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João Vidal de Carvalho
Pedro Liberato
Alejandro Peña *Editors*

Advances in Tourism, Technology and Systems

Selected Papers from ICOTTS 2021, Volume 2

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João Vidal de Carvalho · Pedro Liberato · Alejandro Peña
Editors

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Editors
João Vidal de Carvalho
Porto Accounting and Business
School/CEOS
Polytechnic of Porto
São Mamede de Infesta, Portugal

Pedro Liberato
School of Hospitality and Tourism
Polytechnic of Porto
Vila do Conde, Portugal

Alejandro Peña
Accounting Department
EAFIT University
Envigado, Colombia

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Preface

This book—*Advances in Tourism, Technology and Systems Volume 2*—from the SIST Series is composed of the best selected papers accepted for presentation and discussion at the 2021 International Conference on Tourism, Technology and Systems (ICOTTS'21). ICOTTS is a multidisciplinary conference with a special focus on new technologies and systems in the tourism sector and was held between November 4 and 6, 2021. ICOTTS'21 was supported by the University of Cartagena, in Cartagena de Indias, Colombia, and by International Association for Digital Transformation and Technological Innovation (IADITI).

The International Conference on Tourism, Technologies and Systems is an international forum for researchers and professionals in the tourism sector, which enables the discussion of the latest innovations, trends and concerns in several areas, in the tourism sector, associated with information technologies and systems. It is an event for professionals in the sector, in search of technology solutions, where academics, IT experts and business managers meet to discuss new ideas that help them maximize the potential of tourism business through technology.

The ICOTTS'21 Scientific Committee is composed of a multidisciplinary group of 137 experts who assessed some 245 papers from 22 countries, received for each of the main topics proposed for the conference: (a) tourism research in providing innovative solutions to social problems; (b) information and communication technologies in hospitality and tourism industry; (c) sustainable tourism; (d) tourism trends; (e) health and wellness tourism; (f) tourism management; (g) marketing strategies in hospitality and tourism industry; (h) hospitality, tourism and foodservice environment; (i) tourism in the different scientific areas; (j) eTourism and Tourism 2.0.

The papers accepted for presentation and discussion at the conference are published by Springer and will be submitted for indexing by ISI, Scopus, Ei Compendex, Google Scholar and SpringerLink.

We thank all those who contributed to ICOTTS'21 (authors, committees, workshop organizers and sponsors). We deeply appreciate your involvement and support, which were crucial to the success of the conference.

Porto, Portugal
November 2021

João Vidal de Carvalho
Pedro Liberato
Alejandro Peña

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About the Editors

João Vidal de Carvalho is an Adjunct Professor at Institute of Accounting and Administration of Porto, Polytechnic of Porto (Portugal). Post-Doctorate in Technologies and Information Systems from University of Coimbra (Portugal). Ph.D. in Information Systems and Technology from University of Santiago de Compostela (Spain), MSc in Information Technology Management from University of Minho (Portugal), and Bachelor in Computer Science. He is Vice Director of the CEOS.PP Research Center—Center for Organizational and Social Studies of the Polytechnic of Oporto and Editor-in-Chief of Journal of Information Systems Engineering & Management Conference General Chair of the ICOTTS - The International Conference on Tourism, Technology & Systems and ICITED - The International Conference in Information Technology and Education. Published some books in computer science/Database Management. Scientific committee member of several conferences in the area of Information Systems and Technologies.

Pedro Liberato is a Professor of Tourism, specializing in tourism destinations management, tourism planning and tourism marketing, at the School of Hospitality and Tourism, Polytechnic of Porto. Currently he Coordinates the Tourism and Leisure Department and the Master in Tourism Management in the same School. His main research interests are tourism management, tourism planning, e-tourism, ICT in tourism and tourism marketing.

Alejandro Peña is part of the academic staff in the Accounting Department at Business School of EAFIT University. Dr. Peñas has a Bachelor's degree in Mechanical Engineering, a Master's degree in Systems Engineering, a Ph.D. in Engineering and a Postdoctoral Researcher focused on Machine Learning. Dr. Peña has developed several researches and papers in advanced topics related to computational intelligence and machine learning, in fields such as financial risk, decision management, precision agriculture and other areas related to computer science.

Chapter 1
Impact of Working Capital on the Profitability of Companies in the Tourism Sector in Ecuador

Reinaldo Armas Herrera and Angel Higuerey Gómez

Abstract This article studies the relationship between profitability and working capital components in the Ecuadorian tourism industry in the period 2014–2019 in the lodging sector (hotels) and in the food and beverages sector (restaurants). Both sectors were analyzed separately to test whether the components of working capital had influence on the return on assets (ROA). In the case of hotels, there was no influence of the components, but in the case of restaurants, the average inventory period and the average payment period have a negative influence on ROA. If all companies are analyzed without differentiating their activity, these variables have a negative impact on ROA.

1.1 Introduction

Working capital management is a key element in the operation of companies. CFOs spend considerable time managing working capital. Too much working capital is unprofitable, but with too little the firm does not work properly [1].

The relationship between profitability and working capital management has been studied by multiple authors such as [2] or [3], among others. However, from the literature review, it is not so clear whether the impact of working capital variables is positive or negative on profitability. Positive impacts have been found by [4], while negative effects have been analyzed in [5] or [6].

R. A. Herrera (✉) · A. H. Gómez
Departamento de Ciencias Empresariales, Facultad de Ciencias Económicas Y Empresariales, Universidad Técnica Particular de Loja, 110150 Loja, Ecuador
e-mail: ahreinaldo@utpl.edu.ec

A. H. Gómez
e-mail: aahigurey@utpl.edu.ec

A. H. Gómez
Instituto Experimental de Investigaciones Humanísticas, Económicas Y Sociales (IEXIHES), Universidad de Los Andes, Trujillo 3150, Venezuela

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Another issue is the functional form of the equation relating profitability to working capital components. For example, [2] assume that there is a linear relationship between ROA and working capital components, while [7] or [8] assume that there is a nonlinear relationship.

There are some articles that study the relationship between profitability and working capital in the tourism sector such as [9], who find a negative relationship between profitability and some components of working capital, or [10], where there is a concave relationship between working capital and profitability of restaurants in the USA.

The objective of this paper is to visualize the impact of working capital and cash conversion cycle elements on the return on assets (ROA) of Ecuadorian hotels and restaurants in the period 2014–2019.

1.2 Materials and Methods

The data were obtained from the Superintendencia de Compañías, Valores y Seguros (SUPERCIAS) of Ecuador for the period 2014–2019. Before being used, the data were cleaned with certain selection criteria due to the great heterogeneity present in the data. For the average collection period (PMC), payment (PMP) and inventory (PMI), a range between 0 and 365 days was established, which implies that they have made operations in a calendar year. In addition, the companies have a range of variation in the dependent variable (ROA) of plus or minus 200%. This restriction is because many companies present very large results with respect to their assets because they are service activities that use few assets.

The theoretical references for the variables are [11] and [12]. The dependent variable is ROA, which is defined as net income divided by the company's total assets. As independent variables are the average collection period (PMC), it is defined as accounts receivable divided by sales and by 365. The average payment period (PMP) is defined as accounts payable divided by cost of sales by 365. The average inventory period (PMI) is defined as the ratio of inventories to cost of sales per 365. The cash conversion cycle (CC) is PMI plus PMC minus PMP.

The control variables include size, as the logarithm of total assets, and region, which takes the value of 1 (Costa), 2 (Sierra), 3 (Amazonia) and 4 (Galapagos). Macroeconomic variables are Growth Domestic Product (GDP), which is the annual GDP variation rate, and Consumer Price Index (CPI), which is the annual inflation variation rate. In addition, the risk variable is added, calculated from Altman's Z [13].

The econometric models are as follows:

$$\begin{aligned} \mathrm{ROA}_{it} = {} & \beta_0 + \beta_1 \mathrm{PMI}_{it} + \beta_2 \mathrm{Size}_{it} + \beta_3 \mathrm{Region}_{it} + \beta_4 \mathrm{Risk}_{it} + \beta_5 \mathrm{GDP}_t \\ & + \beta_6 \mathrm{IPC}_t + \eta_i + \varepsilon_{it} \end{aligned} \tag{1.1}$$

$$\begin{aligned} \text{ROA}_{it} = {} & \beta_0 + \beta_1 \text{PMC}_{it} + \beta_2 \text{Size}_{it} + \beta_3 \text{Region}_{it} + \beta_4 \text{Risk}_{it} + \beta_5 \text{GDP}_t \\ & + \beta_6 \text{IPC}_t + \eta_i + \varepsilon_{it} \end{aligned} \tag{1.2}$$

$$\begin{aligned} \text{ROA}_{it} = {} & \beta_0 + \beta_1 \text{PMP}_{it} + \beta_2 \text{Size}_{it} + \beta_3 \text{Region}_{it} + \beta_4 \text{Risk}_{it} + \beta_5 \text{GDP}_t \\ & + \beta_6 \text{IPC}_t + \eta_i + \varepsilon_{it} \end{aligned} \tag{1.3}$$

$$\begin{aligned} \text{ROA}_{it} = {} & \beta_0 + \beta_1 \text{CC}_{it} + \beta_2 \text{Size}_{it} + \beta_3 \text{Region}_{it} + \beta_4 \text{Risk}_{it} + \beta_5 \text{GDP}_t \\ & + \beta_6 \text{IPC}_t + \eta_i + \varepsilon_{it} \end{aligned} \tag{1.4}$$

where i is the company, t is the time, η_i is the unobserved heterogeneity, and ε_{it} is the error term. These equations are used for both the hotel and restaurant sectors. The assumptions are as follows:

- H_1: PMI is related to ROA in Ecuadorian tourism companies in the period 2014–2019.
- H_2: The PMC is related to ROA in Ecuadorian tourism companies in the period 2014–2019.
- H_3: The PMP is related to ROA in Ecuadorian tourism companies in the 2014–2019 period.
- H_4: CC is related to ROA in Ecuadorian tourism companies in the period 2014–2019.

This article used a random effects panel data methodology since the nature of the variables and the data make it the most appropriate. Random panel data is used when the unobserved heterogeneity is not correlated with the explanatory variables of the regression model. Then the unobserved heterogeneity is part of the error term in the regression equation [14]. A robust estimation is performed to mitigate problems of heteroscedasticity and autocorrelation.

1.3 Results

Table 1.1 shows the descriptive statistics of the selected variables. The companies have a positive average ROA, which indicates that the sector is profitable but not for all companies. The PMI, PMC and PMP have positive averages, highlighting that the PMP is higher, which implies that the cash conversion cycle on average is negative. This negative value implies that companies collect before paying, so there should be no financial problems.

Table 1.2 shows the correlation matrix between the variables appearing in the regression equation. There are no correlations exceeding 0.8, which indicates that there are no problems of multicollinearity between the variables.

Table 1.1 Descriptive statistics of the variables

	Obs	Mean	Std. Dev.	Min	Max
ROA	1605	0.0458241	0.1123872	−0.7724317	0.8526346
PMC	1605	20.54523	37.08043	0	346.926
PMI	1605	19.87182	38.39325	0	336.8915
PMP	1605	44.38312	56.44921	0	364.2592
CC	1605	−3.966069	68.06138	−364.2592	394.044
Size	1605	12.93541	1.732332	6.653727	17.71092
Risk	1605	6.519364	50.22807	−6.548068	1852.262
Region	1605	1.682243	0.5844749	1	4
GDP	1605	0.5167772	1.221275	−1.226384	2.368387
IPC	1605	0.9	1.323031	−0.2	3.38

Table 1.3 analyzes the regression equations in the lodging sector. From the analysis of the results obtained, it can be inferred that none of the hypotheses is fulfilled, which implies that ROA does not depend on PMI, PMC or PMP. Control variables as size, GDP and IPC are significant in the models.

Table 1.4 visualizes the econometric results when the companies are restaurants. In this case, there is a negative impact of PMI on ROA, H_1 is not rejected, PMC does not influence ROA, H_2 is rejected, PMP has a negative influence, H_3 is not rejected, and CC does not impact on ROA, H_4 is rejected. In this model, the explanatory variables GDP and CPI are significant, but size is not. This may be because in the case of service companies, size does not have an impact on their operability in terms of working capital.

Table 1.5 shows the regression for companies in the tourism sector without considering whether they are hotels or restaurants. In this case, PMI and PMP have a negative impact on ROA, so hypotheses 1 and 3 are not rejected, while hypotheses 2 and 4 are rejected. In this model, the size of the organizations and GDP as well as CPI are significant in the model. However, regions are not significant in this model.

1.4 Discussion

There are few articles on working capital and profitability focused on the tourism sector and fewer in Latin America and Ecuador. From the results obtained, it is determined that the ROA of hotels is not influenced by the components of working capital, while restaurants see their ROA negatively influenced in the case of PMI and PMP. If we analyze the tourism sector, it is determined that PMI and PMP have a negative influence on the return on assets of tourism companies.

These results are congruent with [9], as there are some components of working capital that negatively impact profitability in the tourism sector. Reference [10]

Table 1.2 Correlation matrix

	ROA	PMC	PMP	PMI	CC	Size	Region	Risk	GDP	IPC
ROA	1									
PMC	−0.0295	1								
PMP	−0.1241	0.1292	1							
PMI	−0.0330	−0.0557	0.1614	1						
CC	0.0682	0.4061	−0.6675	0.3999	1					
Size	−0.0687	0.1745	0.1328	−0.0109	−0.0212	1				
Region	−0.0084	−0.0047	−0.0031	−0.0161	−0.0091	0.0771	1			
Risk	0.0029	−0.0254	−0.0531	−0.0204	0.0187	−0.0826	0.0371	1		
GDP	0.0212	0.0159	−0.0222	−0.0092	0.0219	0.0231	0.0001	−0.0178	1	
IPC	0.0934	0.0141	0.0015	0.0037	0.0086	−0.0359	−0.0006	0.0007	−0.4329|	1

Table 1.3 Results of econometric models applied to the lodging activities services

	(1)	(2)	(3)	(4)
	ecuation1	ecuation2	ecuation3	ecuation4
VARIABLES	ROA	ROA	ROA	ROA
PMI	3.42e-05			
	(0.000107)			
Size	−0.00685*	−0.00700*	−0.00655*	−0.00670*
	(0.00392)	(0.00392)	(0.00395)	(0.00396)
2.Region	0.0119	0.0127	0.0121	0.0121
	(0.0119)	(0.0122)	(0.0119)	(0.0118)
3.Region	0.0750	0.0736	0.0741	0.0735
	(0.0517)	(0.0504)	(0.0520)	(0.0508)
4.Region	0.0544**	0.0550**	0.0527**	0.0537**
	(0.0265)	(0.0269)	(0.0269)	(0.0266)
Risk	7.80e-05	7.36e-05	7.23e-05	7.83e-05
	(9.75e-05)	(9.67e-05)	(9.60e-05)	(9.49e-05)
GDP	0.00627**	0.00619***	0.00618**	0.00610**
	(0.00247)	(0.00239)	(0.00249)	(0.00242)
IPC	0.00834***	0.00828***	0.00833***	0.00830***
	(0.00216)	(0.00213)	(0.00215)	(0.00216)
PMC		5.84e-05		
		(9.45e-05)		
PMP			−4.11e-05	
			(4.29e-05)	
CC				5.82e-05
				(4.34e-05)
Constant	0.0961*	0.0970*	0.0943*	0.0948*
	(0.0549)	(0.0548)	(0.0548)	(0.0551)
Observations	734	734	734	734
Number of companies	147	147	147	147

Robust standard errors in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

indicates that this relationship is concave, which is subject of an expansion of this article.

Negative PMP is a result that is usually very common in the working capital literature and its impact on profitability; in the case of Ecuadorian companies, it has been diagnosed by [2] in the construction sector.

Table 1.4 Results of econometric models applied to food and beverage services

	(1)	(2)	(3)	(4)
	ecuacion1	ecuacion2	ecuacion3	ecuacion4
VARIABLES	ROA	ROA	ROA	ROA
PMI	−0.000329**			
	(0.000138)			
Size	0.00169	0.00245	0.00346	0.00198
	(0.00365)	(0.00365)	(0.00371)	(0.00368)
2.Region	−0.0358**	−0.0343**	−0.0324**	−0.0346**
	(0.0140)	(0.0141)	(0.0138)	(0.0140)
3.Region	0.0383	0.0424	0.0388	0.0427
	(0.102)	(0.100)	(0.102)	(0.0999)
4.Region	−0.0538***	−0.0443***	−0.0530***	−0.0463***
	(0.0118)	(0.0110)	(0.0114)	(0.0110)
Risk	1.30e-06	3.26e-06	−3.45e-06	3.26e-06
	(1.61e-05)	(1.56e-05)	(1.63e-05)	(1.61e-05)
GDP	0.00739***	0.00756***	0.00729***	0.00748***
	(0.00211)	(0.00212)	(0.00212)	(0.00211)
IPC	0.0126***	0.0126***	0.0124***	0.0125***
	(0.00364)	(0.00367)	(0.00367)	(0.00368)
PMC		−0.000109		
		(0.000121)		
PMP			−0.000248***	
			(7.86e-05)	
CC				2.94e-05
				(6.03e-05)
Constant	0.0577	0.0418	0.0380	0.0462
	(0.0457)	(0.0454)	(0.0457)	(0.0459)
Observations	860	860	860	860
Number of companies	172	172	172	172

Robust standard errors in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

1.5 Conclusion

In this article, tourism companies, both hotels and restaurants, have been studied with regard to the impact of working capital on profitability in the period 2014–2019. Regarding hotels, profitability (ROA) is not affected by working capital components, while in the case of restaurants ROA is negatively affected by PMI and PMP. If the

Table 1.5 Results of the econometric models in the tourism sector

	(1)	(2)	(3)	(4)
	ecuacion1	ecuacion2	ecuacion3	ecuacion4
VARIABLES	ROA	ROA	ROA	ROA
PMI	−0.000181**			
	(9.00e-05)			
Size	−0.00470*	−0.00466*	−0.00401	−0.00467*
	(0.00264)	(0.00262)	(0.00264)	(0.00265)
2.Region	−0.00901	−0.00949	−0.00881	−0.00928
	(0.00976)	(0.00977)	(0.00965)	(0.00975)
3.Region	0.0542	0.0568	0.0549	0.0562
	(0.0528)	(0.0524)	(0.0530)	(0.0521)
4.Region	0.0110	0.0136	0.00971	0.0134
	(0.0232)	(0.0228)	(0.0231)	(0.0228)
Risk	3.16e-06	6.03e-06	2.45e-06	5.82e-06
	(1.68e-05)	(1.65e-05)	(1.64e-05)	(1.66e-05)
GDP	0.00673***	0.00680***	0.00662***	0.00672***
	(0.00160)	(0.00158)	(0.00160)	(0.00159)
IPC	0.0103***	0.0103***	0.0103***	0.0103***
	(0.00220)	(0.00220)	(0.00221)	(0.00221)
PMC		−1.75e-05		
		(7.70e-05)		
PMP			−0.000127***	
			(4.31e-05)	
CC				3.88e-05
				(3.58e-05)
Constant	0.102***	0.0986***	0.0953***	0.0985***
	(0.0351)	(0.0346)	(0.0348)	(0.0350)
Observations	1604	1604	1604	1604
Number of companies	321	321	321	321

Robust standard errors in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

analysis is performed globally on companies in the tourism sector, these variables have a negative impact on profitability.

Not using data from 2020 that will incorporate the influence of COVID is an important limitation. However, at the date of writing this article, these data are not available on the SUPERCIAS Web site. The fact that there is a negative impact implies that tourism businessmen should optimize these variables for companies to improve their return on assets. As a future line of research, the presence of nonlinear working

capital ratios can be analyzed and how it impacts both ROA and ROE (shareholder's profitability).

Based on the results, tourism managers should ensure that the investments in working capital are the most appropriate to reduce their risk while maximizing their profitability through efficient management. Those companies located in the less favored regions should improve the management of their inventory accounts, accounts receivable and working capital, taking into consideration that their turnover is low.

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Chapter 2
Seasonal Autoregressive Integrated Moving Average Time Series Model for Tourism Demand: The Case of Sal Island, Cape Verde

Gilberto A. Neves, Catarina S. Nunes, and Paula Odete Fernandes

Abstract This article appears as an essential contribution for decision-makers in the Cape Verdean tourism sector given the impact that the number of overnight stays has on the economy of the country and the Sal Island, which until 2018 had been increasing every year. Since seasonality is a strong feature of the island's tourism, decision-makers are interested in knowing the seasonal variation in tourism demand. Thus, this study focussed on the application of the Box-Jenkins method to the time series of the monthly number of nights stays in tourist establishments on the Sal Island, Cape Verde, over the period from January 2000 to December 2018, to find a model that better describes the series and with good forecast results for the year 2019. Several SARIMA models were studied using the Box-Jenkins method, with the SARIMA$(1, 1, 1)(0, 1, 1)_{12}$ and the SARIMA$(2, 1, 0)(0, 1, 1)_{12}$ demonstrating the best predictive performance in the test phase. However, in forecasting the series for the year 2019, the SARIMA$(2, 1, 0)(0, 1, 1)_{12}$ achieved the best results with a MAPE $= 6.77\%$. This model can be used to simulate and analyze the number of overnight stays that be expected on the Island, if the tourism sector was not affected by the pandemic caused by COVID-19.

G. A. Neves
Universidade Aberta, Rua do Amial 762, 4200-055 Porto, Portugal
e-mail: 1402186@estudante.uab.pt

C. S. Nunes
Departamento de Ciências E Tecnologia, Universidade Aberta, Rua do Amial 762, 4200-055 Porto, Portugal
e-mail: CatarinaS.Nunes@uab.pt

INEGI/LAETA, Porto, Portugal

P. O. Fernandes (✉)
UNIAG, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
e-mail: pof@ipb.pt

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2.1 Introduction

The term tourist describes any person who travels to a place different from their usual environment for less than twelve consecutive months and whose main purpose of the trip is any activity within the destination, as long as it is not paid, thus generating the so-called tourism demand [1]. Different factors influence tourism demand, namely economic, social, technological and political factors that take place in the 'tourism destination'. This demand has been the focus of many studies considering its analysis and forecast accompanying the growth of this sector. To get an idea, 420 studies were published from 1960 to 2002, many of them on the modelling and forecasting of tourism demand [2]. From simple to more complex approaches, time series methods are one of those that have marked this field of research since the 1980s. Models based on dynamic regressions have also started to become popular. Several reviews show the advances in tourism demand modelling from 1960 to 2018 [2–6].

Most of the studies reviewed used time series models, a total of 202 in which 34% used the Box-Jenkins methods [5]. Of the 211 studies published the majority (55.9%) used time series models, of which 60% were ARIMA models [3]. However, seasonal versions of the ARIMA models and specifically the SARIMA were used in several studies, according to [5], revealing a good performance and increasing its application. The SARIMA's popularity is because many decision-makers are interested in knowing the seasonal variation of tourism demand [2].

In this research, it will be applied the Box-Jenkins method to analyze the time series of the number of monthly overnights stays in tourist establishments on Sal Island, from January 2000 to December 2018, to identify the model that adjusts to the data and presents a better prediction performance. A brief review of the tourism demand concept will be presented; a brief description of the state of tourism on the Island; the concept of seasonality as well as the SARIMA model; and finally, the conclusions summarizing the study.

2.2 Tourism Demand

Tourism demand can be split between those who travel (effective demand) and those who do not (latent demand) to a specific destination and focusses on three fundamental aspects: the existence of a destination, the availability of goods and services and the price to be paid throughout the tourism process. It can be understood or expressed as follows: the number of visitors travelling to a specific destination, far from their place of residence or work, by the number of goods and services they consume at a specific price that they are willing to pay during their stay and in a given period of time [7–11]. More details are in Ref. [12].

For this study, the number of overnight stays will be used. The monthly series of overnight stays in accommodation establishments is considered a significant indicator of tourism activity, since it provides information about the number of visitors that have

taken advantage of tourism facilities [13]. The registration of the number of monthly overnights stays from visitors in accommodation establishments on the Sal Island is recorded in two ways: (i) for accommodation establishments that have computer support, the National Statistics Institute of Cape Verde (INE) sends a digital form to fill in the data on the movement of guests; (ii) for accommodation establishments without computer support, a paper sheet is sent to them. Once the forms are filled in, they are sent to INE, which is responsible for processing and disseminating the data.

2.3 Overview of Tourism in the Sal Island

The overview of tourism in Sal Island can be consulted in [12]. In the current research, it was added the facts that in the period between 2000 and 2018, investments in sports infrastructures, combined with hotel infrastructures and the excellent natural conditions of the Sal Island, contributed to the realization of several important events at an international level. Some of the events that mobilized foreign and national visitors were Kite-Surf World Tour (2018: February); finals of the national championships in 2018 (Handball—May/June, Basketball—July, Karate—September, Athletics—June/July, Boxing—August, Chess—March). In addition, the opening of new internationally renowned hotels also increased the number of visitors, such as the Hilton Hotel (2017: October; 2018: January), Riu Funaná (2006: October) renewed for Club-Hotel Riu Funaná (2016), Riu Garopa (2011) renewed for Riu Palace Cape Verde (2016: March), Meliá Lana (2016: December), Meliá Tortuga (2011: May), Meliá Dunas (2014: November), Tui Sensimar (2016: December). At the same time, some cultural events were held, such as the World of Literature (2017 and 2018) and the Santa Maria Festival (2000–2018), which also boosted the movement and increased the number of visitors on the island [14, 15].

2.4 Methodology

2.4.1 Seasonality of the Time Series

The seasonality of a time series can be deterministic (the seasonal pattern is regular and stable) or stochastic (the seasonal pattern varies with time) [16]. The deterministic approach is the most considered in traditional forecasting methods in the tourist context, but more recent methods already suggest stochastic seasonality in the modelling of tourism demand forecasting, especially the Box-Jenkins method and its SARIMA model [17].

In the tourism context, seasonality can be considered as any systematic ups and downs over time in specific tourism activities, including tourist overnight stays [18, 19]. A permanent feature of seasonality is the sudden change in demand in a given

period of the year [20]. Also points out two important causes of seasonality in tourism, namely natural causes, as a result of regular variations in climatic conditions, and institutional causes, as a result of human decisions in a combination of different factors [19]. In addition, there are different areas of impact such as economic, socio-cultural and ecological [21].

2.4.2 The SARIMA Model

The SARIMA model is an extension of the ARIMA model, known as a Box-Jenkins methodology, which integrates autoregressive (AR) and moving average (MA) models [22]. SARIMA, known as seasonal ARIMA, incorporates non-seasonal and seasonal factors into a multiplicative model in the form of $(p, d, q) \times (P, D, Q)_s$, where p is the non-seasonal autoregressive order; d is the non-seasonal differentiation; q is the order of the non-seasonal moving average; P is the seasonal autoregressive order; D is the seasonal differentiation; Q is the order of the seasonal moving average; and s is the seasonal pattern repeat time interval. According to [23] for a monthly time series, $s = 12$. This model is popular because of its ability to handle both stationary and non-stationary series. In the case of non-stationary time series, the variable values are taken as the first differences of the original data to estimate the model. Formally, a time series $\{X_t\}$ is said to follow the SARIMA model if defined as [24]:

$$\Phi\left(B^s\right)\Phi(B)\left(1-B^s\right)^D(1-B)^d X_t = \Theta\left(B^s\right)\Theta(B)e_t, t \in T \tag{2.1}$$

where

$\Phi(B) = 1-\phi_1 B-\phi_2 B^2-\ldots-\phi_p B^p$ is the non-seasonal autoregressive operator;
$\Phi(B^s) = 1-\Phi_1 B-\Phi_2 B^2-\ldots-\Phi_P B^P$ is the seasonal autoregressive operator;
$\Theta(B) = 1+\theta_1 B+\theta_2 B^2+\ldots+\theta_q B^q$ is the non-seasonal moving average operator;
$\Theta(B^s) = 1+\Theta_1 B+\Theta_2 B^2+\ldots+\Theta_Q B^Q$ is the seasonal moving average operator;

$(1-B^s)^D(1-B)^d$ is the seasonal differentiation of order d and non-seasonal differentiation of order D; X_t is the value of the series observed at a given time t.

2.4.3 Autocorrelation

The sample autocorrelation function (ACF) of X_t is generally used to determine whether or not the time series is stationary. A stationary time series will cause the autocorrelation to drop to zero quickly, but for a non-stationary time series, it will drop slowly. The ACF has a greater effect on the stationary series and is given by expression (2.2), considering the pairs of values $(x_1, x_2), \ldots, (x_{n-1}, x_n)$, thus obtaining the correlation between x_t and x_{t+1} [25]:

$$r_1 = \frac{\sum_{t=1}^{n-1}(x_t - \bar{x}_1)(x_{t+1} - \bar{x}_2)}{\sqrt{\sum_{t=1}^{n-1}(x_t - \bar{x}_1)^2 \sum_{t=1}^{n-1}(x_{t+1} - \bar{x}_2)^2}} \tag{2.2}$$

where the sample means are given by

$$\bar{x}_1 = \sum_{t=1}^{n-1} x_t/(n-1) \text{ and } \bar{x}_2 = \sum_{t=2}^{n-1} x_t/(n-1) \tag{2.3}$$

The partial autocorrelation function (PACF) is the correlation of the time series with a delay of itself, removing the linear dependence between lags. It is defined by the correlation between the variables X_t and X_{t+k} without any influence of the intermediate variables $X_{t+k}, \ldots, X_{t+k-1}$ and is given by Eq. (2.4).

$$\rho(k,k) = \frac{\text{Cov}(X_t, X_{t+k}|X_{t+1}, \ldots, X_{t+k-1})}{\sqrt{Var(X_t|X_{t+1}, \ldots, X_{t+k-1})}\sqrt{\text{Var}(X_{t+k}|X_{t+1}, \ldots, X_{t+k-1})}} \tag{2.4}$$

The correlogram is a graph that represents the ACF and PACF functions and presents the k first autocorrelation coefficients as a function of k [23]. It allows identifying some characteristics of the time series, such as randomness, stationarity and seasonality. In case of randomness, it is expected that $r_k = 0$. Dashed horizontal lines usually indicate the lower and upper limits calculated for a given confidence level; for example, 95% confidence limits are defined by $\pm 2/\sqrt{n}$ [23]. Thus, all ACF or PACF values in each k that are outside the limits are considered non-zero, and those that are inside are considered null. The ACF interpretation is also useful in identifying the parameters of the non-seasonal orders p, d, q and the seasonal orders P, D, Q.

2.4.4 Stationarity Analysis

The stationarity of a time series pertains to the following assumption '[…] it develops in time randomly around a constant mean, reflecting some form of stable equilibrium' [22, p. 4]. Chatfield states that most time series are stochastic [26], but Morettin and Toloi [27] state that series are stationary if, at different phases, maintain the same mean, variance and autocovariance. The temporal behaviour can be analyzed graphically, taking into account the data variation over time around a horizontal line. If non-stationarity is verified, the integration order (the number of necessary differences) is used to transform the series. This consists of taking, generally, one (ΔX_t), two ($\Delta^2 X_t$) or $\Delta^d X_t$ successive differences from the original series until obtaining a stationary series. The 1st difference is made if the series is growing at a constant rate, and the 2nd difference is used if the series is growing at a decreasing rate

[16]. Quoting [28], in the case of the seasonal model, SARIMA, the first difference is given by Eq. (2.5).

$$\Delta_s X_t = X_t - X_{t-s} \tag{2.5}$$

However, this technique has its disadvantage, because data could be lost, that is, when we apply, for example, differentiation in a monthly series of size n whose seasonal component is of period s, we will have a series of seasonal differences of size $n - s$ [23].

2.5 Results

In this section, the time series monthly number of overnight stays in accommodation establishments on Sal Island, between 2000:01 and 2018:12, is analyzed (Fig. 2.1). The R software version 4.0.5 packages, functions and commands, are used in this research. Initially, a graph of the series under study is made; trend and seasonality removed; identified the parameters of non-seasonal order p, d, q and the seasonal order P, D, Q; temporary seasonal models identified and their parameters estimated; the diagnosis of the models was carried out, and the best model was chosen based on the Akaike information criteria (AIC) and training and testing error (MAPE-mean absolute percentage error).

When analyzing the behaviour of the series, a growing trend is observed (confirmed by the Cox-Stuart test with a p-value = 2.2e-16 < 0.05) as well as the presence of seasonality (confirmed by the Webel-Ollech test with a p-value < 0.001 < 0.05). It is visible how the variance grows over time. Such a trend leads to the specification of a non-stationary model. This non-stationarity was observed in the simple

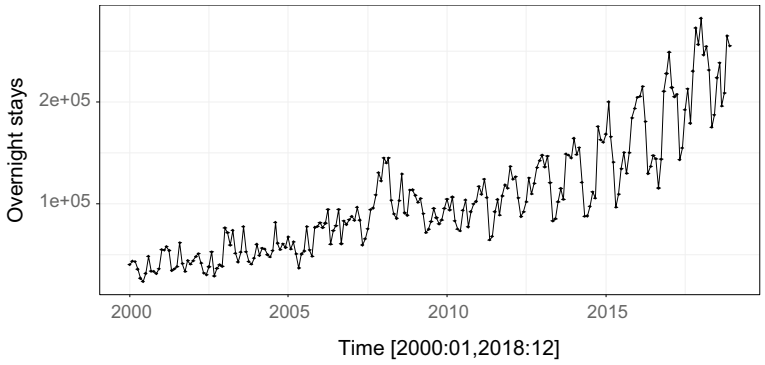

Fig. 2.1 Number of monthly overnight stays in accommodation establishments on Sal Island [2000:01–2018:12]. *Source:* Own elaboration with data provided by INE Cape Verde

correlogram of the series and confirmed with the application of the Dickey-Fuller unit root test with p-value $= 0.05773 > 0.05$.

To stabilize the variation, the series was transformed using the logarithm $\Delta \log(X_t)$. As part of the modelling, 90% of the series data were taken for training and 10% for testing (2000:01–2017:12 and 2018:01–2018:12). The trend was removed by applying the first simple difference from the *log* series. The Dickey-Fuller test was also used, obtaining a p-value $= 0.01 < 0.05$, confirming that the series became stationary with this first non-seasonal difference. Then, with the *nsdiffs()* function, it was determined how many seasonal differences would be needed (in this case one), resulting in the correlogram in Fig. 2.2 which confirms that very little correlation remains in the series after taking two differences (the simple and the seasonal).

After analyzing the correlogram (Fig. 2.2), three models were considered (Table 2.1). The *auto.arima()* function was used to estimate the model parameters and calculate the Akaike information criterion (AIC) and the second-order Akaike information criterion (AICc).

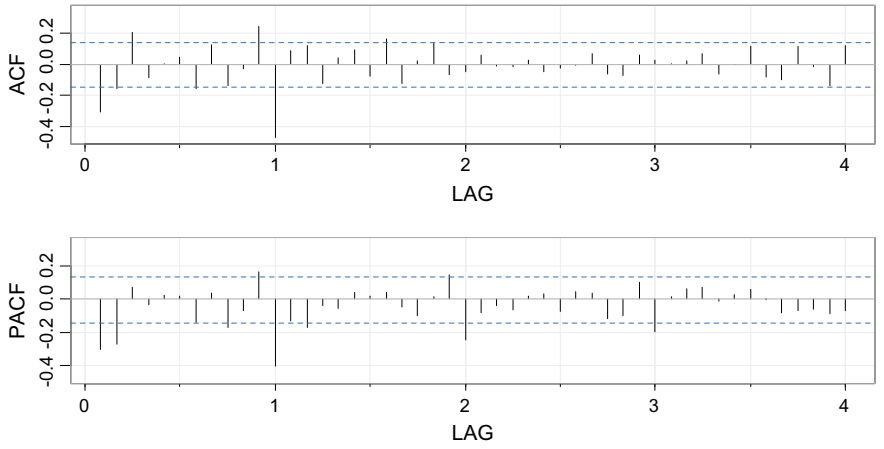

Fig. 2.2 ACF and PACF after the first seasonal difference of the *log* series

Table 2.1 Initial time series models for the monthly overnight stays in tourist establishments on the Sal Island

#	Models	AIC	AICc	MAPE (%) (training data)	MAPE (%) (testing data)
1	SARIMA$(1, 1, 1)(0, 1, 1)_{12}$	−249.59	−249.39	0.794	0.526
2	SARIMA$(2, 1, 0)(0, 1, 1)_{12}$	−249.98	−249.78	0.774	0.578
3	SARIMA$(2, 1, 0)(0, 1, 2)_{12}$	−249.15	−248.85	0.773	0.595