose that using Seasonal Autoregressive Integrated Moving Average or SARIMA model must also be brought into importance in improving the correctness of projection.

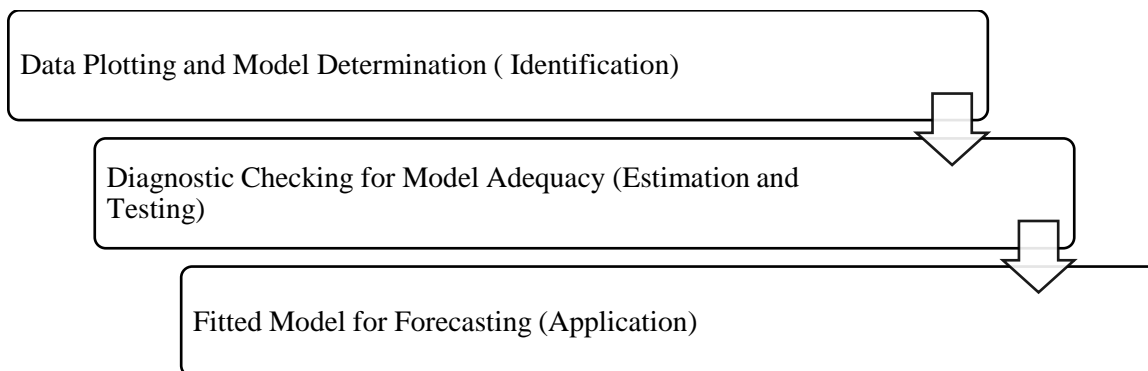
Contemplating from above accounts, the researcher considers all possible ideas for the realization of this research. Additionally, this research will help the administration to monitor and enhance more their policies on this matter.

### 1.1 Objectives

By means of moment sequence investigation, this research intends to shape a better model that is able to foresee the periodic Consumer Price Index in the Philippines. In particular, it aims to seek out answers to the ensuing questions:

1. The performance of the periodic CPI of the Philippines,
2. The contenders' model that be able to estimate the monthly CPI in the Philippines, and
3. The safest model that knows how to calculate the monthly CPI in the Philippines?

### 1.2 Research Paradigm



### 2.0 Methodology

The study uses secondary data obtained from the Authorized Administration Agency that holds record and were employed in constructing a scientific model done by a superior statistical tool with the help of software applications that applies trends and seasonal component in extracting the data.

Although reversion scrutiny is often laboring in such a way as to test concepts that the current values of one or more autonomous time series affect the current value of another time series, this type of data analysis of time succession cannot be applied in this case, since the emphases are on the associating standards of a sole period succession or numerous supported stretch succession at unlike arguments in period (Imdadullah, 2014)<sup>6</sup>.

The researcher has applied the statistics emanating from the website of PSA since January 2000 to December 2018. The researcher applied the cycle of January 2007 to December 2013 for the formation of safest model and model estimating of the continuing data was used for authentication of superlative model for accuracy<sup>7</sup>.

### 2.1. Box-Jenkins Reproductions

The very classic evaluation of this approach involves an efficient method of identifying, fitting, checking, and using incorporated ARIMA point sequence models. Which includes several operators and labels. By way of designing in overall, however, only essential relations should be included in the model. Those concerned with the scientific details can confer to the proceedings of Reisel (1994), Chatfield (1996), or Brockwell and Davis (2002)<sup>8-9</sup>.

The three main platforms in founding a Box-Jenkins model are as follows:

- Model Documentation
- Model Approximation

- Model Authentication

**2.1.1 Box-Jenkins Model Documentation**

Under this platform of Box-Jenkins model, the data are being processed for Stationarity and seasonality using Differencing method done using Statistical Software for accuracy of the result.

**2.1.2 Box-Jenkins Model Approximation**

The data under this platform were subjected to software application to identify the significant coefficients for inclusion in the model.

Maximum likelihood approximation is mostly the favored practice. The Researcher, however, uses the Box-Jenkins method in this study for its appropriateness and suitability. Future researchers might confer with the manuscripts of (Brockwell and Davis, 1991) for the statistical details<sup>11</sup> and allusion.

**2.1.3 Box-Jenkins Model Authentication**

Performing diagnostic authentication for the applied device prototypes is analogous to classical authentication for non-undeviating least squares fitting.

To abide by the assumptions for a stationary univariate data development. The residuals testing was conducted out of illustrations from a fixed distribution with a constant presage and discrepancy. If the Box-Jenkins model is a good model for the data, the residuals should satisfy the assumptions for seasonality of elements in the series<sup>12</sup>.

If these assumptions are not fulfilled, we need to fit a more appropriate model. Fortunately, the assumptions in the process met the required standard to carry out the model.

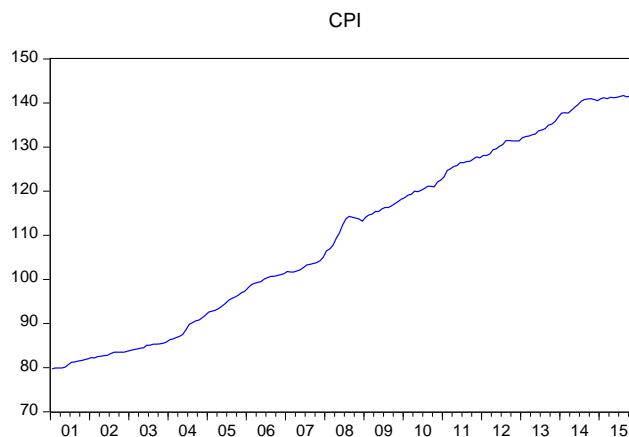
A mode to gauge if the residuals from the Box-Jenkins classical follows the assumptions is to generate a graph known as the scatter plot of the residuals and the autocorrelation graph of the residuals. One could also look at the value of the Box-Ljung (1978) statistic<sup>13</sup> as a reference.

**3.0 Results and Discussion**

CPI is utmost broadly employed in the reckoning of the inflation percentage and acquiring strength of the peso. This made the researcher examined the following: investigative data assessment or identifying the performance of the periodic CPI, establish the entrants model that can foretell the monthly CPI and last, to determine the safest model that will foresee the regular CPI in the Nation. The results show that the typical CPI from year 2000 to year 2018 stands at 108.20 while the maximum CPI in that phase of time stays at 142.6 that occurred in trendy December 2018 in which the lowermost CPI is 75.3 throughout January of year 2000. Utterly, the researcher arrived the safest statistical model that will foresee the forthcoming standards of the CPI founded on the Akaike Information Criterion as standards in selecting the finest model.

**3.1 Exploratory Information Evaluation**

**Figure 1.** Movement and Distribution of the Periodical CPI in the Philippines as of year 2001 to year 2015

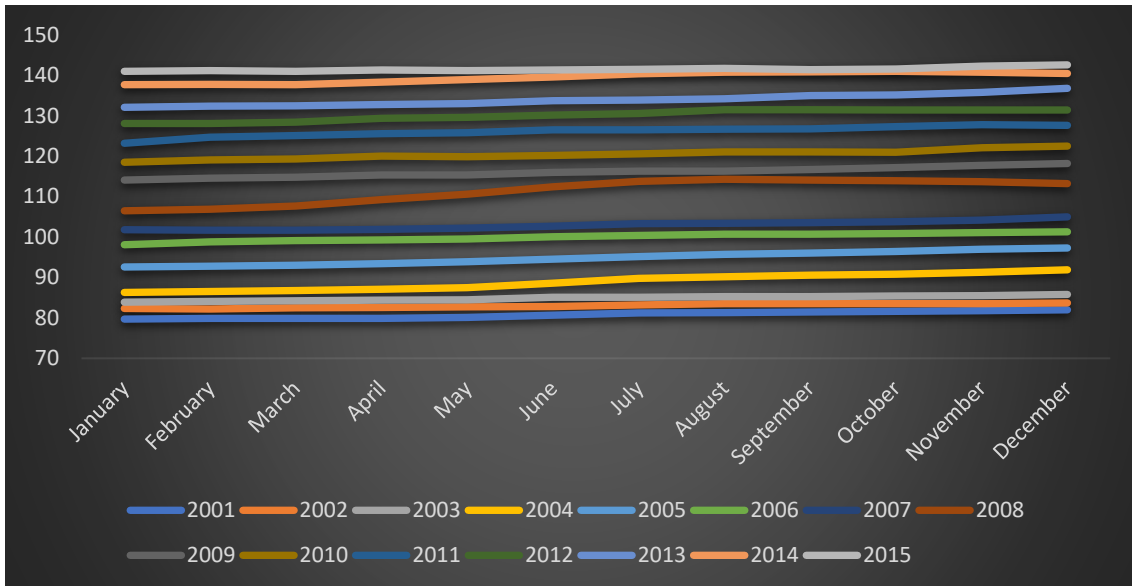


Above shows the factual indicators of the periodic CPI in the Philippines from 2001-2015. It can be noticed that the sequence of CPI has a growing trend with an average equivalent to 110.30. The highest value of CPI comes about 142.60 with skewness coefficient of 0.03, along with the kurtosis coefficient of 1.61. These

## Periodic Consumer Price Index in the Philippines: A Time Progression Analysis

findings signaled that the series happens to be not normally circulated. To validate the above claimed, another test was applied to determine the normality of the distribution using the Jarque-Bera test. Founded on the calculated result of the Jarque-Bera test, it supports the inference that the series is non normally supplied since its calculated probability is smaller than the determined level of significance at 0.05.

**Figure 2:** Graphical Presentation of Periodic CPI in the Country from year 2001 to year 2015



From the figure above, it illustrates the behavior of the CPI in the Country proffered regularly every year. It indicates that following the month of June based on the diagram, there is a slender swing or escalation of CPI up and about to a month of December every year as manifested on the lines in the graph.

### Test for Stationarity

**Table 1.** Significant test: Regular CPI in the Country as of year 2000 to year 2018 based on Augmented Dickey-Fuller (ADF) Unit Root Test

Null Hypothesis: CPI has a unit root		
Exogenous: Constant		
Lag Length: 1 (Automatic - based on SIC, maxlag=13)		
	t-Statistic	Prob.*
<b>Augmented Dickey-Fuller test statistic</b>	0.118639	0.9664
Test critical values:		
1% level	-3.467205	
5% level	-2.877636	
10% level	-2.575430	
*MacKinnon (1996) one-sided p-values.		

The table above reveals the ADF test result to detect if the series stays immobile or none. Established on the calculated probability rate of ADF approximately equivalent to 0.9664 and obviously greater than the level of significance of 0.05 which means that there is no adequate proof to discard the null hypothesis. This indicates that the provided figures have an item root or other word the statistics is nonstationary.

**Table 2.** Significant test: Statistics Stationarity using ADF of the Converted Periodic CPI in the Country as of year 2000 to year 2018

Null Hypothesis: DLOG(CPI) has a unit root		
Exogenous: Constant		
Lag Length: 0 (Automatic - based on SIC, maxlag=13)		
	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-8.512016	0.0000
Test critical values: 1% level	-3.467205	
5% level	-2.877636	
10% level	-2.575430	

\*Mackinnon (1996) one-sided p-values.

As we can glean from the table above, the calculated probability value of ADF check which is corresponding to 0.0000 and it is smaller than the set level of significance at 0.05 which indicates that there is an adequate proof to Discard the null hypothesis. This implies that the provided statistics do have an item root, or the figure is non-stationary.

**Model Documentation**

Under this stage, the regular CPI in the Philippines on or after year 2007 to the year 2013 was used as operating data information for assessment in model identification. Using the suitable arithmetical software system, the researcher produces distinct standard grounded on AIC or Akaike Information Criterion as standard in determining the finest model.

**Table 3.** Result Distribution of Approximate Model based on the AIC as Standard in Picking the safest prototypical

```

ARIMA(2,1,2) (1,0,1) [12] with drift      : Inf
ARIMA(0,1,0) with drift                  : -683.8227
ARIMA(1,1,0) (1,0,0) [12] with drift     : -696.5111
ARIMA(0,1,1) (0,0,1) [12] with drift     : -692.295
ARIMA(0,1,0)                             : -634.3174
ARIMA(1,1,0) with drift                  : -695.505
ARIMA(1,1,0) (2,0,0) [12] with drift     : -695.5579
ARIMA(1,1,0) (1,0,1) [12] with drift     : Inf
ARIMA(1,1,0) (2,0,1) [12] with drift     : Inf
ARIMA(0,1,0) (1,0,0) [12] with drift     : -681.921
ARIMA(2,1,0) (1,0,0) [12] with drift     : -695.3922
ARIMA(1,1,1) (1,0,0) [12] with drift     : -695.4719
ARIMA(2,1,1) (1,0,0) [12] with drift     : Inf
ARIMA(1,1,0) (1,0,0) [12]                : -689.2826

Best model: ARIMA(1,1,0) (1,0,0) [12] with drift
    
```

Table above illustrates the model classification from the prearranged employed facts from year 2007 to year 2013 of the CPI in the Philippines. The series uses log transformed data for correctness and contentment of the supposition under model identification. Based on the result as manifested, the finest prototypical to forecast the regular CPI in the Country based on the data series is an ARIMA (1,1,0) (1,0,0) [12] with drift as shown in the last row of the table.

**Model Estimation**

**Table 4.** Significant Test: Expected rate of the Limitation of the Finest Prototypical

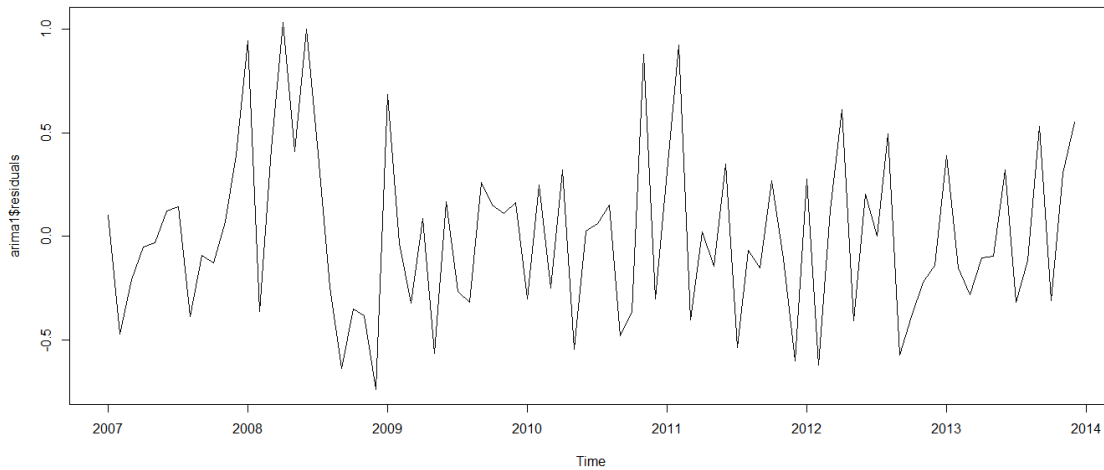
Periodic Consumer Price Index in the Philippines: A Time Progression Analysis

Coefficients:	AR1	SAR1	Drift
	0.401	0.371	0.421
Standard Error	0.101	0.119	0.087

The table above demonstrates the model evaluation of coefficients of the top prototypical to categorize the substantial of its constraint. Constructed at the calculated rate of the coefficient for each structure and its average blunder, the unqualified percentage value of the AR1 and SAR are 3.659 and 3.142 correspondingly is larger than 3.0, as per Diagnosis Analysis is concerned, it designates that there is adequate indication statistically to claim that the constraint is significant.

**Residual Analysis of the Preferred Prototypical**

**Figure 3.** Graphical Presentation: Residual Analysis of the Preferred Prototypical

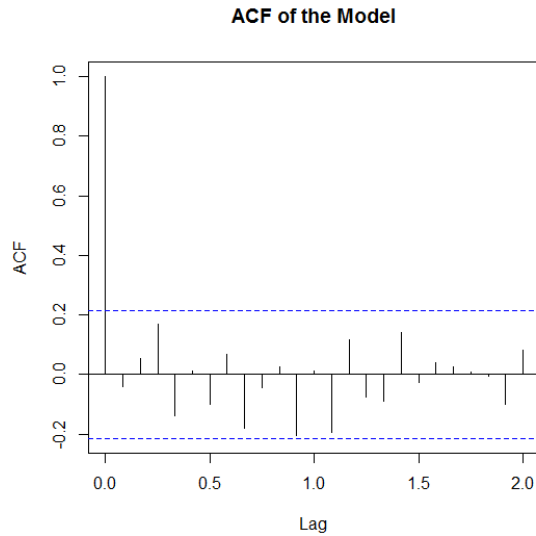


Above picture illustrates the residual plot of the best prototypical formed. It demonstrates that the discrepancy of the error duration appears to be continual as presented in the graph. It likewise emerges that the average of the enduring corresponds to 0.0052 which is roughly near to nothing which, according to diagnostic analysis parlance, it indicates a good model.

**Table 5.** Box-Ljung Significant Test: Independent of Mistake Tenure for Autoregressive Conditional Heteroskedasticity (ARCH)

Autocorrelation test (Ljung-Box)	
X-squared	22.682
Degrees of Freedom	20
Probability Value	0.3047

**Figure 4.** Graphical Presentation: Independent of Mistake Tenure for ARCH

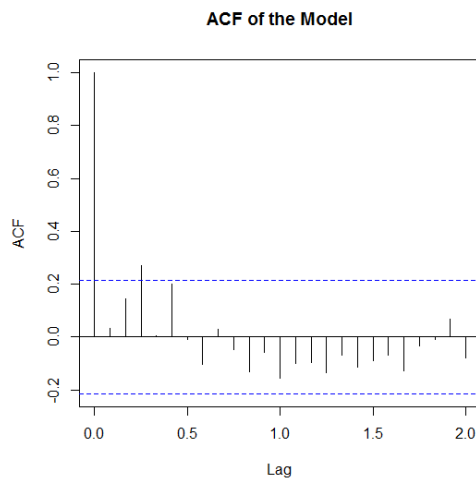


The table and figure above both signify the residual analysis of the best model in distinguishing the independence of inaccuracy duration for ARCH as part of diagnostic analysis. From the results overhead, the calculated probability value of the Box-Ljung test is equivalent to 0.3047 which is obviously larger than the set concentration of significance at 0.05, which indicates that there is a enough indication statistically to say that the error tenure are independent.

**Table 6.** Box-Ljung Test Distribution of Significance in Independent of Mistake Term for Generalized Autoregressive Conditional Heteroskedasticity (GARCH)

Autocorrelation test (Ljung-Box)	
X-squared	26.834
Degrees of Freedom	20
Probability Value	0.1400

**Figure 5.** Graphical Presentation of Independent of Mistake Term Using Generalized Autoregressive Conditional Heteroskedasticity (GARCH)

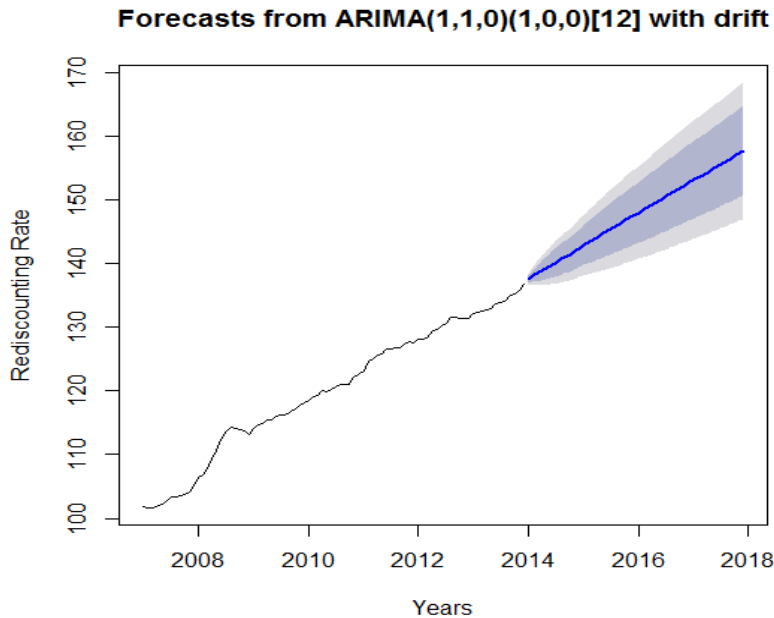


Moreover, table 6 and figure 5 illustrates the residual analysis in identifying the independency of error duration for GARCH in complement to table 5 and figure 4 analysis. Additionally the calculated probability

value of the Box-Ljung test is identical to 0.1400 which is likewise larger than the set level of significance at 0.05, which means also that there is an adequate indication statistically to assume that the error duration are independent.

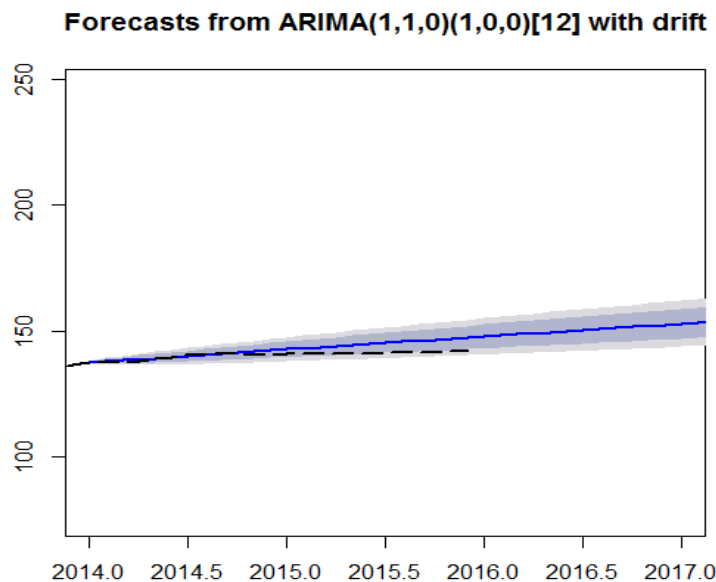
**Forecasted Significance and Model Precision**

**Figure 6.** Graphical Presentation of Forecasted Value in the data series from 2014 to 2018



The above figure illustrates the point forecast between forecasted values and years in blue line. It shows that 80% above average and the minimal forecast in the dim gray and also it presents a 95% elevated and minimal forecast in bright dull. It reveals that the estimated value from the generated prototypical has a rising movement from year 2014 to the year 2018.

**Figure 7.** Graphical Presentation for Similarity of Comprehension to Forecasted Value from 2014 to 2017



On the other hand, the figure above demonstrates the anticipated value with the fulfillment of CPI from year 2014 to the year 2017. It likewise reveals that for some projected value stay down in the understanding of CPI and highly of the understanding of CPI lie down in the 80% projected disparity.

**Table 7.** Model Precision Test Distribution of the Best Model Between Working and Exam Data Setting under Investigation



Data Setting	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1	Theil's U
Working	0.005	0.405	0.329	0.005	0.276	0.063	-0.039	n/a
Exam	-2.028	2.752	2.089	-1.434	1.478	0.404	0.898	7.215

Above table illustrates the accuracy of the model based on several diagnostic kits for the working and exam data set. Equally the said data determined observed that a Mean Absolute Percentages Error or MAPE remains approximately fewer than ten as manifested on its values. This suggests that the anticipated and attainment of CPI is roughly within two percent mistake which statistically tolerable.

#### 4.0 Conclusions

From the results and discussions above, as well as, manifested on the data adventure the following are being decided, that:

1. The periodic Consumer Price Index or CPI of the country since year 2007 to year 2013 demonstrates a way of escalating tendency.
2. It also uncovered out that nearby is a minor swing of CPI after June every year.
3. The safest model that be able to forecast the CPI is a Seasonal Autoregressive Integrated Moving Average (1,1,0) (1,0,0) [12] with drift.
4. The projected value in the data series of the generated model has an increasing tendency. Which implies that there long be an upsurge on expense of income, which is coupled to price increases.
5. An intensification in CPI suggests that a domestic has to splurge extra peso to sustain the identical pattern of income; that's primarily sad for the family unit, but it is able to be nice for enterprises along with the administration.

#### 5.0 Recommendations

Established on the preceding outcomes plus consequential deductions of the research, the succeeding proposals stand articulated:

1. The administration might fine-tune the amounts of the properties and facilities exclusively individual diurnal requirements of comparable sustenance and conveyance for the benefits of the citizen of the country.
2. The administration possibly will courteously upsurge the proceeds of a laboring individual, particularly individual employees accordingly that they can sustain a satisfactory diurnal existing.
3. The administration must fortify the inflexibility of the country's currency.
4. The administration ought to encompass in industrial modernization for fabricating virtuous superiority merchandise in the country to diminish the charge.

Price increases, as controlled by an upsurge in the CPI, signals that the administration can emblem agreements to wage workforces or procurement of resources in existing bucks and then recompense them back in overstated bucks.

#### References

- [1] February 2015 Consumer Price Index. Special release No. 4, March 2015
- [2] Basics of Macroeconomics by Learning at your fingertips retrieved from <http://www.macrobasics.com/chapters/chapter6/lesson64/>
- [3] Fengwang Zhang, Wengang Che, Beibei Xu. The Research of ARMA Model in CPI Time Series Published by Atlantis Press, Paris, France. © the authors, 2013
- [4] Yudie Du, Yue Cai, Mingxin Chen, Wei Xu\*, Hui Yuan, Tao Li. A Novel Divide-and Conquer Model for CPI Prediction Using ARIMA, Gray Model and BPNN. © Published by Elsevier B.V, 2014
- [5] S.O. Adams A. Awujola A.I. Alumgudu. Modeling Nigeria's Consumer Price Index Using Arima Model. International Journal of Development and Economic Sustainability Vol.2, No. 2, pp. 37-47, June 2014
- [6] Imdadullah Khan Lahore University of Management Science, Umm Al-Qura University, Rutgers, <https://scholar.google.com/citations?user=aMwi6UwAAAAJ&hl=en>
- [7] Philippines Statistics Authority Prices retrieved from [http://www.nscb.gov.ph/secstat/d\\_price.asp](http://www.nscb.gov.ph/secstat/d_price.asp)

## Periodic Consumer Price Index in the Philippines: A Time Progression Analysis

- [8] Box GEP, Pierce DA. Distribution of residual autocorrelation in autoregressive-integrated moving average time series models. *Journal of the American Statistical Association*. 1970; 65(332):1509–26. <https://doi.org/10.1080/01621459.1970.10481180>
- [9] Chatfield C. Model Uncertainty and Forecast Accuracy. *Journal of Forecasting*. 1996; 15(7):495–508. [https://doi.org/10.1002/\(SICI\)1099-131X\(199612\)15:7<495::AIDFOR640>3.0.CO;2-O](https://doi.org/10.1002/(SICI)1099-131X(199612)15:7<495::AIDFOR640>3.0.CO;2-O)
- [10] Arima Model. *International Journal of Development and Economic Sustainability* Vol.2, No. 2, pp. 37-47, June 2014
- [11] Brockwell P, Davis R. *Introduction to Time Series and Forecasting*. 2nd Edition. Springer; 2002. p. 1–449
- [12] Testing Normality in Time Series retrieved from [https://editorialexpress.com/cgi-bin/conference/download.cgi?db\\_name=res\\_phd\\_2012&paper\\_id=199](https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=res_phd_2012&paper_id=199)
- [13] Ljung GM, Box GEP. On the measure of a lack of fit in time series models. *Biometrika*. 1978; 65(2):297–303. <https://doi.org/10.1093/biomet/65.2.297>