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Forecasting Tourist Arrivals of Philippines from August 2024 to December 2026 using Seasonal Autoregressive Integrated Moving Average

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A B S T R A C T

Tourism is one of the major contributions to the economic growth of the Philippines where it forms a big share of the Gross Domestic Product (GDP). This research aims to forecast the tourist arrivals in the Philippines from August 2024 to December 2026. Statistical tests were conducted to formulate a model for forecasting using Seasonal Autoregressive Integrated Moving Average (SARIMA) of the EViews 13 statistical software packages; Box-Jenkins Methodology to formulate a model for forecasting, Seasonal; Econometrics Views (Eviews) for forecasting, respectively. The study used data ranging from January 2011 up to July 2024 with a total of 163 observations. Through the Box-Jenkins Methodology, SARIMA (3, 1, 4) (1, 0, 12) model was determined to forecast tourist arrivals from August 2024 to December 2026. From the said dates, it is estimated that the monthly tourist arrivals shall range from 528,158 to 393,433.

Keywords: Seasonal Autoregressive Integrated Moving Average, SARIMA, Tourist arrival, Forecasting, Box-Jenkins Methodology, Eviews, Philippines

1. Introduction

Tourism plays an important role in a country's economy. It helps the country by creating jobs, developing infrastructures, and having "cultural exchange" between the visitors and the locals (Yehia, 2019). While tourism may provide economic advantages, to emphasize its importance, based on a study by Mihalic (2014) about tourism and inflation, prices of goods and services will rise should a country fail to keep pace with its increasing demand. The said demand also involves the number of tourist arrivals in a country since there is a Tourism-pull inflation wherein it "is caused by increases in aggregate demand due to the additional financial resources international tourists bring to a country" (2014). In other words, high tourist arrivals in a country may lead to an increase in the demand for goods and services.

This paper seeks to forecast the monthly tourist arrivals from August 2024 to 2026. Such findings may help the stakeholders, most especially the tourism sector, to prepare long-term plans and informed decisions. Furthermore, this will help the government in formulating appropriate interventions and/or policies that will further promote the tourism sector.

1.1 Objective of the Study

The study focuses on the monthly tourist arrivals in the Philippines. Specifically, it aims to:

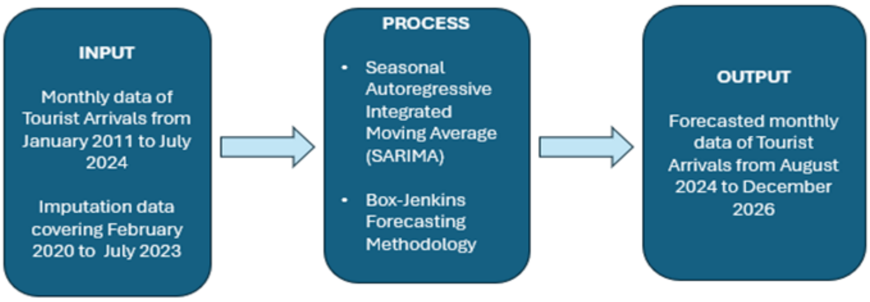
1) Analyze the behavior of the graph of tourist arrivals;
2) Create a model to forecast monthly tourist arrivals from August 2024 to December 2026 using SARIMA.

1.2 Conceptual Framework

The conceptual framework below illustrates the process of forecasting the tourist arrivals in the Philippines. The framework used is also based on a similar study by Urrutia et. al (2017): (1) "Forecasting the Quarterly Production of Rice and Corn in the Philippines: A Time Series Analysis", and (2) "An Analysis on the Unemployment Rate in the Philippines: A Time Series Data Approach" wherein both used SARIMA modelling through Box-Jenkins method to forecast the next five years SARIMA modelling through Box-Jenkins method was used to forecast the next five years (2016 to 2020) of rice and corn production in the Philippines, and Real Gross Domestic Product from 1st Quarter of 2014 to 4th Quarter of 2020, respectively

The monthly figures of the said variable (from January 2011 to July 2024) were used for forecasting (Input). To forecast the next five years figures from August 2024 to December 2026, SARIMA shall be used since seasonality was detected from analyzing the trend of the graph (Process). Thus, the output of this framework is the monthly tourist arrivals from August 2024 to December 2026.

Figure 1. The Research Paradigm of the Study



However, the study recognizes the presence of the pandemic which caused a drastic decrease in tourist arrivals, particularly from February 2020 to July 2023. The range was chosen because it was on February 30, 2020, when the first death was recorded in the country (WHO, 2020). Meanwhile, it was on July 22, 2023 when the Philippine government decided to lift the Covid-19 State of Emergency through Proclamation 297 (Relativo, 2023).

With this, the study used imputation (Shrebati, 2023) wherein data points from February 2020 to July 2023 are replaced with forecasted data. The forecasted replacement data of the said month and year used the data ranging from January 2011 to January 2020.

1.3 Statement of the Problem

This study seeks to address the following problems:

1. What is the behavior of tourist arrivals in the Philippines, based on the graph?

2. What SARIMA model shall be used?

3. What are the predicted forecast values of monthly tourist arrivals from August 2024 to December 2026 using the SARIMA model?

Hypothesis: Tourist arrivals are projected to gradually drop in figures in the next two and a half years (August 2024 to December 2026).

1.4 Scope and Delimitations of the study

The study focuses on forecasting the number of tourist arrivals to the Philippines from August 2024 to December 2026 using historical data taken from the Department of Tourism (DOT) from 2011 to 2024. Year 2011 was the year chosen because it would give the forecasting a minimum of 100 observations (data) to forecast the replacement data from February 2020 to July 2023.

This study is only limited to forecasting. It did not account for the correlation of the tourist arrivals to other possible variables/factors influencing tourist arrivals. However, the study enumerated news articles that may explain the trend of tourist arrivals (e.g. implementation of travel restrictions).

Given the extensive number of combinations generated, manual evaluation of each model is not feasible due to the inherent complexity and computational intensity involved. Thus, this study identified at least two SARIMA models that satisfied the criteria of the Diagnostic and Forecasting stages. Thereafter, upon verifying that the data met the conditions stipulated in the Diagnostics stage, the optimal model was chosen by comparing the Hannan-Quinn Criterion, Schwarz Criterion, and Akaike Information Criterion (with the lowest value among the identified models) as well as the R-Squared value (with the highest value among the identified models).

1.5 Significance of the Study

The findings of this study can be used as the basis of policymakers in terms of drafting policies or legislation centered toward being ready for possible influx of tourist arrivals in the country.

2. Review of Related Literature

2.1 Factors affecting Tourist arrivals in a country

2.1.1 Inflation Rate

The International Monetary Fund (IMF) defines inflation as a measurement of "how much more expensive a set of goods and services has become over a certain period, usually a year". Inflation rates may influence tourist demand because higher inflation may mean higher costs of visit which would cause lesser purchasing power for the tourist (Mihalic, 2014). Hence, inflation on the value of goods and services would influence the consumer (e.g. tourists) preference related to tourism (e.g. choice of destination country). Thus, this may redirect possible tourists to another country (Mihalic, 2014). This was also supported by the study of Athari et. al (2020) who said that "inflation has a statistically significant and negative effect on tourism arrival". In other words, high inflation may lead to low tourist arrivals in a country, vice versa.

Additionally, Athari et. al. (2020) argued that tourism can create jobs which can help minimize inflation because it can reduce poverty and contribute to world Gross Domestic Product (GDP). They also mentioned that there is a substantial and adverse effect of exchange rates on tourist arrivals, and that the exchange rate does not impact tourist arrivals for low political risk countries.

Meanwhile, Mihalic (2014) clarified that "[r]ising tourism prices may be due to either an increase in tourism demand or higher production costs", while outgoing tourism acts may contribute to reduction in inflation rate since it may reduce the purchasing power of an economy. However, a study by Rasool et. al. (2021) cited that there are studies that show an insignificant relationship between tourism and economic growth.

Table 1.

Number of Inflation Rate in the Philippines for year 2011 to 2023

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
January	4	4	3.1	3.7	1.5	0.7	2.5	3.4	4.4	3.0	3.7	3.0	8.7
February	4.7	2.7	3.4	3.6	1.5	0.5	3.1	3.7	3.8	2.5	4.2	3.0	8.6
March	4.9	2.6	3.2	3.5	1.5	0.6	3.1	4.3	3.4	2.2	4.1	4.0	7.6
April	4.7	3	2.6	3.6	1.4	0.7	3.2	4.3	3.2	1.8	4.1	4.9	6.6
May	4.9	3	2.6	4	0.9	0.9	2.9	4.6	3.2	1.6	4.1	5.4	6.1
June	5.2	3	2.7	3.8	0.6	1.3	2.5	5.0	2.7	2.3	3.7	6.1	5.4
July	4.9	2.9	2.5	4.2	0.2	1.3	2.4	5.8	2.2	2.4	3.7	6.4	4.7
August	4.6	3.2	2.1	4.2	0	1.3	2.6	6.6	1.4	2.2	4.4	6.3	5.3
September	4.7	3.8	2.7	3.9	-0.4	1.7	3.0	6.9	0.5	2.2	4.2	6.9	6.1
October	5.2	3.7	2.9	3.7	-0.2	1.8	3.1	6.9	0.6	2.3	4.0	7.7	4.9
November	4.7	3.2	3.3	3	0.3	2.1	3.0	6.1	1.2	3.0	3.7	8.0	4.1
December	4.2	2.8	4.1	1.9	0.7	2.2	2.9	5.2	2.4	3.3	3.1	8.1	3.9
Average	**4.7**	**3.2**	**2.9**	**3.6**	**0.7**	**1.3**	**2.9**	**5.2**	**2.4**	**2.4**	**3.9**	**5.8**	**6.0**

Source: Bangko Sentral ng Pilipinas

2.1.2 Political Stability

Political Stability also affects tourism as it impacts tourism by potentially influencing trade and culture, infrastructure development, job availability, revenue generation, and significantly affecting the integration of the population (Athari et. al, 2020). Due to this, political tensions can lead to the closure of numerous service providers (Athari et. al, 2020). Lastly, military coups can act as a hindrance to expansion of tourism because the government may shift its focus on "managing violence" rather than its long-term plans which may be intended for the tourism industry (Athari et. al, 2020).

2.1.3 Other factors

A study by Prideaux (2005) indicates that the demand for tourism is influenced by factors, including price, personal preferences, destination image, government regulations, individual financial ability to travel, international political and military tensions, health epidemics, concerns about personal safety, and fear of crime.

2.1.4 Tourism efforts in the Philippines

The Philippines implemented various strategies to increase its tourist arrival such as: (1) policies centered on improving access, (2) tourism campaign programs, and (3) infrastructure improvements. However, there were several factors that may also have affected the tourist arrival turnout in the country such as: (1) force majeure brought about by calamity/disasters, (2) security and safety issues, and (3) the pandemic.

In 2011, the Department of Tourism remarked in its 2011 year-end report that connectivity to and access to destinations have increased since the Philippines carried out Executive Orders 28 and 29, where it instituted policy and institutional reforms in the civil aviation sector to back tourism growth. These EOs allow foreign carriers that have air treaties with the Philippines "unlimited unlimited flights to secondary gateways, thus, allowing more visitors to immediately proceed to their choice vacation and holiday destinations". To make the Philippines a more accessible country, DPWH also provided a Php 1.4 billion budget to rehabilitate and build roads leading to the tourist spots.

Aside from this, the DOT also mentioned in their report that several campaigns were launched to promote tourism in the country such as participation in travel fairs and events (e.g. the Internationale Tourismus Bourse (Berlin), World Travel Mart (London), JATA Travel Mart (Tokyo)...). Also, in this year, Philippines received several awards and recognitions (e.g. Most Desirable Beach Holiday Destination, Honeymoon Destination of the Year, Best New Promising Destination and Top Trendy Destination, Top 6 in the Lonely Planet’s Top 10 Best Value Destinations for 2011, and Boracay as the 4th Best Island in the World by Travel+Leisure Magazine) that helped Philippines gain more acknowledgement.

In 2012, Philippines improved its infrastructures that could help attract more tourists such as construction of SM Bay City Arena in the SM Mall of Asia (MoA) and the Cebu Cultural Center or CCC. In the said year, the “It’s more fun in the Philippines” campaign was launched wherein various promotional videos were released to entice more foreign visitors. DOT continued to participate in international travel fairs, expositions, exhibitions and forums (DOT, 2012). Meanwhile, the inflation rate decreased from 4.07% to 3.2%. In this year, the Philippines had a 9.07% increase of tourist arrivals compared to its previous year.

In 2013, international events such as the Meetings, Incentive Travel, Conventions and Exhibitions/Events (MICECON) 2013, the 6th International Hornbill Conference, the EO Global Leadership Conference, and the Asia Pacific Regional Meeting (APRM) of the World Trade Centers Association (WTCA) were hosted in the country which could further help the country’s recognition (DOT, 2013). Despite the occurrence of natural calamities like Typhoon Haiyan and the 7.2 magnitude earthquake in Bohol, the country still recorded 4,681,307 foreign tourist arrivals which is a 9.56% increase from the previous year. The inflation rate, on the other hand, continued to decrease from 3.2% to 2.9%.

In 2014, according to DOT’s 2014 year-end report, international recognitions such as: being the Top 25 countries to retire to in 2015 (Forbes), “a must-see destination” in 2015 (Lonely Planet), Manila, one of the top 30 cities in the world (JLL, Global Real Estate Services), Vigan, one of the New Seven Wonder Cities of the World (World of New 7 Wonders), Palawan, most beautiful island in the world 2014 (Huffington Post Travel) and Philippines as destination of the year 2014 (TTG Asia) were received by the country. Further, the Philippines had 16 tourism projects. Meanwhile, DOT participated in 67 travels fairs and trade shows (e.g. Moscow International Festival-The Golden Dolphin Show and Moscow International Travel and Tourism Exhibition in Russia, Salon de la Plongee Sous Marine 2014 in Paris, France; Outbound Travel Mart- Mumbai and Delhi, India; TTC Travel Mart and Bai Hotel and Solaire Resort and Casino Astindo Fair in Indonesia; Routes Asia 2014 in Kuching, Malaysia; and the Arabian Travel Mart in Dubai, United Arab Emirates) to promote tourism in the country (DOT, 2014).

In 2015, the Philippine government implemented Proclamation No. 991 to formally declare “Visit the Philippines Year” in support of promoting the Philippines in hosting international events. This year also marked a five-day pastoral visit from Pope Francis in mid January. The Philippines continued the “It’s more fun in the Philippines campaign”. Aligning with this, the country implemented various projects such as “Visit Bohol 2015; It’s more fun in the Philippines, Korea Golf Show, Country Commitment, FOBISIA Games 2015, Korea Golf Show, Country Commitment, and two (2) Domestic Special promotions.” Philippines even hosted the APEC 2015: The country hosted the Asia-Pacific Economic Cooperation (APEC) Summit in 2015 (DOT, 2015). In this year, the Philippines had its lowest inflation rate of - 0.4% for the said time span (2011 to 2023). The average inflation rate is 0.7% for this year.

In 2016, DOT launched the “Visit the Philippines again in 2016” to attract tourists to revisit the Philippines (DFA, 2016). This campaign was launched coinciding with the Super Bowl 50 (Sport event) of the United States of America. Materials were displayed to promote tourism, in San Francisco, USA were the said Super Bowl 50 was commenced (DFA, 2016). This was the start of President Duterte's first year in office, a time when his administration focused on fighting terrorism, ending long-standing insurgencies, and addressing violent crime within the country. At the same time, he adopted a flexible approach to foreign policy, giving himself the space and time needed to tackle the pressing issues at home (Chalk, 2018).

In 2017, the Philippines had a martial law declaration, through Proclamation No. 216 issued on May 23, 2017, in the Southern Region of Mindanao, due to threats of terrorism in Marawi. Nonetheless, tourist arrivals were steady as this year garnered 6,480,297, which is a 22.14% increase from the previous year (5,305,690). During the said year, DOT continued with its “It’s More Fun in the Philippines” campaign. In this year, the Philippines had 2.4% inflation rate as its lowest with 3.2% as its highest. The average inflation rate is 2.9% for this year.

In 2018, despite the closure of Boracay for about six months, the Philippines had an increase in tourist arrivals from 6,480,297 in 2017 to 7,095,715 this year. Tourism Secretary Bernadette Romulo Puyat mentioned that the closing of Boracay, has “become a blessing in disguise for secondary tourism sports to have a share of the limelight and attention” (Relativo, 2019). During this year, South Korea continued to be the country’s leading source market, with 1.59 million of its citizens visiting the Philippines (Rey, 2019) followed by China with 1.26 million. The Philippines strengthened its ties with China through President Rodrigo Duterte where he built an “economically beneficial relationship with Beijing” (McKirdy et. al, 2018)

In 2019, the Philippines reported a 7.59% increase in tourist arrivals in the first quarter of 2019. Secretary Puyat credited the rehabilitated Boracay Island and the improved connectivity of the country (PNA, 2019). In this year, the Philippines had 0.5% inflation rate as its lowest with 5.5% as its highest. The average inflation rate is 2.4% for this year. Average inflation rate decreased by 53.8462% from 5.2% (2018) to 2.4% (2019).

In 2020, the COVID-19 pandemic struck the Philippines placing the country into a three month total lockdown which started on February 2; followed by a series of community quarantines. The country also placed travel restrictions. According to a study by Bangko Sentral ng Pilipinas (2022), the “Enhance Community Quarantine” (ECQ) caused a “decline in domestic demand and production, international trade, and high unemployment”. Meanwhile, on an international scale, BSP mentioned international tourist arrivals globally decreased by 74 percent. With this, tourist arrivals in the Philippines decreased by 80 percent.

In 2021, the COVID-19 pandemic continued with the quarantine restrictions (Enhanced Community Quarantine, Modified Enhanced Community Quarantine, Modified General Community Quarantine or General Community Quarantine) implemented in the country. In May to August 2021, quarantine became mandatory for all travelers for at least 14 days upon arrival to the Philippines. Related to political stability, it is also during this year that candidacies for national elections, which includes the presidency, were filed.

In 2022, the DOT mentioned that the Philippines, during this year, opened its borders to all types of travelers starting in February and continuing until December 31, 2022 having a total of 2.65 million international visitor arrivals. However, foreign travelers were still required to be fully vaccinated and undergo pre-departure RT-PCR or antigen testing before entering the country. Further, under the Resolution No. 165, foreign nationals will no longer be required to obtain an Entry Exemption Document (EED) upon entry to the country, easing travel requirements (DOT, 2022). Further, in the month of October, the Philippine president approved the lifting of the “COVID-19 test requirements for incoming visitors” (DOT, 2022) and the mandatory indoor mask-wearing.

In 2023, events like the hosting of the Fédération Internationale de Basketball (FIBA) was held in the Philippines. Basketball teams representing different countries gathered in the Philippines to compete. Because of this, hotel occupancy and tourist arrivals rose during this period (DOT, 2022). Further, based on a report by DOT, visitors from different competing countries grew such as: “Dominican Republic grew by 700 percent, Latvia by 600 percent, China by 595.85 percent, Lithuania by 444.58 percent and Serbia by 429.07 percent”. Meanwhile, from 2011 to 2023, this year recorded the highest inflation rate of 6.0%.

3. Methodology

3.1 Data description

The study used the overall number of tourist arrivals in the Philippines per month per year starting from 2011 to 2024. The level of significance determined by the researchers is 0.05 (alpha).

3.2 Statistical Method

3.3.1. Autoregressive Integrated Moving Average (ARIMA)

The Autoregressive Integrated Moving Average (ARIMA) model is a statistical analysis model that predicts how a variable will behave in the future based on past data. The Autoregressive (AR) component of the ARIMA model describes a time series where the current value of a variable is influenced by and can be predicted from its own previous values. The moving average (MA) part of ARIMA incorporates the dependency between an observation and a residual error from a moving average model applied to lagged observations. The Integrated (I) component of the ARIMA model involves differencing the raw observations to achieve stationarity, which is a necessary condition for applying the ARIMA modeling approach.

3.3.2. Seasonal Autoregressive Integrated Moving Average (SARIMA)

SARIMA is an extension of the Autoregressive Integrated Moving Average model, only used for time series data with periodic patterns. SARIMA accounts for seasonal components of the time series data wherein it is composed of the following components: (S) is for the Seasonal Component, (AR) Autoregressive (AR) Component, (I) Integrated component, and (MA) Moving Average (Science Direct, 1994).

3.3.3. Box-Jenkins Methodology

The Box-Jenkins Methodology is a mathematical method in identifying, fitting, checking, and using Seasonal autoregressive integrated moving average (SARIMA) time series models. This method can analyze several types of time series data for forecasting purposes. The Box-Jenkins method follows three stages which are: (1) Identification, (2) Estimation, and (3) Diagnostic and Forecasting.

The data was checked if it has seasonality by means of examining its graph and correlogram. Based on analysis, the graph does show repeating patterns monthly. Thus, seasonality was detected from the analyzed graphs.

Figure 2. Stages in the Box-Jenkins Iterative Approach (Abonazel et. al, 2019)

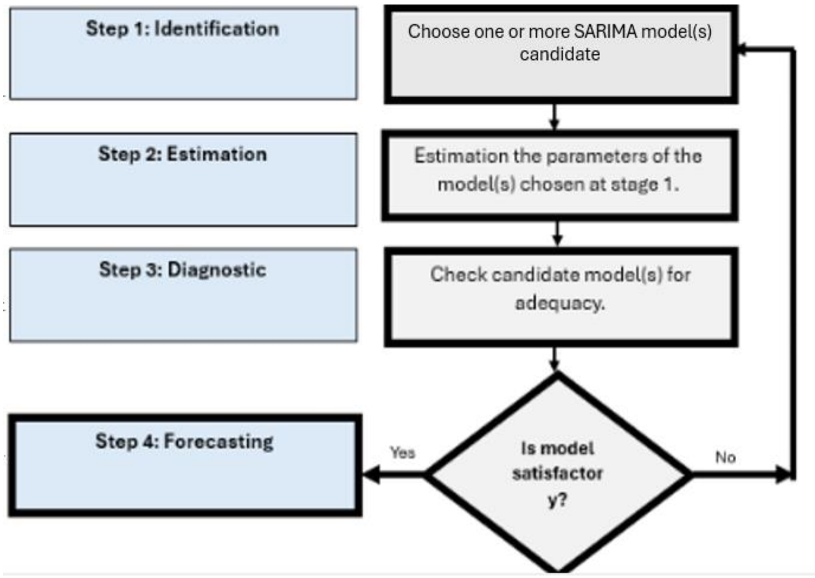


Table 2.

Stages of Box-Jenkins Methodology

Stage	Description	Method
1. Identification	In this stage, (S)ARIMA models are selected based on the information on hand (i.e. autocorrelation, partial autocorrelations, and other information). This is equivalent to estimating appropriate values for p,d and q. In this stage, the data is identified if it is stationary or non-stationary.	1. Check for any seasonality based on the graph of the data. 2. Run Standard Unit Root Test: - Choose Augmented Dickey Fuller (ADF) test in EViews; 3. Run the test for the three test equations accounting the data with monthly seasonality: (a) intercept, (b) trend and intercept, and (c) none. All the p-value must be lower than the assigned alpha (0.05); - If the value is greater, the study must use differencing until all the p-value is lower than the assigned alpha (0.05). ** Lower p-value would mean that the data is stationary.* 4. (S)ARIMA model candidates are listed based on the projected correlogram.
2. Estimation	In this stage the selected models are estimated base on their	1. The candidate (S)ARIMA models are chosen through checking the bars of the correlogram of the candidate model. The models are identified by means of examining the

<table>
<tr><td></td><td>phis and thetas using maximum likelihood approaches, back casting, etc., finding the model that fits the data well</td><td>Hannan-Quinn Criterion, Schwarz Criterion, Akaike Info Criterion and R-Squared
● Hannan-Quinn Criterion, Schwarz Criterion, Akaike Info Criterion - Lowest among identified models
● R-Squared - Highest among identified models
2. Should the (S)ARIMA models not satisfy the conditions of the Diagnostics stage, the next best (S)ARIMA model identified in the estimation stage shall be tested.</td></tr>
<tr><td>3. Diagnostic and Forecasting</td><td>The fitted model is checked if it meets the following assumptions: Residuals must be white noise; AR process is stationary; ARMA process is invertible.</td><td>1. The following must be present on the (S)ARIMA model during this stage:
● Residuals are White Noise. All of the p-values must be greater than the set alpha (0.05).
● “ARMA process” is covariance stationary.
○ All AR roots lie inside the unit circle.
● “ARMA process” is invertible.
○ All MA roots lie inside the unit circle.
2. Upon identification of the SARIMA model, forecasting shall be executed in the EViews.</td></tr>
</table>

3.3.4. Imputation

In the study of Shrebati (2023), it was suggested that when forecasting, the Covid-19 period data can be replaced with forecasted data. In this instance, February 2020 to July 2022 was replaced with a forecasted data. This was then used to forecast August 2024 to December 2026.

3.3.5. Econometric Views (Eviews)

The study used statistical software Econometrics Views 13 in forecasting the tourist arrivals of Philippines. This statistical software has been also used on other similar studies regarding forecasting values such as “Application of Seasonal Autoregressive Integrated Moving Average (SARIMA) in Modeling and Forecasting Philippine Real Gross Domestic Product” and “Forecasting the Quarterly Production of Rice and Corn in the Philippines: A Time Series Analysis” by Urrutia et. al. Eviews can create mathematical models which can be employed for predicting future data values. These are some of the areas which might benefit from Eviews; cost analysis and forecasting, sales forecasting, macroeconomic forecasting, simulation and data analysis.

4. Results and Discussions

4.1 Behavior of Tourist arrivals

The table below is the data set used for forecasting Tourist arrivals. Meanwhile, the cells highlighted in yellow are replaced with forecasted data to improve the predicting performance of the forecasting: The imputation helps to preserve the trends and seasonal patterns of tourist arrivals which may be skewed due to the pandemic (e.g. travel restrictions).

Table 3.

Number of Tourist arrivals per year per month (2011 to July 2024)

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	349713	411064	436079	461383	479149	542832	620121	724586	718118	782132	6109	0	425188	574439
February	318912	361925	418108	422631	456524	537194	569361	669640	762437	439852	9005	26306	431695	582332
March	320876	375083	417392	425858	456163	485892	556906	635485	709399	127721	10446	69639	436292	505720
April	317443	349779	377879	386665	423366	452396	551497	583996	653336	927	5098	115515	417320	459453
May	302707	321930	362062	364598	413937	427934	520780	531175	612861	357	9153	124934	353093	447453
June	309749	323725	369073	372293	390486	444043	462729	524765	638440	1186	10281	153503	407210	459362
July	360784	376948	418288	428144	489724	541298	551638	602112	712285	3380	11784	232317	467919	525466
August	323491	337894	382022	405970	480689	490190	535076	546785	699933	5364	13132	218051	404029	*
September	284040	291637	328114	328981	393589	412202	472766	514174	604552	6410	13891	207224	356300	*
October	298151	328300	358369	358876	412185	432157	513638	518041	634786	8304	16656	227667	378123	*
November	337021	352438	361271	390315	411868	472258	522723	559468	679273	9069	18836	275901	411890	*
December	394567	442088	452650	487654	553002	553186	603062	685488	763057	13753	22697	374346	565351	*

Highlighted in yellow are the data to be replaced (Imputative)

4.1.1 Year 2011 to 2015

The years 2011 to 2015 showed an upward trend year by year. During these 5-year period, Philippines employed strategies such as, but not limited to:

1. Implementation of government policies such as Executive Orders 28 and 29;

2. Improvement of destination image by means of:

a. construction of tourist attracting infrastructures;

b. gaining several awards and recognition for more publicity and better destination image

c. hosting of international events such as meetings;

3. Steady improvement yearly on inflation rate (being under 3.6%).

Despite the pending change of administration in 2016 that may affect political stability, the Philippines continued to gain more tourist arrivals yearly.

4.1.2 Year 2016 to 2020

The upward trend/increase continued from 2016 to 2019 year by year for the tourist arrivals. It was during these years when several campaigns were done by the Philippine government to attract more tourists in the country, such as, but not limited to:

1. Showing of tourism slogans and publicity during the USA Super Bowl 50;

2. Development of ties with China, as one of the largest contributors of tourist visitors; and

3. Completion of Boracay rehabilitation.

4.1.3 Year 2021 to 2024

Starting May 2021, Tourist arrivals started to have small increases due to gradual relaxation of tourist arrival restrictions by means of implementation of varied quarantine restrictions such as Enhanced Community Quarantine, Modified Enhanced Community Quarantine, Modified General Community Quarantine and General Community Quarantine. This can also be seen from the removal of the Entry Exemption Document (EED) as one of the entry requirements for tourists (DOT, 2022) which enabled more tourists to visit the country.

By 2022, the Philippines further relaxed its travel restrictions, reopening its borders for all types of travelers by easing the entry requirements. As a result, Tourist arrivals started to increase from 26,306 in the month of February to 374,346 in the month of December 2022. In 2023, the tourist arrivals kept increasing, from 425,188 in the month of January to 565,351 in the month of December. The increase can also be attributable to the lifting of the State of Emergency on Covid-19 in July 2023.

In summary, the years 2020 to 2022 had a massive decline due to the lockdown restrictions declared in the month of February 2020 (1,398,455.0 - year 2020, 147,088.0 - year 2021, 2,025,403 - year 2022,). Meanwhile, upon lifting of restrictions in 2023, tourist arrivals rebounded to 5,054,410 for the said year which is a 149.551% increase from its previous year (2022). The large increase occurred despite having a 6.0% inflation rate for the said year recorded. Further, events, such as the FIBA, helped increase tourist visitors from different nationalities. This was seen with the increase of visitors from participating countries which were: from Dominican Republic (+700%), Latvia (+600%), China (+595.85%), Lithuania (444.58%) and Serbia (+429.07%).

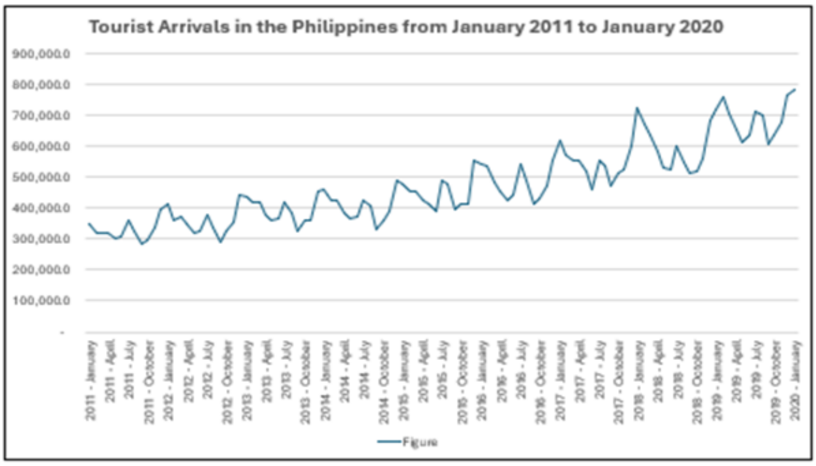
4.2 SARIMA Model and forecasted tourist arrivals Imputation:

4.2.1 Replacement data (February 2020 to July 2023)

4.2.1.1. Stage 1: Identification for Imputation

After examining the autocorrelation function (ACF) and partial autocorrelation function (PACF) from the correlogram data to project the period from January 2011 to January 2020, it was concluded that the data displays seasonality (please see Figure 3), characterized by consistent patterns over specific intervals. Consequently, SARIMA is employed for forecasting.

Figure 3. Line graph of Tourist arrivals in the Philippines from January 2011 to January 2020



Further, Tourist arrivals data were checked if it already has stationarity. Upon running the Augmented Dickey-Fuller (ADF) test, it was found out that tourist arrivals are stationary at:

- Difference of two (Non-seasonal)
- Difference of one (Seasonal)

since it's the intercept, trend and intercept, and the test equation rejects the null hypothesis (significant) (See Appendix a.1 and Appendix a.2).

4.1.1.2 Stage 2 and 3: Estimation, Diagnostics and Forecasting for Imputation

After undergoing the identification stage of the Box-Jenkins Methodology to forecast the possible replacement data for February 2020 to July 2023, the following are the candidate SARIMA models that satisfy the diagnostics stage (See Appendix a.2.3):

- Residuals are White Noise. All of the p-values must be greater than the set alpha (0.05).
- ARMA process is covariance stationary: All AR roots lie inside the unit circle.
- ARMA process is invertible: All MA roots lie inside the unit circle

Table 4

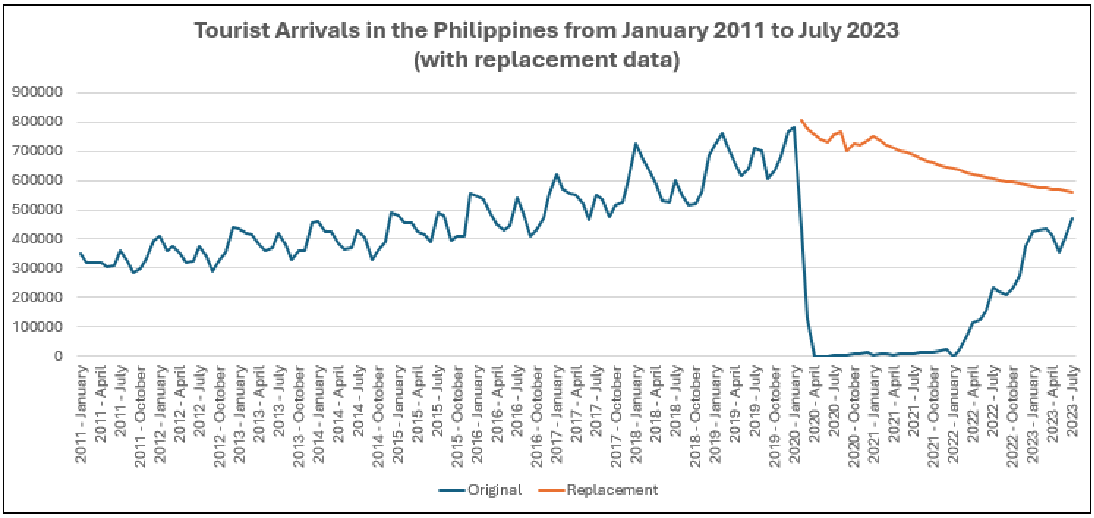
SARIMA Model	Hannan-Quinn Criterion	Schwarz Criterion	Akaike Info Criterion	R-Squared Criterion
1. (1, 1, 5) (2, 2, 7)	23.25768	23.35317	23.1929	0.3498
2. (1, 1, 10) (2, 2, 7)	23.25513	23.35062	23.19035	0.353717
3. (1, 1, 12) (2, 2, 7)* ***Best model***	**23.13555**	**23.23103**	**23.07076**	**0.438916**
4. (1, 1, 19), (2, 2, 7)	23.26419	23.35967	23.1994	0.346266
5. (1, 1, 31), (2, 2, 7)	23.26478	23.36026	23.19999	0.346083
6. (1, 1, 36) (2, 2, 7)	23.26139	23.35687	23.1966	0.349973

Candidate SARIMA models for imputation

Among the listed samples, SARIMA (1, 1, 12) (2, 2, 7) is used because the said model has the lowest Hannan-Quinn Criterion, Schwarz Criterion, and Akaike Info Criterion, while having the highest R-Squared value from the models listed identified. The said model was used to forecast February 2020 to July 2023.

Below are the projected monthly figures in lieu of the data influenced by the pandemic:

Figure 4. Projected Graph for Tourist arrivals in Philippines replacing the data of the February 2020 to July 2023



** Blue line - Affected by Covid-19*

** Orange line - forecasted replacement data*

Table 5

Number of Tourist arrivals per year per month with its respectivereplacement data (January 2011 to July 2024)

Month	2020		2021		2022		2023	
	Original	Replacement	Original	Replacement	Original	Replacement	Original	Replacement
January	*n/a*	*n/a*	6109	751768	0	639097	425188	581046
February	439852	804446	9005	734796	26306	632966	431695	577490
March	127721	772926	10446	718764	69639	627101	436292	574092
April	927	757457	5098	711903	115515	621496	417320	570845
May	357	741840	9153	702157	124934	616142	353093	567743
June	1186	730337	10281	692793	153503	611026	407210	564778
July	3380	753523	11784	683133	232317	606138	467919	561946
August	5364	766185	13132	674002	218051	601466	*n/a*	*n/a*
September	6410	701436	13891	666512	207224	597002	*n/a*	*n/a*
October	8304	722838	16656	659338	227667	592737	*n/a*	*n/a*
November	9069	720528	18836	652266	275901	588661	*n/a*	*n/a*
December	13753	735747	22697	645513	374346	584767	*n/a*	*n/a*

4.2.2 Forecasting August 2024 to December 2026

The forecast utilized the replacement data rather than the original data from February 2020 to July 2023 in order to maintain trends and seasonality by eliminating skewed data resulting from the strict travel restrictions imposed during the COVID-19 pandemic.

4.2.2.1 Stage 1: Identification

After examining the autocorrelation function (ACF) and partial autocorrelation function (PACF) from the correlogram data to project the period from January 2011 to December 2026, consistent with the findings from the identification phase of the imputation, it was concluded that the data displays seasonality. Consequently, SARIMA is also employed for forecasting.

Further, Tourist arrivals data were checked if it already has stationarity. Upon running the Augmented Dickey-Fuller (ADF) test, it was found out that tourist arrivals are stationary at:

- Difference of one (Non-seasonal)
- No difference (Seasonal)

since it's the intercept, trend and intercept, and the test equation rejects the null hypothesis (significant) (See Appendix b.1 and Appendix b.2).

4.2.2.2 Stage 2 and 3: Estimation, Diagnostics and Forecasting for Imputation

After undergoing the identification stage of the Box-Jenkins Methodology to forecast the possible replacement data for February 2020 to July 2023, the following (Please see Table 6) are the candidate SARIMA models that satisfy the diagnostics stage (See Appendix a.2.3 and a.2.4):

- Residuals are White Noise. All of the p-values must be greater than the set alpha (0.05).
- ARMA process is covariance stationary.
  - All AR roots lie inside the unit circle.
- ARMA process is invertible.
  - All MA roots lie inside the unit circle

Table 6

SARIMA Model	Hannan-Quinn Criterion	Schwarz Criterion	Akaike Info Criterion	R-Squared Criterion
1. (3, 1, 4) (1, 0 , 5)	23.68214	23.75333	23.63343	0.791383
2. (3, 1, 4) (1, 0, 12)	**23.62408**	**23.69527**	**23.57538**	**0.808009**
Best model				

Candidate SARIMA models for forecasting of August 2024 to December 2026

Among the listed, SARIMA (3, 1, 4) (1, 0, 12) was used because the said model has the lowest Hannan-Quinn Criterion, Schwarz Criterion, and Akaike Info Criterion, while having the highest R-Squared value from the models identified.

Below are the projected figures for the monthly arrivals until December 2026:

Figure 5. Projected Graph for Tourist arrivals in Philippines from August 2024 to December 2026

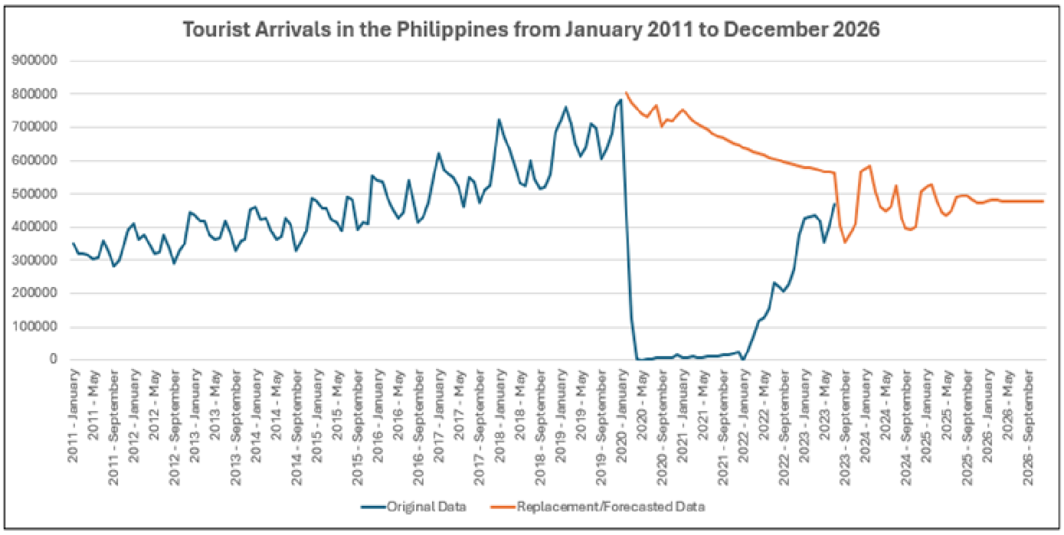


Table 7

Number of Tourist arrivals per year per month from 2011 to July 2024 with forecasted data from August 2024 to December 2026

Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
January	349713	411064	436079	461383	479149	542832	620121	724586	718118	782132	6109	0	425188	574439	518369	477500
February	318912	361925	418108	422631	456524	537194	569361	669640	762437	439852	9005	26306	431695	582332	528158	480088
March	320876	375083	417392	425858	456163	485892	556906	635485	709399	127721	10446	69639	436292	505720	477433	480047
April	317443	349779	377879	386665	423366	452396	551497	583996	653336	927	5098	115515	417320	459453	445836	479216
May	302707	321930	362062	364598	413937	427934	520780	531175	612861	357	9153	124934	353093	447453	437412	478551
June	309749	323725	369073	372293	390486	444043	462729	524765	638440	1186	10281	153503	407210	459362	446090	478588
July	360784	376948	418288	428144	489724	541298	551638	602112	712285	3380	11784	232317	467919	525466	491281	478834
August	323491	337894	382022	405970	480689	490190	535076	546785	699933	5364	13132	218051	404029	427933	496390	479036
September	284040	291637	328114	328981	393589	412202	472766	514174	604552	6410	13891	207224	356300	395525	495538	479049
October	298151	328300	358369	358876	412185	432157	513638	518041	634786	8304	16656	227667	378123	393433	483620	479006
November	337021	352438	361271	390315	411868	472258	522723	559468	679273	9069	18836	275901	411890	402645	474032	478974
December	394567	442088	452650	487654	553002	553186	603062	685488	763057	13753	22697	374346	565351	506684	474289	478992

Highlighted in yellow is the data replaced while grey is the data forecasted.

Conclusion and Recommendation

The Philippines was on an upward trend of tourist arrivals starting from 2011 to 2019. This gradual increase can be attributed to many factors such as the country's persistent efforts to promote, government policies implemented, events hosted, etc… However, the massive decrease occurred entering February 2020, the date when the first death due to Covid-19 was detected in the country. Because of this, for a more accurate forecasting of August 2024 to December 2026, Imputation was used to replace the actual period February 2020 to July 2023 data. SARIMA (1,1,12) (2, 2, 7) model is identified for forecasting the imputation data.

In terms of forecasting tourist arrivals from August 2024 to December 2026, figures showed that tourist arrivals will range from 529,158 to 393,433. The formulated model used is SARIMA (3, 1, 4) (1, 0, 12) after evaluation of the assumptions in modeling.

To further improve the study, the researchers recommend enhancing the research paradigm through considering correlation of factors that could influence tourist arrivals. This would provide future readers with a better picture of factors that may contribute to the increase/decrease in tourist arrivals.

Imputative method predicting the March 2020 to October 2022 data

A.1. **Identification**

a.1.1 Non-Seasonal - Difference of 1

a.1.1.1 Unit Root Test (Intercept)

Null Hypothesis: D2ORIGINALDATA has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.20202	0.0001
Test critical values:	1% level	-3.500669	
	5% level	-2.892200	
	10% level	-2.583192	

*MacKinnon (1996) one-sided p-values.

a.1.1.1 Unit Root Test (Trend and Intercept)

Null Hypothesis: D2ORIGINALDATA has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 11 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.12986	0.0000
Test critical values:	1% level	-4.057528	
	5% level	-3.457808	
	10% level	-3.154859	

*MacKinnon (1996) one-sided p-values.

a.1.1.1 Unit Root Test (None)

Null Hypothesis: D2ORIGINALDATA has a unit root
Exogenous: None
Lag Length: 11 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.27627	0.0000
Test critical values:	1% level	-2.589531	
	5% level	-1.944248	
	10% level	-1.614510	

*MacKinnon (1996) one-sided p-values.

a.1.2 Seasonal - Difference of 2

a.1.2.1 Unit Root Test (Intercept)

Null Hypothesis: D1SEASONALDATA has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.923752	0.0000
Test critical values:	1% level	-3.501445	
	5% level	-2.892536	
	10% level	-2.583371	

*MacKinnon (1996) one-sided p-values.

a.1.2.2 Unit Root Test (Trend and Intercept)

Null Hypothesis: D1SEASONALDATA has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.884981	0.0000
Test critical values:	1% level	-4.058619	
	5% level	-3.458326	
	10% level	-3.155161	

*MacKinnon (1996) one-sided p-values.

a.1.2.3 Unit Root Test (None)

Null Hypothesis: D1SEASONALDATA has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.976840	0.0000
Test critical values:	1% level	-2.589795	
	5% level	-1.944286	
	10% level	-1.614487	

*MacKinnon (1996) one-sided p-values.

A.2. Estimation, Diagnostics and Forecasting

a.2.1 Non-Seasonal Correlogram

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.311	-0.311	14.711	0.000
		2	-0.162	-0.287	18.735	0.000
		3	-0.062	-0.261	19.334	0.000
		4	-0.157	-0.428	23.141	0.000
		5	0.178	-0.249	28.117	0.000
		6	0.055	-0.228	28.596	0.000
		7	0.119	0.011	30.853	0.000
		8	-0.134	-0.071	33.733	0.000
		9	-0.025	0.063	33.832	0.000
		10	-0.213	-0.285	41.143	0.000
		11	-0.140	-0.727	44.358	0.000
		12	0.681	-0.170	120.54	0.000
		13	-0.122	0.015	122.99	0.000
		14	-0.172	-0.051	127.93	0.000
		15	-0.064	0.039	128.62	0.000
		16	-0.135	0.173	131.69	0.000
		17	0.145	0.181	135.29	0.000
		18	0.006	-0.172	135.30	0.000
		19	0.197	0.042	142.03	0.000
		20	-0.156	0.040	146.29	0.000
		21	-0.030	-0.037	146.45	0.000
		22	-0.180	0.022	152.22	0.000
		23	-0.111	0.067	154.40	0.000
		24	0.520	0.002	203.13	0.000
		25	-0.005	0.067	203.13	0.000
		26	-0.212	-0.078	211.35	0.000
		27	-0.026	-0.019	211.47	0.000
		28	-0.123	-0.091	214.28	0.000
		29	0.125	0.087	217.21	0.000
		30	-0.047	-0.126	217.63	0.000
		31	0.267	0.090	231.18	0.000
		32	-0.201	-0.077	238.97	0.000
		33	0.012	0.024	238.99	0.000
		34	-0.148	0.036	243.29	0.000
		35	-0.176	-0.104	249.38	0.000
		36	0.523	0.035	303.80	0.000

Model:

1. AR - 1, 2, 3, 4, 5,6 ,10, 11,18
2. MA - 1,5, 10, 12,19, 22, 24,31,36

a.2.2 Seasonal – Correlogram

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.299	-0.299	12.586	0.000
		2	-0.035	-0.137	12.765	0.002
		3	-0.111	-0.184	14.541	0.002
		4	-0.039	-0.164	14.757	0.005
		5	0.213	0.136	21.344	0.001
		6	0.079	0.199	22.260	0.001
		7	-0.248	-0.159	31.323	0.000
		8	-0.010	-0.101	31.339	0.000
		9	0.062	0.058	31.923	0.000
		10	-0.044	-0.120	32.210	0.000
		11	0.185	0.074	37.402	0.000
		12	-0.215	-0.060	44.514	0.000
		13	0.101	0.109	46.103	0.000
		14	0.080	0.127	47.099	0.000
		15	-0.060	-0.017	47.670	0.000
		16	-0.018	-0.058	47.721	0.000
		17	-0.051	-0.070	48.144	0.000
		18	0.008	-0.004	48.155	0.000
		19	-0.000	-0.136	48.155	0.000
		20	0.017	-0.028	48.202	0.000
		21	-0.081	0.018	49.294	0.000
		22	0.009	-0.064	49.308	0.001
		23	0.097	0.125	50.886	0.001
		24	-0.221	-0.283	59.159	0.000
		25	0.160	0.026	63.523	0.000
		26	-0.104	-0.069	65.402	0.000
		27	0.116	0.038	67.748	0.000
		28	-0.068	-0.081	68.569	0.000
		29	0.044	0.098	68.919	0.000
		30	-0.078	0.080	69.995	0.000
		31	0.150	0.053	74.053	0.000
		32	-0.102	-0.045	75.966	0.000
		33	0.075	0.079	77.008	0.000
		34	-0.043	-0.052	77.353	0.000
		35	-0.142	-0.119	81.161	0.000
		36	0.146	-0.089	85.222	0.000

Models:

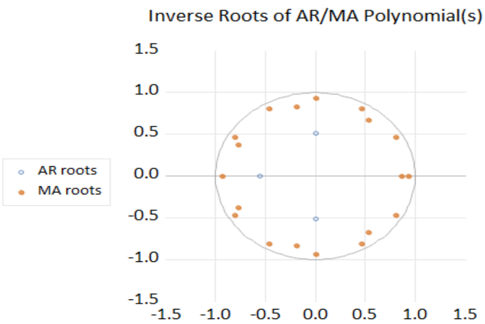
1. SAR - 1, 2, 6, 8
2. SMA - 1, 7,11, 12,25,29

a.2.3. Diagnostics Condition:

SARIMA (1,1,12) (2,2,7)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.004	-0.004	0.0018	
		2	-0.034	-0.034	0.1183	
		3	-0.127	-0.127	1.7453	
		4	-0.108	-0.113	2.9360	
		5	0.077	0.066	3.5427	0.060
		6	-0.012	-0.035	3.5583	0.169
		7	-0.017	-0.043	3.5904	0.309
		8	-0.137	-0.138	5.5934	0.232
		9	0.022	0.027	5.6474	0.342
		10	-0.118	-0.153	7.1830	0.304
		11	0.074	0.037	7.7935	0.351
		12	-0.011	-0.049	7.8060	0.453
		13	0.039	0.036	7.9795	0.536
		14	0.054	0.020	8.3144	0.598
		15	-0.144	-0.133	10.734	0.466
		16	-0.030	-0.066	10.843	0.542
		17	-0.027	-0.021	10.932	0.617
		18	0.074	0.006	11.586	0.639
		19	0.053	0.024	11.934	0.684
		20	0.071	0.059	12.560	0.705
		21	-0.029	0.004	12.668	0.758
		22	0.010	0.025	12.680	0.810
		23	0.029	0.017	12.790	0.849
		24	-0.062	-0.056	13.292	0.865
		25	0.167	0.146	16.982	0.712
		26	-0.025	0.012	17.068	0.760
		27	-0.076	-0.074	17.847	0.766
		28	-0.114	-0.071	19.659	0.716
		29	0.164	0.248	23.458	0.551
		30	0.122	0.101	25.565	0.487
		31	0.091	0.079	26.753	0.477
		32	-0.086	-0.063	27.843	0.473
		33	-0.068	0.088	28.542	0.489
		34	-0.087	-0.114	29.694	0.481
		35	-0.086	-0.056	30.843	0.474
		36	0.063	0.006	31.462	0.494

- Residuals are White Noise. All of the p-values must be greater than the set alpha (0.05).
- ARMA process is covariance stationary.
  - All AR roots lie inside the unit circle.
  - All MA roots lie inside the unit circle.



Forecasting January 2011 to December 2026 Tourist arrival data

A.3. **Identification**

b.1.1 Non-Seasonal - Difference of 1

b.1.1.1 Unit Root Test (Intercept)

Null Hypothesis: DORIGINALDATA has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.051798	0.0325
Test critical values:	1% level	-3.474265	
	5% level	-2.880722	
	10% level	-2.577077	

*MacKinnon (1996) one-sided p-values.

b.1.1.1 Unit Root Test (Trend and Intercept)

Null Hypothesis: DORIGINALDATA has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 11 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.557044	0.0371
Test critical values:	1% level	-4.020396	
	5% level	-3.440059	
	10% level	-3.144465	

*MacKinnon (1996) one-sided p-values.

b.1.1.1 Unit Root Test (None)

Null Hypothesis: DORIGINALDATA has a unit root
Exogenous: None
Lag Length: 11 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.046466	0.0025
Test critical values:	1% level	-2.580470	
	5% level	-1.942967	
	10% level	-1.615298	

*MacKinnon (1996) one-sided p-values.

b.1.2 Seasonal - No difference

b.1.2.1 Unit Root Test (Intercept)

Null Hypothesis: SEASONALDATA has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.160714	0.0244
Test critical values:	1% level	-3.474265	
	5% level	-2.880722	
	10% level	-2.577077	

*MacKinnon (1996) one-sided p-values.

b.1.2.2 Unit Root Test (Trend and Intercept)

Null Hypothesis: SEASONALDATA has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.735125	0.0230
Test critical values:	1% level	-4.020396	
	5% level	-3.440059	
	10% level	-3.144465	

*MacKinnon (1996) one-sided p-values.

b.1.2.3 Unit Root Test (None)

Null Hypothesis: SEASONALDATA has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.164375	0.0017
Test critical values:	1% level	-2.580470	
	5% level	-1.942967	
	10% level	-1.615298	

*MacKinnon (1996) one-sided p-values.

b.2 Estimation, Diagnostics and Forecasting

b.2.1 Non-Seasonal Correlogram

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.137	0.137	3.1073	0.078
		2	-0.192	-0.215	9.2419	0.010
		3	-0.308	-0.264	25.139	0.000
		4	-0.289	-0.289	39.184	0.000
		5	0.087	0.029	40.457	0.000
		6	0.141	-0.067	43.846	0.000
		7	0.141	0.009	47.247	0.000
		8	-0.135	-0.225	50.393	0.000
		9	-0.192	-0.126	56.821	0.000
		10	-0.212	-0.298	64.704	0.000
		11	0.084	-0.026	65.948	0.000
		12	0.626	0.494	135.32	0.000
		13	0.145	-0.025	139.05	0.000
		14	-0.154	-0.089	143.31	0.000
		15	-0.207	0.177	151.06	0.000
		16	-0.167	0.224	156.16	0.000
		17	0.071	0.058	157.07	0.000
		18	0.103	0.004	159.01	0.000
		19	0.117	0.135	161.53	0.000
		20	-0.156	-0.097	166.08	0.000
		21	-0.194	-0.109	173.15	0.000
		22	-0.190	-0.035	179.97	0.000
		23	0.082	0.006	181.26	0.000
		24	0.506	0.006	230.61	0.000
		25	0.175	0.007	236.53	0.000
		26	-0.149	-0.060	240.88	0.000
		27	-0.170	0.056	246.55	0.000
		28	-0.152	-0.022	251.14	0.000
		29	0.051	0.049	251.67	0.000
		30	0.076	-0.054	252.83	0.000
		31	0.144	0.107	257.06	0.000
		32	-0.164	-0.138	262.55	0.000
		33	-0.163	0.036	268.01	0.000
		34	-0.194	-0.089	275.80	0.000
		35	0.053	0.015	276.38	0.000
		36	0.476	0.074	324.09	0.000

Model:

AR - 2, 3, 4, 8, 10, 12, 15, 16

MA - 2,3, 4, 9, 10, 12, 15, 16, 20, 21, 22, 24, 25, 27, 32, 33, 34, 36

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.084	-0.084	1.0865	
		2	-0.034	-0.041	1.2627	
		3	0.007	0.001	1.2709	
		4	-0.041	-0.042	1.5299	
		5	0.057	0.050	2.0395	0.153
		6	0.056	0.063	2.5399	0.281
		7	-0.031	-0.017	2.6934	0.441
		8	0.089	0.089	3.9761	0.409
		9	0.109	0.130	5.9172	0.314
		10	-0.040	-0.010	6.1750	0.404
		11	-0.024	-0.029	6.2704	0.509
		12	0.098	0.102	7.8682	0.446
		13	0.099	0.123	9.5242	0.390
		14	0.023	0.025	9.6150	0.475
		15	0.006	0.011	9.6204	0.565
		16	0.001	0.020	9.6205	0.649
		17	0.026	0.009	9.7391	0.715
		18	0.030	0.002	9.8907	0.770
		19	0.028	0.036	10.029	0.818
		20	-0.001	-0.004	10.030	0.865
		21	0.024	-0.021	10.129	0.898
		22	0.039	0.014	10.398	0.918
		23	-0.017	-0.009	10.452	0.941
		24	-0.165	-0.193	15.393	0.753
		25	0.160	0.104	20.114	0.514
		26	-0.052	-0.063	20.609	0.545
		27	0.073	0.047	21.606	0.544
		28	-0.024	-0.051	21.714	0.596
		29	0.017	0.055	21.769	0.649
		30	-0.024	-0.044	21.882	0.695
		31	0.122	0.108	24.742	0.589
		32	-0.039	0.007	25.031	0.626
		33	0.076	0.114	26.176	0.616
		34	-0.016	-0.053	26.225	0.664
		35	-0.109	-0.097	28.595	0.590
		36	-0.114	-0.136	31.214	0.506

b.2.2 Seasonal - Correlogram

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.871	0.871	116.78	0.000
		2	0.761	0.010	206.49	0.000
		3	0.657	-0.032	273.81	0.000
		4	0.613	0.189	332.83	0.000
		5	0.634	0.282	396.47	0.000
		6	0.636	-0.014	460.90	0.000
		7	0.619	-0.018	522.44	0.000
		8	0.607	0.148	582.04	0.000
		9	0.573	-0.023	635.45	0.000
		10	0.521	-0.159	679.91	0.000
		11	0.483	0.033	718.38	0.000
		12	0.431	-0.058	749.22	0.000
		13	0.425	0.064	779.53	0.000
		14	0.402	-0.109	806.77	0.000
		15	0.367	-0.067	829.59	0.000
		16	0.342	0.055	849.58	0.000
		17	0.318	0.033	867.01	0.000
		18	0.303	-0.039	882.91	0.000
		19	0.288	-0.008	897.39	0.000
		20	0.267	0.057	909.94	0.000
		21	0.236	-0.054	919.86	0.000
		22	0.215	-0.029	928.13	0.000
		23	0.187	0.004	934.41	0.000
		24	0.159	-0.049	939.01	0.000
		25	0.171	0.165	944.36	0.000
		26	0.152	-0.135	948.66	0.000
		27	0.151	0.016	952.91	0.000
		28	0.119	-0.044	955.55	0.000
		29	0.102	0.098	957.52	0.000
		30	0.084	-0.096	958.87	0.000
		31	0.076	0.003	959.97	0.000
		32	0.042	-0.092	960.32	0.000
		33	0.009	-0.049	960.34	0.000
		34	-0.052	-0.206	960.87	0.000
		35	-0.105	-0.069	963.05	0.000
		36	-0.122	0.034	966.06	0.000

Model:

a. SAR - 1, 4, 5, 10, 25, 34

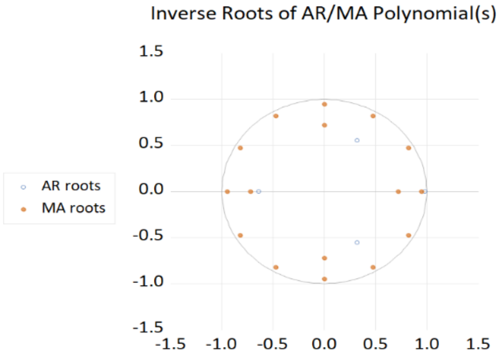
b. SMA -1 to 25

b.2.3. Diagnostics Condition:

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.084	-0.084	1.0865	
		2	-0.034	-0.041	1.2627	
		3	0.007	0.001	1.2709	
		4	-0.041	-0.042	1.5299	
		5	0.057	0.050	2.0395	0.153
		6	0.056	0.063	2.5399	0.281
		7	-0.031	-0.017	2.6934	0.441
		8	0.089	0.089	3.9761	0.409
		9	0.109	0.130	5.9172	0.314
		10	-0.040	-0.010	6.1750	0.404
		11	-0.024	-0.029	6.2704	0.509
		12	0.098	0.102	7.8682	0.446
		13	0.099	0.123	9.5242	0.390
		14	0.023	0.025	9.6150	0.475
		15	0.006	0.011	9.6204	0.565
		16	0.001	0.020	9.6205	0.649
		17	0.026	0.009	9.7391	0.715
		18	0.030	0.002	9.8907	0.770
		19	0.028	0.036	10.029	0.818
		20	-0.001	-0.004	10.030	0.865
		21	0.024	-0.021	10.129	0.898
		22	0.039	0.014	10.398	0.918
		23	-0.017	-0.009	10.452	0.941
		24	-0.165	-0.193	15.393	0.753
		25	0.160	0.104	20.114	0.514
		26	-0.052	-0.063	20.609	0.545
		27	0.073	0.047	21.606	0.544
		28	-0.024	-0.051	21.714	0.596
		29	0.017	0.055	21.769	0.649
		30	-0.024	-0.044	21.882	0.695
		31	0.122	0.108	24.742	0.589
		32	-0.039	0.007	25.031	0.626
		33	0.076	0.114	26.176	0.616
		34	-0.016	-0.053	26.225	0.664
		35	-0.109	-0.097	28.595	0.590
		36	-0.114	-0.136	31.214	0.506

SARIMA (3,1,4) (1,0,12)

- Residuals are White Noise. All of the p-values must be greater than the set alpha (0.05).
- ARMA process is covariance stationary.
    - All AR roots lie inside the unit circle.
    - All MA roots lie inside the unit circle.



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