UDC 339.138

**Hassan Ali Al-Ababneh**
*PhD in Economics*
*Department of International Marketing Economics*
*Donetsk National Technical University*
**Хасан Алі Аль-Абабнех**
*кандидат економічних наук*
*Кафедра міжнародної економіки маркетингу*
*ДВНЗ «Донецький національний технічний університет»*
**Хасан Али Аль-Абабнех**
*кандидат экономических наук*
*Кафедра международной экономики маркетинга*
*ГВУЗ «Донецкий национальный технический университет»*

**Yaser Eisa Al-Momani**
*PhD in Economics*
*College of Business Administration of*
*Ajloun National University (Jordan)*
**Ясер Ейса Al-Momani**
*кандидат економічних наук*
*Коледж ділового адміністрування*
*Національного університету Ajloun (Йорданія)*
**Ясер Эйса Al-Momani**
*кандидат экономических наук*
*Колледж делового администрирования*
*Национального университета Ajloun (Иордания)*

# RELEVANCE OF FUZZY LOGIC IN THE ECONOMY

# АКТУАЛЬНІСТЬ НЕЧІТКОЇ ЛОГІКИ ДЛЯ ЕКОНОМІКИ

# АКТУАЛЬНОСТЬ НЕЧЕТКОЙ ЛОГИКИ ДЛЯ ЭКОНОМИКИ

***Summary.*** *This article describes the features of the economic environment. We characterize the external and internal factors impact on the economic projects. The definition of the concept of fuzzy logic and linguistic variable and their relationship with the economy as a whole. The features of a fuzzy model and the possibility of applying this method in the economy. The conclusions about the prospects of the use of fuzzy modeling method in economic planning.*

***Key words:*** *economy, fuzzy logic, linguistic variable, modeling.*

***Анотація.*** *У даній статті описуються особливості економічного середовища. Ми характеризують вплив зовнішніх і внутрішніх факторів на економічні проекти. Визначення поняття нечіткої логіки та лінгвістичних змінні і їх взаємозв'язку з економікою в цілому. Особливості нечіткої моделі і можливість застосування цього методу в економіці. Зроблено висновки про перспективи використання методу нечіткого моделювання в економічному плануванні.*

***Ключові слова:*** *економіка, нечітка логіка, лінгвістична змінна, моделювання.*

***Аннотация.*** *В данной статье описываются особенности экономической среды. Мы характеризуем влияние внешних и внутренних факторов на экономические проекты. Определение понятия нечеткой логики и лингвистической переменной и их связь с экономикой в целом. Особенности нечеткой модели и возможность применения этого метода в экономике. Выводы о перспективах использования метода нечеткого моделирования в экономическом планировании.*

***Ключевые слова:*** *экономика, нечеткая логика, лингвистическая переменная, моделирование.*

**Formulation of the problem.** The issue of determining the effectiveness of advertising is still open, because the process is dynamic and multifactorial. There is no generally accepted methodology for determining criteria and performance indicators for advertising communication. At the same time, advertising is an integral part of the marketing strategy. Evaluation of the effect of the advertising campaign makes it possible to make adequate managerial decisions, so the use of the most informative and reliable method of determining the effectiveness of the functioning of advertising is necessary. Against this background, it is important to develop an alternative to the classical method for determining the results of advertising activities.

**The analysis of the latest research and publications** confirms the relevance of the issue under consideration with respect to techniques for evaluating the effect of advertising. In their scientific publications M. Chumachenko, A. Amosha, Yu. Makogon, I. Buleev, A. Martyakova, V. Novitsky, G. Skudar, V. Gospodin, A. Novikova, N. Jankowski, J. Gohberg and others Concern current marketing issues and focus on addressing individual market problems through the activation of the marketing mechanism and its tools.

**The purpose of the article** is to make an analysis of the feasibility and feasibility of using fuzzy modeling with elements of metauristics to evaluate the effectiveness of the advertising process.

**Results of the study.** Under market conditions, any economic entity in its activity inevitably faces uncertainty. Even high-class specialist is unable to predict the changes that may occur in the external environment. Planning is one of the components of the controlling of business processes, it is the way to reduce uncertainty and risk. However, any, even the largest firm can not afford to completely eliminate uncertainty and, therefore, absolutely take into account the impact of all factors.

When you are working with precise parameters and systems, everything is quite simple. In another case with fuzzy systems. It operates so-called principle of incompatibility: to obtain definite conclusions about the behavior of a complex system should be involved in its analysis of the approaches that utilize the principles of fuzzy logic.

Fuzzy logic — is a branch of mathematics which deals with complex classical logic and the theory of fuzzy sets. The main characteristic of the fuzzy set theory is the manipulation of a component as a linguistic variable. A linguistic variable is a variable whose values are not numbers, and words and expressions, which cause blurred because they do not have a specific numeric value.

Each linguistic variable consists of:

- title;
- the set of its values, which is also called the base-set term;
- universal set X;
- syntactic rules G, which are generated by the new terms by using the words natural or formal language;
- semantic rules P, which each value of the linguistic variable assigns a fuzzy subset of X.

Often the output data for the solution of economic problems are the opinions and conclusions of the experts presented by phrases and words, or linguistic data, so there is a need to transform the linguistic parameters in numeric expressions. That is the problem and solve the theory of fuzzy sets.

Limitations and disadvantages of the use of "classical" formal methods in solving semistructured problems are the result of articulated founder of the theory of fuzzy sets, LA Zadeh's principle of incompatibility: "... the closer we come to the solution of real world problems, it is clear that with increasing complexity of the system our ability to make accurate and confident conclusions about its behavior is reduced to a certain threshold, beyond which precision and confidence are almost mutually exclusive" [5, p. 165].

Disclosure of uncertainty in an unstable environment may be classical probabilistic and statistical methods, but it is an average assessment with a fictitious character. In volatile market situation, the application of statistical methods correctly, and then decisions should be made according to the rules of the principal settings of the decision maker with regard to the phenomenon of uncertainty.

In such situations, decision-making is largely accounted based on expert assessments. However, any expert opinion, even made of the exact objective data, it is much more uncertain than a complex multi-dimensional data set, which is available in a comprehensive manner is extremely difficult (and sometimes impossible). Thus, although expert opinion may contain generalizations and predictions that are relevant to the practice, it does not reduce the level of uncertainty.

It should be noted that another source of uncertainty may be the decision maker. One of the problems associated with it — a fuzziness in concepts, judgments and preferences, the uncertainty of the time interval in which is stored the monotony of human preferences and judgments [1, p. 312].

Methods based on the theory of fuzzy sets, refer to the methods of evaluation and decision-making under uncertainty. Their use involves the formalization of baselines and targets for the efficiency of the process as a vector of interval values (fuzzy interval), hit in each interval is characterized by a certain degree of uncertainty.

The essence of the concept of the effectiveness of advertising is much broader than simply an indicator of the increase in turnover. The concept of efficiency includes the process of research and entering a new market segment, raising or lowering prices, rebranding,

reaching a new target audience, etc. At the same time, the indicators of the effectiveness of the advertising process affect many independent from the advertiser and uncontrolled factors (currency exchange rates, peculiarities of national legislation, political situations, force majeure circumstances, etc.) [1, p.258]. That is, the advertising process is characterized by dynamism, multifactority, the presence of a large number of process characteristics, etc. Considering this, it is proposed to use fuzzy modeling to determine the effectiveness of the advertising process, namely, modeling using the parameters of the genetic algorithm model at the adaptation stage.

In this paper, we propose a method for constructing a performance evaluation model, which includes:
- formation of fuzzy rules on the basis of which the model is constructed;
- creation of model structure;
- development of a model evaluation procedure;
- selection of the quality criterion for learning the model;
- adaptation of model parameters.

The fuzzy rules used in the construction of the fuzzy neural network model have the form:

RULE $k$: IF the condition $k$ THAT conclusion $k$ ($F^k$)

$k$ — is the rule number,

$F^k$ — the coefficient of certainty, the confidence factor or the weight of the fuzzy rule (takes a value from the interval [0,1]), $k \in \overline{1,r}$

A condition $k$ is a collection of subwords of the form

$$\tilde{x}_1 \text{ there is } \tilde{\alpha}_1^k \text{ And ... And } \tilde{x}_n \text{ there is } \tilde{\alpha}_n^k,$$

conclusion $k$ is a conclusion of the kind

$$\tilde{y} \text{ is } \tilde{\beta}^k,$$

$\tilde{x}_i$ — the name of the input linguistic variable corresponding to the factor, $i \in \overline{1,n}$,

$\tilde{y}$ — the name of the output linguistic variable corresponding to the complex evaluation,

$\tilde{\alpha}_i^k$ — the qualitative value of the variable, $\tilde{x}_i$, $k \in \overline{1,r}$, $i \in \overline{1,n}$,

$\tilde{\beta}^k$ — qualitative value of the variable, $\tilde{y}$, $k \in \overline{1,r}$.

Due to the shortcomings inherent in the models of performance evaluation, a four-layer fuzzy neural network model is proposed.

The model of a fuzzy neural network for estimating the efficiency of functioning is formed according to the following principle:
- the input (zero) layer contains neurons that correspond to factors affecting the efficiency of functioning, the number of neurons $N^{(0)} = n$;
- the first layer realizes fuzzification, and its neurons correspond to the qualitative values of the factors, the number of neurons, $N^{(1)} = \sum_{i=1}^{n} n_i$, where $n_i$ — the number of qualitative values for the i-th input linguistic variable;
- the second layer implements the aggregation of subwords, and its neurons correspond to the conditions, the number of neurons $N^{(2)} = \prod_{i=1}^{n} n_i = r$;
- the third layer implements the activation of the rules, and its neurons correspond to the conclusions, the number of neurons $N^{(3)} = \prod_{i=1}^{n} n_i = r$;
- the fourth (output) layer implements the aggregation of the conclusions, and its neurons correspond to the qualitative values of the complex estimation, the number of neurons $N^{(4)} = q$, where q is the quantity of qualitative values of the output linguistic variable.

By arithmetic and other operations with such fuzzy intervals according to the rules of fuzzy mathematics, experts receive the resulting fuzzy interval for the target. Based on the initial information, experience and intuition of experts often can quite confidently quantify boundaries (intervals) possible (permissible) values of the parameters and the area of their most possible value.

The main disadvantages and limitations of the existing economic and mathematical models and methods to assess the efficacy and the risk of economic projects in the face of uncertainty in comparison with the methods of fuzzy logic are:
- lack of statistical information for the sound application of probabilistic methods,
- a high proportion of subjectivity in assigning probabilities of expert assessments,
- lack of completeness of classification system uncertainty [3, p. 181; 4, p. 274].

To overcome the above drawbacks and limitations of traditional methods justified the use of fuzzy sets theory for the development of models and methods of strategic management of economic activities.

It is worth paying attention to the fact that fuzzy modeling process consists of two key stages:
- identification of the structure (the process of determining the structural characteristics, or the number of fuzzy rules and linguistic terms);
- identification of parameters (selection of antecedent and consequent parameters). It is at this stage minimizes system error, so special attention should be paid to the optimization of this phase in modeling economic problems.

**Conclusions.** Business Economics is a multifactor system which, moreover, is focused on the end user, to predict the behavioral characteristics of which are quite problematic. In addition, the economy is quite sensitive to the social trends of the industry. Moreover, to predict changes in the economic activity under the influence of external and internal factors in the majority of cases it is possible only in terms linguistic (or fuzzy) concepts. Based on this priority in the economy is the use of fuzzy logic and fuzzy modeling.

**References**

1. Чернов В. Г. Модели поддержки принятия решений в инвестиционной деятельности на основе аппарата нечетких множеств / В. Г. Чернов. — М.: Горячая линия — Телеком, 2007. — с. 312.
2. Риск — анализ инвестиционного проекта / Под. ред. М. В. Грачевой. — М.: ЮНИТИ, 2000. — с. 344.
3. Недосекин А. О. Нечетко-множественный анализ риска фондовых инвестиций / А. О. Недосекин. — СПб.: Типография «Сезам», 2002. — с. 181.
4. Рыбак В. А. Методологические основы принятия решений для управления природоохранной деятельностью: монография / В. А. Рыбак. — Мн.: РИВШ, 2009. — с. 274.
5. Заде Л. А. Понятие лингвистической переменной и его применение к принятию приближенных решений: пер. с англ. / Л. А. Заде. — М.: Мир, с. 1976. — с. 165.
6. Ходашинский И. А. Идентификация нечетких систем: методы и алгоритмы / Проблемы управления. — 2009. — № 4. — С. 15–23.
7. Штовба С. Д. Проектирование нечетких систем средствами MATLAB / С. Д. Штовба. — М.: Горячая линия — Телеком, 2007. — с. 288.
8. Espinosa J., Vandewalle J., Wertz V. Fuzzy logic, identification and predictive control. — London: Springer-Verlag, 2005. — P. 263.