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Spatial Intensity in Tourism Accommodation: Modelling Differences in Trends for Several Types through Poisson Models

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Abstract: The distribution pattern of tourist activity in space represents valuable information to improve the management of a tourist destination. This is why there is a trend in the current literature in proposing modelling that allows for the incorporation of how tourist activity is distributed in an operational way in order to characterize and measure the patterns identified for tourism management. The present study focuses on carrying out this modelling in an inland territory in an expansion phase which, according to the knowledge available from previous work, presents a strong territorial imbalance in the distribution of its housing pool, the region of Extremadura in Spain. For this reason, tourism intensity is modelled through a Poisson process to determine which model best fits the pattern of accommodation in the region. The results represent a valuable tool for public–private management of the tourism sector in the area under study.

Keywords: spatial point pattern (SPP); modelling trends; tourist intensity; Poisson's models; Extremadura; tourism management

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1. Introduction

The use of spatial statistic techniques to obtain improved knowledge of tourism activities is nowadays an increasingly common practice. It is evident that tourism is a geographical phenomenon, which means that considering the spatial interaction between space and tourism activity in the analyses carried out is a crucial practice for the proper planning and management of tourism activities.

Knowledge of the localization patterns of tourism supply and demand provides vital information for destination managers, investors, and the remainder of the private sector. Knowing the location of the accommodation therefore provides essential information for regional planning efforts, especially in those cases involving the planning of infrastructure services [1]. For their part, private investors obtain valuable information on market access for potential tourists from knowledge of the location pattern of hotel accommodation, and also use it to understand the level of competition existing in a given territory [2].

For this reason, a series of studies are emerging from the academic field that seek to elucidate knowledge about the distribution patterns that tourist variables follow in space. In this way, work that aims to analyze the patterns of tourist activity in the territory has proliferated in recent years [3–17].

To achieve their objectives, most of these works have used spatial association measures such as Moran's I or Getis and Ord's G [18,19], managing to identify different regimes of spatial association in each of the territories analyzed. Although these indices have demonstrated their validity to analyze associations in space, they present a series of limitations in their use, among which a great sensitivity to certain parameters, such as the neighborhood criterion used (euclidean distance, contiguity, spatial weight matrix, etc.), or the influence of the demarcation of the administrative limits of each territory (size, shape, position in the territorial division, etc.). For all these reasons, Wall et al. (1985) [20] recommend using various statistical techniques to obtain greater reliability and validity in the results.

On the other hand, the objective pursued by this work is not so much oriented towards identifying spatial trends in the distribution of tourist accommodation in the region, but rather the modeling of this trend in order to offer information on the spatial trends of the data to destination managers that can be of help in decision-making on the most appropriate policies for tourism development in the region. The information offered by this modelling could be used for the proper planning of tourist activity in the region, helping, for example, when making decisions about the suitability of making infrastructure investments in a certain location. Therefore, the objective is to propose the model that best describes how tourist accommodation is being distributed within the region under study.

Along these same lines, and in order to be able to synthesize the information obtained in an operational way after analyzing the interaction of tourism and space, different models have also been proposed, both theoretical and empirical, which aim to help to characterize, map, and measure the identified spatial structures in order to help decision-making in tourism. Yang et al. [2] carried out a review of the main models proposed in the current literature, concluding on one hand that there is no superior method in all situations; for this reason, adapting the method to the characteristics of the territory to study is a great help. On the other hand, as a result of their work, it is confirmed that most previous research takes the intra-metropolis area as a spatial reference, but there is a shortage of studies providing information on how tourism activities are distributed on an intra-regional scale, despite the usefulness of this information for the strategic planning of the destination [21–24]. To be precise, of the 54 papers reviewed to carry out their study the authors found that only 12 used the intra-regional scale (within the territorial limits of a whole region) as a reference for their analysis.

Taking into account all that has been said so far, the main objective of this research is to generate knowledge about this gap in the current literature. To do so, we intend to propose an empirical model that shows a satisfactory level of adjustment in the pattern existing in the distribution of accommodation in the region of Extremadura in Spain. It is therefore an analysis on an intra-regional scale which also takes an inland region as a basis for its analysis that is in a stage of expansion.

In order to achieve this objective, in this study, the tourist intensity is modelled through a Poisson process which, once a non-homogeneous distribution of the activity is verified, allows the definition of conditioned tourist intensity based on the location of the pattern of points that represent all the accommodation establishments existing in the region and therefore the mention of the existence of a spatial trend. In order to create this analysis, the three main types of accommodation existing in the region are considered (hotel, non-hotel and rural) so as to confirm whether there are significant differences that must be considered in the distribution of each type of accommodation. After verifying the non-homogeneous distribution of the accommodation in the space, different models are initially proposed that are estimated using a maximum pseudo-likelihood method for Poisson models to subsequently validate whether these models fit the data well and ensure that all their terms are appropriate. Finally, the different models proposed are compared to check which best fits the pattern of points observed in the region.

The classification carried out to distinguish between the three typologies considered in the present investigation (hotel, non-hotel and rural) follows the criteria established by the legislation in force in the region under study. Specifically, it can be seen in Law 2/2011, of 31 January, on Tourism Development and Modernization. In this law, a clear classification is established, of which establishments are included within each of the typologies and can be summarized as follows: hoteliers (hotels, hotel-apartments, hostels and pensions), non-hoteliers (tourist apartments, tourist hostels, camps, camping areas, motorhome areas) and rural (rural houses and hotels).

The main contributions that are pursued with the completion of this work can be summarized as follows. On one hand, the knowledge extracted from this work will allow us to propose a modelling adjusted to a destination which, owing to its peculiar characteristics as an interior destination in a growth phase, does not have a background in current literature to the best of the authors' knowledge. On the other hand, although tourism intensity and spatial distribution patterns have been analyzed by different studies in the target area of study, to date, analyses have not taken into account a disaggregation of the existing accommodation establishments in the main categories in the region: hotel, non-hotel, and rural accommodation, which is the perspective used to carry out the analysis of this research. Therefore, the results achieved from the latter will be a valuable tool for the public–private management of tourism activities in the region.

The following research is structured as follows to achieve our goals. After this introduction, Section 2 is a bibliographic review of the main contributions made in this field. The area under study is subsequently described exhaustively so that the reader can contextualize the situation of the tourism sector in the region. Section 4 describes the methodology to be used for the development of this research work. Finally, Sections 5 and 6 list the results of the analysis and their main conclusions and implications for tourist activity in the region.

2. The Importance of Space in Accommodation Distribution

Correct planning in the tourism industry involves having exhaustive information, and for this reason, it is important for this sector to have techniques that allow for the monitoring and analysis of tourist flows. This allows us to obtain exhaustive information for correct decision-making [25]. In addition, tourism variables have a strong interaction with the territory which is characterized by an unequal distribution within and between the territories [17]. For all these reasons, knowing how tourist variables are distributed in space is essential for the correct management of tourist activity.

In effect, analyzing the geographical dimension of tourist flows helps us to understand the characteristics of their distribution and transition, while it is a valuable input for tourism management and marketing. For this reason, the variable space has been recognized and taken into account in more and more economic processes [26].

This trend is especially accentuated in the case of tourism, since this sector is highly dependent on the tourist assets and attractions that are found in specific locations, which results in a high spatial concentration in terms of both supply and demand [27]. The tourist concentration of companies must, however, be understood not only as a spontaneous process motivated by the nature of the business involved, but also as a mechanism of positive response between the demand and the productive system of tourism, which tends to develop the so-called economies of agglomeration [28].

The agglomeration economy is understood to be the geographical concentration of interconnected companies, related industry companies, and associated institutions in related fields which cooperate but also compete [29].

The basic premise of agglomeration is that the spatial grouping of interrelated industries or entities can be beneficial to the economy as a whole, as well as to sectors and companies grouped in a certain location [30]. Marshall [31] points out that companies can benefit from those economic externalities, which are also called geographic spillover effects, that occur in those companies that choose to locate areas where there is a strong concentration of economic activity, with the purpose of intensifying the offer of a range of more specialized services.

The main benefits deriving from the formation of agglomeration economies can be summarized as follows. Firstly, transaction costs fall while the exploitation of scale economies increases through the expansion of risk and the improvement of access to complementary resources [32]. Secondly, the growth of long-term stakeholder conflict resolution costs is avoided [33]. Finally, the coordination of related policies and actions is improved to promote the consideration of the economic, environmental and social impacts of tourism [34]. In short, it can be synthesized that there are two different types of profit: improvement in production and intensification of demand [31].

From the first studies carried out by Marshall [31], Hoover [35] and Jacobs [36], which were more focused on the manufacturing industry, a series of studies have emerged to analyze the effects of agglomeration economies in the service sector [37–40] which have particular influence on the specific field of tourism.

Some authors even consider agglomeration to be the key factor for the promotion of the development of tourism through externalities, which encourage competition and cooperation between companies [41,42]. This ensures that the growth ratio is more related to betting on localization economies than with the endowment of natural resources that destinations have [43], so that destinations can overcome an inadequate resource base if the localization economies support the tourism industry [44].

For all these reasons, there is a belief that agglomeration economies have become an important driving force in the development of tourism [45,46]. For this reason, numerous studies have examined how agglomeration theories and geographic spillover effects affect the spatial pattern followed by tourist accommodation in a given territory.

Most of the studies carried out are exploratory in nature and therefore seek to identify spatial trends through the use of spatial statistical techniques that can help with the correct management and planning of tourist activity in the territories that have been targeted. From the initial studies of Wall et al. [20], the amount of research pursuing this purpose as well as diversifying the techniques used for this purpose has intensified. Therefore, without wishing to be exhaustive, the work of Majewska [3,4] and of Majewska and Trukolaski [47] focusing on the analysis of the pattern of tourist activity in Poland and other countries in central Europe could be highlighted, identifying different clusters that represent important outputs for tourism management in these territories.

For their part, Yang and Wong [5] identify the presence of a cluster in China which they associate with certain coastal areas, mountainous regions, and cities acting as gateways or higher hierarchies, which in addition produce a spillover effect that extends beyond natural boundaries.

García-Palomares et al. [15], for their part, use big data techniques which allow them to identify certain hotspots through the movement of tourists in eight of the main European cities; they conclude that Rome is the city with the strongest spatial concentration compared with the other destinations analyzed. Together with previous studies, other analyses pursuing the same activity could be highlighted in a descriptive manner so as be able to identify and describe the spatial pattern of tourist activity in specific territories [10,16,17,44,48–53].

Parallel to these studies—the results of which have helped to confirm that the distribution of tourism variables in space is not homogeneous but rather shows a tendency to concentrate in space, causing synergies and contagion effects—others have been developed to demonstrate the effects of this concentration of supply in space.

A large proportion of these studies have focused on contrasting the agglomeration effect in the intensification of demand. Chung and Kalmins [54] carried out a study in Texas in 1992 on a sample of hotels and motels to determine which type of company contributes the most to creating externalities and which type benefits the most from them. Among their main conclusions, they found that the presence of chains intensifies the demand, especially in rural markets, with independent hotels obtaining benefits from being located near these chains. For their part, Canina et al. [22] carried out research in the USA on a sample of 14,955 companies to confirm the benefits and disadvantages of the competitive group, they detect that the hotels of higher category are those that generate those positive effects from which those hotels of a lower category located next to them benefit. Finally, Freedman and Kosová [55] conclude that the benefits of the agglomeration depend on the type of hotel, and that the chosen location depends on the degree of concentration and diversity that the complex reaches, preferring those areas in which its product segment is not present.

As a conclusion of all the above, it is confirmed that the concentration of accommodation in a certain area helps to intensify demand and that it is important for this spatial concentration to have a supply diversified enough to generate high profits in order to reduce the possible adverse effects of excess competition. As Majewska [3] affirms, the heterogeneity and density of the tourist supply can also serve as a tourist attraction.

As far as the improvement of production is concerned, although Canina et al. [22] mention these types of benefits such as the creation of a highly specialized labor market, the transfer of knowledge or technology, among others, they are usually more associated with technologically sophisticated industrial sectors. A series of studies have been carried out that have helped to confirm that this effect may also be beneficial in the specific case of the tourism sector. Polo et al. [11] confirm that spatial concentration favors the creation of a competitive climate that makes companies have a greater tendency to adopt a more market-oriented strategy. For his part, Yang [46,56] demonstrates that Chinese tourism has formed the agglomeration phenomenon through the formula to improve the productivity of production factors.

Although the different benefits that companies can obtain from concentrating on space have been listed, it should not be forgotten that this greater concentration of companies can also produce a series of disadvantages when a certain level of tourist intensity is reached. In fact, the research carried out by Baum and Haveman [57] and Ingram and Inman [58] identifies that there is an inverted U relationship between the current number of competitors and the entry of new participants, which the authors attribute to the deterrent effect produced by an excessive level of competition. On the other hand, it should not be forgotten that developing a sustainable tourism model entails not exceeding certain levels of tourist pressure that could generate inadequate resource management. The impact of tourism tends to occur when more tourists visit a place that it can sustain; therefore, knowing and identifying how much and when an attraction is visited helps to design solutions to avoid the potential negative social, environmental or cultural impacts that exceeding the tourist load threshold may entail [59].

In view of the data presented, the need to know how tourism activities are distributed in a region is reflected in order to be able to carry out realistic planning, which, on one hand, will enhance the positive externalities that may arise from tourism concentration while on the other hand its possible negative effects are minimized. This importance is increased when it comes to emerging destinations, where in addition to planning their tourism strategy, it is necessary to create infrastructure in addition to a series of investments that will help guide the growth path of this sector, especially when the tourism products on offer suggest the need for creating a sustainable development model, as is the case of the region that concerns us in this research, Extremadura in Spain.

With reference to this region, different analyses have been carried out that have confirmed that tourist activity tends towards concentration in space, which favors the creation of certain clusters or hotspots, or indeed cold spots, which must be analyzed and understood for the correct management of the activity [13,14,60–64].

The present study proposes the continuation of advancement along these lines, empirically evaluating said spatial trends in order to propose a modelling that allows for the characterizing, mapping and measuring of the different spatial structures and the organization of activities in space in order to provide a practical tool for both the public and private management of tourist activity in the region.

The next section gives a description of the region under study that allows the reader to contextualize the results obtained and also synthesize the previous results achieved in the study of the pattern of tourist activities in the region of Extremadura.

3. Case Study: Extremadura

The region of Extremadura located in the southwest of the Iberian Peninsula (see Figure 1) stands out for having a vast territory, with its two provinces (Badajoz and Cáceres) being the largest in Spain and with a low population density of only 27 inhabitants per km^2. It is, therefore, an inland region that, due to its endowment of natural resources and heritage, has enormous potential to base its development model on highly sustainable tourism products. Despite this, it can be considered that its tourism sector is still in a growth phase, driven by the need to diversify the economic activity of the region heavily dependent on livestock and agriculture, which makes it the Spanish region with the lowest GDP per capita [65].

Figure 1. Location of area of study.

Considering its tourist activities, it should be noted that its unfavorable economic context has made the region a priority objective of the European aid programs LEADER (Liaisons entre Activités de Development de L'Economie Rural), LEADER II, and PRODER (Programa Operativo de Desarrollo y Diversificación de Zonas Rurales) which have developed among its priority objectives the diversification of agricultural income through the development of tourism. These grants, together with the expansionary growth policies implemented by the regional administration, have caused a noticeable increase in the number of lodging facilities in the region, especially in the case of rural tourism. As can be seen in Table 1, the region had a total of 1591 accommodation units at the beginning of 2019 providing a total of 40,947 places, of which just over half correspond to rural tourism establishments.

Table 1. Tourism Magnitude of Extremadura (year 2019).

Type of Accommodation	Number of Establishments	Number of Places
Hotels	451	19,268
Non-hotels	343	13,301
Rural	797	8378
Total	1591	40,947

Source: Registry of Companies and Tourist Activities of Extremadura.

However, this increase in accommodation capacity has not been accompanied by a strong increase in the number of travelers visiting the region, which means that the tourism sector is characterized by strong imbalances between supply and demand. In addition, the growth in the accommodation capacity has not been evenly distributed over the territory, which generates the need to investigate the pattern of tourism activity in the region in order to be able to carry out joint planning of the territory that allows the monitoring and planning of this activity so as to achieve its optimal development.

For this reason, different studies have been focused on creating knowledge of the pattern that the tourist sector draws in the territory of Extremadura. The work of Nieto and Cárdenas [64] included a study examining how the materialization of the investments made by the LEADER programs in the region between the years 2000 and 2013 have been distributed; they found that their distribution has a strong tendency to concentrate on high values, the north being one of the main beneficiary areas of the same.

Other studies have concentrated on examining the pattern drawn by tourist sites in the region of Extremadura. Sánchez [60] focuses on analyzing how tourist sites are distributed in the region, both accommodation and restaurants. Among his main conclusions, it is noteworthy that while hotel places tend to be concentrated in the three main cities of Badajoz, Cáceres and Mérida, those of rural accommodation are located in the north of the region (Jerte and La Vera) and also in the territory of Tajo Internacional-Sierra de San Pedro and around the Monfragüe Biosphere Reserve National Park. On the other hand, he finds that that the premise that the distribution of restaurant places follows a random pattern in space which cannot be ruled out. (see Figure 2).

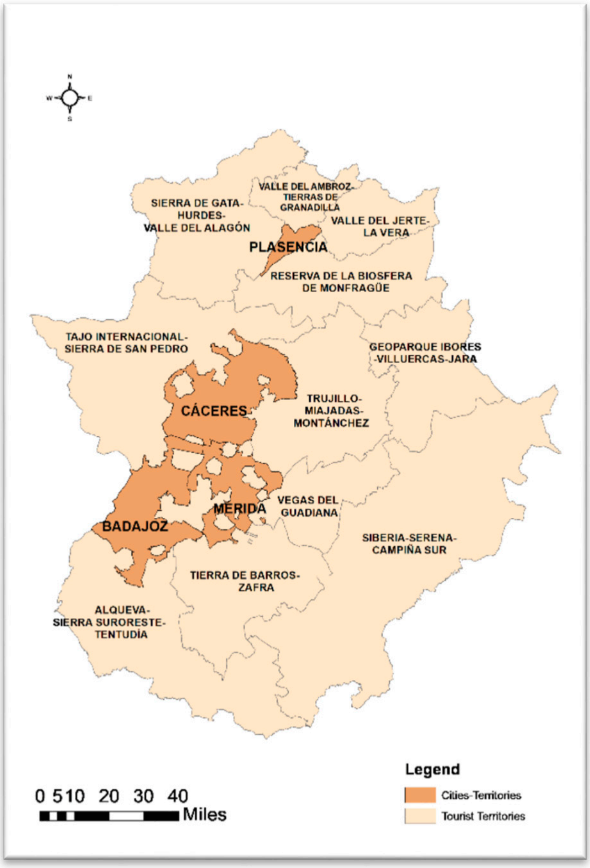

Figure 2. Maps of tourist territories of Extremadura.

Taking as a reference the number of places offered by accommodation in the region, Sánchez et al. [62] likewise analyzed the distribution and evolution of the places offered in the region between 2004 and 2014. Their results identify a cluster in the north of the region and also in the three main cities of the region, although with a different level of significance. The distribution of rural accommodation places was subsequently studied in isolation, with high value clusters being identified in the territories of La Vera, Zafra-Río Bodión, Vegas Altas, and the vicinity of Alange, and others of low value located in the territories of Montánchez, Sierra de Gata, and Jerte (see Figure 2).

The number of accommodation establishments were also analyzed; two quadrants with a high degree of tourist intensity have been identified, one in the micro-territories of Plasencia, Jerte-La Vera and the Ambroz Valley, and the second in the vicinity of the city of Cáceres and Monfragüe Natural Park [66] (see Figure 2).

From a demand perspective, different studies have also been carried out to confirm that its distribution also tends towards concentration in space. Rodríguez and Sánchez [13] analyze the pattern presented by the travelers visiting the region; they found a trend towards their concentration in the three main cities of the region. The efficiency of tourist sites is subsequently analyzed from a spatial perspective, using the level of occupancy as a proxy indicator of the satisfactory adjustment between supply and demand. The results achieved allow us to identify three clusters with a satisfactory level of adjustment between supply and demand in the three main cities of the region and also two low-value clusters with the greatest imbalances between supply and demand in the territories of the Villuercas-Ibores-Jara Geopark and the Trujillo-Miajadas-Montánchez Geopark [14] (see Figure 2).

In view of all these results, it is evident that both the distribution of supply and demand in the region under study present strong territorial imbalances that must be analyzed for the proper monitoring of the activity if we are to propose adequate planning for the tourism development in the region adapted to visitors' specific needs.

4. Methodology

In this paper, intensity is defined as the average density of points in space, i.e., the expected number of points per unit area [67]. This intensity may be constant for every unit area (uniform intensity or Complete Spatial Randomness, CSR) or may vary from location to location (inhomogeneous intensity). This intensity is modelled as a Poisson process with the parameter $\lambda(u, \mathrm{x})$, where x is a spatial point pattern and u is a location. This parameter represents the conditional intensity of the spatial process.

The simplest way to model this conditional intensity in a loglinear form is as follows:

$$\lambda(u, \mathrm{x}) = \exp(\theta_0) \tag{1}$$

in which θ_0 is a constant. This means that intensity does not depend on the location of the point pattern. This parametrization of the intensity is equivalent to a stationary Poisson process (complete spatial randomness) [68].

If the Poisson process is not homogeneous, then the conditional intensity will depend on the location of the point pattern (a nonstationary Poisson process). The location u is determined by the X coordinate (longitude) and/or by the Y coordinate (latitude) of each spatial point. When the conditional intensity depends on the location, it is possible to speak of a "spatial trend". The estimation of the trend best fitted to the observed spatial points is the objective of this applied research. When the intensity of a Poisson process varies spatially, this intensity is modelled as a log-linear function of the geographic coordinates, that is, $ln\lambda(u, \mathrm{x}) = f(x; y)$. Log-linearity is a natural assumption in this case, because it ensures that intensity is a non-negative quantity, and it is the canonical link for Poisson data [69]. Furthermore, this log-linear modeling can capture non-linear relationships between intensity and x,y coordinates.

If the spatial trend depends only on the longitude, the conditional intensity is defined as follows:

$$\lambda(u, \mathrm{x}) = \exp(\theta_0 + \theta_1 x) \tag{2}$$

in which θ_0 and θ_1 are scalar parameters to be fitted and x is the longitude Cartesian coordinate. This means that the conditional intensity varies from East to West or vice versa.

If it is considered that the spatial trend depends on the latitude, then the conditional intensity is modelled as follows:

$$\lambda(u, \mathrm{x}) = \exp(\theta_0 + \theta_2 y) \tag{3}$$

in which y is the latitude Cartesian coordinates. In this case the conditional intensity varies from North to South or vice versa.

It is possible to consider also that both longitude and latitude determine the spatial trend of the Poisson process. If this is the case, the following spatial trend could be proposed:

$$\lambda(u, \mathrm{x}) = \exp(\theta_0 + \theta_1 x + \theta_2 y) \tag{4}$$

In Expression (4), it is assumed that the conditional intensity may vary not only from East to West but also from North to South or vice versa.

In the previous models, a linear relationship between the conditional intensity and the location (coordinates x and y) is assumed. In many cases however (especially in spatial clusters) this relationship could be not linear. This could be due to the fact that, in a portion of the territory there is a high concentration of accommodation, the fit of a linear trend would not be adequate, while a non-linear trend could better fit to this concentration. A polynomial function of degree r could then be used to model the spatial trend.

The first polynomial stationary model that can be proposed is that in which the conditional intensity is related only to the longitude of the point pattern through a quadratic function, i.e.,

$$\lambda(u, \mathrm{x}) = \exp\left(\theta_0 + \theta_1 x + \theta_3 x^2\right) \tag{5}$$

If, on the contrary, the conditional intensity is related only to the latitude, the quadratic function to model it is as follows:

$$\lambda(u, \mathrm{x}) = \exp\left(\theta_0 + \theta_2 y + \theta_4 y^2\right) \tag{6}$$

Finally, if the relationship between the conditional intensity and both Cartesian coordinates in a non-stationary Poisson process is quadratic, the intensity could be defined as follows:

$$\lambda(u, \mathrm{x}) = \exp\left(\theta_0 + \theta_1 x + \theta_2 y + \theta_3 x^2 + \theta_4 y^2 + \theta_5 xy\right) \tag{7}$$

Of all these models, the only "pure" Poisson model is model 1 (which does not include either spatial trends or mark dependencies). The rest of the models (model (2) to model (7)) are, in fact, Gibbs point processes [70,71]. These Gibbs point models relax the independence assumption by assuming interactions between set of points. In addition, these models allow the inclusion of spatial trend and dependency on marks [72].

To estimate all these models, a maximum pseudo-likelihood method [73] for Poisson models [74] is used with the Huang–Ogata improvement [75] is used.

Once the model is estimated, it must be validated by checking that the model is a good fit for the data and that all terms in the model are appropriate. In order to do so, residuals from the satisfactory model (the differences between observed and expected values) can be calculated [76–78]. These residuals can be represented in a diagnostic plot to assess goodness-of-fit, to identify outliers in the data, to reveal departures from the fitted model, etc.

Finally, and due to the maximum pseudo-likelihood being equivalent to the maximum likelihood for Poisson processes [69], nested models (one model is a special case of another) can be compared using a composite likelihood ratio test [79]. Given the two nested models (model 0 is the "smaller" one, i.e., the simpler model; 1 is the "greater" one, i.e., the model with more parameters), and defining the null hypothesis as "the smaller model is the best model", this test is defined as follows:

$$\Lambda = 2\ \log \frac{\mathrm{CL}(\hat{\theta}_1, x)}{\mathrm{CL}(\hat{\theta}_0, x)} \tag{8}$$

in which $\mathrm{CL}(\hat{\theta}_0, x)$ are the maximum composite likelihood estimates of θ under the smaller model and $\mathrm{CL}(\hat{\theta}_1, x)$ are the maximum composite likelihood estimates of θ under the greater model. Λ has an asymptotic χ^2 distribution with d degrees of freedom, in which d is the difference in the number of parameters for the two models. If the value of Λ is large (i.e., p-value below level of significance), the null hypothesis should be rejected. This means that the greater model fits the data better than the smaller one.

5. Results

The spatial point patterns analyzed in this article are the total number (whole population) of hotels, non-hotel establishments and rural accommodation establishments located in Extremadura on 1 January 2019 (1591 spatial points). The spatial representation of these three types of establishments is shown in Figure 3. The Coordinate Reference System used in this research is EPSG (European Petroleum Survey Group): 4326—WGD84. It is important to note that in Figure 3, the longitude (X axis) takes values between −7.55° and −4.75° and the latitude (Y axis) takes values between 37.9° and 40.5°. These values represent the respective minimum and maximum of the geographical coordinates of the region of Extremadura. This means that all the 1591 spatial points are represented in Figure 3 (spatial points are not excluded in this representation).

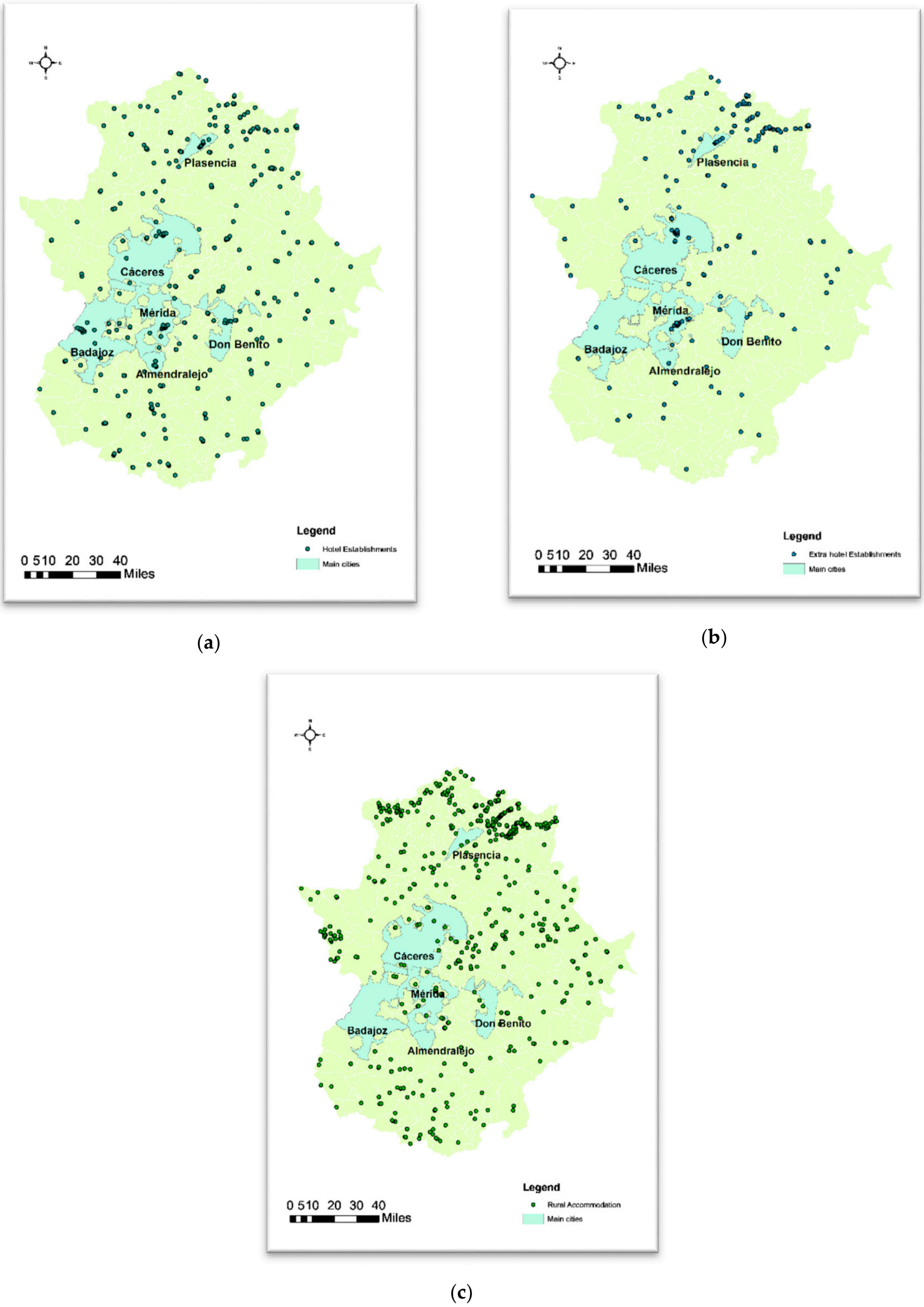

Figure 3. Spatial representation of types of accommodation establishments in Extremadura. (**a**) Hotel establishments. (**b**) Extra-hotel establishments. (**c**) Rural accommodation.

To identify possible differences in the estimated values of the models presented earlier in the methodology section, a covariate (factor) representing the type of accommodation was introduced. This factor has three levels: hotel establishments (hotels, hostels, pensions, and apartment hotels), extra-hotel establishments (tourist apartments, tourist camps, and lodges) and rural accommodation (rural hotels, *casas rurales*, and rural apartments). The total number of spatial points analyzed is 451 hotel establishments, 343 extra-hotel establishments, and 797 rural accommodation establishments. In this way it has been possible to obtain the estimated values of these three types of accommodation.

The first model to provide an estimate is the stationary Poisson process (model (1)). The results of the estimation of the model (1) are shown in Table 2. It can be observed that the intercept of the model is statistically significant for the three types of establishment. The estimated value of the conditional intensity, according to this model, reaches a value of 61.9 hotel establishments, 47.1 extra-hotels establishments, and 109.5 rural accommodation establishments per unit area. However, the higher concentration of certain establishments observed in the northern third of the region (mainly rural accommodation) and the lower concentration in the southeast quadrant of the region (see Figure 3) suggest that this stationary model is not the most suitable for modelling accommodation distribution establishments in Extremadura.

Table 2. Estimation of model (1) $\lambda(u, x) = \exp(\theta_0)$.

(a) **Global Estimation (Total Population)**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	5.3870	0.0251	5.3379	5.4361	214.8726	0.0000
(b) **Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−0.5694	0.0589	−0.6849	−0.4539	−9.6631	0.0000
(c) **Extra-Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−0.8431	0.0646	−0.9997	−0.7166	−13.0562	0.0000
(d) **Rural Accommodation**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	4.6957	0.0354	4.6263	4.7651	132.5659	0.0000

Notes: S.E: Standard error. CI95.lo: lower limit of the 95% confidence interval of parameter estimation. CI95.hi: higher limit of the 95% confidence interval of the parameter estimation. Source: own work.

Compared with model (1), model (2) incorporates the possible influence of the longitude (X coordinate) to estimate the conditional intensity. However, this coordinate is not statistically significant for the three types of establishment (*p*-values higher than 0.05 in all cases) (see Table 3). As a consequence, the conditional intensity of accommodation establishments in Extremadura does not depend (at least linearly) on the longitude, which means that there does not seem to be a greater concentration of hotels, extra-hotel establishments, or rural accommodation establishments when moving from east to west through the region or vice versa. This situation may be due to the fact that the main tourist resources in the region (specially, Zafra, Mérida, Cáceres, Trujillo, Plasencia, Monfragüe and Valle del Jerte), road infrastructures (highway A-66) and the most populated cities (Cáceres, Mérida and Plasencia) are located in the geographical center of the region (without there being a greater or lesser concentration of establishments to the East or West of this geographical center) in a strip that crosses the region from North to South, or vice versa (around the A-66 highway).

Table 3. Estimation of model (2) $\lambda(u, x) = \exp(\theta_0 + \theta_1 x)$.

(a) **Global Estimation (Total Population)**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	5.5773	0.1918	5.2013	5.9533	29.0751	0.0000
θ_1	0.0309	0.0310	−0.0298	0.0918	0.9990	0.3178
(b) **Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	−1.1913	0.4516	−2.0764	−0.3062	−2.6379	0.0083
θ_1	−0.1015	0.0729	−0.2444	0.0415	−1.3911	0.1642
(c) **Extra-Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	−1.4981	0.4954	−2.4691	−0.5270	−3.0237	0.0025
θ_1	−0.1068	0.0799	−0.2635	0.0499	−1.3364	0.1814
(d) **Rural Accommodation**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	5.2028	0.2699	4.6739	5.7318	19.2797	0.0000
θ_1	0.0828	0.0439	−0.0032	0.1688	1.8872	0.0591

Notes: S.E: Standard error. CI95.lo: lower limit of the 95% confidence interval of the parameter estimation. CI95.hi: higher limit of the 95% confidence interval of the parameter estimation. Source: own work.

This does not, however, hold true when instead of conditioning the estimated intensity of accommodation establishments to longitude, it is conditioned to latitude (coordinate Y). As can be seen in Table 4, it is very clear that the Y parameter is statistically significant for all types of establishments. This means that the latitude of the location of the accommodation establishments of the region determines their concentration (intensity).

Table 4. Estimation of model (3) $\lambda(u, x) = \exp(\theta_0 + \theta_2 y)$.

(a) **Global Estimation (Total Population)**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-vaLue
θ_0	−19.6440	1.4108	−22.4091	−16.8789	−13.9242	0.0000
θ_2	0.6357	0.0357	0.5658	0.7056	17.8209	0.0000
(b) **Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	31.1094	3.2770	24.6866	37.5322	9.4933	0.0000
θ_2	−0.8022	0.0831	−0.9650	−0.6394	−9.6591	0.0000
(c) **Extra-Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	9.7399	3.7433	2.4032	17.0767	2.6020	0.0093
θ_2	−0.2671	0.0945	−0.4523	−0.0819	−2.8261	0.0047
(d) **Rural Accommodation**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	−32.4629	2.1501	−36.6771	−28.2487	−15.0980	0.0000
θ_2	0.9418	0.0542	0.8357	1.0480	17.3854	0.0000

Notes: S.E: Standard error. CI95.lo: lower limit of the 95% confidence interval of the parameter estimation. CI95.hi: higher limit of the 95% confidence interval of the parameter estimation. Source: own work.

Incorporating the X coordinate, model (4) (with estimates presented in Table 5) into model (3) does not substantially improve the theoretical model adjustment to the observed distribution of the three types of spatial points being analyzed. It was already commented (model (2)) that the X coordinate is not statistically significant in this case; this is also true when estimating the same coordinate in model (4).

Table 5. Estimation of model (4) $\lambda(u, x) = \exp(\theta_0 + \theta_1 x + \theta_2 y)$.

(a) **Global Estimation (Total Population)**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−19.4537	1.4235	−22.2438	−16.6636	−13.6657	0.0000
θ_1	0.0310	0.0310	−0.0298	0.0918	0.9992	0.3167
θ_2	0.6357	0.0357	0.5658	0.7056	17.8209	0.0000
(b) **Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	30.4875	3.3074	24.0051	36.9699	9.2179	0.0000
θ_1	−0.1015	0.0729	−0.2444	0.0415	−1.3911	0.1642
θ_2	−0.8022	0.0831	−0.9650	−0.6394	−9.6591	0.0000
(c) **Extra-Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	9.0851	3.7754	1.6854	16.4847	2.4064	0.0161
θ_1	−0.1068	0.0799	−0.2635	0.0498	−1.3364	0.1814
θ_2	−0.2671	0.0945	−0.4523	−0.0819	−2.8260	0.0047
(d) **Rural Accommodation**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−31.9557	2.1667	−36.2024	−27.7090	−14.7484	0.0000
θ_1	0.0828	0.0439	−0.0032	0.1688	1.8874	0.0591
θ_2	0.9418	0.0542	0.8357	1.0480	17.3854	0.0000

Notes: S.E: Standard error. CI95.lo: lower limit of the 95% confidence interval of the parameter estimation. CI95.hi: higher limit of the 95% confidence interval of the parameter estimation. Source: own work.

Model (2) postulates a linear relationship between longitude and the conditional intensity of accommodation establishments in Extremadura, while model (5) (estimates for which are presented in Table 6) postulates a quadratic relationship. As is noted, the quadratic term in the model is statistically significant in the case of extra-hotel establishments and rural accommodation, but not in the case of hotel establishments (at a 5% level of significance). Therefore, the longitude must be incorporated into the model in a quadratic and not in a linear manner when modelling intensity in extra-hotel establishments and rural accommodation establishments.

In model (6), the latitude is the coordinate that has been entered into the non-stationary Poisson model in a quadratic manner. All the parameters of this model are statistically significant for the three types of accommodation at a 5% level of significance (see Table 7). Therefore, the relationship between latitude and the conditional intensity of accommodation establishments in the region could be quadratic in some cases.

Incorporating the information provided by models (5) and (6) into a single model, model (7) was proposed as the final one. Table 8 shows the estimates for this quadratic model for the three types of establishment. All the parameters of this model are statistically significant at a 1% level of significance. In this manner, the best possible fit for the XY coordinates of the accommodation establishments analyzed is obtained in a single model.

Once all the previous models are estimated, and in order to determine which of them best fits the spatial point patterns observed, the composite likelihood ratio tests of different nested models are calculated. The results of these calculations are shown in Table 9.

Table 6. Estimation of model (5) $\lambda(u, x) = \exp(\theta_0 + \theta_1 x + \theta_3 x^2)$.

(a) **Global Estimation (Total Population)**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−72.6416	3.0781	−78.6746	−66.6085	−23.5992	0.0000
θ_1	−25.7337	1.0059	−27.7054	−23.7621	−25.5817	0.0000
θ_3	−2.0994	0.0819	−2.2599	−1.9388	−25.6289	0.0000
(b) **Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−14.6098	6.9978	−28.3253	−0.8943	−2.0877	0.0368
θ_1	−4.3359	2.2829	−8.8105	0.1386	−1.8993	0.0575
θ_3	−0.3315	0.1856	−0.6952	0.0321	−1.7867	0.0740
(c) **Extra-Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−65.7370	10.8322	−86.9678	−44.5061	−6.0686	0.0000
θ_1	−20.8973	3.5225	−27.8014	−13.9933	−5.9325	0.0000
θ_3	−1.6735	0.2858	−2.2336	−1.1134	−5.8564	0.0000
(d) **Rural Accommodation**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−60.2502	3.8558	−67.8074	−52.6929	−15.6257	0.0000
θ_1	−21.5681	1.2665	−24.0504	−19.0858	−17.0295	0.0000
θ_3	−1.7702	0.1036	−1.9732	−1.5671	−17.0893	0.0000

Notes: S.E: Standard error. CI95.lo: lower limit of the 95% confidence interval of the parameter estimation. CI95.hi: higher limit of the 95% confidence interval of the parameter estimation. Source: own work.

Table 7. Estimation of model (6) $\lambda(u, x) = \exp(\theta_0 + \theta_2 y + \theta_4 y^2)$.

(a) **Global Estimation (Total Population)**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−785.5298	91.5826	−965.028	−606.031	−8.5772	0.0000
θ_2	39.5602	4.6514	30.4437	48.6767	8.5051	0.0000
θ_4	−0.4944	0.0590	−0.6101	−0.3787	−8.3731	0.0000
(b) **Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−859.7298	213.2334	−1277.659	−441.799	−4.0319	0.0000
θ_2	44.6835	10.8492	23.4195	65.9475	4.1186	0.0000
θ_4	−0.5804	0.1380	−0.8509	−0.3100	−4.2068	0.0000
(c) **Extra-Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-Value
θ_0	−2073.040	300.0644	−2661.156	−1484.925	−6.9087	0.0000
θ_2	105.4399	15.2073	75.6340	135.2458	6.9334	0.0000
θ_4	−1.3409	0.1927	−1.7185	−0.0963	−6.9603	0.0000
(d) **Rural Accommodation**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	*p*-value
θ_0	−304.3357	129.0645	−557.2976	−51.3739	−2.3580	0.0184
θ_2	14.7380	6.5468	1.9065	27.5696	2.2512	0.0244
θ_4	−0.1750	0.0830	−0.3377	−0.0023	−2.1079	0.0350

Notes: S.E: Standard error. CI95.lo: lower limit of the 95% confidence interval of the parameter estimation. CI95.hi: higher limit of the 95% confidence interval of the parameter estimation. Source: own work.

Table 8. Estimation of model (7) $\lambda(u, x) = \exp(\theta_0 + \theta_1 x + \theta_2 y + \theta_3 x^2 + \theta_4 y^2 + \theta_5 xy)$.

Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
(a) **Global Estimation (Total Population)**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	−1139.59	101.6837	−1338.9	−940.3	−11.2072	0.0000
θ_1	−56.1434	3.9503	−63.8859	−48.4008	−14.2123	0.0000
θ_2	48.8087	4.9353	39.1356	58.4818	9.8896	0.0000
θ_3	−2.2017	0.0854	−2.3690	−2.0345	−25.7966	0.0000
θ_4	−0.5542	0.0607	−0.6732	−0.4353	−9.1326	0.0000
θ_5	0.7373	0.0892	0.5624	0.9122	8.2630	0.0000
(b) **Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	−1120.26	239.3995	−1589.475	−651.0467	−4.6795	0.0000
θ_1	−26.3308	9.2414	−44.4437	−8.2180	−2.8492	0.0044
θ_2	53.8047	11.6214	31.0273	76.5822	4.6298	0.0000
θ_3	−0.4672	0.1959	−0.8511	−0.0832	−2.3849	0.0171
θ_4	−0.6555	0.1429	−0.9355	−0.0375	−4.5881	0.0000
θ_5	0.5220	0.2085	0.1134	0.9306	2.5040	0.0123
(c) **Extra-Hotel Establishments**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	−2717.49	358.2552	−3419.660	−2015.326	−7.5854	0.0000
θ_1	−74.1553	15.4549	−104.4464	−43.8642	−4.7982	0.0000
θ_2	126.4228	17.0084	93.0869	159.7586	7.4330	0.0000
θ_3	−1.9685	0.3102	−2.5764	−1.3605	−6.3459	0.0000
θ_4	−1.5080	0.2050	−1.9097	−1.1062	−7.3559	0.0000
θ_5	1.2555	0.3438	0.5818	1.9293	3.6523	0.0000
(d) **Rural Accommodation**						
Parameter	Estimate	S.E.	CI95.lo	CI95.hi	Z value	p-Value
θ_0	−524.5467	138.0345	−795.0894	−254.0040	−3.8001	0.0001
θ_1	−40.2522	4.9010	−49.8580	−30.0646	−8.2130	0.0000
θ_2	19.6935	6.7744	6.4159	32.9712	2.9070	0.0036
θ_3	−1.8108	0.1055	−2.0175	−1.6041	−17.1712	0.0000
θ_4	−0.2022	0.0841	−0.3670	−0.0374	−2.4054	0.0161
θ_5	0.4583	0.1132	0.2364	0.6803	4.0476	0.0000

Notes: S.E: Standard error. CI95.lo: lower limit of the 95% confidence interval of the parameter estimation. CI95.hi: higher limit of the 95% confidence interval of the parameter estimation. Source: own work.

Initially, the stationary Poisson model (1) and the non-stationary Poisson model (2) were compared. This is because we wished to determine whether the conditional intensity $\lambda(u, x)$ depends on the longitude of each spatial point pattern. As can be seen, the likelihood ratio test is not statistically significant at 5%, which means that model (2) is not significantly better than model (1) for any type of establishment. Consequently, the intensity of the accommodation establishment does not seem to depend linearly on the longitude, so it can be said that there is no greater or lesser concentration of establishments as we move from the west to the east of the region or vice versa.

On the contrary, when comparing the stationary Poisson model (1) with the non-stationary Poisson model (3), it was confirmed that the likelihood ratio test is statistically significant at a 1% level of significance for non-hotel establishments and rural accommodation establishments, and at a 5% level of significance for hotel establishments. Consequently, it can be said that model (3) fits the observed spatial point patterns better than model (1). It can therefore be concluded that the conditional intensity $\lambda(u, x)$ depends linearly on the latitude associated with spatial point patterns. In other words, the intensity of accommodation establishments varies as we move from north to south of the region or vice versa.

In order to confirm that the Y component (latitude) of the geographical location of the accommodation establishments determines their conditional intensity, the non-stationary model (2) was compared with non-stationary model (4). While the first of these models considers that

$\lambda(u, x)$ depends only on longitude, model (4) assumes that it depends on both longitude and latitude. The likelihood ratio test results indicate that the latter model fits the observed spatial point patterns significantly better than the former. Therefore, the latitude of these spatial points determines the conditional intensity, a situation that does not occur when longitude is considered.

Table 9. Composite likelihood ratio tests (comparison between nested models).

Comparison of Models	Λ	d.f.	*p* Value
(1) vs. (2)			
Total population	0.9982	1	0.3177
Hotel establishments	0.1032	1	0.7480
Non-hotel establishments	0.1307	1	0.7177
Rural accommodation	3.5639	1	0.0590
(1) vs. (3)			
Total population	339.1	1	0.0000
Hotel establishments	4.9335	1	0.0263
Non-hotel establishments	81.754	1	0.0000
Rural accommodation	346.64	1	0.0000
(2) vs. (4)			
Total population	339.1	1	0.0000
Hotel establishments	4.9335	1	0.0263
Non-hotel establishments	81.754	1	0.0000
Rural accommodation	346.64	1	0.0000
(3) vs. (4)			
Total population	0.9987	1	0.3176
Hotel establishments	0.1032	1	0.7480
Non-hotel establishments	0.1310	1	0.7174
Rural accommodation	3.5669	1	0.0589
(2) vs. (5)			
Total population	1116.1	1	0.0000
Hotel establishments	316.75	1	0.0000
Non-hotel establishments	396.34	1	0.0000
Rural accommodation	451.33	1	0.0000
(3) vs. (6)			
Total population	76.162	1	0.0000
Hotel establishments	53.074	1	0.0000
Non-hotel establishments	105.32	1	0.0000
Rural accommodation	4.5855	1	0.0322
(4) vs. (7)			
Total population	1265.2	3	0.0000
Hotel establishments	404.72	3	0.0000
Non-hotel establishments	533.36	3	0.0000
Rural accommodation	472.83	3	0.0000

Source: own work.

As a complement to the previous analysis, nested models (3) and (4) are compared considering the initial scenario in which $\lambda(u, x)$ depends exclusively on latitude; a final scenario is reached in which it is supposed that the conditional intensity also depends on longitude. In this case, the model that incorporates both coordinates is not significantly better than the model only including the Y coordinate. This conclusion is valid for the three types of establishment. The longitude of each spatial point does not therefore contribute in linear terms to the modelling of the conditional intensity of the accommodation establishments located in Extremadura.

From the comparison of the first four models proposed, it can be concluded that the best of all is model (3). However, this model assumes that the relationship between $\lambda(u, x)$ and the Y coordinate of each spatial point pattern is a linear relationship. Especially when particularly high concentrations of accommodation establishments occur, it is possible for this relationship to be not linear but rather of a polynomial nature (for example, the relationship between the conditional intensity and geographic coordinates may be quadratic).

To test whether this relationship is linear or not, model (2) was compared to model (5). The first postulates a linear relationship between conditional intensity and the longitude of spatial points. As can be seen, model (5) generates an adjustment to the observed data significantly better than model (2). This means therefore that the influence of the X coordinate on $\lambda(u, x)$ is better captured by the model including the quadratic term the one that only captures the linear relationship.

The result is similar when the nested models (3) and (6) are compared. The likelihood ratio test result indicates that model (6) provides a better fit than model (3) for the three types of establishments. Consequently, the relationship between conditional intensity and latitude is better captured by the model including the quadratic term the one that only captures the linear relationship.

Finally, and to confirm the quadratic relationship between the conditional intensity and the XY coordinates of the spatial point patterns analyzed, model (4) was compared with model (7). While model (4) establishes an exclusively linear relationship between the $\lambda(u, x)$ and Y coordinate, model (7) postulates a quadratic relationship. In this case, if the likelihood ratio test results are observed, it can be concluded that model (7) significantly improves the fit to the observed spatial point patterns compared with model (4).

Consequently, of all the models proposed, model (7) is best fitted to the observed location of the accommodation establishments in Extremadura. This is to such an extent that Figure 4 shows the observed intensity (left) and the expected intensity according to model (7) (right) for hotel and extra-hotel establishments and for rural accommodation establishments. The great similarity between both graphs confirms that the selected model (7) allows the spatial distribution of the accommodation establishments in Extremadura to be very closely modelled.

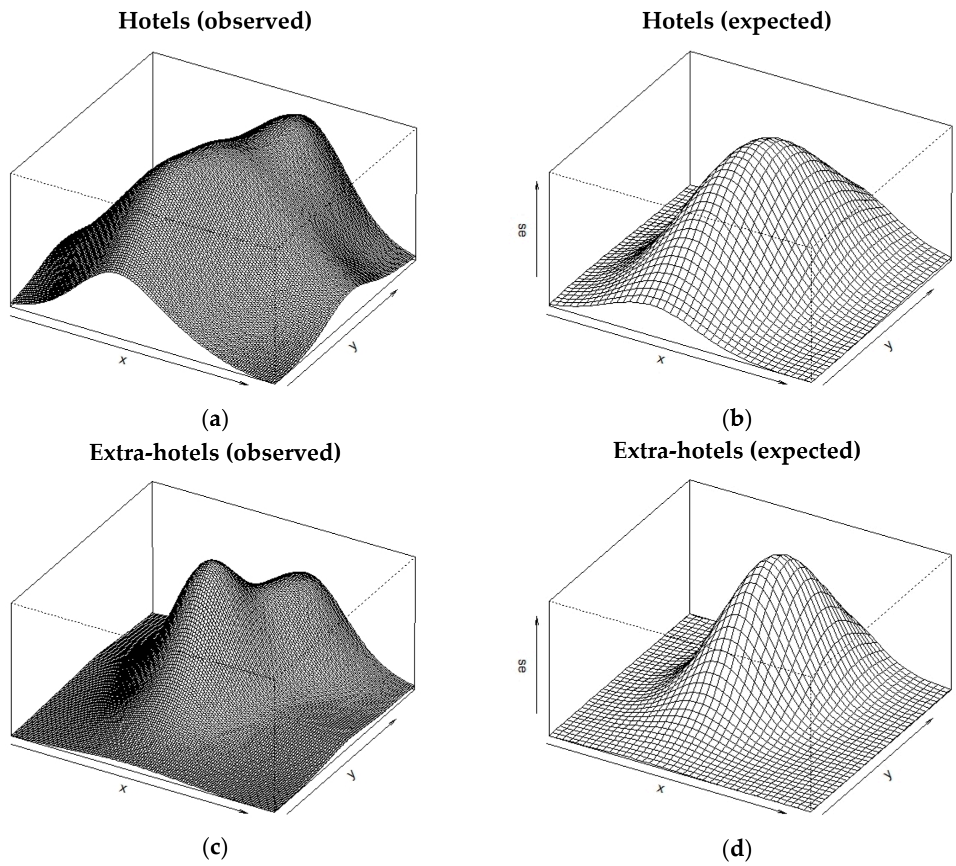

Figure 4. *Cont.*

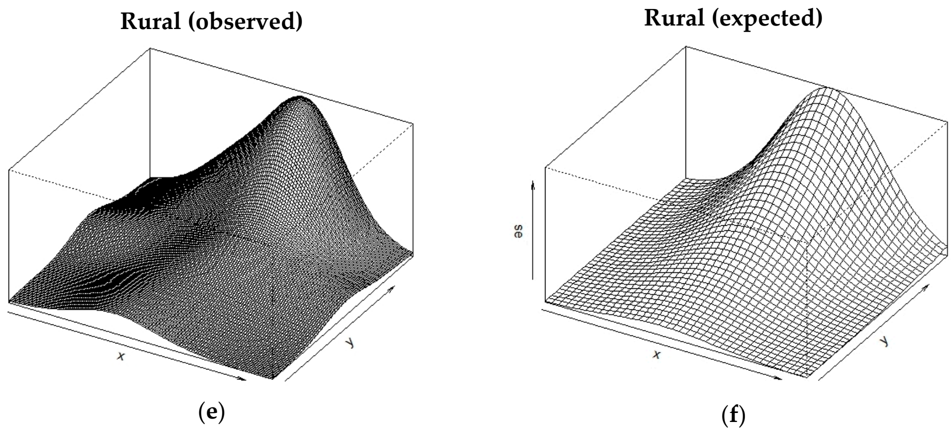

Figure 4. Comparison between the observed (**left**) and the expected (**right**) spatial pattern under model (7) of accommodation establishments in Extremadura (**a**) Hotels (observed) (**b**) Hotels (expected) (**c**) Extra-Hotels (observed) (**d**) Extra-Hotels (expected) (**e**) Rural (observed) (**f**) Rural (expected).

All calculations in this paper were made with the R package "spatstat" [80]. The point process models estimated in spatstat are Gibb point processes [70,71,81].

6. Discussion and Conclusions

The interaction of tourism and space achieves special relevance in the field of tourism activity planning and management. The planning processes of the tourism sector need to have exhaustive information that allows the different agents involved to make decisions based on the situation of the sector. In this sense, incorporating information on the distribution patterns of tourist activity in the territory allows for more efficient management of resources, favoring certain positive synergies such as those derived from agglomeration economies, and managing and minimizing possible negative impacts such as the saturation of the destination or excess competition.

This trend takes the form of the proliferation of studies which, through the conjunction of GIS (Geographic Information Systems) and proprietary techniques of spatial statistics, seek to explain how tourist variables are distributed in space, proposing different theoretical or empirical models that allow operationalization decision-making in relation to different areas of tourist activity, considering their interaction with space.

The present work begins with the aim of proposing a model with a satisfactory level of adjustment with the existing pattern of points in Extremadura. It is an inland region which is in a stage of expansion, and based on the identification of different previous studies, this presents a series of imbalances that deserve to be analyzed for the proper planning of the evolution and needs of the sector. The authors therefore consider that modelling this pattern can be a valuable tool for public–private sector management.

After proposing and estimating different models considering the intensity of accommodation conditioned by longitude and latitude, it was found that the model which best fits the reality of the region is to show that tourist intensity is in a quadratic relationship with latitude and longitude for the three types of accommodation used to carry out this research.

Knowing the model that best explains the geographical location of the supply of the accommodation establishments in a tourist destination is essential in both public and private tourism management. The creation of accommodation infrastructure in a destination must always start from a previous premise: these infrastructures are not equally necessary throughout the destination. It is only when the intensity of these infrastructures is spatially homogeneous throughout the entire territory of the destination that the opening of new tourist accommodation is equally successful regardless of where it is located. However, this situation of spatial homogeneity is unusual at tourist destinations, since the usual scenario is that there are spatial concentrations in the supply of tourist accommodation, especially around tourism resources and products offered by the destination. For this reason, modelling the intensity of accommodation at a destination is a preliminary step in determining whether the location chosen for the opening of new establishments is the most appropriate.

From the perspective of the public tourism administration, the aid granted for the creation of tourism infrastructure in general and accommodation infrastructure in particular hardly ever takes into account the influence of the location on the suitability of that new infrastructure. Providing financial aid to create a new offer of accommodation in spaces where there is a high concentration of establishments (observed values higher than expected ones) only contributes to increase competition between the accommodation establishments located in that space. On the contrary, the location in spaces with a deficit of accommodation (observed values lower than expected ones) can help to create tourism development which currently does not exist, owing to a lack of infrastructure among other things.

In addition, considering the characteristics of the objective territory in which natural resources constitute an important claim for the satisfactory operation of the tourism sector, it is essential to create a sustainable development model that allows for the correct exploitation of its resources while guaranteeing their preservation. In this sense, monitoring those areas with the highest tourist intensity will be essential in order to guarantee that the tourist carrying capacity that can be associated with the territory is not exceeded for proper resource management.

Furthermore, from the perspective of private entrepreneurship, knowledge of the focus of business concentration at the destination is vital information when it comes to guiding investments. In those areas of the territory that are considered "tourist deserts" due to the limited offer of accommodation and complementary services (probably due to their low tourist attraction), investment groups will therefore not be interested in investing in the creation of tourist infrastructure, since it is very probable that the low tourism activity compromises the economic profitability of the project. On the contrary, in the spaces of the territory in which there is a high concentration of tourist accommodation and a complementary supply ("tourist oasis"), investment will be much more attractive given that the existence of scale economies between companies and complementary services will guarantee a minimum economic return that will encourage investment in the area.

In this way, the research carried out in this paper has an unquestionable practical use as ignoring the spatial distribution of the accommodation supply in a destination can lead, in most cases, to incorrect political and business decisions.

Having a model in which one can estimate the expected number of accommodation establishments that should be in a specific geographical space from the coordinates of longitude and latitude of that space and comparing it with the actual (observed) number of accommodation establishments is a very valuable tourism management tool which should be considered by all tourist destinations.

As a future line of research, and as there is no evidence of the existence of similar studies in destinations comparable to that analyzed, it would be interesting to extend this modelling proposal to other territories to confirm whether similarities exist that can be understood as characteristics of inland destinations in a stage of growth. On the other hand, although the present work focused on proposing a model that, by means of the position of each one of the accommodations that make up the accommodation plant in the region, allows us to describe how these accommodations are distributed in the region object of study in an operational way, it would be interesting in future works to be able to include other covariates that can help explain the identified spatial distribution pattern, such as income level, prices, or proximity to communication routes, at the same time that it allows the suggestion of development possibilities depending on the endowment of available resources.

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