A way to measure the opinion of Europeans about Utilities

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Abstract: *This paper concerns the measure the opinion of European citizens about utilities. The Eurobarometer Survey data are considered and two non-standard techniques - Rasch Model and Nonlinear Principal Component Analysis - originally proposed in other fields are applied and discussed. The potential of both methods is highlighted; in particular the methods allow the questionnaire to be calibrated and the consumer satisfaction to be assessed and compared among European countries and different years.*

Keywords: Eurobarometer, Non Linear Principal Component Analysis, Rasch Analysis, Service Quality

1. Introduction and Methods

It is generally accepted that Customer Satisfaction, like every subjective attitude, is a complex concept that can not be directly observed but should instead be measured using other observed variables which are connected to different aspects and levels of satisfaction itself.
In order to have a knowledge of Customer Satisfaction, survey questionnaires are usually used. The statistical analysis of data from these surveys is then carried out and measures of each aspect or/and of overall satisfaction are obtained.
Many different methods to assess Customer Satisfaction have been proposed. Two main approaches can be identified. The first one uses statistical models to estimate the relationship between the latent variable and the manifest variables, among others: the structured equation models by applying LInear Structured RELationship (LISREL, see for example Joreskog, 1994) or Partial Least Squares (PLS, presented for example in Tenenhaus et al., 2005). The second approach uses instead descriptive analysis by adopting dimensionality reduction methods, such as: Factor Analysis (FA) or Principal Component Analysis (PCA). All of the above methods assume that the observed variables' categories are numerical, however, so that at least a Likert scale (Likert, 1932) is required. In addition they postulate linear relationships between the variables and this assumption might be not realistic.
In this paper two different methods are adopted to assess Customer Satisfaction. These method, described in the final paper, are able to take into account the order of categories without establishing an a priori difference between them and can pick up on nonlinear relationships. They are: the Rasch Model (RM) and the Nonlinear Principal Components Analysis (NLPCA). The first approach assumes a model entirely known except for the values of parameters which have to be estimated (we use in particular the Extended Logistic Model following Andrich et al. 2000). The second method instead is connected to an algorithmic procedure (see Gifi, 1990 and Michailidis and De Leeuw,1998), no data generating process is assumed but the best representation of data is sought. The potential of both methods is examined. To be precise RM is a good tool for calibrating the questionnaire properly whilst NLPCA can be used subsequently to quantify the variables' categories and weights of manifest variables in order to set up a synthetic indicator of the level of satisfaction available for further analysis.

2. Application to Eurobarometer Data

The two methods, RM and NLPCA, allow for a preliminary study of European utilities users' satisfaction, with the aim of emphasising the main features of satisfaction, detecting hotspots and establishing the role played by the different services and aspects of service in users' satisfaction.
Services of General Interest questions present in Eurobarometer survey related to three years (2000, 2002, 2004) are considered. Data are pooled in order to compare countries and years. The final data set for the analysis is structured as follows: the rows (almost 47.000) represent the respondents belonging to different Countries (almost 15.000 for each year in question), the columns refer to items (12 dimensions) relevant to four services (fixed telephone, electricity, gas and water) and three aspects (accessibility, price and quality).
We curry out an analysis of items and an analysis of subjects (see Florio et at., 2007 and Ferrari and Salini, 2008). Item analysis highlights which items (service or aspects of service) are more important for the Consumer (NLPCA) and which of these are perceived by the Consumer to be of a high or low quality (RM). Using RM coefficients we can observe that the item with the largest quality score is *accessibility* of *water supply* and the item with the lowest quality score is *price* of *fixed telephone service*, as it is shown in Table 1.

Items	Location Parameters	Thresholds		
SGIaccW	-1.899	-3.074	-0.725	
SGIaccE	-1.804	-2.866	-0.742	
SGIaccT	-1.473	-2.062	-0.884	
SGIaccG	-1.179	-1.85	-0.509	
SGIquaE	0.277	-1.667	-0.673	3.171
SGIquaG	0.443	-1.214	-0.669	3.213
SGIquaW	0.587	-0.915	-0.503	3.18
SGIquaT	0.68	-0.921	-0.411	3.372
SGIpriG	0.929	0.156	1.703	
SGIpriE	1.045	0.237	1.853	
SGIpriW	1.052	0.403	1.7	
SGIpriT	1.342	0.546	2.137	

Table 1: Items sorted by Rasch Item Location Parameter ordered from the best to the worst quality.

By NLPCA the weights of the manifest variables in defining the satisfaction index are determined: *Accessibility* of *gas supply* has the lowest loading (see Table 2) and hence has the least importance and the least weight in the overall index.

Items	accT	accE	accG	accW	priT	priE	priG	priW	quaT	quaE	quaG	quaW
Component Loadings	0.45	0.663	0.188	0.61	0.474	0.563	0.478	0.521	0.653	0.747	0.603	0.721

Table 2: Component Loadings

By the quantifications of categories we can see that the hypothesis of equal distance between categories does not hold, and for some items a few categories are redundant (see Figure 1). It is also interesting to note that for the same items the thresholds estimated by the RM are very close (see Table 1).

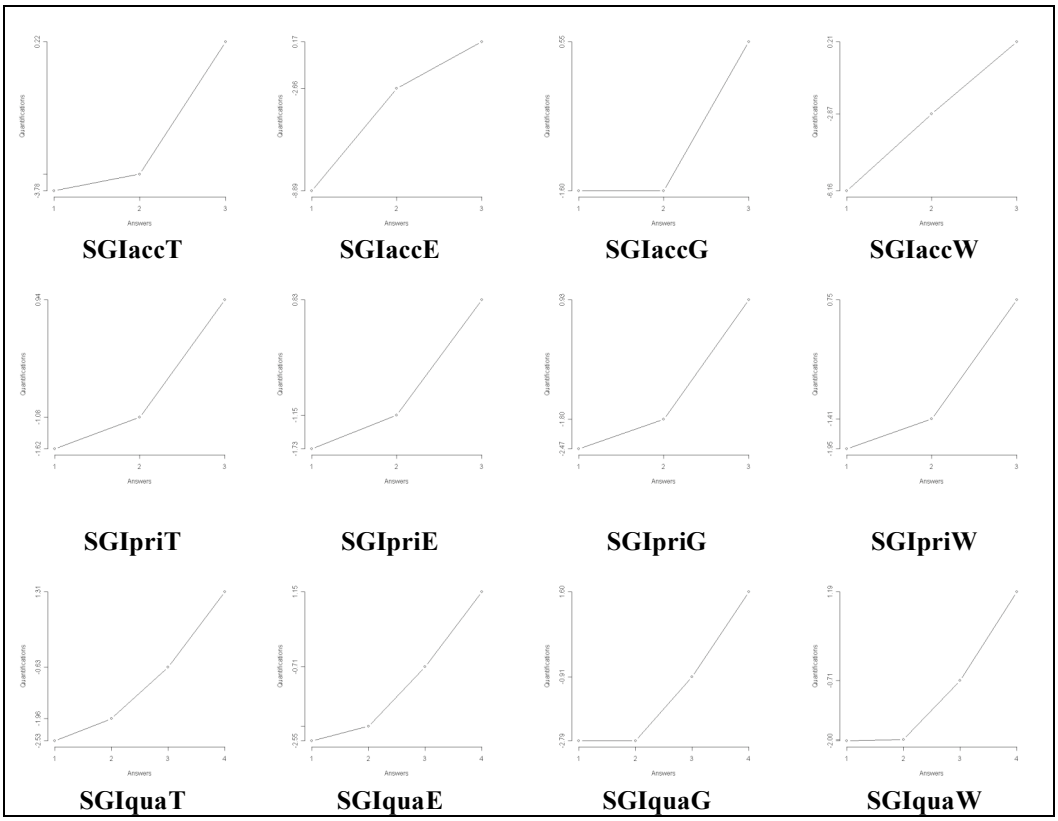

Figure 1: Quantifications of item categories

The subject analysis uses the Rasch person parameter as the value of the global customer satisfaction index, which summarises all the services and all the aspects of a service. Italy and Portugal have the lowest average levels, Ireland and Denmark the highest ones.
Similar scores with similar meaning are obtained by NLPCA. They are sketched in Figure 2 where for each European country the average score in conjunction with its bootstrap percentile confidence interval are reported. The CI is obtained by bootstrap percentile method; the average scores by European countries are ordered from the highest to the lowest and the results are similar to ones obtained by RM.

3. Conclusion

Our starting point is the Consumers' perception of service quality. First we consider the customer satisfaction survey as a useful instrument in order to measure service quality as perceived by users and examine the Eurobarometer survey data.
With this goal in mind, two different techniques are proposed. They are: the Rasch Model (RM) and the Nonlinear Principal Components Analysis (NLPCA).
The two methods allow us to establish a ranking of items, on one hand based on the perceived quality and on the other based on the importance. Moreover they allow for synthetic indicator of the level of satisfaction to be provided for more in-depth analysis. The NLPCA analysis shows that the service aspects play different roles in the evaluation of different European countries. In addition, the RM model results suggest that the Eurobarometer questionnaire presents some measuring problems, and therefore a recalibration or else a different way to measure the Service quality could be in order

The details of the calibration analysis and a comparison between aspects, services, years and countries will be presented in the final paper.

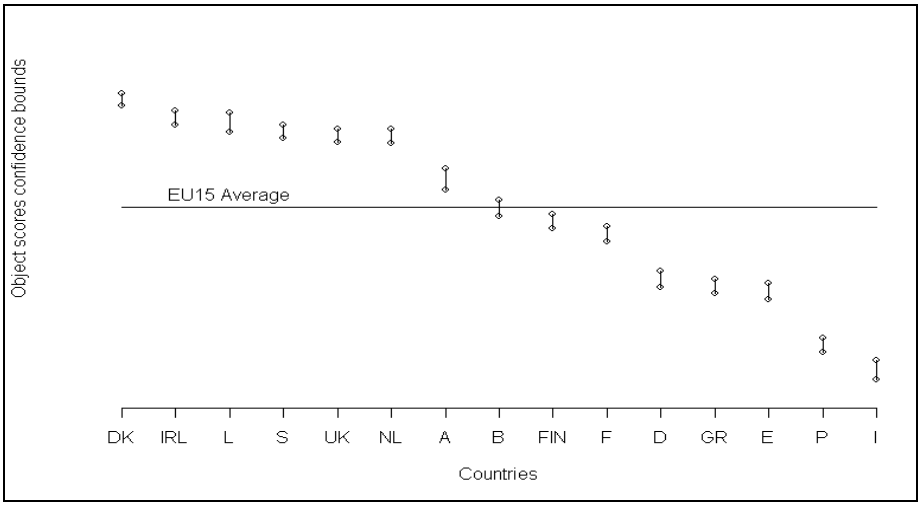

Figure 2: 95% bootstrap CI of Average Satisfaction in of European Countries

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Bibliography

Andrich D., Sheridan B., Lyne A. and Luo G. (2000), RUMM: A windows-based item analysis program employing Rasch unidimensional measurement models. Perth, Australia: Murdoch University.

Ferrari P.A., Salini S. (2008), Measuring Service Quality: the opinion of Europeans about Utilities, FEEM working paper No. 36.

Fiorio C.V., Florio M., Salini S., Ferrari P.A. (2007), *Consumers' Attitudes on Services of General Interest in the EU: Accessibility, Price and Quality 2000-2004* - In: Servizi Pubblici: Nuove Tendenze nella Regolamentazione, nella Produzione e nel Finanziamento ; [a cura di] M. Marrelli, F. Padovano, I. Rizzo. - [s.l.] : Franco Angeli, 2007.

Gifi, A. (1990). Nonlinear Multivariate Analysis. Wiley, New York.

Joreskog, K.G. (1970). A general method for analysis of covariance structure, Biometrika, 57, 2, 239-251.

Likert, R. (1932). *A Technique for the Measurement of Attitudes*, Archives of Psychology, 140, 595-639.

Michailidis, G. and De Leeuw, J. (1998). The Gifi system of descriptive multivariate analysis. Statistical Science, 13, 307-336.

Tenenhaus, M., Esposito Vinzi, V., Chatelin, Y. M. and Lauro, C. (2005). PLS Path Modeling, Computational Statistics and Data Analysis, 48, 159-205.

