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TO ORDERING THE INCOMING AND OUTGOING PARAMETERS OF AN OBJECT

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Abstract:

The issues of identifying the most important properties of an object with the help of methods of simple ranking, direct and pairwise ranking are studied. The problem of ordering the input and output parameters of an object using the method of expert assessments is investigated.

Keywords: Object

There are many processes and events today that do not have quantitative characteristics to describe them, or they change rapidly. Mathematical models also use the relationships between input and output variables derived from different considerations. In cases where it is not possible to substantiate the results of experiments or tests and to evaluate the results of decisions made, the method of expert evaluation is used to study the nature of the process or event [1]. The complexity of the formation of the research object or the lack of complete information about the nature of the object requires the use of expert systems. The examination process, on the other hand, involves the identification of a hypothesis that is true on the basis of an overall assessment by each expert from among the predicted hypotheses presented (based on selected factors). As a result, the factor or indicators that significantly affect the object are regulated [2].

The purpose of this article is to study the criteria for regulating the input and output parameters of the object under study using the method of experts.

Processing of experimental or test results.

If it is not possible or appropriate to assess the performance of the objects directly, then the coloring method can be used. The coloring process indicates which of the objects being studied is important. The following methods of coloring are widely used in practice [3,4]:

simple coloring;
direct staining;
pairwise comparison, etc.

The simple staining method is based on arranging objects in ascending or descending order according to their characteristic factors, indicators and traits. In painting, the expert assigns a natural number to each object in order, that is, each object is colored based on its properties. The number of colors is equal to the number of sorted objects. If an object is being studied in N, the color of the most influential object by its nature is denoted as 1, and the color of the least influential object is denoted by N. The value of an object's color actually represents its number in an ordered row of colors. For example, if the row of colors is 1,3,5,7,7,10, the color corresponding to 5 numbers is equal to 3.

In some cases, as a result of the expert giving the same color to several objects, the number of objects, which are differentiated by the number of colors, remains the same. In such cases, objects are given standardized colors. In this case, the number of standardized colors is assumed to be n. Objects with the same color are assigned an XS standardized color. The value of a standardized color is equal to the arithmetic mean of the places of objects of the same rank by color. For example, in the table below, five objects (factors) are given the colors x_i (i = 1,..., 5) according to Table 1.

Table 1. Assign colors to objects.

i	1	2	3	4	5
X_i	1	2	3	2	3

The standardized color of the second and fourth objects, which correspond to the second and third places in terms of color, is X_S = (2 + 3) / 2 = 2,5. The standardized color of the fourth and fifth objects, corresponding to the fourth and fifth places in terms of color, is X_S = (4 + 5) / 2 = 4.5. As a result, the final view of the object is shown in Table 2 below.

Table 2. Using standardized colors, reassignment of ranks to objects.

i	1	2	3	4	5
x_i	1	2,5	4,5	2,5	4,5

The set of colors obtained by coloring n objects $X_S(n)$ is defined as follows:

$$X_S(n) = \sum_{i=1}^{n} x_i = \frac{n(n+1)}{2}$$

where x_i is the rank corresponding to the *i*-th object. In fact, applying this formula to Table2,we can be sure that $X_S(5)$=5(5+1)/2=(1+2.5+4.5+2.5+4.5)=15

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If the staining is performed by an expert in k, then the color of each object x_{ij} $\left(i=\overline{1,n};\ j=\overline{1,k}\right)$is determined as the final color by the colors determined by all experts. The object with the smallest set of colors is given the highest (first) color, otherwise the lowest n colors are given. The rest of the objects are arranged in the order of growth of the sum of colors relative to the first object.

The main advantage of the method of painting is explained by its easy implementation. The main disadvantages of this method are:

-coloring a small number of small objects, because if their number exceeds
15-20, it is difficult to color them;

-In this way, the question of how important the objects under study differ from each other in importance remains unresolved.

Direct staining method. This method is based on qualitatively describing the degree of significance of the process or factors when it is difficult to quantify them. In this way, the expert uses his own scale to color the objects in the proposed range of colors. When the number of objects is large, it is difficult to use the direct staining method.

Pair comparison method. This method of coloring is convenient when the number of objects is large. Based on this method, objects are compared in pairs to determine which is more important than each pair of objects. To do this, if the number of objects is n, the expert elements x_{ij} form a square matrix of dimension $n*n$. The elements of the matrix assume the following values:

if the i-th object is more important than the j-th object $x_{ij} = 1$;
if the j-th object is more important than the i-th object $x_{ij} = 0$.

Suppose that objects O_1, O_2, O_3, O_4 and O_5 are required to be painted by an expert. In this case, the expert can construct the following matrix:

Table 3. Pair comparison matrix.

	O_1	O_2	O_3	O_4	O_5	Total color
O_1	0	0	1	1	0	2
O_2	1	0	1	1	0	3
O_3	0	0	0	0	1	1
O_4	0	0	1	0	1	2
O_5	1	1	0	0	0	2

As you can see from the table, the most important object here is the O_2 object, the most insignificant object is the O_3 object. Taking into account the relative importance of the remaining O_1, O_3 and O_4 objects, the order of the objects can be arranged as follows:
O_2, O_5, O_1, O_4, O_3.

Assess the consistency of expert assessments.

The results of any expert are not convincing.Indeed, if the conclusions of the experts differ sharply (for example, if half of the experts are the first color for the factor x_i,and the color of the remaining experts is the last color), then the consensus criterion is used.The criterion for evaluating the results of any expert is called the consensus criterion (or indicator).The higher the coherence of the experts,the higher the confidence in the results of the expert evaluation [4].

There is a need to quantify the degree of coherence of experts and to explain the inconsistency of expert opinions [5]. The measure of conformity is determined on the basis of statistics available to all experts. If the conclusions of the experts do not differ much, then the level of agreement of the experts can be considered good.

The purpose of assessing the consistency of an expert's opinion is to identify a group of experts who agree with each other. The high final agreement of all groups of experts can be the only final assessment. It is necessary to separate a subgroup of experts with a high degree of consensus from a group of experts with a low level of consensus, and to analyze the work of the group's experts in order to determine the reasons for differences in the views of this subgroup. If the reason for the difference of opinion of the experts is the dishonesty of some of them, then it is necessary to reorganize the expert assessment.

Each expert has his own personal assessment, but the agreement factor can be used to verify the final result of the group of experts. The concordance coefficient is used to assess the coherence of the opinions of experts. This coefficient was introduced by Maurice George Kendall, a well-known statistician in the United Kingdom [4].

Suppose that m requires an expert to evaluate n an object. In this case, the coloring matrix is measured in $m*n$ $\| r_{ij} \|$ (j=1,…, m; i = 1,…, n). Here r_{ij} is the rank assigned to the i-th object by the j-th expert. The values of the elements of the matrix are equal to one of the natural numbers $1,…, n$ set by the experts, indicating the importance of the objects.

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$r_i = \sum_{j=1}^{m} r_{ij}, \quad (i = 1, 2, \dots, n)$

The total color of the object's significance can be defined as the sum of the colors on each column of the matrix:

$r_1 < r_2 < \cdots r_{n-1} < r_n$.

The color of this collection shows the importance of the objects in the assessment of all experts. The result is a sequence of n objects arranged as follows:

Given that r_i quantities are random quantities, we determine their variance estimates. According to the requirement of the minimum standard error, the variance estimate can be determined as follows:

$$D = \frac{1}{n-1} \sum_{i=1}^{m} (r_i - \bar{r})^2,$$

(1)

where $\bar{r} = \frac{1}{n} \sum_{i=1}^{n} r_i$ is determined by the formula and represents the mathematical expectation.

The coefficient of coherence is an immeasurable quantity and is defined as the variance relative to the maximum variance as follows:

$$W = \frac{D}{D_{max}}. \quad (2)$$

determined by The maximum value of the variance estimate, depending on the number of objects and experts, is determined by the following equation:

$$D_{max} = \frac{m^2(n^3 - n)}{12(n-1)} = \frac{m^2(n^2+1)}{12}.$$

(3)

Using the notation $S = \sum_{i=1}^{n} (r_i - \bar{r})^2$, Equation (1) can be expressed as follows:

$$D = \frac{S}{n-1}.$$

(4)

Considering equations (3) and (4), the coefficient of agreement is expressed as follows:

$$W = \frac{12\,S}{m^2(n^3 - n)}$$

(5)

Equivalent objects are usually given the same colors, and such colors are called linked colors. The values of the linked colors are equal to the arithmetic mean of the colors. If there are bound colors in the staining, then the maximum value of the variance decreases and the coefficient of concordance is determined by the following relationship:

$$W = \frac{12\,S}{m^2(n^3 - n) - m \sum_{j=1}^{m} T_j}.$$

(5)

In formula (5), the color index associated with the j-th rank is denoted by T_j. In turn, the value of this indicator is found in the following formula:

$$T_j = \sum_{k=1}^{H_j} (h_k^3 - h_k).$$

Here H_j - j is the number of groups with the same color as the color, and h_k -j is the number of colors with the same color in the k group.

In conclusion, it should be noted that the agreement coefficient takes values between 0 and 1. The fact that the value of the agreement coefficient is close to 0 means that the agreement is low. If the value of the coefficient is less than 0.3, it means that the opinions of the experts do not agree with each other, that is, there is no consensus. Also, the values of the coefficient of agreement between 0.3 and 0.7 and greater than 0.7 correspond to the average and high agreement, respectively. In the case of $W = 1$, the experts agree.

When arranging the parameters by the method of expert evaluation, all input and output parameters are determined. These input and output parameters must be sufficiently studied. Otherwise, their use in the model will not be effective.

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