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The application of multivariate statistical methods for understanding food consumer behaviour

Zoltán Lanker¹
Istvánné Hajdu²
Diana Bánáti³
Erzsébet Szabó³
Gyula Kasza²

Abstract

Understanding consumer behaviour is a necessary precondition for a targeted communication strategy. The behaviour is a complex phenomenon and research needs to undertake a rigorously apply sophisticated methods. This article entails the combined utilisation of categorical principal component analysis and cluster analysis to determine the major, relatively homogenous consumer groups and this is coupled with confirmatory factor analysis and structural model building to understand consumer behaviour, based on Fishbein and Ajzen's theoretic model.

Keywords

Categorical principal component analysis, cluster analysis, confirmatory factor analysis, consumers' segmentation, structural model building

1. Introduction

During the last ten years, the number of publications on the food safety issue has exploded. These publications' common features are the following: (1) They concentrate mainly on food safety problems in developed states. (2) Consumer behaviour is analysed through a precise demographic or sociological segment of society, or one well-defined product category (Sapp, 2003). (3) Mainly attitude scales are used to investigate and, to analyse research results, they utilise classical data analysis methods, which were developed for values analysis which are measured on a numeric scale. Consumer segmentation as well as understanding motivation are essential for consumer education and for working out a better risk communication strategy (Porter, 1980). To achieve this it is not enough to apply results in the field of consumer research because Hungarian consumers' socio-economic situation differs considerably from that in developed states. The major specific features regarding this can be summarised as follows: (1) After the dissolution of state-farms and co-operatives, the number of small and middle-size agricultural producers has increased; (2) food industry privatisation has been mainly accomplished by foreign direct investment (3) because of economic transformation and privatisation a bipolar food industry structure and trade have been formed: on the one hand, large concentrated economic entities; on the other hand, a large number of smaller scale entities often with backward processing capacities (4) income differences among the population have increased, eclipsing those in Western-Europe (5) there has been a rapid proliferation in snack bars and other facilities representing a trend of *outside home* eating, often resulting in unsatisfactory hygienic conditions.

¹ corresponding author, Budapest Corvinus University, H-1118, Budapest, Villányi út 35-43.
(phone: +36-1-209-0961; fax: +36-1-209-0961), e-mail: zoltan.lakner@uni-corvinsus.hu

² Budapest Corvinus University, H-1118, Budapest, Villányi út 35-43.
(phone: +36-1-209-0961; fax: +36-1-209-0961)

³ Central Hungarian Food Research Institute, H-1022, Budapest, Herman Ottó utca 15.
(phone: +36-1-355-8991; fax: +36-1-2129853)

2. Hypothesis development

We have carried out a critical review of the pertinent literature. We have also conducted interviews with leading Hungarian food safety specialists, food safety agencies, and various enterprises. From the previous research, we have derived the following hypotheses:

- H₁ Among Hungarian consumers there are different approaches towards the food safety problem. These approaches can be quantified (measured) by Likert-type attitude-scales (Likert, 1967), and separated by multivariate statistical methods.
- H₂ Based on awareness of the respondents' attitude-system, it is possible to distinguish between different consumer groups. Thus we will be able to form relatively homogenous consumer clusters, making communication easier.
- H₃ Food consumer behaviour can be explained through the general theory of the well-known Fishbein-Ajzen model of planned behaviour. In trying to understand the basis for consumer behaviour psychologists, marketing specialists, and health educators have compiled an impressive list of factors and constructs which at times have been deemed relevant, but these factors are hard to apply. That's why we have a rather simple, but easily applicable method of investigation, meaning the Fishbein-Ajzen (Collins & Wugelther, 1992; Fishbein & Ajzen, 1974) model. Probing the causes for human behaviour, Ajzen and Fishbein state, that "*the ultimate determinants of any behaviour are the behavioural beliefs concerning its consequences and normative beliefs concerning the prescriptions of others*" and "*variables other than these two components (are) shown to affect behavioural intentions and overt behaviours indirectly by influencing one or both of the components*". This certainly curtails the number of relevant factors influencing consumer behaviour and explains why this approach has been used to analyse consumer behaviour. Behaviour is defined as "*Observable acts ... that are studied in their own right*". The model provides a framework to study attitudes toward behaviour. According to the theory, the most important determinant of a person's behaviour is behavioural intent. The individual's intention to undertake a given behaviour is a combination of attitude toward undertaking the behaviour and subjective norm. If a person perceives that the outcome from performing a behaviour is positive, she/he will have a positive attitude toward performing that behaviour. If the person's *significant others* see the behaviour as positive and the individual is motivated to meet their expectations, then a positive subjective norm is expected. Attitudes and subjective norm are measured on scales (as an example the Likert Scale) using phrases or terms such as like/unlike, good/bad, and agree/disagree. A positive product indicates behavioural intent (Glanz et al., 1997). Behavioural intention's third determinant is perceived behavioural control. This perception can reflect past experiences, anticipation of upcoming circumstances, and influential norm attitudes that surround the individual (McKenzie & Jurs, 1993).

3. Methodology

The overall research design has been quasi experimental and multifactorial. It is therefore largely quantitative and deductive, rather than qualitative and interpretive (Galser & Strauss, 1967).

Focus group interviewing was the method used to study consumer experience regarding safety of food industry products. Topics were selected in advance but actual questions were not precisely specified.

Based on interview results, we developed multi-item scales, following standard psychometric scale development procedures. To determine the consumers' attitude system, we utilised Likert-type interval scales. In general, for these surveys, 1-7 scales are utilised, but in Hungary from elementary school to universities the 1-5 scales are utilised (5-very good ... 1-unsatisfactory). That's why the questions about attitudes were scored on a five-point Likert scale, with options 5 strongly agree, 4 basically agree, 3 uncertain, 2 rather disagree, 1 strongly disagree.

To save respondents' time, two surveys were completed. Each of the surveys was based on more than 600 respondents. The sample was representative in terms of gender. In the samples better educated people were over-represented as well as village dwellers and younger respondents. This does not make interpreting the results inaccurate because relatively younger, better educated respondents can be considered as trend-setters; awareness of their attitudes is revelatory about the future attitude system and Hungarian consumers as a whole.

The questionnaire was composed of more than 500 items. The questions encompassed different aspects of consumer behaviour.

It is well-known that factor analysis attempts to identify underlying variables, or factors, that explain correlation patterns within a set of observed variables, but utilising factor analysis for quantities, determined on an interval scale, is rather biased (Joereskog & Sordom, 1999). That's why we had to apply an analogous method for categorical data. This algorithm was categorical principal component analysis, of which the procedure simultaneously quantifies categorical variables while reducing the data's dimensionality (SPSS Inc., 2002).

Based on Chronbach's alpha, a reliability analysis was conducted. In Cronbach's (2000) opinion, the interpretation of Cronbach's alpha coefficients of 0.75 and above are generally acceptable. Between 0.65 and 0.75, they are often used, although it must be recognised that there is some instability in the instrument. Below 0.65 it is difficult to form solid conclusions regarding the data, although you will notice that sometimes this occurred.

Based on eigenvalues and Cronbach's alpha, for further research we utilised three dimensions. As with classical factor analysis, it is possible to determine each respondent's component scores. Using the individual score values as starting points, the city-block method of cluster analysis (based on Euclidean-distance measure) have been used (Horváth et al., 2001). Relying on the experts' opinion, using heuristic methods, a quasi-optimal number of principal components and factors was determined.

To operationalise this model we utilised a series of questions. Regarding the consumers' information study, the "behaviour" was determined by answering four questions.

Using the Fishbein-Ajzen theory, we were able to determine the factors system, influencing consumer behaviour by confirmatory factor analysis and structural equation modelling. Confirmatory factor analysis was used to study the relationships between a set of observed variables and a set of continuous latent variables. Concepts such as "attitude" or "perceived control" are hard to quantify and that's why we approximated them by the respondents' level of acceptance toward certain statements, which reflected a given statement, or its negation.

Structural equation modelling included models in which regressions among the continuous latent variables were estimated. The conventional way of determining structural equation models is Lisrel software. We utilised analogous, more user-friendly software for this purpose: Mplus, Statistical Analysis Software for Latent Variables analysis (Muthén, 2002). The algorithm applied was the weighted least square parameter estimates with conventional standard errors and chi-square test statistic using a full weight matrix (Muthén & Muthén, 2004).

4. Results

The application of categorical principal component analysis to our data set led to the conclusion that the first six dimensions (with terminology of factor-analysis: factors) had an eigenvalue above 1. Each of the dimensions listed in Table 1 was labelled by an appropriate name according to the components that loaded most highly for that dimension.

Drawing from eigenvalues and Cronbach's alpha, three dimensions were accepted for further investigation. According to their individual score, respondents were classified by cluster analysis. Utilising these scores we were able to determine the most important groups of Hungarian consumers (Table 2).

The model construction to determine the most important influencing factors yielded a chi-square test acceptable result (Fig. 1). The chi-square test showed that model's suitability was not significant, indicating null hypothesis. One cannot dispute that the model corresponds with the data. This finding was corroborated by Root Mean Square Error of Approximation (RMSEA) statistics. According to Hu and Bentler (1999) the recommended cut-off value is 0.06. The RMSEA estimation was 0.04, and that's why the model fits well. The structural model describes two types of relationships: the relationships between observed variables and latent variables, and that among latent variables. The directly observed variables are indicated by ellipses. The continuous latent variables (attitude, norms, perceived control) are indicated by rounded rectangles. The behaviour itself (marked by a rectangle) was measured by four indicators. These indicators were marked by pentagons. The graph shows the unstandardized coefficients. Each unstandardized estimate represents the amount of change in the outcome variable as a function of a single unit change in the variable causing it. For instance, for each single unit change in the "attitude" latent factor, plus the agreement level with the statement: "I want to be informed on food safety" increases by 1.301 units. By definition, the first estimate in each group of variables is set as 1.

Figure 1

System of factors, influencing the food consumer behaviour

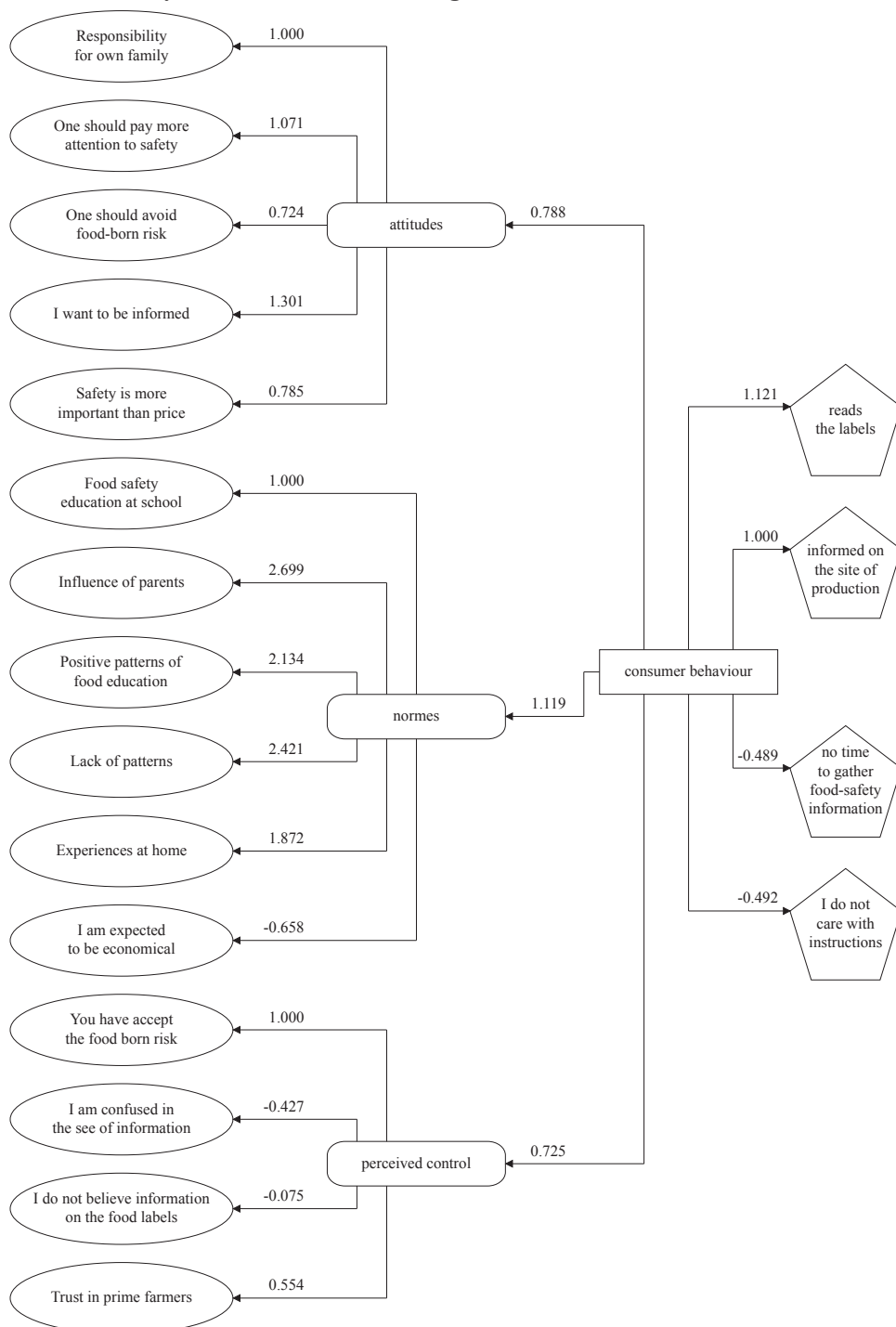


Table 1

Results of principal component analysis

Statement	Dimension					
	1	2	3	4	5	6
	Carelessness	Optimism	Responsibility	Demand	Anti-globalisation	Risk-acceptance
The food products in the Hungarian trade are safe and do not mean any threat to consumer	0.136	0.572	0.142	-0.296	0.013	-0.009
The import of foreign products increases the danger of food-borne diseases. One has to buy food with great precaution	0.034	0.110	-0.032	0.104	0.645	0.021
The food quality and safety has been increased as a result of technical progress and the improvement of food processing technologies	0.057	0.666	0.162	0.011	-0.077	-0.183
The main cause of food-borne diseases is the carelessness of the food consumers	0.134	-0.056	0.249	0.236	0.342	0.188
The consumers do get so much, sometimes contradictory information on food safety, that the man/woman of the street hardly get ones bearings	0.050	-0.114	0.063	-0.012	0.410	0.591
The food safety in Hungary is well regulated and guaranteed by severe government control	-0.115	0.729	-0.125	0.058	0.157	0.119
If the health of others depends on you (e.g. you have children) you must do all in your capacity to supply them with safe food	-0.138	0.116	0.748	-0.148	0.065	0.053
It is very important for the consumers to be continuously informed on food safety issues	-0.087	-0.021	0.767	0.175	-0.029	-0.048
The Hungarian consumers have access to a wide range of reliable pieces of information on food safety	-0.023	0.646	-0.055	0.160	-0.054	0.026
The food consumption is a dangerous thing with its own threats.	0.207	0.148	-0.038	-0.027	-0.088	0.715
The quality of Hungarian food products has been increased as a result of the foreign direct investments into Hungarian food industry	0.120	0.506	-0.026	0.108	-0.321	0.316

Statement	Dimension					
	1	2	3	4	5	6
	Carelessness	Optimism	Responsibility	Demand	Anti-globalisation	Risk-acceptance
I have not time and energy enough to pay special attention, when and what I eat	0.815	-0.032	0.072	0.024	-0.037	0.095
I have a lot of more important problems in my life. I do not worry myself with the food safety problem	0.839	0.038	-0.093	-0.086	-0.081	0.076
One has to pay special attention to food-borne risks	-0.190	0.022	0.447	0.497	0.192	-0.082
I want to know more on that, how to defend myself and my family against the food-born diseases	-0.219	-0.042	0.508	0.468	0.198	0.022
In the era of our parents and grandparents the food safety issue got much lesser emphasis, but they were in a good health condition. This is an overemphasised topic	0.598	0.076	-0.171	-0.210	0.198	0.103
This food safety issue is the problem of yawning housewives	0.610	0.012	-0.321	-0.016	0.096	0.061
I am ready to pay more if I can get a serious guarantee on the safety of the food product	-0.232	0.032	0.094	0.708	-0.041	0.261
In opinion of my relatives and acquaintances I am too meticulous on food safety related questions	0.091	0.106	-0.040	0.772	0.100	-0.181
In era of our parents and grandparents the quality of food was much more safer. The modern, industrialised food production is more hazardous	0.208	-0.270	-0.071	0.097	0.473	0.322
The globalisation of the food trade threatens the food safety. The safety of imported food products is lower	-0.058	-0.064	0.133	-0.022	0.722	-0.065
Eigenvalue	3.562	2.468	2.048	1.474	1.368	1.083
Cronbach's alpha	0.854	0.723	0.636	0.337	0.282	0.080

Table 2

Typology of Hungarian food consumers
(in brackets the average evaluation values of possible answers, on an 1-5 interval scale)

Phantasy –names of the segments					
	Unsure curious	Optimistic technocrat	Indifferent	Distrustful curious	Conservative cautious
Share (%)	38	5	12	27	18
Typical respondent of the cluster	Middle aged respondent, who is living in a middle-scale country town. Hers/his highest qualification level is secondary school. Hers/his qualification or work is not joining to the food chain	Food industrial specialist with college or university level of qualification	Young respondent living in the capital of the state, having no children yet. higher Hers/his qualification or work is not joining to the food chain	Elder small town or village resident, with college or university qualification, not joining to the food production; or town dweller with small children	Respondent with at least accomplished high school, elder (45+), living in small town or village, with an above average income level
The safest sources of food procurement	own-produced fruits and vegetables (4.11); meat of own-fattened animals (3.97) biomarket, bio-shop (3.92)	own-produced fruits and vegetables (4.15); expensive restaurants (4.08) super-and hypermarkets (3.85)	sown-produced fruits and vegetables (3.90); expensive restaurants (3.87) super-and hypermarket (3.68)	own-grown fruits and vegetables (4.37); meat of own-fattened animals (4.02) biomarket, bio-shop (3.80)	high –level restaurant (4,14) bio-market, bio-shop (4,05); own-grown fruit or vegetable (4,00)
The most risky sources of food procurement	Salad-bar, (2,94) moving vendor (2,45) street corner snack bar (2,17)	Agricultural producer on the market (2,64) moving vendor (2,10) street corner snack bar (1,86)	exotic restaurants (2,87) moving vendor (2,27) street corner snack bar (2,17)	exotic restaurants (2,78) moving vendor (2,11) street corner snack bar (1,88)	salad-bar, (2.83) street corner snack bar (2,28) moving vendor (1,88)
The most important food product attributes	shelf life (4.57) price (4,42) organoleptic value (4,41)	shelf life (4.84); readability of food label (4.65) organoleptic value (4,57)	price (4,29) shelf life (4.15); price (4,12)	shelf life (4.79); price (4,35) readability of the food label (4,32)	shelf life (4.79); price (4,44); readability of the food label (4,36)

Phantasy –names of the segments					
	Unsure curious	Optimistic technocrat	Indifferent	Trustful curious	Conservative cautious
Share (%)	38	5	12	27	18
The less important food –product-related attributes	bioproduct (3,20) energy content (3,18) TV promotion(2,48)	brand name (3,27) bio product (3,17) TV promotion (2,32)	aesthetic packaging (3,32) bioproduct (2,95) TV promotion (2,80)	aesthetic packaging (2,93) brand name (2,78) TV promotion (1,99)	energy content (3,27) aesthetic packaging (3,19) TV promotion (2,50)
Attitude to the food labels	Each ingredients should be indicated even when they are not understandable to the consumers	Each ingredients should be indicated; this is not confusing to the consumer	The indication of the ingredients has not too much importance, but they do not disturb the consumers	Each ingredients should be indicated; this is not confusing to the consumer shelf life	The indication of every and each ingredients is of primary importance. For him/her the information dumping is not disturbing
The most important food-related risks	chemical residuals from environmental production (4.52) agro-chemical residuals (4.42) mildew and micotoxins (4.23)	chemical residuals from environmental production (4.69) mildew and micotoxins (4.55) microorganisms (4.46)	agro-chemical residuals (4.25) chemical residuals from environmental production (4.17) residuals of natural toxicants (4.15)	agro-chemical residuals (4.78) antibiotic residuals in meat or milk (4.17)	chemical residuals from environmental production (4.79) mildew and micotoxins (4.68)
Main sources of food safety related knowledge	TV(3,52) domestic experiences (3,30)	university, college studies (3,75) social life (3,00)	domestic experiences (3,50) TV (3,38)	social life (3,70) studies in the secondary schools (3,40)	university, college studies (3,40) domestic experiences (3,32)

5. Discussion

The H_1 hypothesis has been proven: there are well-defined patterns toward food safety regarding Hungarian consumers' attitudes.

From these attitude-systems a rather well-defined consumer profile could be developed. Moreover, the H_2 hypothesis can be considered as proven. In this regard, there is potential to communicate effectively with different groups of consumers. The major communication focus for food safety should be multi-faceted and geared toward different groups of consumers. These are as follows:

1. *unsure curious consumers*-to supply reliable information on a given firm, coupled with a scientific approach that emphasises the ill-founded nature of some current and fashionable theories of health and food safety;
2. *optimistic technocrats*-to strengthen this consumer type's optimism, at the same time stressing the potential threats of food consumption
3. *indifferents*-accentuating the importance of food safety, via media utilised by these consumers;
4. *distrustful consumers*-greater attention on communication and reliability
5. *conservative cautious consumers*- stressing the impact of region of origin in dealing with this group of consumers.

One can consider the H_3 hypothesis as proven. The Fishbein-Ajzen model seems appropriate to evaluate consumer behaviour. After applying the Fishbein-Ajzen theorem, one observes the importance of the family in food safety education.

Attitudes and perceived control equally influenced consumer behaviour. The role of norms was especially high. Interestingly, parental influence had a higher than average impact. We were not able to prove a significant relationship between the attitudes, control and norms. This can be attributed to the rather low number of respondents.

Moreover, the school's role in food safety education seemed to be limited, and did not play a significant role. This reveals the relatively low level of food safety education in Hungarian schools. This fact is especially significant because if both parents work and grandparents are absent, in the future the importance of family/home education will diminish.

References

1. Bloch P. H. – Sherrell, D. L. – Ridgway, N. M. (1986): Consumer search: An extended framework; *Journal of Consumer Research*; 13: 325-340
2. Collins, L. M. – Wugelter S. E. (1992): Latent class models for stage-sequential dynamic latent variables. *Multivariate Behavioural Research*, 27:131-157
3. Conlon E. (2000): Issues in quantitative research, Gold coast, Griffith University;
4. Fishbein, M. – Ajzen, I. (1974): Attitudes towards objects as predictors of single and multiple behavioural criteria. *Psychological Review*, 81(1), pp. 29-74.
5. Glanz, K. – Lewis, F. – Rimer, B. (1997): Health Behavior and Health Education: Theory, Research, and Practice, Jossey –Bass Inc. California. pp. 125-151.
6. Glaser B. – Strauss M. (1967): The discovery of grounded theory, Chicago, Aldine p. 227
7. Horváth Á. – Komáromi N. – Lehota J. (2001): Marketingkutatás az agrárgazdaságban, Mezőgazda Kiadó, Budapest pp. 1-233
8. Joereskog, K. – Sordom, D. (1999): Lisrel 8 user's reference guide Chicago, Scientific Software Int. Inc.
9. Likert, R. (1967): The method of constructing an attitude scale. In Fishbein, M. (ed.), *Attitude theory and measurement* (pp. 90-95). New York: John Wiley & Sons.
10. McKenzie, J. F. – Jurs, L. J. (1993): Planning, Implementing, and Evaluating Health promotion Programs, A Primer. Macmillan Publishing Company, New York. Chapter 6: Theories and Models Commonly Used for Health Promotion Interventions pp.124-143.
11. Muthén B. (2002): Beyond SEM: General latent variable modelling. *Behaviormetrika* 29: 81-117
12. Muthén, L. K. – Muthén, B. (2004): MPlus Statistical Analysis with latent variables, User's Guide, Muthén and Muthén, Lons Angeles, pp.1-505
13. Porter, M. (1980): Competitive strategy: Techniques for analyzing industries and competitors; Free Press; New York:
14. Sapp, S. G. (2003): A comparison of alternative theoretical explanations of consumer food safety assessments; *International Journal of Consumer Studies*; 27: pp. 34-39
15. SPSS Inc. (2002): SPSS user's reference guide for SPSS 12.0 , Scientific Software Int. Inc.