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Analyzing and Forecasting International Tourist Arrivals in Nepal: Trends, Patterns, and Future Prospects

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ABSTRACT

This paper aims to analyze and forecast international tourist arrivals in Nepal, a country known for its rich cultural heritage and breathtaking natural landscapes. Using time series analysis and Auto-Regressive Integrated Moving Average (ARIMA) modeling, the study investigates the data on tourist arrivals, highlighting the significant impact of the COVID-19 pandemic on travel trends. Descriptive statistics were used to examine tourist demographics including gender, age groups, and the purpose of visit, revealing seasonal trends that influence arrival patterns. The findings indicate that international tourism plays a vital role in Nepal's economy, while the pandemic has led to unprecedented decline in arrivals. The study offers valuable insights for policymakers and stakeholders in the tourism sector, emphasizing the need for sustainable tourism development and investment in infrastructure to recover and enhance the country's tourism potential. By providing forecasts of future tourist arrivals, this research serves as a critical tool for strategic planning in the post-pandemic landscape.

Keywords: Tourism, Cultural Heritage, Time Series Analysis, ARIMA Modeling, COVID-19 Pandemic, Forecasting.

1 Introduction

Tourism can be categorized into two types based on the origin and destination of travellers: domestic and international. Domestic tourism involves people travelling within their own country, whereas international tourism entails travelling to a different country. Tourism is a significant economic contributor for many nations. In 2023, Nepal welcomed 1,014,876 tourists, placing it 147^{th} globally in terms of tourist numbers. Tourism is Nepal's largest industry and a primary source of foreign income and revenue. The country draws many tourists interested in adventure activities like mountaineering, rock climbing, and hiking, as it boasts eight of the world's ten highest mountains. Additionally, Nepal's Hindu and Buddhist culture and favourable climate are attractive to visitors (Subedi, 2017).

The 2024 report on tourism in Nepal highlighted that the top five nations contributing tourists to the country are India, USA, UK, China, and Australia. From 2000 to 2023, the total number of visitors to Nepal rose significantly, increasing from 463,646 to 1,014,876 (Nepal Tourism Statistics, 2023). Nevertheless, the tourism sector in Nepal faced a significant decline due to the COVID-19 pandemic, reflecting global trends. According to the United Nations World Tourism Organization (UNWTO, 2020), there was a 74 percentage drop in international tourist arrivals worldwide, which severely impacted Nepal, resulting only 230,085 visitors in 2020 (Nepal Tourism Statistics, 2021), the lowest figure in many years. The decrease in tourist numbers between 2019 and 2021 can also be linked to political instability and natural calamities; for example, the tourism sector suffered a setback after the catastrophic earthquakes in 2015 (World Bank, 2015). In addition, tourist arrivals fluctuate throughout the year, suggesting that seasonal weather plays a role in tourism trends. Generally, Nepal sees a higher influx of tourists during the months of March-April and October-November, when the climate is more pleasant, while the rainy season sees fewer visitors. The sudden halt in tourism activities had serious consequences for the economy and jeopardized the livelihoods of many individuals

dependent on this sector. As the industry begins to recover, it is crucial to analyze the factors that affect tourist arrivals to effectively restore and maintain the tourism sector.

Nepal's tourism industry is one of the country's most thriving sectors. It generates substantial foreign exchange and provides employment opportunities for a wide range of individuals, both skilled and unskilled. Tourism plays a crucial role in the growth of Nepal's economy and society. The country is an appealing destination for international tourists, attracted by its diverse offerings. These attractions include the magnificent Himalayan peaks, vibrant Nepalese culture and festivals, picturesque landscapes, rivers, lakes, wildlife, historical sites, ancient temples, the birth place of Buddha, various religions, languages, and the warm hospitality of the Nepalese people.

Nepal is renowned for its stunning geographical diversity, abundant biodiversity, and vibrant socio-cultural heritage, attracting numerous visitors who are captivated by its natural and cultural wonders, often describing it as a paradise on earth. Despite these attractions, Nepal faces significant economic challenges. Only 17 percent of its land is suitable for efficient farming, while its extensive forests and woodlands, covering 33 percent of the total area, are threatened by deforestation and degradation. The country's economy is predominantly rural and heavily reliant on agriculture, contributing 24.12 percent to its GDP (Ministry of Finance, 2023). As of FY 2022/23, Nepal's Gross National Product reached Rs 41.385 billion USD, which decrease from previous number of 41.422 USD billion for 2022, and the per capita income stood at Rs 1,399 USD (Ministry of Finance, 2023). Nepal ranks 149th in the Human Development Index, highlighting ongoing socio-economic challenges, with 42 percent of the population living below the poverty line.

The World Travel and Tourism Council (2023) highlighted that, in 2019, tourism contributed about 7.9 percent to Nepal's GDP, underlining its critical importance to the national economy. Additionally, the industry provides both direct and indirect employment for millions, making it a vital engine for socio-economic development. Despite these strengths, Nepal has considerable potential to further develop its tourism sector by enhancing infrastructure, services, marketing efforts, and fostering innovation. By leveraging tourism to highlight its biodiversity and promote conservation, Nepal aims to achieve sustainable development goals and alleviate poverty. Tourism serves as a potent vehicle for Nepal to showcase its natural beauty and cultural richness globally, fostering a prosperous and harmonious society.

This research aims to analyze and forecast international tourist arrivals to Nepal from 2019 to 2028, using data from 1996 to 2023. The primary objective is to identify key trends, patterns, and fluctuations in tourist arrivals, while also examining specific factors such as gender, age, and preferences that influence tourism dynamics. A key aspect of this study is to apply suitable statistical methods to predict future arrivals, with a particular focus on assessing the impact of the COVID-19 pandemic on tourism trends between 2020 and 2022. By comparing these forecasts with actual data, the research seeks to provide valuable insights for policymakers, enabling them to make informed decisions that promote sustainable tourism development. The ultimate goal is to highlight the resilience and adaptability required in the tourism sector, fostering recovery and long-term growth in a post-pandemic context.

2 Methodology

Time series analysis involves examining data points collected or recorded at specific time intervals to uncover trends, seasonal patterns, and cyclical behaviors (Pradhan et al., 2023).The methodology for this research is designed to provide a comprehensive analysis of international tourist arrivals in Nepal, combining both descriptive and predictive approaches. The study relies on secondary data from the Ministry of Culture, Tourism, and Civil Aviation's Department of Tourism, Nepal, over the period 1996 to 2023, which offers a reliable and valid source of historical records. These data are organized and processed using Microsoft Excel, and analyzed through SPSS-27 to identify patterns and trends. A descriptive approach was employed to examine the demographic characteristics of tourists, such as age, gender, and purpose of visit, as well as seasonal variations in tourist arrivals. For predictive analysis, the research applies the Auto-Regressive Integrated Moving Average (ARIMA) model, after ensuring the dataset's stationarity through the Augmented Dickey-Fuller (ADF) test and performing necessary differencing (Upadhyay and Pradhan, 2023). The ARIMA model's parameters are optimized using Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots, with model selection based on evaluation metrics such as R-squared, Mean Absolute Percentage Error (MAPE), and Normalized Bayesian Information Criterion (BIC). This methodology enables a thorough examination of past trends and provides a robust framework for forecasting future tourist arrivals in Nepal.

$$Y_t = a_0 + a_1 Y_{t-1} + a_2 Y_{t-2} + \cdots + a_p Y_{t-p} - b_1 \varepsilon_{t-1} - b_2 \varepsilon_{t-2} - \cdots - b_q \varepsilon_{t-q} + \varepsilon_t \tag{1}$$

Where, p is the order of the autoregressive part, q is the moving average order and is a white noise type process (a sequence of independent and identically distributed random variables with zero mean). The autoregressive moving average ARMA models are suitable for stationary series. These were generalized for non-stationary series that become stationary by differentiation; the resulting models are called autoregressive integrated-moving average ARIMA (p, d, q) where d is the order of differentiation required for stationary series (Mills, 1990).

The ADF test is used to test the null hypothesis that a unit root is present in a time series. The test statistic is given by:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta Y_{t-i} + \varepsilon_t \tag{2}$$

Where, Δ is difference operator, Y_t is time series value at time t, α is constant, β is coefficient of the time trend, γ is coefficient of the lagged level of the series, δ_i is coefficients of the lagged differences, ε_t is error term

MAPE is a measure of prediction accuracy in a forecasting method. It is calculated as:

$$\text{MAPE} = \frac{1}{n} \sum_{t=1}^{n} \left| \frac{Y_t - \hat{Y}_t}{Y_t} \right| \times 100 \tag{3}$$

Where, Y_t is actual value, $\hat{Y}_t$ is forecast value and n is number of observation

BIC is used for model selection among a finite set of models. It is calculated as:

$$\text{BIC} = \log(n)k - 2\log(L) \tag{4}$$

Where, n = number of observations, k = number of parameters in the model and L = maximum likelihood of the model.

The ACF measures the correlation between observations of a time series separated by (k) time units. The formula for the sample autocorrelation at lag (k) is given by:

$$\rho_k = \frac{\sum_{t=k+1}^{n} (Y_t - \bar{Y})(Y_{t-k} - \bar{Y})}{\sum_{t=1}^{n} (Y_t - \bar{Y})^2} \tag{5}$$

Where, ρ_k is autocorrelation at lag (k), Y_t is value of the time series at time (t), $\bar{Y}$ is mean of the time series, n is total number of observations

The PACF measures the correlation between observations of a time series after removing the effects of intermediate lags. The PACF can be computed using the Yule-Walker equations, which relate the autocorrelations to the coefficients of the autoregressive model:

$$\phi_{kk} = \rho_k - \sum_{j=1}^{k-1} \phi_{kj} \rho_{k-j} \tag{6}$$

Where, ϕ_{kk} is partial autocorrelation at lag (k), ρ_k is autocorrelation at lag (k), ϕ_{kj} is partial autocorrelation at lag (j) (for (j < k)

The Ljung-Box Test is a statistical test used to check for the presence of autocorrelation in a time series. It evaluates whether a series of residuals is random, or if it exhibits significant correlations over different time lags. It is particularly useful for assessing the adequacy of time series models.

The Ljung-Box test statistic is calculated as:

$$Q = n(n+2) \sum_{k=1}^{m} \frac{\hat{\rho}_k^2}{n-k} \tag{7}$$

Where: n is number of observations, m is number of lags to test and $\hat{\rho}_k$ is the autocorrelation of the sample at lag k.

3 Results

This study examines the trends and determinants of international tourist arrivals in Nepal over the period 1996 to 2023, with a particular focus on understanding the dynamics of tourism. Employing ARIMA modeling, it forecasts tourist inflows for the years 2020 to 2028 and evaluates the actual data from 2020 to 2023 to quantify the effects of the COVID-19 pandemic. The analysis highlights variations in tourist arrivals, influenced by factors such as growth rates (Figure 1), weather patterns, demographics (age and gender, visit purposes, and seasonal fluctuations, offering critical insights for strategic tourism planning and policy development.

FIGURE 1. Tourist arrival with growth rate

Gender wise trend of tourist arrival

The Figure 2 shows the gender distribution of tourists visiting Nepal from 1996 to 2023 and their average length of stay. Throughout these years, male tourists consistently outnumber female tourists, with males generally making up 55 percent to 65 percent of the total, while females account for about 35 percent to 45 percent. This trend highlights the dominance of male visitors. The average length of stay for tourists varies significantly, starting at around 10 days in the early years and peaking around 2017 at approximately 14-16 days. The COVID-19 pandemic caused a sharp drop in tourist numbers and their average stay in 2020 and 2021. However, by 2022 and 2023, there is a noticeable recovery, with the average stay stabilizing around 12-14 days. Overall, the chart captures nearly three decades of tourism trends in Nepal, showing the persistent gender imbalance in tourist arrivals, fluctuations in stay duration, and the tourism sector's resilience in recovering from global disruptions like the pandemic.

Age wise tourist arrival

The data on age-wise tourist arrivals in Nepal from 1996 to 2023 reveals significant trends and fluctuations over three decades (Figure 3). The 0-15 age group saw gradual growth, with a peak in 2009-2010 and a dramatic rise to 613,116 in 2023, likely driven by increased family tourism or school trips. The 16-30 age group, popular among adventure-seeking young travelers, peaked at 269,648 in 2018, then dropped to 30,713 in 2021 due to the pandemic, before recovering to 189,790 in 2023. The 31-45 age group, which consistently records the highest numbers, reached a peak of 383,155 in 2019, followed by a sharp decline to 67,829 in 2020, then rebounded strongly to 317,170 in 2023, reflecting a robust recovery. Similarly, the 46-60 age group, which peaked at 305,651 in 2019, saw a sharp drop to 61,874 in 2020 but recovered to 272,342 in 2023. The 60+ age group, attracting older travelers interested in cultural and scenic experiences, peaked in 2018 and 2019 at 173,299 and 176,872, respectively, with a dip to 9,036 in 2021, before recovering to 169,771 in 2023. The "Not Specified" category, which includes tourists without

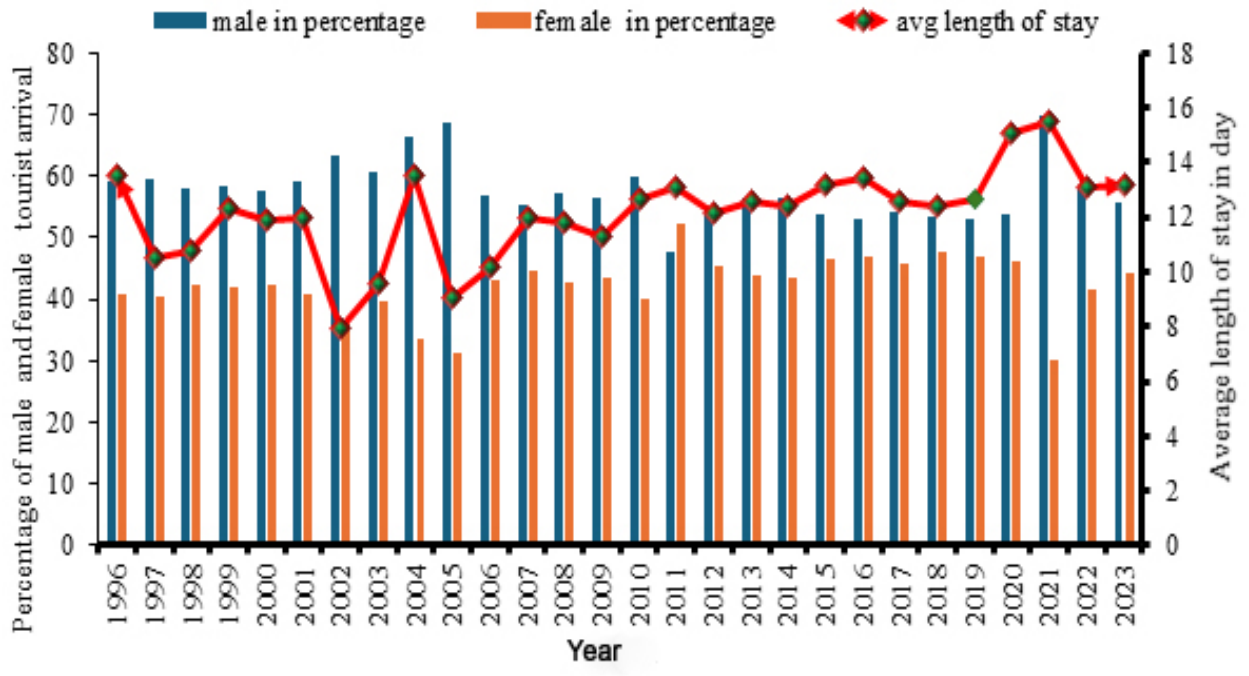

FIGURE 2. Percentage of male and female tourist arrival with average length of stay

age data, showed variable peaks, including 59,454 in 2011. Overall, while the pandemic caused drastic declines in 2020 and 2021 across all age groups, the data highlights the strong recovery in 2022 and 2023, underscoring Nepal's tourism sector's resilience. The notable surge in the 0-15 age group in 2023 suggests shifting travel trends, while the consistent popularity of the 31-45 age group highlights a stable and lucrative market segment. The data reveals both the challenges posed by global events and the enduring appeal of Nepal's tourism to a diverse range of age groups.

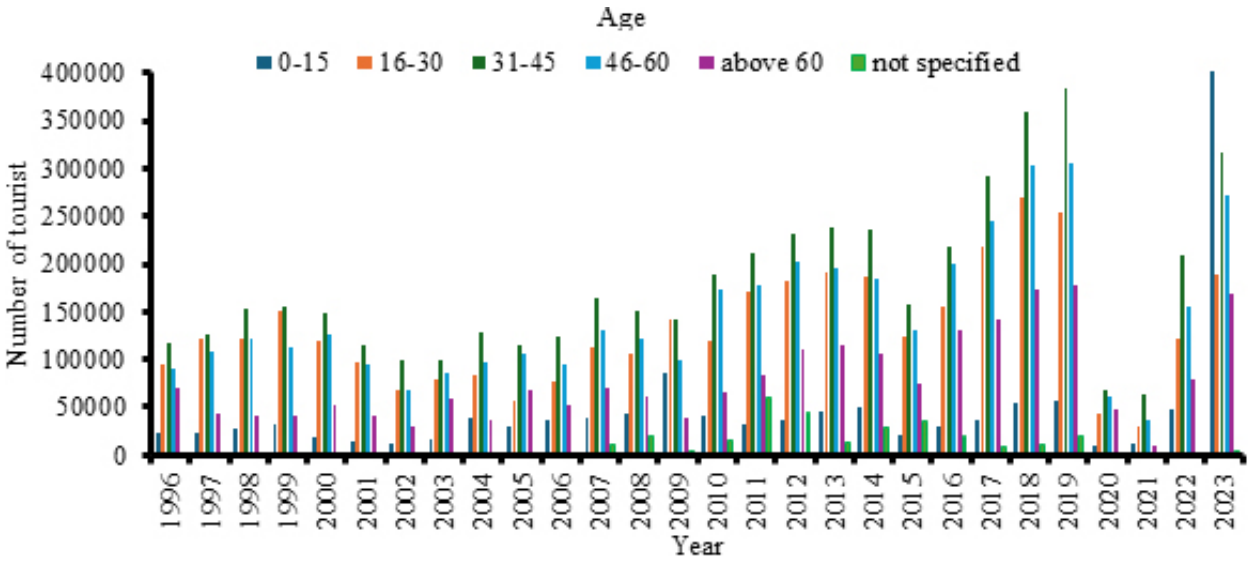

FIGURE 3. Age wise distribution of tourist arrival

Purpose of visit and trend of tourist arrival

The detailed breakdown of the distribution of tourist activities in Nepal from 1996 to 2023 is shown in Figure 4.

Over the years, holiday tourism consistently accounted for the largest portion of visitors, peaking in 2015 at 71.67 percent, and maintaining strong numbers through the years, ranging from 27.61 percent in 2009 to around 60-65 percent in most recent years. Trekking tourism showed a more fluctuating pattern, with its highest share in 2001 (27.92 percent) and 2009 (26.06 percent), but it declined significantly after 2010, reaching its lowest in 2015 at 1.7 percent. Business and official tourism remained relatively small, typically below 7 percent in most years, with some variations. The pilgrimage segment exhibited some significant peaks, such as in 2004 (11.85 percent) and 2006 (15.43 percent), but remained moderate otherwise. Conference and convention tourism was negligible in most years, although it rose slightly in 2007 and 2010. The "Others" category, which includes unclassified activities, varied widely over the years, peaking in 2003 at 33.1 percent, and saw a rise during the pandemic years (2020-2021), reaching 15.48 percent in 2021. The Not Specified category is a small part of the data, reflecting those tourists whose activities were not recorded. Overall, this dataset highlights the shifts in tourism trends in Nepal, such as the growth of holiday and pilgrimage tourism and the fluctuating popularity of trekking, with the impact of the pandemic also visible in the changes to the distribution of activities.

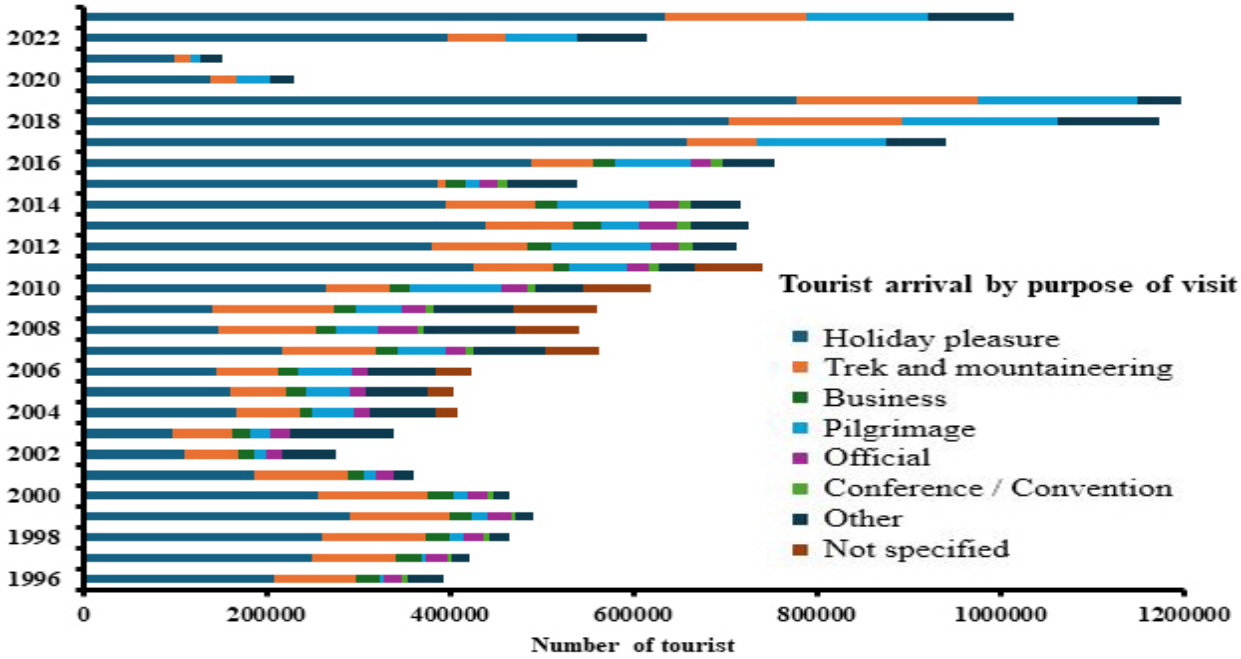

FIGURE 4. Distribution of tourist according to purpose of visit

Seasonal trend of tourist arrivals

The tourism data for Nepal from 1996 to 2023 shows a steady increase in visitor numbers, reflecting the country's growing popularity as a travel destination (Figure 5). Tourist arrivals rise from 271,101 in 1996 to a peak of 1,197,191 in 2019, driven by Nepal's rich cultural heritage, natural beauty, and improved infrastructure. Monthly data reveals seasonal peaks in October and November, aligning with major festivals like Dashain and Tihar, as well as favorable weather conditions. However, the COVID-19 pandemic caused a severe downturn in 2020 and 2021, with numbers plummeting to 230,085 and 150,962, respectively, due to global travel restrictions and health concerns. Despite this setback, the sector showed resilience, rebounding strongly in 2022 and 2023, with arrivals rising to 614,869 and 1,014,882, respectively. The data also highlights seasonal trends, with fewer tourists visiting during the monsoon (June-July) and winter months (January-February), and higher numbers in autumn and spring, likely influenced by Nepal's diverse climate and major cultural events. Overall, the data emphasizes the resilience and enduring appeal of Nepal's tourism industry.

The monthly tourist arrival data for Nepal from 1996 to 2023 reveals notable trends and variations (Table I). October and November are the peak months, with November having the highest tourist arrivals (132,116) and October showing a high mean (60,897). These months also have significant variability, as reflected in their high standard deviations. Skewness values indicate that most months experience lower-than-average arrivals, with occasional spikes

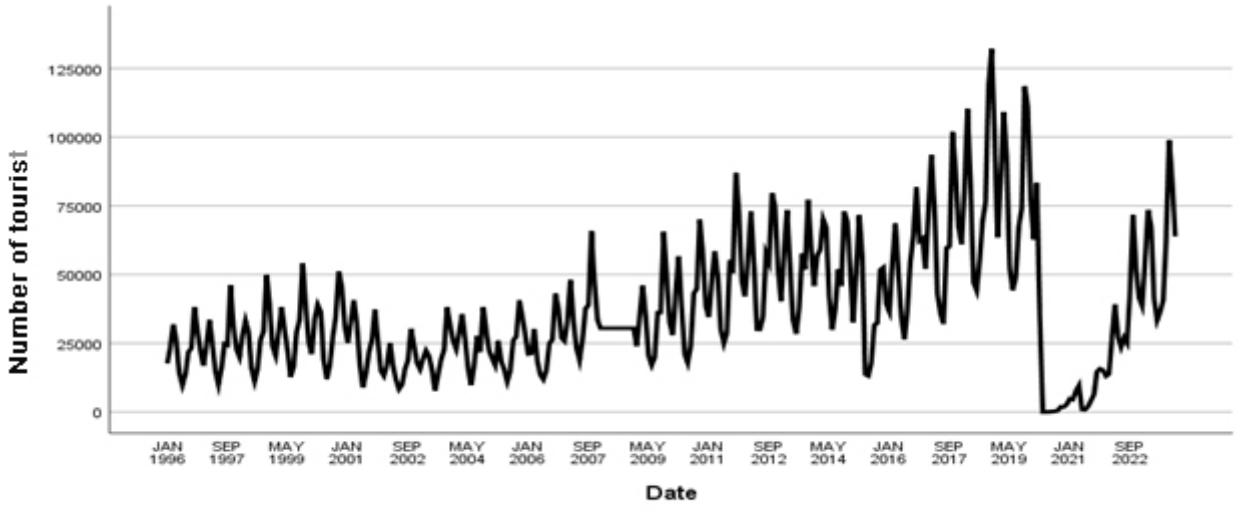

FIGURE 5. Seasonal trend of tourist arrivals

TABLE I. Descriptive statistics for monthly data

Months	Range	Min.	Max.	Mean	S.D.	Skewness	Kurtosis
JAN	58736	4845	63581	30767.64	16200.37	0.783	-0.277
FEB	80256	4499	84755	41012.29	22017.54	0.555	-0.486
MAR	102673	7602	110275	51032.68	26039.46	0.774	0.079
APR	92281	12	92293	39594.39	22312.86	0.641	-0.016
MAY	52290	24	52314	23342.54	13090.96	0.516	-0.171
JUN	44293	76	44369	18438.86	11909.87	0.706	-0.234
JUL	54726	170	54896	23136.79	13013.74	0.609	0.169
AUG	69140	244	69384	35312.50	18063.87	0.221	-0.574
SEPT	75977	543	76520	38039.64	18810.12	0.277	-0.233
OCT	117180	1918	119098	60897.39	28491.84	0.259	-0.044
NOV	130285	1831	132116	51470.43	28382.61	1.025	1.465
DEC	97248	2845	100093	38032.14	21437.22	1.085	1.330

in peak months. June and July show the lowest tourist numbers, marking them as off-peak months. Overall, the data highlights October and November as key months for tourism, driven by favorable weather and cultural events.

Model for forecasting

An ARIMA (p, d, q) model was attempted to forecast future international tourist arrivals in Nepal. The key stages of the Box-Jenkins method involve identifying the three parameters: p, d, and q. The appropriate values for p and q are determined by calculating the autocorrelation function (ACF) and partial autocorrelation function (PACF) values and plotting the corresponding graphs (Figure 6) of these functions (Singh et al., 2013). This analysis involves applying an ARIMA (0, 1, 0) model to forecast international tourist arrivals in Nepal, using data from 1996 to 2019. The ARIMA model, which is an Autoregressive Integrated Moving Average model, is used to identify patterns in time series data and make future predictions. In this case, the (0, 1, 0) configuration indicates that the model is using differencing to make the data stationary and then predicting future values without any autoregressive or moving average components.

The resulting chart (Figure 7) illustrates several key elements. The line with orange color represents the actual number of tourists from 1996 to 2019, showing an overall upward trend with some fluctuations. The lines with blue and green color indicate the ARIMA model's lower and upper confidence limits (LCL and UCL), respectively, providing a range within which the actual values are expected to fall. The data following the vertical line presents the projected number of tourist arrivals from 2020 to 2028, indicating a potential rise if previous trends continued. The forecasted figures has been exhibited in Table II.

To provide context on the impact of unforeseen events, actual tourist arrival data from 2020 to 2023 was included.

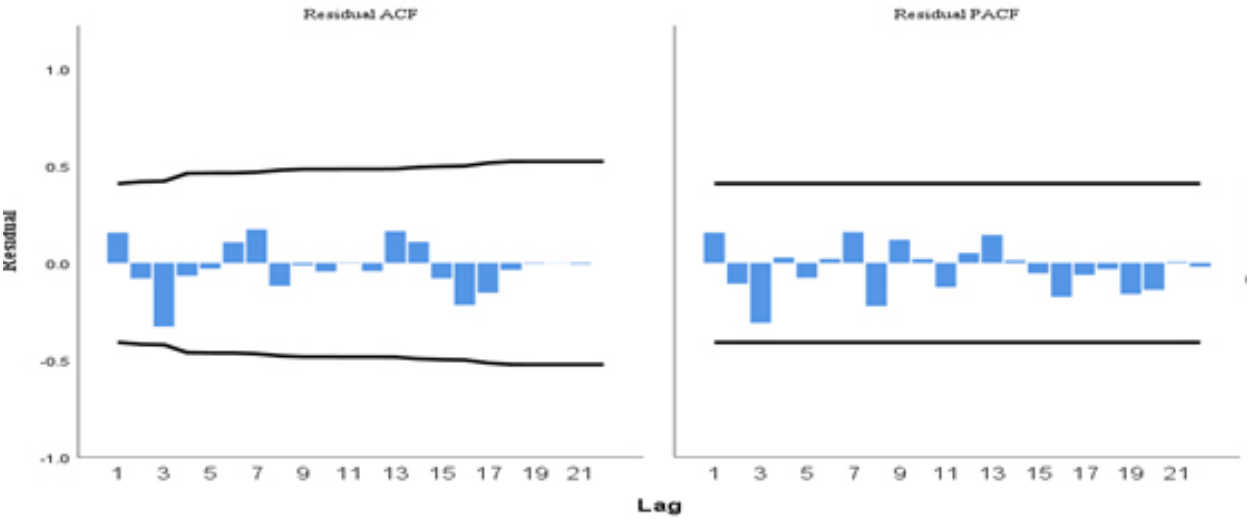

FIGURE 6. Residual of ACF and PACF

TABLE II. Forecasted tourist arrivals

Year	Forecast	UCL	LCL
2020	1,232,129	1,453,680	1,010,578
2021	1,267,067	1,580,388	953,747
2022	1,302,006	1,685,743	918,268
2023	1,336,944	1,780,045	893,842
2024	1,371,882	1,867,285	876,479
2025	1,406,820	1,949,507	864,133
2026	1,441,758	2,027,927	855,590
2027	1,476,696	2,103,337	850,056
2028	1,511,635	2,176,287	846,982

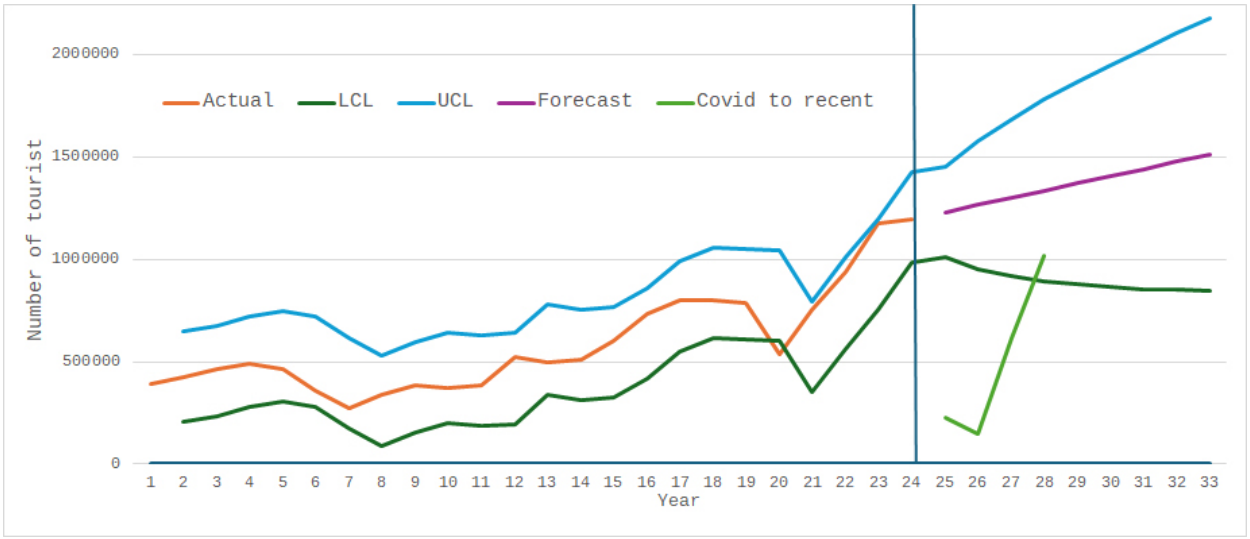

FIGURE 7. Actual and forecasted tourist arrivals

This period was significantly affected by the COVID-19 pandemic, which caused a dramatic drop in international travel. The deviation of the line with light green color from the forecasted line with magenta color highlights the

disruption, underscoring the pandemic's impact on tourism. This comparison helps to understand how external factors, such as global health crises, can drastically alter forecasted trends and real-world outcomes.

Model Adequacy

Determining the optimal ARIMA (p,d,q) model requires a trial-and-error approach. Various combinations of the p, d, and q parameters must be tested, and the best model is selected based on specific criteria. In this study, different models were compared using R-squared, Mean Absolute Percentage Error (MAPE), and Normalized Bayesian Information Criterion (BIC). The final model, along with its diagnostic, is presented in Table III.

TABLE III. Diagnosing the ARIMA model for the number of tourist

Model fit statistics			Ljung-Box statistic			Number of outliers
R^2	MAPE	Normalized BIC	Statistics	d.f	p-value	
0.826	13.74	23.94	15.204	18	0.648	0

The ARIMA (0, 1, 0) model for the arrival of tourist was discovered was found best-fitting model according to R-squared, MAPE and Normalized BIC (larger R^2, smaller MAPE and smaller Normalized BIC). An important step towards constructing the final model that requires confirming the random distribution of residues is diagnosing an ARIMA candidate model. First, it can be seen from examining the indicator (Table III) that 82.6 percent of the variation in the series is explained by the constructed model. Furthermore, the Ljung-Box test yields no statistically significant results, indicating that the model is feasible.

4 Discussion

The analysis revealed a dramatic decline in international tourist arrivals in Nepal during the COVID-19 pandemic, with numbers dropping by over 80 percent in 2020 compared to previous years. This aligns with findings from global studies, such as Gössling et al. (2020), which documented a significant decrease in global tourism due to pandemic-related travel restrictions. Similarly, the UNWTO (2020) reported a 74 percent decline in international tourist arrivals worldwide, highlighting the pandemic's widespread impact. These findings suggest that Nepal's tourism sector experienced challenges comparable to the global tourism industry, underscoring the universal nature of the pandemic's effects.

The demographic analysis shows that most international tourists visiting Nepal are aged between 25 and 44, with male travelers slightly outnumbering females. This trend is consistent with UNWTO (2021), which identifies young adults as the dominant age group in international travel. Additionally, Fuchs and Weiermair (2003) found that younger travelers are more inclined toward adventure and experiential travel, aligning with Nepal's appeal as an adventure tourism destination. However, while other regions, such as Southeast Asia, have seen a growing proportion of female travelers (Lee & Chang, 2021), Nepal continues to exhibit gender disparities in its tourist demographics, warranting further investigation.

The study identified holiday pleasure and adventure tourism as the primary reasons for visiting Nepal. Visitors are drawn to Nepal's rich cultural heritage and natural landscapes, which provide opportunities for exploration and engagement with local environments. This aligns with Chen et al. (2016), who suggest that leisure travel is driven by the pursuit of meaningful experiences and personal development. While this study emphasizes Nepal's cultural and natural attractions, Chen et al. (2016) highlight similar motivations for Chinese tourists, including cultural exploration and relaxation. These findings underscore the need for a nuanced understanding of tourist motivations to enhance visitor experiences and maintain competitiveness in the tourism sector.

The analysis of seasonal patterns revealed peaks in tourist arrivals during the spring and autumn, coinciding with favorable weather conditions for trekking and cultural activities. This trend is consistent with studies in other mountainous regions, such as Bhutan (Wangchuk, 2019), which report similar seasonal peaks. Bhatia (2016) also highlighted the significant influence of seasonality on tourist behavior in the Himalayas. Recognizing these patterns is crucial for optimizing resource allocation and developing effective marketing strategies for Nepal's tourism industry.

Using ARIMA modeling, the study predicts a gradual recovery in international tourist arrivals post-pandemic, with a return to pre-pandemic levels expected by 2024. This projection aligns with forecasts by the World Travel & Tourism Council (2021), which outlines a global recovery trajectory for the tourism industry. However, Nepal's

recovery may be slower than that of more developed destinations due to challenges in healthcare infrastructure and tourism management.

The analysis provides valuable insights into the trends, demographics, and behaviors of international tourists in Nepal, contributing to strategies for post-pandemic recovery and sustainable growth in the tourism sector.

5 Conclusion

This study analyzed tourism trends in Nepal from 1996 to 2023, using the ARIMA model to predict future arrivals. The findings highlight the influence of global events, particularly the COVID-19 pandemic, which caused a significant drop in 2020. Despite this, the tourism sector demonstrated strong recovery in the following years, underscoring Nepal's resilience as a travel destination. Key insights include the dominance of holiday tourism, with trekking and mountaineering also being significant attractions. Men, particularly in the 31-45 age group, make up the majority of visitors. Seasonal patterns reveal lower numbers during the monsoon and winter months, with peak arrivals in autumn and spring. The forecasting model predicts continued growth, offering valuable guidance for policymakers to support sustainable tourism development in Nepal.

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