FORECASTING THE PHILIPPINE INFLATION RATE USING BOX-JENKINS AUTOREGRESSIVE INTEGRATED MOVING AVERAGE AND MULTI-LAYER PERCEPTRON NEURAL NETWORK TECHNIQUES

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14th NCS National Convention on Statistics

1-3 October 2019 | Crowne Plaza Manila Galleria

Organized by the Philippine Statistical System

Spearheaded by the Philippine Statistics Authority

BACKGROUND OF THE STUDY

- Inflation is one of the biggest issues not only for macroeconomics but also for government across the world and it is the annual percentage of the cost of living as measured by the CPI.
- Labonte (2011): Two different views of Inflation in United States
- Hellerstein (1997): Perception of Inflation
- Ganesh (2010)
- Pettinger (2008)
- McMahon (2014): Forecasting the Inflation Rate

OBJECTIVE AND THE SIGNIFICANCE OF THE STUDY

- Objectives:
  - The researchers were motivated to study on Forecasting the Philippine Inflation Rate using Box-Jenkins Autoregressive Integrated Moving Average (ARIMA) Model and Multi-layer Perceptron Neural Network (MLPNN) techniques, for which the researchers will determine the behavior and will identify the best model of the inflation rate in the Philippines.
- Significance:
  - Government of the Philippines
  - Students

CONCEPTS OF TIME SERIES, ARIMA, NEURAL NETWORK and MLPNN

- Time Series and Time Series Analysis
- ARIMA

$$\phi(B)(1-B)^d \tilde{z}_t = \theta(B)a_t$$

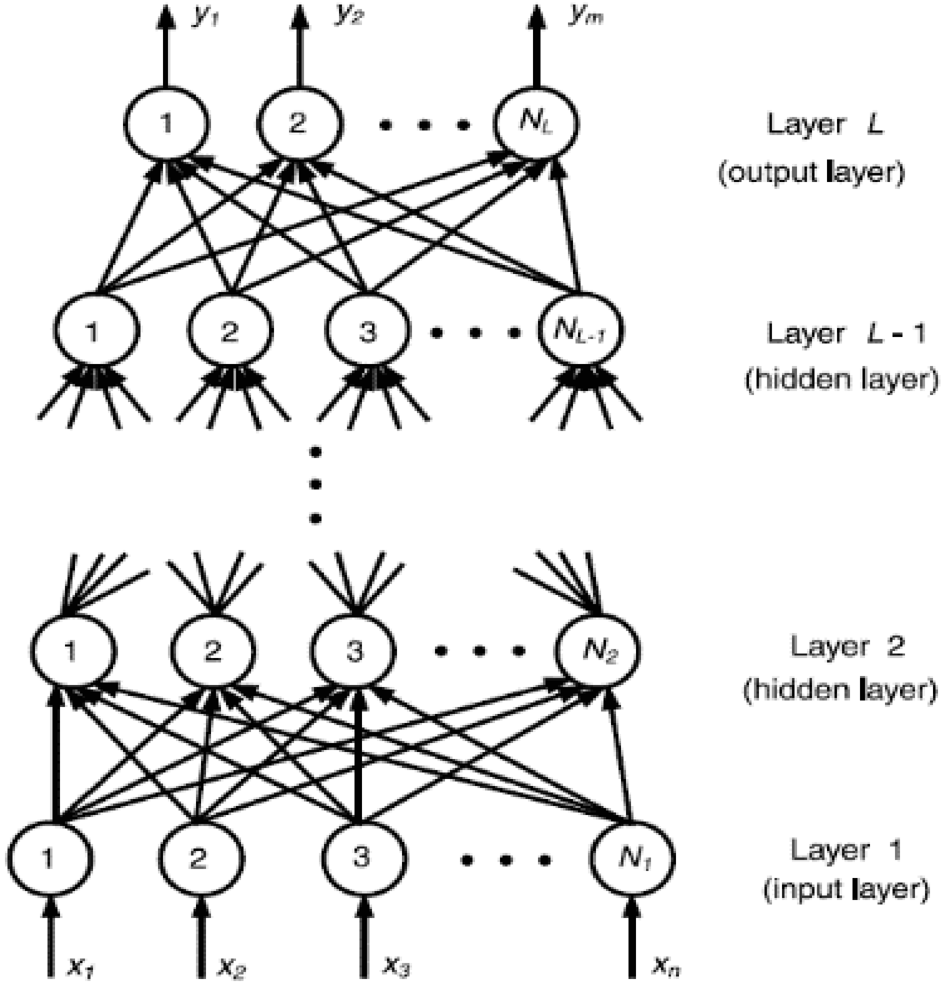
- Seasonal ARIMA

$$\Phi_P(B^s)\phi_p(B)(1-B)^d(1-B^s)^D \tilde{z}_t = \ \theta_q(B)\Theta_Q(B^s)a_t$$

where $\Phi_P(B^s) = 1 - \Phi_1 B^s - \Phi_2 B^{2s} - \cdots - \Phi_P B^{Ps},\ \Theta_Q(B^s) = 1 - \Theta_1 B^s - \Theta_2 B^{2s} - \cdots - \Theta_Q B^{Qs}$

CONCEPTS OF TIME SERIES, ARIMA, NEURAL NETWORK and MLPNN

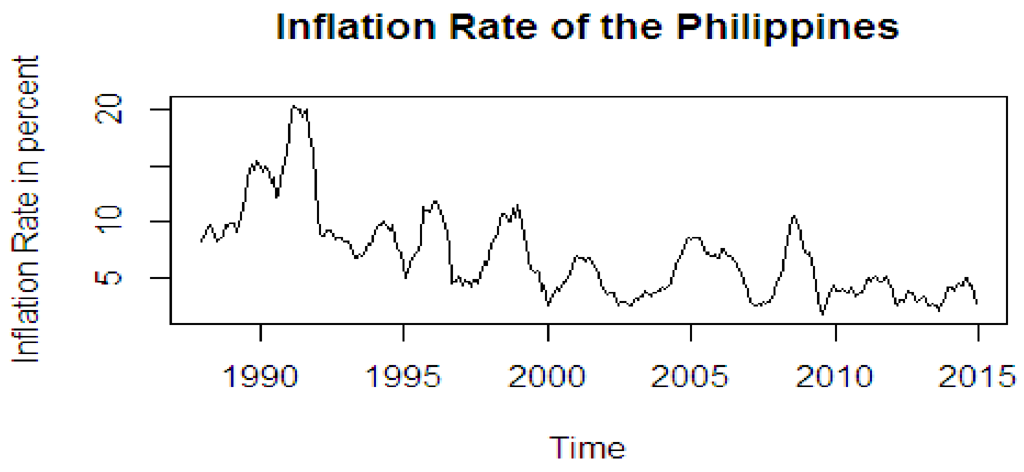
- Neural Network and MLPNN
  - ANN is information processing paradigm inspired by the way biological nervous system, such as the brain (Stergiou & Siganos, 1996)
  - MLPNN is the most popular type of neural networks in use today (as shown on the right side). The first and last layers are called input and output layers respectively, because they represent inputs and outputs of the overall network. The remaining layers are called hidden layers.

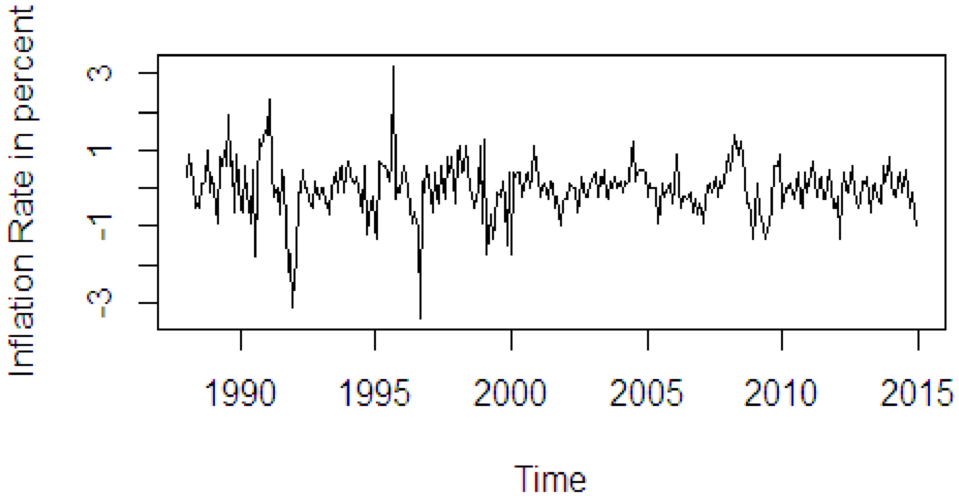


METHODS (PROCEDURES)

STEP	ARIMA	MLPNN
1	Model Identification -Stationarity Test, ACF and PACF plots, overfitting and best model based on AIC	Identify the number of layers in the network
2	Model Estimation -p-values	Identify the number of neurons is input and hidden layers. Choose an activation function
3	Model Diagnostics -Ljung-Box Q* Test	Test the Model
4	Forecast	

RESULTS

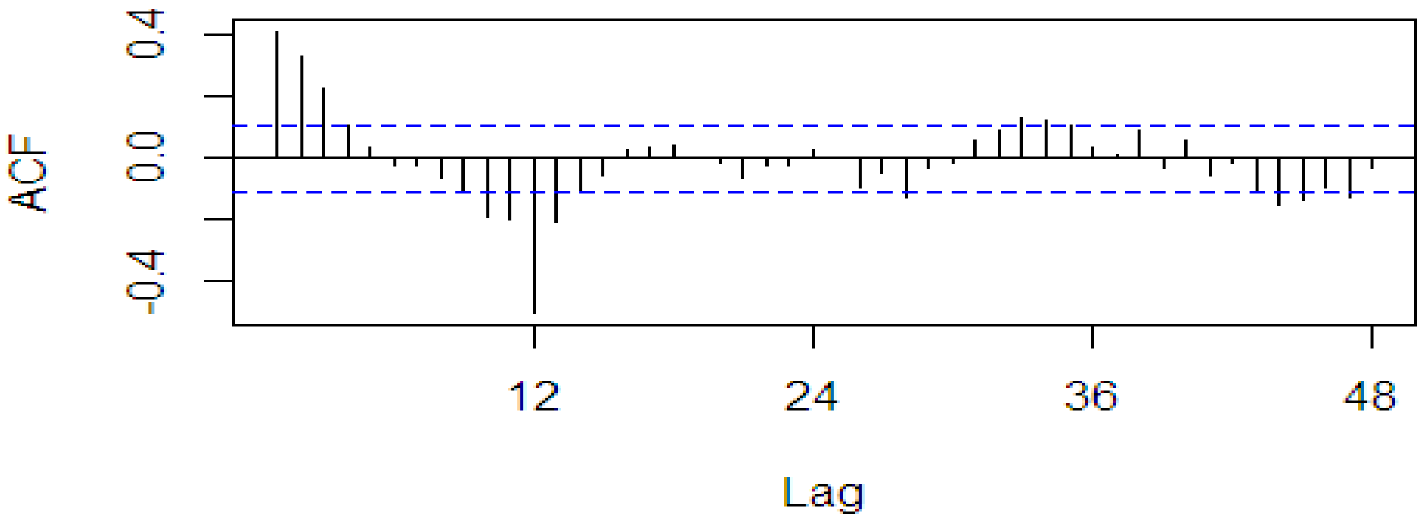


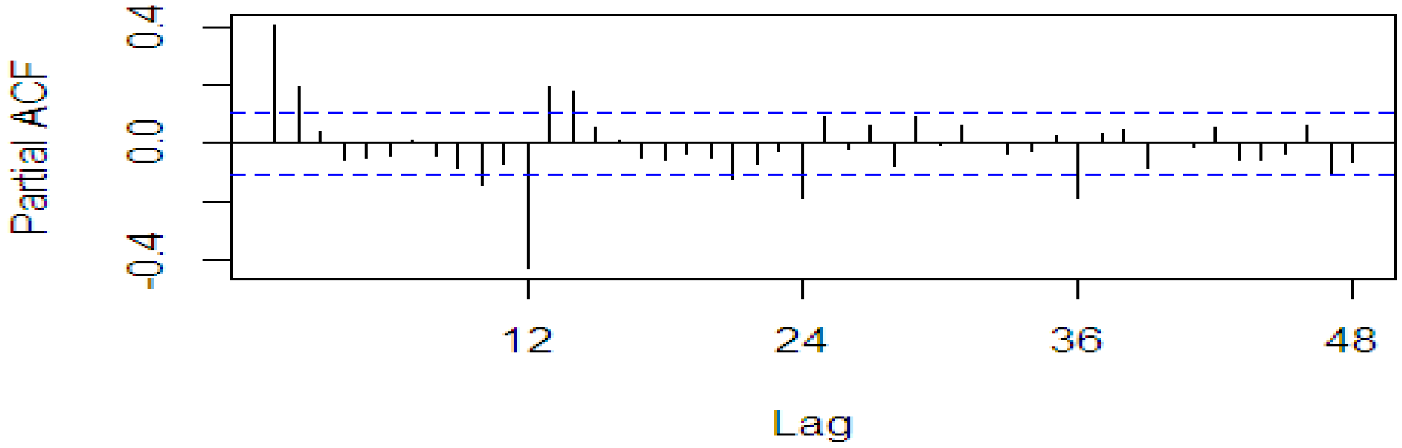


KPSS Test Statistic	Critical Value (5% level of significance)	Remark/s
15.968	0.463	Not Stationary

KPSS Statistic	Critical Value (5% level of significance)	Remark/s
0.0714	0.463	Stationary

ACF and PACF plots





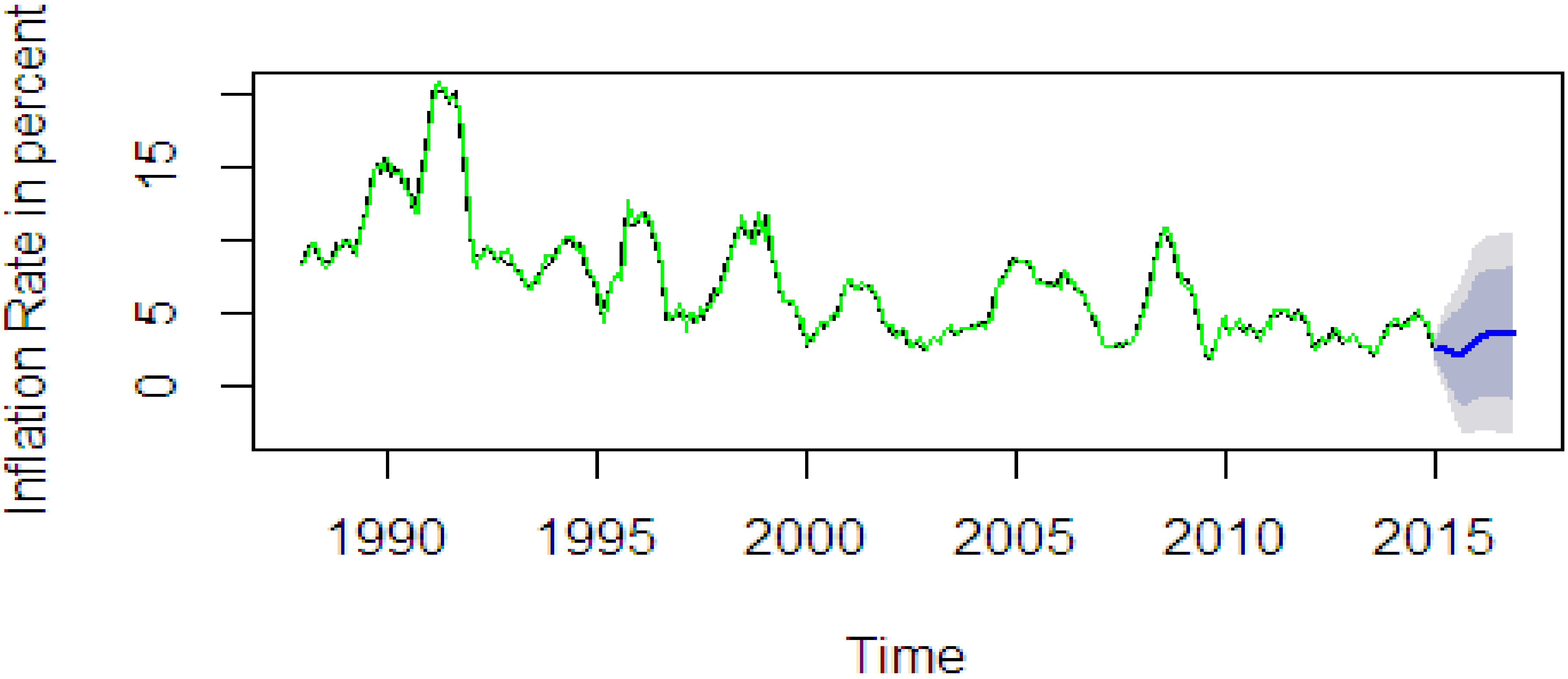
POSSIBLE MODELS, ESTIMATION and DIAGNOSTIC CHECKING OF THE BEST MODEL OF ARIMA

Tentative Models	AIC
ARIMA (2,1,0)	620.9
ARIMA $(2, 1, 0) \times (2, 0, 1)_{12}$	492.56
ARIMA $(2, 1, 0) \times (0, 0, 1)_{12}$	**490.22**
Overfitted Models	
ARIMA (3,1,0)	622.38
ARIMA (2,1,1)	622.59
ARIMA $(3, 1, 0) \times (2, 0, 1)_{12}$	493.70
ARIMA $(2, 1, 1) \times (2, 0, 1)_{12}$	493.95
ARIMA $(2, 1, 0) \times (3, 0, 1)_{12}$	494.45
ARIMA $(2, 1, 0) \times (2, 0, 2)_{12}$	494.13
ARIMA $(3, 1, 0) \times (0, 0, 1)_{12}$	491.54
ARIMA $(2, 1, 1) \times (0, 0, 1)_{12}$	491.76
ARIMA $(2, 1, 0) \times (1, 0, 1)_{12}$	491.70
ARIMA $(2, 1, 0) \times (0, 0, 2)_{12}$	491.78

Model	$AR(1)$	$AR(2)$	$SMA(1)$
Estimate	0.3152	0.2007	−0.7005
Standard Error	0.0545	0.0546	0.0439
Z	5.7890	3.6736	−15.9665
p-value	7.081×10^{-9}	0.0002	$< 2.2 \times 10^{-16}$

Q*	df	P-value	Remark/s
11.603	21	0.9497	Residuals are uncorrelated and the model is adequate

PREDICTED VALUES VERSUS ACTUAL INFLATION RATE IN THE PHILIPPINES BASED ON 'BEST' ARIMA MODEL



Model	Activation Function	MSE	MAE
ANN(12,4,1)	Semi-linear	23.50565	3.22651
	Sigmoid	0.44384	0.49983
	Bipolar Sigmoid	0.31846	0.42093
	Hyperbolic Tangent	0.62532	0.61098
ANN(24,5,1)	Semi-linear	20.49447	2.94138
	Sigmoid	0.40946	0.45031
	Bipolar Sigmoid	0.21639	0.35090
	Hyperbolic Tangent	0.59485	0.67263

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P-value	Remark/s
0.0561	Residuals are uncorrelated

Month	Actual	Forecast based on ARIMA$(2, 1, 0) \times (0, 0, 1)_{12}$	Absolute Error	Forecast based on ANN(48, 7, 1) with Bipolar Sigmoid Function	Absolute Error
January 2015	2.4	2.3998	0.0002	2.6291	0.2291
February 2015	2.5	2.3724	0.1276	2.8770	0.3770
March 2015	2.4	2.5012	0.1012	3.3197	0.9197
April 2015	2.2	2.4899	0.2899	3.2358	1.0358
May 2015	1.6	2.2107	0.6107	2.9426	1.3426
June 2015	1.2	2.2665	1.0665	2.9158	1.7158
July 2015	0.8	1.9909	1.1909	2.8220	2.0220
August 2015	0.6	2.0214	1.4214	2.8438	2.2438
September 2015	0.4	2.1029	1.7029	2.8447	2.4447
October 2015	0.4	2.1756	1.7756	3.0189	2.6189
November 2015	1.1	2.5709	1.4709	3.2227	2.1227
December 2015	1.5	2.9317	1.4317	3.4125	1.9125
MAE		**0.9325**		1.5821	