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Forecasting value of production of palay and retail price of rice in the Philippines using ARIMA modelling

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Abstract

As rice (milled palay) is an integral part of a Filipino meal, it is important to have an accurate estimation of its governing economic factors such as value of production and retail price. This study utilized Autoregressive Integrated Moving Average (ARIMA) Modelling and Box-Jenkins Method to forecast the value of production of palay and the retail price of the three varieties of its end-product, rice (regular-milled, well-milled, and special), for 2023 to 2027 using historical data from 2000 to 2022, and from 2012 to 2021, respectively. Results suggested that ARIMA (4, 1, 1) can be used to predict the value of production of palay, and ARIMA (1, 1, 1) to predict the retail prices of the three rice varieties. The value of production of palay was forecasted to continuously increase for the next 5 years, retaining its annual seasonal behavior. The retail price of all the three rice varieties were also forecasted to continuously increase, with the special variety of rice expected to surpass its 2018 maximum value by 2027. This study will be of significance in ensuring adequacy and stability of supply in the country for this major agricultural crop.

Keywords: ARIMA; EViews; Palay; Rice; Agriculture; Forecasting

1. Introduction

Philippines is known for its agriculture industry, able to produce a wide variety of feed crops. Its agricultural landscape is an important sector for inclusive growth, especially in the rural areas where agriculture is the primary economic driver [1]. Among the country's feed crops, palay is the most important one since it serves as a major source of income, particularly of millions of Filipino farmers. As of Q4 of 2022, palay production was recorded at 7.22 million metric tons [4], contributing the biggest share in Philippines' GDP among the crops.

Palay is milled to produce rice, which is the staple food of about 80 percent of Filipinos [4]. It is an essential component of any Filipino meal, forming the basis of the Filipino diet on average. Rice is integral to the Filipino concept of a meal, being crucial for commensality in Philippine households [3]. Aside from its regular consumption with viand for every meal of the day, it is also eaten in different ways depending on the socio-economic class. For relatively low-income households, rice can be cooked as porridge or "lugaw", or steamed and served plain with soy sauce. For average to high income households, rice can be served as "merienda" in the form of native delicacies such as "biko" and "suman" [3].

Because of the significance of palay and rice in the country, the government is significantly involved in its supply chain to ensure adequate and stable supply. Currently, the National Food Authority (NFA) under the Department of Agriculture is tasked for the monitoring and strict implementation of the various programs for this product. In 2018, the NFA Council developed guidelines in the suggested retail price (SRP) of rice strictly classifying it in the market into: regular-milled, well-milled, special, and premium. Regular-milled rice are those that contain about 20-40% bran streaks; well-milled rice with 1-19% bran streaks; and premium grade if it contains a maximum of 5% broken kernels

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with 0-19% bran streaks. Special rice are glutinous, aromatic, pigmented japonica, micronutrient-dense rice, including varieties with excellent eating and nutritive quality) [2].

Objectives of the Study

This study aims to answer the following:

- How do the value of production of palay and the retail price of the three varieties of rice (regular-milled, well-milled, and special) behave for the past years?
- What ARIMA Models would best fit these variables?
- What are the forecasted values of production of palay from 2023 to 2027?
- What are the forecasted retail prices of regular-milled, well-milled, and special rice from 2022 to 2027?

1.1. Scope and Limitation

The study only focused on the use of ARIMA modelling and Box-Jenkins Method in forecasting using the software, Econometrics View (EViews) with version number 12. Furthermore, the variables used in the study were limited on the quarterly value of production of palay from 2000 to 2022 (total of 92 observations) and monthly retail prices of only the three varieties of rice (regular-milled, well-milled, and special) from 2012 to 2021 (total of 120 observations), as available in the Philippine Statistics Authority (PSA) website.

1.2. Conceptual Framework

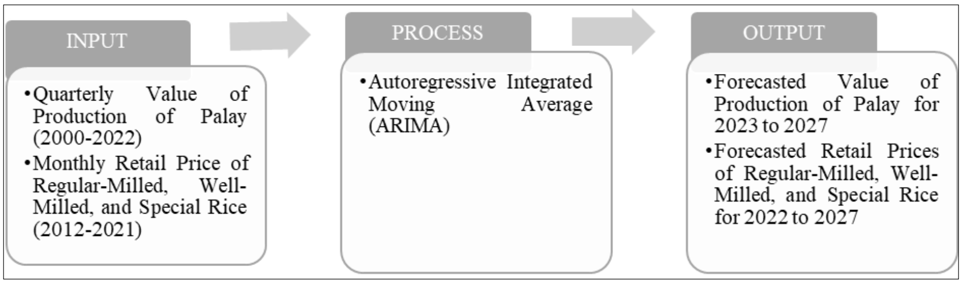

Figure 1 Research Paradigm Used in the Study

The quarterly value of production of palay from 2000 to 2022, and monthly retail prices from 2012 to 2021 of the three rice varieties in the Philippines were used for a three-step research paradigm in this study, as shown in Figure 1.

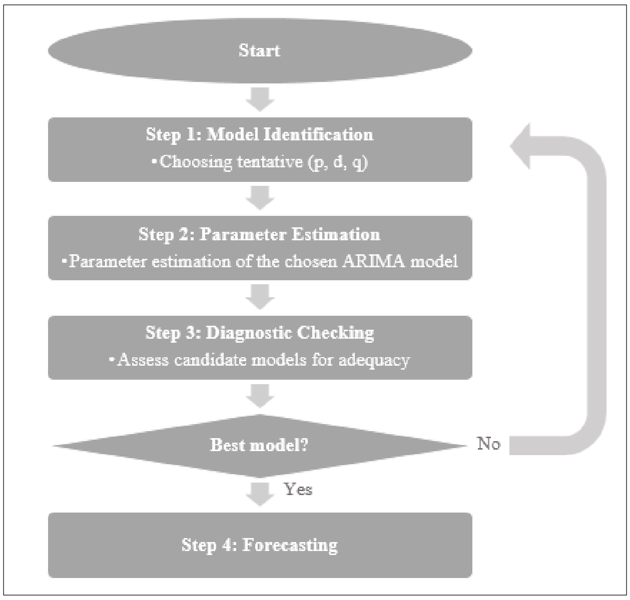

Figure 2 Conceptual Framework of the Study

The study utilized the Box-Jenkins method (Figure 2) to forecast the value of production of palay and the retail prices of the rice varieties for the next five years (2023 to 2027).

1.3. Review of Related Literature

In the study of Urrutia et. al. [5] the total production of palay and corn were predicted using Seasonal Autoregressive Integrated Moving Average (SARIMA) Modelling and Box-Jenkins method of forecasting. The researchers were able to conclude that SARIMA (2 1 8)(1 1 0)4 and SARIMA (3 1 8)(0 1 1)4 are the best fit models for forecasting palay and corn productions, respectively.

Prices of rice, wheat, and corn were also predicted by Cortez [8] where 309 records were gathered to develop a variety of models. The construction of the models relied on the assumption that the models' structures will not change over time, hence, the ARIMA model for their proposed integrated models need not be rebuilt even if additional sample data become available. This gave it a big advantage over other models. To put it another way, the ARIMA feature selection procedure only requires one go-through. To make predictions, typical CI forecasting methods require the right explanatory variables. However, it was concluded that it is impossible to obtain the future values of proper explanatory variables because they are difficult to capture. To forecast the prices of three important food crops in their paper, they proposed integrating the ARIMA-ANN, ARIMA-SVR, and ARIMA-MARS models [9]

In 2018, the country's rice inventory decreased by 17.91%, falling below the 1,422.84 thousand metric tons it had in the previous year [6]. This trend of continuously falling rice stocks continued for several months, giving an inventory that is only sufficient for 62 days based on Filipinos' average daily consumption of 32,000 MT, indicating a rice shortage or a rice crisis [7]. In order to minimize risk in situations such as this, close monitoring and accurate prediction of the trend in the agriculture industry of the Philippines is needed.

2. Material and methods

2.1. Data Source

The time-series data used in the study of value of production of palay and retail price of regular-milled rice, well-milled rice, and special rice in the Philippines were obtained from the Philippine Statistics Authority (PSA) website.

2.2. Statistical Tool

The data were treated using Econometrics Views (EViews) version 12, a statistical tool widely used for financial and macroeconomic analyses and forecasting.

2.3. Model Description

The statistical model used for the study is the Autoregressive Integrated Moving Average (ARIMA) model. An ARIMA model is a univariate forecasting model that predicts future values of a time-series data using its own historical or past values. It divides a time-series data into 3 components – p, d, and q – that function as parameters to indicate the type of model. The autoregressive component, denoted as ***p***, refers to the number of lag observations which is also known as the lag order. The differencing component or degree of differencing, ***d***, is the number of times the raw observations are differenced in order to achieve stationarity. The moving average component or the order of the moving average, ***q***, describes the outside "shocks" to the model. Hence the notation, ***ARIMA (p, d, q).***

In order to accurately forecast the selected time-series data, the study specifically used the Box-Jenkins method which is composed of an iterative three-stage process:

- Model identification,
- Parameter estimation,
- Diagnostic checking.

2.3.1. Model Identification

ARIMA models require that the time series should be stationary which means that its statistical properties, such as mean and variance, should be constant over time and there should be no indication of seasonality. The model identification step involves ensuring this stationarity. The researchers used the Augmented Dickey-Fuller (ADF) test for this step, where its null hypothesis is that the time series has unit root, i.e., non-stationary. In order to achieve stationarity, the data were differenced by varying the component ***d*** until the null hypothesis is rejected.

Once the data were stationary, the researchers identified possible candidates for the autoregressive (***p***) and moving average (***q***) components by observing the correlogram which is the graphical representation of the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF). In a correlogram, both the ACF and PACF plots are presented as bar charts showing 95% confidence intervals as the visually indicative horizontal lines. Bars crossing these horizontal lines were noted as possible candidates with the PACF as the reference for ***p*** candidates, and ACF as the reference for ***q*** candidates.

2.3.2. Parameter Estimation

After identifying the possible candidates for the ARIMA components, parameter values were estimated to obtain the best-fit model for the time series data. The best-fit model was selected by comparing the (a) adjusted r-squared, (b) Akaike information criterion, (c) Schwartz criterion, and (d) Hannan-Quinn criterion. The model that minimizes the value of the latter 3 criteria (and highest adjusted r-squared) was chosen as the best ARIMA model for forecasting the data.

Diagnostic Checking

The objective of the diagnostic checking is to check the adequacy of the model to predict the future data by considering the autocorrelations of the residuals. For this step, the researchers checked if the model satisfies the requirements for a stable univariate process:

- Residuals of the model are white noise.
- The model is (covariance) stationary.
- The model is invertible.

Ljung Box Q statistic was used for the first requirement with the null hypothesis that the autocorrelations of the residuals are zero, i.e., the residuals are white noise. The p-value should be greater than alpha across all the lags in order for the model to satisfy this. Additionally, the AR roots and MA roots should lie inside the unit circle for the model to be concluded as (covariance) stationary and invertible, respectively. If the model was able to satisfy all of these requirements, it can be, therefore, used to generate forecasts.

3. Results and discussion

3.1. Value of Production of Palay

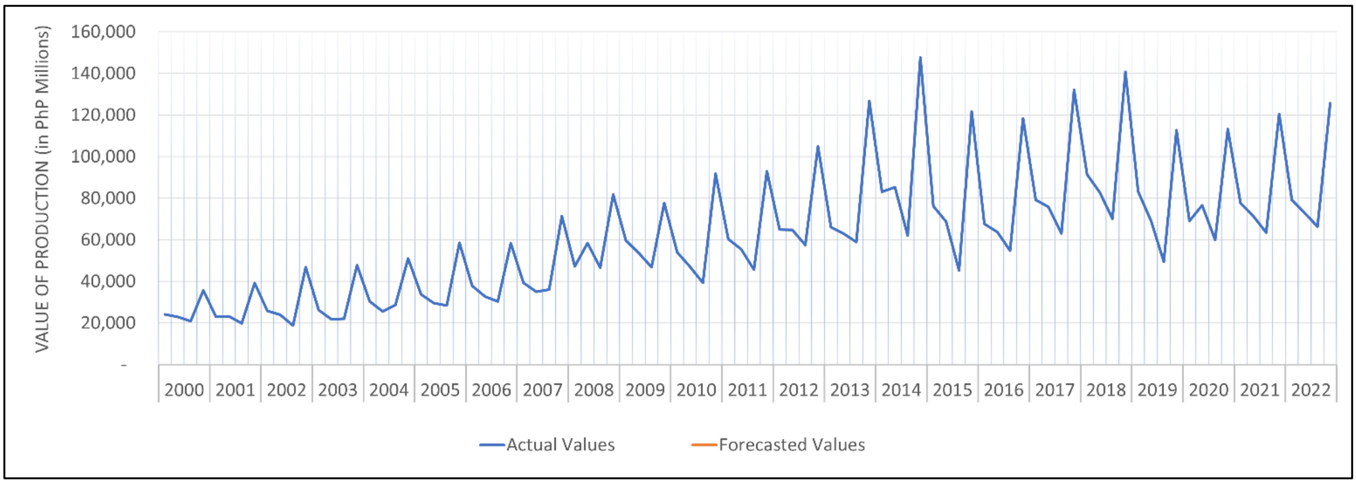

Figure 3 Value of production of palay from 2000 to 2022

As can be seen in Figure 3, the value of production of palay (VOP) in the Philippines from 2000 to 2022 displays an oscillating behavior indicating seasonality. Highest values were recorded every fourth quarter of the year which can possibly be attributed to more productive work during this humid season. On the other hand, lowest values were recorded every third quarter of the year which can possibly be due to the presence of strong typhoons during this time of the year.

The presence of seasonality observed in the graph was further verified with the data failing to reject the null hypothesis of Augmented Dickey-Fuller (ADF) test, i.e., the VOP time series of palay has unit root. Hence, differencing was done with d=1 rejecting the null hypothesis shown in Table 1.

Table 1 p-Values for the Augmented Dickey-Fuller (ADF) test on level and 1st order differencing of values of production of palay. (If p-value is less than α=0.05, null hypothesis is to be rejected.)

	Level	**1st Differencingd=1**
Intercept	0.607233	0.000227
Trend and Intercept	0.324040	0.001502
None	0.883472	0.000019

Possible candidates for the ARIMA ***p*** and ***q*** components were then identified by generating the correlogram (Figure 4) and subsequently, estimating the equation. Using the Akaike information, Schwartz, and Hannan-Quinn criteria, ARIMA (4, 1, 1) was the best model among the candidates model (Table 2), able to minimize the value of these criteria.

Table 2 Summary of the ARIMA model candidates with the criteria values for the diagnostic checking

	Adjusted R-squared	**Akaike info criterion**	**Schwartz criterion**	**Hannan-Quinn criterion**
ARIMA (1,1,1)	0.5585	22.8306	22.9410	22.8752
ARIMA (1,1,3)	0.5586	22.8549	22.9653	22.8995
ARIMA (1,1,4)	0.6971	22.4719	22.5823	22.5164
ARIMA (2,1,1)	0.5441	22.8632	22.9736	22.9078
ARIMA (2,1,3)	0.5441	22.8632	22.9736	22.9078
ARIMA (2,1,4)	0.5441	22.8632	22.9736	22.9078
ARIMA (3,1,1)	0.5689	22.8085	22.9189	22.8530
ARIMA (3,1,3)	0.5096	22.9587	23.0691	23.0032
ARIMA (3,1,4)	0.7021	22.4643	22.5747	22.5089
ARIMA (4,1,1)	0.9296	21.0733	21.1837	21.1179
ARIMA (4,1,3)	0.9252	21.1365	21.2468	21.1810
ARIMA (4,1,4)	0.9288	21.0964	21.2068	21.1409
ARIMA (4,1,5)	0.9243	21.1514	21.2617	21.1959
ARIMA (4,1,6)	0.9255	21.1394	21.2497	21.1839
ARIMA (4,1,10)	0.9244	21.1511	21.2615	21.1956
ARIMA (6,1,1)	0.5555	22.8398	22.9502	22.8843
ARIMA (6,1,4)	0.6218	22.7017	22.8121	22.7463
ARIMA (1,2,1)	0.7522	23.4046	23.5157	23.4494
ARIMA (2,2,1)	0.6581	23.7114	23.8225	23.7562
ARIMA (4,2,1)	0.9749	21.1572	21.2683	21.2020

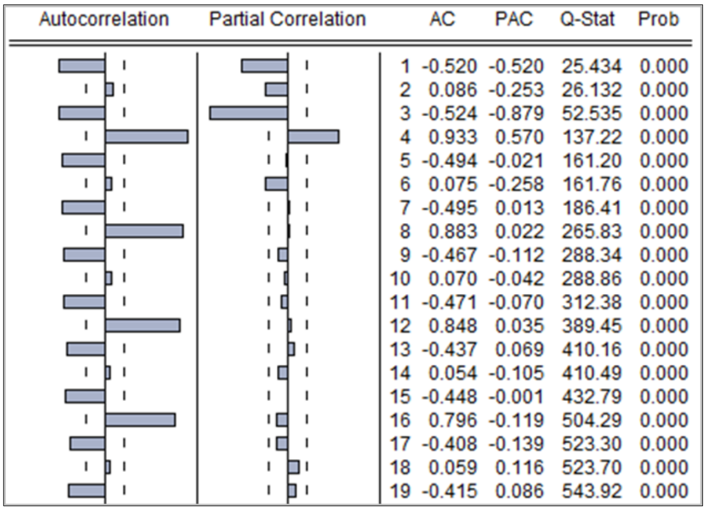

Figure 4 Correlogram for the ACF and PACF for the value of production of palay. (Bars crossing the confidence interval lines indicate possible candidates for the ARIMA p and q components.)

The adequacy of ARIMA (4, 1, 1) was further checked using the Ljung Box Q statistic and the unit circle (Figure 5), and hence was used to generate forecast of value of production of palay for the next five years (2023 – 2027). The coefficients for this ARIMA model can be seen in

Table 3.

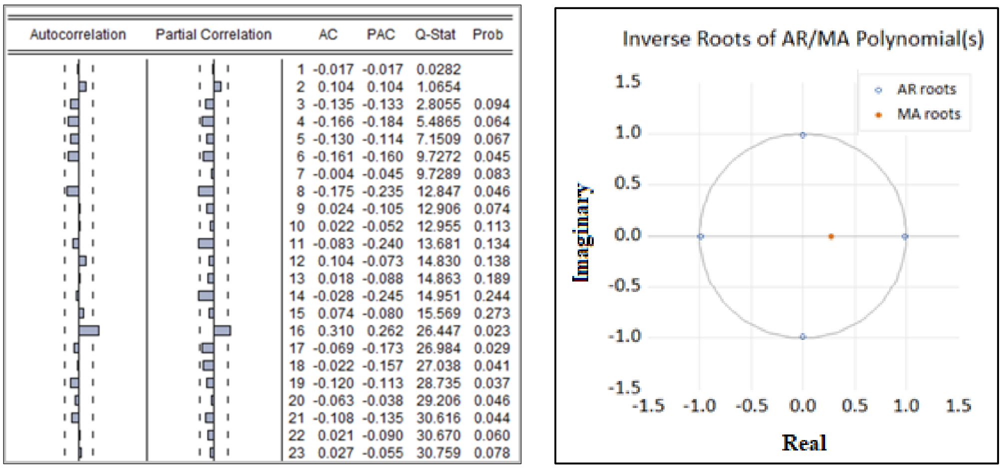

Figure 5 (a) Correlogram for the Ljung Box Q Statistic, and (b) unit circle test for ARIMA (4,1,1) model

Table 3 Coefficients obtained for the ARIMA (4,1,1) forecast model of value of production of palay

c	651.4427964
AR (4)	0.948181129
MA (1)	-0.276847693

As can be seen in Figure 6, the behavior of the forecasted values is consistent with the continuously upward direction of the historical values with maximum values during the 4th quarter and minimum values during the 3rd quarter of every year. Additionally, the variation between years is forecasted to be constant for the next 5 years. The specific values can be found in **Error! Reference source not found.**.

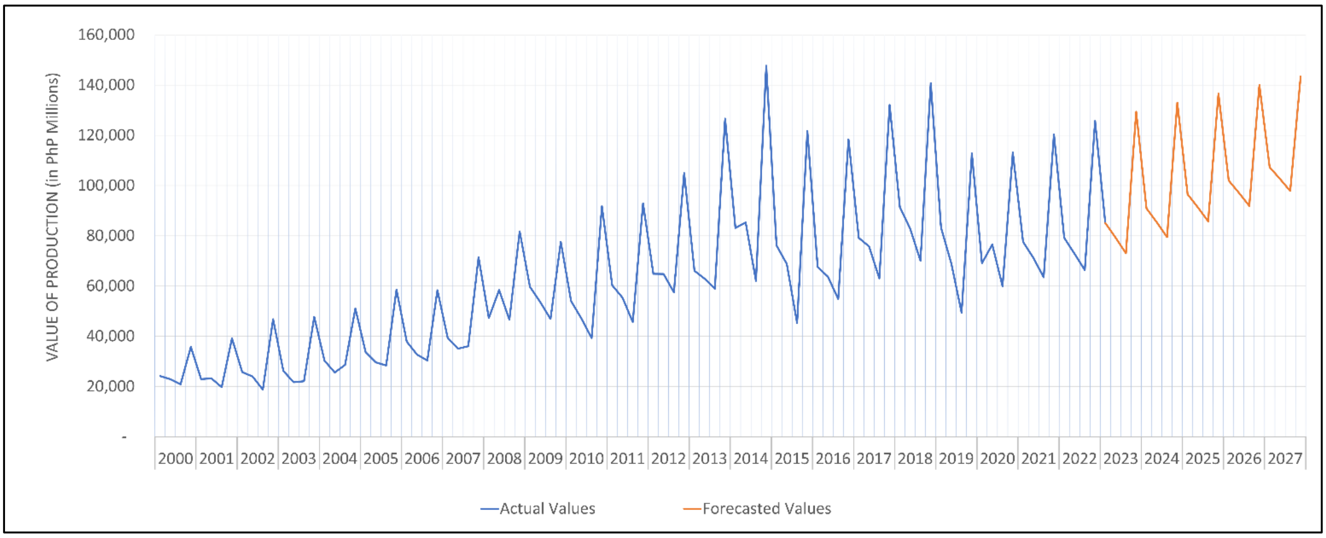

Figure 6 Combined actual (2000-2022) and forecasted (2023-2027) value of production of palay

3.2. Retail Price of Rice

Retail prices of the three rice varieties (regular-milled, well-milled, and special) have continuously increased from 2012 to 2014, and eventually stabilizing starting from 2015 to 2017. However, by 2018, there was an upsurge on the retail price of rice. During this time, regular-milled rice was priced at PhP 49.83 per kg, well-milled rice at PhP 46.19 per kg, and special rice at PhP 54.69 per kg. Inflation, shortage of National Food Authority (NFA) rice, along with the implementation of the Tax Reform for Acceleration and Inclusion (TRAIN) law in January of this year may have contributed to this increase. Starting 2019, there has been an observed continuous decrease which can possibly be due to government efforts such as the Rice Tariffication Law (RTL) to lower retail price of rice and use the tariff revenues to provide more assistance to farmers.

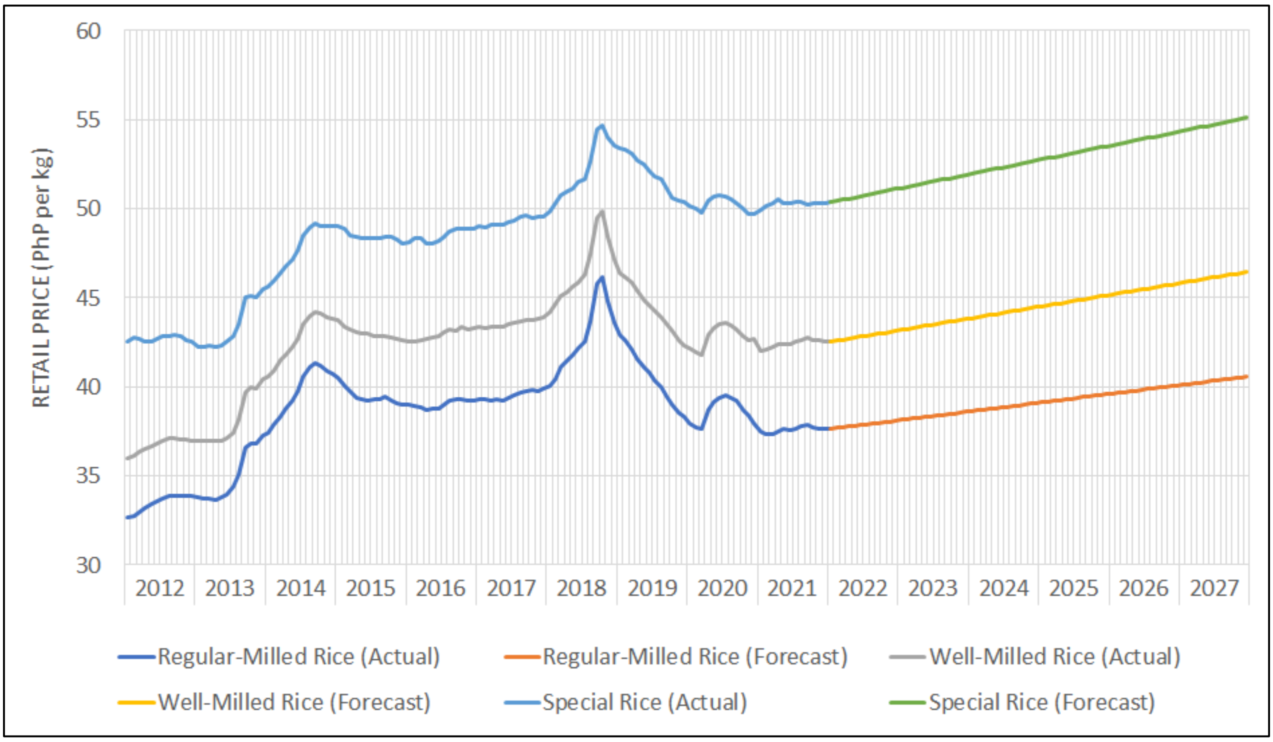

Figure 7 Historical data of retail prices of regular-milled, well-milled, and special rice from 2012 to 2021

To identify if differencing is needed for the time series to be stationary, ADF test was also used, with Table 4 showing that differencing at d=1 for all rice varieties was needed to achieve stationarity.

Similar with the procedure for the VOP of palay, possible model candidates were determined using the three criteria previously discussed. It was found out that ARIMA (1, 1, 1) was the best among the possible candidates for all the rice varieties. This can possibly be because of the similar behavior displayed by the time series of the three varieties.

Table 4 p-Values for the Augmented Dickey-Fuller (ADF) test on level and 1st order differencing of retail price of the 3 varieties of rice. (If p-value is less than α=0.05, null hypothesis is to be rejected.)

	Regular-Milled Rice		**Well-Milled Rice**		**Special Rice**	
	Level	**1st differencing**	**Level**	**1st differencing**	**Level**	**1st differencing**
Intercept	0.2150	2.1500E-06	0.2134	4.9000E-07	0.4083	1.0100E-06
Trend and Intercept	0.7660	8.4200E-06	0.8004	1.9300E-06	0.7870	6.8700E-06
None	0.7974	1.0000E-08	0.8661	0.0000E+00	0.9078	1.0000E-08

Table 5 Summary of the ARIMA model candidates for retail price of rice varieties with the criteria values for the diagnostic checking

	Adjusted R-squared	**Akaike info criterion**	**Schwartz criterion**	**Hannan-Quinn criterion**
Regular-Milled Rice				
ARIMA (1, 1, 1)	**0.4582**	**0.5851**	**0.6785**	**0.6230**
ARIMA (1, 1, 2)	**0.4475**	0.6042	0.6976	0.6421
ARIMA (2, 1, 1)	**0.4444**	0.6096	0.7031	0.6476
ARIMA (2, 1, 2)	**0.0568**	1.1348	1.2282	1.1727
Well-Milled Rice				
ARIMA (1, 1, 1)	**0.3959**	**0.5965**	**0.6900**	**0.6345**
ARIMA (1, 1, 2)	**0.3890**	0.6077	0.7011	0.6456
ARIMA (1, 1, 17)	**0.3771**	0.6313	0.7247	0.6692
ARIMA (2, 1, 1)	**0.3841**	0.6152	0.7086	0.6532
ARIMA (2, 1, 2)	**0.0197**	1.0762	1.1696	1.1141
ARIMA (2, 1, 17)	**0.0731**	1.0274	1.1209	1.0654
Special Rice				
ARIMA (1, 1, 1)	**0.3074**	**0.3387**	**0.4322**	**0.3767**
ARIMA (1, 1, 16)	**0.2781**	0.3806	0.4740	0.4185
ARIMA (3, 1, 1)	**0.3004**	0.3488	0.4422	0.3868
ARIMA (3, 1, 16)	**0.0439**	0.6642	0.7576	0.7021

Furthermore, ARIMA (1, 1, 1) was able to satisfy all the requirements for a stable univariate process on the three rice varieties, with Ljung Box Q Statistics and the unit circles shown in Figure 8Figure 10Figure 9

Date: 02/23/23 Time: 17:33
Sample (adjusted): 2012M02 2021M12
Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.009	0.009	0.0097	
		2	-0.004	-0.004	0.0115	
		3	-0.021	-0.021	0.0677	0.795
		4	0.017	0.018	0.1048	0.949
		5	0.068	0.067	0.6849	0.877
		6	0.042	0.041	0.9107	0.923
		7	-0.039	-0.039	1.1062	0.954
		8	-0.037	-0.034	1.2863	0.972
		9	-0.063	-0.063	1.7989	0.970
		10	0.032	0.026	1.9371	0.983
		11	-0.003	-0.009	1.9385	0.992
		12	0.028	0.031	2.0416	0.996
		13	-0.002	0.009	2.0421	0.998
		14	-0.065	-0.057	2.6168	0.998
		15	0.012	0.013	2.6372	0.999
		16	-0.076	-0.086	3.4373	0.998
		17	-0.149	-0.159	6.5767	0.968
		18	-0.098	-0.106	7.9537	0.950
		19	0.098	0.111	9.3359	0.929
		20	0.026	0.033	9.4358	0.949
		21	0.025	0.042	9.5277	0.964
		22	0.018	0.052	9.5749	0.975
		23	-0.005	0.005	9.5783	0.984

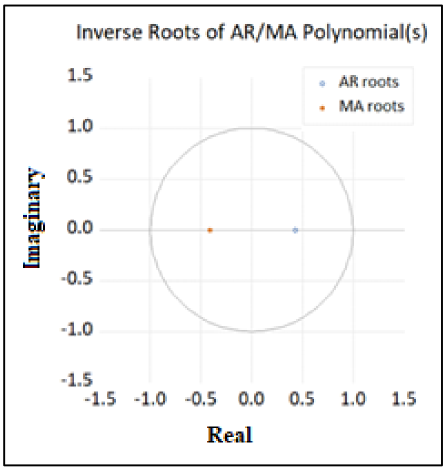

Figure 8 (a) Correlogram for the Ljung Box Q Statistic, and (b) unit circle test for ARIMA (1,1,1) model of regular-milled rice

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.008	0.008	0.0072	
		2	-0.003	-0.003	0.0083	
		3	-0.014	-0.014	0.0312	0.860
		4	0.001	0.001	0.0313	0.984
		5	0.050	0.050	0.3462	0.951
		6	0.059	0.059	0.7951	0.939
		7	-0.007	-0.008	0.8015	0.977
		8	0.049	0.051	1.1167	0.981
		9	-0.158	-0.158	4.3735	0.736
		10	0.112	0.116	6.0233	0.645
		11	-0.049	-0.064	6.3471	0.705
		12	0.024	0.026	6.4266	0.778
		13	-0.041	-0.049	6.6538	0.826
		14	-0.046	-0.035	6.9485	0.861
		15	-0.039	-0.031	7.1564	0.894
		16	-0.024	-0.038	7.2362	0.925
		17	-0.168	-0.154	11.220	0.737
		18	-0.091	-0.129	12.407	0.716

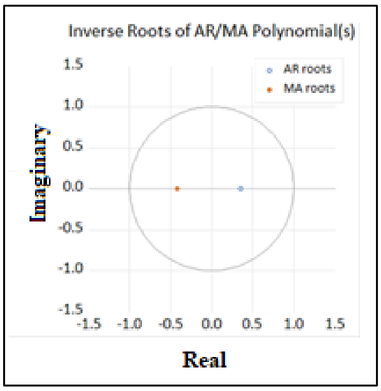

Figure 9 (a) Correlogram for the Ljung Box Q Statistic, and (b) unit circle test for ARIMA (1,1,1) model of well-milled rice

Date: 02/23/23 Time: 17:48
Sample (adjusted): 2012M02 2021M12
Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.005	-0.005	0.0026	
		2	0.019	0.019	0.0450	
		3	0.086	0.086	0.9636	0.326
		4	0.035	0.035	1.1130	0.573
		5	0.057	0.055	1.5204	0.678
		6	0.099	0.093	2.7748	0.596
		7	0.033	0.028	2.9148	0.713
		8	-0.053	-0.066	3.2789	0.773
		9	-0.032	-0.056	3.4165	0.844
		10	0.067	0.054	4.0089	0.856
		11	-0.031	-0.032	4.1372	0.902
		12	0.029	0.025	4.2502	0.935
		13	-0.150	-0.159	7.2940	0.775
		14	0.047	0.063	7.6032	0.815
		15	-0.069	-0.066	8.2644	0.826
		16	-0.103	-0.095	9.7521	0.780
		17	-0.109	-0.124	11.438	0.721
		18	-0.139	-0.121	14.173	0.586
		19	0.087	0.142	15.268	0.576
		20	-0.026	0.004	15.366	0.637
		21	-0.035	0.000	15.545	0.687
		22	-0.021	-0.013	15.611	0.740

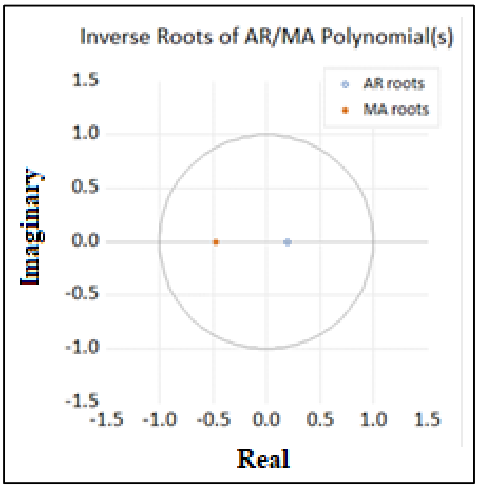

Figure 10 (a) Correlogram for the Ljung Box Q Statistic, and (b) unit circle test for ARIMA (1,1,1) model of special rice

The coefficients of the ARIMA (1,1,1) model obtained are shown in Table 6.

Table 6 ARIMA (1,1,1) model coefficients for the retail prices of the three varieties of rice

	Regular-Milled Rice	Well-Milled Rice	Special Rice
c	0.041155	0.055277	0.066787
AR (4)	0.433279	0.351145	0.198946
MA (1)	0.410176	0.424333	0.476780

ARIMA (1, 1, 1) was then used to generate forecast for the retail price of regular-milled rice, well-milled rice, and special rice for the year 2022 to 2027. The retail prices of the three varieties of rice are expected to continuously increase for the next 5 years, with a notable price of PhP 54.70 for special rice starting June 2027, surpassing the all-time high PhP 54.69 in October 2018. The actual and forecasted values can be found in **Error! Reference source not found.**.

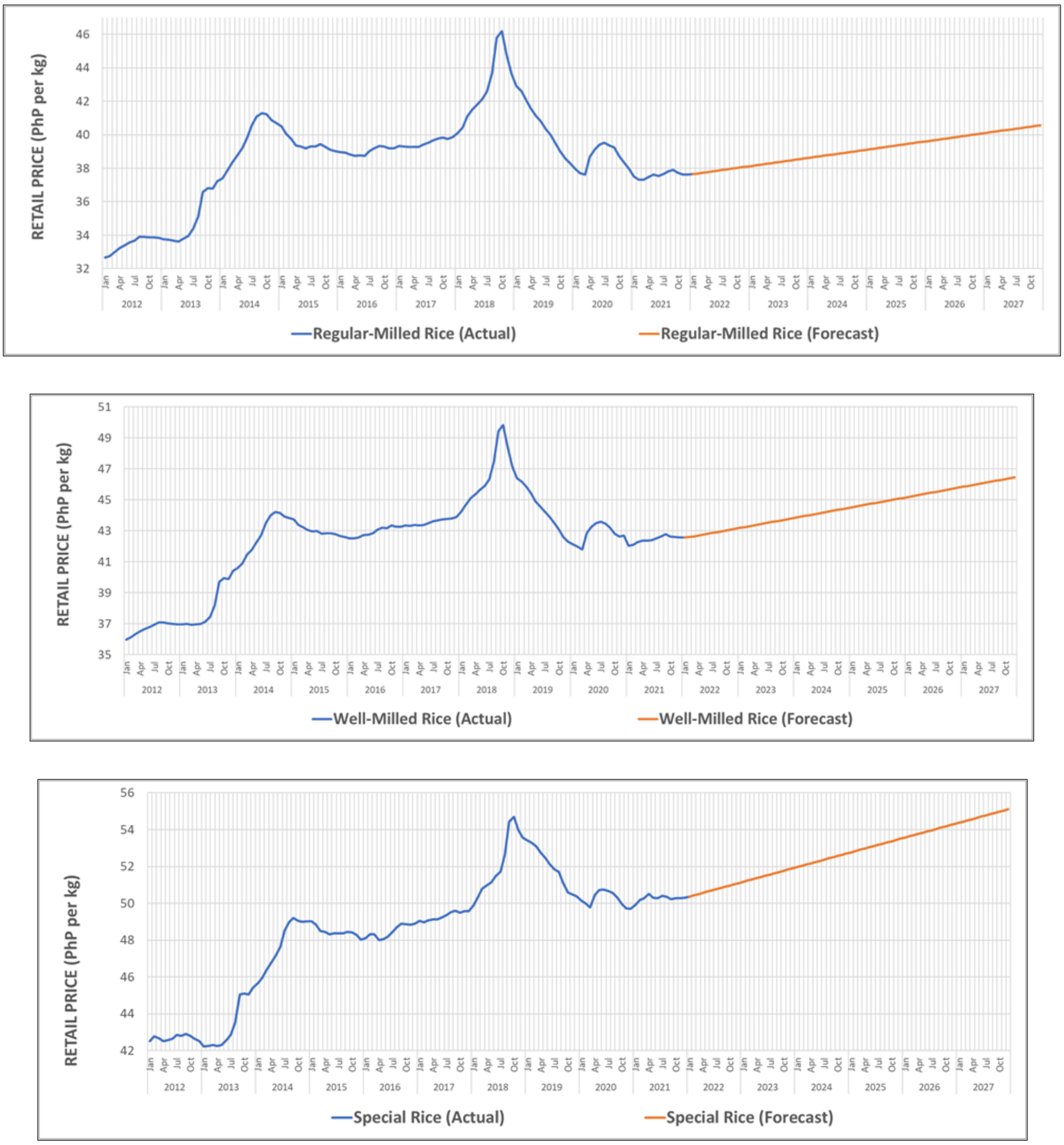

Figure 11 Combined actual (2012-2021) and forecasted (2022-2027) values of retail price of (a) regular-milled rice, (b) well-milled rice, and (c) special variety of rice

4. Conclusion

The study was able to generate an ARIMA model to provide a 5-year forecast for the value of production of palay, and retail prices of regular-milled, well-milled, and special varieties of rice. ARIMA (4, 1, 1) was found out to be the best-fit model for the value of production of palay, while ARIMA (1, 1, 1) was found out to be the best-fit model for the retail prices of the three rice varieties. Value of production of palay was forecasted to continuously increase and retain its seasonal behavior for the next 5 years. Retail prices of different rice varieties were also forecasted to continuously increase for the next 5 years.

The researchers recommend to quantify the relationship between these variables to further understand their behavior and check for possible causality. Moreover, multivariate forecasting methods may also be used to account for other possible factors and provide a more accurate forecast of the said variables.

Compliance with ethical standards

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Disclosure of conflict of interest

The researchers have no affiliations with or involvement in any organizations, or entities with any financial, and non-financial interest in the subject matter, materials, and methods discussed in this study.

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Appendix A

Actual and Forecasted Value of Production of Palay (in PhP Millions)

Period	Value of Production
Actual	
Q1 2000	24136
Q2 2000	22965
Q3 2000	20917
Q4 2000	35715
Q1 2001	22905
Q2 2001	23215
Q3 2001	19779
Q4 2001	39191
Q1 2002	25749
Q2 2002	24016
Q3 2002	18793
Q4 2002	46795
Q1 2003	26207
Q2 2003	21760
Q3 2003	22091
Q4 2003	47707
Q1 2004	30326
Q2 2004	25617
Q3 2004	28659
Q4 2004	51024
Q1 2005	33729
Q2 2005	29596
Q3 2005	28391
Q4 2005	58595
Q1 2006	37855
Q2 2006	32718
Q3 2006	30393
Q4 2006	58312
Q1 2007	39377
Q2 2007	35078
Q3 2007	36022
Q4 2007	71441
Q1 2008	47236
Q2 2008	58446
Q3 2008	46591

Q4 2008	81786
Q1 2009	59683
Q2 2009	53666
Q3 2009	46855
Q4 2009	77608
Q1 2010	53992
Q2 2010	47115
Q3 2010	39339
Q4 2010	91748
Q1 2011	60345
Q2 2011	55387
Q3 2011	45711
Q4 2011	92916
Q1 2012	64873
Q2 2012	64762
Q3 2012	57501
Q4 2012	104962
Q1 2013	66066
Q2 2013	62914
Q3 2013	58970
Q4 2013	126669
Q1 2014	83137
Q2 2014	85294
Q3 2014	62089
Q4 2014	147672
Q1 2015	76174
Q2 2015	68822
Q3 2015	45284
Q4 2015	121701
Q1 2016	67621
Q2 2016	63743
Q3 2016	54827
Q4 2016	118377
Q1 2017	79199
Q2 2017	75789
Q3 2017	63070
Q4 2017	132093

Q1 2018	91376
Q2 2018	82789
Q3 2018	70056
Q4 2018	140788
Q1 2019	83243
Q2 2019	69050
Q3 2019	49393
Q4 2019	112759
Q1 2020	69106
Q2 2020	76551
Q3 2020	59930
Q4 2020	113169
Q1 2021	77593
Q2 2021	71232
Q3 2021	63496
Q4 2021	120447
Q1 2022	79154
Q2 2022	72914
Q3 2022	66337
Q4 2022	125743
Forecast	
Q1 2023	85118
Q2 2023	79235
Q3 2023	73033
Q4 2023	129394
Q1 2024	90908
Q2 2024	85363
Q3 2024	79516
Q4 2024	132991
Q1 2025	96533
Q2 2025	91309
Q3 2025	85799
Q4 2025	136536
Q1 2026	102001
Q2 2026	97082
Q3 2026	91891
Q4 2026	140033

Q1 2027	107321
Q2 2027	102691
Q3 2027	97802
Q4 2027	143484

Appendix B

Actual and Forecasted Retail Price of Rice (PhP per kg)

Period	Regular-Milled	Well-Milled	Special
Actual			
Jan-12	32.68	35.97	42.52
Feb-12	32.76	36.14	42.77
Mar-12	33	36.35	42.68
Apr-12	33.22	36.51	42.51
May-12	33.39	36.68	42.56
Jun-12	33.56	36.79	42.66
Jul-12	33.69	36.94	42.87
Aug-12	33.91	37.09	42.82
Sep-12	33.9	37.09	42.90
Oct-12	33.88	37.02	42.82
Nov-12	33.88	37.01	42.64
Dec-12	33.85	36.96	42.52
Jan-13	33.77	36.97	42.23
Feb-13	33.73	36.99	42.27
Mar-13	33.69	36.93	42.32
Apr-13	33.62	36.98	42.27
May-13	33.78	37.00	42.30
Jun-13	33.95	37.14	42.57
Jul-13	34.37	37.44	42.86
Aug-13	35.1	38.20	43.51
Sep-13	36.6	39.70	45.06
Oct-13	36.81	39.96	45.11
Nov-13	36.78	39.90	45.05
Dec-13	37.23	40.42	45.45
Jan-14	37.41	40.62	45.66
Feb-14	37.84	40.90	45.94
Mar-14	38.34	41.47	46.42

Apr-14	38.74	41.78	46.78
May-14	39.19	42.25	47.13
Jun-14	39.79	42.71	47.65
Jul-14	40.6	43.54	48.53
Aug-14	41.08	44.01	48.96
Sep-14	41.3	44.23	49.21
Oct-14	41.22	44.16	49.05
Nov-14	40.87	43.93	49.00
Dec-14	40.71	43.82	49.03
Jan-15	40.5	43.75	49.01
Feb-15	40.06	43.38	48.85
Mar-15	39.76	43.24	48.49
Apr-15	39.36	43.06	48.45
May-15	39.3	42.98	48.33
Jun-15	39.2	42.99	48.38
Jul-15	39.31	42.83	48.38
Aug-15	39.3	42.84	48.38
Sep-15	39.43	42.86	48.44
Oct-15	39.26	42.78	48.41
Nov-15	39.11	42.66	48.28
Dec-15	39.01	42.61	48.04
Jan-16	38.97	42.53	48.10
Feb-16	38.93	42.53	48.32
Mar-16	38.82	42.59	48.32
Apr-16	38.73	42.73	48.01
May-16	38.77	42.77	48.06
Jun-16	38.75	42.85	48.19
Jul-16	39.02	43.08	48.44
Aug-16	39.2	43.20	48.70
Sep-16	39.33	43.17	48.89
Oct-16	39.3	43.36	48.86
Nov-16	39.19	43.25	48.84
Dec-16	39.2	43.26	48.89
Jan-17	39.32	43.35	49.04
Feb-17	39.3	43.32	48.96
Mar-17	39.26	43.39	49.07
Apr-17	39.28	43.34	49.13

May-17	39.26	43.39	49.12
Jun-17	39.4	43.51	49.24
Jul-17	39.53	43.63	49.36
Aug-17	39.66	43.67	49.52
Sep-17	39.79	43.73	49.60
Oct-17	39.82	43.76	49.48
Nov-17	39.75	43.79	49.56
Dec-17	39.87	43.89	49.58
Jan-18	40.09	44.22	49.89
Feb-18	40.42	44.68	50.33
Mar-18	41.1	45.12	50.79
Apr-18	41.5	45.34	50.99
May-18	41.78	45.65	51.13
Jun-18	42.13	45.89	51.48
Jul-18	42.58	46.31	51.70
Aug-18	43.66	47.43	52.63
Sep-18	45.8	49.44	54.44
Oct-18	46.19	49.83	54.69
Nov-18	44.79	48.39	53.99
Dec-18	43.6	47.15	53.57
Jan-19	42.92	46.41	53.42
Feb-19	42.6	46.18	53.29
Mar-19	42.08	45.85	53.11
Apr-19	41.58	45.44	52.73
May-19	41.11	44.91	52.46
Jun-19	40.82	44.57	52.13
Jul-19	40.33	44.26	51.85
Aug-19	40.01	43.93	51.70
Sep-19	39.48	43.52	51.10
Oct-19	39	43.12	50.59
Nov-19	38.58	42.60	50.48
Dec-19	38.29	42.32	50.38
Jan-20	37.96	42.14	50.15
Feb-20	37.71	41.97	49.99
Mar-20	37.61	41.81	49.78
Apr-20	38.69	42.89	50.45
May-20	39.14	43.26	50.72

Jun-20	39.4	43.50	50.75
Jul-20	39.52	43.58	50.66
Aug-20	39.37	43.46	50.56
Sep-20	39.24	43.22	50.32
Oct-20	38.72	42.82	49.97
Nov-20	38.36	42.64	49.74
Dec-20	37.96	42.70	49.71
Jan-21	37.51	42.03	49.91
Feb-21	37.31	42.11	50.18
Mar-21	37.32	42.27	50.28
Apr-21	37.48	42.38	50.51
May-21	37.62	42.37	50.31
Jun-21	37.54	42.39	50.27
Jul-21	37.66	42.53	50.40
Aug-21	37.82	42.64	50.36
Sep-21	37.89	42.80	50.23
Oct-21	37.73	42.63	50.28
Nov-21	37.63	42.60	50.28
Dec-21	37.63	42.58	50.30
Forecast			
Jan-22	37.66	42.57	50.36
Feb-22	37.69	42.60	50.43
Mar-22	37.73	42.65	50.50
Apr-22	37.77	42.70	50.56
May-22	37.81	42.75	50.63
Jun-22	37.85	42.81	50.70
Jul-22	37.89	42.86	50.76
Aug-22	37.93	42.92	50.83
Sep-22	37.97	42.97	50.90
Oct-22	38.02	43.03	50.96
Nov-22	38.06	43.08	51.03
Dec-22	38.10	43.14	51.10
Jan-23	38.14	43.19	51.17
Feb-23	38.18	43.25	51.23
Mar-23	38.22	43.31	51.30
Apr-23	38.26	43.36	51.37
May-23	38.30	43.42	51.43

Jun-23	38.35	43.47	51.50
Jul-23	38.39	43.53	51.57
Aug-23	38.43	43.58	51.63
Sep-23	38.47	43.64	51.70
Oct-23	38.51	43.69	51.77
Nov-23	38.55	43.75	51.83
Dec-23	38.59	43.80	51.90
Jan-24	38.63	43.86	51.97
Feb-24	38.67	43.91	52.03
Mar-24	38.72	43.97	52.10
Apr-24	38.76	44.02	52.17
May-24	38.80	44.08	52.23
Jun-24	38.84	44.13	52.30
Jul-24	38.88	44.19	52.37
Aug-24	38.92	44.24	52.43
Sep-24	38.96	44.30	52.50
Oct-24	39.00	44.36	52.57
Nov-24	39.04	44.41	52.63
Dec-24	39.09	44.47	52.70
Jan-25	39.13	44.52	52.77
Feb-25	39.17	44.58	52.83
Mar-25	39.21	44.63	52.90
Apr-25	39.25	44.69	52.97
May-25	39.29	44.74	53.04
Jun-25	39.33	44.80	53.10
Jul-25	39.37	44.85	53.17
Aug-25	39.42	44.91	53.24
Sep-25	39.46	44.96	53.30
Oct-25	39.50	45.02	53.37
Nov-25	39.54	45.07	53.44
Dec-25	39.58	45.13	53.50
Jan-26	39.62	45.18	53.57
Feb-26	39.66	45.24	53.64
Mar-26	39.70	45.30	53.70
Apr-26	39.74	45.35	53.77
May-26	39.79	45.41	53.84
Jun-26	39.83	45.46	53.90

Jul-26	39.87	45.52	53.97
Aug-26	39.91	45.57	54.04
Sep-26	39.95	45.63	54.10
Oct-26	39.99	45.68	54.17
Nov-26	40.03	45.74	54.24
Dec-26	40.07	45.79	54.30
Jan-27	40.11	45.85	54.37
Feb-27	40.16	45.90	54.44
Mar-27	40.20	45.96	54.50
Apr-27	40.24	46.01	54.57
May-27	40.28	46.07	54.64
Jun-27	40.32	46.12	54.70
Jul-27	40.36	46.18	54.77
Aug-27	40.40	46.23	54.84
Sep-27	40.44	46.29	54.91
Oct-27	40.49	46.35	54.97
Nov-27	40.53	46.40	55.04
Dec-27	40.57	46.46	55.11