

## Application of Fuzzy Sets Theory to Assessment of Audit Risk in a Tax Audit

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**Abstract:** With the increasing complexity of economic relations (increased requirements for tax control, the value of the tax audit requirements for the quality of evidence and others). Required justification value of audit risks are not using probabilistic and statistical models, using methods that take into account the auditor's judgment. In this regard also, the role of techniques based on expert assessments and the theory of fuzzy sets. Theory of fuzzy sets to evaluate the relationship of quantity and quality, the contradictions between them, do not take into account the empirical probability and confidence auditor. Assessment of audit risk, based on the theory of fuzzy sets, allows you to objectively assess for factors affecting the components of audit risk. Unlike other methods, the addition of alternative does not change the order of previously ranked sets.

**Key words:** Methods of the theory of fuzzy sets, the audit, audit risk, tax liabilities, inherent risk

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### INTRODUCTION

Today, the scope of audit and accounting is growing rapidly. With the complexity of the political and economic situation is increasingly attracting the attention of the risks of tax reporting (Strelnik *et al.*, 2015; Filippova *et al.*, 2014). In connection with this increased interest in the methodology of the audit, including in the field of tax audit (Kaspina, 2015).

The model of audit risk, based on methods of expert estimations, game theory, fuzzy set theory, etc. is used quite frequently abroad. However, in the Russian theory the information about the development of these models have not been published yet and their application in practice is also unknown.

A detailed analysis of the publications revealed that the majority of authors in their works propose a method of ranking. In our view, the assessment of audit risk by ranking can be subjective. We believe it is more reasonable to adopt the method of fuzzy set theory for the objective evaluation of audit risk.

In addition, this technique is widely used for a comprehensive assessment of the effectiveness of different types of industries such as agriculture (Nagumanova and Sabirova, 2014).

A method, based on the theory of fuzzy sets allows to evaluate the relationship between quality and quantity, the contradiction between them. This method does not account for the empirical likelihood but the confidence of the auditor.

To date, topical application of professional judgment in assessing how the financial statements and the assessment of audit risk (Kulikova *et al.*, 2014a, b).

### MATERIALS AND METHODS

**Theory:** Consider the application of the method of fuzzy set theory in relation to risk assessment at the level of tax reporting.

Suppose the auditor assesses audit risk on the basis of three grades (low, moderate, high), by analyzing the influencing risk factors. We introduce the following notation:

- $x_i$  = the analyzed factor
- $N$  = a number of factors
- $i$  = the current number of factor ( $1 \leq i \leq N$ )

Each factor in the component of audit risk corresponds to one of three levels, that correspondes to gradations of risk (low, moderate, high).

The weighting of each factor is denoted as  $r_i$ . Then, we need to define the equivalence of selected factors by the expert way (Zhang *et al.*, 2007). When the factors are equal the coefficients of importance are equal too and defined by the Eq. 1:

$$r_i = \frac{1}{N} \quad (1)$$

When expert assessments reveals the disparities of factors, they should be ranked in descending order of their influence (Beasley *et al.*, 2005). In this case, the weight factors may be determined by the Fishburnes Eq. 2 and 3:

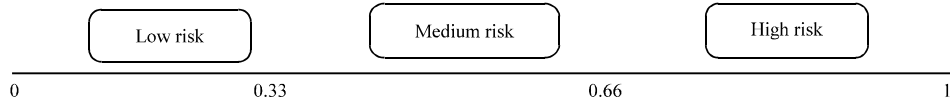


Fig. 1: Intervals subsets of audit risk

$$r_i = \frac{d_i}{\sum_{i=1}^N d_i} \quad (2)$$

Where:

$$d_i = \frac{2 \times (N - i + 1)}{(N - 1) \times N} \quad (3)$$

Assign each factor  $x_i$  is the current value  $r_{ij}$ ,  $r_{ij} = 1$  (high), 2 (medium), 3 (low) is the number corresponding to the gradation level of risk in descending order.  $r_{ij} = 1$ , if it matches to the level of factor, selected by the auditor  $r_{ij} = 0$  otherwise.

We introduce the membership function  $g$ , the scope of which is set  $R$ , the range of value-interval  $[0-1]$ . Construct a classification of the current values- $g$ , corresponding to the decomposition of the set  $R$  into three equal subsets-low risk, moderate risk, high risk (Fig. 1):

The boundaries of the interval subsets are selected by the professional opinion of the auditor, in our case, we divided the interval into three equal subsets.

Next, determine the value of the membership function based on the received current values of the factors (Eq. 4):

$$g = \sum_{j=1}^3 g_j \sum_{i=1}^N r_{ij} \quad (4)$$

where,  $g$  is the arithmetic mean of the membership function for each interval, determined from the expression (Eq. 5):

$$g_j = 0.83 - 0.33(j - 1) \quad (5)$$

The resulting value of the membership function  $g$  (Eq. 5) specifies a subset  $R$  (low, medium or high risk). Accurate assessment of audit risk affects the formation of the level of importance and size of the sample (Meleshenko and Usanova, 2014; Kharisova and Rakhmanova, 2014).

## RESULTS AND DISCUSSION

In estimating inherent risk, we have identified five factors ( $x_1, x_2, \dots, x_5$ ) (Kharisova and Kozlova, 2014) and ranked them in descending order as follows: present the

ranked factors of the inherent risk in descending order and assigned coefficients of significance in Table 1. The coefficients of significance of factors ( $r_1, r_2, \dots, r_5$ ) are determined by the auditor according to Eq. 3 and 4:

According to the results of audit procedures (inquiry, observation, inspection of documents, confirmation, recalculation, re-performance analytical procedures), the auditor analyzes the factors affecting the risk and assigns the current value (Table 2).

The results of the audit procedures showed that the factor  $x_1$  corresponds to low risk, qualification of the chief accountant assessed at a high level, the chief accountant is functionally overloaded;  $x_2$  is corresponds to high risk, the indicators assessed by the tax authorities in the framework of field inspections rejected from the norm;  $x_3$  is at a low level, for business transactions of the organization there is a stable regulatory framework;  $x_4$  is corresponds to moderate risk, violations identified by the results of past audits of tax liabilities or tax audits have not been totally eliminated;  $x_5$  is corresponds to low risk, the nature of the activities of the audited entity does not presuppose the availability of complex operations. The mean values of the membership function defined by Eq. 3 will be:  $g_1 = 0.17$  (low risk);  $g_2 = 0.50$  (medium risk);  $g_3 = 0.83$  (high risk).

$$g = \sum_{j=1}^3 g_j \sum_{i=1}^N r_{ij} = 0.17 \times (0.33 \times 1 + 0.27 \times 0 + 0.20 \times 1 + 0.13 \times 0 + 0.07 \times 1) + 0.50 \times (0.33 \times 0 + 0.27 \times 0 + 0.20 \times 1 + 0.13 \times 1 + 0.07 \times 0) + 0.83 \times (0.33 \times 0 + 0.27 \times 1 + 0.20 \times 0 + 0.13 \times 0 + 0.07 \times 0) = 0.50$$

According to the classification of the current values of the membership function (Table 2), we obtain the average value of the inherent risk.

A qualitative assessment of risk controls and the risk of undetected at the level of the tax reporting in general, can be similarly carried out on the basis of factors defined in Table 2.

Summing counting of qualitative assessments of inherent risk, the risk of undetected and risk controls, it is advisable to carry out a qualitative assessment of audit risk in General, using the obtained values of membership functions  $g$ . To do so, we build the classification of the current values of membership functions of audit risk, corresponding to the decomposition of audit risk into

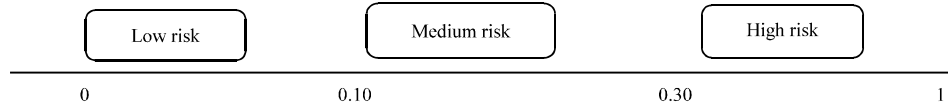


Fig. 2: Intervals subsets of audit risk when checking financial statements

Table 1: Ranking of factors affecting inherent risk

Rank	Factors	$d_i$	$r_i$
$x_1$	The person factor	0.5	0.33
$x_2$	Key performance indicators of the audited entity and their trends	0.4	0.27
$x_3$	Legal factor	0.3	0.20
$x_4$	The completeness of elimination of violations identified during previous audits	0.2	0.13
$x_5$	The nature of the activities of the audited entity	0.1	0.07

Table 2: The estimates of the factors

Factor	The value of the factor corresponding		
	Low risk	Moderate risk	High risk
$x_1$	1	0	0
$x_2$	0	0	1
$x_3$	1	0	0
$x_4$	0	1	0
$x_5$	1	0	0

three subsets (low, moderate, high risk). The classification of the current values of membership function of audit risk may not coincide with the classifications of membership functions of its components. Kochenev Y.Y. proposes to use the following intervals of values (Fig. 2).

The construction of the above classification is carried out by the auditor's peer review and based on its professional judgment may differ from the classification presented in Table 2.

Membership function of audit risk will consist of works qualitative assessments of the components of audit risk.

### CONCLUSION

Using in its calculations, the methods of fuzzy sets theory, the auditor can evaluate the audit risk as a whole and its separate components, by analogy with the grade proposed above or in more detailed gradation.

### IMPLEMENTATION

The implementation of this method in practice will require training of the auditor in the application of elements of fuzzy set theory and the interpretation of its results.

Increasing complexity of economic relations (the increasing demands for tax control, the values of the tax audit, requirements to the quality of evidence, etc.)

requires a substantiation of the audit risks using not probability and statistical models but methods that take into account professional judgement of the auditor. In this regard, the role of methods based on expert judgement and fuzzy set theory also increases.

The proposed method can be implemented in the basys of MS EXCEL spreadsheets. Thus on the basis of simulation modeling there is a possibility to choose the optimum characteristics for the ranked entity as well as to develop interventions aimed at reducing risk to acceptable.

The assessment of audit risk based on fuzzy set theory, allows to objectively assess the factors influencing the components of audit risk.

Unlike other methods, the addition of alternatives does not change the order of previously ranked sets.

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