



Seasonal effects of tourism on Mousuni Island: A quantitative approach

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Abstract

Seasonality is a common phenomenon in every tourist spot all over the world. It results from an uneven level of tourism activity throughout the year. Both the governmental and private sectors are aware of this phenomenon. This paper analyzes the problem of seasonality and its mitigation in Mousuni Island. Although Mousuni Island is a new tourist destination, it is very prominent among tourist spots in West Bengal. This paper's objective is to give an overview of the present condition of seasonality in Mousuni Island. While the measures and approach used would seem to have relevance and applicability, the study finds that additional research is required to achieve conclusive results and completely understand the process of seasonality in tourism. This study suggested a method for generating quantitative answers that will ultimately help marketers reduce the effects of seasonality. The study used financial portfolio theory, which is frequently used to decide how to allocate securities. According to this study, given a demand-risk target, marketers should pick a variety of tourism sectors that are situated along the seasonal demand efficient frontier. The seasonal demand efficient frontier and segment mix solutions connected to seasonality are described in order to achieve this.

Keywords: Seasonality, Mousuni Island, tourism

Introduction

In the tourism sector, seasonality is a notable and frequent phenomenon. One of the key operational and policy concerns of tourist interests in both the governmental and private industries is the influence of seasonal demand fluctuation. Although many individuals would think they are despite the fact that many people would assume they are familiar with seasonality. it is not something that can be easily defined. Hylleberg (1992)^[10] offered the definition that has gained the most traction. He described seasonality as a regular, albeit not necessarily predictable, intra-year movement influenced by changes in the timetable, environment, and decision-making timing, either directly or indirectly via the choices made by economic agents in terms of output and consumption. All aspects of supply-side behavior in the tourism industry are affected by seasonality, including marketing (packaging, pricing, distribution), stakeholder management (suppliers, intermediaries), the labor market (skills availability, sustainability of employment, nature and quality of employment), business finance (attracting investment, cash flow, pricing), and all operational aspects (Baum & Svend Lundtorp, 2001)^[7]. RRV Baron remarked on seasonality that "tourism has been characterized by a single main season in many regions and in some entire countries, with hotels and other facilities, closed or operating at reduced potential over the remainder of the year (BarOn,1973)^[3]." According to Butler, seasonality is a temporary mismatch between demand and supply and an imbalance between coming and going tourists. Seasonality, according to BarOn (1973)^[3], an early pioneer in the field of research, means an improper and uneven utilization of the resources at economy's disposal. This is associated with inequity in the economic cycle, in which, depending on the stage of the cycle, Either the economy is overheating or it is underperforming its full potential. One of the biggest problems with outside activities and tourism is pollution. the definition of

seasonality is the irregular distribution of use throughout time (peaking), a strain on social and ecological carrying capacities, which results in inefficient loss of profit potential, resource use, and scheduling issues on the administrative level (Manning & Powers, 1984)^[16].

Seasonal variations cause market segmentation in the tourist industry to shift over time. For instance During one season, certain visitor groups may choose the warmth of the sun and the water, while during another they may prefer city, artistic, and cultural tourism.. Understanding the origins and effects of seasonality is essential given the variations in the spatial and temporal requirements for tourism (Reintinger *et al.*, 2016)^[20]. Most of the research on seasonality in tourism has mostly concentrated on case studies or practical concerns, with little effort put into developing theories or conceptual frameworks that may be used by tourists (Koenig-Lewis & Bischoff, 2005)^[12]. According to Turrión-Prats and Duro (2016): "when designing strategies for tackling seasonality, it is necessary then to measure, evaluate and understand the factors behind this phenomenon, recognize seasonal patterns of their markets and attracting appropriate target market segments in each one of the seasons (p. 29)". Tourism managers should therefore be aware of the elements that influence seasonal fluctuations in visitor travel behaviors as well as the motives of tourists.

The seasonality not only impacted India and its island tourism. The impact of seasonality has been found in the tourism sector of almost every county of the world, such as: including; Norway (Flognfeldt, 2001); Greece (Drakatos, 1987; Tsitouras, 1998); UK (Ball, 1989; Koenig and Bischoff, 2004)^[13]; Spain (Pearce, 1989); and Turkey (Sezer and Harrison, 1994; Tosun, 1999). International tourism has also been reported to experience seasonal demand variations. Researchers examined the seasonal trends of tourism on all Greek islands based on the number of nights that foreign visitors spent and found that summer also saw

the highest concentration (Donatos and Zairis 1991)^[9]. In order to understand how American community festivals influence travel demand, Janiskee (1996) looked at how they change over time. Seasonal trends were found, with a significant peak in July, followed by another in September throughout the peak season (May through October). Numerous festival organizers favor the months with the ideal weather for outdoor activities. A review of the literature shows that island locations experience more severe seasonality. This is due to a variety of factors, Their dependence on access carriers and tour operators, their distance from major urban areas, their problems with accessibility in the winter, and more (Andriotis, 2004)^[1]. Lim and McAleer (2001) give a quantitative definition of when tourist seasons appear, defining them as "*months for which the corresponding average indices exceed 1.0, indicating that seasonal factors increase tourist numbers above the trend and cyclical components.*"

Issues of seasonality

Determinant of seasonality

The demand for tourism seasonally for a number of reasons. The identification of determinants has been one of the key areas of contribution in this regard. The predictable and recurring temporal variations in the local natural phenomena are those that are most commonly noted., which are typically connected to the local climate and the actual seasons of the year. In the Balearic Islands, according to Nadal *et al.* (2004)^[18], there is high seasonality which sees more than 80% of its visitors between May and September. This is caused by a combination of factors, including the favorable weather as well as human decision-making factors like extended school breaks, business closures, and holidays. Particularly, these have historically and conceptually been divided into two big groupings (Bar-On, 1975). In the first, they emphasize the importance of factors related to climatic conditions, which have a strong connection to geographic location; in the second, institutional factors are highlighted, related to the distinctive laws of various countries that are applied to particular holiday periods. Beyond the conventional method, recent work has suggested the relevance of additional factors, such as economic ones, that may affect both the magnitude of inter-annual distribution as well as variations in yearly tourism demand (Nadal *et al.*, 2004)^[18]. Another factor that determines outcomes in human decision-making, varies significantly more than its natural counterpart (Butler, 1994). It also takes into account social, religious, cultural, and ethnic aspects, as well as official and private holidays and school breaks. The most crucial component of this seasonality variable is the summer break from schools.

Impact of seasonality

The most major detrimental effect of seasonality on the tourism industry has been considered to be a decline in business revenue (Scott & McBoyle, 2006)^[22]. Tourist sites

experience considerable population growth at certain times of the year, which results in environmental issues, transportation congestion, and resource shortages, which put a strain on the locations' routine services and infrastructure. In the Caribbean, tourists consume significantly more electricity per capita than locals do, and during the busiest travel season, this leads to more frequent electricity blackouts. Similar issues arise with the water supply since seasonal tourist arrivals use large amounts of water (Jackson, 1984)^[11]. The environmental implications of seasonality have also received a lot of attention with a focus on the considerable stress that crowding and overuse during the peak seasons inflict on frequently fragile surroundings. According to Hudson "*the viewpoint that seasonality is a problem is primarily taken from an economic position and reflects concerns with the difficulty of ensuring efficient utilization of resources*" (Hudson & Cross 2005). refer to the inherent waste in hiring temporary employees making investments in them, then after the tourist season is gone, losing that money. imply that hiring temporary employees is essentially wasteful to invest in them only to lose money when the tourist season is over. (Cooper *et al.*, 2005).

Operations are frequently complicated by their excess capacity, a decrease in the personnel, underutilization of the infrastructure, and the failure to attract investments during the off-season due to demand swings. The seasonal nature of tourism causes changes in the number of jobs available locally. As a result, there is considerable off-season unemployment and a staffing shortage during peak season. Some authors claim that because the tourism industry is seasonal, workers frequently need to find side jobs. At the busiest time of the year, there is an increase in visitors to many tourist attractions, which strains the system and raises the cost of services. As a result, when additional staff are needed, they frequently lack the necessary expertise. This could lead to a drop in service quality and attention to detail. Seasonality is typically considered negatively. There is relatively little mention of its positive benefits. Arguments were made that seasonality can really be very advantageous for some stakeholders. This is so that this naturally occurring high-altitude ecosystem can recover from being overused during the peak season. Additionally, an off-season is frequently necessary for improvements and for permanent residents to recuperate from feelings of overwhelm caused by the high volume of visitors during the busiest times (Murphy, 2014)^[17]. It was emphasized that people may only resume their regular lives, take part in cultural and social activities, and use neighborhood services and facilities without experiencing significant hassles during the off-season. Some seasonal workers view their inability to find work during the off-season as advantageous. Because the high tourist season offers them a higher wage than other employees that are available at the same time, some workers prefer to work just during that period (Ainsworth, 2009).

Methodology

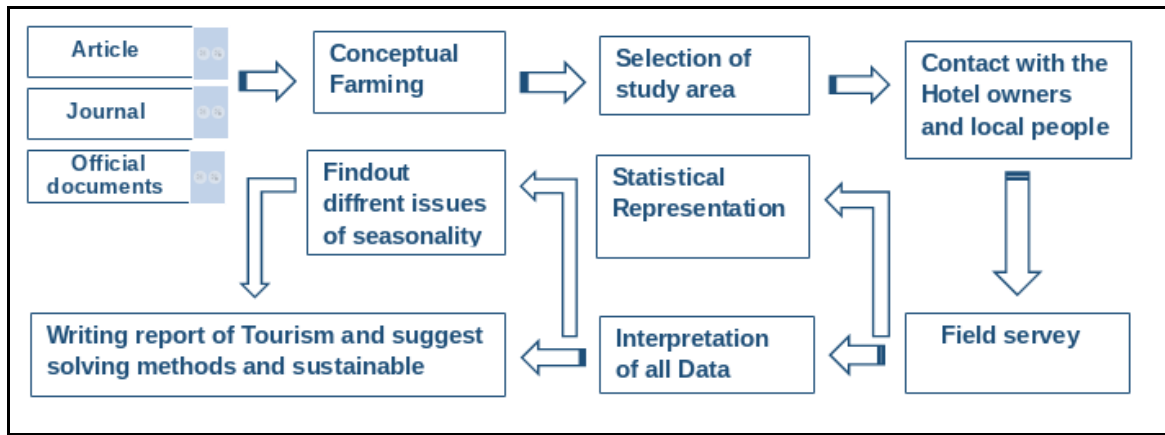


Fig 1: Schematic diagram of methodology.

Different seasonality coefficients such as Oliver (OC), Gini (GC), Walsh-Lawler (WLC), variation coefficients (VC), Oliver (OC), and entropy (EC) are used as metrics to determine how seasonal the tourism industry is (Table 1). Here is their statistical expression. It should be emphasized that the majority of the scholarly literature on the seasonality of tourism uses these indexes. Typically, The

main indicator of tourism seasonality is the number of visitors. The production of earnings would be a preferable standard to use if the goal were to quantify economic benefits, but such data is rarely available. Therefore, the number of visitors—including departures, arrivals, overnight guests, and so forth—is used for practical purposes.

Table 1: variability of the different coefficients of seasonality

Coefficient	Minimum Value	Maximum Value
Gini (GC)	0 denotes Equidistributional	1 maximum concentration
Variation (VC)	0 denotes Equidistributional	3.31
Walsh-Lawler (WLC)	0 denotes Equidistributional	1.83 maximum concentration
Oliver (OC)	0.08 denotes Equidistributional	1 maximum concentration
Entropy (EC)	0 maximum concentration	0 maximum concentration

Coefficient of seasonal variation and seasonality ratio

Yacomis (1980) discusses the significance of seasonality using two metrics. The first, which he calls the coefficient of seasonal variation, is equal to the standard deviation of the seasonal indices (explained below), where index = 100 represents the average monthly attendance. The second measuring process is known as the seasonality ratio. The formula of the seasonality ratio is described below

$$V_o = \sum_{i=1}^{12} V_i$$

Where V_o is the annual number of visits as a whole. V_i is the monthly visitor. The average annual number of tourists is, $\bar{V} = \frac{V_o}{12}$. So, the seasonality ratio is $R = V_n / \bar{V}$, Where V_n is indicated as having the most visits. The ratio will be 1 if the same amount of visitors arrive each month. If every visitor arrives in month n, the ratio is 12. So, the highest and lowest possible value will be 12 and 1 respectively. Furthermore, the seasonality indicator is defined as the reverse value of the seasonality ratio. So, the formula of seasonality indicator is $\omega = \bar{V} / V_n$. So, the possible highest and lowest value of ω is $1/12 \leq \omega \leq 1$. Let V_i represent the number of hotel overnights, and with V_n , X represents both the hotel's maximum capacity and its actual capacity. As a result, during the peak season, every room is occupied. If yes, ω displays the average overnight occupancy rate and the typical overnight stay in relation to the available space. ω is

a measure of capacity utilization as a result. ω also serves as a gauge for the typical seasonal use of rooms by displaying the occupancy rate. A room is typically used 50% of the year, or for six months, if, for instance, $\omega = 0.5$, which indicates that 50% of the hotel's capacity is utilized annually. As a result, the seasonality indicator also measures the length of the season. In the event where V_n is less than the capacity, ω represents the proportional capacity utilization as compared to the use during the peak month (Lundtorp, 2001) [15].

Lorentz curve and Gini coefficient (GC)

American economist Max Lorenz created the Lorenz curve in 1905 as a way to visualize wealth or income disparity. The Lorenz curve can serve to demonstrate how systems are distributed unevenly. although it is most often applied to illustrate financial disparity. As the curve departs from the baseline, which is represented by the straight diagonal line, the degree of inequality grows. If Lorenz were a straight line, it would be the line of equality if there were an equal number of visitors each month. the region that lies between the equality line and the Lorenz curve will be higher the more asymmetric the seasonal distribution of visits is. The area between the curve and the 45-degree equality line is divided by the entire area beneath the 45-degree line to determine the Gini coefficient. GC can be calculated by using the area of the triangle of the Lorenz curve very easily (Fig. 2).

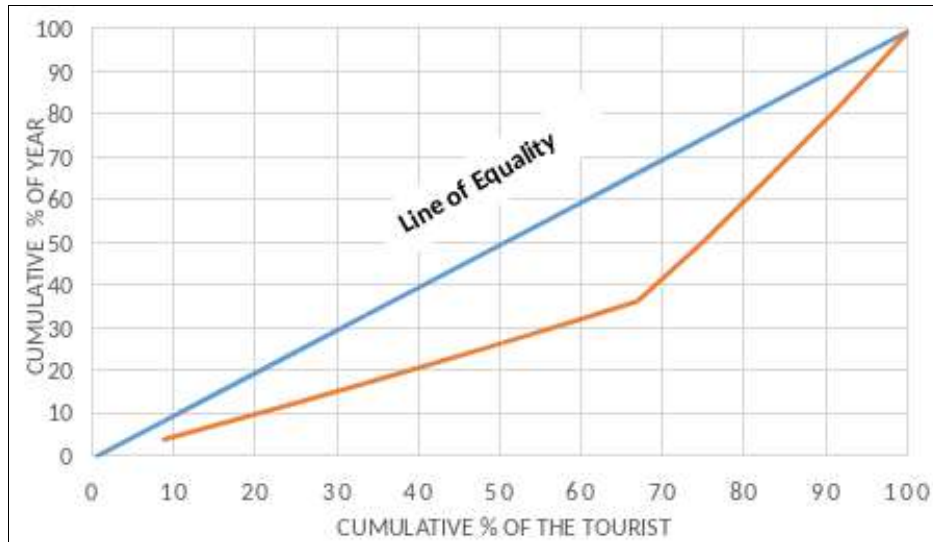


Fig 2: Lorenz curve

The general and simplest formula of the Gini coefficient is

$$GC = \frac{2}{n} \sum_{i=1}^n (X_i - Y_i) \quad (\text{Baum \& Svend Lundtorp, 2001})^{[7]}$$

Where,

n = The quantity of fractiles. (In the case of the month, n=12)

X_i = The position of fractiles. (in case of the month that is 1/12, 2/12, 3/12.....so the formula of X_i = i/n) and Y_i = accumulated fractals in the Lorenz curve.

On the other hand, $\frac{2}{n} \left[\sum_{i=1}^n i f_i - \frac{(n+1)}{2} \right]$ This is easier to computable to the researcher (Baum & Svend Lundtorp, 2001) ^[7]. There is another process to find out the value of GC. before calculating GC the value of the tourist activity should be arranged in low to high order with in each and every year. The indicator's value for a month i of year j is represented by the symbol (Lambert & Aronson, 1993) ^[14]. According to this, the formula for measuring GC is $GC_j = \frac{\sum_{i=1}^{12} (p_i - q_i)}{\sum_{i=1}^{12} p_i}$. The cumulative proportion of the months in a single year (1/12, 2/12...) is represented by p_i, while the indication of tourism activity for each month (rearranged) within year j is represented by q_i. Since both numbers are equal in the final month of analysis, which concentrates on the total amount of tourism activity, this coefficient only defines the discrepancies between q_i and p_i for the eleven months with the lowest value of the year. The GC statistic would be equal to 0 if a tourism destination doesn't experience seasonality or If monthly visitor numbers are consistent, since every month of the year has the same values for the coefficients p_i and q_i. On the other hand, it is evident that the value of q_i would equal 1 for month i if all tourism activity were concentrated in that month alone, but not for the other months (Table 1).

Notation and Seasonality Coefficients

It is crucial to consider certain aspects of the phenomenon under study, such as its periodicity, while calculating the coefficients of seasonality. The study's data set includes monthly values for various years and for all of the supply and demand-related tourism activity variables. The indicator's value for a month i of year j is represented by the symbol x_{ij}, thus, $x_j = \sum_{i=1}^{12} X_{ij}$. It indicates the year j's overall yearly tourism indicator. Therefore, for the year j,

the average monthly is, $X_j = \frac{\sum_{i=1}^{12} X_{ij}}{12} = X_j/12$. From the X_j we can find the value of variance and standard deviation. The formula of variance and standard deviation are given respectively. Variance $(\sigma_{x_j}^2) = \sum_{i=1}^{12} (X_{ij} - \bar{X}_j)^2 \frac{1}{12}$ and standard deviations $(\sigma_{x_j}) = \sqrt{\sigma_{x_j}^2}$. By using Notation and Seasonality Coefficients we can find the value of variation coefficient, Walsh–Lawler coefficient, Oliver coefficient, Shannon entropy or Entropy coefficient of information, all of these are given below.

Variation coefficient

This relative measure of variance reveals the size of a standard deviation in proportion to the mean. The If the indicator or variables used to quantify travel activity do not show fluctuations in demand, that is, if they show the same level of travel activity every month, then VC is equal to zero (null standard deviation) (Table 1). However, if this coefficient has a positive value, it would indicate some seasonality because not every month will see the same degree of tourist activity. As a result, as the coefficient of variation rises, so does the seasonality of visitor flows. The

variation coefficient is expressed as $VC_j = \frac{\sqrt{\sum_{i=1}^{12} (x_{ij} - \bar{X}_j)^2}}{x_j} = \sigma_{x_j} / x_j$

Walsh–Lawler coefficient

This coefficient makes it possible to quantify the variance in tourism activity over the course of each year. The basis for this statistic is the discrepancy between the observed monthly travel activity, x_{ij}, and the average for each month for the year, x_j. This coefficient ranges from zero, which occurs when there is an equal amount of tourism activity in all the months, to the highest value 22/12 = 1.83, which happens when there is an equal amount of tourism activity in all the months (Table 1). The mathematical expression of

this coefficient is, $WLC_j = \frac{1}{x_j} \sum_{i=1}^{12} |X_{ij} - \bar{X}_j|$ (Walsh & Lawler, 1981)^[24]

Oliver coefficient

By using the provided quotient, this coefficient aims to quantify the magnitude's intensity of concentration. establishing monthly values for each year j. The only period

that records a value other than zero; the limitations of this coefficient are a minimum value of 0.08 under equidistributional and a maximum value of 1 under maximal concentration (Table 1). The expression of the Oliver coefficient is $\epsilon_{ij} = X_{ij} / X_j$ and $OC_j = \sum_{i=1}^{12} \epsilon_{ij}^2 / (\sum_{i=1}^{12} \epsilon_{ij})^2$ (Oliver, 1980)^[19].

Shannon entropy

This indicator aims to quantify the set of states in a system in relation to the likelihood that each state will occur. When all of the states have the same likelihood of occurring, the system is said to be exhibiting equidistributional, and this metric reaches its maximum value (Shannon, 1948)^[23]. The measure assumes its minimal value, 0, and is interpreted as a maximum concentration when one of the states has a chance of occurrence equal to 1 (Table 1). The expression of the Shannon entropy is $EC_j = - \sum_{i=1}^{12} \epsilon_{ij} \log_2 \epsilon_{ij}$.

Index of satisfaction

The index of contentment with a few facilities that are provided has been calculated to gauge the level of satisfaction of the tourists. This demonstrates the location's strengths and weaknesses in relation to some crucial and necessary facilities. Hall, Yen, and Tan (1975) developed a satisfaction index, with a maximum value of +1 and a minimum value of -1, which was chosen to measure the respondents' level of satisfaction and discontent with the various environmental variables. The formula of satisfaction index is $I_s = f_s - f_d / N$ (Hall, 1975). Where, I_s =Satisfaction of Index, f_s = Number of respondents who were satisfied, f_d = Number of Respondents Who Were Unsatisfied., N = Total Respondents Counts.

Objective of the study

The main goal of this study was to increase knowledge of the techniques that should be used in order to maximize the economic advantages of tourism and minimize risk. With this study, we will understand about pattern and the seasonality of Mousuni Island. On the other side, we will understand the pattern of seasonality in a new tourist spot named Mousuni Island. This is also trying to find out about the technique investment plan from the supply side. We are trying to find out about the satisfaction level of the visitors. Besides this, the main objective of the studies are:

1. Is seasonality present on Musuni island or not?
2. Status of seasonality in the island over the year.
3. Satisfaction level of the tourist.
4. If there seasonality is present, how can it be mitigated?

‘For calculating the satisfying index, the sample size is not taken randomly. For the statistical analysis of the satisfying index, we tried to minimize the error. To minimize the error of sampling we followed Yamane’s rule of sampling. The mathematical expression of Yamane’s hypothesis is $n = N / (1 + Ne^2)$. Where, N = size of population, $e = 0.05$ based on the research condition, and e = Margin of error (MoE), n = corrected sample size.

Data

The data used essentially comes from a variety of sources. For the purpose of examining the seasonality of tourism activities on Mousuni Island, the essential data for the period of January 2015 to December 2022 is required and it is represented in Table 2.

Table 2: Collected tourist count data from different sources.

Year	2015	2016	2017	2018	2019	2021	2022
Month							
January	1352	3181	4272	2313	4321	2895	3387
February	876	2231	3669	2116	3891	2983	3486
March	374	657	1057	870	1236	921	1306
April	404	589	1123	843	1370	977	1234
May	309	681	953	808	1203	943	1177
June	347	689	896	887	1110	813	1235
July	289	659	989	821	1289	723	1272
August	367	671	1004	769	1304	867	1406
September	313	653	1019	813	1187	997	1127
October	384	597	977	973	1219	773	1506
November	938	1864	3469	2370	4271	2875	3772
December	1416	2130	3157	2416	4672	2970	3981
Total visitors	7369	14802	22985	15999	27073	18737	24889

Because of the tourism campaign's high volatility for this year and unpredictable character, it should be noted that 2020 is not taken into account in this study. The indicator used in this study to gauge tourist activity is the number of travelers who have checked into hostels, rural homes, hotels, boarding houses, and campsites (together referred to as lodging establishments). Just a few of the indicators taken into consideration from the standpoint of supply are the number of open tourism establishments, hotel occupancy rates, and the number of employees hired. The study is completely based on primary data, because of the unavailability of secondary data on government websites. Data for coefficient analysis is collected from the local union office as registered and Freserganj coastal police

station provided some additional data about islands tourism. On the other side data to measure the satisfying index, the author collected data from a primary survey. The number of passengers who have checked into hotels, boarding houses, rural homes, hostels, and campsites is the indicator utilized in this study for tourism activity. We should mention that 2020 is not taken into account in this study due, in part, to the unpredictable nature of the tourism campaign and its high volatility for this year. The entire piece is built upon both primary and secondary sources of facts and information. Primary information was gathered through conversations with residents, visitors, businesses, hoteliers, etc. A District census guide, journals, books, research reports, both published and unpublished, and online

resources were also explored to get further information. The entire project was completed using both analytical and descriptive methods. The authors analyzed and presented the primary data after gathering it using questionnaire surveys given to visitors at each location. As a result of being gathered and organized, statistical and cartographic representations of both desk and field data have been made.

Causes of seasonality

Two fundamental origins of phenomena—"Natural" and "Institutional"—can be connected to the thorough analysis of Butler seasonality. Natural seasonality results from regular oscillations in the climatic variables of temperature, precipitation, rainfall, and daylight. Distance from the equator enhances natural seasonal fluctuation, and its worst effects are frequently seen at places on the perimeter that are close to the poles (Baum & Svend Lundtorp, 2001)^[7]. Every nation has unique climate patterns, transient mobility occurs due to natural forces (BarOn, 1973)^[3]. As the name suggests, natural seasonality is a result of natural phenomena brought on by the forces of nature, including factors like humidity, ice cover, water temperature, sunlight, rainfall, snowfall, temperature, wind, precipitation, daylight, cloudiness, and visibility. Decision-makers have no control over natural causes. Hartmann (1986) emphasizes the fact that seasonal changes brought on by natural forces are predictable since they are generally stable in a given location and reoccur with only minor modifications. Despite the fact that the climate plays a significant role in luring tourists, it is frequently seen as a barrier to the growth of the tourism industry (Higham and Hinch, 2002). Natural seasonality has a pronounced effect on remote and distant regions with wide seasonal temperature fluctuations. With increasing distance from the equator, seasonality rises (Butler, 1994). Problems brought on by natural seasonality are hardest to resolve at high-latitude locations, especially in the outlying areas.

Institutional seasonality is far more pervasive and unpredictable than natural seasonality since it is the product of human actions. Religious holidays, pilgrimages, and times of public prayer are all examples of governmental seasonal fluctuations in demand for tourism-related services. It is the result of a combination of cultural, ethnic, religious, and social elements. Butler (1994) highlighted three more factors that contribute to seasonality: social pressure or fashion (elites partaking in spa treatments or hunting on country estates), sporting season (snow skiing or surfing), and inertia or tradition. One of the most important problems with seasonality Facilities frequently fill up in the peak season. As a result, it is difficult to maintain service quality and delight customers, making it riskier from a marketing perspective to develop a strong, long-lasting relationship

with them. In his article, Butler (1994) proposes that key additional factors of seasonality include societal sporting season, peer pressure or fashion, and tradition or inertia. Social pressure, as defined more formally, is the urge to engage in a certain activity at a given location during a particular season.

One of the seasonality variables is inertia, which explains why some tourists prefer to go on vacation at a particular time of year even when they are no longer required to (Higham and Hinch, 2002). Frechtling (2001) cited calendar influences as a significant additional factor contributing to the seasonality of the tourism industry. Act institutional, social pressure or fashion calendar, inertia, and accessibility as pull factors for sporting seasons, leisure travelers, while climate, activity opportunities, physical attractions, licensing requirements, events, accessibility alternative uses of tourism resources, the use of tourism as a supplemental source of revenue, and trading patterns of other businesses, lodging structure, wet-weather facilities, and alternative uses of tourism resources are all factors in the receiving area. Hylleberg (1992)^[10] categorized the primary variables affecting seasonality into three groups: weather (such as sunshine and hours temperature), calendar effects (such as the timing of religious holidays like Durga puja, Easter, Eid, and Christmas), and timing decisions (such as dates for dividend and industry vacations, bonus payments, accounting periods, tax years, etc.). The two categories of institutional and natural causes make up the most popular classification of seasonality. Instead of focusing on the uncommon irregularities within the tourism business, seasonality focuses on the seasonal patterns that are reliable and well-established (Ferrante, Lo Magno and De Cantis, 2018).

Geographical aspects of the study area

The Mousuni Island is situated in South 24 Parganas district of West Bengal. The latitudinal and longitudinal location of the island is 21.6624° N, 88.2023° E. It is a subset of the Bengali deltaic group of islands, with the Chinai River passing between the Mousuni and Bakkhali shoreline in the east and the Muri Ganga dividing the Mousuni and Sagar Islands in the west (**Fig.3**).

The serene island features a long, narrow beach lined with the local mangrove vegetation, as well as a scenic view of the Ganga's distributaries fast flowing into the Bay of Bengal. The island has a vast geological history, but it has a fairly recent history as a destination for those who enjoy unconventional travel. Sadly, due to rising sea levels, an increase in the frequency and intensity of cyclones, and coastal flooding, global warming is dangerously jeopardizing this stunning location in Bengal.

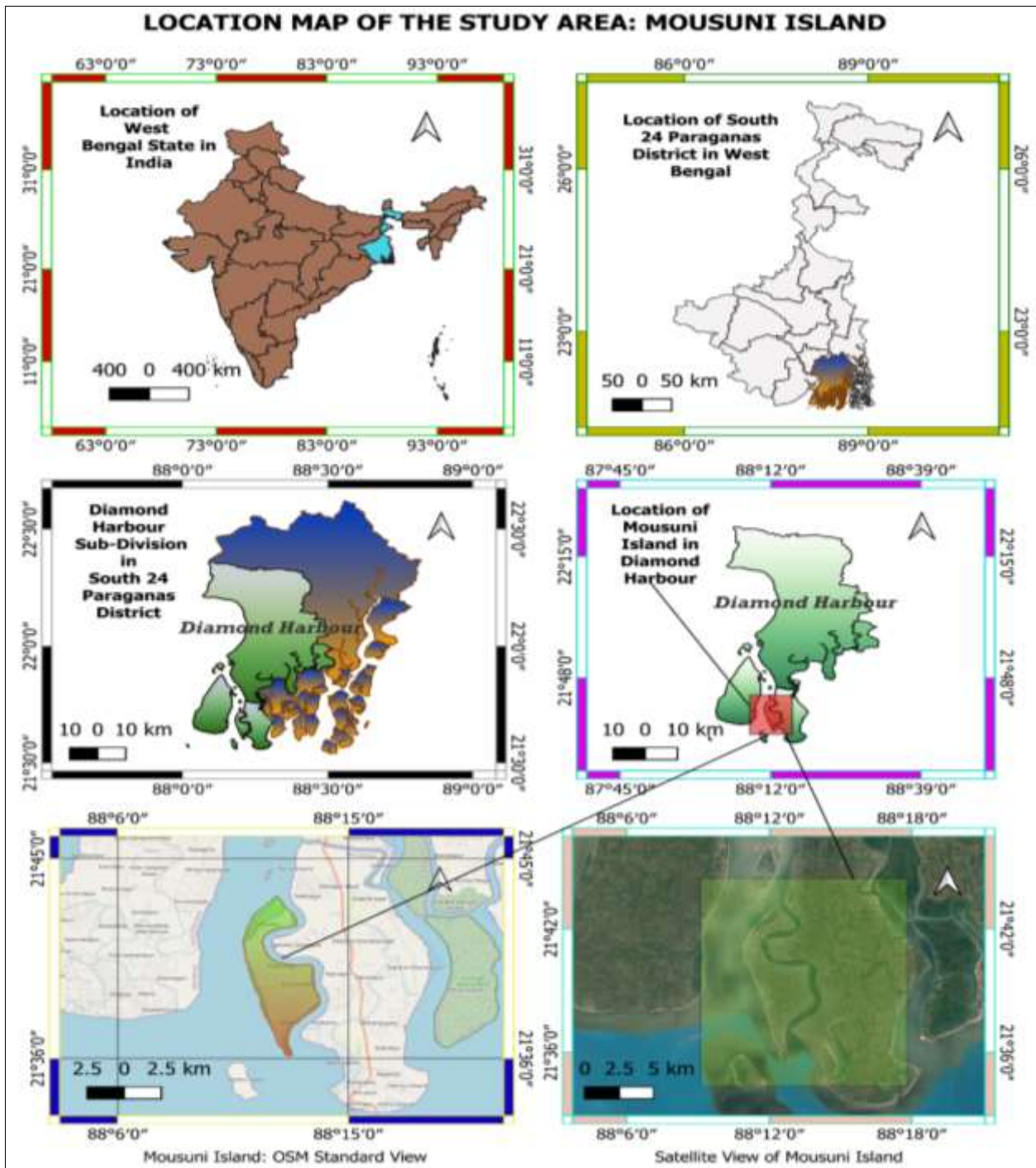


Fig 3: Geographical location of Mousuni Island. This map is generated by the QGIS software

Physiography

Mousuni island is distinguished by a fairly mild slope to the south and southeast. Only one BenchMark (BM) is displayed on the Survey of India (1922) survey pillar, which was built close to the ancient collector building (the former GP office) in the island's central region, marking the maximum height (3.90 m). The two villages of Kusumtala and Baliara's micro-level elevation models show three topographically vulnerable zones: Less vulnerable zones include elevated areas that are >2.5 m high, moderately elevated areas that are 2.0–2.5 m high, and low-lying areas that are less than 2.0 m high (Samanta *et al.*, 2017) [21]. But because of embankment failure and high tide during the monsoon season, the entire island is vulnerable to flooding. The mangroves on this island were damaged by tropical cyclones that struck Bangladesh and West Bengal (India) in

November 2007, April 2009, November 1988, October 1989, and November 1991.

Population

Mousuni Island is extremely vulnerable due to severe coastal erosion, frequent embankment breaches, cyclones, storm surge, and inundation that result in the loss of lives, property damage, and the dispersal and migration of families. The island experienced a 16% land loss between 1968/69 and 2012. However, there are 20013 people and 3340 families living on the island. The size of Mousuni Island is steadily decreasing (Samanta *et al.*, 2017) [21]. The coastal erosion is worrying along the West Coast, as evidenced by the shifting of the high-water line caused by erosion, which was anticipated to occur at intervals of 500 m along the southern reaches of the two coasts, west and

east, namely Kusumtala, and Baliara. Mousuni Island suffers from significant coastline erosion, frequent embankment breaches, flooding, and family displacement in addition to a very high population density, frightening poverty, and weak catastrophe resilience.

Drainage and water bodies

The Hoogly Estuary is on the western side, and the Saptamukhi Estuary is on the eastern side. Ocean current

dominance is visible in the southern portion's open ocean. Intertidal creeks, such as Edward's Creek, Hatania-Doania Creek, Helen Khal, etc., have divided this area multiple times. There are a lot of abandoned channels and non-perennial tidal creeks.

The analysis

Table 3: Coefficients value

YEAR	2015	2016	2017	2018	2019	2021	2022
Coefficients							
VC	0.65	0.70	0.67	0.52	0.64	0.62	0.55
GC	0.179	0.195	0.184	0.108	0.167	0.158	0.125
WLC	0.58	0.62	0.62	0.49	0.60	0.58	0.51
OC	0.12	0.12	0.12	0.11	0.12	0.12	0.11
Entropy	3.31	3.27	3.29	3.40	3.31	3.33	3.39

In order to properly examine the behavior of the several seasonality coefficients in use, Table 3 shows, a Calculated is an ordinary correlation between two coefficient sets.. The findings demonstrate that the data produced by the seasonality coefficients GC, VC, and WLC, are comparable and that the data produced by the EC and OC coefficients are also extremely similar. However, it should be noted that the EC's estimation is inverse to that of the other indices, meaning that its maximum value (3.58) denotes equidistributional and its highest value (0) indicates maximum concentration, giving the EC a distinct sign in the correlation matrix. This indicates that selecting any one of them is appropriate, The quantitative sensitivity study of the different seasonality coefficients indicates. In the case of variation coefficient the value 0 indicates the equidistributional of tourist participation, and the value 3.31 of VC denotes the maximum seasonality of the area. If we analyze the value of VC from table 3 it seems that the value of VC is more nearly 0 than 3.31. On the other hand, the value 0 of WLC indicates the equidistributional of tourism, and the value 1.83 denotes the maximum concentration. From the above analysis we found the value of WLC remains between 0.62 to 0.51. The value 0.08 of OC denotes the equidistributional and value 1 denotes the maximum seasonality of the area.

After the analysis, the value of OC remains between 0.11-0.12. The 0 value of the entropy coefficient denotes the maximum concentration of tourists, and the value 3.58 denotes the equidistributional of tourism in the area. After the analysis, the value of EC lies between 3.27 to 3.40. Besides this, the analysis shows the value of GC remaining between 0.125 to 0.195. So, it also denotes the same result as the other coefficients. The Lorentz curve not only defines the Gini coefficient but also measures the inequality of tourism activity in the area. There are some Lorentz curves of every year displayed below for a better understanding of tourism inequality.

The value of different coefficients displays the real condition of the seasonality of the tourist area. The value of the above coefficient denotes that this tourist spot was not now affected by seasonality widely. Although, the trend of the coefficients seems to be that the area shall be affected by seasonality in the very near future. It shall be easy if we try to understand the trend of the coefficient with graphical expressions throughout the year.

From Table 2 we can analyze the most tourist visited month. It shall be more clarify the seasonality. The Pie diagram shows the monthly visited tourist between 2015 to 2022.

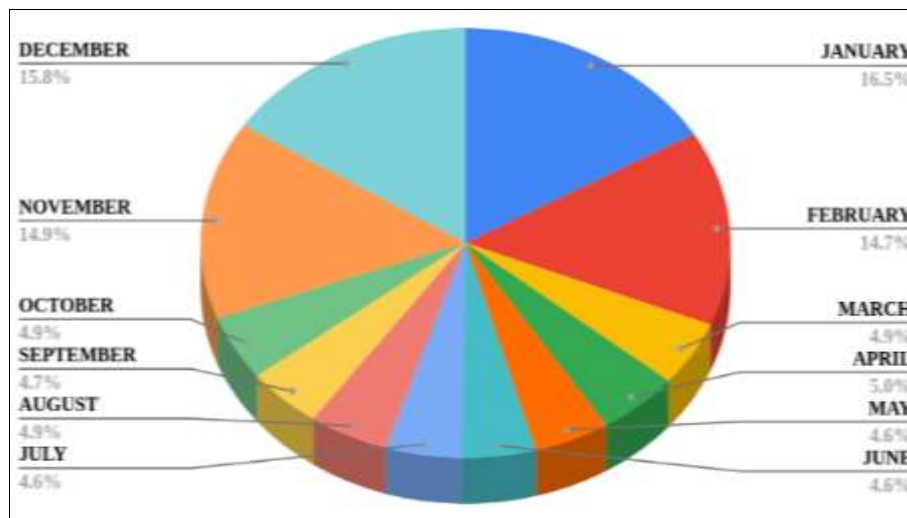


Fig 4: The monthly visited tourist from 2015 to 2022

Satisfaction index

Table 4: Satisfaction Index

Facilities	Degree of satisfaction			Total Respondent (N)	Satisfaction Index (Is)
	fs	Acceptable respondents	fd		
Transport	47	51	36	134	0.08
Food	113	1	20	134	0.69
Guide	103	17	14	134	0.66
Bank/ATM	1	2	131	134	-0.97
Market	12	9	113	134	-0.75
Security	98	7	29	134	0.51
Recreation	81	21	32	134	0.36
Hotel	123	2	9	134	0.85

According to Table 4, the satisfaction index of different parameters is transport (0.08), food (0.69), Guide (0.66), ATM (-0.97), market (-0.75), Security (0.51), Recreation (0.36), hotel (0.85). It is clear that the market and the ATM facility should be improved for more tourist gatherings. Most of the tourists stated about the transportation cost after the National highway (NH 12). Local tourism authorities must take measures to improve the ATM facility, Market, and reduce transportation costs for more tourists arriving on this island.

Mitigation of seasonality

Public and corporate sector responses to seasonality largely revolves around two possibilities: extending the current tourist season into shoulder seasons or developing new seasons of tourism activity (Andriotis, 2001) [2]. Altering the product mix is the first alternative, notably through providing all-weather facilities and holding events and festivals. By making considerable investments A product differentiation strategy should often consider intangible characteristics of the product such as technology, infrastructure, buildings, and landscapes as well as intangibles like research, customer service, marketing, or design and reputation strive to create a one-of-a-kind offering. (Baum & Hagen, 1999) [6].

There are several approaches to dealing with seasonality-related issues, including accurate measurement of seasonal swings, extending peak seasons by creating a travel product unaffected by seasonality, pushing a pricing differential model, and multiple-use programs (BarOn, 1975) [5]. The Gini coefficient, Seasonality Indicator, the Maximal Utilization constrained by Seasonality (MUS), and the Seasonal Underutilization Factor (SUF) are just a few of the measurement methodologies that have been developed to reduce investment risk. Seasonal patterns have also been measured and analyzed using applied investment theory, such as financial portfolio theory ((BarOn, 1999, Lundtorp, 2001) [15]. Although seasonality will never be completely avoided, there are many techniques to balance out its peaks and valleys. The matching of destination items with the needs of the tourist market segment is a requirement for successful plan implementation (McEniff, 1992). There is a variation in the types of tourism advantages desired during different travel seasons. When destination marketers want to draw in more visitors, they must completely understand the unique beneficial demands of each season's tourist population (Calantone & Johar, 1984) [8]. Some of the theories indicate a shared accusation between the public and private sectors. Private subjects bemoan the absence of public actions intended to lessen demand seasonality.

Conversely, private forms do not consistently respond to governmental initiatives. Conversely, private forms do not consistently respond to governmental initiatives. The creation of strategies must be based on the geographic, as well as the precise spatial, characteristics of the site, as well as the socioeconomic trends of the target areas. Although the aforementioned studies gave domestic marketers use data, the existing literature on seasonality reduction has focused on qualitative fixes. Therefore, greater effort and focus are required to address the negative effects of tourism's seasonality. In that regard, it is anticipated that this research will advance the literature by broadening the possibilities for approaching seasonality from a quantitative perspective.

Financial Portfolio Theory and Efficient Frontier

American economist Harry Markowitz served as the head of the Financial Portfolio Theory Foundation. The "Portfolio Selection" Journal of Finance paper was published in 1952. After that, he was awarded the Nobel Prize for his contributions to economics. Depending on the level of risk, the majority of assets either offer low returns at low risk or low returns at high risk. According to Markowitz, the best way for an investor to deal with the problem is by selecting the taking into account their individual risk tolerance, the appropriate ratio of the two. Segmentation or diversification is the main base component of MTP theory. It is a useful strategy for picking assets that will maximize total returns while posing a manageable degree of risk. The two major tenets of this theory are as follows: Every investor wants to maximize return for whatever amount of risk. By diversification a portfolio with distinct, unrelated securities, risk can be decreased. A useful theory for investors who want to build an efficient portfolio is one that maximizes returns while minimizing risks, or the other way around.

$E[R] = \sum_{i=1}^n R_i P_i \dots\dots\dots (1)$, where R_i is the proportion of asset i in the portfolio, P_i is the expected return of asset i , $E[R]$ is the expected return of the portfolio, and so on. Equation 1 reduces to if a two-asset portfolio exists. $E[R] = R_1 P_1 + (1-R_1) P_2 \dots\dots\dots (2)$. The variance of a portfolio's return, which is based on the variance of returns for each asset additionally, take into account the covariance of returns between each pair of assets., measures the risk of the portfolio:

$$V[R] = \sum_i R_i^2 \sigma_i^2 + 2 \sum_i \sum_j R_i R_j \sigma_{ij} \dots\dots\dots (3)$$

Where $V[R]$ denotes the portfolio's variance of return, σ_i^2 is the variance of the return of asset i , and σ_{ij} is the return

covariance between assets i and j. Based on the correlation between the returns of the two assets and the variances of those returns, the second factor determines how closely the returns move together.: $\sigma_{ij} = \rho_{ij} \sigma_i \sigma_j \dots\dots\dots (4)$

where the correlation between the returns of assets i and j is represented by the number ρ_{ij} . When equation 4 when put into equation 3 the new form of equation 3 is:

$$V[R] = \sum_i R_i^2 \sigma_i^2 + 2 \sum_i \sum_j R_i R_j \sigma_{ij} \sigma_i \sigma_j \dots\dots (5)$$

It's crucial to keep in mind that the variance of a portfolio's return is calculated using both the correlation of returns between each pair of assets and the variance of each asset's return. Equation 5 changes when a two-asset portfolio is,

$$V[R] = R_1^2 \sigma_1^2 + (1-R_1)^2 \sigma_2^2 + 2R_1(1-R_1) \rho_{12} \sigma_1 \sigma_2 \dots\dots (6)$$

If the $\sigma_1 = \sigma_2 = \sigma$, then the equation 6 becomes

$$V[R] = R_1^2 \sigma^2 + (1-R_1)^2 \sigma^2 + 2R_1(1-R_1) \rho_{12} \sigma^2$$

$$V[R] = \sigma^2 (R_1^2 + (1-R_1)^2 + 2R_1(1-R_1) \rho_{12}) \dots\dots\dots (7)$$

It can be seen that,

$$R_1 + (1-R_1)^2 = 1 = R_1^2 + (1-R_1)^2 + 2R_1(1-R_1) \dots (8)$$

Substituting equation 8 into equation 7 shows that if $\rho_{12} = 1$

$$V[R] = \sigma^2 \dots\dots\dots (9)$$

If $\rho_{12} < 1$, and $R_1^2 + (1-R_1)^2 + 2R_1(1-R_1) \rho_{12} < 1$ therefore,

$$V[R] < \sigma^2 \dots\dots\dots (10)$$

Equations (9) and (10) show that low asset return correlation causes a portfolio to have a narrow range of returns, and that negatively correlated returns in particular significantly reduce risk. To entirely eliminate risk, the third component on the right side of equation (6) It has to be negative and equal to the sum of the first two components in actual magnitude. The Markowitz formulation fails to identify a single efficient portfolio. It provides a variety of portfolios which are optimal in terms of risk and return because each one gives the highest expected return at a given level of risk or the lowest risk at a given level of expected profit.

Conclusion

It is clear that seasonality is the most practical concern for tourism managers and policymakers. Seasonality affected almost every aspect of the tourism sector including hospitality performance, tourist behavior, policy-making, demand and supply chain, and local economy. This study explains the evolution and future trends of the seasonality of Mousuni Island. This research also attempts to propose how to obtain quantitative solutions and analysis to dominate the seasonality. Seasonality is described in the literature along with its causes, consequences, and possible remedies. This paper helps to find the quantification of the seasonality of

Mousuni island, links the causes of the seasonality of the island, mitigation of seasonality, and its quantifications of implications, for managing, understanding, and pattern of the seasonality of this island.

Reference

1. Andriotis K. The perceived impact of tourism development by Cretan residents. *Tourism and Hospitality Planning & Development*,2004:1(2):123-144.
2. Andriotis K, *Tourism Planning and Development in Crete: Recent Tourism Policies and their Efficacy. Journal of Sustainable Tourism*,2001:9(4):298-316.
3. Baron RRV. Seasonality in tourism–part II. *International Tourism Quarterly*,1973:1:51-67.
4. Baron RRV. The measurement of seasonality and its economic impacts, *Tourism Economics*,1999:5:(4)437-458.
5. Baron RRV. Seasonality in tourism: a guide to the analysis of seasonality and trends for policy making, *Economist Intelligence Unit*, London, (1975)
6. Baum T, Hagen L. Responses to seasonality: the experiences of peripheral destinations. *International journal of tourism research*,1999:1(5):299-312.
7. Baum T, Svend Lundtorp. *Seasonality in Tourism*. Pergamon, 2001.
8. Calantone RJ, Johar JS. Seasonal Segmentation of the Tourism Market Using a Benefit Segmentation Framework. *Journal of Travel Research*,1984:23(2):14-24.
9. Donatos G, Zairis P. How to access research remotely, 1991.
10. Hylleberg S. *Modelling Seasonality. Repec-Econpapers*, 1992.
11. Jackson I. Reference Guidelines for Enhancing the Positive Socio-Cultural and Environmental Impacts of Tourism - V.1 - Enhancing the Positive Socio-Cultural Impacts of Tourism in the Caribbean. Jackson I, 1984.
12. Koenig-Lewis N, Bischoff EE. Seasonality research: the state of the art. *International Journal of Tourism Research*,2005:7(4-5):201-219.
13. Koenig N, Bischoff EE. Analyzing Seasonality In Welsh Room Occupancy Data. *Annals of Tourism Research*,2004:31(2),374-392.
14. Lambert PJ, Aronson JR. Inequality Decomposition Analysis and the Gini Coefficient Revisited. *The Economic Journal*,1993:103(420):1221.
15. Lundtorp S. *Seasonality in Tourism*. Pergamon, 2001.
16. Manning RE, Powers LA. Peak and Off-Peak Use: Redistributing the Outdoor Recreation/Tourism Load. *Journal of Travel Research*,1984:23(2):25-31.
17. Murphy PE. *Tourism: a community approach*. Routledge, 2014.
18. Nadal JR, Font AR, Rosselló AS. The economic determinants of seasonal patterns. *Annals of Tourism Research*,2004:31(3):697-711.
19. Oliver JE. Monthly Precipitation Distribution: A Comparative Index. *The Professional Geographer*,1980:32(3):300-309.
20. Reintinger C, Berghammer A, Schmude J. Simulating changes in tourism demand: a case study of two German regions. *Tourism Geographies*,2016:18(3):233-257.

21. Samanta B, Das S, Sugata Hazra. Micro Level Vulnerability Assessment of a Community Living in Mousuni Island in the Indian Sundarban: An Integrated Study Employing Geoinformatics. Micro Level Vulnerability Assessment of a Community Living in Mousuni Island in the Indian Sundarban: An Integrated Study Employing Geoinformatics, 2017, 195-213.
22. Scott D, McBoyle G. Climate change adaptation in the ski industry. Mitigation and Adaptation Strategies for Global Change, 2006;12(8):1411-1431.
23. Shannon CE. A Mathematical Theory of Communication. Bell System Technical Journal, 1948;27(3):379-423.
24. Walsh RPD, Lawler DM. Rainfall Seasonality: Description, Spatial Patterns and Change Through Time. Weather, 1981;36(7):201-208.