FORMALIZATION OF ART PRODUCTS EXPERTISE IN FUZZY SETS

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Abstract: There had been suggested a new method of estimating works of art by experts, based on fuzzy sets usage and simulation in the fields of linguistic variable. The methods of examination formalization and the algorithm of receiving estimations of four canvases by a group of three experts had been also worked out.

Keywords: an expert estimation, art product, fuzzy sets

1   DESCRIPTIVE CHARACTERISTIC OF A TASK

The expert estimation of art products always assumes subjective perception by the professionals of the certain phenomena of art.

The subjective perception of the expert, based on deep special knowledge, on skill to distinguish specific features of the art phenomena and professional methods of determining criteria in accordance with the existing standards, an expert subjective perception concentrates mainly the individual aesthetic taste, individual art experience, individual system of moral coordinates, which intensificate intuition and therefore help an expert to see and estimate that invisible "something", which is the unique nature of any highly artistic work.

The more profound and considerable this invisible "something" in a work of art is, the more concentrated and individual an expert subjective perception should be.

However, despite of the subjective expert perception being, the expert estimation must be as objective as possible, since the expert estimation is capable of directing the flow of public interest, forming aesthetic tastes and public opinion and in a definite way of "managing" art processes in the society, influencing public self-knowledge, development, establishment and keeping to the cultural traditions.

Art is significant and valuable for the society because it unites people in their common hopes, thoughts and aspirations and reflects the barest necessity of every man for individualization.

In the world of stamps and standards, which level a person, in the world of stereotyped culture and ethical subcultures, which threaten with monotonous variety and mental anaesthesia, works of art can be and must be that natural counterbalance and that ecological niche, which do not let destroy a man's personality by satiating him with dynamics of feelings, reflections, sensations and common experiences. Owing to this, an individual doesn't retreat into himself, like a snail, but being self-sufficient, he is eager to be fit for the world of common culture, and being distinct he strives for self-perfection.

That is why it is important for an expert estimation of works of arts not to depend on momentary tendencies and commercial interests, which characterize the public development. It should be a peculiar guarantor of the inexhaustable public need for mental growth.

But is it possible to replace anything intuitive, sensual and organically necessary with the truth of figures, to express in the language of formulas and figures, when conducting an art examination?

Is it possible to deduce a formula of the viable feeling of mental impulse or spiritual strain?

Such a formulation of a task could have excited puzzled look, and in reply to this questions we could have heard categorical NO.

However to the extent of developing the theory of linguistic variable, which the authors of this report got acquainted in the work [1] with, the certain answer has been "And why not".

In the work [2] we made a step in this direction.

In this report we are making the second step – using linguistic variable and indefinite logic, we attempted to find a formula of measurements and an algorithm, which will help to separate subjective things from subjectivism, unique things from shocking, invariable value things from commercial ones.

No doubt, that the character of an expert estimate depends much on the goal, which defines the necessity of an art examination.

An expert estimate can be caused by the following goals:

–   to determine the value of a certain work of art in monetary unites;

    – to recommend for a premium in accordance with the scale of nominations to be offered;
    – to present at the contest of one or another level;
    – to form a public aesthetic ideal;
    – to create a scale of art preference;
    – to define a role, place and historical significance of a concrete work of art in the culture (of the world, of a nation or a region…);
    – to establish standard samples to symbolize a certain period, stage, style, direction, etc. in the cultural development;
    – the tasks of an expert estimate may be more private and concrete.

Every task will be in accordance with its own system of criteria which takes into consideration the specification of the given task, if necessary.

However, in order that the expert estimation of any specialist was corrected and in its ideal variant approximated the estimation of the most precise, fair and perfect expert, that is, His Majesty Time – the searches for new methods of measurements are necessary.

The time marked works of art constitute that spiritual potential, which provides for the self-preservation of a personality, society and the mankind.

That is why independently of the goals and tasks of an examination, when necessary, the common fundamental criteria, which guarantee the objectivity of any expert estimation of works of art, must be taken into consideration.

The quantity of such criteria may be different and rather great, and may rise with the increase of the task detalization level.

However it is necessary to remember that experts are human beings who can hardly keep in mind more than seven parameters at the same time, so the psychologists say. For this reason we decided to comment on seven estimation criteria in the present work when formalizing the process of works of art estimation, and in particular:

1) the skills level;
2) the novelty level;
3) the complex of aesthetic advantages;
4) the power of psychological influence;
5) the level of common human values and ideals and ideals assertion;
6) associatinity and richness of content;
7) the level of perpetual and present things correlation.

In this system of criteria we shall solve the given task.

2   THE TASK FORMALIZATIONS

We shall choose as linguistic variables (LV) $X_{jk}^{(i)}$, $i = \overline{1,7}$ established in the previous paragraph and put in order according to (i) criteria of an expert estimation; doing this by the index $j = \overline{1,n}$ We shall mark a serial number of a work of art, which is being estimated, and by the index $k = \overline{1,m}$ – serial number of an expert specifying the fuzzy value $x_{jk}^{(i)}$ LV $X_{jk}^{(i)}$.

Taking into consideration the lack of interaction of variables of the LV [1] theory, it follows that

$$X_j^{(i)} = X_{j1}^{(i)} \cap X_{j2}^{(i)} \cap \cdots \cap X_{jm}^{(i)}, \quad i = \overline{1,7}. \tag{1}$$

Or

$$X_j^{(i)} = \sum_{u \in U^*} (\boldsymbol{m}_{x_{j1}^{(i)}}(u) \wedge \boldsymbol{m}_{x_{j2}^{(i)}}(u) \wedge \cdots \wedge \boldsymbol{m}_{x_{jm}^{(i)}}(u)) / u, \quad i = \overline{1,7}, \tag{2}$$

Where U^* – universal set given on a segment [0, 1], u – element of this set, and $\boldsymbol{m}_{x_{jk}^{(i)}}(u)$ – function of belonging (FB) of elements $u \in U^*$ fuzzy sets $x_{jk}^{(i)}$, being value LV $X_{jk}^{(i)}$.

We shall remind, that in the theory LV the symbol "$\wedge$" designates operation of search of a minimum.

It is easy to see, that by the formulas (1), (2) we set integrated opinion $X_j^{(i)}$ All experts about product with number j by criterion with number i.

From the same work [1] with reference to conditions of the given task follows, that

$$X_j = X_j^{(1)} \cup X_j^{(2)} \cup \cdots \cup X_j^{(7)}, \quad j = \overline{1,n}. \tag{3}$$

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Or

$$X_j = \sum_{u \in U^*} (m_{x_j^{(1)}}(u) \vee m_{x_j^{(2)}}(u) \vee \cdots \vee m_{x_j^{(7)}}(u))/u, \quad j = \overline{1,n}, \tag{4}$$

Where $m_{x_j^{(i)}}(u)$ − FB of elements $u \in U^*$ Indistinct sets $x_j^{(i)}$, being value LV $X_j^{(i)}$.

We shall remind, that in the theory LV the symbol "$\vee$" designates operation of search of a maximum.

It is obvious, that by the formulas (3), (4) we set an integrated indistinct expert estimation X_j Work of art with number j on all to seven criteria, which we consider equilibrium, taking into account opinion of all experts.

For transformation of an indistinct expert estimation X_j In precise $\tilde{N}_j$, it is necessary to make it defuzzification [3], which in case of application of a method "Centroid" is necessary for carrying out under the formula

$$\tilde{N}_j = \frac{\sum_{l=1}^{s} u_l \cdot m_{x_j}(u_l)}{\sum_{l=1}^{s} m_{x_j}(u_l)}, \tag{5}$$

Where $m_{x_j}(u_j)$ − value FB of elements $u_l \in U^*, l = \overline{1,s}$ fuzzy sets x_j, being value LV X_j.

The sequence of numbers $\{C_j\}$ $j = \overline{1,n}$ Sets integrated expert weight of each work of art and allows to make their ordering in the chosen system of criteria.

3 THE RECOMMENDATIONS AS FOR THE CHOICE OF THE UNIVERSAL SET, KIND OF AN APPURTENANT FUNCTION AND VALUES OF FUZZY VARIABLES

As well as in work [2], as universal set U^* We shall choose only nine internal points of a piece [0,1], i.e.

$$U^* = 0,1 + 0,2 + 0,3 + 0,4 + 0,5 + 0,6 + 0,7 + 0,8 + 0,9, \tag{6}$$

Which it is enough in case of use of nine meanings $x_{(\cdot)}^{(\cdot)}$ To each LV $X_{(\cdot)}^{(\cdot)}$ Of, as which we shall accept a term-set:

$$\left[\begin{matrix} extremely\ low(EL), very\ low(VL), low(L), \\ below\ average(BA), average(A), above\ average(AA), \\ high(H), very\ high(VH), extremely\ high(EH) \end{matrix} \right\} \tag{7}$$

We shall remind, that in expression (6) symbols "+" do not designate the operation of arithmetic summation, but the operation of multiple association of elements.

In work [2] it was proved, that FB $m_{x_{(\cdot)}^{(\cdot)}}(u)$ is very convenient to be used in function

$$m_{x_{(\cdot)}^{(\cdot)}}(u) = \exp\left[-\frac{1}{2}\left(\frac{u - m_{x_{(\cdot)}^{(\cdot)}}}{s_{x_{(\cdot)}^{(\cdot)}}} \right)^2 \right], \tag{8}$$

In which for all fuzzy restrictions $x_{(\cdot)}^{(\cdot)}$ All LV $X_{(\cdot)}^{(\cdot)}$ It is accepted

$$s_{x_{(\cdot)}^{(\cdot)}} = 0,15, \tag{9}$$

And as parameter $m_{x_{(\cdot)}^{(\cdot)}}$ act the values of universal set U^*, given by expression (6), taken in the same order, i.e.

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$$\begin{cases} m_{EL} = 0,1;\ m_{VL} = 0,2;\ m_L = 0,3; \\ m_{BA} = 0,4;\ m_A = 0,5;\ m_{AA} = 0,6; \\ m_H = 0,7;\ m_{VH} = 0,8;\ m_{EH} = 0,9. \end{cases} \tag{10}$$

At performance of conditions (8), (9), (10) and keeping in values FB only one figures after a comma, as well as in work [2], we receive such expressions for the description fuzzy variable $x_{(\bullet)}^{(\bullet)}$, set by a term-set (7):

$$EL = 1/0,1 + 0,8/0,2 + 0,4/0,3 + 0,1/0,4, \tag{11}$$

$$VL = 0,8/0,1 + 1/0,2 + 0,8/0,3 + 0,4/0,4 + 0,1/0,5, \tag{12}$$

$$L = 0,4/0,1 + 0,8/0,2 + 1/0,3 + 0,8/0,4 + 0,4/0,5 + 0,1/0,6, \tag{13}$$

$$BA = 0,1/0,1 + 0,4/0,2 + 0,8/0,3 + 1/0,4 + 0,8/0,5 + 0,4/0,6 + 0,1/0,7, \tag{14}$$

$$\tilde{N} = 0,1/0,2 + 0,4/0,3 + 0,8/0,4 + 1/0,5 + 0,8/0,6 + 0,4/0,7 + 0,1/0,8, \tag{15}$$

$$AA = 0,1/0,3 + 0,4/0,4 + 0,8/0,5 + 1/0,6 + 0,8/0,7 + 0,4/0,8 + 0,1/0,9, \tag{16}$$

$$\hat{A} = 0,1/0,4 + 0,4/0,5 + 0,8/0,6 + 1/0,7 + 0,8/0,8 + 0,4/0,9, \tag{17}$$

$$\hat{IA} = 0,1/0,5 + 0,4/0,6 + 0,8/0,7 + 1/0,8 + 0,8/0,9, \tag{18}$$

$$x\hat{A} = 0,1/0,6 + 0,4/0,7 + 0,8/0,8 + 1/0,9. \tag{19}$$

4   EXAMPLES OF SOLVING A CONCRETE TASK

We shall assume, that it is necessary for three experts to estimate four pictures with the purpose of award to three of them the first, second and third premium.

Let's assume that the experts on each of seven criteria have exposed by each of four pictures such estimations:

$$\begin{cases} x_{11}^{(1)} = H, & x_{21}^{(1)} = L, & x_{31}^{(1)} = A, & x_{41}^{(1)} = VH; \\ x_{11}^{(2)} = H, & x_{21}^{(2)} = H, & x_{31}^{(2)} = A, & x_{41}^{(2)} = VL; \\ x_{11}^{(3)} = H, & x_{21}^{(3)} = A, & x_{31}^{(3)} = BA, & x_{41}^{(3)} = L; \\ x_{11}^{(4)} = L, & x_{21}^{(4)} = VL, & x_{31}^{(4)} = A, & x_{41}^{(4)} = BA; \\ x_{11}^{(5)} = H, & x_{21}^{(5)} = VH, & x_{31}^{(5)} = H, & x_{41}^{(5)} = AA; \\ x_{11}^{(6)} = L, & x_{21}^{(6)} = A, & x_{31}^{(6)} = AA, & x_{41}^{(6)} = AA; \\ x_{11}^{(7)} = AA, & x_{21}^{(7)} = A, & x_{31}^{(7)} = AA, & x_{41}^{(7)} = BA; \end{cases} \tag{20}$$

$$\begin{cases} x_{12}^{(1)} = L, & x_{22}^{(1)} = L, & x_{32}^{(1)} = VL, & x_{42}^{(1)} = A; \\ x_{12}^{(2)} = H, & x_{22}^{(2)} = L, & x_{32}^{(2)} = VL, & x_{42}^{(2)} = A; \\ x_{12}^{(3)} = A, & x_{22}^{(3)} = H, & x_{32}^{(3)} = BA, & x_{42}^{(3)} = BA; \\ x_{12}^{(4)} = H, & x_{22}^{(4)} = BA, & x_{32}^{(4)} = EH, & x_{42}^{(4)} = A; \\ x_{12}^{(5)} = A, & x_{22}^{(5)} = VL, & x_{32}^{(5)} = L, & x_{42}^{(5)} = AA; \\ x_{12}^{(6)} = A, & x_{22}^{(6)} = BA, & x_{32}^{(6)} = A, & x_{42}^{(6)} = AA; \\ x_{12}^{(7)} = H, & x_{22}^{(7)} = A, & x_{32}^{(7)} = AA, & x_{42}^{(7)} = A; \end{cases} \tag{21}$$

$$\begin{cases} x_{13}^{(1)} = A, & x_{23}^{(1)} = A, & x_{33}^{(1)} = AA, & x_{43}^{(1)} = A; \\ x_{13}^{(2)} = VL, & x_{23}^{(2)} = L, & x_{33}^{(2)} = AA, & x_{43}^{(2)} = A; \\ x_{13}^{(3)} = A, & x_{23}^{(3)} = A, & x_{33}^{(3)} = BA, & x_{43}^{(3)} = BA; \\ x_{13}^{(4)} = L, & x_{23}^{(4)} = BA, & x_{33}^{(4)} = H, & x_{43}^{(4)} = BA; \\ x_{13}^{(5)} = A, & x_{23}^{(5)} = VL, & x_{33}^{(5)} = EL, & x_{43}^{(5)} = L; \\ x_{13}^{(6)} = A, & x_{23}^{(6)} = A, & x_{33}^{(6)} = EH, & x_{43}^{(6)} = H; \\ x_{13}^{(7)} = AA, & x_{23}^{(7)} = AA, & x_{33}^{(7)} = AA, & x_{43}^{(7)} = BA. \end{cases} \tag{22}$$

In sets of estimations (20), (21), (22) each of three experts columns set an estimation by one expert for each of pictures on seven criteria, and the lines set an estimation of one expert for four pictures on one criterion.

Substituting meanings fuzzy variables $x_{jk}^{(i)}$ from sets (20), (21), (22) in expression (1) in view of their decoding set by expressions (11) ÷ (19), and carrying out operations set by expression (2), and then, substituting the received results in expression (3) and carrying out operations ordered by expression (4), we shall have:

$$x_1 = 0,1/0,2 + 0,4/0,3 + 0,8/0,4 + 0,4/0,5 + 0,8/0,6 + 0,8/0,7 + 0,4/0,8 + 0,1/0,9; \qquad (23)$$

$$x_2 = 0,1/0,1 + 0,4/0,2 + 0,8/0,3 + 0,8/0,4 + 0,8/0,5 + 0,8/0,6 + 0,4/0,7 + 0,1/0,8; \qquad (24)$$

$$x_3 = 0,1/0,1 + 0,4/0,2 + 0,8/0,3 + 1/0,4 + 0,8/0,5 + 1/0,6 + 0,8/0,7 + 0,8/0,8 + 0,1/0,9; \qquad (25)$$

$$x_4 = 0,1/0,1 + 0,4/0,2 + 0,4/0,3 + 0,8/0,4 + 0,8/0,5 + 0,8/0,6 + 0,8/0,7 + 0,4/0,8 + 0,1/0,9. \qquad (26)$$

It is obvious, that, considering the expressions (23), (24), (25), (26), we can't determine neither the premium nor picture to award. We can't do it however by using expressions (20), (21), (22).

And therefore we shall make fuzzification of fuzzy estimations (23), (24), (25), (26), using the formula (5).

As a result of serial substitution of expressions (23), (24), (25), (26) in the formula (5) we shall receive:

$$\tilde{N}_1 = 0,55; \ \tilde{N}_2 = 0,45; \ \tilde{N}_3 = 0,66; \ \tilde{N}_4 = 0,52. \qquad (27)$$

From expressions (27) it follows, that the first premium is necessary to award the picture under number three, the second – picture under number one and the third – picture under number four.

The lowest expert estimation was received by a picture under number two, which has remained without the premium.

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