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Analysis of temporal evolution of tourist visits to the Morón de la Frontera region (Spain). Two possible explanatory variables of this evolution

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Abstract

The municipality of Morón de la Frontera located in the province of Seville (Spain) has been promoting tourist visits in recent years, measured through the number of visitors, as another public and private income source. This number, considered at a monthly or annual level, is a good indicator of the tourist evolution of the municipality and, for this reason, in this work, it is chosen as an objective variable, in the sense of trying to explain it from nearby variables. Then, for the said variable, we carry out a TRAMO analysis, reflecting its trend and showing its seasonality. Also, a regression analysis with the objective variable explained by the time series measures the number of monthly visitors to the province of Seville, resulting in a positive and significant correlation of 0.4914 between both series. And, finally, a regression analysis where the objective variable, this time measured at an annual level, is explained by the GDP of the province of Seville, showing a positive and significant correlation, 0.489.

Keywords: *TRAMO-SEATS, components of a time series, Morón de la Frontera visitors, Seville visitors, Seville GDP*

1. Introduction

The analysis of time series constitutes an efficient and intuitive tool for the study of tourist series, given its ability to predict and, therefore, its usefulness in decision-making by tourism agents, public or private, related to the series data [22]. We intend to use an analysis of this type to study the monthly and annual evolution of a tourist series related to a municipality in the province of Seville, Spain, located about 70 kilometers from the capital of the Province, and whose name is Morón de la Frontera, with a rich historical, cultural and natural heritage, and with a population of 27,844 inhabitants, according to the last census of 2018, published by the Spanish National Institute of Statistics (INE). The municipality is located in a unique region of this area of Andalusia (Spain) which is known as Sevillian southwest Sierra,

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and which stands out for its natural landscapes, its rich historical-artistic heritage, its gastronomy, its mild, Mediterranean climate, and the kindness of its people.

Little by little, the most rural areas of Andalusia are discovering what tourist visits and stays can contribute to their wealth, which is why, in recent years, we observed a clear commitment, on the part of public administrations, to the recovery and revaluation of heritage assets as resources and tourist attractions.

With the data provided by the Morón de la Frontera Tourist Office, with the monthly number of visitors to this city, we find a time series that begins in January 2013 and ends in December 2021, therefore including in the last stretch of this period the months of the COVID-19 pandemic (since April 2021), with the confinement period decreed by the Spanish government in the spring of 2020. Well, this is the objective variable of this work or, in terms of econometrics, the variable to be modeled. We use this monthly time series as a good indicator of the monthly tourist evolution for this municipality. For this reason, we focus our study on this series and try to verify the existence of two possible variables as explanatory variables for it.

Therefore, our objective in this work is an analysis of the series at a monthly level to extract the seasonal component (regular movement of the series within each year) and the estimation of the trend-cycle component (movement of the long-term series). The weight of seasonality in the analysis of time series associated with tourism is well known when the data is less frequent per year. López Bonilla and López Bonilla [13] analyze the seasonality of tourist demand in Andalusia and, in particular, in each of the Andalusian provinces, including Seville. For Rey et al. [19], seasonality is one of the defining characteristics of tourism activity.

To carry out the analysis, we used the methodology based on ARIMA models implemented in the time series regression with ARIMA noise, missing observations, and outliers (TRAMO) and signal extraction in ARIMA time series (SEATS) programs, programs created by Maravall and Gómez [4–8, 17] which, among others, can be found implemented in the Gretl econometric program, version 1.9.4. We compare the analysis with a similar one for the number of visitors to the province of Seville, where the Morón de la Frontera region is located. We assume that the number of visitors to Seville is a significant variable when it comes to explaining the number of visitors to the Morón region. Therefore, a cause-effect regression equation is estimated. Jin et al. [11] used monthly time series data and the TRAMO/SEATS model to detect and estimate the impact of a variety of political, economic, and environmental crisis events on tourist flows from China to Japan and Japan–South Korea during the period 2005–2017. Koc and Altinoy [12] analyze seasonal variations in monthly tourist expenditure per person in Turkish inbound tourism from a market segmentation perspective, using TRAMO-SEATS to analyze seasonal components and decomposition techniques.

Based on the monthly data, we create an annual series of visits to this region to relate them to the gross domestic product of Seville at market prices. Wealth and tourism are increasingly related variables, and many Spanish regions have found tourist visits to be an important source of income. In this case, moreover, the relationship is justified because more than 70% of visitors to Morón de la Frontera come from the province of Seville itself, according to survey data from the Morón de la Frontera Tourist Office. Therefore, in this second section we are interested in analyzing the possible direct correlation between the variation in Seville's provincial GDP and the number of visitors to the Morón de la Frontera region, all with annual data. We estimate, then, a regression where the explanatory variable is the annual GDP of the province of Seville, and, based on it, we try to explain the annual evolution of visitors to the municipality. In other words, we explain a cause–effect relationship, where the cause is the annual GDP of Seville, and the effect – the annual number of visitors to Morón de la Frontera. Manzoor et al [14] investigate the impact of tourism on economic growth and employment in Pakistan, in the period between 1990 and 2015. Sánchez-Rivas et al. [20] analyze the effect of GDP as an influential factor in the arrival of visitors to Andalusia. Guevara [9] studies the impact of tourism on the local economy of Lanzarote. Similarly, Del Corral et al. [3] analyze the effect of tourism on the local economy of a region of Ecuador.

The article has been structured as follows: after the introduction in Section 1, we continue with the methodology used for the analysis of monthly time series, as is the case, in Section 2, and an empirical and graphic analysis of the series that constitutes the objective variable in Section 3, including the estimates of the linear models in the context of autocorrelation. An analysis of the time series objects of our investigation but on an annual basis has been presented in Section 4, and we end with the conclusions in Section 5, and the references.

2. Methodology

TRAMO is a useful program to estimate regression models and thus be able to predict non-stationary temporal processes. The program interpolates missing values, identifies and corrects three types of outliers, and estimates special calendar effects. In addition, it can create and include different regression variables. The three types of outliers that the program detects automatically are the additive (AO), which refers to sudden jumps that occur on a particular date and do not affect subsequent observations, the level change (LS) which refers to sudden jumps that permanently affect the level of the series, and the transient level change (TS), that is, sudden jumps whose effect decays over time. Balke [1] indicates that there may be problems in identifying innovative outliers in the presence of other outliers, which is why they do not recommend the location of this type. The procedure used by the program for the correction and detection of outliers, according to Lorenzo and Revuelta [18], is an improved version of the method proposed by Chen and Liu [2]. As regards calendar effects, TRAMO incorporates three different types of phenomena into its automated procedures: trading days, Easter effect, and leap year.

The prior adjustment methodology is as follows: With the observed data of the time series, the $Y = (Y_1, \ldots, Y_t, \ldots, Y_T)$ vector is constituted where, obviously, $1 < \ldots < t < \ldots < T$. It is assumed that this series satisfies a process of the type:

$$Y_t = X_t^{'}\beta + Z_t \tag{1}$$

where $\beta = (\beta_1, \ldots, \beta_n)^t$ is a vector of regression coefficients, $X_t = (X_{1t}, X_{2t}, \ldots, X_{nt})$ is a vector of deterministic regressors, and Z_t is a stochastic variable that, we assume, follows an ARIMA process, which is what the researcher expects from the series if it were not affected by any of the effects considered deterministic. Therefore, $X_t^{'}\beta$ represents the deterministic part of the model, being the vector of parameters to be estimated and corresponding to the calendar effect, the analysis of the aforementioned outliers, as well as the variables that are built ad hoc.

We describe a generic ARIMA model of order $(p, d, q)(P, D, Q)_s$. It must be fulfilled:

$$\phi(L)\delta(L)Z_t = \theta(L)\varepsilon_{zt} \tag{2}$$

where L is a lag operator, $\phi(L)$, $\delta(L)$, and $\theta(L)$ are finite polynomials in L, and ε_{zt} is a random variable assumed to follow a normal distribution with mean 0 and variance σ_z^2. Of the three polynomials involved we can say:

- The $\delta(L)$ polynomial is associated with the order of integration of the process.
- The $\phi(L)$ polynomial is associated with the autoregressive process.
- The $\theta(L)$ polynomial represents the moving averages.

For these polynomials the following multiplicative specifications are used:

$$\begin{aligned} \delta(L) &= (1 - L)^d(1 - L^s)^D \\ \phi(L) &= (1 + \phi_1 L + \cdots + \phi_p L^p)(1 + \Phi_1 L^s + \ldots + \Phi_p L^{sxP}) \\ \theta(L) &= (1 + \theta_1 L + \cdots + \theta_q L^q)(1 + \Theta_1 L^s + \ldots + \Theta_q L^{sxQ}) \end{aligned} \tag{3}$$

where s indicates the number of observations per year. In all three polynomials, the operators with superscripts s are associated with seasonal factors.

To make inferences about a time series, it is assumed that the series itself is stationary in covariance, which implies, among others, that the series has bounded variance. Therefore, it is necessary to check if this occurs to decide if the model applies to the series at its level, or if some transformation of it is necessary. In the automatic procedure that incorporates a section, the program itself decides between working with the series at its level or with the series under the natural logarithm. To do this, TRAMO divides the original series into subsamples, and estimates for the subsample a regression of the range of the same on its mean. If the mean regression coefficient exceeds a certain value, then TRAMO uses the natural logarithm of the series.

The identification of the ARIMA model is carried out in the sense proposed by Box and Jenkins. Thus, for the model of the residuals, which appears in equation (2), both the order of integration and the orders of the autoregressive polynomials and moving averages are determined. That is, the $\phi(L)$, $\delta(L)$ and $\theta(L)$ polynomials are determined. The estimation of the model parameters, described by equations (1) and (2), is carried out following the iterative process that follows:

Conditional on the β vector, the coefficients of the ARIMA model, from equation (2), are estimated by maximum likelihood. Then, conditioned to the newly estimated ARIMA parameters, we proceed to estimate using the generalized least squares method. The process is iterated until the difference between the estimates, from one iteration to the next, is less than a certain pre-established amount. In practice, the two steps described are carried out using the Kalman filter, an algorithm that allows estimating generalized least squares iteratively [10].

The program provides the value of the estimated coefficients for the ARIMA model, along with their standard errors, as well as information on the complex roots of the model. Also, diagnostics are performed on the regression residuals to determine if the ARIMA model that has been used appropriately describes the time series being analyzed. Descriptive statistics of the residuals are incorporated, as well as diagnoses on normality, bias, and kurtosis of their distribution. Finally, the program calculates autocorrelations and partial autocorrelations, with their respective standard errors, carrying out Box–Ljung type diagnoses.

SEATS is a program that estimates the unobservable components of a time series, following the ARIMA model-based method. With them, the trend cycle, the seasonal component, and the irregular component are estimated and predicted. The authors of the program Gómez and Maravall [7] describe it as follows: *SEATS is a program for the identification of unobserved components in time series following the approach based on ARIMA models. Trend, seasonal, irregular, and cyclical components are estimated and predicted with signal extraction techniques applied to ARIMA models. The standard errors of the estimates and predictions are obtained and the model-based structure is exploited to answer questions of interest in the short-term analysis of the data.*(. . .) *When [the TRAMO and SEATS programs] are used for seasonal adjustment, TRAMO previously adapts the series that is going to be adjusted by SEATS*. The long-term evolution is determined by the trend of the series while the movements of an average period (between 2 and 8 years usually) are usually considered cyclical movements. On the other hand, the movements of the series associated with different periods of the year are attributed to the seasonal component, and the short-term movements without an established pattern are usually considered irregular components. As these components are not observable, to extract them from the observed series, filtering techniques based on the smoothing of the original series are usually used.

The application of centered moving averages of seasonal order can be an adequate filter to obtain the trend-cycle component, in many cases, the optimal weightings of the moving average (the optimal design of the filter) will be different depending on the characteristics of the series in question. One way to make the filter dependent on the characteristics of the original series is to estimate an ARIMA model for each component of the series; Thus, one model is estimated for the trend-cycle component, another for the seasonal component, and another for the irregular component, respectively. Subsequently, the weights of each filter are obtained based on the coefficients of the estimated ARIMA model. This is what the unobserved component-ARIMA (UC-ARIMA) methodology does, which allows obtaining different filter designs for each series depending on the best ARIMA model that fits the observed series. In addition, this methodology also allows predictions to be obtained for each component or signal, which is essential when you want to analyze the economic situation.

The long-term evolution is determined by the trend of the series while the movements of an average period (between 2 and 8 years usually) are usually considered cyclical movements. Normally, in short series, both components are estimated jointly, thus being called the trend-cycle component. On the other hand, the movements of the series associated with different periods of the year are attributed to the seasonal component, and the short-term movements without an established pattern are usually considered as irregular components. As these components are not observable, to extract them from the observed series, filtering techniques based on the smoothing of the original series are usually used.

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The UC-ARIMA methodology is implemented in free software through the TRAMO-SEATS program available, among others, in Gretl, as has already been said. This program allows to automatically obtain the non-observable components from ARIMA models of the original series. The relevance of this modeling is because the ARIMA model can be understood as the expected behavior according to the random structure existing in the observed data, therefore, the deviations observed between the observations themselves and those adjusted according to the ARIMA structure indicate events unrelated to the expected behavior [21]. TRAMO-SEATS builds the linearized series that allows us to compare with the original series and detect the differences between one and the other.

3. Analysis of the monthly series of visitors

Figure 1 shows the monthly evolution of the number of visitors to the place under investigation. We find, as atypical, the data corresponding to April and May 2020, a period of confinement decreed by the Spanish government due to the pandemic explosion caused by COVID-19. In both months the variable takes the value 0.

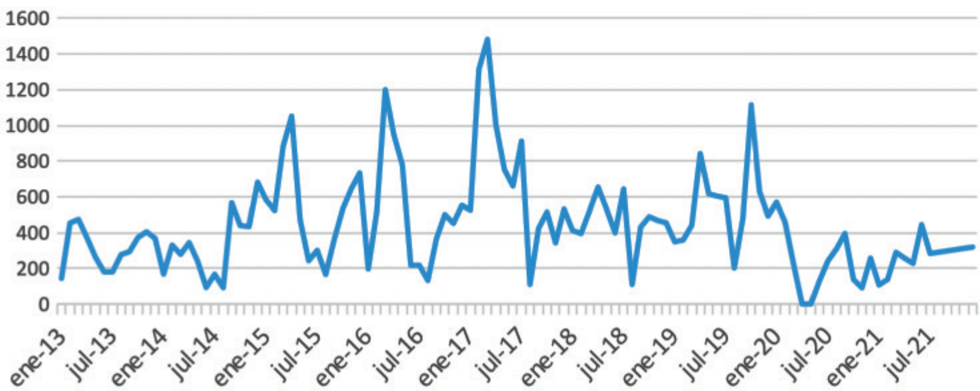

Figure 1. Monthly evolution of the number of visitors to the Morón de la Frontera region (based on the Morón de la Frontera Tourist Office data)

The main statistics of the series are given in Table 1.

Table 1. Main statistics of the variable number of visitors in the period 01.2013–12.2021 of the Morón de la Frontera region

Mean	Median	Minimum	Maximum	Typical deviation
436.76	398.50	0.00000	1482.0	272.36
Coefficient of variation	Asymmetry	5th percentile	95th percentile	Interquartile range
0.62359	1.3081	100.30	1029.9	284.50

Based on the Morón de la Frontera Tourist Office data.

In Figure 2, we show the temporal evolution of the two series: monthly visitors to Morón and monthly visitors to Seville.

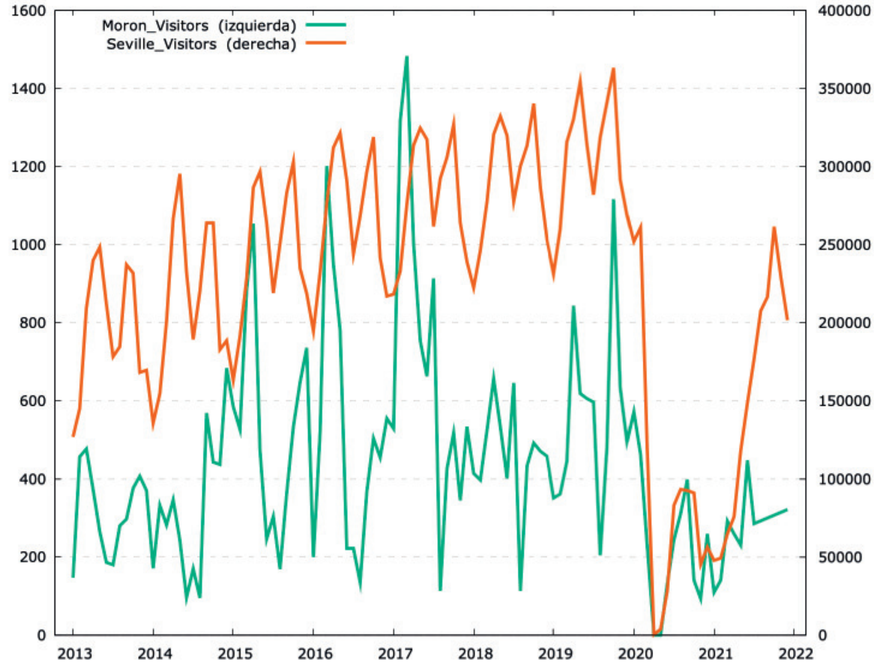

Figure 2. Monthly evolution of the number of visitors to the region of Morón and the province of Seville (based on the Morón de la Frontera Tourist Office data and the Andalusian Institute of Statistics and Cartography)

To identify the possible seasonal component, in Figure 3, we show annual series for both cases during the first 5 years.

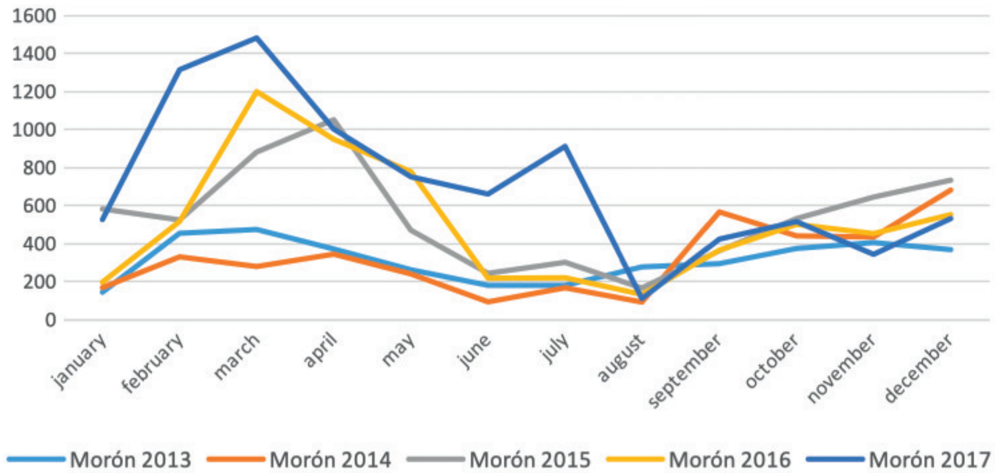

Figure 3. Monthly evolution of the number of visitors to the Morón region at the first four years of the series (based on the Morón de la Frontera Tourist Office data).

The seasonal component is visible in the visits to Seville. We observe two peak periods, in spring and autumn, while in January, and in the more classic months of summer, July and August, there is a decrease in visitors. It coincides with the series observed for the visits to the Morón region (Figures 4, 5).

In Figure 6, the original and linearized data on the monthly series of visitors to Morón de la Frontera based on the TRAMO-SEATS analysis. We have assumed parameter 1 in the AR component (autoregressive of order 1) and, also, 1 in the MA component (moving average of order 1). We observe that the adjustment is almost perfect, except in the central months of 2017, and the last semester of 2020.

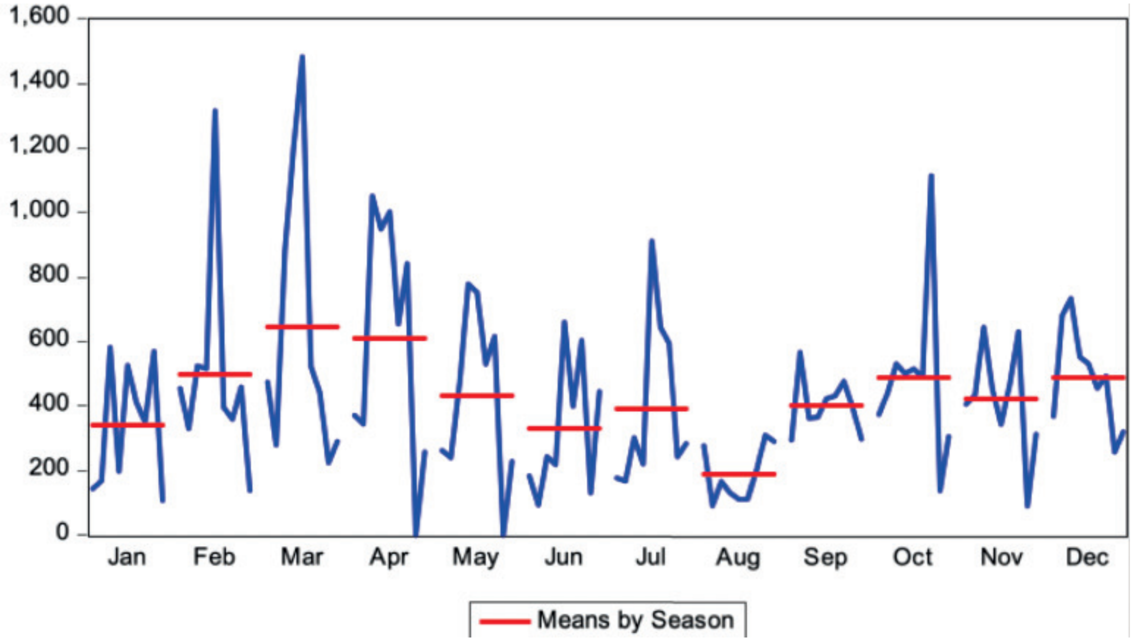

Figure 4. Average numbers of visitors to the Morón de la Frontera region. The lowest levels are observed in the summer months (based on the Morón de la Frontera Tourist Office data)

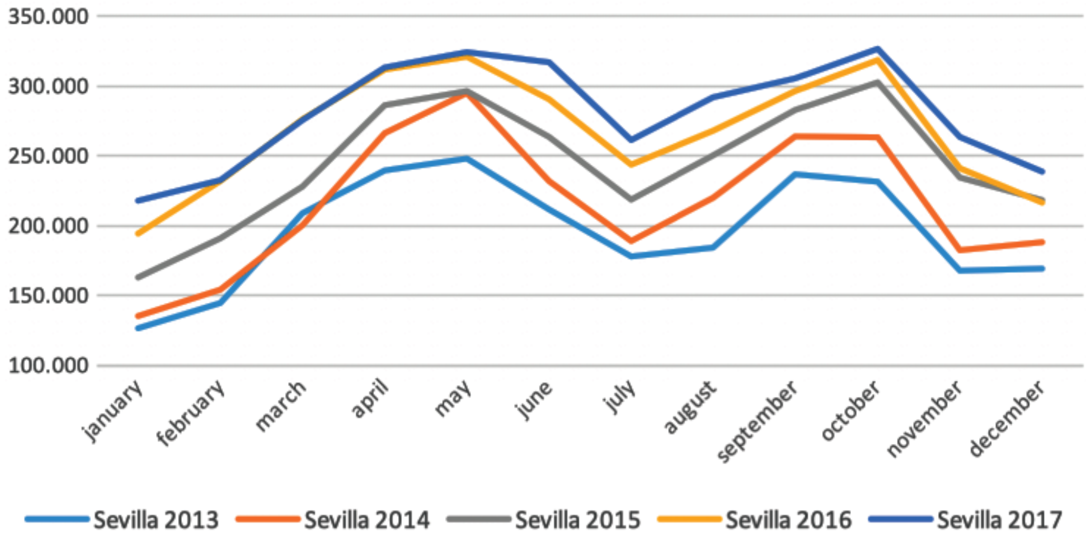

Figure 5. Monthly evolution of the number of visitors to the province of Seville for the first four years of the series (based on data provided by the Institute of Statistics and Cartography of Andalusia)

In Figure 7 we show the original series and the trend-cycle component provided by SEATS. This component shows a growing phase until 2017 and, later, a decreasing phase caused, in part, by the COVID-19 effect, the months of confinement in 2020, and the subsequent restrictive months for travel.

In Figure 8, we present an irregular component of the series of visitors to Morón de la Frontera. It reflects the differences between the observed values and the linearized ones, similarly as in Figure 6.

Next, we show the plots based on the TRAMO-SEATS analysis of the monthly series of visitors from the province of Seville to which the Morón de la Frontera region belongs.

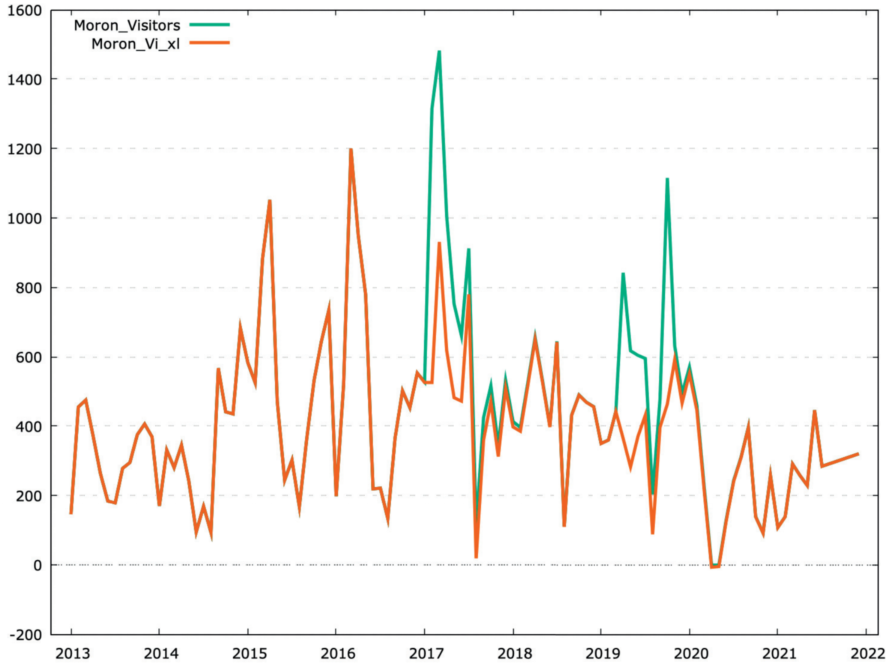

Figure 6. Original and adjusted series according to ARIMA of the monthly visitors to Morón de la Frontera (based on the Morón de la Frontera Tourist Office data)

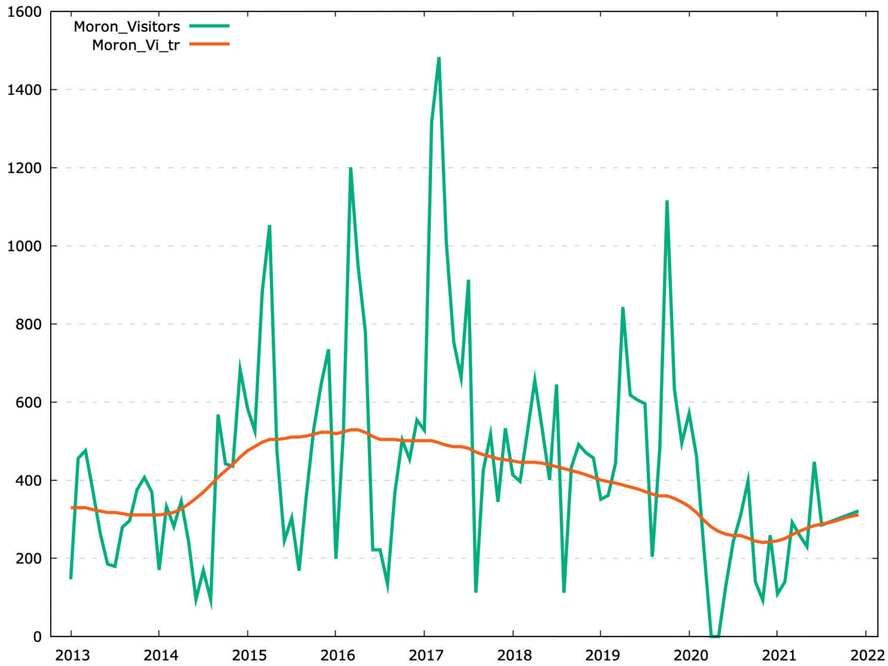

Figure 7. Original series and trend-cycle component of monthly visitors to Morón de la Frontera (based on the Morón de la Frontera Tourist Office data)

In Figure 9, the observed values and those adjusted using ARIMA are shown. We observe an almost perfect fit between both series. The imbalance is caused by the COVID-19 effect, with two months of absolute confinement, and the following with strong restrictions when traveling. In the second half of 2021, we detected a significant recovery but still not reaching the values of the adjusted series.

In Figure 10, we show the original series and the trend-cycle component: a growing trend, with smooth but constant growth from 2013 to 2019, and the subsequent impact of the pandemic, with a new

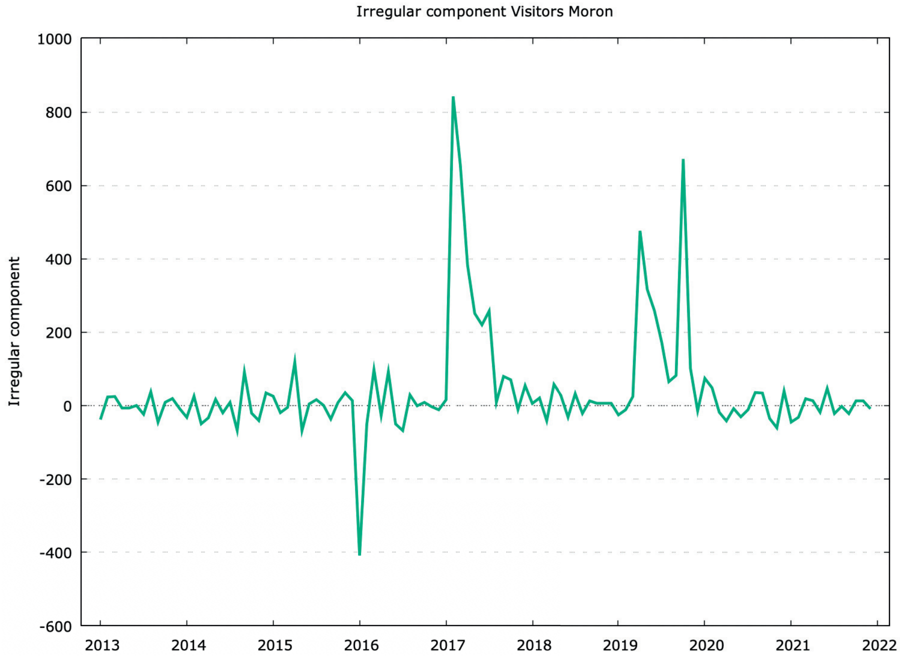

Figure 8. Irregular component of the series of monthly visitors to Morón de la Frontera(based on the Morón de la Frontera Tourist Office data)

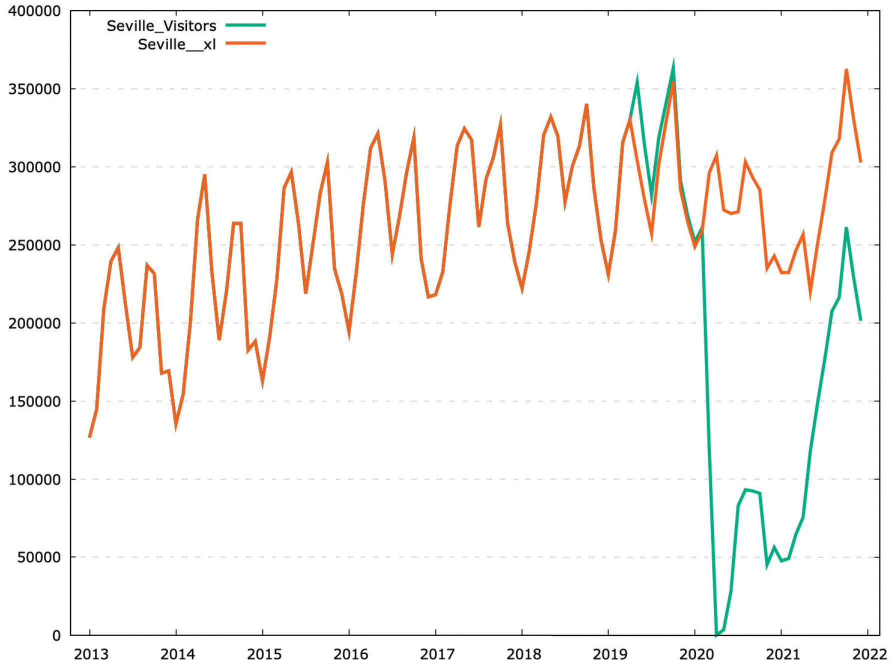

Figure 9. Original series and adjusted series according to ARIMA of the monthly visitors to the province of Seville (based on the data from the Institute of Statistics and Cartography of Andalusia)

growing trend from 2022. Between both series, there is a positive correlation of 0.49143814. And a causal analysis, of the Prais–Winsten type (given the existence of autocorrelation, with $\rho = 0.494508$ and Durbin–Watson statistic $= 1.0109$. The critical values of this statistic, for that sample size and with an explanatory variable, are 1.6676 and 1.7050, so that, according to the Durbin and Watson statistic, we admit the possibility of an autoregressive process of order 1 where we assume that the visits to Morón are an effect of the visits to Seville, which gives us the following estimate (Table 2).

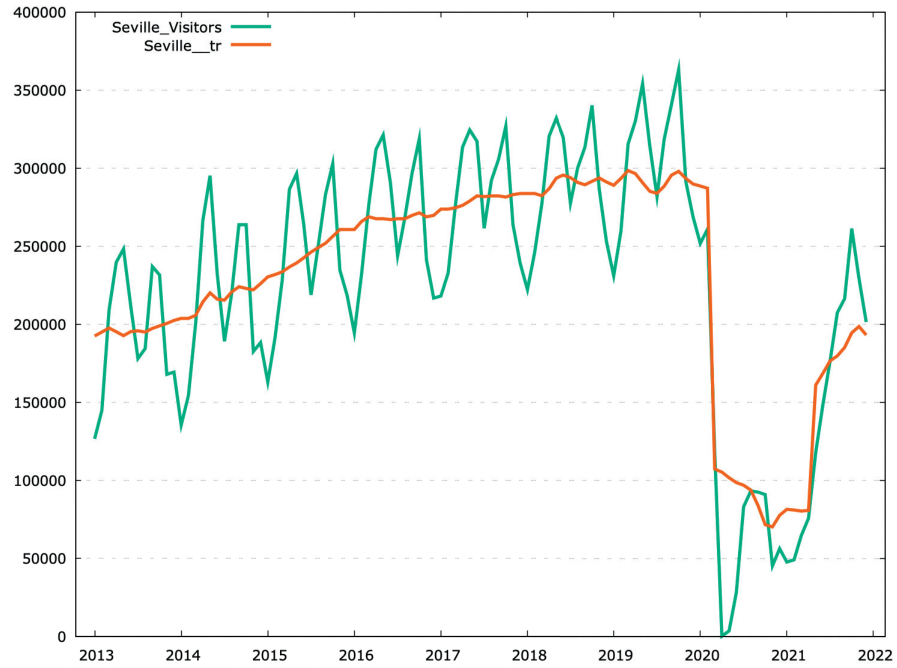

Figure 10. Original series and trend-cycle component of monthly visitors to the province of Seville (based on the data provided by the Institute of Statistics and Cartography of Andalusia)

Table 2. Estimation of the AR(1) model

	Coefficient	Standard error	t-statistic	p-value
Constant	82.3790	97.0074	0.8492	0.3977
Seville visitors	0.00155295	0.000393511	3.946	0.0001
	R-square	0.423906	R-squared corrected	0.418471

Monthly evolution of visitors to Morón explained through the monthly evolution of visitors to Seville.
Based on the Morón de la Frontera Tourist Office data and the Andalusian Institute of Statistics and Cartography.

The estimated slope (significant at 1%) of the model informs us that, for every 1000 visits, that increase to the province of Seville, 1.5 visits will increase to the region of Morón.

Figure 11 shows the observed series and the one adjusted using the Prais–Winsten type regression.

From the development of this section, we highlight the following results:

- The monthly average number of visits is 437, with a wide dispersion of slightly more than 50% ($CV = 0.62359$) due to seasonality. However, the seasonal component of visitors to Seville province is more visible than that of visitors to Morón of the Border.
- The number of visitors to Morón de la Frontera fits quite well with an autoregressive of order 1, $AR(1)$ and a moving average of order 1, $MA(1)$. The fit of the monthly time series using ARIMA (1, 0, 1) is almost perfect, except for the months of COVID confinement.
- The trend of the monthly series of visitors to Morón de la Frontera has a period of growth between 2013 and 2016, and then a slight drop specially at the end of the series studied, years 2020 and 2021, due to the crisis generated by COVID.

- With an estimation of the Prais–Winsten type, an adjustment is achieved with $R^2 = 0.423906$ in which the monthly visitors to Morón de la Frontera are explained through the variable that quantifies the visitors to the province of Seville.

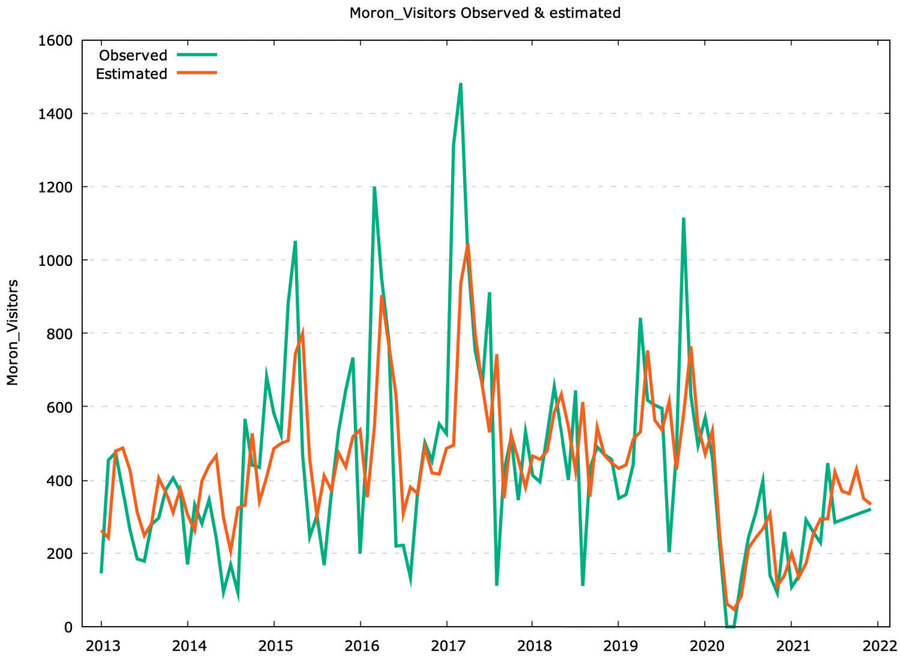

Figure 11. Original series of visitors to Morón and series adjusted by Prais–Winsten using visitors to Seville as an explanatory variable (based on data from the Morón de la Frontera Tourist Office and the Andalusian Institute of Statistics and Cartography)

4. Annual evolution of visitors and GDP

As we do not have data on the Sevillian GDP at a monthly level, we have constructed, by adding, an annual series of visitors to Morón de la Frontera to relate it to the annual series of the Sevillian GDP. The data we handle are given in Table 3.

Table 3. Annual visitors to Morón and GDP at market prices for the province of Seville

Year	Number of visitors	GDP at market prices [1000 €]
2013	3795	35711820.01
2014	3846	35637285.14
2015	5480	37113834.82
2016	5185	37676355.00
2017	5748	39299863.00
2018	5473	40400859.00
2019	5682	41417112.00
2020	2825	37522254.00
2021	3285	39360844.45

Based on the Morón de la Frontera Tourist Office data and the Andalusian Institute of Statistics and Cartography.

The two series, represented on their respective scales, are shown in Figure 12. They are two growing series until 2019, with a spectacular drop due to the COVID-19 pandemic in 2020 and a modest improvement in 2021.

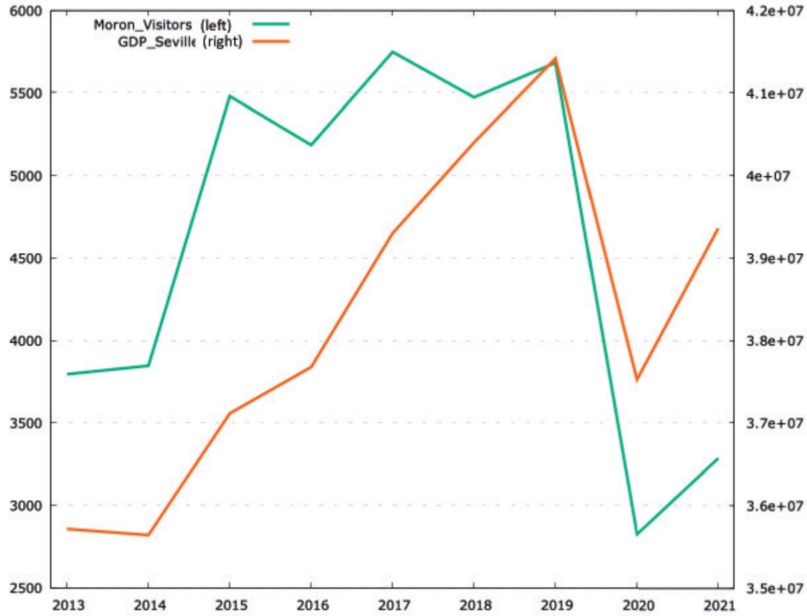

Figure 12. Annual evolution of the number of visitors to Morón and the GDP at the market price of the province of Seville (based on data from the Morón de la Frontera Tourist Office and the Andalusian Institute of Statistics and Cartography)

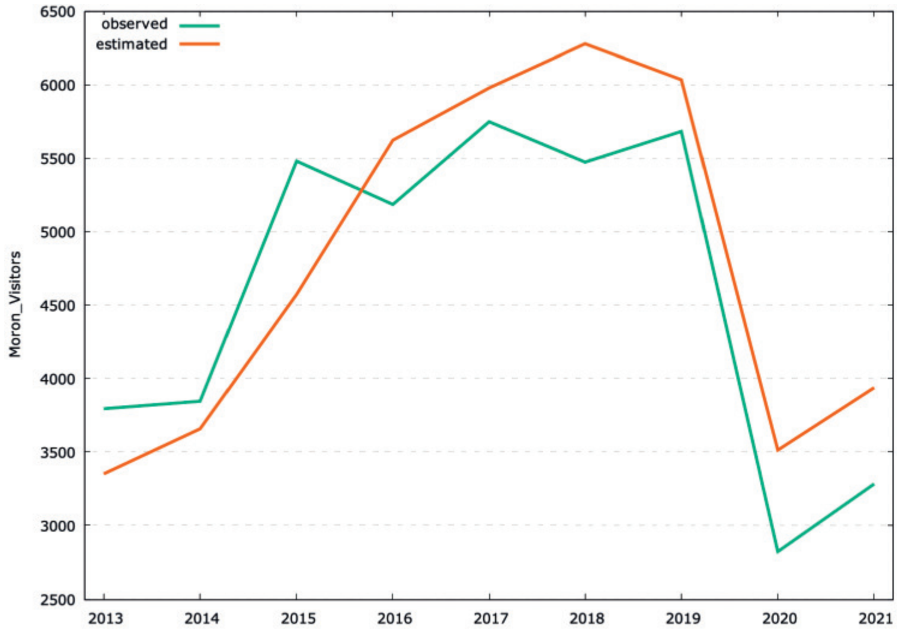

Figure 13. Original series of visitors to Morón and series adjusted by Prais–Winsten using Seville's GDP as an explanatory variable (based on data from the Morón de la Frontera Tourist Office and the Andalusian Institute of Statistics and Cartography)

Assuming the Sevillian GDP at market prices as an explanatory variable for the number of visitors to the Morón de la Frontera region, we would have a regression model with an autocorrelation given by $\rho = 0.912241$. If we proceed to estimate according to an autoregressive process of order 1 (given the correlogram associated with the residuals of the estimation by Ordinary Least Squares), using the Prais–Winsten estimation method, we obtain the result as in Table 4).

Table 4. Estimation of the AR(1) model

	Coefficient	Standard error	t-statistic	p-value
Constant	-17357.7	5154.96	-3.367	0.0120
GDP-Seville	0.000562009	0.000131722	4.267	0.0037
	R-square	0.774221	R-square corrected	0.741967

In the model, the annual evolution of visitors to Morón is explained through the annual evolution of Seville's GDP.
Based on the Morón de la Frontera Tourist Office data and the Andalusian Institute of Statistics and Cartography.

The estimate provides a positive and significant slope: the growth of Seville's GDP increases the number of visits to the Morón de la Frontera region. Figure 13 shows the annual series observed and the one adjusted using the AR(1) regression using Seville's GDP as an explanatory variable.

5. Conclusions

This work has a local character, and it seeks to analyze possible incident factors in tourist evolution, measured through the number of visitors of a medium-sized town in southern Spain. For local authorities, such visits constitute a source of both public and private income. We found two possible explanatory variables for the number of visits to Morón de la Frontera. An explanatory variable for the monthly number of visitors is the number of monthly visitors to the province of Seville, the province to which that region belongs. The monthly analysis allows the study of the seasonality associated with both series, detecting high values of visitors in spring and autumn, and more moderate values in summer. A linear regression analysis, introducing autocorrelation corrections (usual in time series modeling) allows us to estimate the slope of the cause-effect relationship between monthly visitors to Seville and monthly visitors to Morón de la Frontera. The estimated slope was 0.00155295, with visitors to the province of Seville as a significant explanatory variable, with a positive slope (considering the number of visitors as the unit of measurement in both variables). Therefore, an increase of 1000 visitors to the province of Seville implies an increase of 155 visitors to the Morón de la Frontera region.

Also, with annual data, we studied the relationship between the evolution of Seville's GDP and the number of visitors to the Morón de la Frontera region. The idea is that the growth in the wealth of the citizens of the province of Seville can be an explanatory factor for the number of visitors to the region, given that a large part of these visitors are from the province. In the regression analysis, it was obtained that GDP is also an explanatory and significant variable, with a positive slope of 0.000562009 (for GDP expressed in billions of euros and the explained variable expressed in number of visitors).

Therefore, visitors to the province of Seville and its GDP are two explanatory factors for the number of visitors to Morón de la Frontera. Our contribution to the literature with this work is that of a local tourist analysis, in the south of Spain, based on variables from the locality's environment.

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