METHODOLOGICAL APPROACHES IN ANALYZING THE STRENGTH OF SEASONALITY IN TOURISM TIME SERIES

GORDAN MARIUS IONUȚ[1], ADAMOV TABITA CORNELIA[*1], MILIN IOANA ANDA[1], PASCARIU ANKA ROXANA[1], IANCU TIBERIU[1]
[1]University of Life Sciences "King Mihai I" from Timisoara, Faculty of Management and Rural Tourism, Romania
*Corresponding author's e-mail: adamovtabita@usvt.ro

Abstract: *This paper investigates methodological strategies for analyzing seasonality in tourism time series, employing advanced methods such as Seasonal-Trend decomposition using Loess (STL), the GINI index, seasonality index and other methods. Through those approaches, researchers can unravel complex temporal patterns in tourism time series data. STL decomposition can be applied to time series data, revealing trend, seasonal, and residual components. The GINI index measures distributional inequality of tourism activity across seasons, while the seasonality index quantifies the intensity of fluctuations between quarters or months of high and low season.*

Key words*: seasonality in tourism, fluctuations in tourism arrivals, seasonality of time series*

INTRODUCTION

Tourism demand and offer exhibit significant cyclical fluctuations, influenced by factors like weather and cultural events, which in turn create distinct high and low seasons. As such, seasonality is a significant force in tourism, profoundly shaping traveler behavior, economic viability, and resource management. Recognizing the importance of seasonality is crucial for optimizing operations and fostering sustainable growth in the tourism sector, helping both businesses and policymakers in optimizing outcomes in tourism and sustainable development [8,10].

Seasonality, defined by the fluctuating distribution of tourist arrivals throughout the year, triggers economic complexities, particularly disrupting income flow for hospitality businesses. These fluctuations also impact the labor market from this field, causing variations between peak and trough seasons, while also affecting various economic activities linked to tourism [2].

Seasonality is in itself a big challenge for the tourism industry, as the recurrence of seasonal variations influences the economic performance and sustainability of businesses within the sector, as well as in fields that provide other services to tourists, especially in the context of rural development [3,12]. As such, this paper delves into methodological approaches aimed at analyzing the strength of seasonality in tourism time series.

The study explores the nature of the patterns in tourism seasonality, typically characterized by a single peak season, which is during the summer months for sun and sea tourism and in most other cases, or during the winter months in the case of ski tourism or during the winter holidays. Additionally, off-peak and two-peak patterns are observed in certain regions, where either the seasonal effect is lessened (in the case of destinations with suitable climate conditions year-round) or where both winter and summer months are attractive, respectively [14].

Factors contributing to these patterns are classified as natural, including climate, weather, and geographic location, or anthropogenic, encompassing holidays, weekends, and some economic policies. Future research endeavors can utilize the methodological insights from this paper in order to assess and model the factors influencing seasonality in the tourism industry [15].

MATERIALS AND METHODS

This research relies on a review of academic resources, including articles and books, to explore diverse methodologies for measuring seasonality in the tourism industry and in other types of time series, from theoretical and empirical perspectives.

The research databases used in this research are Web of Science, Scopus, and Google Academic, encompassing a wide time period (as seasonality has long been a concern for both academics and businesses alike), while focusing on recent research.

Several strengths and weaknesses for each method in part will be highlighted, with corresponding recommendations for usage in research.

RESEARCH RESULTS

Various quantitative techniques and indices have been utilized in prior studies to evaluate the degree of seasonality in diverse domains such as tourism arrivals, labor markets, retail, and meteorology.

One commonly employed method, the seasonal range, calculates the difference between the highest and lowest values within a specified period, usually a year. However, this method is inconclusive for comparisons involving time series with distinct statistical properties, as the seasonal range is an absolute value [6,11].

Alternatively, the seasonality ratio and indicator offer a means to compare time series by representing the ratio between the maximum value in the studied period and the annual average, as well as its inverse, respectively. Despite their utility, these indicators do not capture the dynamics in months other than the peak season. Another method, the coefficient of variation, akin to the seasonality ratio, gauges the ratio of the standard deviation in the time series to the mean [9]. Those methods are susceptible to distortion if there is an evolving trend component in the time series.

The GINI coefficient, along with the coefficient of variation, has been extensively employed in assessing various facets of economic activity in tourism. The GINI coefficient, linked to the Lorenz curve concept, quantifies the inequality in time series data [5, 9]. While it provides insights into the evolution of tourist flows throughout the year, it does not differentiate between trend and seasonality. Using the GINI coefficient to measure seasonality is limited to relatively short time periods, due to evolving trends that might skew the value of the index.

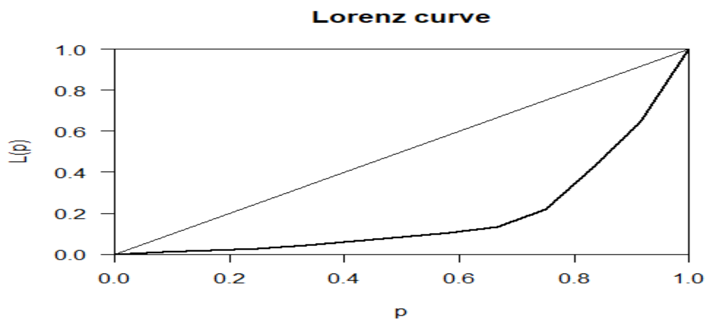

Figure 1. An example of the Lorenz curve and Gini calculation in agritourism

Source: own calculations, 2023

An example of the Lorenz curve and Gini calculation, applied to arrivals of foreigners to agritourism accommodations in the Alba county, are evidenced in figure 1. This plot was obtained in the R programming environment, with the usage of the ineq package. The calculated Gini index for 2010 was 0.62, followed by 0.68 and 0.59 for the subsequent years.

Debates in econometrics and forecasting have prompted the adoption of the Seasonal and Trend decomposition using Loess (STL decomposition) to parse trend variations and seasonality, with the advantage of preserving low dimensionality for subsequent modeling. STL decomposition separates time series into three components: season, trend, and remainder [4]. The method allows researchers to control the rate of change in seasonality and the smoothness of the trend-cycle, facilitating customization to the specificities of the time series analyzed. Unlike other methods such as SEATS or X11, STL decomposition demonstrates robustness to outliers and accommodates changes in the seasonal component over time (unless the seasonal window is periodic, which means that the seasonal component should remain stable over time) [7].

Expressed mathematically, the time series data using STL decomposition is represented as:

$$y_t = S_t + T_t + R_t$$

where y_t is the data, S_t is the seasonal component, T_t is the trend component, and R_t is the remainder not explained by trend or seasonal variations [1, 13]. The remainder should not exhibit discernable trends or cyclic variations, while the trend-smoothing and seasonality window parameters should be high enough in order to avoid overfitting the data to the algorithm. The resulting STL decomposition subsequently offers a powerful means to discern the strength of seasonal and trend variations, as exemplified in figure 2.

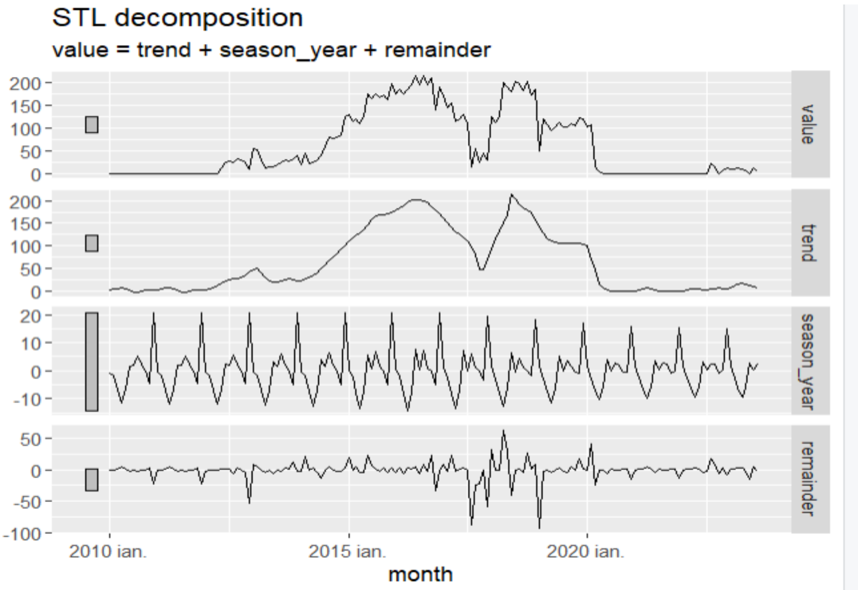

Figure 2. An example of STL decomposition applied to Romanian tourism data

Source: own calculations, 2023

An index of seasonality (Fs) is derived from the STL decomposition results, given by:

$$F_S = \max\left(0{,}1 - \frac{Var(R_t)}{Var\ (S_t + R_t)}\right)$$

where Fs signifies the strength of seasonality, Var(Rt) is the variance of the remainder component, and Var(St) is the variance of the seasonal component. This value ranges from 0 to 1, with 0 indicating series with no seasonality and values closer to 1 corresponding to time series with prominent seasonal components [7].

CONCLUSIONS

In summary, this study investigates the seasonality of tourism arrivals through a comprehensive examination of quantitative methods and indices. Traditional metrics like seasonal range, seasonality ratio, and the coefficient of variation can be critiqued for their limitations in capturing diverse dynamics across time series. While the GINI coefficient offers valuable insights into inequality within time series data, its inability to differentiate trends from seasonality motivates a shift towards more advanced methods. The STL decomposition method, known for its robustness and adaptability, enables a nuanced exploration of the three key components: season, trend, and remainder.

REFERENCES

[1]. ADIL MOHD, JEI-ZHENG WU, RIPON K CHAKRABORTTY, AHMAD ALAHMADI, MOHD FAIZAN ANSARI, MICHAEL J RYAN, 2021, Attention-based stl-bilstm network to forecast tourist arrival, Processes, 1759

[2]. ALSHUQAIQI AHMAD, SHIDA IRWANA OMAR, 2019, Causes and implication of seasonality in tourism, Journal of Advanced Research in Dynamical and Control Systems, pp.1480-1486

[3]. CIOLAC RAMONA, TIBERIU IANCU, GABRIELA POPESCU, TABITA ADAMOV, ANDREA FEHER, SORIN STANCIU, 2022, Smart tourist village-an entrepreneurial necessity for maramures rural area, Sustainability, 8914

[4]. CLEVELAND ROBERT, WILLIAM S CLEVELAND, JEAN E MCRAE, IRMA TERPENNING, 1990, Stl: A seasonal-trend decomposition, J. Off. Stat, pp.3-73

[5]. ĆORLUKA GORAN, ANA VUKUŠIĆ, IVAN KELIĆ, 2018, Measuring tourism seasonality: Application and comparison of different methods, Journal, pp.55-63

[6]. GRIZANE TAMARA, 2016, Measuring tourism seasonality in regions of latvia, Journal,

[7]. HYNDMAN ROB, GEORGE ATHANASOPOULOS, 2018, Forecasting: Principles and practice,

[8]. KURTULUS KARAMUSTAFA, SEVKI ULAMA, 2010, Measuring the seasonality in tourism with the comparison of different methods, EuroMed Journal of Business, pp.191-214

[9]. MARTÍN JOSÉ MARÍA, JOSE ANTONIO SALINAS FERNÁNDEZ, JOSÉ ANTONIO RODRÍGUEZ MARTÍN,MARÍA DEL SOL OSTOS REY, 2020, Analysis of tourism seasonality as a factor limiting the sustainable development of rural areas, Journal of Hospitality & Tourism Research, pp.45-75

[10]. ALKA OBADIĆ, LORENA PEHAR, 2016, Employment, capital and seasonality in selected mediterranean countries, Zagreb International Review of Economics & Business, pp. 43-58

[11]. GYĐA ÞÓRHALLSDÓTTIR, RÖGNVALDUR ÓLAFSSON, 2017, A method to analyse seasonality in the distribution of tourists in iceland, Journal of Outdoor Recreation and Tourism, pp.17-24

[12]. IANCU TIBERIU, ADAMOV TABITA CORNELIA, PETROMAN IOAN, CLAUDIA SÎRBULESCU, MILIN ANDA, ȘUBA ANKA and PASCARIU LUCIAN, 2020, Agritourism-supplementary income source for the rural population, Lucrari Stiintifice Seria I, Management Agricol

[13]. WANG HAIYAN, TAO HU and HUIHUI WU, 2023, Tourism demand with subtle seasonality: Recognition and forecasting, Tourism Economics

[14]. ZHANG JING, ZHONGLEI YU, CHANGHONG MIAO, YUTING LI and SHUAI QIAO, 2022, Cultural tourism weakens seasonality: Empirical analysis of chinese tourism cities, Land, 308

[15]. ZVAIGZNE ANDA, LIENITE LITAVNIECE and IVETA DEMBOVSKA, 2022, Tourism seasonality: The causes and effects, Worldwide Hospitality and Tourism Themes, pp.421-430