RESEARCH METHODS OF MEMBERSHIP FUNCTION FOR FUZZY MATH COORDINATION OF EVALUATION OF MARKET VALUE

Yu. Hubar
National University "Lviv Polytechnic"

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Formulation of the problem

The basis of coordination of evaluation is the final study procedure to achieve the ultimate objective examination. This definition is most market value of the assessment on the basis of socio-economic factors and civil restrictions affecting the estimated cost and conditions of sale. For coordination of evaluation in all cases must be guided by major professional appraisers rule - the principle of reasonable caution. This principle implies in terms information security payments, uncertainty interim judgment, without the possibility of objective justification advantages of a result of the most pessimistic estimates. We set a goal to develop a method to negotiate the results of the assessment, the results of which would be understood by all stakeholders and would not cause doubt.

Communication to important scientific and practical problems

Highlights in this publication issues closely related to the Land Code of Ukraine, the Law of Ukraine "On Land Valuation" International and national standards of assessment. Processes improvement of real estate appraisal in our country too slow. The main result of the article will set out to speed up the pace and extent determine the market value of the property for future development of land and economic reforms in Ukraine.

Analysis of recent research and publications in which a solution of the problem

In theory there is not enough evaluation confident and conventional method of aligning evaluation results. Do not give specific recommendations on how to implement the coordination process known American authors. For example, Harrison [1] considers that the concordance of results evaluator collects data and cost figures obtained using three approaches and evaluates them using the method of causal analysis that leads to the reasonable conclusion that the market value of the assessment. Thus, it is necessary to clearly define the nature and extent of custom work and start weighing various data and approaches to the problem.

According to Eckert [2, 3] "thorough evaluation of the results reconciliation provides a brief analysis of the information used, assess its quality and volume setting relative strength or weakness of each of the approaches used on specific property." Because it is not possible to deduce the arithmetic mean of the three results of the assessment and not necessarily that one of the results will be final. The purpose of the study is to calculate the approximate value of the market value, defined as the most likely sale price and the value of this can not be

the result obtained by the three methods of assessment. The final value will be determined valuation somewhere in between. However, it is not clear how this cost between search?

Friedman and Horde [4] believe that reconciliation - a kind of "examination of conscience", that is the decision-making process, not a mechanical process of selecting the average value of the use of three approaches. The appraiser may use statistical calculations to develop a possible distribution. Later, you can think about the range within which the value should be in the desired value.

Unresolved of the problem

In world practice real estate appraisal is a problem harmonize methodological approaches to assess the market value of a single property that is to solve two important tasks: to ensure the reliability of the results; quickly perform assessment work on time. These tasks are the implementation of duplicate payments for each object from a comparison of the results and conclusion of the relevant harmonized evaluation. Requirements for the implementation of these duplicate payments and approving the estimates recorded in the International Valuation Standards. This requirement increases the complexity of the evaluation work at least three times, but does not solve the problem of reliability assessment. Differences evaluation results obtained by different methods, both due to the influence of a large number of pricing factors and economic measurement errors. Result assessment in any way - is the market value of the most probable price set by the algorithm based pricing factors of this method.

Setting objectives

With the need to harmonize the assessment results obtained from cost, comparative and income approaches faced each evaluator. The logic of harmonization in this should be understood not only the appraiser, but also user account. Often appraiser difficult to justify the result, due to the lack of theoretical justification of the results of different approaches and the existence of great opportunities for subjectivity in the known procedures for approval. Methods of different approaches to assessment should aim for the same result - the market value of the most probable price of transactions. If not, then various methods designed to assess various objects on the coordination can not be considered.

Presenting main material

In theory, property valuation uncertainty and uncertainty is usually introduced with the concepts and methods of probability theory. In the study of real estate appraisal sources are the inaccuracies are not random variables, and the appearance in this job any class or classes that do not have well-defined boundaries.

Detailed analysis indicates that most classes of objects, which is necessary to meet are class fuzzy type, class, determined accurately. In these cases, an item may belong or not to belong to the relevant class and in addition, will also be possible intermediate gradations and therefore belong to describe the degree of belonging to a member of the class required to use meaningful logic.

In papers [10,11] defines fuzzy sets and proved that in mathematics long used the concept of sets - set of objects selected by some criteria. This concept is considered basic to modern mathematics and therefore not strictly defined, formal. The basic concepts necessary to work with classes in which there are degrees of affiliation, the entire intermediate between belonging and not belonging complete. Central to this case is the concept of fuzzy set - a class with many different degrees of belonging to it, which may be continuous infinite set.

So, let - X a set of objects (values) x, that is $X = \{x\}$. Then the fuzzy A set X given to membership function corresponding $\mu_A(x)$ to the number x of each interval $[0,1]$, which in turn is a power belonging x to A. The closer to the unit value $\mu_A(x)$, the higher the degree of belonging x to A. In a clear set of any element can either belong or do not belong to this set and therefore the membership function takes only two possible values - zero or one. In the fuzzy set any item $x \in X$ can belong to the set with some degree of confidence that takes the value from zero (not significantly item belongs plural) to one (element truly belongs plural). Accordingly, the membership function of fuzzy set can take any value in the range from zero to one [10,11].

Among the set of real prices of different objects relevant type of property (land, apartments, buildings, etc.) there is a subset of market values counterparts. The cost of these facilities is considered likely to turn and prices can be attributed to the actual price and must be attributed to the fuzzy sets.

For coordination of evaluation in all cases be governed by major professional appraisers rule - the principle of reasonable caution.

The market value as defined based on the principles of market conditions, highest and best use, expected changes and return the land, of the individual features of the land and the economic situation at the time of evaluation. Therefore, the market value is shown as the most probable price at which an object can (could) be sold on the open competitive market at a time that coincides with the valuation date, if all signs of fair dealing and without atypical terms of financing, given that lifetime of the object to be with reasonably long.

The result of evaluation of the same object, made by different evaluators in accordance with the methods of coordination can vary by more than half. Therefore, subjective weighting method, in our case, can not be used, as well as expert method, which is on the verge of subjective and mathematical weight - weight set is subjective, but further calculation is done using mathematical tools [5- 9].

The most common method of classical coordination of evaluation now is the calculation of the average value of the formula:

$$V = \sum_{i=1}^{n} W_i \cdot V_i , \qquad (1)$$

where n - the total amount of the applied evaluation methods; i - the method of evaluation; V_i - the results of the assessment; W_i - weight of evaluation.

Weight the results W_i necessary to take into account the subjective opinions of appraisers about the reliability of the results. Weight determined by an expert. There is no objective justification for methods validity of results. Procedures for determining the validity of the results can be quite complex (hierarchy analysis method), but they do not avoid subjectivity in the coordination of evaluation. More sophisticated methods of determining the validity of the results require consideration of a large number of additional factors, but really just synthesize subjective opinion appraisers. However, in practice, the weight calculation results of more sophisticated methods do not solve the problem of clarity of justification, and limited to the introduction of a large number of numerical values of benefits.

Table 1 shows the embodiment of coordination of evaluation currently the most common method of calculating the average classic.

Table 1

Harmonization of evaluation classical method

Indexes	The method of the comparative approach	The method of the income approach	The method of the cost approach
The cost for one of the methods V_i, thousand ₴	800	750	850
W_i - weight of evaluation, %	45	20	35
The proportion of market value method $(V_i \cdot W_i)$, thousand ₴	360	150	297,5
Substantiates market value of the assessment, thousand ₴ $V = \sum_{i=1}^{n} W_i \cdot V_i$	**807,5**		

Some data table. 1 will be used by us in subsequent calculations.

Evaluation results can be obtained by one or more methods of each approach to valuation (cost, comparative and income). Do not always use all methods possible approaches (for example, due to lack of sufficient and reliable information or for other reasons). Harmonization of evaluation needed to maximize convergence of different points of view. The result of this convergence should be the desired value estimated market value of the facility as the most probable price that emerging markets. The basis of this understanding should be understanding appraiser dominant role in the formation most correct, fair evaluation.

It is known that the evaluators at the legislative level only allowed to watch the prices and find their most probable value for each of the assessment in determining its market value. Speak Your Mind as a result of evaluation on the basis of correctness or incorrectness of the existing price appraiser has no right. To control the prices there are corresponding state structures. Therefore, methods to assess various approaches should aim for the same result - the market value of the most probable price of transactions. If not, then various methods designed to assess various objects on the coordination can be no question.

Sometimes evaluators use not one but two or more methods of assessment within the same approach. The question is how to do: first coordinated approach results methods, and then the results of approach, or immediately reconcile the results of methods. We believe that all methods should be aimed at measuring the same indicator - the market value of the property and is coordinate all the necessary result of methods. The analogy here is very simple. If we measure the width of the building steps, elbows, tape measure and a laser rangefinder, it is not necessary first steps coordinate measuring results and elbows, so that all meters are used to measure the same parameters were different. Note that in this analogy cause differences results can only error of measuring instruments.

In the article the way of coordination results determine the market value based on fuzzy math methods.

All the raw materials for the calculations can be obtained from the report "On the market value of the property." With this report, we received input data for the calculations (Table. 1) and report the expert made a detailed analysis of the property market, which revealed the minimum and maximum market prices for similar properties (V_{min}, V_{max}). So, for further calculations take the following notation:

1. The result obtained cost approach - V_B ;

2. The result obtained comparative approach - V_{Π} ;

3. The result obtained income approach - $V_{\mathcal{Д}}$;

4. The minimum market price for similar facilities - V_{min} ;

5. The maximum market price for similar facilities - V_{max} ;

6. Minimum the result of methodological approaches - A ;

7. Maximum the result of methodological approaches - B ;

8. The membership function of evaluation - F_v ;

9. Result coordination methodological approaches - V .

The calculations shall be financed by formulas (1-4) [10, 11]:

$$A = min(V_B, V_{\Pi}, V_{\mathcal{Д}});\qquad(1)$$

$$B = max(V_B, V_{\Pi}, V_{\mathcal{Д}});\qquad(2)$$

$$F_v = \frac{V_{max} - V_{min}}{B - A + V_{max} - V_{min}}\;;\qquad(3)$$

$$V = \frac{V_{max} \cdot B - V_{min} \cdot A}{B - A + V_{max} - V_{min}}\;.\qquad(4)$$

To simplify the calculations, we consider it appropriate to introduce such values as follows:
1. Reject the maximum and minimum values obtained from methodological approaches:

$$M = B - A.\qquad(5)$$

2. Deviations between the maximum and minimum market prices for similar items:

$$N = V_{max} - V_{min}.\qquad(6)$$

Then, taking into account (5) and (6) of the formula (3) and (4) can be written as:

$$F_v = \frac{N}{M + N}\;.\qquad(7)$$

$$V = \frac{V_{max} \cdot B - V_{min} \cdot A}{B - A + V_{max} - V_{min}} =$$
$$= \frac{V_{max} \cdot (M + A) - V_{min} \cdot A}{M + N} =$$
$$= \frac{V_{max} \cdot M + A \cdot (V_{max} - V_{min})}{M + N};$$

Therefore, given the formula (5) and (6) we get:

$$V = \frac{V_{max} \cdot M + A \cdot N}{M + N} . \qquad (8)$$

Table 2 presents the basic data for the calculations.

Initial data for calculations

The result of the cost approach, thousand ₴	V_B	850
The result of of the comparative approach, thousand ₴	$V_П$	800
The result of the income approach, thousand ₴	$V_Д$	750
The minimum market price of similar objects, thousand ₴	V_{min}	500
The maximum market price for similar objects, thousand ₴	V_{max}	1000
Minimum the result, thousand ₴	A	750
Maximum the result, thousand ₴	B	850
Deviations of maximum and minimum values obtained from methodological approaches, thousand ₴	M	100
The deviation between the maximum and minimum market prices for similar objects, thousand ₴	N	500

To perform the calculations and graphing are used above formulas 1-8 and data tables 1, 2.

$$F_v = \frac{N}{M + N} = \frac{500}{100 + 500} = 83\% ;$$

$$V = \frac{V_{max} \cdot M + A \cdot N}{M + N} = \frac{1000 \cdot 100 + 750 \cdot 500}{600} =$$
$$= 791,67 thousand\ grn$$

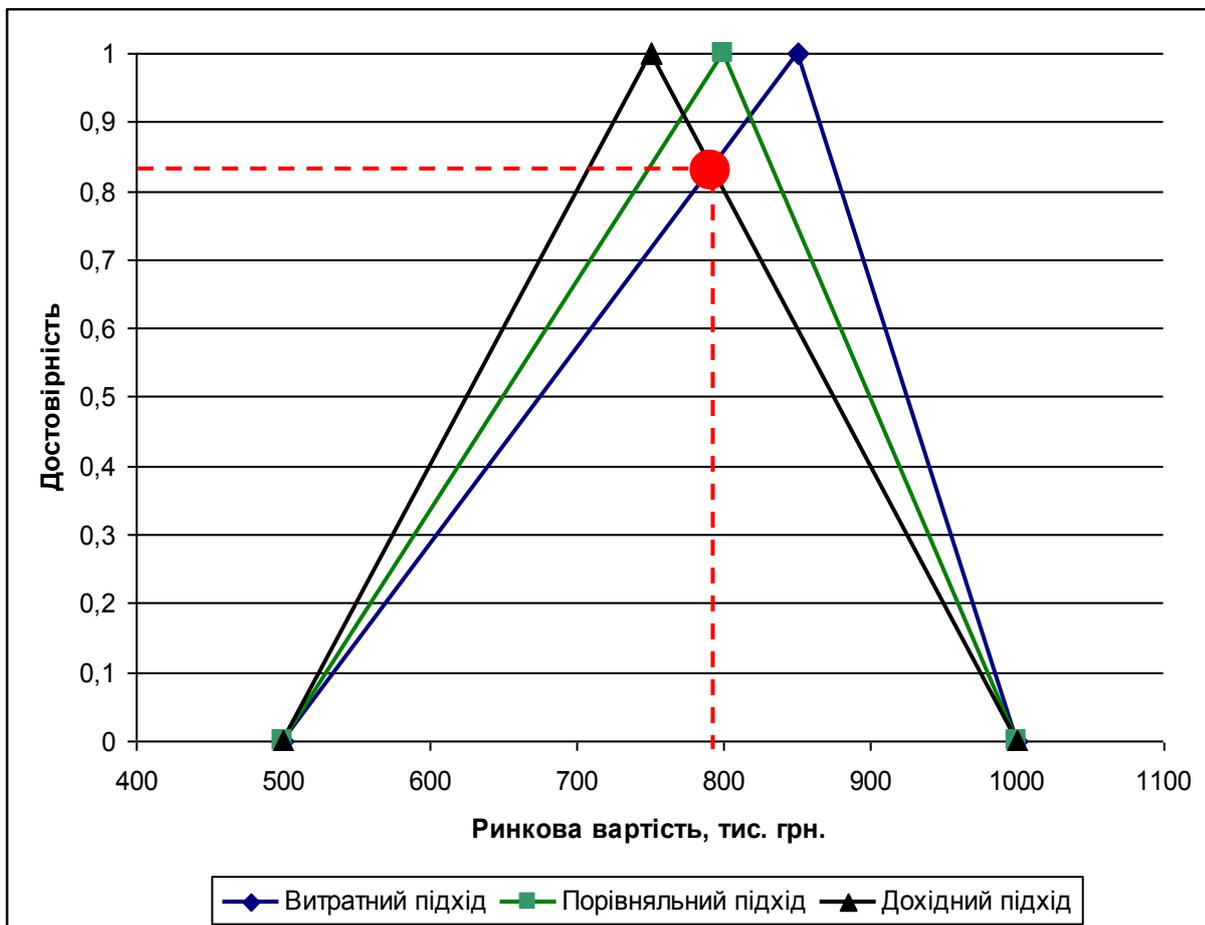The calculation results are presented in table 3 and graphically.

Fig. Graphical representation of the membership function and coordinated evaluation.

Table 3

Calculation of the membership function evaluation results
market value and the agreed outcome of the evaluation

Function membership the cost approach	F_B	0	1,00	0
	V_B	500	850	1000
Function membership of the comparative approach	$F_{\varPi}$	0	1,00	0
	$V_{\varPi}$	500	800	1000
Function membership the income approach	$F_{\varД)}$	0	1,00	0
	$V_{\varД}$	500	750	1000
The function of belonging outcome of the evaluation of market value	F_v	0	**0,83**	0
	V	500	**791,67**	1000

In comparison with the result of table 1 (classic method) and table 3 (proposed) the results differ by 15,83 thousand ₴, or 2% on the basis of what can be said about the reliability of the results of evaluation.

So, will evaluate the accuracy of the results, including:

1. Calculate the rate of oscillation V_R, which reflects the relative values of extreme fluctuations signs around the middle and is given by:

$$V_R = \frac{V_{max} - V_{min}}{\overline{V}_0} =$$

$$= \frac{850 - 750}{(850 + 800 + 750 + 792) \div 4} = \frac{100}{798} = 12,5\%$$

It is when the oscillation rate exceeds 20%, then the results are within acceptable limits.

2. Calculate the value of tracking TS, which is a measure of accuracy of forecasting. This ratio of total error $RSFE$ to the mean of the absolute deviations MAD. Perform the appropriate calculations.

$$RSFE = (807,5 - 850) + (807,5 - 800) + \\ + (807,5 - 750) + (807,5 - 792) = 38$$

$$MAD = (42,5 + 7,5 + 57,5 + 15,5) \div 4 = 30,75.$$

$$TS = \frac{RSFE}{MAD} = \frac{38}{30,75} = 1,24 < |\pm 2|.$$

It is known [1] if the absolute value of tracking more than 2, then the evaluation results can not be reasonably accurate.

Thus, the above results obtained allow to conclude that sufficient accuracy the coordination of the proposed method of evaluation.

The proposed method is not without subjectivity, but it is much less than with known methods.

The basis of the method on the following assumptions:

1. Result (most probable price of the object) assessment of each method, according to appraiser is the most reliable, but he admits that the required market value may be within the range of possible variation in prices for this object.

2. Differences evaluation results obtained by different methods, due to different algorithms and different composition discounted pricing factors, but the points of view of the seller, buyer or a neutral observer.

3. The results of the assessment, obtained by different approaches can be presented in the form of membership functions. Membership functions show a minimum, most reliable and maximum value possible values of the market value (see. Fig.). The minimum and maximum values for all functions of receiving equal the range of market prices for similar items.

4. The intersection of membership functions - conciliation membership function of market values that can be obtained by different approaches to assessment. Abscissas maximum function and conciliation is the most probable price or market value of the assessment, which is set used in the report on the evaluation methods. Ordinate (see. Fig.) Allows you to graphically establish the authenticity of the reconciliation methodological approaches.

Conclusions

The advantages of this method of coordination of evaluation are:

1. No need to study the weight (importance) assessment results obtained from the various approaches is anticipated that used for assessing all available options, and the advantage is not given to any method that reduces the subjectivity of the final result.

2. Increased attention to the study limits the range of minimum and maximum prices under comparative approach as going beyond the results of two different approaches invalid (task has no solution) which reduces the possibility of unrealistic results, such methods intended use.

3. Visibility and credibility to assess the final outcome. In this example, we got the result in the 791,670 USD which can be trusted by 83% and the

broader range of market prices objects counterparts, the lower level of confidence.

Prospects for further research of this area, in our opinion, will be the implementation of other methods of coordination of evaluation of properties that allow appraisers to avoid subjectivity in determining the market value of objects.

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Research methods of membership function for fuzzy math coordination of evaluation of market value
Yu. Hubar National University "Lviv Polytechnic"

This article has explored methods membership function of fuzzy mathematics for coordination of evaluation of the market value of the property. The advantage of this method is no need to prove the weight (importance) assessment results obtained from the various approaches is anticipated that used for assessing all available options, and the advantage is not given to any method that reduces the subjectivity of the final result. In the method, increased attention to the study limits the range of minimum and maximum prices under comparative approach that justifies the need for a detailed analysis of the property market in the performance evaluation of real estate.