Time Series Forecasting of Purchasing Power of Peso in Davao City: A Comprehensive ARIMA Modeling Approach

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INTRODUCTION

This study delves into the analysis and forecasting of the purchasing power of peso in Davao City, aiming to provide valuable insights into the economic conditions and standard of living in the area. By understanding the fluctuations in purchasing power, individuals, businesses, and policymakers can make informed decisions regarding financial planning, pricing strategies, and economic policies. This study utilizes forecasting techniques to generate reliable predictions about future changes in purchasing power, enabling stakeholders to adapt and plan accordingly. By examining the purchasing power dynamics in Davao City, this study contributes to the existing body of knowledge on economic trends and provides practical implications for various stakeholders.

BACKGROUND OF THE STUDY

The authors aim to analyze the purchasing power of peso in Davao City, which is crucial for understanding the region's economic conditions and standard of living. This problem offers valuable insights for individuals, businesses, and policymakers, as it helps assess the impact of economic factors on households' ability to afford necessities. By employing forecasting techniques such as time series analysis through ARIMA models, researchers can predict future trends in the purchasing power of peso, enabling stakeholders to make informed decisions and adapt to changing economic conditions. The study's expected outcome is to provide accurate forecasts for the purchasing power of peso in Davao City from June 2023 to December 2024, empowering individuals, businesses, and policymakers to plan effectively. The beneficiaries of this study include individuals who can gain insights for financial planning, businesses that can make pricing decisions based on the forecasts, policymakers who can implement economic policies, and researchers who can utilize the study as a reference for further analysis and contribute to the understanding of purchasing power dynamics.

DATA GATHERING PROCEDURE

To conduct their analysis, the authors plan to utilize data obtained from the Philippine Statistics Authority (PSA). The dataset encompasses information on the purchasing power of peso in Davao City, spanning from January 2018 to May 2023. The data will be collected from the official database of the Philippine Statistics Authority, accessible through their website or specific data portals. The dataset is expected to be available in digital formats like CSV files or spreadsheets, enabling the authors to download and utilize it for analysis purposes.

DATA PROCESSING AND TECHNIQUES

Plotting the data

The first step in forecasting using ARIMA is to plot the data and observe for any patterns. The figure below shows a time series plot of the purchasing power of peso in Davao City from January 2018 to May 2023 with a frequency of 12. The authors also used time series decomposition to assess the data's behavior, which showed a non-stationary behavior and an decreasing trend with no seasonality.

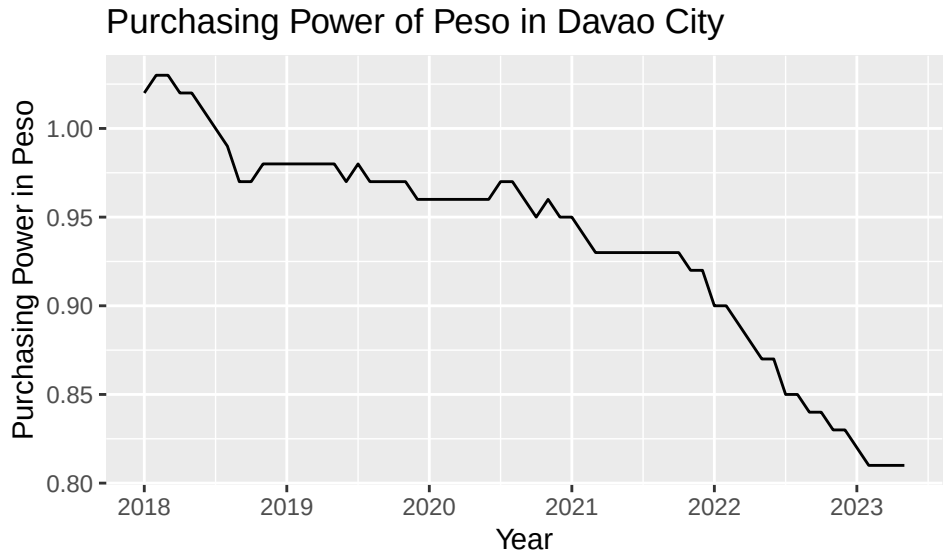

Figure 1: Time Series Plot of Purchasing Power of Peso in Davao City

Differencing

An alternative method for determining the non-stationarity of the data involves employing a unit root test. In this particular scenario, the authors utilized the KPSS test to ascertain the non-stationarity of the data and the necessity of applying differencing.

Upon subjecting the original data to the KPSS test, the obtained results indicated the non-stationarity of the data since the test statistics **(1.583)** exceeded the critical value **(0.739)**. Consequently, the data was deemed non-stationary and necessitated the application of differencing.

After applying differencing to the data and subsequently subjecting it to the KPSS test, it can be observed that the data has become stationary, with the test statistics **(0.2689)** falling below the critical value **(0.739)**. Differentiating the data to attain stationarity determines the parameter "d" for our ARIMA model. In this case, the data was differenced once, indicating that our value for "d" equals 1.

Choosing an ARIMA model

When selecting an ARIMA model, it is essential to compare various ARIMA models and choose the one that exhibits the lowest Akaike Information Criterion with correction (AICc).

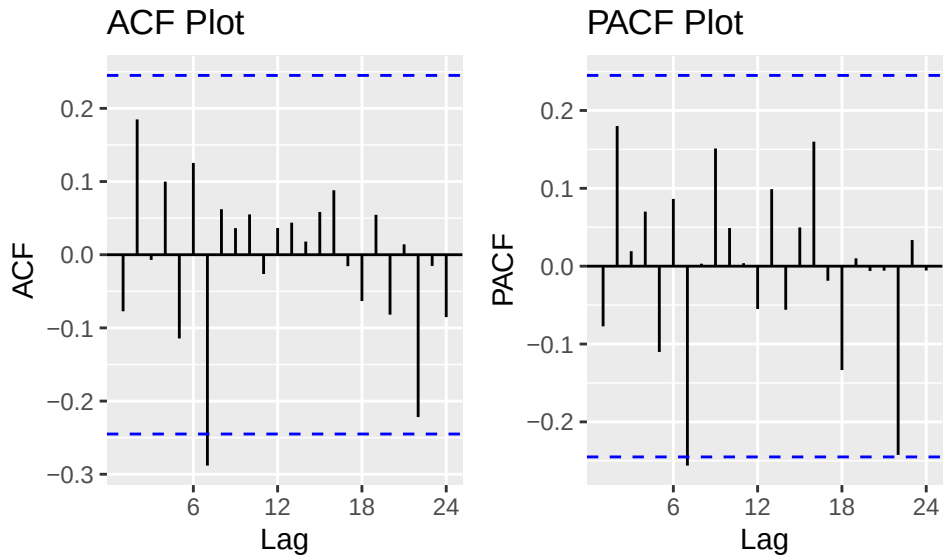

Figure 2: ACF and PACF Plots of the Differenced Data

Initially, our analysis focused on the **AR(0,d,q)** model. The PACF plot of the differenced data displayed an exponential decay and sinusoidal pattern. By examining the ACF plot, we identified a single prominent spike, indicating a value of q = 1. Consequently, our initial ARIMA model became **AR(0,1,1)**.

Next, we explored the **AR(p,d,0) model**. Utilizing information from the PACF plot, we identified a single significant spike, leading to the determination of p = 1. Therefore, our second ARIMA model was selected as **AR(1,1,0)**.

Additionally, we employed the auto.arima() function to assist us in the model selection process. The third model was fitted with **seasonal = FALSE**, while the fourth model was incorporated with arguments **stepwise = FALSE** and **approximation = FALSE**, to make it work harder.

Table 1: The AICc values of the four (4) ARIMA models

NO.	Model	AICc
1	ARIMA(0,1,1)	-439.42
2	ARIMA(1,1,0)	-439.90
3	ARIMA(0,1,0) w/o Seasonality	-451.90
4	ARIMA(0,1,0) w/o Seasonality, approximation, stepwise	-451.90

The ARIMA model exhibiting the lowest AICc suggests its suitability for our dataset. Among the four (4) models, the one generated by the auto.arima() function demonstrated the lowest AICc. Therefore, either of the two models can be employed for data forecasting. In this instance, we will utilize the fourth model with an AICc value of **-451.90**.

Checking for accuracy from the error

Accuracy evaluation is crucial in determining the ARIMA models that exhibit the lowest Root Mean Squared Error (RMSE). A smaller RMSE signifies superior performance, indicating that the model fits the data well and provides more accurate predictions.

Table 2: The RMSE values of the four (4) ARIMA models

NO.	Model	RMSE
1	ARIMA(0,1,1)	0.0075036
2	ARIMA(1,1,0)	0.0074747
3	ARIMA(0,1,0) w/o Seasonality	0.0068072
4	ARIMA(0,1,0) w/o Seasonality, approximation, stepwise	0.0068072

Comparing the RMSE for the four models, the models from the auto.arima() function yielded the smallest RMSE. Therefore, we can use either of the two for forecasting our data. However, in this case, we will use the fourth model with an RMSE value of **0.006807219**.

RESULTS AND DISCUSSION

Forecasting our data

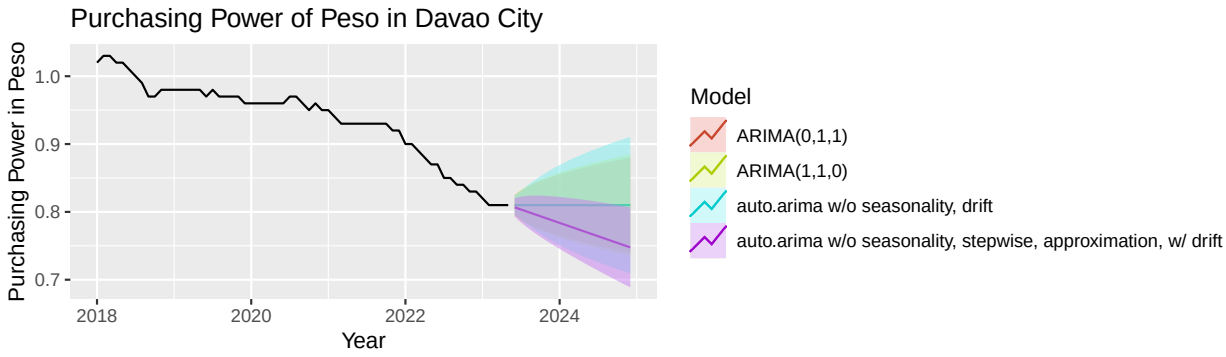

Figure 3: Time Series Plot of the Forecasted Purchasing Power of Peso in Davao City from May 2023 to December 2024

In forecasting the data, the authors utilized the four models generated through ARIMA to forecast the next 19 months or from June 2023 to December 2024. The authors also predicted the forecast with a 95% confidence interval to provide a better range of outcomes. The graph indicates that ARIMA (0,1,1), ARIMA(1,1,0), and auto.arima without seasonality and drift predicts a stationary forecast until December 2024. This stationarity implies that the purchasing power of peso in Davao City will be constant until December 2024. On the other hand, the authors also used the model produced by auto.arima without seasonality, approximation, and stepwise but with drift to account the downward trend or behavior of the observed data. Hence, this model follows the typical pattern or trend, as the previous data's behavior shows.

CONCLUSION

Based on the study's findings, the authors applied four ARIMA models to forecast data for the period from June 2023 to December 2024. The forecasts were accompanied by a 95% confidence interval to provide a comprehensive range of potential outcomes. The graphical representation of the models revealed that ARIMA (0,1,1), ARIMA(1,1,0), and auto.arima without seasonality and drift yielded stationary forecasts until December 2024, suggesting that the purchasing power of peso in Davao City will remain consistent during this period.

Additionally, the authors incorporated a model generated from auto.arima without seasonality, approximation, and stepwise but with drift to capture the downward trend observed in the data. Consequently, this model successfully aligns with the expected pattern or trend based on the behavior of previous data. However, it should be noted that this model is not realistic since purchasing power should not decrease until zero or indefinitely. Hence, the authors suggest to apply another forecasting method, such as damped trend method. Nonetheless, these results hold valuable implications for various stakeholders.

Firstly, **policymakers and economists** can utilize this information to make informed decisions regarding monetary and fiscal policies. Understanding the anticipated decrease in purchasing power allows for appropriate adjustments and considerations to safeguard the economy and mitigate potential adverse effects.

Furthermore, **businesses and industries** operating in Davao City can leverage these forecasts to plan their strategies effectively. Anticipating a decline in purchasing power enables them to adjust pricing strategies, optimize resource allocation, and identify potential areas for growth or diversification.

Consumers and households can also benefit from this study by being more aware of the anticipated changes in purchasing power. With this knowledge, individuals can adjust their spending habits, plan for future expenses, and make informed financial decisions.

In essence, the comprehensive forecasting analysis utilizing the ARIMA(0,1,0) model has shed light on the expected trajectory of the peso's purchasing power in Davao City. These results provide valuable insights for policymakers, businesses, and consumers, allowing them to proactively respond to the forecasted downward trend and make informed decisions to navigate the evolving economic landscape.

CODES AND DATASET

The authors utilized the RStudio application to analyze and forecast the data. The codes can be accessed through the link: https://github.com/tunafish9867/AMAT-132-FILES.git.

The dataset can be accessed in the Philippine Statistics Authority database through the link: https://openstat.psa.gov.ph/.

The specific dataset used in the study can be accessed in this link: https://openstat.psa.gov.ph/PXWeb/pxweb/en/DB/DB___2M___PI___CPI___2018/0012M4ACP11.px/table/tableViewLayout1/?rxid=0302bdd0-96d2-4ef1-b7e8-acb225281dfe

The dataset can be downloaded as a CSV, xlsx, and px files.