

ECONOMIC-MATHEMATICAL MODEL IN E-TRADE APLYING FUZZY LOGIC

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In the paper the economic-mathematical model of income maximization was considered in the virtual business using the fuzzy logic. Some qualitative and quantitative indicators, affecting to the profit of e-shop from the sale of the i-th product was investigated by fuzzy methods.

Keywords: *economic-mathematical modeling, virtual business, membership function, fuzzy logic, price fixing*

One of the most dynamic and perspective market segments is an electronic commerce. This trend has a set of unique features, but it is based on the general principles of marketing.

In electronic commerce, as well as in the usual one, there is a large variety of possible commercial activities. The most obvious is the selling of products and services over the internet.

Internet environment provides a huge opportunity to develop own business. One of them is eshop.

E-shop is described as a website specially designed for easy buying and selling goods and services over the websites. In fact, eshop is the web site only with a set of programs that are specifically oriented to e-commerce. E-shop has a number of advantages in comparison with regular points of sale:

- it's not of necessity the available-for-sale goods (but in this case, be sure to have a set of suppliers, working on the principle of "just in time").
- It doesn't need placement for sales
- Sellers' movement flexibility.
- You can expand the geography of your business up to the world markets.
- You don't need to hire sellers, administrators, managers, commodity, cashiers, security guards and someone else.
- E-shop makes it possible to distribute themselves working hours.

But, there are essential risks in this kind of business.

The risks of e-shop:

- Hackers.
- "Bugs" (software errors)
- Buying a "pig in a poke."
- The clients easy come and go.

To take full advantage of the e-shop and practically to reduce to zero above risks, it is necessary to find the really best engineering of the software and a professional software company. This is very important, because with the internet development e-commerce is becoming for businessmen not a luxury but means to promote the products to broader target groups [10].

The main aim in the creating e-shop which will be a functional and convenience platform is to give profit and justify investment in it. In other side the convenience and profitability of the e-shop depends on internet providers' speed of the users. The speed, comfort, security of operations depends on how high speed and safer provider use the costumers.

It is clear that in the real and virtual space in the long-term perspective the aim of the company is the profit maximization. The main aim of this study is constructing the adequate economic-mathematical model of income maximization for the e-shop. The price of the product is considered as a fuzzy parameter and on this basis the fuzzy model is constructed of e-shop income maximization. On the basis of this model the maximization of the income is reduced to the corresponding linear programming problem. To solve this problem the basic idea is to divide the fuzzy numbers on the α -level cuts with the

definite step. Further is shown that the result obtained using fuzzy analysis is much better than the result obtained by the classical way.

The standard problem of mathematical programming is usually formulated as a problem of maximization (or minimization) of the given function on the given set of admissible alternatives, which is described by the system of equations or inequalities. The set of admissible alternatives is the set of all possible distribution methods of resources, which the expert is going to invest in this operation. Modeling this form of real decision-making problems at the disposal of the expert are only fuzzy descriptions of the parameters by means of linguistic variables. Fuzziness in the formulation of the mathematical programming problem can be contained in the description of the alternatives set, as well as in the description of the objective function. The various forms of the initial information description are responsible for different formulations of fuzzy mathematical programming problems.

Analysis of recent research and publications. In [5] the price fixing problem was studied from the different aspects. In [14] was considered the problem of inter-sectoral equilibrium price. As we know, income of any economic object depend on the price of the products. In [6] is considered the new aspects of the organization of production with the method of "just in time". The linguistic variables and fuzzy-term sets is considered in detail in [2;4;12]. The data processing and the decision making problems under uncertainty are considered in [1;7]. In [3;8;10;11;12;14] is constructed the fuzzy model and the fuzzy inference logic method is applied to the different types of problems. In [9] is considered the mathematical models of economic systems. Application of fuzzy logical inference rules to the economic-mathematical model is considered in [8].

Development of the model using the fuzzy theory is not enough studied. This also applies to the fuzzy economic-mathematical modeling of maximizing the profit to the e-shop that can give very good results.

Statement of the problem. Let construct a mathematical economic model maximize profits for e-shop, applying the fuzzy logic. To do this, we must determine the main parameters affecting to the profit in this environment.

First, consider the classic (crisp) profit maximization model for the shop in real environment:

$$\sum_{i=1}^n b_i x_i \rightarrow \max \quad (1)$$

$$\sum_{i=1}^n a_{ij} x_i \leq a_j, \quad j = \overline{1, k} \quad (2)$$

$$x_i \geq 0, \quad i = \overline{1, n}, \quad (3)$$

Here

x_i – amount of the i -th ($i = \overline{1, n}$) product type;

b_i – profit from realization of the i -th product type unit;

a_{ij} – j -th kind the costs for per unit of i -th type of product;

a_j – j -th type of costs ($j = \overline{1, k}$).

In the virtual environment the goods $x_i, i = \overline{1, n}$ (n -number of kinds of products) are fixed, since these products are delivered from a base to customers. This means that the shop does not pay for each unit of goods costs as rent for premises, the cost of windows, wages, etc. This means that the condition (2) for the online store is not relevant. If $x_i, i = \overline{1, n}$ (n -number of kinds of products) are fixed, then it maximizing by profits $b_i, i = \overline{1, n}$.

We take into account that the income from the sale of the i -th product in the virtual business depends on the variety of qualitative and quantitative indicators - the price of goods and services, security parameters of the e-shop, payment issues, number of internet users in target country, legislative base of electronic trade, the market for Internet access services, long-term trend of the potential size of the market, seasonal fluctuations in business activity, the quality of Internet service providers, the price attractiveness providers, the influence of the speed of access to Internet resources, sources of inflow and outflow of customers, and so on., which have the

fuzzy descriptions. Since many of these parameters have fuzzy description, taking them into account in the model (1)-(3) as a crisp indications, or aren't impossible or maybe with the significant assumptions. On the basis of these arguments we can say that the fuzzy description of these parameters in the model may be more adequate than in a sense taking a crisp description.

Given these statements, the profit from the sale of units of the i -th type of product b_i ($i = \overline{1, n}$). It can be represented as a variable dependent on the of fuzzy parameter $\tilde{a}_j, j = \overline{1, m}$, i.e. $b_i(\tilde{a}_1, \tilde{a}_2, \dots, \tilde{a}_m)$. Note that fuzzy parameters $\tilde{a}_j, j = \overline{1, m}$ affecting to the profit from the sale of units of the i -th type of product are such indicators as income consumers, the living standards of consumers, fashion, the price of goods substitutes or complementary goods, etc. and specifications listed above. Such as $\tilde{a}_j, j = \overline{1, m}$ are fuzzy subsets, they have their membership function, given by the expert, for example, in a triangular form with the support of the corresponding set A_j , where the left and right, respectively carrier boundary fuzzy subset $\tilde{a}_j$:

$$\text{Supp } \tilde{a}_j = \{x | \mu_{\tilde{a}_j}(x) > 0\} = [a_{jl}, a_{jr}] \subset A_j, \quad j = \overline{1, m} \quad (4)$$

A triangular membership functions of fuzzy sets $\tilde{a}_j, j = \overline{1, m}$ can be described in the form (fig.).

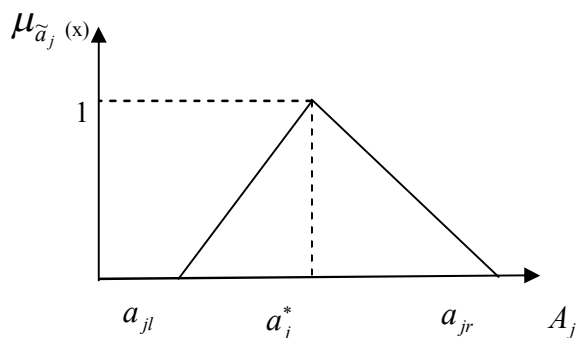


Figure. Graph a triangular membership function fuzzy sets $\tilde{a}_j$

$$\mu_{\tilde{a}_j}(x) = \begin{cases} \frac{(x - a_{jl})}{(a_j^* - a_{jl})}, & \text{if } a_{jl} \leq x \leq a_j^* \\ \frac{(a_{jr} - x)}{(a_{jr} - a_j^*)}, & \text{if } a_j^* \leq x \leq a_{jr} \end{cases} \quad (5)$$

Note that fuzzy parameters, including, linguistic ones can be described by different methods selected from the DMP [3].

Thus the model (1) - (3) can be written as the following fuzzy form:

$$\sum_{i=1}^n b_i(\tilde{a}_{l1}, \tilde{a}_{l2}, \dots, \tilde{a}_{lm}) x_i \rightarrow \max \quad (6)$$

$$\tilde{a}_j \subset A_j, j = \overline{1, m} \quad (7)$$

In this model, the objective function (6) is defined implicitly. For each case it can be determined using the appropriate mathematical or fuzzy methods.

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QEYRİ-SƏLİS MƏNTİQİN TƏTBİQİ İLƏ ELEKTRON TİCARƏTİN İQTİSADI-RİYAZİ MODELİ

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İşdə qeyri-səlis məntiqin tətbiqi ilə elektron ticarətdə mənfəətin maksimallaşdırılmasının iqtisadi-riyazi modelinə baxılmışdır. Burada i-ci məhsulun satışından əldə olunmuş mənfəətə təsir edən müəyyən kəmiyyət və keyfiyyət parametrləri qeyri-səlis üsullarla tədqiq olunmuşdur.

Açar sözlər: iqtisadi-riyazi modelləşdirmə, elektron ticarət, qeyri-səlis məntiq, qiymətmələgəlmə

ЭКОНОМИКО-МАТЕМАТИЧЕСКАЯ МОДЕЛЬ ЭЛЕКТРОННОЙ ТОРГОВЛИ С ПРИМЕНЕНИЕМ НЕЧЕТКОГО АППАРАТА

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В статье рассмотрена экономико-математическая модель максимизации прибыли в виртуальном бизнесе с применением нечеткого аппарата. Некоторые качественные и количественные показатели, влияющие на прибыль Интернет магазина от реализации i-го продукта, исследуются нечеткими методами.

Ключевые слова: математико-экономическое моделирование, виртуальный бизнес, функция принадлежности, нечеткая логика, ценообразование