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Factors Affecting Public Transport Use in Touristic Areas

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Abstract

The paper explores the underlying unobserved factors that influence transit ridership as well as the levels of satisfaction when using transit services of both tourists and residents in tourist areas in the peak summer period and in winter. The popular tourism destination of the Island of Kos in Greece was used as the case study for this research, while two appropriate statistical methods were employed, Factor Analysis and Ordered Probit models. According to the analysis, the most significant factor for the tourists when deciding to use public transport is service production, reflecting route frequencies and reliability of service. On the contrary, residents place more focus on qualitative aspects such as comfort, safety and information. Furthermore, a common factor that holds a high position in the preferences of both tourists and residents is transfer quality, comprising attributes related to transfer coordination. The paper presents in detail the results derived from the two analyses and discusses the use of these results by local authorities in order to adjust their policy plans accordingly and to define actions that can better tackle the residents and tourists' needs and expectations.

Keywords: *Customer satisfaction, transit ridership, seasonal transport demand*

1. Introduction

Many urban touristic areas around the world face numerous problems caused by the seasonality of transport demand, meaning the predictable or unpredictable variations in demand for transport services imposed by other sectors; in this case tourism. Such problems are congestion in the major transport routes, damage of the transport infrastructure, severe environmental pollution, energy loss, increased travel times, damage to the natural environment, low quality services provided to the visitors and harms to the historical sites. Another crucial problem encountered in these areas is the major difference of the traffic and transport patterns between low and high touristic seasons. For example and in areas where the tourist peak is concentrated in the summer, the increase in the traffic flows may exceed the 600% in relation to the low season (*i.e.*, winter). This major imbalance in traffic flows between low and high seasons generates even more negative effects related to problematic use of transport resources and unemployment. The latter applies to specific transport means used to tourists' mobility, such as tourist buses. In the low season these means are not used at all.

Moreover, with the sharply increasing number of vehicles on the road connections in these regions and the ever decreasing possibilities for creating enough new resources to cater to seasonal demand, road traffic threatens to come to a grinding halt.

Therefore, the effective handling of seasonal traffic peaks is essential so as to avoid the decrease in tourism in these areas and therefore to maintain the high income deriving from the

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tourist sector. Research needs to focus on finding ways to understand the seasonal traffic patterns and also the mobility behaviour of tourists and residents. Furthermore, research efforts may provide valuable knowledge to policy makers in tourist areas. Despite the fact that some research has already been conducted regarding mobility management in tourist areas, as shown below, research and policy-making operate under different settings, each with its own professional culture, resources, imperatives and time frames [1]. Since knowledge brokerage is not only concerned about knowledge transfer from researchers to policy makers [2], there is an imperative need to provide the responsible decision makers in these areas with the suitable tools and information that will facilitate their decision making process in order to create sustainable transit means.

Tourists and residents are two different target groups with different characteristics, mobility needs and priorities. Understanding their mobility habits, needs and expectations will give a major insight into the key criteria that drive their mobility choices and therefore the policies and actions that need to be taken in order to establish a socially acceptable and sustainable transportation environment.

In this respect, the aim of the present research is to explore the factors influencing the use of public transport of both tourists and residents in an attempt to facilitate the transport planning process in areas with seasonal variations of transport demand and to adjust the mobility services accordingly. Two statistical methods have been employed, Factor Analysis and Ordered Probit models, through which two distinctive analyses have been conducted respectively: a) the factors influencing the use of public transport between summer and winter periods for both tourists and residents have been first identified, and b) the way these factors affect the satisfaction of tourists and residents with respect to transit services in the summer period (market segmentation analysis) has then been quantified. The first analysis aims to uncover factors that drive the choices of both target groups when deciding to use public transport and explore the differences between these choices, while the estimated models of the second analysis explain the variability of the perceived satisfaction in different factors taken into account by the two target groups when traveling with public transport in the peak summer period.

The paper presents the results derived from the two analyses and discusses the use of these results by local authorities in order to adjust their policy plans accordingly and to define actions that can better tackle the residents and tourists’ needs and expectations.

2. Background

2.1 Literature review

The literature review conducted for the needs of this research is presented below along two axes: the first includes scientific publications and the second research projects, both in the direction to provide an overview of the research and scientific efforts performed in the topic of understanding the mobility behaviour of tourists and residents in tourist areas.

One of the few scientific approaches in an attempt to examine together tourism and mobility was performed by Hall [3], who defined a framework for understanding tourism in relation to contemporary human mobility over space and time. In this framework, the implications of tourism over mobility are outlined with respect to mobility as a form of capital, the relationships between different forms of mobility, including public transport as examined by the present research, and an improved understanding of tourism's impacts at all stages of the travel process rather than just at the destination.

In his research, Høyer linked sustainable tourism with the concept of sustainable mobility [4]. He quite well argued, “the current focus on stationary activities and local, intensive environmental issues is too limited both in relation to the concept of tourism and the concept of sustainable development". Therefore, he bridged the two concepts bringing into a critical discussion new forms of tourism and changes of mobility means.

Szivas *et al.*, conducted a study in the United Kingdom examining labor mobility into tourism [5]. Their research was oriented towards mobility patterns of tourism employment. According to their results, there are no significant differences between the rural and the urban experience of mobility. Another interesting survey associated with focus groups was conducted by Rubin and Deakin aiming to assess mode choices, attitudes toward transit and other modes, and willingness to pay for reliable service in the San Francisco Bay Area [6]. In some of their findings, the factors that most significantly affected mode choice were whether the traveller had a free parking space and whether access to and from the mainline transit service, bus or rail, was fast. The research presented in this paper gives major insight on the use of public transport by travellers (and residents) and reveals particular factors that drive their choices.

Using as case the Old City of Jerusalem, Israeli and Mansfeld performed a study that investigates the interrelations between urban tourism and transportation systems [7]. They derived recommendations on the preferred combined strategies, including decentralization of the tourism demand, better transportation-oriented management of the tourist attractions, improved tourism demand management, and the introduction of information technology as a supporting management tool.

Go and Govers placed mobility in a broader perspective of quality management in tourist destinations towards achieving competitiveness [8]. Applying the European Foundation for Quality Management model, they conducted a comparative survey of eight best practice case studies of different destinations in four European countries. According to their results, integrated quality management (meaning including measures and actions that stimulate complete monitoring and management of the quality of transport services) in tourist destinations is rather underdeveloped, while mobility is not high in the priority list of local authorities. The results of the present research may contribute to define factors that are of major importance for travellers when mobility using public transport in tourist destinations comes in question.

Although the scientific research conducted so far regarding seasonality of transport demand and the customer satisfaction in terms of mobility is quite limited, there are however specific research actions and initiatives worth mentioning, some the most important of which are presented below:

DELTA, an EC 7th Framework Programme funded project, comprises the most recent research initiative regarding the handling of seasonal traffic peaks related to tourism mobility management in Europe. The main aim of this project was to give to local stakeholders and policy makers knowledge and tools (*e.g.*, strategies, policy support, research guidelines and benchmarks) in order to effectively tackle the serious effects of seasonal transport demand.

The research conducted in the framework of the DELTA project clearly demonstrated the gap in the existing knowledge on the issue of handling seasonal variations of transport demand. The review verified that the issue of mobility management mainly in cities has been extensively addressed by many projects and initiatives and at different levels, while on the other hand, only few projects have concentrated mobility management on tourist regions and examined seasonality and only from a peripheral perspective and marginally [9]. The present research may provide additional knowledge to the DELTA project results and to its tools by stimulating how public transport use can be further promoted in areas with seasonal traffic peaks.

The first European project that attempted to address the sectors of tourism and transport, the results from awareness of the increasing significance of tourist flows for the management of transport infrastructures and services, and the specificities of tourist transport was the ARTIST Project (Agenda for Research on Tourism by Integration of Statistics). This project, funded under the 4^{th} Framework Programme, addressed the lack of analysis of tourism's significance in transport studies, particularly in relation to the urban sector. The project proposed solutions and practices to planning and environmental problems tourism mobility can create in cities and, more generally, in tourism destinations, making recommendations to both public and private sector players in European tourism and to the European Commission, so as to evaluate the need for a specific Commission initiative [10]. Although the results of this project may be regarded outdated (as of 2000), its recommendations are still valid due to the limited or inadequate bridging of the gap between tourism and transport in tourist areas. The current research may enrich the recommendations agenda placing particular emphasis on how to encourage public transport use.

The International Association of Public Transport (UITP) conducted in late 2001/early 2002, in cooperation with Aare Seeland Mobil, a survey regarding the benefits that leisure and tourism can bring to public transport. In the relevant document where the results of the survey were published, the benefits of the public transport sector were assessed, the need for sustainable mobility was examined, while the opportunities for the increase of both the tourism sector and the use of public transport modes were investigated [11].

Finally, the German Federal Ministry of Education and Research (BMBF) conducted a survey in the framework of the “Social Ecological Research” program that dealt with the tourist travel behaviour, the individual characteristics of travellers and the potential strategies to change this behaviour [12]. The results of the survey included the holiday mobility of the sample, the definition of the travel groups and their description, the ecological assessment of the travel groups, the prediction of greenhouse gas emissions and the potential for change in the travel behaviour. Encouraging travellers to use more public transport means by examining their preferences is a subject that is directly related to the scope of the above survey.

2.2 Synthesis and contribution

Mobility management is a field for which in depth analysis and intense research have been conducted. Numerous research efforts and initiatives have dealt with various aspects of this field, while it is also a very popular topic of scientific publications and presentations. Especially, the analysis of travellers’ satisfaction, the factors affecting passengers’ modal choices, the public transit user satisfaction and the travel information analysis are some of the most extensively research topics in the international literature. However, the vast majority of these concentrate on urban areas. The literature review presented above revealed that very few research efforts address the seasonal variations of transport demand and the factors that affect tourists and residents transit choices in tourist areas.

Therefore, the major contribution of the present research to the current knowledge and scientific community as well as its added value lay on the use of appropriate statistical methods for analysing tourists and residents’ mobility behaviour with public transit in tourist areas. The paper addresses an unexplored research field and proposes a methodology for assessing the quality implications of the variability of the users’ perceived satisfaction with respect to the public transit systems.

3. Case study and Methodology

3.1 Study area

Kos island is located in the South East Aegean Sea in Greece and is one of the most popular Greek destinations mainly for European tourists. In 2011, Kos was visited by more than 1.1 million tourists. 5% of these tourists were Greeks, 70% originated from other EU member states, while the remaining 25% came from outside the EU [13]. Kos has a population of close to 31.000 residents and a surface area of 287.2 km^2. Kos' residents own approximately 13.000 cars. The peak season in Kos includes July, August and September. These three months account for 71% of the tourists visiting the island throughout the entire year.

There are two bus public transport operators in Kos, the Municipal bus transit operator and the interurban bus operator. The first serves the city centre and the surrounding areas, while the second the rest of the island. Tour buses and coaches are not considered public transport modes in this research, as they do not provide organized scheduled transit services. During the high tourist season, the frequency of both bus operators' services is satisfactory (on average every 10-15 min. depending on the line), however the coverage of remote destinations is the main weakness of the existing public transport system [14]. The most popular poles of attraction are covered.

Cycling, public transport and coach are the dominant modes used by tourists, as the modal split for the tourists is: 25% cycling, 25% bus, 19% rental car, 18% walking and 13% taxi [13]. Cycling is extensively used by tourists, since Kos has one of the most attractive and well organized cycling infrastructures in Greece, including 28 km of two-lane cycling network connecting many hotels and resorts with well-known tourist attractions, such as beaches, archaeological sites, *etc.* The cycling infrastructure also includes parking stations at terminals, signalizing pathways and bicycle rental services.
For residents, the situation during the tourist season is different, since modal split is allocated as follows: 28% private car, 20% motorbike, 19% bus, 13% cycling, 13% walking and 7% taxi. In winter, the situation is much worse, since the vast majority of daily trips is conducted with private cars (90%) [14]. Despite these figures, it is very encouraging that residents are becoming more and more familiar with this mode, as they directly see the benefits of using it. Therefore, a high priority of the local authorities is to further expand the cycling network and develop additional forms of mobility based on this network, such as bike sharing. This policy is strengthened by traffic congestion especially in the peak period taking into account that the average mileage travelled annually by rental cars alone is approximately 55 million km.

3.2 Data Collection

A customer satisfaction/dissatisfaction questionnaire survey was conducted in summer 2011 aiming to obtain the opinions and preferences of both tourists and residents concerning the provided public transport services in the island of Kos. The questionnaire is broken into three parts:

- Part A: Information about the respondent;
- Part B: Trip description (presented in Appendix A with frequency of responses filled in); and
- Part C: Evaluation of transport services (presented in Appendix B, with average values of the responses filled in).

The survey included a number of qualitative and operational service attributes (parameters). The list of attributes finally used was based to a large extent on the TRB's Handbook for Measuring Customer Satisfaction and Service Quality [15], following some adjustment to reflect existing conditions in the island, the particular characteristics of the local transportation systems and the key priorities of the local authority. The selected attributes were classified in four categories, which are presented below:

1. Before trip, including attributes related to the availability of tickets, the availability of trip information, walking time to the bus stops and network coverage.
2. Terminals and bus stops, including attributes related to waiting time at the terminals/bus stops, route frequencies, schedule adherence/delays, availability of route information at the bus stops, availability of waiting time information at the bus stops, seat availability at the bus stops, bus stops' conditions (comfort, cleanliness, protection from weather conditions and safety).
3. On board conditions, including attributes related to congestion, cleanliness inside the bus, seat comfort, existence of air-conditioning, safe driving, passengers safety, driver behaviour.
4. Transfer points, including attributes related to distance between transfer points, waiting time at transfer points and information provision at transfer points.

In total 23 qualitative and operational service attributes were included in the questionnaire, while 445 tourists and 327 residents responded to the survey. In each attribute, the respondents were asked to provide two rates: one for significance and one for satisfaction, both in a four-level rating scale. The satisfaction rate was distinguished between summer and winter periods, only for the residents.

3.3 Methodological elements

Two statistical methods have been used for the analysis of the survey responses. The output of these statistical methods is then interpreted in order to assess the quality implications of the variability of the users' perceived satisfaction with respect to the public transit systems.

3.3.1 .Factor analysis: The objective of factor analysis is to reduce the number of p variables in a dataset into a smaller set of $m < p$ variables. The m factors are usually unobservable factors that describe the correlation among the p variables. Factor analysis is closely related to principal components analysis (*e.g.*, both rely on the correlation matrix), but, unlike principal components analysis, it is based on a specific statistical model [16]. Factor analysis was developed in the early 20th century by Karl Pearson and Charles Spearman with the intent to gain insight into psychometric measurements, in particular the directly unobservable variable intelligence [17]. Factor analysis should not be blindly applied to a dataset with several variables hoping that some underlying patterns would be uncovered; instead, a theoretical motivation should drive factor analysis applications.

In the remainder of this section, the presentation and notation from Washington et al. [16] is used. The factor analysis model can be formulated by expressing the X terms as linear functions, such that

$$
\begin{aligned}
X_1 - \mu_1 &= \ell_{11}F_1 + \ell_{12}F_2 + \cdots \ell_{1m}F_m + \varepsilon_1 \\
X_2 - \mu_2 &= \ell_{21}F_1 + \ell_{22}F_2 + \cdots \ell_{2m}F_m + \varepsilon_2 \\
&\vdots \qquad\qquad \vdots \qquad\qquad \ddots \qquad \vdots \\
X_p - \mu_p &= \ell_{p1}F_1 + \ell_{p2}F_2 + \cdots \ell_{pm}F_m + \varepsilon_p
\end{aligned}
$$

Where the F are factors, with means μ are the means of the observed variables X and the l are the factor loadings. The ε are associated only with the X, and the p random errors and the pxm factor loadings are unobservable or latent.

In matrix notation, the factor analysis model is given as

$$
(\mathbf{X} - \mu)_{p \times 1} = \mathbf{L}_{p \times m}\mathbf{F}_{m \times 1} + \varepsilon_{p \times 1}
$$

The above systems have p equations and $p+m$ unknowns (the p error terms and the m factor loadings), which implies that a unique solution cannot be obtained without additional information. Additional restrictions, in the form of factor rotation models, are typically imposed, resulting in orthogonal or oblique factor analysis models. Varimax rotation maximizes the sum of the variances of the factor loadings and is commonly used for orthogonal rotation. Oblique factor analysis models relax the restriction of uncorrelated (orthogonal) factor loadings, striving to obtain a more easily interpretable factor structure.

The objective of the various rotations is to move each factor as close to 1 or 0 as possible. Large factor loadings indicate a significant influence of the factor to the respective variable, while small factor loadings suggest that the variable is not substantially influenced by that factor. Therefore, extreme loading values are more easily interpretable, and therefore more desirable. One key question associated with factor analysis is the determination of the appropriate number of factors. The approach followed in this research is to incrementally increase the number of factors and check the amount of the variance that each additional factor explains. This process stops when no additional factor can explain more than 10% of the variance of the data. This process is similar to the scree plot approach and is demonstrated in the factor analysis results presented in the next section.

3.3.2.Ordered probit model: Respondents in surveys are often asked to express their preferences in a rating scale. Such scales are often called Likert scales [18,19]. A multinomial logit model could be specified with each potential response coded as an alternative. However, the ordering of the alternatives violates the independence of the errors for each alternative, and therefore the Independence for Irrelevant Alternatives (IIA) assumption of the logit model. Nested or cross-nested models are one approach to overcoming this issue [20], while multinomial probit models also do not suffer from this limitation. Ordered logit and probit models provide another approach that estimates parameter coefficients for the independent variables, as well as intercepts (or threshold values) between the choices.

Figure 1 shows the distribution of the choice probability P as a function of the utility U. Assuming a ranking scale with four levels (like the one used in the questionnaire in this study), there are three thresholds or critical values (k1 through k3) that separate the four choices ("Unacceptable", "Not good", "Good", "Very good"). For example, respondents choose the alternative "Unacceptable" if the utility is below k1, alternative "Not good" if the utility is between k1 and k2, and so on.

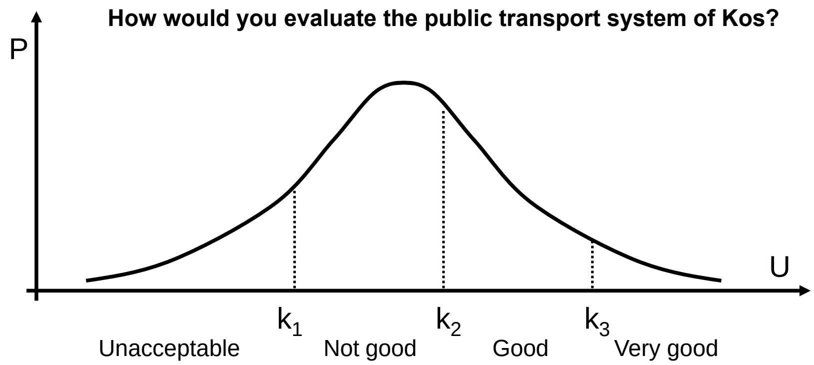

Figure 1. Distribution of the respondents' preference (adapted from Train [21])

In the ordered probit models developed in this research, the ordered response is used directly as the dependent variable. In each model, the response variable takes numerical values between 1 and 4, with 1 indicating that the respondent is stating that he considers the public transport system in Kos as unacceptable and 4 indicating that the respondent would evaluate the system as very good.

If Y is the response factor with K levels, the model can be written as:

$$P(Y \leq k_i \mid x) = P(\beta' x \leq \theta_j) = P(u \leq \theta_j - \beta' x) = \Phi(\theta_i - \beta' x)$$

Where:

- Φ is the cumulative normal function,
- $\Phi(\theta_j - \beta' x)$ is the cumulative distribution function of an unobserved random error term u,
- $\theta_0 = -\infty < \theta_1 < \ldots < \theta_k < \infty$ are the breakpoints,
- x is the vector of the explanatory factors, and
- β is the vector of the unknown parameters.

3.4 Measurement items for SEM

Wordings for the measurement items were adapted from relevant prior studies [34, 36, 38] with changes to make them contextually suitable. PBC was represented by two items of CON and PD, and five items of PC. Section 3.2 discussed the trip attributes which were used to measure the control beliefs of self-efficacy and PC. All measurement items were presented in the context: given travel time savings using routes with transfers, will improvement made to the trip attribute in question cause the PT user to feel more capable of using the connections, *i.e.*, will the relevant control beliefs become more positive. For CON1 and CON2, the term "more confident" was used to capture their sense of ability. For PD1 need for information, the terms "easy or difficult" was used to assess if PT users' felt more capable of making transfers with better information on connection. Similarly for PD2 perception of security, the term "comfortable or uncomfortable" was used to capture their sense of reassurance for personal safety given good security provisions. Dzieken and Vermeulen [58] discussed that travelers are more willing to use PT given that their fears have been addressed. Intention was measured by two items and behavior was the only construct measured as a dichotomous variable [36]. The items for intention and behavior were presented under the assumption that the transfer routes have high quality information services, minimized transfer waiting and walking times, highly reliable connections and good security facilities.

Table 1 gives the measurement items for the constructs of the research model. All items except the item for behavior were measured using a Likert scale. Participants selected either “Yes/No” for the behavior item. The Likert scale represents one of the most adopted approaches for generating reliable scales of individual differences [59, 60] and has been commonly used in travel behavioral studies [11, 30, 31, 61]. A 5-point Likert scale (“1” for strongly disagree to “5” for strongly agree) was used in the present study.

4. Research Results

Survey respondents were asked to rate each attribute according to how they would rank the public transport service in question with respect to that attribute (satisfaction). The data were used as input for the factor analysis. The output of the factor analysis (loadings) was used to create variables reflecting the four factors. In particular, the factor values for each observation were created by multiplying the factor loadings by the individual satisfaction values that the respondents had indicated for each of these values. Since a number of different variables were assessed (23 as a matter of fact), the final factors were divided by the number of variables in order to maintain the scale of the factors (*i.e.*, 1 to 4, as the original variables). The obtained factors were used as explanatory variables in ordered probit models explaining the respondents’ satisfaction (*i.e.*, using the answer to the question “how satisfied are you with public transport services”) as the dependent variable. All models have been estimated using the R framework for statistical computing, v. 2.15.1 [22].

4.1 Factor analysis

Four factor analysis models were developed:

- one for summer for all respondents;
- one for summer for residents only;
- one for summer for tourists only;

Table 1 presents the results for these four models. Different models have been estimated and the best one has been retained. One key parameter relates to the number of factors. The criterion that has been used is to retain factors that explain at least 10% of the variance of the respective model). The obtained factor loadings have been rotated to obtain a practical and easily interpretable set across the various models. To simplify the interpretability of the models and the presentation of the table, loadings below 0.3 are not shown. Furthermore, loadings above 0.6 are highlighted in bold. For two of the models (summer for all respondents and winter for the residents) the optimal number of factors is four, explaining almost 61% and 70% of the variability, respectively, while for the other two models (summer for residents and tourists, respectively) three factors are retained, explaining almost 60% and 62% of the variability.

The objective of factor analysis is to try to discern and recognize the underlying unobserved factors that the respondents perceive. Such an interpretation of the main factors is attempted in the last line of Table 1. Each of the factors has been interpreted as one of the following:

- Transfer quality: comprising attributes related to transfer coordination (distance, waiting time and information provision),
- Service production: reflecting service frequency and reliability,
- Service information: reflecting information about the offered service, or
- Comfort/ Safety/ Information: comprising information on the comfort of the service, the safety, information provision and behavior of the personnel.

The interpretation of the factors is based on an assessment of the variables that the factor analysis groups together. It is not unlikely that a seemingly unrelated variable is grouped by the factor analysis algorithm into a factor. Furthermore, in some cases, these factors may be combined (such as the interpretation for Factor 1 in the model for tourists), or only a subset of the interpretation may be isolated (*e.g.*, only comfort in lieu of the combination of comfort/safety/information for factor 4 for the model for residents in the winter).

Some interesting observations can be made when one looks at the factor analysis results for the residents. In particular, there is a significant difference in the fraction of the variance that is explained by the factor Service production (17.5% in the summer, but 26.1% in the winter), while the fraction of the variance explained by the other factors remains roughly the same (comfort/information accounted for 27.1% in the summer and 16.5+13.5=30% in the winter, while Transfer quality accounted to 15.2% in the summer and 13.7% in the winter). This approximately 10% increase in the proportion of the variance that is explained by the factors is reflected in the total variance that is explained, which increases from about 60% in the summer to about 70% in the winter for residents. This increase -which as discussed above is not due to the larger number of factors, as the proportion explained by the other factors is overall the same- may be explained by the more varied lifestyle in the summer (as opposed to the more limited activities in the winter).

Figures 2 through 4 provide some further insight regarding the distribution of each of the four factors for the various groups. The factors were calculated through multiplication of the loadings for each factor with the data values for each individual. As a result, empirical distributions of these factor values for the considered sample were obtained. Theoretical distributions (among a number of well-known distributions) have also been fit. Figure 2 demonstrates the statistical diagnostics that have been considered in selecting the appropriate theoretical distribution (statistical tests have also been performed): Q-Q plot, plot of theoretical and empirical CDFs and P-P plot. The factor “Service information” for the summer period (all respondents) has been selected, as an example; the best-fitting theoretical distribution in this case is the Weibull.

Figure 3 shows the empirical vs. theoretical distributions for all factors for the summer period and all respondents. The distribution that best fit the first factor is the normal, for the second it is the log-normal, while for the last two Weibull distributions provided the best fit. Figure 4 provides a comparison across models, choosing the “Transfer quality” factor, which is shared across all groups. The best-fitting distribution for the summer (all respondents) is a log-normal, while for the other three cases (the summer, both for residents and tourists, as well as winter for the residents) it is a cauchy.

Table 1. Factor analysis results

	SUMMER - ALL RESPONDENTS				SUMMER - RESIDENTS			SUMMER - TOURISTS			WINTER - RESIDENTS			
SATISFACTION	Factor1	Factor2	Factor3	Factor4	Factor1	Factor2	Factor3	Factor1	Factor2	Factor3	Factor1	Factor2	Factor3	Factor4
BEFORE TRIP														
Availability of tickets				0.351		0.531						0.461		0.396
Availability of trip information			0.462	**0.603**	0.342	0.583		**0.652**		0.351	0.527	0.592		
Availability of information regarding bus stops			0.481	0.473	0.49	0.496		0.579			0.332	**0.876**		
Walking time to the bus stop				**0.898**		**0.891**		**0.601**				0.513		**0.66**
Network coverage		0.377	0.339	0.592		**0.685**	0.45	**0.657**		0.374		**0.81**		
AT THE BUS STOPS / TERMINALS														
Waiting time at the terminal/bus stop		0.315		0.595		**0.699**		**0.868**						**0.88**
Route frequencies			0.47	0.409	0.327	0.52	0.309	**0.885**				0.347	0.337	0.435
Schedule adherence / Delays		0.334	0.391		0.562			0.57		0.32	**0.619**			
Availability of route information at the bus stops			**0.758**	0.34	**0.716**	0.345		**0.78**		0.382	0.392	**0.704**		
Availability of waiting time information at the bus stops	0.326		**0.735**		**0.807**			**0.81**			**0.715**			
Seat availability at the bus stop	0.595		0.369		0.563			0.45	0.453		0.522	0.468		
Bus stop shelters: comfort, cleanliness, protection from weather conditions	**0.660**	0.329			**0.727**				0.538	0.416	**0.659**	0.319		
Passenger safety at bus stops	0.458		0.496		**0.696**			**0.677**	0.4		**0.763**	0.358		
ON-BOARD														
Bus capacity (congestion)	0.568	0.504			0.498	0.338	0.462	0.422	0.499	0.538	**0.739**			
Cleanliness inside the bus	**0.624**		0.359		**0.879**				0.545	0.485	**0.81**			
Seat comfort	**0.668**			0.411		**0.63**			**0.805**		0.327			**0.617**
Existence of air-conditioning	**0.713**				0.454	0.366			**0.811**		**0.614**			0.419
Safe driving	**0.691**				**0.785**			0.346	**0.731**		**0.817**			
Passengers safety	**0.686**		0.374		**0.793**			0.401	**0.79**		**0.669**		0.469	
Driver behavior	0.46				0.347	0.341			0.546	0.303	0.35			**0.654**
DURING TRANSFER (if applicable)														
Walking time for transfer at interchanges or from bus stop to bus stop		**0.874**					**0.874**			**0.868**			**0.871**	
Availability of transfer information at bus tops		**0.875**					**0.959**	0.503		**0.697**			**0.917**	
Waiting time for transfer at bus stops		**0.799**					**0.855**	0.483		**0.631**			**0.823**	
Factor Interpretation	Comfort/ Safety	Transfer Quality	Service Information	Service Production	Comfort/ Safety/ Information	Service Production	Transfer quality	Service Production/ Service Information	Comfort/ Safety	Transfer quality	Service Production	Service Infor-mation	Transfer Quality	Comfort
	Factor1	Factor2	Factor3	Factor4	Factor1	Factor2	Factor3	Factor1	Factor2	Factor3	Factor1	Factor2	Factor3	Factor4
SS loadings	4.386	3.395	3.136	3.092	6.225	4.032	3.503	6.532	4.376	3.246	6.013	3.786	3.14	3.095
Proportion Variance	0.191	0.148	0.136	0.134	0.271	0.175	0.152	0.284	0.19	0.141	0.261	0.165	0.137	0.135
Cumulative Variance	0.191	0.338	0.475	0.609	0.271	0.446	0.598	0.284	0.474	0.615	0.261	0.426	0.563	0.697

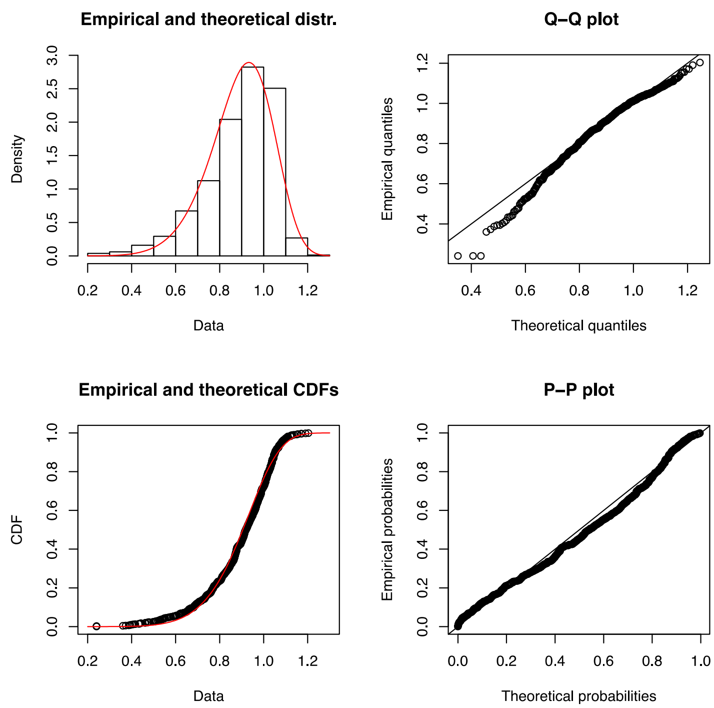

Figure 2. Empirical vs. theoretical distribution (Weibull) for factor "Service Information" for the summer period (all respondents), along with goodness of fit diagnostics

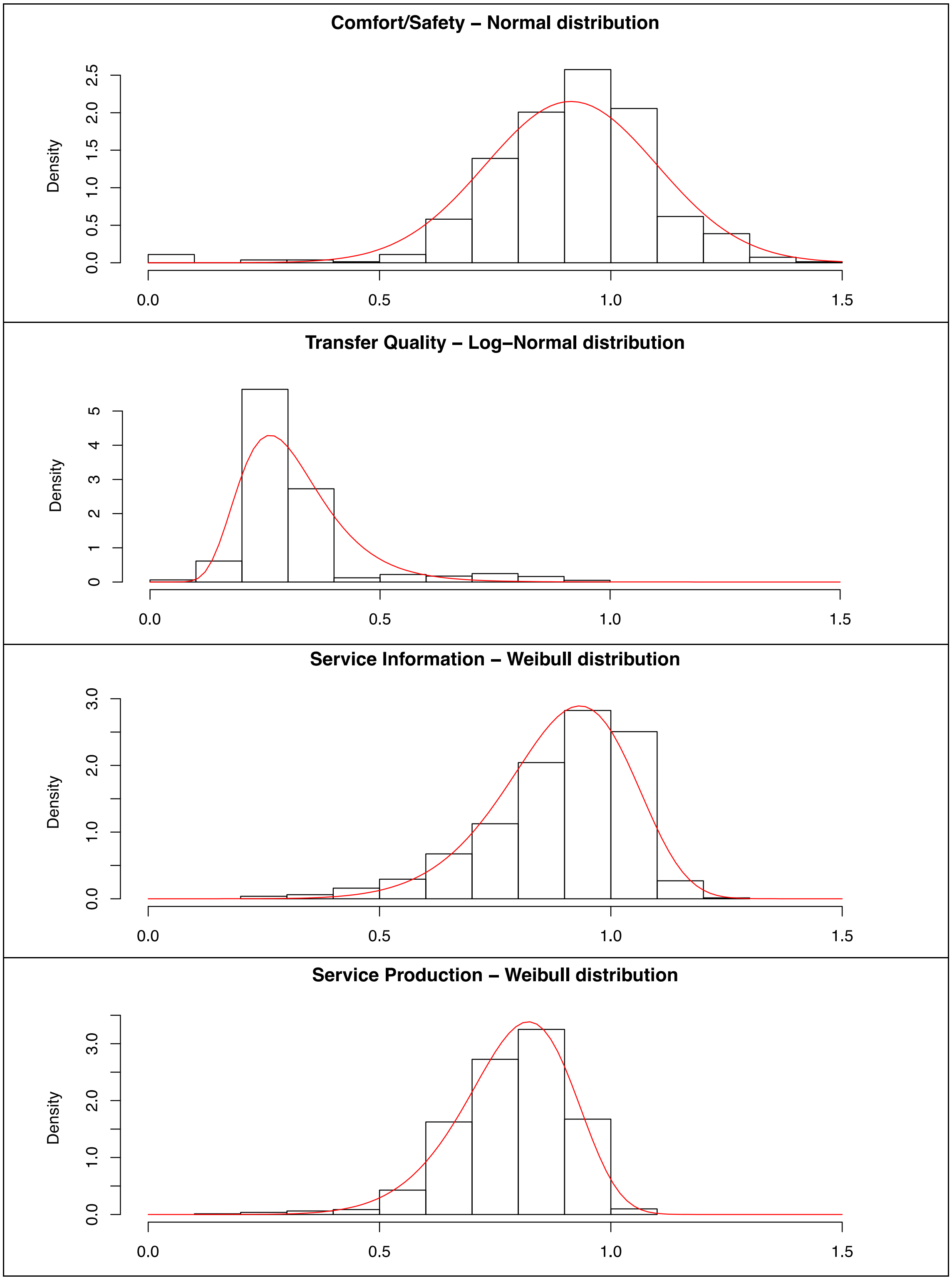

Figure 3. Empirical vs. theoretical distributions for all factors for the summer period (all respondents)

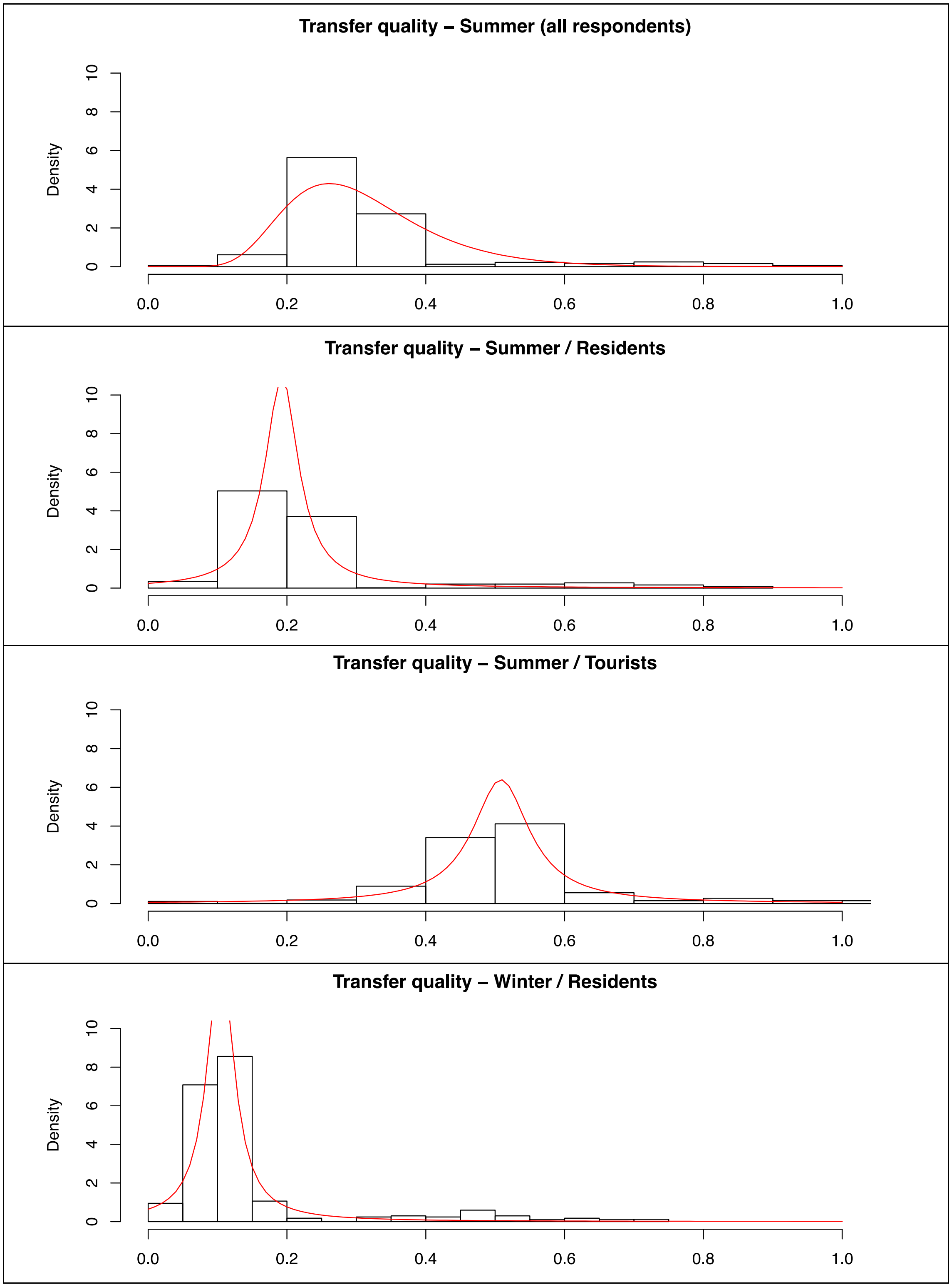

Figure 4. Empirical vs. theoretical distributions for transfer quality across all groups

4.2 Analysis of users' satisfaction by the transit services

The satisfaction data of the surveyed individuals was used to fit a number of ordered probit models. Table 2 presents the results of the ordered probit model estimated for all respondents for the summer months. The considered explanatory variables were the three factors that were obtained through the factor analysis in the previous section, plus socio-economic and other data about the respondents. A full model with all available attributes as explanatory variables was estimated first. The model was then gradually simplified by removing attributes that did not contribute to the model. In general, variables whose inclusion contributed less than 1/2 AIC [23] point were removed. The intention of the researchers was to retain only coefficients that are significant at the 95% level; however some coefficients significant at about 90% have also been retained, when it could be justified (*i.e.*, in the case of bicycle being the habitual model, which is a variable that appeared very significant in other models). The satisfaction variables were obtained in a range of 1 (most dissatisfied) through 4 (most satisfied). As a result, the estimated coefficient of the contribution of each service attribute to the satisfaction should be positive. Furthermore, as the coefficients are in the same scale (since each variable takes the same values, *i.e.*, 1 through 5), the unit-less coefficients are directly comparable.
A positive coefficient for a socio-economic and other variable indicates a positive link with satisfaction, while a negative coefficient suggests the opposite. For all respondents in the summer period, the most important satisfaction parameter is comfort/safety, followed by the provision of service information. Younger people are in general more satisfied with the services (possibly because they are in good physical shape and can walk to the stops). Respondents whose usual mode is bicycle or walking show a higher satisfaction level over the others, which is a reasonable finding as they are accustomed to alternative and environmentally friendly (compared to the passenger car) modes of transport. It is reminded that Kos has an excellent bicycle network and this transport element is reflected in the results. Finally, the summer respondents that consider the sufficiency of routes significant in their decision to use public transport are more satisfied with the transit services.

Table 2. Ordered probit models of satisfaction of PT users

	Summer - All respondents	
Coefficients:	Estimate	t-value
Comfort/Safety	1.644	4.786
Service Information	1.341	3.777
Age between 19-29 y.o.	0.2948	3.082
Usual Mode: Bicycle	0.4575	3.572
Usual Mode: Walking	0.2357	1.654
Significance: Routes Sufficient	0.1369	1.947
Intercepts:	Estimate	t-value
1|2	1.3698	3.498
2|3	2.498	6.315
3|4	4.5127	11.0053

Number of observations:	801	
Residual Deviance:	1466.49	
AIC:	1484.49	

4.3 Market segmentation

Having looked at the distinction between summer and winter respondents, it is interesting to also look at the differences between residents and tourists in the summer months. Table 3 presents the results of ordered probit models estimated for residents and tourists for the summer months, and only for residents for the winter months (only a very small number of visitors/tourists visit the island during the winter months).

The most important factor is again comfort and safety for all groups. For the tourists, service production also plays a significant role (actually it is almost as significant as comfort and safety). It is noted that the factor for service production also includes service information for the tourists, which may partly explain the higher significance of that factor for tourists. Younger residents are much more satisfied with the public transport services in the summer, while older residents are less satisfied in the winter. The tourists that usually use bicycle or walking for their trips are significantly more satisfied with the public transport services, possibly because they liberate them and offer them a much larger range of activity. On the other hand, those residents that use other modes for their trips are less satisfied with the public transport system, both in the summer or the winter. The residents that only use public transport occasionally are less satisfied by the transit services in the summer. Those tourists that consider the sufficiency of routes a significant attribute are more satisfied with the services, indicating that the network coverage is good.

Table 3. Ordered probit models of market segmentation in satisfaction of summer PT users: residents vs. tourists, summer vs. winter

	Summer				Winter	
	Residents		Tourists		Residents	
Coefficients:	Estimate	t-value	Estimate	t-value	Estimate	t-value
Comfort/Safety*	1.894	6.683	1.316	2.964	1.533	4.184
Service production**			1.230	4.330		
Age between 19-29 y.o.	0.481	2.802				
Age greater than 40 y.o.					-0.257	-2.049
Usual Mode: Bicycle			0.869	4.714		
Usual Mode: Walking			0.468	2.368		
Usual Mode: Other	-1.579	-1.974			-1.511	-1.876
Occasionally use PT	-0.414	-3.018				
Significance: Routes Sufficient			0.302	2.942		
Intercepts:	Estimate	t-value	Estimate	t-value	Estimate	t-value
1|2	0.308	0.793	2.319	4.070	-1.289	-4.704
2|3	1.625	4.255	3.342	5.797	-0.049	-0.198
3|4	3.495	8.559	5.530	9.150	1.732	6.692

Number of observations:	318		457		324	
Residual Deviance:	605.39		785.24		639.39	
AIC:	619.39		801.24		655.39	
* Includes service information for Summer – Residents; only comfort for Winter - Residents						
** Includes service information for Summer - Tourists						

5. Discussion and Conclusions

Transport and tourism are in the majority of cases treated as separate sectors, especially by local public and private organizations; tourism planners generally focus their efforts on promoting the destination and managing tourism, demand and supply, while transport planners often do not take into account or underestimate the effects of tourists' mobility on total mobility of the tourist area [12]. Tourism cannot exist without transport. It is therefore essential for researchers studying one or both of these sectors to investigate the topic of tourists' mobility from a broader perspective.

Many touristic regions around the world experience the severe effects of the seasonal variations of transport demand, especially in the peak periods. One important conclusion of the research conducted in the framework of the present paper is that although the issue of mobility management has been extensively addressed by many projects and initiatives, however very few of them has directly addressed the problem of handling seasonal traffic peaks [9]. Some local authorities have taken few initiatives, however, their effectiveness is far behind the expectations of the authorities and the strong variations of the traffic peaks between the peak and off-peak seasons, and their consequences still remain.

Several actions should be taken mainly at local level in order to address the above problem and to highlight the necessity for concrete and sustainable solutions. Such actions could be the wider use of transit services, the increase of synergies among existing transport modes, the modal shift to more energy efficient and environmental friendly transport modes, and the promotion of behavioural changes for both visitors and local citizens. At this point it should be noted that an additional finding of the literature review conducted for the needs of this research is that the factors that affect the transit choices of tourists, residents and other target groups in tourist areas is very limited. The findings in this research reveal interesting differences between the seasonal transport demand of tourists in a touristic area and the transport demand of residents in the same area.

The present research aims to contribute to the existing knowledge by investigating the underlying unobserved factors that influence the transit ridership as well as the levels of satisfaction when using transit services of both tourists and residents in tourist areas in the peak summer period and in winter. The popular tourism destination of the Island of Kos in Greece was used as the case study for this research, while two appropriate statistical methods were employed, Factor Analysis and Ordered Probit models. The research placed particular emphasis on market segmentation aspects in order to highlight the varying perceptions of different segments and thus drive the possible future actions of local agents to meet the expectations and needs of particular target groups.

According to the factor analysis, the most significant factor for the tourists when deciding to use public transport is service production, reflecting route frequencies and reliability of service. On the contrary, residents place more focus on qualitative aspects such as comfort, safety and information. To some extent, this explains the different criteria and preferences of these two target groups, as a result of their different needs and expectations. Tourists want to explore the island and visit numerous locations in their short vacation, thus they cannot afford delays or other services' limitations. On the other hand, residents are quite familiar with the local transit system and thus they give more emphasis on service characteristics that will make their trips more comfortable.

A common factor that holds a high position in the preferences of both tourists and residents is transfer quality, comprising attributes related to transfer coordination (distance, waiting time and information provision). This is a quite reasonable finding taking into account the many changes that both tourists and residents make to complete their trips, but for different reasons. Tourists want to reach the various poles of attraction in short time and explore as many of them as possible, while residents to minimize their travel time for their businesses and other purposes.

Based on the econometric models, developed within this research, the most important satisfaction parameter when using public transport was comfort/safety, followed by the provision of service information. This applies both to summer and winter periods. The market segmentation analysis went some steps further highlighting the higher satisfaction of young respondents, bicyclists and pedestrians on the transit services. This is rather reasonable taking into account that these three market segments are more accustomed to alternative and environmentally friendly transport modes.

As stated above, an additional aim of this research is to demonstrate how research can provide policy makers in touristic areas with appropriate tools and information that will facilitate their decision making process in order to create sustainable transit means. Therefore, the results and findings of this research can also be used by local authorities in order to adjust their mobility plans accordingly and to improve the transit services in order to better address the residents and tourists' needs. However, it is not easy for a public transport operator, especially in a tourist area, to effectively address the needs and expectations of different target groups with different priorities. For this reason, statistical approaches, such as the proposed ones, can be an excellent tool for providing targeted results and thus concrete recommendations. In the particular case study, for example, one possible conclusion might be that the transit network coverage in Kos needs to be expanded, while service production (in terms of frequencies and reliability) to be improved. Furthermore, the research revealed that the tourists using mainly bicycle or walking for their trips are significantly more satisfied with the public transport services, while residents that use other modes for their trips are less satisfied with the current public transport system, both in the summer or the winter. This different perception on the use of transit services highlights the necessity to encourage residents to shift to public transport through targeted actions, like the better network coverage, the adjustment of journeys' timetables, the more effective transfer coordination, the provision of park and ride facilities, and others. It is reminded that the significantly lower use of public transport resources and facilities during the off-peak season creates many problems to local transport operators (*e.g.*, economic viability), and only through the increase of transit ridership by residents these problems can be effectively addressed.

A natural question that may arise is to what degree the results (and conclusions) presented in this paper can be applicable to other areas with similar characteristics (*e.g.*, strong seasonal demand changes). Extreme caution is always needed when attempting to transfer findings from other areas, as there may be minute, but decisive differences between the two regions. One way to obtain some insight onto whether a finding is more universally relevant could be to replicate the same study to multiple regions. If some results are replicated, then one could cautiously argue that they seem to be shared by regions with similar underlying profiles. In any case, the methodology presented through this paper aiming at uncovering factors that influence public transport use as well as the degree of satisfaction when using transit services can be applied not only in other tourist destinations but also in other urban areas.

Such operational adjustments and service improvements may facilitate mobility in popular tourist destinations that suffer from the severe traffic effects and environmental pollution especially in peak seasons. Having said that, it is stated that customer satisfaction measures alone cannot provide estimates of new patronage or assess alternative methods of addressing high-season mobility challenges.

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