An ordered regression model to predict transit passengers' behavioural intentions

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An Ordered Regression Model to Predict Transit Passengers' Behavioural Intentions

Abstract

Passengers' behavioural intentions after experiencing transit services can be viewed as signals that show if a customer continues to utilise a company's service. Users' behavioural intentions can depend on a series of aspects that are difficult to measure directly. More recently, transit passengers' behavioural intentions have been just considered together with the concepts of service quality and customer satisfaction. Due to the characteristics of the ways for evaluating passengers' behavioural intentions, service quality and customer satisfaction, we retain that this kind of issue could be analysed also by applying ordered regression models. This work aims to propose an ordered Probit model for analysing service quality factors that can influence passengers' behavioural intentions towards the use of transit services. The case study is the LRT of Seville (Spain), where a survey was conducted in order to collect the opinions of the passengers about the existing transit service, and to have a measure of the aspects that can influence the intentions of the users to continue using the transit service in the future.

Keywords: LRT service; behavioural intentions; service quality; ordered regression model

1. Introduction

Transit managers and marketers can achieve an useful support from the knowing of passengers' behavioural intentions after experiencing transit services. Availability of information about transit passengers' behavioural intentions can address the most convenient strategies to satisfy existing passengers and attract new ones.
Passengers' behavioural intentions have been subject matter of the research for a long time. As an example, Zeithaml et al. (1996) considered behavioural intentions as signals that show whether a customer continues to utilize a company's service or switch to a different provider. In the last fifteen years, there has been an interest in analysing the concept of behavioural intention together with the concepts of service quality and customer satisfaction, and the well-known Theory of Planned Behaviour (TPB) has been applied to the concept of customer satisfaction. In studies based on TPB, customer satisfaction has been widely identified as the most important determinant of favourable behavioural intentions (Chen, 2008; Jen and Hu, 2003; Petrick, 2004). All these concepts are very complex and need to be analysed by sophisticated techniques. Almost all the studies analysing transit passengers' behavioural intentions adopted the structural equation models as technique. Some examples can be found in: Chen (2008), who focused on the impact of service quality, perceived value and satisfaction, on behavioural intentions for air passengers. The study of Lai and Chen (2011) suggested a model incorporating the roles of service attitudes (i.e. service quality, perceived value and satisfaction) and involvement, and explored their effects on behavioural intentions. In Chen and Chao (2011) the main aim was to examine the switching intentions toward public transit by private vehicle users (both car and motorcycle users) by means of an integrated model combining the TPB, the Technology Acceptance Model, and habit. Sumaedi et al. (2012) explored the relationship between passengers' behavioural

intentions and other latent factors, including satisfaction, perceived value, perceived sacrifice, and service quality. The study of Chowdhury and Ceder (2013) tried to explore the cognitive factors which influence travellers' willingness to make transfers. de Oña et al. (2016) investigated on the relationship among some aspects influencing passengers' behavioural intentions towards the use of a light rail transit (LRT) service; they observed that behavioural intentions are mostly affected by passengers' judgements about LRT service quality and their satisfaction with the service.

We retain, as it was proved by the above mentioned works, that the concept of behavioural intentions to use transit service is strongly linked to the concept of service quality, that is passengers' satisfaction with the several factors characterizing the quality of a transit service have surely an influence in the decision of passengers to continue to use a transit service. On the other hand, we think that this kind of relationship could be analysed by models less complex than structural equation models, which require more sophisticated tools and consistent amount of data. An alternative interesting kind of models used in the field of transit service quality are surely the ordered models, which are relatively easy to estimate. This kind of models is particularly appropriate when the overall satisfaction is measured on ordinal scales, that is when discrete outcomes have a natural (ordinal) ranking. Ordinal regression allows to compensate for the limits of linear regression of considering the same differences between the various categories. As an example, if the dependent variable has three categories, a linear regression would recognize the difference between category 3 and 2 identically to the difference between category 2 and 1 (Borooah, 2002). While the use of the ordered models is enough widespread for analysing transit service quality in terms of passengers satisfaction (e.g. Tyrinopoulos and Antoniou, 2008; Dell'Olio et al., 2010; Celik and Senger, 2016; Cao et al., 2016), this technique has not been adopted for investigating the relationship between passengers' satisfaction and behavioural intentions. For these reasons, in this paper we want to investigate on the appropriateness of the Ordered Probit (OP) modelling to analyse how passengers' perceptions about the service quality factors influence directly passengers' behavioural intentions towards the use of transit services. Authors of the proposed paper have a certain experience in OP models because in the past they adopted OP models for analysing service quality of airport transit services (Eboli and Mazzulla, 2009), and also in the field of road safety (Cardamone et al., 2016, 2017; de Oña et al., 2014). In this paper the proposed methodology is tested by using data concerning the LRT of Seville (Spain). We collected through an ad-hoc survey the opinions of the passengers about the used LRT system. More specifically, the OP model will allow to explain how passengers' opinions influence their intentions to use the LRT again. We retain that this methodology is convenient also for investigating about the transit passengers' behavioural intentions, which have to be considered as a very important element to be investigated with the final aim to help transport planners and providers of services in identifying the right strategies for improving service quality and increasing the use of transit systems.

In the following, we provide a description of the case study, where we describe the transit service and the survey supporting the research, the sample characteristics, and the opinions expressed about the LRT system. Then, we propose the section about the OP model, by providing a theoretical framework, and successively the description of the proposed model and a discussion of the results. The paper ends with brief conclusions about the work.

2. The case study

2.1. The transit service and the survey

The analysis conducted in this paper is based on the LRT service of Seville, a city located in the South of Spain. Seville is populated by about 700,000 inhabitants, and covers an area of 140.8 km^2; the population density is equal to 4,950 inhabitants/km^2. The LRT system came into operation in 2009. Currently, it consists of a sole line characterized by a length of 18 kilometers (10.08 kilometers underground) and 21 stations connecting four of the main municipalities in the metropolitan area of Seville, and serving a population of about 850,000 people.

Before opening the LRT system, as highlighted by the results of the last mobility household survey conducted in 2007 (OMM, 2015), the modal split in the whole metropolitan area showed a predominance of private vehicle (54%) against the public transport modes (10 %) and walking and cycling modes (36%). Currently, this trend seems to be changed in favour of the public transport modes. In 2013, the LRT carried more than 13.7 million passengers. In addition, this system is integrated with other transit alternatives in the city of Seville, such as suburban train (5 lines), metropolitan bus (64 lines), urban bus (51 lines), tram (1 line) and public bicycle (250 facilities and more than 2,500 bicycles for hiring), all of them coordinated by the Public Transport Authority of Seville (Consorcio de Transportes del Área de Sevilla). It is important taking into account that bicycles have reached a great importance in urban mobility since numerous cycle paths were built (80 kilometers), and some parking for bicycles were created. Most of the LRT stations also have parking facilities for bicycles in their nearness.

A survey was addressed online to the users of the LRT system, via a web-based platform. For the distribution process, a card marked with a code was handed out to users at LRT stations. This card included a brief description of the survey objectives. The survey code provided each respondent with an individual access to the online survey, which was accessible on computers, smartphones, tablets, and so on. This data collection approach combined an innovative kind of survey (Internet-based) with a traditional face-to-face survey. Specifically, 19,863 cards were administered to users by four trained interviewers during a card delivery period of 2 weeks (May to June 2014), on weekdays, Saturdays, and Sundays. Users who were invited to participate in the study had 3 weeks for completing the online survey. 3,365 responses were registered, of which 3,211 were valid for subsequent analysis.

The questionnaire is divided into four main sections. The first part concerns the attitude of the passengers towards the service of LRT. The questions were measured on an 11-numeric scale defined as 0-totally disagree and 10-totally agree. This part of the questionnaire had the aim to collect also the intentions of the users to continue to use the transit service. Specifically, behavioural intentions were collected by presenting to the users this sentence: “Surely. I will use the LRT service again”.

The second section regards the perceptions of passengers about the service characteristics. The passenger directly rates the different service aspects that they use, as well as they provide a global score for the service. This part contains 37 questions related to various aspects of the LRT service, such as availability of the service, accessibility, information, time, attention to client, comfort, safety and environmental pollution. Respondents rated their perceived level of quality of each attributes and their overall perceived level of quality of the LRT service according to an 11-numeric scale from 0 to 10 (0 being of poor quality and 10 being of the highest quality).

In the third section, the passengers were asked about general information on the trip that they were taking when they got the card from an interviewer. Finally, the fourth section concerns on socioeconomic characteristics of the respondents. The results of this section show that the sample is made up of more females (53.3%) than males (46.7%). The passengers between 18 and 25 years are the most numerous (41.6%), followed by people between 26 and 40 years (28.8%) and 41 and 65 years (25.5%). About education and occupational status, respondents mainly has a bachelor' degree at university (48.5%) or a degree of high school or professional education (41.9%), and are employees (43.7%) and students (41.5%). Most of the interviewees who declared the requested net monthly income have an income equal or lower than 1,200 Euros (28.7%). The respondents that travel by LRT every day amount to 52.1%, and only 16.4% use this transit service occasionally. LRT is more taken for going to school (38.8%) or to work (35.5%). Many interviewees prefer to reach (or to egress) the LRT station mainly by walking (62.6% and 86.3%, respectively), and in average they walk for a distance of 12 minutes long on a total trip of about 34 minutes.

2.2. The service quality factors

As above mentioned, 37 service quality factors were judged by the users. A Principal Component Analysis (PCA) was performed on data for better assessing users' perceptions about service quality, and for grouping the factors regarding the same service aspect. PCA is a statistical approach that can be used to analyze interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions (Hair et al., 2010).
The results of the PCA showed that eight service aspects can be identified for grouping the 37 factors (de Oña et al., 2015). Table 1 shows the arrangement of the service factors into the eight main aspects and the analysis of the rates expressed by the users about the level of quality of the characteristics of the LRT service.
Factors concerning "Availability of the service", which was judged by considering some factors such as service regularity and number of trains per day, registered a discrete average satisfaction rate, equal to 7.3, ranging from about 6 to almost 8. As an example, the attribute "Operating hours of the service" is the least satisfactory for the users obtaining an average rate of 5.8, and it is also the factor registering the highest standard deviation (2.9) meaning that users' judgements are rather heterogeneous; on the contrary the attribute "Punctuality" registered a good average rate, equal to 8.5, and this good result is strengthened by the low value of standard deviation (1.5).
All the attributes related to "Accessibility" were positively judged by passengers, which expressed high rates (around 8). For example, "Easy access to stations and platforms from the street" and "Operation of elevators, escalators, etc." were evaluated with a rate equal to 8.2 in average; also in this case, the service attributes most satisfying are the most homogeneous in terms of users' judgements (standard deviation equal to 1.7 amd 1.8, respectively).

Table 1. Statistics about passengers' opinions about service quality

	Mean	Standard deviation
Availability of the service		
Operating hours of the service	5.8	2.9
Number of trains per day (frequency of the service)	7.3	2.1
Proximity of stops to origin and/or destination	6.3	2.9
Regularity of the service (absence of interruptions caused by breakdown or incidents)	7.7	2.1
Punctuality	8.5	1.5
Speed of the trip	8.1	1.8
Waiting time on the platform	7.3	2.1

Accessibility		
Easy connection with other transportation modes such as bike rental, taxis, buses, etc.	7.5	2.1
Easy access to stations and platforms from the street	8.2	1.7
Operation of elevators, escalators, etc.	8.2	1.8
Easy access of persons with reduced mobility	8.0	2.0
Operation of ticket validators at the entrance and exit of stations	7.9	2.0
Easy use of ticket vending machines	7.5	2.1
Information		
Updated, precise and reliable information in vehicles (operating hours, stops, etc.)	7.8	1.9
Updated, precise and reliable information at stations (price, operating hours, stops, etc.)	7.8	1.9
Information available through other communication technologies (internet, phone, etc.)	6.4	2.6
Clear and simple notice boards with information and directions at stations	8.5	1.5
Customer Service		
Appearance of employees	8.0	1.8
Courtesy of the employees	7.8	2.0
Effectiveness and speed of employees to give information and deal with user´s daily problems	7.6	2.2
Performance of the Customer Service (offices, web site, phone, deal with complaints, etc.)	7.0	2.4
Tangible service equipment		
Cleanliness of the stations	8.5	1.5
Cleanliness of the vehicle	8.1	1.8
Lightning at stations	8.4	1.5
Lightning in vehicle	8.3	1.5
Temperature and ventilation system in vehicle and at stations	7.3	2.2
Appropriate driving	7.2	2.2
Individual space		
Seat availability at stations and on platforms	6.2	2.6
Level of comfort in vehicle (seat availability or enough room while standing up)	6.4	2.4
Coverage to use cell-phone and 3G at stations and in vehicles	2.7	3.0
Security		
Sense of security against accidents while travelling (crash/vehicle derailment)	7.3	2.2
Sense of security against theft and aggression at stations and in vehicles	7.3	2.2
Sense of security against slipping, falling and accidents at vehicle doors and escalators	7.1	2.3
Signage of emergency exits and extinguishers	7.6	2.0
Environmental pollution		
Noise level at stations	6.5	2.4
Noise level in vehicle	6.4	2.4
Vibration level in vehicle	6.3	2.3
Overall service quality	7.6	1.5

Also information services were appreciated enough, registering an average satisfaction rate of 7.6. Users are very satisfied with the aspect concerning notice boards with information and directions at stations (average rate equal to 8.5, and standard deviation equal to 1.5). They expressed the same good opinion both for information on the vehicles and at stations, registering the same average rate of 7.8; on the other hand, information through internet, phone, etc. was less appreciated by users (average rate of 6.3); this attribute is also the most heterogeneous in terms of judgements (standard deviation of 2.6).

Users positively evaluated the conduct of the employees (average rate of 7.6); among the attributes describing “Customer Service” only the attribute “Performance of the Customer Service”, have an average rate of 7, even if the rating can be considered rather variable among users (standard deviation equal to 2.4).

The aspect “Tangible service equipment” concern different attributes: cleanliness, lighting, temperature, and driving. Specifically, users are very satisfied with cleanliness and also with lighting both of the station and in the vehicle (average values around 8), while they are less satisfied with the factors linked to the temperature (7.3) and driving (7.2). The attributes most satisfying are the attributes which are also the most homogeneously judged, as observed for all the other service aspects.

Different opinions were registered about the factors regarding individual space. The users appear just enough satisfied with the factors linked to the seats (average rates around 6 both for seat availability at stations and in vehicle), whereas the results show that users are not satisfied with cell-phone and 3G coverage at stations and in vehicle

(average rate equal to 2.7). Users negatively judged this aspect because, when the survey was conducted, the underground part of the LRT line got out of telephonic coverage (at this moment, along the line there is full coverage).
The factors concerning “Safety” registered average rates around 7. The most satisfactory factor is “Signage of emergency exits and extinguishers”, which reached an average rate of 7.6.
Rates around 6.5 were assigned to all the characteristics concerning “Environmental Pollution”.
After the analysis of the average rates registered for the various service aspects, we can make some considerations. “Tangible service equipment” and “Accessibility” aspects are the service characteristics better judged by the passengers, followed by “Information”, and “Customer Service”. On the other hand, the aspect worse judged is “Individual space” which however registered average rates above 6.
In addition to the judgements on the various service quality characteristics, users expressed also their opinions about the overall service, which reached an average rate equal to 7.6, with a standard deviation of 1.5.

3. Ordered Probit model

3.1. Theoretical framework

The OP model was originally developed by McKelvey and Zavoina (1975). The observed ordinal variable *Y* is, in turn, a function of another variable Y^* that is not measured, whose values determine what the observed ordinal variable *Y* matches. The continuous latent variable Y^* has various threshold points. The value Y_i of the observed variable depends on whether or not the value of Y^* crossed a particular threshold, as showed by the following formulas (1):

$$Y_i = 1 \text{ if } Y_i^* \le \mu_1 \quad (1)$$

$$Y_i = 2 \text{ if } \mu_1 < Y_i^* \le \mu_2$$

(...)

$$Y_i = j \text{ if } \mu_{j\text{-}1} < Y_i^* \le \mu_j$$

(...)

$$Y_i = m \text{ if } Y_i^* > \mu_{m-1}$$

In the population, the continuous latent variable Y^* is equal to:

$$Y_i^* = \sum_{k=1}^{K} Z_i + \varepsilon_i = \sum_{k=1}^{K} \beta_k X_{ki} + \varepsilon_i \quad (2)$$

where ε_i is a random disturbance term normally distributed, due to the fact that the variables may not be perfectly measured, and some relevant variables may be not introduced in the equation.
By means of the OP we can estimate the expected average value of the Y_i^* (formula 3):

$$E(Y_i^*) = Z_i = \sum_{k=1}^{K} \beta_k X_{ki} \quad (3)$$

Once we have estimated β coefficients and the (m-1)k cutoff terms, we can estimate the probability that *Y* will have a particular value. The formulas are the following (4):

$$P(Y_i = j) = \Phi(\mu_j - X_i\beta) - \Phi(\mu_{j-1} - x_i\beta) \quad (4)$$

$$P(Y_i = m) = \Phi(\mu_m - X_i\beta) - \Phi(\mu_{m-1} - x_i\beta) = 1 - \Phi(\mu_{m-1} - x_i\beta)$$

Finally, the OP model can be used to estimate the probability that the unobserved variable Y^* falls within the various threshold limits.

3.2.The proposed model

Before deciding the structure of the model, we analysed the nature of the variables which we defined as response. Our intent is to focus on the behavioural intentions of the users to continue to use the LRT service again; we decided to assume just this variable as dependent variable of the proposed model. On the other hand, the PCA results described in the previous section allows the selection of the independent variables to include in the model. By considering the factor weights allocated by PCA to each service quality factor, we selected only the factors having a weight greater than or equal to 0.7, in order to take into account the variables that impacting more on the dimension or service aspect. We identified 23 attributes out of the 37 investigated ones to consider in the final proposed model. The selected attributes belong to all the eight service aspects, and represent the attributes that mainly characterize each service aspect, because they have the greatest factor weights. As an example, the service aspect "Availability of the service" results represented only by two attributes (relating to frequency of the service and waiting time), while "Accessibility" is represented by three attributes (concerning the access to station, the presence of elevators and escalators, and the facilities for persons with reduced mobility). Instead, the information aspects mostly important for the users are the information at stations and on vehicle (two out of the four attributes describing this aspect). On the other hand, all the four factors regarding the aspect "Customer Service" are important for the users. The aspect concerning the tangible service equipment is represented by the four attributes relating to cleanliness and lighting both at station and in vehicle, while the aspect "Individual space" is considered as aspect regarding seat availability at station and comfort in vehicle. The aspect concerning security is represented by the most traditional attribute relating to accidents while travelling, theft and aggression, and accidents at vehicle doors and escalators. Finally, the aspect regarding pollution is mostly represented by noise pollution and vibration in the vehicle.

We introduced 69 independent variables representing "high", "medium" and "low" satisfaction level with the 23 service quality factors selected through the PCA. All the variables representing responses of our model showed a natural ordering and then they are ordinal variables. We decided to transform the responses of the users given on 11-numeric scales into categorical variables having three levels. Being our scale made up of 11 levels, the mean value is 5. Therefore, in order to maintain the centrality of the value 5, we have considered a central interval (from 4 to 6) where 5 is the central value, and other two intervals each made up of four values (one from 0 to 3, and the other from 7 to 10). Definitively, the three levels of our categorical variables are: 0, 1, 2, where the level 0 groups the rates from 0 to 3, the level 1 from 4 to 6, and the level 2 from 7 to 10. In order to calibrate the coefficients, the model was based on a particular reference case, which corresponds to level "2" that means "high" level of quality (satisfaction rate from 7 to 10). The statistics on the goodness of fit are adequate (table 2). Based on the p-values of the Wald tests, 11 variables are found to be significant with $p<0.05$; the other variables cannot be considered as significant. In particular, significant variables concern the following eight service factors:

- number of trains per day (frequency of the service);
- easy access to stations and platforms from the street;
- easy access of persons with reduced mobility;
- updated, precise and reliable information at stations (price, operating hours, stops, etc.);

- waiting time on the platform;
- lightning in vehicle;
- level of comfort in vehicle (seat availability or enough room while standing up);
- sense of security against theft and aggression at stations and in vehicles.

In this way, the model results highlighted what are the factors that influence the behavioural intentions of the users to continue to use the LRT service again among all the service quality factors investigated in the survey. Even if according to PCA, 23 service attributes were considered as most important for the users, only 8 out of 23 have an influence in the decision to reuse the analysed system. As an example, in terms of availability of the service, the satisfaction with frequency of the trains and waiting time on the platform influence the intention to continue to use LRT system. In terms of accessibility, the satisfaction with the factors concerning access to station and facilities for persons with reduced mobility, which is an aspect involving many people if we consider also mothers with babies in buggy. Information at stations is the only information attributes influencing the intention to reuse the service, as well as lighting in vehicle is the sole attribute concerning the tangible service equipment and level of comfort in vehicle is the sole attribute regarding the individual space. Finally, intention to continue to use LRT system is influenced only by the security in terms of theft and aggression at stations and in vehicles. These service characteristics identified as key aspects that influence on the intention to continue to use the LRT system, have also be identified as important factors for other rail transport systems. For example, Lai and Chen (2011) found that vehicle safety had a significant influence on passenger behavioral intentions at a Mass Rapid Transit System on Taiwan (China). Likewise, Information distribution/disclosure and confort were found by Shen et al. (2016) to exert a high influence on passengers' loyalty at an urban train service in Suzhou (China). Machado et al. (2017) analyzed three different rail transit modes (metro, commuter rail and tramway) in Alger (Algeria), and they identified that for all the three rail transit modes, frequency, regularity and operating hours were very important attributes of the service. Furthermore, the accessibility of the service (operation of elevators, escalators, tickets validators, and the access to stations and platforms) was derived as very important for metro passengers, and an adequate availability of seating/standing up space on the vehicle and other aspects related with confort and information were key attributes for tramway passengers. In the case of the commuter rail and tramway in Alger, all safety attributes were also classified as very important. Aydin et al. (2015) evaluated service quality of six rail transit lines in Istanbul (Turkey), being one of them a light rail. They determined that safety, time and accessibility were the most important main criteria of these rail transit modes, and particularly, the light rail line needed improvements in information system, accessibility and safety factors.

The signs of the significant variables are negative, meaning that low and medium levels of satisfaction with the various characteristics have a negative effect on the intentions to use LRT as regards high levels of satisfaction with the same attributes. In other words, the analysis of probability values suggests that when the level of satisfaction with a certain attribute is medium or low, the probability to have higher levels of intentions to use LRT system decreases than the reference case and the probability to have lower level tends to increase.

By observing the estimated probabilities we can state that the probabilities of the reference case are about 95% for "high" level and about 0.40% for "low" level. This was to be expected because the reference case corresponds to the case where satisfaction is "high" for any service factor. The result means that when all the independent variables assume a "high" level, the intentions to continue to use LRT has a probability of 0.95 to assume a "high" level.

Table 2. Model results

Service quality factor Variable	Estimated Coefficient (β)	Wald	p-value	Estimated probability		
				0	1	2
Reference case				0.0040	0.0479	0.9481
Number of trains per day (frequency of the service)						
[V1=0]	-0.327	6.057	0.014	0.0422	0.1822	0.7756
[V2=1]	-0.297	10.927	0.001	0.0281	0.1488	0.8231
[V3=2]	0	.	.	0.0028	0.0411	0.9561
Easy access to stations and platforms from the street						
[V4=0]	n.s.					
[V5=1]	-0.215	4.284	0.038	0.0454	0.2027	0.7518
[V6=2]	0	.	.	0.0043	0.0507	0.9451
Operation of elevators, escalators, etc.						
[V7=0]	n.s.					
[V8=1]	n.s.					
[V9=2]	0	.	.	0.0050	0.0536	0.9413
Easy access of persons with reduced mobility						
[V10=0]	n.s.					
[V11=1]	-0.197	4.166	0.041	0.0344	0.1673	0.7983
[V12=2]	0	.	.	0.0044	0.0492	0.9464
Updated, precise and reliable information in vehicles (operating hours, stops, etc.)						
[V13=0]	n.s.					
[V14=1]	n.s.					
[V15=2]	0	.	.	0.0042	0.0496	0.9462
Updated, precise and reliable information at stations (price, operating hours, stops, etc.)						
[V16=0]	n.s.					
[V17=1]	-0.233	5.152	0.023	0.0328	0.1688	0.7985
[V18=2]	0	.	.	0.0035	0.0459	0.9506
Waiting time on the platform						
[V19=0]	-0.383	7.257	0.007	0.0493	0.1933	0.7574
[V20=1]	-0.214	5.914	0.015	0.0242	0.1390	0.8368
[V21=2]	0	.	.	0.0033	0.0421	0.9546
Appearance of employees						
[V22=0]	n.s.					
[V23=1]	n.s.					
[V24=2]	0	.	.	0.0044	0.0515	0.9440
Courtesy of the employees						
[V25=0]	n.s.					
[V26=1]	n.s.					
[V27=2]	0	.	.	0.0041	0.0498	0.9461
Effectiveness and speed of employees to give information and deal with user's daily problems						
[V28=0]	n.s.					
[V29=1]	n.s.					
[V30=2]	0	.	.	0.0036	0.0464	0.9500
Performance of the Customer Service (offices, web site, phone, deal with complaints, etc.)						
[V31=0]	n.s.					
[V32=1]	n.s.					
[V33=2]	0	.	.	0.0028	0.0412	0.9561
Cleanliness at stations						
[V34=0]	n.s.					
[V35=1]	n.s.					
[V36=2]	0	.	.	0.0058	0.0583	0.9359
Cleanliness in vehicle						
[V37=0]	n.s.					
[V38=1]	n.s.					
[V39=2]	0	.	.	0.0050	0.0543	0.9407
Lightning at stations						
[V40=0]	n.s.					

	[V41=1]	n.s.					
	[V42=2]	0	.	.	0.0051	0.0556	0.9392
Lightning in vehicle							
	[V43=0]	n.s.					
	[V44=1]	-0.319	7.578	0.006	0.0526	0.2208	0.7265
	[V45=2]	0	.	.	0.0044	0.0525	0.9431
Seat availability at stations and on platforms							
	[V46=0]	n.s.					
	[V47=1]	n.s.					
	[V48=2]	0	.	.	0.0029	0.0403	0.9567
Level of comfort in vehicle (seat availability or enough room while standing up)							
	[V49=0]	-0.243	4.439	0.035	0.0337	0.1522	0.8141
	[V50=1]	n.s.					
	[V51=2]	0	.	.	0.0028	0.0398	0.9574
Sense of security against accidents while travelling (crash/vehicle derailment)							
	[V52=0]	n.s.					
	[V53=1]	n.s.					
	[V54=2]	0	.	.	0.0040	0.0468	0.9493
Sense of security against theft and aggression at stations and in vehicles							
	[V55=0]	-0.311	4.620	0.032	0.0392	0.1603	0.8006
	[V56=1]	-0.230	6.238	0.013	0.0246	0.1367	0.8387
	[V57=2]	0	.	.	0.0033	0.0431	0.9537
Sense of security against slipping, falling and accidents at vehicle doors and escalators							
	[V58=0]	n.s.					
	[V59=1]	n.s.					
	[V60=2]	0	.	.	0.0046	0.0487	0.9467
Noise level at stations							
	[V61=0]	n.s.					
	[V62=1]	n.s.					
	[V63=2]	0	.	.	0.0043	0.0475	0.9482
Noise level in vehicle							
	[V64=0]	n.s.					
	[V65=1]	n.s.					
	[V66=2]	0	.	.	0.0047	0.0485	0.9468
Vibration level in vehicle							
	[V67=0]	n.s.					
	[V68=1]	n.s.					
	[V69=2]	0	.	.	0.0039	0.0444	0.9518
Number of observations		3211					
k_1 (threshold)		-3.356					
k_2 (threshold)		-2.149					
ρ^2 (Cox and Snell)		0.122					
ρ^2 (Nagelkerke)		0.260					
ρ^2 (McFadden)		0.205					
log likelihood		-765.448					

By observing the estimated probabilities, the significant variables mainly influencing the intentions to use LRT are those corresponding to a low level of satisfaction about the factor. Specifically, the variable V19=0 has the biggest influence; if users reveal a low satisfaction level about “Waiting time on the platform”, the probability to have low level of intentions to use LRT system is equal to 4.93% and it is higher than the reference case. Instead, for the same factor, the probability to have high level decreases to the value of about 76%, lower than the reference case (94.81%). Other important variables regard “Number of trains per day” (V1=0) and “Sense of security against theft and aggression at stations and in vehicles” (V55=0). Even in these cases, the probabilities to have low and medium levels of intentions to use LRT are higher than the probabilities for the reference case, and, at the same time, the probability to have

high levels of intentions to use LRT decreases compared to the reference case.
Concerning the medium level of satisfaction, the variable V44=1 relating to "Lightning in vehicle" presents the greatest impact on intention to use LRT. In fact, the probability to have low level of intentions to use LRT is equal to 5.26%, whereas the probability to have medium level is 22.08%. Both the probabilities are higher than the values representing the reference case. Instead, for the same factor, the probability to have high level decreases (72.65%) and is lower than in the reference case.
The variables V5=1 and V11=1, related respectively to the factors "Easy access to stations and platforms from the street" and "Easy access of persons with reduced mobility", have a relevant impact on the users' intentions and produce the decrease of high level of the probability and the rise of the low and medium level compared to the reference case.
Ultimately, the service aspects "Availability of the service" and "Accessibility" mainly influence users' intentions to use LRT system, because the factors belonging to these aspects significantly impact on the probability to have higher or lower levels of intentions to use LRT.

4. Conclusions

The main aim of this paper was to analyse the effects of users' perceptions about some service quality factors on their intentions to continue to use transit service. Passengers' behavioural intentions are strictly correlated with the opinions of the passengers about the transit service that they use, and specifically their decision to continue to use the service is very much influenced by the performance of the service, the quality levels of the various factors characterizing it and the levels of satisfaction expressed by the users. Due to the characteristics of the ways for evaluating passengers' behavioural intentions, service quality and customer satisfaction, this kind of issue could be analysed conveniently by ordered regression models. In fact, when the variables are measured on ordinal scales, that is when discrete outcomes have a natural (ordinal) ranking, an ordinal regression is a more convenient tool of analysis.
Based on the case study represented by the LRT system of Seville, this work aimed to propose an ordered Probit model for analysing service quality factors that can influence passengers' behavioural intentions towards the use of transit services.
The model provided the evaluation of passengers' behavioural intentions to continue to use LRT among three levels (low, medium, and high) by varying the level of satisfaction with any service quality factor considered in the model. In this way, the variables that cause the increase of the probabilities to have higher levels of intention to use LRT system could be identified.
Among the various interesting results, we found that the service aspects concerning "Availability of the service" and "Accessibility" mainly influences users' intentions to use LRT system. In particular, if users perceive high levels of quality about service factors as number of trains per day, waiting time on the platform, easy access to stations and platforms from the street, and easy access of persons with reduced mobility, they are inclined to reuse LRT system. Availability and accessibility factors have also been identified as key elements at different rail transport systems (Aydin et al., 2015; Machado et al., 2017), as well as safety (Aydin et al., 2015; Lai and Chen, 2011; Machado et al., 2017), information and confort (Machado et al., 2017; Shen et al., 2016).
These findings can be useful for the operators to identify the service characteristics that play a role in the decision of the users to use the transit system. Specifically, in this

case, the model results suggest that operators should put their efforts in improving frequency of service and reducing the passengers' waiting time on the platform, by improving the punctuality of the LRT service. Another convenient strategy is to offer to users facilities to access to stations and platforms, and specifically for persons with reduced mobility. Concentrating the efforts in these specific aspects is surely more convenient for the operators, because an improvement of these aspects conduct to a continued use of the managed transit system. There are other service factors which should be considered more than others. As an example, concerning information, the efforts of the operators should be oriented to the information at stations, rather than other kinds of information, as well as, in terms of comfort, the factors most influencing passengers' behaviour concern lighting and comfort in vehicle, rather than cleanliness or comfort at stations. Finally, operators should assure to users a sense of security against theft and aggression at stations and in vehicles.
Future developments of the work could be to propose models where also socio-economic characteristics and travel habits of the passengers are introduced. This could be useful for operators to better understand the preferences of the various groups of passengers and orient different strategies to improve the service and most of all to make sure that users continue to use the service.

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