

CONSUMERS' CHOICE RATIONALITY SCORE MODEL

Ya.S. Kuryshova*

Department of Engineering Business and Management, Peoples Friendship University of Russia
(RUDN University), Moscow, Russia

* Corresponding Author: kuryshova_yas@pfur.ru

T.V. Bogacheva

Department of Engineering Business and Management, Peoples Friendship University of Russia
(RUDN University), Moscow, Russia

V.L. Snezhko

Department of Informational Technologies, Russian State Agrarian University - Moscow Timiryazev
Agricultural Academy, Moscow, Russia

N.S. Shcherbakova

Department of Engineering Business and Management, Peoples Friendship University of Russia
(RUDN University), Moscow, Russia

ABSTRACT

The paper deals with a generic methodology of rating of choice rationality for different target groups. Offered method is based on the cardinal utility theory and social research about value of goods from different levels of Maslow's pyramid. This method will help to provide company's competitive edge by marketing strategy improvement. This improvement is achieved by application of customer focus policy. The novelty of the study is in the creation of a model for assessing the choice rationality for individual consumers of different gender, age, income level and place of residence. The advantages of the proposed method are simplicity, flexibility and effectiveness. The model has both scientific and practical significance. The proposed method will let the enterprises select an individual approach to each segment of their target audience, which will increase the competitiveness of the company. From the theoretical point of view, the value of the method is in its universality. The method can be useful in economics, in psychology, and in sociology.

Keywords: *utility, marginal utility, total utility, consumer behavior, segmentation*

Introduction

Market offer on world and regional markets abounds in its diversity nowadays. The level of competition in prevalent number of business fields tends to be perfect. It is a good macroscale trend however there is not so clear for the micro-level: high resilience companies improve their indicators, but companies, less adaptable to new situations, deteriorate their market position. Chiefs who are aware of competition risks undertake different measures to secure their market position. One of such measure is company's customer focus policy. Similar ideas were outlined in the other articles also (Balyhin, Alekseenko (2015), Kafidov, Kovaleva (2017), Sopilko, Nawrotskaya (2017), and ets.).

The concept "customer focus policy" ("client-centeredness") implies that it is an individual approach to the each customer. In order to choose the right approach, it is necessary to have an idea about the theory of consumer behavior: about the propensities, interests, customer's values, their financial status, etc. One of the main sections of the theory of consumer behavior is theory of utility.

Review of relevant studies and problem statement

The most famous studies conducted by Marshall (1920), Von Neumann and Morgenstern (1953), Kahneman and Tversky (1979), Grechuk and Zabarankin (2016), Ingersoll (1987), Castagnoli (1996), Bordley (2000, 2004, 2009), Berger (1985), Robinson (1962), Pilkington (2014).

The theory of utility has two directions: cardinal and ordinal. The cardinal utility theory is based on the allowance that it is possible to accurately measure the utility of goods and on the use of hypothetical quantitative units for this purpose - utiles. Theory of ordinal utility is a later direction that focuses on the priorities of consumption. The emphasis here is not on the absolute value of utility, but it is on comparative preferences, on the order in which people assess goods from the most desirable to the least attractive. Theory of ordinal utility has more followers.

However, if we put utiles "into shape", they cease to be hypothetical units. Thus, the function of marginal utility can be defined by formula 1.

$$MU = R_n + \frac{k_n + k_s}{n} - C_n \quad (1),$$

where MU is the marginal utility; R – expected result; n - number of consumptions; k_n - coefficient of necessity, k_s - coefficient of satisfaction; C - costs.

The total utility function is defined by the formula 2.

$$TU = MU_1 + MU_2 + \dots + MU_n \quad (2),$$

Knowing the average income of the target group, we can calculate the utility of the produced goods for the customer, and accurately determine the subjective component of the utility of the product and the irrational factor of purchasing decision. The knowledge about the age, the place of residence and the interests of the consumer will make it possible to predict the influence of subjectivity and irrationality on the purchasing decision as much as possible. For scientific purposes, or for specific purposes of the company, it is possible to calculate for each certain customer. If you know the irrational factor in decisions about buying, you can develop the marketing strategy as competently as possible.

The objectives of the research are the testing of hypothesis about nuances of consumer behavior with gender and other differences in a subjective component of utility, and in irrationality in assessing the different goods, as well as developing a universal model of the rationality of the target group behavior.

Research methodology

To classify customers according to the principle of subjectivity and irrationality, the preferences of people of different sex, age, prosperity and living in different territories were researched.

The research was based on a survey of 255 people. The questionnaire included a scale by which respondents rated the usefulness from 0 to 10 of the following goods and services:

- drinking water;
- bread;
- vacuum cleaner;
- a car (worth up to 800,000 rubles);
- mobile phone (worth up to 30,000 rubles);
- film-going;
- going to a concert / sporting event (ticket price starting from 1,500 rubles);
- salmon caviar;
- trip abroad (cost from 30 000 rubles per person);
- book;
- Arts & Crafts set.

The obtained points were transformed into the original 200-point scale, then the subjective component was derived from the utility estimations (from the value of utility the expected result and expenditure on acquisitions were subtracted), and the maximum adequate subjectivity was subtracted from the subjective component (according to formula 1 and Maslow's hierarchy of needs) to derive the degree of irrationality.

To achieve these goals, mathematical modeling methods were used (to establish the existence of nuances of consumer behavior for gender and other differences) and the method of data system analysis (for developing a method for analyzing the rationality of the behavior of the target group).

Results and Discussion

To complete the task of multiparameter data analysis, the method of discriminant (separation) analysis was used. Predetermined groups of questionnaires (men and women) were compared for the following factors:

- purchasing of the 1st order goods (physiological needs);
- purchasing of the 2nd order goods (security needs);
- purchasing of the 3rd order goods (social needs)
- purchasing of the 4th order goods (the need for respect).

The goods of the 5th order (the need for self-realization) and the trip, as a good of the 4th order, could not be objectively assessed for discriminant analysis according to the questionnaire.

Also, only statistics provided by residents of large cities of Russia (with the population of more than 500,000 people) aged 14 to 25 with an income of up to 30,000 rubles could be used to create the model.

The final stage was the construction of ranging functions of subjectivity and irrationality for men and women.

The choice of discriminant variables was made on the basis of grouping of goods by categories (orders) according to the Maslow pyramid. The variables were independent; the discriminating power of each one was not taken into account at the initial stage of inclusion in the model.

As discriminant variables, the following benefits' estimations were calculated on the base of the questionnaire results:

- x₁₁ - drinking water;
- x₁₂ - bread;
- x₂₁ - vacuum cleaner;
- x₂₂ - the car;
- x₃₁ - film-going;
- x₃₂ - going to a concert or sporting event;
- x₄₁ - red salmon caviar.

It was necessary to find such a linear combination of variables x₁ ... x₄, which would let us reveal differences in the subjective and irrational component in assessing of the benefits by young people living in large cities with average and below average income.

In general, the form of the discriminant function of estimating the benefits from the 1st to the 4th order for men or women:

$$d_{gm} = \beta_0 + \beta_{1k}x_{1m} + \beta_{2k}x_{2m} + \beta_{3k}x_{3m} + \beta_{4k}x_{4m} \quad (3),$$

where g is the gender of the m-th participant in the questionnaire when assessing benefits in the group g = 1 (male) or g = 2 (female); β_0 - a coefficient whose value is to be determined for g = 1 and g = 2; β_{ik} - the coefficient of the k-th good in the group of goods i, where i = 1, 2, 3, 4; x_{im} is the value of each of the discriminant variables for the mth participant of the survey for the benefit of k group i.

In the general case, eight variables were considered, one of which (sex) was a classification one. Discriminant functions were hypersurfaces of multidimensional space.

Discriminant analysis was performed in the STATISTICA system. The grouping variable g had two meanings "male" and "female", a stepwise method with an exception was used as a method of selecting meaningful variables. As a result, variables such as x₁₁ - drinking water and x₂₂ - car were excluded from consideration, for which p-values were higher than the accepted level of significance $\alpha = 0.05$.

To test the statistical significance of discriminant functions, a null hypothesis was proposed about the equality of centroids in two groups, which was verified using Wilkes statistics. The value of $\Lambda = 0.23$ for the subjective component and $\Lambda = 0.28$ for irrational. It should be noted that the value $\Lambda = 0$ characterizes the ideal case, $\Lambda = 1$ is typical for the complete impossibility of constructing a discriminant function.

The quality of classification was evaluated by classification matrixes. The training sample let us achieve 100% of the efficiency factor (including for each group), which is higher than the satisfactory value, accepted in practice, equal to 70%.

The classification functions of the generalized subjective component of utility are:
for men:

$$S_1 = -3,300 + 0,298x_{12} + 0,419x_{21} + 0,343x_{31} + 0,019x_{32} - 0,076x_{41} \quad (4),$$

for women:

$$S_1 = -10,302 - 0,366x_{12} + 1,720x_{21} + 1,347x_{31} - 0,674x_{32} - 0,984x_{41} \quad (5),$$

Classification functions of the generalized irrational utility component have the form:
for men:

$$I_1 = -0,334 + 0,008x_{12} + 0,117x_{21} + 0,036x_{31} + 0,027x_{32} - 0,084x_{41} \quad (6),$$

for women:

$$I_{-1} = 6,191 - 0,493x_{12} + 1,164x_{21} + 1,083x_{31} - 0,733x_{32} - 0,938x_{41} \quad (7),$$

Here, variables are estimates of the benefits

- x_{12} - bread;
- x_{21} - vacuum cleaner;
- x_{31} - film-going;
- x_{32} - going to a concert or sporting event;
- x_{41} - red salmon caviar.

Estimates of the subjective component of utility, grouped with the help of classification functions, let us compare the gender preferences among youth of megacities with below-average prosperity. For this, the ratios of the coefficients of the function are calculated for identical variables.

If you look at the tendency of subjectivism in assessing the benefits for specific goods, you can draw the following conclusions:

-for a subjective component, women and men appreciate bread, and women in different ways (because the sign of the coefficient is different), women give a lower, and men a higher rating. Women estimated the availability of a vacuum cleaner as a good of the second order 4 times higher. Women estimated going to the cinema 3.9 times higher, and going to a concert or sporting event for them is not comparable to men who rate it higher. Such a good of the 4th order, as red caviar for women, is almost 12 times less important than for men.

- for an irrational component, women and men appreciate bread. and women in different ways (because the sign of the coefficient is different), women give a lower, and men a higher rating. Women estimated the availability of vacuum cleaner as a good of the second order almost 10 times higher. Film-going is rated by women 30 times higher, and going to a concert or sports event for them is still incomparable with men who gave higher ratings. Such a good of the 4th order, as red caviar is almost 11 times less important for women than for men.

These conclusions prove the existence of nuances of consumer behavior with gender and other differences as a subjective component of utility, and in irrationality in assessing goods of different orders. Accordingly, the approach to each group of consumers, for client-oriented purposes, should be different. To determine the degree of subjectivity and irrationality of different target audiences, a systematic analysis was carried out.

For the system analysis, the responses of people classified by sex (male and female), age (up to 14, 14-18, 19-25, 26-35, 36-50, 51-70, over 70), income (up to 15 TR, 15-30 TR, 30-60 TR, 60-150 TR) and the place of residence (Moscow and St. Petersburg, other large cities of Russia, small settlements (population up to 100 thousand people)).

The result of the system analysis are tables 1-4 (where the values of the top subtable are subjectivity, the lower are irrationality).

Table 1: Aggregate indicator of subjectivity and irrationality in the acquisition of different categories of goods, depending on the age group of consumers

Age	The 1 st order goods	The 2 nd order goods	The 3 rd order goods	The 4 th order goods	The 5 th order goods
the indicator of subjectivity					
<14	3,1	9,2	6,6	5,5	9,3
14-18	4,9	7,7	5,3	4,8	6,8
19-25	4,5	7,8	5,5	4,2	7,4
26-35	4,4	6,4	5,3	4,7	6,6
36-50	4,5	6	4,6	4,5	6,7
51-70	3,4	4,8	4,8	5,3	9,1
>70	3,6	6,9	3,3	3	3,1
the indicator of irrationality					
<14	-1,5	4,7	2,4	2,6	6,1
14-18	0,3	3,3	1,2	2	4
19-25	-0,1	3,3	1,5	1,4	4,2
26-35	-0,2	1,9	1,5	1,8	3,4
36-50	-0,2	1,5	0,4	1,6	3,4
51-70	-1,2	0,3	2	2,4	5
>70	2	2,4	-0,8	0	-0,1

Table 2: Aggregate indicator of subjectivity and irrationality in the acquisition of different categories of goods depending on the sex of consumers

Sex	The 1 st order goods	The 2 nd order goods	The 3 rd order goods	The 4 th order goods	The 5 th order goods
The indicator of subjectivity					
men	4,6	7,5	5,2	4,4	6,8
women	4,6	7,4	5,5	4,6	7,3
The indicator of irrationality					
men	0	3	1,2	1,5	3,6
women	0,1	3,3	1,4	1,7	4

Table 3: Aggregate indicator of subjectivity and irrationality in the acquisition of different categories of goods depending on the income of consumers

Income (tRub)	the 1 st order goods	the 2 nd order goods	the 3 rd order goods	the 4 th order goods	the 5 th order goods
the indicator of subjectivity					
<15	4,8	8,2	5,5	4,6	7,7
15-30	3,9	6,5	4,7	4,1	6,3
31-60	4,7	6,5	6,5	4,8	6,5
61-150	4,4	5,8	5,2	4,2	7
the indicator of irrationality					
<15	0,2	3,7	1,4	1,8	4,4
15-30	-0,7	2	0,6	1,2	3,1
31-60	0,1	2,1	2,3	1,9	3,2
61-150	-0,2	1,3	1,1	1,4	3

Table 4: Aggregate indicator of subjectivity and irrationality in the acquisition of different categories of goods depending on the residence of consumers

Place of residence	the 1 st order goods	the 2 nd order goods	the 3 rd order goods	the 4 th order goods	the 5 th order goods
the indicator of subjectivity					
mega-polis	4,5	7,9	5,6	4,1	7,3
city	4,7	7,1	5,4	4,9	6,8
town	4,2	7,6	5,3	5,2	6,6
the indicator of irrationality					
mega-polis	-0,1	3,4	1,5	1,3	4,1
city	0,1	2,7	1,2	2	3,5
town	-0,4	3,1	1,2	2,2	3,4

The subjective component of utility shows the share of subjectivity in the evaluation of the good. That is this indicator reflects the personal interest of the consumer. The higher the value, the higher the personal interest. Normal (rational) indicator of subjectivity is: 1-5. At 0 and negative values, the utility of the good is determined only on the basis of its properties and value. At the same time, the smaller the unit value, the greater the consumer's antipathy for the good.

Irrationality shows the share of irrationality of the evaluation of the good. 0 is the absolute rationality of behavior. The rationality framework are: from -2.5 to 2.5. Negative values indicate how much the good is undervalued, positive values - are overrated.

Based on data from all tables, the following conclusions can be drawn:

- the most subjective and irrational decisions are made for the goods of the 2nd and 5th categories (security needs and needs for self-fulfillment). This suggests that the policy of promoting of these products and services should be based not on the client, but on the competitor. Because the consumer

is so interested in acquiring goods of these categories, the main problem with marketing is competition;

- the most undervalued benefits are the benefits of the 1st category (physiological needs). In most cases, the decision to purchase such goods is taken rationally and objectively, while the share of buyers with negative irrationality exceeds the share of customers with a positive irrationality;

- for the second (safety needs) and the third (social needs) categories, there is a tendency to lower subjectivity (left) and irrationality (right) over the course of the age.

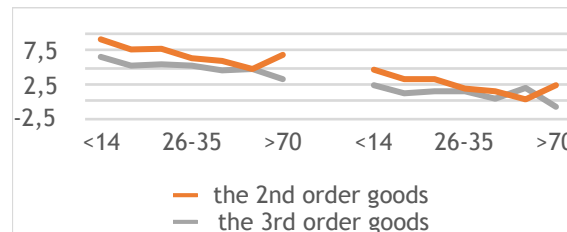


Fig. 1: The tendency to reduce subjectivity (left) and irrationality (right) with age

While there is observed for the benefits meeting the need for security, there is a jump for the category of elderly people. Probably, it is due to deterioration of health and needs in care and medicines;

- for persons under 14 years, for almost all categories of goods, irrationality and subjectivity of choice are inherent;

- in general, men are more rational when making purchasing decisions.

Also the above tables can be used to assess the subjectivity and irrationality of the target audience. To do this, it is sufficient to choose a suitable value for each target group and calculate the arithmetic mean. Thus, you can see the average for this segment of customers, and, based on this, to adjust the marketing strategy.

Conclusions

The proposed method based on the theory of cardinal utility will let the enterprises select an individual approach to each segment of their target audience, which will increase the competitiveness of the company.

From the theoretical point of view, the value of the method is in its universality - the method can be applied not only in the economics, but also in psychology, and in sociology as well.

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