Analysis and Forecast of Monthly Tourist Arrivals and Revenue using the ARIMA Model: A Case of Thailand

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Abstract

Thailand is one of the world's most popular tourist destinations, known for its rich cultural heritage, diverse landscapes, and vibrant cities. Tourism plays a crucial role in the country's economy, contributing significantly to GDP and employment. Among the numerous tourist destinations in Thailand, Phuket stands out as a premier location, attracting millions of international tourists each year due to its pristine beaches, luxury resorts, and vibrant nightlife. Phuket's tourism industry is a major economic driver, generating substantial revenue and influencing the overall growth of the national tourism sector. This research comprises two primary components aimed at enhancing the understanding and management of tourism in Thailand. The first component involves the creation of data visualizations depicting the number of tourists and the revenue generated from tourism in each province of Thailand from 2020 to 2023. The focus is primarily on Phuket, a globally renowned tourist destination, to compare its tourism statistics with those of other provinces. Phuket is highlighted due to its significant annual tourist influx and substantial contribution to national revenue. These visualizations are crucial for identifying trends, making comparisons, and informing strategic decisions for stakeholders. The second component utilizes the ARIMA Model, a widely-used statistical model for time series data forecasting, to predict the daily number of tourists and the associated revenue for each province in Thailand. These forecasts extend to the year 2028, offering insights into the future growth of Thailand's tourism sector. The emphasis remains on Phuket, with comparative analyses involving other provinces. Overall, this paper provides a comprehensive dataset highlighting trends in tourist statistics and revenue generation, including projected forecasts. The forecasted data is very important for decision-making, providing both government and private sectors with valuable information to optimize tourism management, enhance competitiveness, and promote sustainable tourism development. This data-driven approach ensures that strategies are based on robust evidence, facilitating more effective and efficient tourism planning and operations.

CCS Concepts

• : **Information systems** → Information systems applications; Decision support systems; Data analytics.

Keywords

Data Visualization, Forecast, ARIMA, Decision Making, Tourism, Phuket

1 Introduction

Thailand is one of the world's premier tourist destinations, distinguished for its rich cultural heritage, diverse landscapes, and vibrant urban centers. Tourism in Thailand is a cornerstone of the national economy, significantly contributing to GDP and employment. It has been a major driver of economic growth. In the wake of the COVID-19 pandemic, the tourism sector in Thailand is undergoing a recovery phase, with extensive efforts to rejuvenate the industry and attract international visitors once more. Among Thailand's many tourist destinations, Phuket is particularly noteworthy. It attracts millions of international tourists annually with its pristine beaches, luxury resorts, and vibrant nightlife. The tourism industry

in Phuket serves as a major economic engine, generating substantial revenue and significantly influencing the overall growth of the national tourism sector [1].

Phuket, a province in Thailand, is a large island renowned for its stunning natural beauty, pristine beaches, crystal-clear waters, and abundant marine life. It offers a wide range of activities for tourists, including water sports, sightseeing, and cultural experiences. The island's western coast is characterized by bays and coves, while the eastern coast features long, sandy beaches and mangrove forests. Phuket is also home to several cultural and historical sites, including the old Town, which features Sino-Portuguese architecture and hosts the first Thai cultural park in the world. The town also houses several museums, including the Thai Hua Museum, which explores the history of Chinese immigrants in Phuket. In addition to its natural and cultural attractions, Phuket is also known for its vibrant nightlife. The island is home to numerous luxury resorts and spas, making it a popular destination for those seeking relaxation and pampering. Overall, Phuket is a must-visit destination for anyone traveling to Thailand, offering stunning beaches, rich culture, and an abundance of activities for both relaxation and adventure [2] [3]. The number of tourists visiting Phuket has significantly increased since 2022 until now. Phuket aims to attract over 14 million international and domestic tourists and government hope that can get revenue expected to exceed 200 billion baht in 2023. This marks a remarkable recovery from the impact of the COVID-19 pandemic. The main foreign tourist groups visiting Phuket in 2023 include travelers from China, Russia, Australia, India, and Hong Kong. The number of tourists from these countries has shown a positive trend compared to the same period last year. Due to the relaxation of international travel restrictions as the global COVID-19 situation has improved. However, the overall number of foreign tourists remains lower than pre-pandemic levels in 2019. Particularly for Chinese tourists, whose recovery has been slower than anticipated due to economic slowdowns caused by prolonged lockdowns and a real estate crisis that has impacted the financial sector. The weakened Chinese economy has affected the purchasing power of Chinese tourists, and stricter visa application conditions for entering Thailand have further contributed to this slower recovery [4].

The growth and expansion of the number of tourists requires comprehensive to support decision-making for both government and private agencies involved to tourism at both the national and provincial levels, especially in Phuket. This data is essential for informed decision-making in sustainable tourism management. Therefore, this research focuses on analyzing historical data on tourist arrivals and revenue and forecasting future trends in tourist arrivals and revenue using the ARIMA model.

2 Literature Review

Presenting tourism data through data visualization is crucial for informed decision-making in tourism management [5]. Various factors are considered in the presentation of this data. The analysis of tourist data in Phuket involves studying various factors such as the number of tourists, their preferences, and the impact of tourism on the local economy. The following are some key points from the search results:

1) The Phuket Tourism Development Strategy Report provides an overview of the tourism industry in Phuket, including the number of tourists and their preferences. The report highlights the importance of analyzing the competitiveness of Phuket's tourism industry and developing strategies to enhance its appeal to tourists.

2) A study on Thai tourists' travel behavior in Phuket examines the factors that influence their travel decisions and preferences. The study aims to understand the needs and preferences of Thai tourists and how they impact tourism in Phuket.

3) Research on the factors influencing ecotourism behavior in Phuket focuses on understanding the motivations and barriers to ecotourism among tourists. The study aims to develop strategies to promote sustainable tourism in Phuket.

4) The Phuket Tourism website provides general information about tourism in Phuket, including the number of tourists and the types of attractions available. The website highlights the importance of tourism to the local economy and the need to provide facilities and services to support tourists.

5) A research report on the development of a tourism information system in Phuket focuses on the use of technology to improve the tourism industry in Phuket. The report highlights the importance of providing accurate and up-to-date information to tourists to enhance their travel experience. In summary, the analysis of tourist data in Phuket involves studying various factors that impact tourism, including the number of tourists, their preferences, and the impact of tourism on the local economy. The use of technology to improve the tourism industry and promote sustainable tourism is also an important consideration [1] [6] [7].

And the research focuses on analyzing historical tourist arrival data and forecasting future trends using the ARIMA model. The ARIMA (autoregressive integrated moving average) model [8] is a widely used method for time series forecasting, including tourist arrivals. The model involves several steps, including identifying stationarity, determining the orders of autoregression (AR) and moving average (MA), and using maximum likelihood estimation to estimate the unknown parameters. Several studies have applied the ARIMA model to forecast tourist arrivals, such as: Predicting tourism demand by A.R.I.M.A. models. The main aim of this research is to identify a model that best describes and forecasts international tourism demand in F.Y.R. Macedonia [9]. Forecasting the number of incoming tourists using ARIMA model: case study from Armenia. This article aims to predict the number of incoming tourists to the RA using the ARIMA model. The theoretical analysis reviewed various methods and models for forecasting, noting that multiple variables are used in tourism modeling and prediction [10]. ARIMA model to forecast international tourist visit in Bumthang, Bhutan [11].

3 Research Process

The primary process of this research consists of two parts. The first part involves creating data visualizations of the monthly tourist arrivals and the revenue generated from tourism for each province in Thailand from 2020 to 2023, with a focus on Phuket as the main point of comparison with other provinces. Phuket is highlighted due to its status as a world-class tourist destination, attracting a large number of tourists annually and significantly contributing
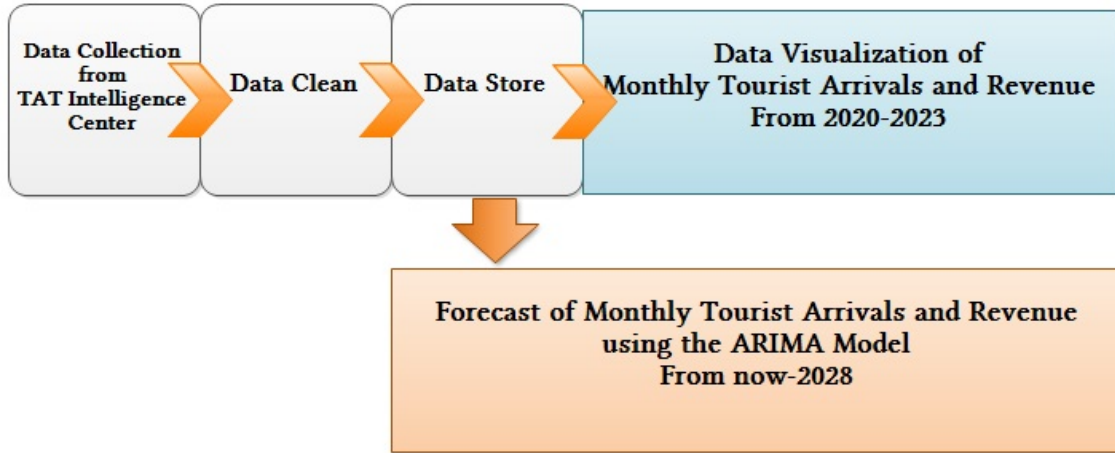
Figure 1: Conceptual Framework of Research

to the country's revenue. The second part involves forecasting the monthly number of tourists and the revenue generated in each province of Thailand using the ARIMA Model, a popular statistical model for time series data forecasting. The predictions extend to the year 2028 to illustrate the growth trajectory of Thailand's tourism sector, with a primary focus on Phuket and comparisons with other provinces. The forecasted data will provide both government and private sectors with valuable information for making informed decisions to manage tourism effectively and sustainably. The conceptual framework of this research is shown in Figure 1.

3.1 Data Visualization

The creation of data visualizations of monthly tourist numbers and revenue in Thailand from 2020 to 2023 utilizes data collected and published by the Tourism Authority of Thailand [3]. The presentation of this data emphasizes comparisons between Phuket and other provinces, enabling stakeholders in both the public and private sectors involved in tourism to use this information to support decision-making in tourism management. Specifically, for Phuket, this data is crucial for making informed decisions regarding infrastructure development and other areas.

3.2 Arima Model

The process of forecasting monthly tourist arrivals and revenue up to the year 2028 involves utilizing the data collected, as shown in Figure 1, and applying it to the ARIMA Model. The detailed procedure is as follows:

3.2.1 Forecasting methods. Forecasting tourist numbers and revenue is important for planning and decision-making in the tourism industry. In this study, we use the ARIMA model to forecast tourist numbers and revenue in Phuket and other provinces over the next five years. The ARIMA model is chosen due to its capability to analyze time series data and its flexibility in capturing patterns in historical data.

3.2.2 Data Collection and Preparation. In this study, we are collecting data from government tourism databases, encompassing annual

visitor numbers and revenue. The datasets were preprocessed as follows:

- Conversion of relevant data columns to numeric values to ensure proper numerical operations.
- Removal of duplicate records to maintain data integrity.
- Aggregation of monthly data into yearly totals suitable for forecasting.

3.2.3 Data Aggregation. The annual visitor numbers and revenue data were aggregated and sorted by year. Let $V(t)$ represent the number of visitors in year t and $R(t)$ represent the revenue in year t. The data aggregation process can be mathematically expressed as:

$$V(t) = \sum_{i=1}^{12} V_i(t)$$

$$R(t) = \sum_{i=1}^{12} R_i(t)$$

where $V_i(t)$ and $R_i(t)$ are the monthly visitor numbers and revenue, respectively, for month i in year t.

3.2.4 ARIMA Model. The ARIMA model, denoted as ARIMA(p, d, q) is used to model the time series data. The parameters p, d, and q represent the order of the autoregressive part, the degree of differencing, and the order of the moving average part, respectively. In this study, we use an ARIMA model with p, d, and q equal 1, which is mathematically defined as:

$$\Delta Y(t) = \phi_1 \Delta Y(t-1) + \theta_1 \epsilon(t-1) + \epsilon(t)$$

Where:

$\Delta Y(t)$ is the first difference of the time series $Y(t)$

ϕ_1 is the autoregressive coefficient.

θ_1 is the moving average coefficient.

$\epsilon(t)$ is the white noise error term

For visitor numbers $V(t)$ and revenue $R(t)$, the respective ARIMA models are:

$$\Delta V(t) = \phi_1 \Delta V(t-1) + \theta_1 \epsilon(t-1) + \epsilon(t)$$

Figure 2: Data Visualization of Monthly Tourist Arrivals and Revenue From 2020-2023

Figure 3: User Interface of the Forecast of Monthly Tourist Arrivals and Revenue using the ARIMA Model From now-2028

$$\Delta R\,(t) \;= \phi_1 \Delta R\,(t-1) + \theta_1 \epsilon\,(t-1) + \epsilon\,(t)$$

The ARIMA model was fitting process involves estimating the parameters ϕ_1 and θ_1 to minimize the error in the model. Forecasts were generated for the next five years using the fitted ARIMA model. The forecasted values provide an estimate of the visitor numbers and revenue for future years, based on historical trends.

Algorithm 1 Using SQL in Python for Forecast Tourist Arrivals and Revenue in Phuket with AIMA Model (Partial)

– **Convert to numeric and handle errors by setting them to NULL**

```
SELECT
    CAST(Current_year_Revenue_from_visitors_(million_baht) AS
DECIMAL) AS Revenue,
    Year_1
INTO temp_revenue
FROM visitor_revenue
WHERE
ISNUMERIC(Current_year_Revenue_from_visitors_(million_baht))
= 1;
```

– **Remove duplicates**

```
SELECT DISTINCT
    Revenue,
    Year_1
INTO temp_revenue_dedup
FROM temp_revenue;
```

– **Aggregate monthly data to yearly data**

```
SELECT
    YEAR(Year_1) AS Year,
    SUM(Revenue) AS Total_Revenue
INTO annual_revenue
FROM temp_revenue_dedup
GROUP BY YEAR(Year_1);
```

– **Check annual data**

```
SELECT * FROM annual_revenue;
```

–**Forecast Using ARIMA with Python**–

```
import pandas as pd
from statsmodels.tsa.arima.model import ARIMA
# Assuming 'annual_revenue' is loaded into a pandas DataFrame
annual_revenue_df = pd.read_sql('SELECT * FROM
annual_revenue', connection)
# Fit the ARIMA model
if len(annual_revenue_df) > 1:
    model = ARIMA(annual_revenue_df['Total_Revenue'], order=(1,
1, 1))
    model_fit = model.fit()
    forecast = model_fit.forecast(steps=5)
    # Create a DataFrame for forecasted data
    future_years = [annual_revenue_df['Year'].max() + i for i in
range(1, 6)]
    forecast_data = pd.DataFrame({'Year': future_years,
'Forecasted_Revenue': forecast})
    # Combine actual and forecasted data
    combined_data = pd.concat([annual_revenue_df,
forecast_data.rename(columns={'Forecasted_Revenue':
'Total_Revenue'})])
    # Print forecasted results
    for i in range(len(forecast)):
        print(f"Forecasted revenue from visitors in year
{future_years[i]}: {forecast[i]:,.0f} million baht")
else:
    print("Not enough data for forecasting")
```

– **Assuming 'forecast_data' has been created in Python and imported back to SQL as a table**

```
SELECT * FROM annual_revenue
UNION
SELECT Year, Forecasted_Revenue AS Total_Revenue FROM
forecast_data;
```

3.2.5   Using SQL in Python for ARIMA Model.

4   Data Visualization and Forecast of Monthly Tourist Arrivals and Revenue in Thailand using the ARIMA Model

Figure 2 consists of four images with the following details: Image 1 illustrates a comparison of tourism statistics between Phuket and other provinces over a four-year period (2020-2023). The data comprises four key metrics: Total Visitors, indicating the number of visitors; Total Revenue, representing the total revenue generated from tourism; and the averages, Average Visitors and Average Revenue. The interface for displaying this data can be customized for comparative purposes, allowing users to select specific provinces and years of interest. From the example in Image 1, it is observed that both the number of tourists and the average revenue in Phuket remained relatively stable following the COVID-19 pandemic. In contrast, other provinces showed an increasing trend in the number of tourists and average revenue. This increase is attributed to tourists' growing confidence in the safety measures implemented by the government to control the pandemic across the country, alongside extensive public communication. Images 2 and 3 provide detailed insights into the number of tourists visiting Thailand and the revenue generated over the same four-year period. There is a noticeable decline in both tourist numbers and revenue in 2021, attributable to the COVID-19 outbreak. However, after 2021, as tourist concerns diminished, the tourism sector demonstrated a recovery, with growth evident in 2022 and 2023. Besides annual data, users can also view monthly data, as shown in Image 4, where an increase in both the number of tourists and their spending is observed from January to July.

Figure 3 provides an example of forecasting monthly tourist numbers and revenue for Phuket and other provinces, extending predictions to the year 2028. The results presented in Image 1 indicate an anticipated increase in tourist numbers for Phuket, which consequently leads to higher revenue. Additionally, Image 2 compares the tourist numbers and revenue between Phuket and other provinces in Thailand. Users can select which provinces to compare with Phuket. Image 3 presents an overview of the nationwide forecast of tourist numbers and revenue, while Image 4 offers a similar overview but allows for year-by-year comparison.

5   Discussion

In this research, data is presented through visualizations, making complex information easier to understand and practically applicable. Users can access an interactive dashboard to explore the data effortlessly. They can select specific provinces and time periods to analyze tourism trends and revenue data. This interaction between users and data serves not only as a tool for summarizing information but also fosters engagement, allowing stakeholders to gain deep insights and make informed decisions. The data is presented with summary statistics, bar charts, and line graphs to facilitate an easy understanding of tourism trends. For example, bar charts show the comparative performance of provinces in terms of tourist arrivals and generated revenue, while line graphs illustrate data trends, highlighting periods of growth or decline. Such clear visual communication enables the rapid identification of crucial

insights, such as the highest-performing provinces, variations over different periods, and the impact of specific events or policies on tourist numbers and revenue.

The forecasting in this research uses the ARIMA model, which is a tool that can predict future trends based on historical data. This model is useful for planning and policymaking because it can simulate and predict future trends. The accuracy of the model is evaluated through back testing with historical data. Accurate forecasting allows stakeholders to prepare for expected changes. For example, predicting an increase in tourists in a province can encourage local authorities to develop infrastructure, such as expanding airport capacity, improving public transportation, and ensuring suitable accommodations. Forecasting an increase in income can also lead to investment in premium services and attractions, targeting high-spending tourists to maximize economic benefits. The performance of this model can be continuously improved by incorporating new data, thus improving its long-term forecasting capability. This approach is a reliable tool for planning and decision-making.

Overall, the key stakeholders who will benefit from this research are government agencies, local governments, tourism businesses, and the general public. Government agencies can use the data to shape tourism policies. Local governments can plan and prioritize infrastructure development and tourism service improvements based on projected trends. Tourism businesses can strategize their marketing offerings in line with tourist behavior and preferences. Meanwhile, the general public will benefit from improved services and economic opportunities resulting from these policies and investments.

6 Conclusion

This research has been developed to provide information that supports decision-making for all relevant stakeholders, including both the public and private sectors, in managing tourism in Thailand, particularly in Phuket, a province renowned for its global tourist appeal. However, despite its popularity, Phuket currently faces several issues that impact its tourism industry, such as traffic congestion, which significantly affects both the tourism sector and the daily lives of its residents. Therefore, analyzing data to create visualizations from 2020 to 2023, which present the number of tourists visiting Phuket and the revenue generated each month, will demonstrate the importance of this information in shaping policies and developing tourism in Phuket and other provinces in Thailand. Furthermore, forecasting the monthly number of tourists and revenue using the ARIMA Model up to 2028 will illustrate the tourism trends in each province, using Phuket as a comparative benchmark. The results from the data visualization and forecast of monthly tourist arrivals and revenue will enable stakeholders in the tourism sector to make high-quality decisions and mitigate risks effectively.

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