Latent Classes Exploring the Sense of Passengers Well-Being in the Terminal: Evidence from a Peripheral Airport

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Abstract. This paper aims to explore the sense of passengers well-being in the terminal of an airport. The proposed methodology is performed into two stages: firstly, we use a basic latent class modeling approach in order to identify the latent classes representing air passengers' attitude towards the different provided service quality aspects, and detecting the sense of passengers well-being in the terminal; then, we introduce covariates in order to better explore latent class memberships as a function of socio-economic characteristics, travel habits and flight features. Evidences from a peripheral airport placed in the south of Italy were used for testing the proposed methodology and for obtaining practical issues. Specifically, we found that three latent classes of air passengers can be identified, namely no-sensitive passengers, cleanliness-sensitive and information-sensitive passengers. We found also that among the socio-economic characteristics, gender does not very influence very much class memberships, whereas age and level of education strongly affect class population shares. At the same time, travel purposes, country and arrival time before the flight showed a certain influence in predicting passengers class memberships.

Keywords: Latent class analysis · Air transport service quality · Passenger well-being

1 Introduction

Airport facilities and services are the first experiences that a passenger receives upon arrival. Therefore, measuring the sense of passengers well-being in the terminal by using passengers' evaluation about the service is essential to understand the needs of customers. In this manner, the different needs of the actors involved in the overall airport system should be satisfied: to optimize resource allocation for improving terminal infrastructures and services, and to have high-quality services for passengers. In order to better understand passengers' needs and expectations, a deep analysis for exploring the differences among people or groups of air transport users is of a certain importance; it was not very explored in previous works especially regarding peripheral airport with less importance to national and international level.

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Literature studies, where differences in perceptions of service quality among different groups of users were analyzed, were proposed by Bezerra and Gomez [1, 2], Pantouvakis and Renzi [3], and Bellizzi et al. [4]. Bezerra and Gomez [1, 2] considered personal characteristics of the passengers like parameters of models as a way to divide the sample of users to calibrate different models. Specifically, in Bezerra and Gomes [1] nationality, gender, trip purpose and mobility condition presented no significant effect; however, they found that the earlier the passenger arrives at the airport, the more likely he/she is to present a higher overall satisfaction. On the other hand, Bezerra and Gomes [2] discovered differences of perceptions between international and domestic passengers for service aspects such as availability and quality of stores, cleanliness of airport facilities, and wayfinding. Pantouvakis and Renzi [3] explore only the potential differences concerning resident versus visiting nationalities perceptions of airport service quality. They considered three groups of respondents: Italian passengers, English speaking travelers, and airport users from other nationalities. They found that Italian air travelers displayed significantly lower scores in their perceptions of the service quality offered by their homeland's airport industry regarding all the dimensions. Also Bellizzi et al. [4] found significant differences between Italian passengers and passengers from other countries; specifically, their results showed that announcements, staff and noise are very important for Italians, whereas baggage control and the aspect concerning display are more relevant for the foreign passengers. They also discovered that people travelling for leisure retain as most important aspects related to comfort, while people travelling for purposes linked to work or study give priority to technical aspects such as modal integration and information. Other interesting findings regarded people arriving more than two hours early, who give more importance to terminal cleanliness.

The aim of this paper is to contribute to the literature review by introducing covariates in order to better explore latent class memberships as a function of socio-economic characteristics, travel habits and flight features. The remainder of the paper is structured into 6 sections. The next section introduces the adopted methodology. Section 3 describes the case study in terms of airport characteristics, sample data and air passengers' evaluation. Section 4 explains the estimation results (Subsect. 4.1), with latent class memberships presented in Subsect. 4.2. The paper ends with a discussion of the main findings and a concluding section where some directions for future study are given.

2 Methodology

The proposed methodology performs into two stages: (1) to use a basic latent class modeling approach in order to identify the latent classes representing air passengers' attitude towards the different provided service quality aspects, and detecting the sense of passengers well-being in the terminal; (2) to introduce covariates in order to better explore latent class memberships as a function of socio-economic characteristics, travel habits and flight features. Latent class analysis is a statistical technique for the analysis of multivariate categorical data like observed data taking the form of a series of categorical responses [5]. In our study, individual-level voting data are analyzed for identifying and characterizing clusters of similar cases. Latent class analysis is a useful

tool for accomplishing these goals. The latent class model seeks to stratify a number of observed variables by an unobserved latent unordered categorical variable that eliminates all confounding between the observed variables. The unobserved latent variable is nominal, namely the membership of a class. Conditional upon values of this latent variable, responses to all of the observed variables are assumed to be statistically independent: the model probabilistically groups each observation into a latent class, which in turn produces expectations about how that observation will respond on each observed variable [5]. Although the model does not automatically determine the number of latent classes in a given data set, it offers a variety of parsimony and goodness of fit statistics that the researcher may use in order to make a theoretically and empirically sound assessment. An extension of this basic model permits the inclusion of covariates to predict latent class membership. While in the basic model every observation has the same probability of belonging to each latent class prior to observing the responses to the observed variables, in the more general latent class regression model these prior probabilities vary by individual as a function of some sets of independent concomitant variables [5]. For estimating latent class models and latent class regression models, poLCA user-friendly package in R software was used [6, 7].

3 Case Study

3.1 Airport Characteristics

The international airport of Lamezia Terme was chosen as a case study, that is a peripheral airport placed in the Calabria region, south of Italy. Lamezia Terme is the most important airport in the region, connecting Calabrian citizen with the Italian hubs of Roma Fiumicino and Milano Malpensa, and directly with various national and international airports. In 2018, about 40 airlines provided flights from/to the airport, mainly low-cost airlines providing connections with the cities in the northern Italy (Milan, Turin, Venice, Genoa, Bologna, Bergamo, Pisa, Treviso) or in all the European countries (Hamburg, Brussels, Bucharest, Budapest, Cologne, Krakow, Düsseldorf, Frankfurt, London, Madrid, Prague, Warsaw, Vienna, Zurich). The airport infrastructures and all the activities of private operators working in the airport are managed by the S.A.CAL. (Società Aeroportuale Calabrese). During 2017, Lamezia Terme registered more than 2,500,000 passengers and about 22,000 flights between landings and take-offs [8].

3.2 Sample Data

The data supporting this study were collected by S.A.CAL. through Customer Satisfaction Surveys during the period from January 2015 to December 2016. Face-to-face interviews were addressed to the departing passengers. An amount of 2,087 interviews were collected but, after a preliminary selection of valid data, a sample of 1,873 records was obtained.

Each interviewed passenger had to evaluate the service aspects expressing a rating through a 5-level verbal scale ranging from “very poor”, “poor” and “fair” to “good” and “excellent”. In Table 1, sample socio-economic characteristics are reported joined with travel habits and flight characteristics.

Table 1. Sample socio-economic and flight characteristics, and travel habits.

Sample characteristics		n.	%
Gender	Male	884	47.2
	Female	989	52.8
Age	Less than 30	248	17.3
	Between 30 and 40	444	31.0
	Between 40 and 50	303	21.1
	Between 50 and 60	249	17.4
	More than 60	189	13.2
Level of education	Junior high school diploma	135	12.1
	High school diploma	539	47.9
	Bachelor or Master degree	450	40.0
Country	Italy	1133	60.5
	Other Europe Countries	541	28.9
	Extra Europe Countries	199	10.6
Flight destination	Italy	895	47.8
	Other European Countries	765	40.8
	Extra European Countries	213	11.4
Trip purpose	Work/business	291	15.5
	Holiday	1389	74.2
	Study	22	1.2
	Medical care	74	4.0
	Other	97	5.2
Travelling alone	Yes	125	6.7
	No	1748	93.3
Mode for reaching the airport	Car as driver (16.0%),	300	16.0
	Car as passenger (46.8%),	876	46.8
	Taxi (3.7%),	70	3.7
	Rental car (15.5%),	290	15.5
	Rental bus (7.3%),	137	7.3
	Bus (5.8%),	108	5.8
	Bus shuttle (4.9%)	39	2.1
	Other	53	2.8
Time of arrival	Less than 1 h before the flight	152	8.1
	From 1 to 2 h before the flight	912	48.7
	More than 2 h before the flight	809	43.2

The sample is made up of more females (53%) than males; about 70% of users are under 50, half of them with a High School diploma. The major part of the sample comes from Italy (60%), but about 30% of the passengers is going towards other European Countries. Domestic flights account for 48% of the total flights. A strong tourist vocation of the airport is highlighted by the high percentage of users who travel for holiday (74%).

Regarding travel habits, we can observe that most of the interviewed passengers travel with other people (93.3%), and arrive at the airport by car (82%), especially by a car driven by someone (47%). Almost half of the sample arrives at the airport from one to two hours before the departure time of the flight, 43% of users arrive more than two hours early, and the remaining part of passengers less than one hour before.

3.3 Air Passengers' Evaluation

In Table 2, statistics about the judgements expressed by the passengers about each analyzed service aspects were reported.

Table 2. Judgements about each airport service quality aspect.

V	Service quality aspect	Non-positive judgements		Positive judgements	
		n.	%	n.	%
V1	Road signposting	296	16.8	1469	83.2
V2	Flight information	127	7.3	1616	92.7
V3	Terminal signposting	131	7.2	1683	92.8
V4	Infopoint and security staff	87	5.0	1655	95.0
V5	Information accessibility	76	4.5	1626	95.5
V6	Personal security	86	4.9	1682	95.1
V7	Cleanliness of terminal	244	13.6	1547	86.4
V8	Cleanliness of toilets	322	22.5	1107	77.5
V9	Terminal air conditioning	343	19.3	1437	80.7
V10	Terminal comfort	245	13.7	1537	86.3

For the attribute "cleanliness of toilets" we have a relevant lack of information (23.7% of non-response data) because the toilets are not used by all the passengers during their staying in the airport. For all the attributes, we can note that positive judgements are largely chosen by the passengers, although certain aspects were less satisfactory for the passengers; as an example, "cleanliness of the toilets" shows 22.5% of non-positive judgements, "cleanliness of terminal" shows a percentage of 13.6%, and "terminal air conditioning" show a percentage of non-positive judgements closed to 19%. The service quality aspects with the highest percentage of positive judgements are "information accessibility" (95.5%), "personal security" (95.1%), and "Infopoint and security staff" (95.0%); in our opinion, the perception of the passengers can relate to the geographical favorable position of the airport and the size of the terminal.

4 Latent Class Memberships

4.1 Basic Latent Class Modeling

The proposed methodology is oriented to use a basic latent class modeling approach in order to identify the latent classes representing air passengers' attitude towards the different provided service quality aspects, and detecting the sense of passengers well-being in the terminal.

This approach allows to estimate a class population share on the basis of the judgements expressed by the air passengers about the analyzed service quality aspects in the terminal. Each service aspect is represented by a dichotomous variable assuming a value equal to 1 when the judgement expressed by the passenger is non-positive ("very poor", "poor", or "fair") and equal to 2 when the judgement is positive ("good" or "excellent"). The aim of this analysis is examining how subjects might be divided into groups depending upon the consistency of their judgements.

A three-class basic latent class model was estimated, where Fig. 1 represents a screen capture of the model results. Each group of red bars represents the conditional probabilities, by latent class, that passengers rated positively each of the ten service quality aspect (labeled V1 through V10). Taller bars correspond to conditional probabilities closer to 1 of a positive judgement. The three estimated latent classes clearly correspond to a pair of classes (the first and the third one) that are consistently rated positive (class population share 79%) or quite non-positive (class population share 14%), plus an intermediate class representing only 7% of the population. In the second class, only the variables V7 and V8 tend to have non-positive judgements whereas the other service aspects tend to have positive judgements. On the contrary, in the third class service aspects from V1 to V5 tend to have a non-positive judgement whereas service aspects from V6 to V10 tend to have positive judgements.

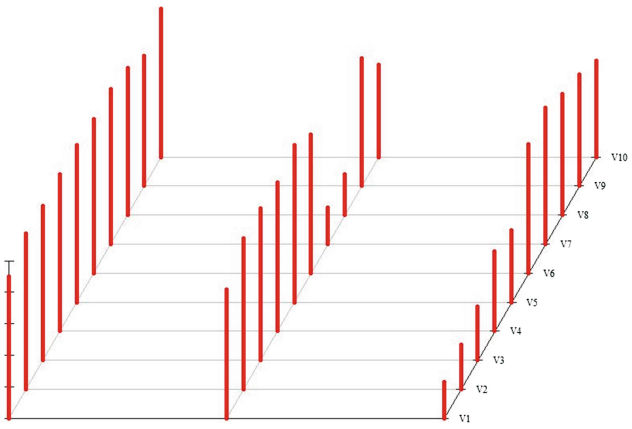

Fig. 1. Estimation of the three-class basic latent class model.

In order to choose the optimal number of latent classes, a number of goodness of fit statistics were performed. Specifically, both the minimum Akaike information criterion, or AIC [9], and Bayesian information criterion, or BIC [10], indicate that the three-class model is most parsimonious: the AIC is 10321 and the BIC is 10498. When a two-class model was performed AIC resulted equal to 10816 and BIC 10932 (about 500 units more than the previous values in both cases); in addition, in this case the predicted class memberships reached more than 90% of share for the first class. On the contrary, when a four-class model was performed we obtained quite lower value for AIC and BIC (10225 and 10463 respectively) but, conversely, the third and fourth classes registered low class population shares (4% in both cases) by maintaining the same class population share in the first class (79%). Definitively, as suggested by some authors [11, 12], the four-class model is over-specified containing very small groups of passengers; therefore, the three-class model was selected.

By following the statistical results of the basic latent class model, we can conclude that air passengers using Lamezia Terme terminal facilities can be subdivided into three classes, where: (1) the first class represents passengers with a strong sense of well-being in the terminal, and with attitude to express positive judgements towards all the service quality aspects (so-called "no sensitive passengers"); (2) the second class represents passengers with a soft sense of well-being in the terminal, and with attitude to express positive judgements towards all the service quality aspects except for cleanliness (so-called "cleanliness-sensitive passengers"); (3) the third class represents passengers with a weak sense of well-being in the terminal, and with attitude to express non-positive judgements towards the service quality aspects linked to the information (so-called "information-sensitive passengers").

4.2 Exploring Latent Class Memberships with Covariates

The above introduced latent classes were deeply explored with the aim to explain air passengers' membership as a function of socio-economic characteristics, travel habits and flight features. For this aim, a number of covariates were introduced, as reported in Table 3.

Firstly, we analyzed trip purposes and age interactions, by distinguishing among traveling for holiday and for other purposes (see Fig. 2). By examining the estimated class-conditional response probabilities, it seems confirmed that the model finds that the three groups indeed separate as expected, with 80–90% of passengers belonging to the first class, 10–20% to the second one, and 0–10% to the third class.

As we can note, no-sensitive passengers have a probability of latent class membership invariant with the age when they travel for holiday, whereas the probability tends to increase with the age when they travel for other purposes. Passengers cleanliness-sensitive seem to be also not changing with the age when they travel for holiday, whereas they tend to become less sensitive when traveling for other purposes.

On the contrary, information-sensitive passengers, when travelling for holiday, tend to become more sensitive towards these aspects when they are aged.

Concerning the interactions between trip purposes and education level, it can be noted that passengers with higher education levels traveling for holiday are more sensitive towards both cleanliness and information.

Table 3. Covariates

Covariate	Item	Value
Gender	Male	1
	Female	2
Age	Less than 30	1
	Between 30 and 40	2
	Between 40 and 50	3
	Between 50 and 60	4
	More than 60	5
Level of education	Junior high school diploma	1
	High school diploma	2
	Bachelor or Master degree	3
Country	Italy	1
	Other Countries	2
Trip purpose	Holiday	1
	Other purposes	2
Time of arrival	Less than 1 h before the flight	1
	From 1 to 2 h before the flight	2
	More than 2 h before the flight	3

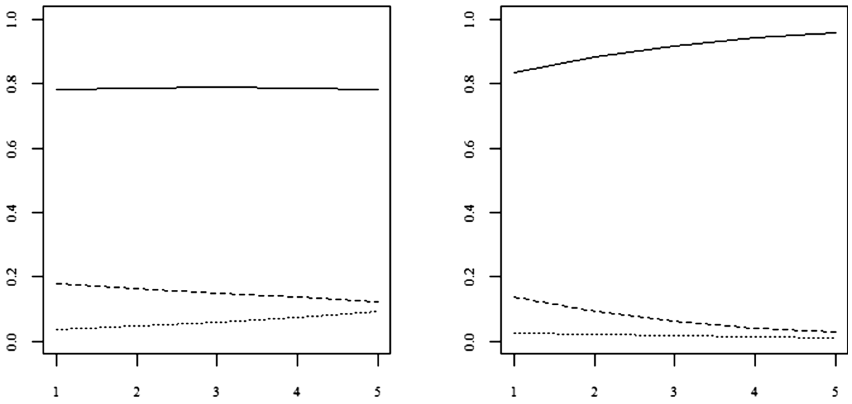

Fig. 2. Predicted probabilities of latent class memberships for "holiday as trip purpose" (on the left side), and "other trip purposes" (on the right side) and age [less than 30 (1), between 30 and 40 (2) between 40 and 50 (3), between 50 and 60 (4), more than 60 (5)] [*continuous line represents the first latent class, dashed line the second one, and dotted line represents the third latent class*].

As you can see from Fig. 3, the probability of belonging to the first latent class tends to decrease whereas the probabilities of belonging to both the second and the third classes increases. The same tendency can be noted for passengers traveling for holiday when their arrival time at the terminal increases (see Fig. 4).

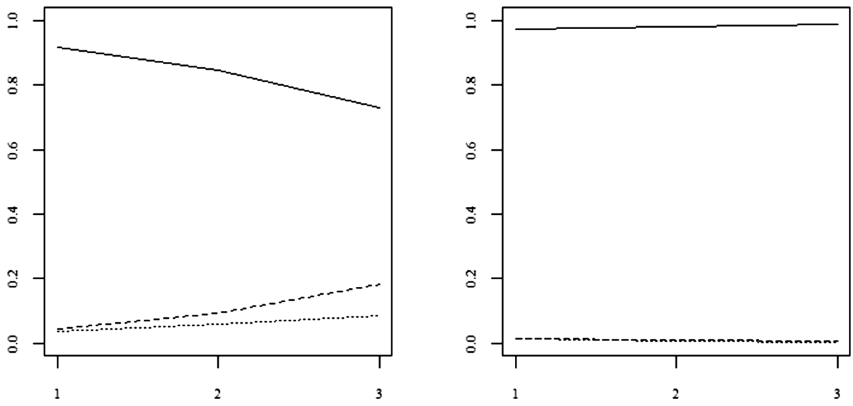

Fig. 3. Predicted probabilities of latent class memberships for "holiday as trip purpose" (on the left side), and "other trip purposes" (on the right side) and education level [Junior high school diploma (1), High school diploma (2) and Bachelor or Master degree (3)] [*continuous line represents the first latent class, dashed line the second one, and dotted line represents the third latent class*].

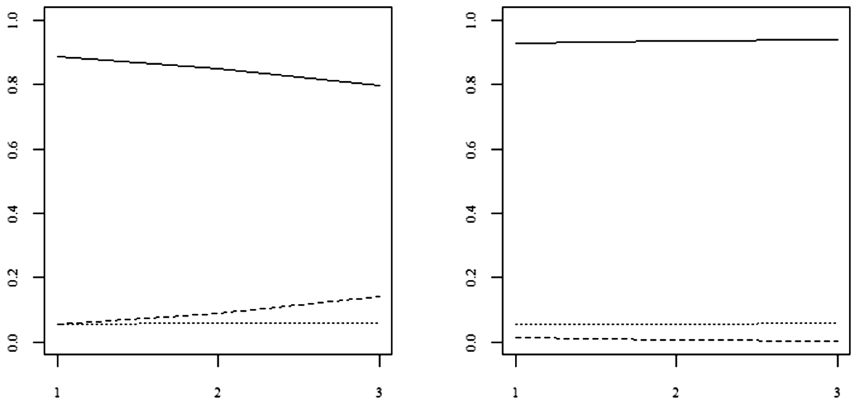

Fig. 4. Predicted probabilities of latent class memberships for "holiday as trip purpose" (on the left side), and "other trip purposes" (on the right side) and arrival time before the flight [less than 1 h (1), from 1 to 2 h (2) and more than 2 h (3)] [*continuous line represents the first latent class, dashed line the second one, and dotted line represents the third latent class*].

In Fig. 5 the interactions between gender and age are shown. In this case, it emerges that there is not difference in the attitude between male and female, and the passengers tend to become less sensitive towards all service quality aspects when their age increases; definitively, aged passengers are less exigent and with a higher sense of well-being in the terminal.

Relevant differences emerge between males and females when the interactions with passengers' education level are analysed (Fig. 6).

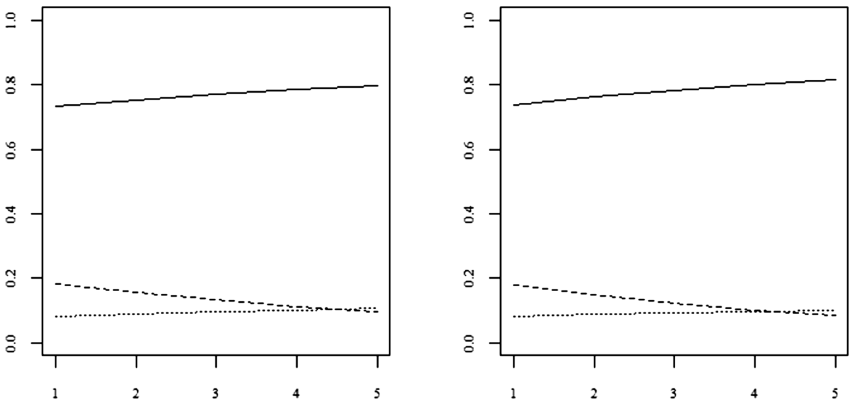

Fig. 5. Predicted probabilities of latent class memberships for "male" (on the left side), and "female" (on the right side) and age [less than 30 (1), between 30 and 40 (2) between 40 and 50 (3), between 50 and 60 (4), more than 60 (5)] [*continuous line represents the first latent class, dashed line the second one, and dotted line represents the third latent class*].

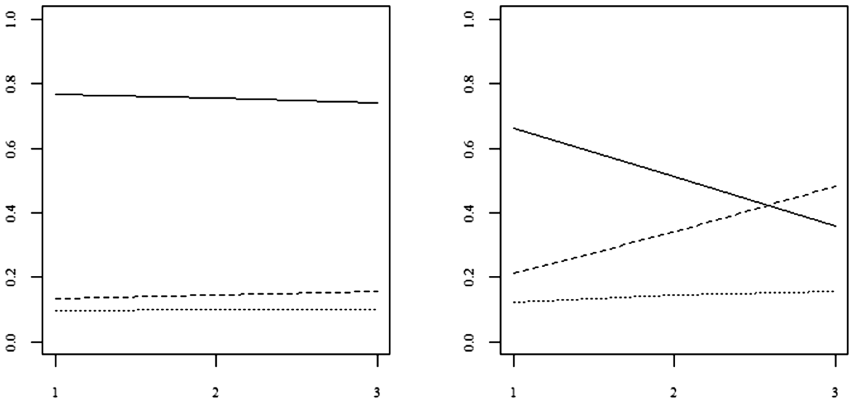

Fig. 6. Predicted probabilities of latent class memberships for "male" (on the left side), and "female" (on the right side) and education level [Junior high school diploma (1), High school diploma (2) and Bachelor or Master degree (3)] [*continuous line represents the first latent class, dashed line the second one, and dotted line represents the third latent class*].

In this case, male passengers with different education levels have the same probabilities of latent class memberships. Differently, female passengers are not very information-sensitive but their membership to the first latent class drastically decreases when their level of education increases and the sensitiveness towards cleanliness strongly increases.

Gender differences are highlighted also by Fig. 7, where predicted probabilities of latent class memberships are shown as a function of the arrival time at the terminal. In this case, females arriving more than 2 h before the flight become more sensitive towards cleanliness and their sense of well-being decreases.

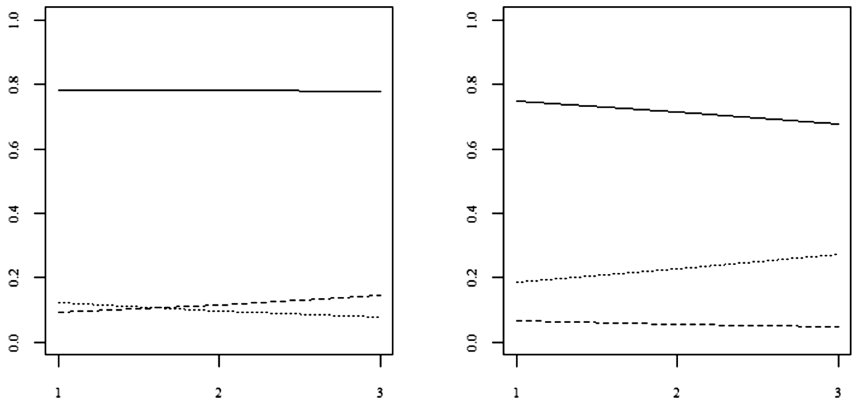

Fig. 7. Predicted probabilities of latent class memberships for "male" (on the left side), and "female" (on the right side) and arrival time before the flight [less than 1 h (1), from 1 to 2 h (2) and more than 2 h (3)] [*continuous line represents the first latent class, dashed line the second one, and dotted line represents the third latent class*].

Lastly, differences between Italian passengers and passengers from other countries were analysed (Figs. 8, 9 and 10). Generally, passengers from countries different from Italy are more sensitive towards all the service quality aspects, because latent class memberships show lower probabilities, but the probabilities to belong to each latent class are quite invariant with age. Conversely, aged Italian passengers become less cleanliness-sensitive and tend to increase their sense of well-being in the terminal.

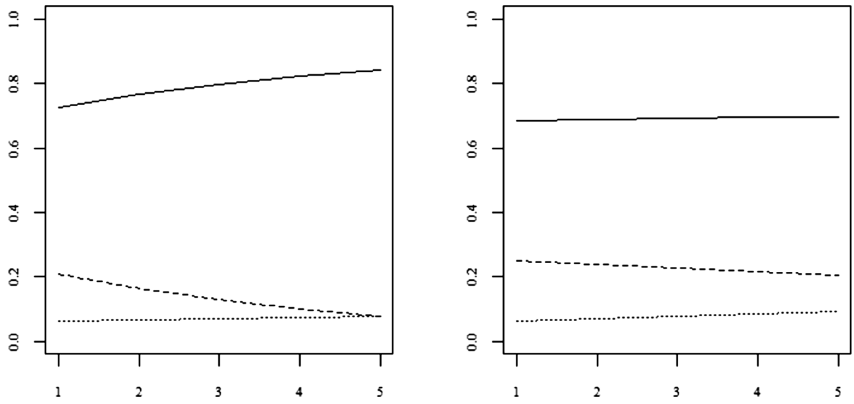

Fig. 8. Predicted probabilities of latent class memberships for "Italian travelers" (on the left side), and "travelers from other Countries" (on the right side) and age [less than 30 (1), between 30 and 40 (2) between 40 and 50 (3), between 50 and 60 (4), more than 60 (5)] [*continuous line represents the first latent class, dashed line the second one, and dotted line represents the third latent class*].

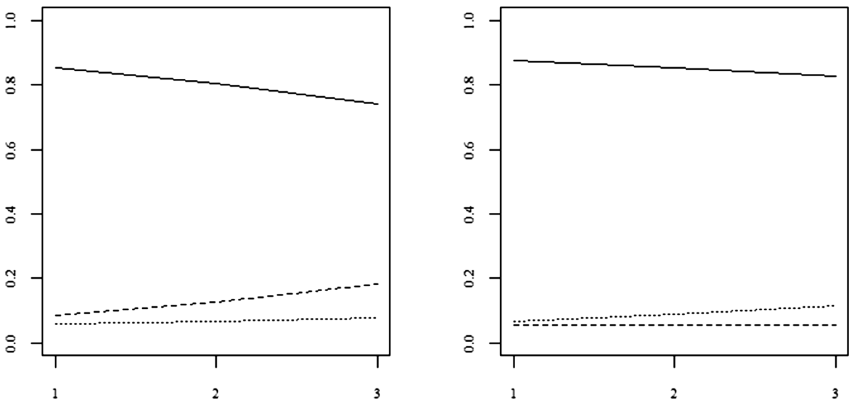

Fig. 9. Predicted probabilities of latent class memberships for "Italian travelers" (on the left side), and "travelers from other Countries" (on the right side) and education level [Junior high school diploma (1), High school diploma (2) and Bachelor or Master degree (3)] [*continuous line represents the first latent class, dashed line the second one, and dotted line represents the third latent class*].

Similar attitudes can be noted from Fig. 9, where the interactions with nationality and education level are shown. However, in this case passengers from countries different from Italy have a higher probability to belong to the first latent class (more than 80%), showing an attitude to have a good sense of well-being. Differently from Fig. 8, Italian passengers with higher levels of education increase their sensitiveness to quality aspects, especially those linked to cleanliness.

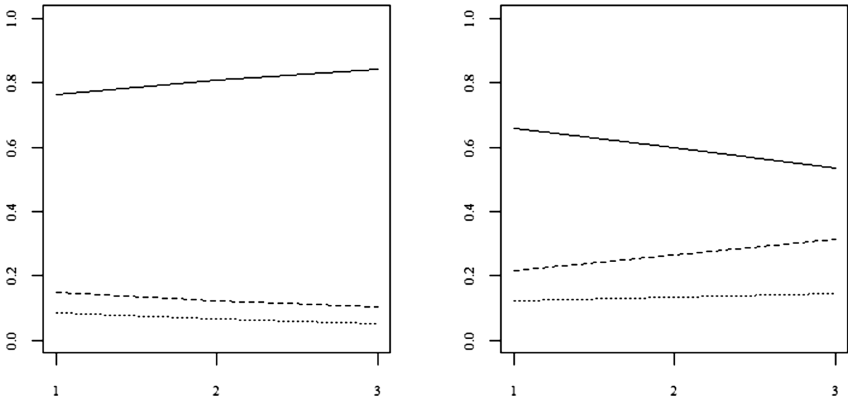

Fig. 10. Predicted probabilities of latent class memberships for "Italian travelers" (on the left side), and "travelers from other Countries" (on the right side) and arrival time before the flight [less than 1 h (1), from 1 to 2 h (2) and more than 2 h (3)] [*continuous line represents the first latent class, dashed line the second one, and dotted line represents the third latent class*].

Finally, attitudes quite different can be noted by comparing Italian travelers with travelers from other countries when arrival time before the flight is considered (Fig. 10). In this case, Italian passengers are very inclined to a good sense of well-being, whereas non Italian passengers are more exigent and become more sensitive, especially towards cleanliness and especially when arrival time increases.

5 Discussion of the Results

The influence of age over the class memberships is clear: aged passengers tend to be less exigent (increasing the probability to belong to no-sensitive class of passengers) and less sensitive towards terminal cleanliness (decreasing the probability to belong to cleanliness-sensitive class of passengers). This behavior was observed also in studies investigating on bus service quality; in fact, some authors verified that young people are more exigent than aged passengers [13, 14]. This evidence is particularly relevant when passengers travel for purposes different from holiday and for Italian passengers. Also Bellizzi et al. [4] registered that people travelling for work or study retain as less important aspects related to comfort. Instead, concerning the perceptions of the Italian passengers, Pantouvakis and Renzi [3] discovered that the opinions of Italian passengers regarding airport's physical environment and facilities, are less positive than those of the other passengers.

Differently from age, education level contributes to have more exigent passengers, decreasing the probability to belong to no-sensitive class of passengers; at the same time, sensitiveness towards terminal cleanliness and information increases. The emerging results is highlighted especially for female, Italian passengers and holiday travels. From the literature analyzing bus service quality, analogous findings emerges; Allen et al. [13, 14] verified that females are more demanding than males in travelling by a public transport mode concerning the need of time, security level, comfort and cleanliness, and so on.

Lastly, we consider the influence of arrival time over the latent class memberships. We can note that when arrival time before the flight increase air passengers reduced their sense of well-being in the terminal, probably due to their longer stay at the airport. In this case, the probability to belong to the no-sensitive class decreases and conversely the probabilities to belong to the cleanliness and information-sensitive classes increases, by proving a higher passengers' sensitiveness. These attitudes are particularly evident for female, passengers traveling for holiday and from countries different from Italy. Concordant findings were discovered by Bellizzi et al. [4] who found that people arriving more than two hours early give a certain importance to terminal cleanliness. On the contrary, Bezerra and Gomes [1] found that the earlier the passenger arrives at the airport, the more likely he/she is to present a higher overall satisfaction. They interpret this evidence by considering that the fact that passenger's level of stress is related to the amount of time available for complying with the required checkpoints.

6 Conclusion

In this paper, the sense of passengers well-being in the terminal of the Lamezia Terme international airport, a peripheral airport placed in the south of Italy, was explored. Experimental evidences showed that the sense of passengers well-being in the terminal can be explored by three latent classes, and specifically: (1) a first class representing passengers with attitude to express positive judgements towards all the service quality aspects (no-sensitive passengers); (2) a second class representing passengers with attitude to express positive judgements towards all the service quality aspects except for the aspect linked to the cleanliness (cleanliness-sensitive passengers); (3) a third class representing passengers with attitude to express non-positive judgements towards the service quality aspects linked to the information (information-sensitive passengers).

Also, a deeper analysis of the interactions among socio-economic characteristics, travel habits and flight features allowed some interesting issues to be discovered. We found that among the socio-economic characteristics, gender is not always very influencing class memberships, whereas age and level of education strongly affect class population shares. At the same time, travel purposes, country and arrival time before the flight showed a certain influence in predicting passengers class memberships.

The obtained results have practical implications because allow the agency managing airport infrastructures and services to better understand the needs and attitudes of air passengers. In turn, these issues can be used for improving the quality levels of the provided services and for suggesting customized services for each class of passengers using the terminal, by taking into account especially the sensitiveness towards cleanliness and information of certain class of users'.

References

1. Bezerra, G.C.L., Gomes, C.F.: The effects of service quality dimensions and passenger characteristics on passenger's overall satisfaction with an airport. J. Air Transp. Manag. **44**, 77–81 (2015)
2. Bezerra, G.C.L., Gomes, C.F.: Measuring airport service quality: a multidimensional approach. J. Air Transp. Manag. **53**, 85–93 (2016)
3. Pantouvakis, A., Renzi, M.F.: Exploring different nationality perceptions of airport service quality. J. Air Transp. Manag. **52**, 90–98 (2016)
4. Bellizzi, M.G., Eboli, L., Forciniti, C., Mazzulla, G.: Air transport passengers' satisfaction: an ordered logit model. Transp. Res. Procedia **33**, 147–154 (2018)
5. Linzer, D.A., Lewis, J.B.: poLCA. An R package for polytomous variable latent class analysis. J. Stat. Softw. **42**(10), 1–29 (2011)
6. Linzer, D.A., Lewis, J.: poLCA. Polytomous Variable Latent Class Analysis. R package version 1.3 (2011). http://CRAN.R-project.org/package=poLCA
7. R Development Core Team R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria (2010). http://www.R-project.org
8. S.A.CAL: Calabrian Airport Company: Service Charter Guide, Lamezia Terme (2018)
9. Akaike, H.: Information theory and an extension of the maximum likelihood principle. In: Petrov, B., Csake, F. (eds.) Second International Symposium on Information Theory, pp. 267–281. Akademiai Kiado, Budapest (1973)

10. Schwartz, G.: Estimating the dimension of a model. Ann. Stat. **6**, 461–464 (1978)
11. Greene, W.H.: Heterogeneity. Latent Class Models. New York University (2014)
12. Hensher, D.A., Rose, J.M., Greene, W.H.: Applied Choice Analysis, 2nd edn. Cambridge University Press, New York (2015)
13. Allen, J., Eboli, L., Mazzulla, G., de Dios Ortúzar, J.: Effect of critical incidents on public transport satisfaction and loyalty: an Ordinal Probit SEM-MIMIC approach. Transportation (2018). https://doi.org/10.1007/s11116-018-9921-4
14. Allen, J., Eboli, L., Forciniti, C., Mazzulla, G., de Dios Ortúzar, J.: The role of critical incidents and involvement in transit satisfaction and loyalty. Transp. Policy **75**, 57–69 (2019)