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MEASUREMENT OF SEASONAL INDICES AND FORECASTING OF TOURIST ARRIVALS IN PURBA MEDINIPUR, WEST BENGAL

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ABSTRACT

Purba Medinipur, a coastal district in West Bengal, serves as a vital hub for religious, historical, and beach-based tourism. Despite its popularity, the region faces challenges due to significant seasonal fluctuations in tourist arrivals, leading to resource strain during peak periods and under-utilization during lean months. This study utilizes monthly secondary data from 2011 to 2024 to measure seasonal indices and develop a ***Seasonal Autoregressive Integrated Moving Average (SARIMA)*** *econometric model for forecasting tourist inflows. By identifying peak, shoulder, and lean seasons, the research aims to provide actionable insights for tourism management, infrastructure planning, and sustainable economic growth. The analysis highlights the impact of the COVID-19 pandemic and the disproportionately low share of foreign tourist arrivals compared to domestic visitors. The findings serve as a strategic tool for stakeholders to stabilize revenue, minimize environmental degradation, and enhance the overall visitor experience through informed decision-making.*

Keywords: *Tourism Forecasting, SARIMA Model, Seasonal Indices, Purba Medinipur, Sustainable Tourism.*

1.0 INTRODUCTION

Purba Medinipur, a coastal district in West Bengal, is a popular tourism destination known for its (a) Scenic beaches like Digha (old and new), Mandarmani, Shankarpur, Chandpur, Udaypur, Junput, Taalsari and Tajpur etc, offering visitors sea, sand, and sun with opportunities for

swimming, bathing, and relaxation; Prominent religious sites like (1) ancient Maa Bargabhima Mandir (a 51 Shaktipeeth), Narayanpur Kali Mandir, Astarah Kali Mandir etc in Tamluk; (2) Kanakdurga Mandir in Digha, (3) Gopaljew Mandir, Muktidham etc in Haldia, (4) historical Kapal Kundala Mandir at Dariyapur in Contai associated with Bankim Chandra Chatterjee's famous Bengali novel Kapalkundala, which in turn provided the national song "Vande Mataram", a great inspiration for Indian freedom movement, (5) Mecheda ISCON, (6) Nandakumar Shiv Mandir, (7) Jishnu Hari Mandir, Ramjiu Deul Mandir, Gopaljiu Nabaratna Mandir in Mahishadal;

(b) Historical ratha yatra in Mahishadal and ratha yatra in other places of Purba Medinipur, particularly in Digha and other festivals in the district; numerous local temples dedicated to various deities, such as (1) Shitala Mandir at Nachinda, (2) recently established Jagannath Mandir Dham in Digha, and (3) Chandaneswar Mandir (which is technically in Odisha but nearby) etc;

(c) Hijli Mazar Sharif also known as Dargah of Masnad-e-Aala, associated with a Sufi community of Islam, believed to be linked to the lineage of Taj Khan, a disciple of Guru Peer Mackdram Sha Chisti, who was a ruler of the Hijli Kingdom. The Dargah is a significant religious site near contain, known for fulfilling the desires of visitors from all religions and notable historical sites and monuments including (1) Tamralipta (ancient port city), which served as a historical Buddhist and academic centre and a major trade emporium for ancient India, (2) Mahishadal Rajbari (royal palace with a museum), and (3) Tamluk Rajbati etc.

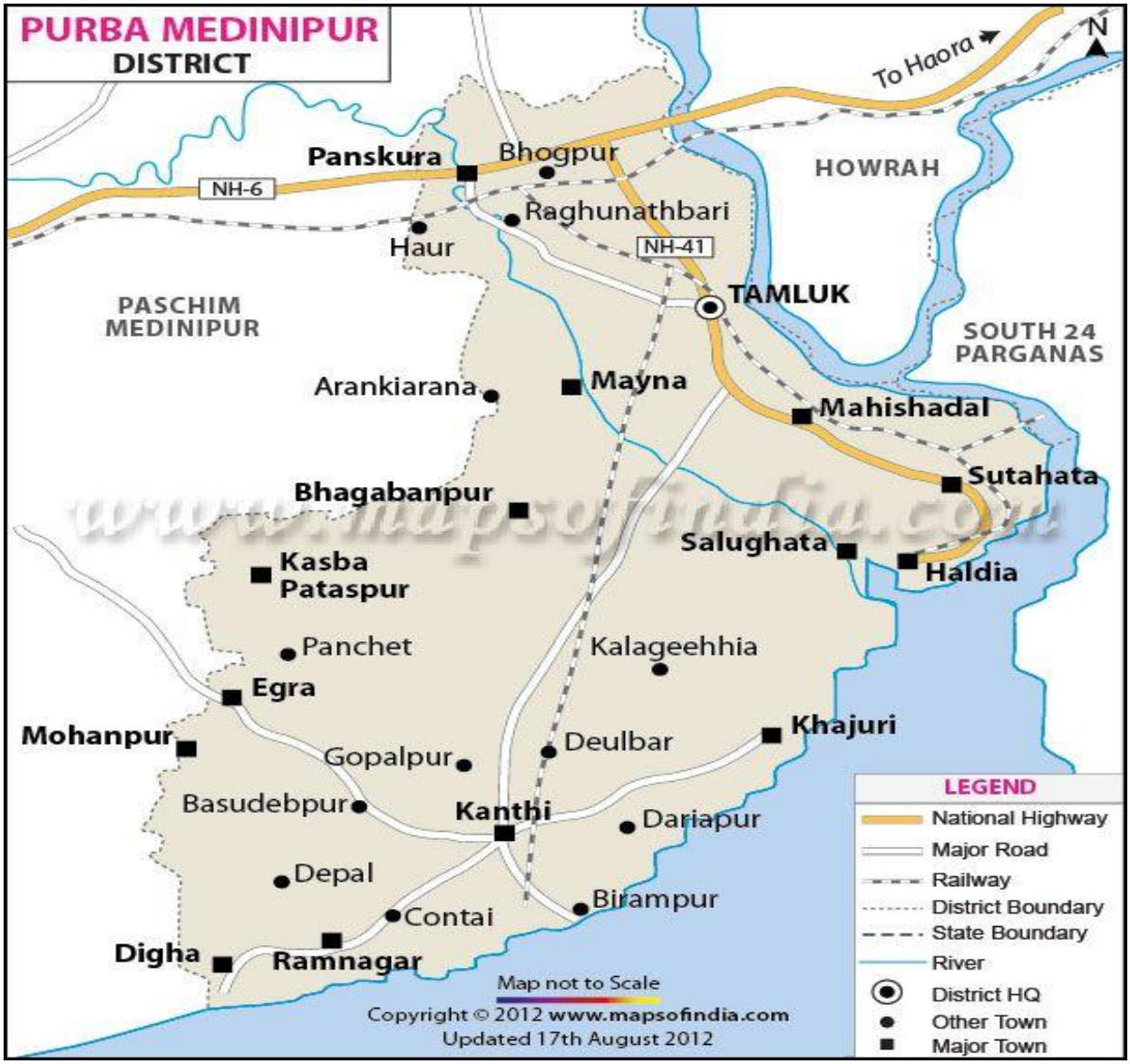
1.1 Geographical Location and Administrative Structure

The political maps of West Bengal and Purba Medinipur have been provided through the following maps: Map 1 and Map 2 respectively. West Bengal has 23 districts.

Map 1: Political Map of West Bengal

Source: https://www.dreamstime.com/west-bengal-map-showing-international-state-boundary-district-boundary-west-bengal-political-administrative-color-image218734206

The district Purba Medinipur is located in the southern part of West Bengal, bordered by the Bay of Bengal to the south and Paschim Medinipur district to the west, Howrah district to the northeast and the South 24 Parganas district and the Hooghly River to the east. The state of Odisha is located along its southwestern border. The district's topography is mostly flat, consisting of Indo-Gangetic plain and coastal plains, with the Bay of Bengal providing a long coastline along its southern border. The district headquarters is at Tamluk. The district is divided into four subdivisions: Tamluk, Contai, Haldia, and Egra. These subdivisions include various community development blocks, municipalities, and urban areas that are part of the district's administrative structure.



Map 2: Political Map of Purba Medinipur

Source: https://in.pinterest.com/pin/223983781438848311/

1.2 Climates

The district has a tropical wet and dry climate, identified by extremely hot and dry summers from March to June, a humid and rainy monsoon season with heavy rainfall, and a pleasant, warm, and humid winter from late October to mid-November, with temperatures ranging from about 54°F to 98°F (12°C to 37°C) and is vulnerable to natural calamities, primarily floods and cyclones, with the district's coastal location creating it susceptible to storm surges and rising sea

levels. Other issues include coastal erosion, salinization, and even a rare major earthquake in 1964. The southwest monsoon brings significant rainfall, increasing flood risks annually.

1.3 Tourism Infrastructure

Tourism infrastructure encompasses the physical structures and services that support tourism, including transportation, accommodation, attractions, and amenities like food, water, and sanitation. Effective infrastructure is essential for increasing tourist numbers, enhancing visitor experiences, and developing economic growth through job creation and local business expansions. Key components are hard infrastructure (for example, roads, airports) and soft infrastructure (for example, training, information services), which collectively make a destination accessible and attractive to tourists.

Transportation in the district includes road, rail, and water transport, with roads serving as the primary mode for both local and inter-district travel, connecting to major routes and cities like Tamluk and Haldia. The district has rail connectivity via stations such as Kharagpur, Tamluk and Digha, facilitating travel to different parts of India. Digha has rail connectivity with Howrah in Kolkata via a direct line. There is also a planned project for a Jaleswar-Chandaneswar-Digha railway line in Odisha, connecting it to a major temple and the coastal areas. Additionally, a Digha-NJP Vande Bharat Express was proposed to connect New Jalpaiguri to Digha, and a Namo Bharat Rapid Rail was proposed to connect Digha to Kolkata.

National Highways include NH 6 (partially) and NH 41 which connects to the Haldia Port, as well as NH 116B linking Nandakumar to Chandaneswar via Contai and Digha. State Highway SH 4 is a significant route through the district, connecting Panskura to Tamluk, then to Durgachak and the coastal areas of Contai and Digha.

Water transport is significant, especially in the coastal areas of the district.

Accommodation in the district includes a range of options, from beachside resorts and hotels in popular destinations like Digha, Tajpur, and Shankarpur to more budget-friendly lodges and guest houses in Tamluk and other towns.

For the tourists in the district, a key **healthcare facility** is the District Hospital in Tamluk. Smaller private hospitals like Sister Nibedita Sebasadan and Nursing Home are available, along with numerous smaller medical centres and rural hospitals in towns like Panskura.

Basic amenities including education facilities, drinking water, health services, banks, and electricity are available, particularly in rural areas, to support the quality of life for the tourists.

In the district, there are some **homestays** are available at the sea sides in Digha, Mandarmoni, Tajpur and Panchetgarh etc.

In the district, coastal tourism provides recreational, leisure, and sport activities focused on the coastal zone and marine environment. It fringes land-based activities like sunbathing and beach sports, as well as sea-based activities such as boating, diving, and fishing (water tourism or nautical tourism).

1.4 Livelihood through Tourism

Tourism in the district provides livelihood opportunities to local people, particularly in coastal areas like Digha and Mandarmani etc by creating jobs in hotels, transport, and related businesses. While offering economic benefits, this tourism also poses environmental challenges due to mass visitor influx, increasing the need for sustainable ecotourism to protect the fragile coastal ecosystem and ensure long-term resilience for the local community.

Women in the district derive livelihoods from tourism through self-help groups (SHGs), homestays, selling local crafts and products, and increasingly through innovative ventures like floating hydroponic farms that address climate change impacts. These opportunities provide income, promote economic and social empowerment, increase decision-making power within households, and build confidence, although challenges like resource access and traditional gender norms persist.

1.5 Tourism Security and Safety

Purba Medinipur is generally safe for tourists, with a focus on providing a modern, yet traditional, tourist experience. There have been adequate security and safety measures in the sea beaches in the district.

1.6 Positive and Negative Factors affecting Tourism

Positive factors for tourism in the district include economic benefits for locals, the creation of livelihood options, and the region's natural appeal of beaches and biodiversity. Negative factors include significant environmental degradation due to mass tourism, including coastal erosion, loss of biodiversity, and increased pollution from unbalanced development. Other challenges involve the deterioration of the coastal ecosystem from urbanization, the risk of cyclonic

disasters, and the necessity for better management to prevent negative impacts on the environment.

1.7 Statement of the Present Study

Tourism in Purba Medinipur, like many tourist destinations, experiences significant seasonal fluctuations, leading to periods of over tourism and under-utilization of tourist resources like man-made facilities (accommodations, transportations), supporting services (restaurants, agencies), essential human resources (skills, labor), financial resources (investment capital), natural attractions (landscapes, wildlife), cultural attractions (heritage sites, festivals) etc. That unpredictability of tourist inflows creates challenges for tourism management, infrastructure development, and sustainable economic growth. The primary focus of the present study is to develop econometric model: seasonal autoregressive integrated moving average (SARIMA) to forecast and utilization of a statistical (time series) tool to measure seasonal (monthly) indices of tourist (domestic and foreign) arrivals in the district to enable informed decision-making for the planners, government and tourism stakeholders.

1.8 Significance of the Study

The present study is very much significant for the following utilities:

Improved Tourism Management

Resource Allocation: Forecasts help allocate resources like hotel beds, transport, and staff more efficiently, minimizing waste during off-peak seasons and averting strain during peak times etc.

Policy Development: Seasonal data informs the creation of effective policies and planning to promote off-season tourism, diversify offerings, and manage overcrowding etc.

Economic Benefits

Revenue Stabilization: By predicting seasonal demand, businesses and the government may implement strategies in smoothing out revenue flows throughout the year, leading to more stable economic growth.

Infrastructure Planning: Accurate forecasts promotes investment in necessary infrastructure, such as transports and public services, confirming that developments oriented with projected tourist volumes.

Enhanced Visitor Experience

Reduced Overcrowding: Knowing seasonal peaks allows for strategies to disperse tourist inflows, improving the visitor experience and reducing pressure on popular sites.

Marketing and Product Development: Information into seasonal demands help customizing marketing promotions and develop new products or experiences that are attractive during specific times of the year.

Sustainable Tourism

Minimizing Negative Impacts: By forecasting and managing fluctuations, the research contributes in minimizing the negative environmental and social impacts often associated with tourism seasonality, supporting more sustainable tourism development.

1.9 Research Questions

(a) What are the peak, shoulder and lean seasons?

(b) What will be tourist (domestic and foreign) inflows?

2.0 REVIEW OF LITERATURE

Dandapath et al. (2013) mentioned that coastal tract of Purba Medinipur was an attractive combination of sea and land where the casuarinas and mangrove forest were whispering, sea was roaring, the flora and fauna were blooming and where visitors could rejuvenate in the company of sea, sand and sun in the pristine open air. Greater pressure of population inevitably put more pressure on environment which had led to the deterioration in environmental quality and put detrimental effect on coastal biodiversity in Purba Medinipur.

The objective of the study of Tarafder et al. (2014) was concerning the management of coastal tourism in general and coastal resorts in Digha, Mandarmoni etc in West Bengal in without hampering the development.

Mandal, P. K. (2015) studied about the status of tourism, its environmental impacts and its potentiality for Purba Medinipur and Paschim Medinipur of West Bengal based on both primary and secondary data obtained from the Ministry of Tourism, West Bengal. The PCA (Principal Component Analysis) had been applied and finally a Tourism Potentiality Index (TPI) had been calculated with the help of weights of demand or resource components and weights of supply elements or tourism components. The final conclusion of the study was while Purba Medinipur had already experienced the development of coastal tourism, the Paschim Medinipur had to utilize its natural and ethno tourism resources in order to establish tourism industry as an instrument for backward area development.

The study of Dandapath et al. (2016) attempted to correlate among tourism and biodiversity, environment, physical and socio-cultural landscape and assessed the tourism and

natural environmental landscape such as biodiversity, ecology or environment. The concept of mutual relationship among tourism and biodiversity, ecology or environment, which indicated that conservation of biodiversity, ecology or environment was a recreational activity of human life.

Baitalik et al. (2018) analysed the performance and seasonality of coastal tourism in the state of West Bengal. Performance of coastal tourism had been considered in terms of tourist arrivals. Seasonality had been measured by Seasonality Indicator (SI) and Gini-Coefficient (G). It was revealed that tourist arrivals at various coastal tourist spots were increasing continuously over the years. But each coastal tourist spot was suffering from specific type of seasonality.

Duari, B. (2018), keeping in view the importance and relevance of the stakeholder cooperation for sustainable coastal tourism development, and the local community/residents being the key stakeholders, attempted a quantitative research to study the local residents' attitude in coastal resort in Digha-Sankarpur, West Bengal towards the impacts of coastal tourism as also to suggest the strategic interventions for current problems and future needs. The researcher collected primary data from 180 respondents in the study area by survey method and further analysis done

through some statistical tools like correlation, regression to come to the conclusion. The study finding suggested that the residents' participation and co-operation was necessary to make the development more imperishable.

The study of Acharya et al. (2021) focused on the economic impact of tourism and ecotourism potential and attempted to record community perspectives and to analyze the nature of impact, status of tourism and potentiality of ecotourism of the coastal belts of Purba Medinipur district, West Bengal, by employing primary survey and secondary database along with the application of various statistical methods like exploratory factor analysis (EFA) of the variables using principal component analysis (PCA) and geo-informatics technique.

Sahani et al. (2022) mentioned that the three key sectors for the growth of a nation's economy at the moment are technology, telecommunications (essentially the IT sector), and tourism. Based on the primary data, the study through descriptive statistics like frequencies, percentages and statistical charts revealed that region becoming more appealing to tourists, other infrastructure improvements that benefit the locals and improve their quality of life include

improved power supply, easier access to web assets for instructive purposes, and different other correspondence and foundation enhancements.

2.1 Identification of Research Gap

After the extensive search of literatures relating to the tourism visiting Purba Medinipur, only eight literatures including one Ph. D. thesis have been traced. Out of those, the studies of Mandal, P. K. (2015) and Acharya et al. (2021) have utilized PCA and EFA, and Baitalik et al. (2018) measured seasonality in terms of seasonal indicator (SI) and Gene coefficient (G), but no study has been found in dealing with the forecasting and the measurement of seasonal indices of seasonal tourist arrivals visiting Purba Medinipur.

Therefore, it may be claimed that the present study is unique and original one.

3.0 OBJECTIVES OF THE STUDY

The objectives of the present study are forecasting and measuring seasonal indices of tourist arrivals in Purba Medinipur include identifying seasonal patterns of, developing forecasting model to predict seasonal tourist arrivals, and providing data for effective tourism planning and management. The study have been provided through the following sections: 1. Introduction, 2. Review of literatures, 3. Objectives of the study, 4. Methodology and data, 5. Analysis and findings, 6. Summary and Conclusions.

4.0 METHODOLOGY AND DATA

The present study is based on the secondary data on monthly tourist (domestic, foreign) arrivals in different tourist destinations of West Bengal during the years 2011 to 2024 obtained from the Ministry of Tourism, Government of West Bengal. The study utilized two techniques (a) statistical (time series) measurement of seasonal (monthly) indices of tourist arrivals, (b) econometric: seasonal (monthly) autoregressive integrated moving average (SARIMA).

In Purba Medinipur, tourists arrival are domestic as well as foreign. The share of foreign tourists arrival is very less compared to that of domestic one. Numbers of domestic, foreign and total tourists arrivals are denoted by DTA, FTA and TTA respectively. Therefore,

Total Tourists Arrival (TTA) = Domestic Tourists Arrival (DTA)+Foreign Tourists Arrival (FTA)

Data indicates a significant decline in India's tourism sector in January 2020 to March 2022 due to the COVID-19 global pandemic. Therefore, the forecasting of tourist arrivals by SARIMA model has been performed using the data for the years 2011 to 2019. Again, since the

share of the foreign tourist arrivals are very less compared to the total tourist arrivals, the forecasting and measurement of seasonal indices have been performed on the total tourist arrivals.

Data analyses have been done through the software IBM SPSS ver 21. The results have been presented through tables and diagrams (figures).

4.1 Measurement of Seasonal (Monthly) Indices

For the measurement of seasonal indices of the tourist arrival data in Purba Medinipur, the Ratio to Trend Method or the Simple Average Method for calculating seasonal indices are both applicable, with the Ratio to Trend Method being a more sophisticated approach that accounts for the overall trend in tourist arrivals over time. The Ratio to Trend method involves calculating the ratio of actual tourist arrivals to the established trend line to reveal seasonal patterns. Alternatively, the Simple Average Method is easier and simpler and involves averaging monthly tourist arrivals to establish a baseline, which can then be used to identify seasonal deviations.

The Simple Average (monthly) Average method where each monthly index is considered as 100 in case of uniformly distributed case, resulting sum of monthly indices as 1200, has been utilized to calculate seasonal indices for time series data (Goon et al. 1996).

Seasonality in tourism data refers to the predictable, recurring fluctuations in tourist numbers and activities throughout the year, driven by both natural factors like climate and institutional factors such as school holidays, festivals, and social trends. This creates a pattern of "peak" seasons with high demand and "off" or "lean" seasons with low demand, leading to imbalances in resource allocation, fluctuating prices, and varied visitor experiences; the season other than peak and lean is shoulder season.

4.2 Seasonal (Monthly) ARIMA Model

This model has been developed by Box, G. E. and Jenkins, G. M. in the early 1970s. A Seasonal ARIMA (SARIMA) model is the extension of the standard ARIMA model formulated to forecast time series data that exhibit seasonal patterns, such as daily, monthly, or quarterly fluctuations. It explicitly adds seasonal components to capture these predictable periodic variations, which are then combined with non-seasonal components to create the full SARIMA model. The model is associated with seven parameters: (a) non-seasonal parameters p, d, q; (b) seasonal parameters P, D, Q representing the orders of autoregressive (AR), differencing (I), and moving average (MA) components respectively, along with the parameter S: seasonal period. The values of the

parameter S are 12 and 4 for monthly, quarterly data respectively. The SARIMA model procedure involves

data preparation (loading, plotting, and checking for stationarity), parameter identification (using autocorrelation function (ACF) / partial autocorrelation function (PACF) plots to find the non-seasonal (p, d, q) and seasonal (P, D, Q) orders), model fitting to the training data, forecasting, and model evaluation by analyzing residuals and forecast accuracy.

A stationary time series has mean and variance that remain constant over time, meaning its behavior is independent of the specific point in time it was observed. In contrast, a non-stationary time series has mean and variance that change over time, often due to a trend (a general upward or downward movement), seasonality (repeating patterns at fixed intervals), or a random walk. Non-stationary series are problematic for many time series models, as they must often be transformed to a stationary form to be analyzed effectively. A random walk in time series data describes a process where the next value is equal to the current value plus a random increment or decrement (a white noise term) represented as

$$Y_t = Y_{t-1} + \epsilon_t$$

where Y_t, Y_{t-1} are the values of the time series data at the time periods t and t-1 respectively and ϵ_t is the white noise or residual or error term at the time period t.

To convert non-stationary time series data to a stationary one, common techniques include differencing (calculating the difference between consecutive observations to remove trends and seasonality) and transformations such as logarithms to stabilize variance, often used in concurrence with differencing or decomposition. Successive differencing transforms non-stationary time series into stationary ones by removing trends and seasonality, which stabilizes the mean and variance over time.

The differencing of non stationary time series data at time t (Y_t) of order r is denoted by $\Delta^r Y_t$, where r = 0, 1, 2 … .

$$\Delta^r Y_t = \Delta^{r-1} Y_t - \Delta^{r-1} Y_{t-1}$$

The construction of ARIMA (p, d, q) is given by

$$z_t = \delta + \varphi_1 z_{t-1} + \varphi_2 z_{t-2} + ... + \varphi_p z_{t-p} + \theta_1 a_{t-1} + \theta_2 a_{t-2} + ... + \theta_q a_{t-q}$$

Where z_t is the level of differencing, ‘a’ is a random shock corresponding to time period t, φ is an autoregressive operator, δ is the constant and θ is moving average operator.

A backshift operator (B) is used in order to establish the Model SARIMA (p, d, q)(P, D,Q)s.

B_k symbolizes the backward time series observation backward in time by k period, such that $B_k y_t = y_{t-k}$.

Backshift operator helps in presenting general stationarity transformation.

$z_t = \Delta_S^D \Delta^d y_t = (1 - B^s)^D (1 - B)^d y_t$

Where z is the time series differencing, D is the degree of seasonal differencing and d is the degree of no seasonal differencing used.

Finally, the general form of SARIMA model: SARIMA (p, d, q)(P, D,Q)s is stated in the following manner: $\varphi_p(B)\varphi_p(B^S)z_t = \delta + \theta_q(B)\theta_Q(B^S)a_t$

SARIMA model coefficients are estimated utilizing statistical optimization technique Maximum Likelihood Estimation (MLE).

Assessment of the significance of coefficients and the overall SARIMA model are performed through the significance tests on the individual AR/MA/SAR/SMA coefficients using their p-values, which indicate whether each coefficient's estimated effect is statistically different from zero. The overall significance is performed through diagnostic tests like the Ljung-Box test on the model's residuals. A significant result for the Ljung-Box test with a low p-value (< 0.05) would suggest that the model has not captured all the temporal patterns, indicating a need for refinement, while insignificant results (high p-values > 0.05) suggest the residuals are close to white noise, confirming a good model fit. In a SARIMA model, "Stationary R-squared" indicates the proportion of the variance in the stationary time series that is explained by the model. A higher Stationary R-squared value suggests that the model better captures the underlying patterns of the stationary data, leading to improved forecasts (Ramesh et al., 2019 and Box et al., 2009).

SARIMA excels over ARIMA when strong, predictable seasonal patterns exist in time series data by incorporating a seasonal component. Compared to models like Prophet, SARIMA offers a strong statistical foundation but requires more expertise for parameter tuning, while Prophet is simpler and better for complex seasonal patterns and holidays. Machine learning models, such as LSTM, can capture intricate, non-linear patterns that SARIMA may miss but are generally more complex to implement and interpret. Seasonal ARIMA is better for complex, short-term forecasts with weak or irregular seasonality and strong autocorrelations, while Exponential Smoothing (specifically, Holt-Winters) is ideal for strong, stable, and clearly defined seasonal patterns or when a simple, interpretable baseline forecast is needed.

5.0 ANALYSIS AND FINDINGS

5.1 Measurement of Seasonal (Monthly) Indices of Tourist Arrivals

Year-month wise total tourists arrival have been presented in the following table (Table 1).

Table 1: Year-month Wise Total Tourist Arrivals

Year	Total Tourist Arrivals											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	427517	424273	422791	428124	422790	429338	418312	249167	211601	410459	428705	422670
2012	439079	432735	431220	436636	431890	437734	411189	255122	215711	418681	418681	411130
2013	475305	405770	460882	462630	653320	487476	504300	533630	387365	414420	442090	480810
2014	501538	452932	493176	488680	696895	516260	534455	590315	630440	550500	714075	788425
2015	673385	808070	622940	667750	581220	555160	605675	731745	805765	597205	627450	857530
2016	739090	864635	678360	735525	580785	655320	675440	823550	927700	647970	533850	934585
2017	780520	987170	659220	695805	639300	685465	773700	910675	970390	726400	538950	1026980
2018	848575	951920	719645	742460	690270	740230	819990	964275	1029125	782928	581555	1073195
2019	905575	999910	762605	820450	471805	640830	885630	1030025	1111220	862190	622055	1158985
2020	152094	150051	147275	0	55	20	3520	3950	6015	18988	26322	35823
2021	46390	52770	59950	22270	3525	18830	2525	30750	46991	32859	37377	40724
20	5089	912	194	1626	2486	3057	1710	1047	1070	1104	1104	1533

22	2	40	435	730	615	730	370	016	882	802	802	421
2023	977891	509029	425316	1041737	878374	844163	697047	699383	675276	1132048	989474	1639157
2024	1121377	596762	555876	501209	349693	738480	848537	901726	673647	1139970	999158	1640342

Source: Ministry of Tourism, Government of West Bengal

There was a sudden fall down of total tourists arrival in 2020 and continued up to 2021due to global pandemic and then again in March 2022, there was a sudden rise up of it.

Year wise and overall seasonal (monthly) Indices of TTA and share of FTA out of total tourist arrivals in percent have been presented in the following table (Table 2).

Table 2: Seasonal (Monthly) Indices of Total Tourist Arrivals and Share of FTA (%)

Year	Seasonal (Monthly) Index of Total Tourist Arrivals												Share of FTA (%)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2011	109.25	108.42	108.04	109.41	108.04	109.72	106.90	63.67	54.07	104.89	109.56	108.01	0.66
2012	111.16	109.56	109.17	110.55	109.34	110.82	104.10	64.59	54.61	106.00	106.00	104.09	0.65
2013	99.92	85.31	96.89	97.26	137.35	102.48	106.02	112.19	81.44	87.12	92.94	101.08	0.86
2014	86.50	78.12	85.06	84.28	120.19	89.04	92.18	101.81	108.73	94.95	123.16	135.98	0.78
2015	99.35	119.22	91.90	98.51	85.75	81.90	89.36	107.95	118.88	88.11	92.57	126.51	0.64
2016	100.82	117.95	92.54	100.34	79.23	89.39	92.14	112.34	126.55	88.39	72.82	127.49	0.58
2017	99.7	126.	84.2	88.8	81.6	87.5	98.8	116.	123.	92.7	68.8	131.	0.5

	0	09	0	8	6	6	3	32	95	9	4	18	6
2018	102.40	114.87	86.84	89.60	83.30	89.33	98.95	116.36	124.19	94.48	70.18	129.51	0.54
2019	105.80	116.82	89.10	95.85	55.12	74.87	103.47	120.34	129.82	100.73	72.68	135.40	0.52
2020	335.43	330.93	324.80	0.00	0.12	0.04	7.76	8.71	13.27	41.88	58.05	79.00	1.22
2021	140.95	160.33	182.14	67.66	10.71	57.21	7.67	93.43	142.77	99.83	113.56	123.73	0.01
2022	4.05	7.26	15.47	129.46	197.89	243.34	136.11	83.32	85.22	87.92	87.92	122.03	0.00
2023	111.66	58.13	48.57	118.95	100.30	96.39	79.60	79.86	77.11	129.27	112.99	187.17	0.00
2024	133.67	71.14	66.26	59.75	41.68	88.03	101.15	107.49	80.30	135.89	119.10	195.54	0.00
Overall	92.81	88.11	75.64	98.86	101.33	111.83	101.38	100.02	99.91	100.80	91.96	137.33	0.41

Source: Prepared by Researchers based on data obtained from the Ministry of Tourism, Govt. of West Bengal

There is no specific season for tourist arrivals in the district, as like many tourist destinations, there are peak and lean seasons influenced by weather and holidays. The district's coastal areas attract visitors year-round for its sea, sand, and sun (3Ss).

Yet the entire year may be classified into three seasons: peak, lean/off and shoulder, mentioned as follows:-

Peak Season: October to March, when temperatures are milder and more pleasant, making it ideal for beach activities and sightseeing.

Shoulder Season: (a) Late February to Early April: The period following the cool winter and before the extreme heat of summer and

(b) Late October to Mid-November: A brief window after the monsoon and before the peak winter season begins.

Lean/Off-Season: (a) April to June: This is the summer period, characterized by extremely hot and humid conditions, which makes sightseeing difficult and uncomfortable and

(b) July to September: The monsoon season, with heavy rainfall and potential power supply issues that can create problems for tourists.

5.2 Forecasting of Tourist Arrivals by SARIMA Model

The pattern of total tourists arrival (TTA) during 2011 to 2024 has been presented through a sequence chart (Figure 1). There was a sudden fall down of total tourists arrival in 2020 and continued up to 2021due to global pandemic and then again in March 2022, there was a sudden rise up of it.

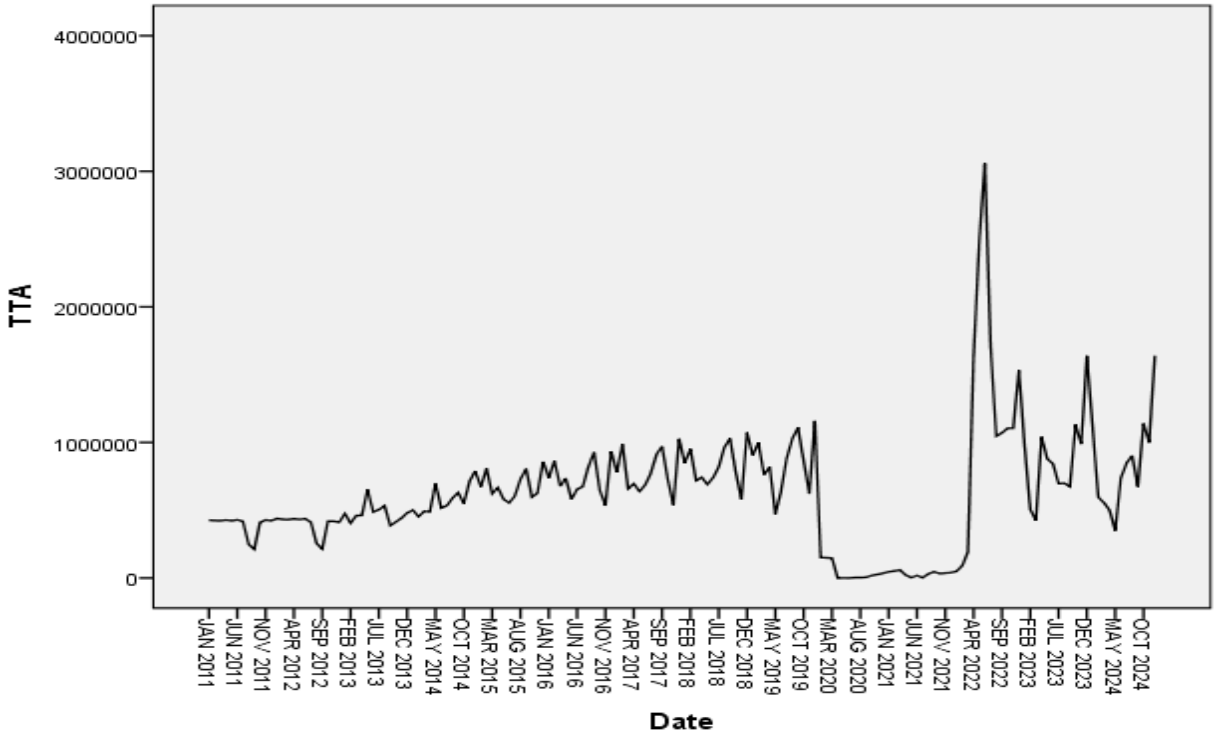


Figure 1: Sequence Chart for TTA in Purba Medinipur during 2011 to 2024

Data Source: The Ministry of Tourism, Government of West Bengal

The fitted SARIMA $(2,0,1)s(1,0,0)_{12}$ model without any transformation parameters have been presented in the following table (Table 3).

Table 3: Fitted SARIMA (2,0,1)s(1,0,0)12 Model Parameters

Component	Parameter	Lag	Estimate	SE	t	Significance
Constant			646951.279	239645.108	2.700	0.008

Non-Seasonal	AR	1 (AR1)	1.259	0.135	9.544	< 0.001
	AR	2 (AR2)	-0.303	0.125	-2.428	0.017
	MA	1 (MA1)	0.888	0.087	10.256	< 0.001
Seasonal	AR	1 (SAR1)	0.849	0.067	12.587	< 0.001

Data Source: The Ministry of Tourism, Government of West Bengal

Fitted SARIMA equation of TTA at time t = 646951.279+1.259 AR1 -0.303 AR2 +0.888 MA1 + 0.849 SAR1

(SE) (29645.108) (0.135) (0.125) (0.087) (0.067)

((P-Value) ((0.008)) ((<0.001)) ((0.017)) ((<0.001)) ((<0.001))

All the individual parameters of the fitted model are highly significant.

Again, from the residual (difference between observed and predicted)

The following table (Table 4) provides the results of the diagnostic test for the overall significance of the fitted model.

Table 4: Results of Diagnostic Test for Overall Significance of Fitted Model

Statistic	Estimate/ Value	Remarks
Stationary R^2	0.853	85.3 percent of data have been explained by fitted model
R^2	0.853	
Normalized BIC (Bayesian Information Criterion)	22.853	Lower value is desirable. It is good significance
Ljung-Box Q	15.238 =14 Sig. 0.362	Greater than 0.05 is desirable
Number of Outliers	0 (Zero)	

Data Source: The Ministry of Tourism, Government of West Bengal

Considering the results of Table 3 and Table 4, it may be inferred that the fitted model is highly significant.

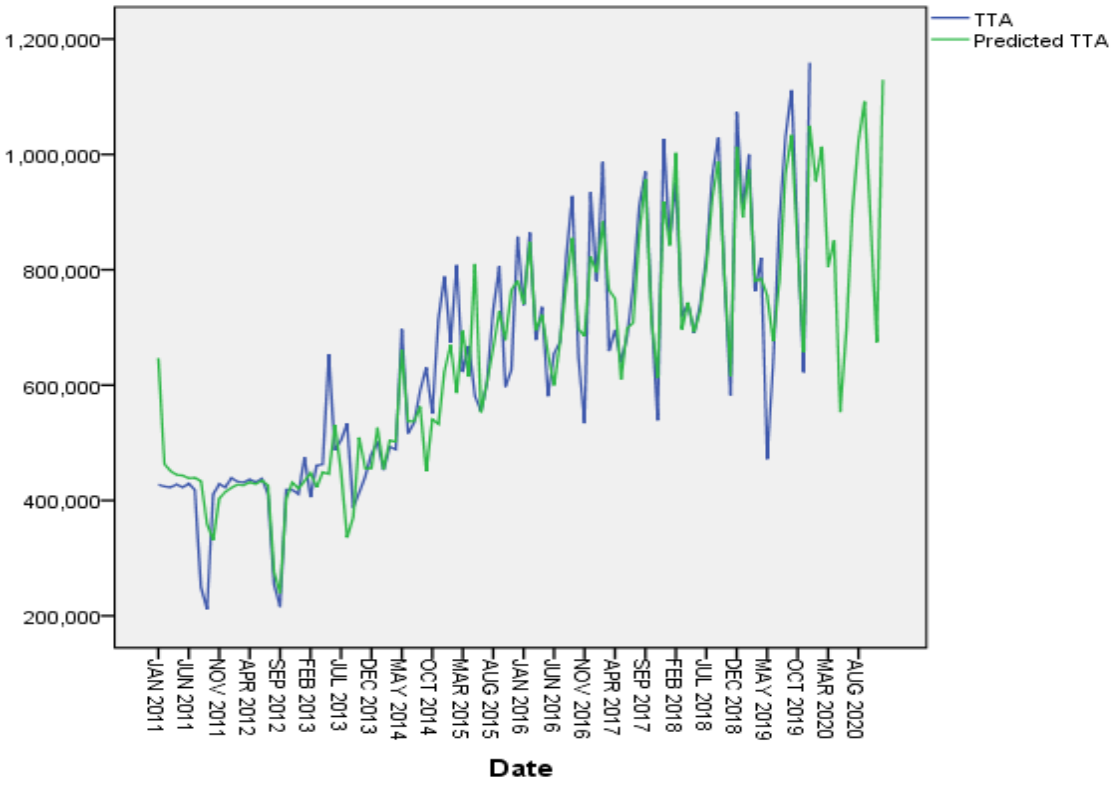


Figure 2: Sequence Chart for (a) TTA during 2011 to 2019 and (b) Predicted TTA during 2011 to 2020 in Purba Medinipur

Data Source: The Ministry of Tourism, Government of West Bengal

From the above figure (Figure 2) and the residual autoregressive function (residual ACF) and the residual partial autoregressive function (residual PACF), it may be inferred that residuals are "almost" white noise meaning residuals (errors or differences between observe and predicted) TTAs are highly negligible.

The actual and predicted values of TTA for 2019 and predicted values of TTA for 2020 have been provided in the following table (Table 5).

Table 5: Actual and Predicted Values of TTA for 2019 and Predicted Values of TTA for 2020

Year	Month	Actual Value of TTA	Predicted Value of TTA
2019	January	905575	890482
	February	999910	973878
	March	762605	780239
	April	820450	784798
	May	471805	754850
	June	640830	676435
	July	885630	779671
	August	1030025	966389
	September	1111220	1033648
	October	862190	839239
	November	622055	657343
	December	1158985	1049602
2020	January		953570
	February		1013422
	March		804853
	April		851043
	May		553296
	June		695597
	July		902392
	August		1023974
	September		1091915
	October		879431
	November		674521
	December		1129564

Data Source: The Ministry of Tourism, Government of West Bengal

6.0 SUMMARY AND CONCLUSIONS

Purba Medinipur, a coastal district in West Bengal, is a popular tourism destination known for its (a) scenic beaches, (b) prominent religious sites, (c) festivals, (d) numerous local temples, (e) notable historical sites and monuments etc. The district has a tropical wet and dry climate, identified by extremely hot and dry summers and is vulnerable to natural calamities, primarily floods and cyclones, with the district's coastal location creating it susceptible to storm surges and rising sea levels. Other issues include coastal erosion, salinization etc. Tourism infrastructure encompasses the physical structures and services that support tourism, including transportation, accommodation, attractions, and amenities like food, water, and sanitation. Transportation in the district includes road, rail, and water transport, with roads serving as the primary mode for both local and inter-district travel, connecting to major routes and cities. Water transport is significant, especially in the coastal areas of the district. Accommodation in the district includes a range of options, from beachside resorts and hotels in popular destinations to more budget-friendly lodges and guest houses. For the tourists in the district, a key healthcare facility is the District Hospital in Tamluk. Smaller private hospitals are available, along with numerous smaller medical centres and rural hospitals in towns. Basic amenities including education facilities, drinking water, health services, banks, and electricity are available, particularly in rural areas, to support the quality of life for the tourists. There are some homestays are available at the sea sides in the district.

In the district, coastal tourism provides recreational, leisure, and sport activities focused on the coastal zone and marine environment. It fringes land-based activities like sunbathing and beach sports, as well as sea-based activities such as boating, diving, and fishing. Tourism in the district provides livelihood opportunities to local people, particularly in coastal by creating jobs in hotels, transport, and related businesses. While offering economic benefits, this tourism poses environmental challenges due to mass visitor influx, increasing the need for sustainable ecotourism to protect the fragile coastal ecosystem and ensure long-term resilience for the local community.

Women in the district derive livelihoods from tourism through self-help groups (SHGs), homestays, selling local crafts and products, and increasingly through innovative ventures like floating hydroponic farms that address climate change impacts. These opportunities provide income, promote economic and social empowerment, increase decision-making power within

households, and build confidence, although challenges like resource access and traditional gender norms persist. The district is generally safe for tourists, with a focus on providing a modern, yet traditional, tourist experience. There have been adequate security and safety measures in the sea beaches in the district.

Positive factors for tourism in the district include economic benefits for locals, the creation of livelihood options, and the region's natural appeal of beaches and biodiversity. Negative factors include significant environmental degradation due to mass tourism, including coastal erosion, loss of biodiversity, and increased pollution from unbalanced development. Other challenges involve the deterioration of the coastal ecosystem from urbanization, the risk of cyclonic disasters, and the necessity for better management to prevent negative impacts on the environment.

The objectives of the present study on forecasting and measuring seasonal indices of tourist arrivals in the district include identifying seasonal patterns of, developing forecasting model to predict seasonal tourist arrivals, and providing data for effective tourism planning and management.

Measurements of seasonal (monthly) indices of tourists arrivals and development of a robust seasonal ARIMA SARIMA$(2,0,1)s(1,0,0)_{12}$ have been done.

Tourism contributed 5.00 percent to India's GDP in 2022-23, with a direct contribution of 2.60 percent and an indirect contribution of 2.40 percent, according to the Ministry of Tourism, Government of India. This figure represents a significant recovery after a dip due to the pandemic and shows positive growth projections for the future, driven by both domestic and international tourism and government support initiatives. Tourism industry have vast potential for India being a country known for its rich culture, accounting for 30 world heritage sites (Kumar et al., 2018).

The money multiplier effect for tourism in India is considered high and is a key driver of economic growth. Tourism stimulates the economy by creating jobs in the hospitality, transport, and retail sectors, and boosting growth in other industries as tourist money circulates, leading to increased income, tax revenue, and infrastructure development. While the exact multiplier varies, this effect highlights how tourism spending generates a larger overall impact on the nation's GDP and employment than the initial tourist expenditure.

Geo-ecotourism is a sustainable tourism practice that combines the principles of ecotourism with those of geo-tourism, focusing on responsible travel to natural areas that conserves the environment and improves local well-being, while also highlighting the geological features, heritage sites, and the interrelationships between abiotic (non-living) and biotic (living) components of a destination. It aims to provide visitors with a deeper understanding and appreciation of a place's unique geological character, biodiversity, cultural heritage, and the local community, ensuring both environmental and social benefits.

Experiential tourism is a form of travel that emphasizes deep, authentic, and immersive engagement with a destination's culture, people, food, and environment, rather than just sightseeing traditional landmarks. Travelers actively participate in local activities, such as cooking classes or crafting workshops, to foster a deeper personal connection, gain first-hand knowledge, and create transformative, memorable experiences that go beyond the surface level of mass tourism.

To promote tourism in the district, policymakers should focus on developing robust geo-ecotourism, coastal tourism and experimental tourism by investing in sustainable infrastructure, creating eco-friendly accommodation and visitor centers, implementing sustainable fishing practices, and managing waste effectively. Community involvement in planning, promoting eco-friendly practices through local awareness programs, and enhancing transportation networks are crucial for a sustainable and economically beneficial tourism sector. Along with the promotion of tourism, policymakers should also focus on controlling environmental pollution, beach erosions, plantation and beautification of the tourist sites.

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