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MULTISTEP PROCEDURE OF STATISTICALLY CONCERTED GROUP PREFERENCES SYSTEM IMPLEMENTATION

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Abstrakt. *Taking into consideration the fact that the concerted group preferences system is the most common way for making an objective choice, and focusing on the established minimum value according to Kendall's coefficient of concordance, a multistep procedure of consistent marginal opinions rejection has been developed, where the theory of pattern recognition methods serves as their identification. The application of the procedure is illustrated on the example of construction of group preferences system for the set of typical traits of misbehavior of certain group of students.*

Keywords: concordance of group preferences system, coefficient of concordance criteria value, marginal opinions, theory of pattern recognition methods.

Introduction. Contemporary management of an object is performed by a set of successive functions [1; 2]: forecasting – planning – assessment of the situation – decisions making (DM) – decisions performing – control and accounting. Among the enumerated management functions DM occupies a special role since it is more generalized than the other management functions. Every management function can be represented as a chain (sequence) of solutions, which falls into generalization. Therefore, DM can be observed as a typical problem, which should be solved during various management functions realization. At the same time special attention to the expert procedures (EP) should be attracted, as they are the basis of contemporary intelligent systems decisions support [3; 4]. Taking the above into consideration, the task of EP improving, especially in the case of group decisions formulation, which is rightly considered to be more objective and reasonable than individual [5 – 7], should be considered as actual.

Analysis of researches and publications. Group decisions making strategies according to the results of researches [1, 3 – 7] are: 1) a mare majority; 2) summing up and ranks averaging; 3) those that are based on classical criterion of DM (Wald, Savage, Bayes–Laplac, Hurwitz, etc.); 4) optimal forecasting. The first and the third among them, applied in the classic Savage criterion, are "traditionally" to be considered as democratic, because they minimize the deviation of both minority and majority experts opinions involved in the examination. The second strategy requires determination of the opinion concordance degree, because the generalization can average contradictory poll results. The fourth strategy is actually focused on the application of the second, so it has not reached wide extension [8].

The simplest way of DM is the detection of individual and based on them - group preference system (PS). Thus, under the PS we will understand any form of ordering (in the context of the publication from the most significant to the least) of investigated alternatives [5; 8 – 10]. And if the group PS (GPS) is formed, the DM is trivial because initially the best alternative with rank No.1 should be chosen, if it is impossible, in the case of any force majeure circumstances, then with rank No.2, and so on. So, if GPS is indeed formed, it is necessary to determine its concordance with the degree, which is usually performed with multiple rank correlation coefficient (the coefficient of concordance according to Kendall) [1; 3; 4; 6 – 16]:

$$W = \frac{12S}{m^2\left(n^3 - n\right) - m\sum_{i=1}^{m} R_i}, \qquad (1)$$

where

$$S = \sum_{i=1}^{n}\left(\sum_{j=1}^{m} r_{ij} - \overline{r}\right)^2; \quad (2)$$

r_{ij} is the rank which was assigned by *j*-th expert ($j = \overline{1,m}$) to *i*-th ($i = \overline{1,n}$) alternative in individual PS; $\overline{r_i}$ is group average rank of *i*-th alternative:

$$\overline{r} = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{m} r_{ij}; \quad (3)$$

R_j is quantity of the same ranks, provided by each *j*-th student typical traits of misbehavior (TTM) that is analyzed:

$$R_j = \sum_{j}\left(r_{ij}^3 - r_j\right). \quad (4)$$

Concordance coefficient varies within W = [0, 1]. Its high value indicates a high level of concordance of experts' opinions in GPS. However, the more professionals are involved in the examination, and the more investigated alternatives are ordered by them, the greater variability of opinions will be observed and it will inevitably have an influence on the absolute value of the concordance coefficient. Therefore, the received empirical value of the concordance coefficient W is considered to be statistically reliable, and GPS is concerted, if the condition is fulfilled [1; 3; 4; 6 – 16]:

$$\chi^2_{emp} = \frac{12S}{(n+1)mn - \frac{1}{(n-1)}\sum_{j} R_j} \gg \chi^2_{\alpha;k}, \quad (5)$$

where $\chi^2_{\alpha;k}$ is a theoretical value of the variable "xi-square" with $k = m - 1$ degrees of freedom on the permitted level (significance) α, which is determined from the special table [13].

On the other hand, a criterion restriction on the absolute value of W is also imposed:

$$W \geq 0,7...,0,8. \quad (6)$$

So, GPS is considered to be concerted under both conditions fulfillment (5), (6).

As follows from expressions (1) – (5), in the process of GPS construction and assessment of the degree of its concordance the contradictory opinions can really be generalized, that certainly will have an influence on the values determined by expressions (1), (5), (6). From the analysis of scientific sources [1; 3; 4; 7; 9; 11; 12; 15; 16] it follows that the determination of experts' marginal opinions usually occurs with methods used in identification of regular errors of technical measurements [17; 18], which is methodologically incorrect. At least for the reason, that the comparative qualitative (PS ranks) rather than quantitative assessments are inherent in human thinking [5; 19].

Formulation of the task of the investigation. It is necessary to realize the development and implementation of procedures (if it is necessary – multistep) of nonparametric detection of marginal experts' opinions for obtaining GPS, the characteristics of which would satisfy the conditions (5), (6).

Development and realization of multistep procedures for obtaining statistically reliable GPS of experts. All the methods, technologies, and procedures developed in this work, will be illustrated by the construction of students GPS on the set of TTM. Such choice is explained as follows. First, any classroom always has a "black sheep" whose behavior significantly differs from the conventional in particular educational society and prevents the teacher from performing his professional duties. Second, diagnostics and correction of misbehavior of young pilots is recognized by International Civil Aviation Organization (ICAO) as one of proactive measures of preventing the

negative impact of human factor on flight safety. In this respect one of ICAO Manuals contains a list of the most common types of misbehavior, their indicators and appropriate antidotes [20]. For the realization of investigations an enhanced and more complete list of TTM was formed, which characterizes false behavior (table 1) more completely and comprehensively. Third, one of the expected positives from Ukraine's joining to the Bologna agreements is "the increase of motivation for studying and classes attending" [21], the content of which also shows public understanding of misbehavior problems (table 1).

Table 1

Set of typical traits of misbehavior of students during the studying process

Mark of the trait, H_i	**Description of typical traits of misbehavior**
1	2
H_1	Misses classes without excuse
H_2	Considers, that everything is wrong: criticizes the education system, equipment and everything he sees
H_3	Disobligingly disposed, captious, always ready to quarrel and provokes it
H_4	Extremely persistent, seeks at whatever cost, even at friends' cost to fulfill orders, supremely selfish
H_5	Time waster, chatterbox, works lazily and slowly
H_6	Timid, afraid of his friends and teachers, works alone, as a rule does not ask for help and does not aspire to success
H_7	Disinterested, always inattentive and quick
H_8	Knows everything, sees little benefit from the lessons, the teacher for his own, "considers that his system of training is better", idle talker and chatty
H_9	Slow, it is always lack of time for him to finish the assignment, but he always accomplishes what is necessary
H_{10}	Doesn't approve of group work
H_{11}	Avoids work at the lessons
H_{12}	Doesn't perform instructions and does everything in his own way
H_{13}	Makes no attempt to help friends or teachers
H_{14}	Irresponsible, careless, negligent in use of equipment, untidy, tactless
H_{15}	Absent-minded, his thoughts are always focused not on the subject of study, confuses the reality with fiction
H_{16}	Impulsive, aspires to get result as soon as possible, doesn't fall to thinking about its correctness
H_{17}	Non-independent, bows to the wishes of fellows
H_{18}	Systematically comes late for classes
H_{19}	Does not do homework
H_{20}	Doesn't attend general events of an institution or faculty
H_{21}	Overdues books to the library

Given 179 students – managers, who built individual preferences on the set with the help of pair wise comparison and such method of preferences detection as a part of total intensity, built on a set of individual preferences on the list of TTM (table 2), were involved in the investigation. Their generalization with the help of such group decisions strategy as summing up and averaging ranks made possible to get such GPS:

$$H_3 \underset{g}{\succ} H_1 \underset{g}{\succ} H_4 \underset{g}{\succ} H_2 \underset{g}{\succ} H_{19} \underset{g}{\succ} H_{12} \underset{g}{\succ} H_{16} \underset{g}{\succ} H_{11} \underset{g}{\succ} H_{18} \underset{g}{\succ} H_8 \underset{g}{\succ} H_{17} \underset{g}{\succ} H_{15} \underset{g}{\succ} H_{14} \underset{g}{\succ} H_{10} \underset{g}{\succ} H_{13} \underset{g}{\succ} H_{17} \underset{g}{\succ} H_6 \underset{g}{\succ} H_5 \underset{g}{\succ} H_9 \underset{g}{\succ} H_{20} \underset{g}{\succ} H_{21}, \quad (7)$$

where $\underset{g}{\succ}$ denotes group preference of the *i*-th trait before the *j*-th.

According to formula (1) such empirical values of concordance coefficient is calculated:

$$W = \frac{12 \cdot 5508002,5}{179^2\left(21^3 - 21\right) - 179 \cdot 10350} = 0,2247,$$

Table 2

Individual preferences system of students of the group in the number of *m*=172 people (fragment)

H_i	Student-respondent *j*										$\sum r_{ij}$	$\bar{r}_i$	r_i
	1	2	3	4	…	28	…	44	…	179			
1	2	3	4	5	...	29	...	45	...	173	174	175	176
H_1	10	20	1,5	7,5	…	16	…	18	…	6	1357	7,89	2
H_2	18,5	13,5	6	1	…	16	…	4	…	1	1434	8,34	3
H_3	1	10	10	2,5	…	7	…	14,5	…	2	1004	5,84	1
H_4	2	13,5	1,5	2,5	…	18	…	2	…	9,5	1443	8,39	4
H_5	18,5	10	17	4,5	…	11,5	…	5	…	9,5	2207,5	12,83	18
H_6	5	6,5	18	7,5	…	14	…	9,5	…	17	2024,5	11,77	17
H_7	15,5	2,5	14	7,5	…	9,5	…	18	…	11	2010,5	11,69	15
H_8	15,5	6,5	20,5	4,5	…	9,5	…	16	…	3	1712,5	9,96	10
H_9	12,5	4,5	20,5	21	…	21	…	21	…	15	2794,5	16,25	19
H_{10}	3	16,5	3,5	7,5	…	6	…	18	…	8	2003,5	11,65	13
H_{11}	12,5	4,5	10	14	…	4	…	6,5	…	6	1630	9,48	8
H_{12}	8	1	12	11	…	1,5	…	12	…	4	1483,5	8,63	5
H_{13}	5	13,5	16	10	…	11,5	…	9,5	…	13,5	2011,5	11,69	16
H_{14}	11	16,5	15	12	…	4	…	12	…	21	2005,5	11,66	14
H_{15}	8	18,5	19	16	…	8	…	14,5	…	16	1970,5	11,46	12
H_{16}	8	18,5	13	14	…	13	…	6,5	…	6	1629	9,47	7
H_{17}	5	21	3,5	14	…	16	…	1	…	18,5	1856	10,79	11
H_{18}	20	10	7,5	20	…	4	…	3	…	13,5	1692,5	9,84	9
H_{19}	17	13,5	10	17	…	1,5	…	20	…	12	1499,5	8,72	6
H_{20}	14	8	7,5	18,5	…	19	…	8	…	18,5	2947	17,13	20
H_{21}	21	2,5	5	18,5	…	20	…	12	…	20	3016	17,53	21
L_j	121	179	104	114	…	83	…	141	…	79			
L^*_j	0,68	1	0,58	0,64	…	0,46	…	0,79	…	0,44			

it indicates a determined general concordance of students' opinions concerning the significance and importance of TTM students in GPS (7). Herewith it should be mentioned that the large amount of sample (m = 179) and a great number of TTM (n = 21) resulted in significant variability of opinions that had an impact on the value of the concordance coefficient. To become finally sure of the calculated value W reliability, it is necessary to check the appropriate statistical hypothesis, namely to see whether the condition (5) is fulfilled. Hence:

$$\chi^2_{emp} = \frac{12 \cdot 5508002,5}{179 \cdot (21+1) \cdot 21 - \frac{1}{(21-1)} 10350} = 804,3 \gg \chi^2_{20;\ 0,02\%} = 45,31,$$

it reflected a statistically reliable concordance of GPS (7). However, the criterion (6) is not fulfilled: $W_{m=179} = 0,2247 \ll 0,7,$ that is why special procedures of deprivation of marginal opinions should be used, the occurrence of which has to be explained: first, by the uniqueness of personal working or studying experience in a particular higher education establishment (HEE); second, by the lack of awareness of experts in the application of the proposed methods to identifying their opinions; third, by the high variability of opinions due to sufficiently large number of TTM; fourth, by the impact of external and internal factors of the objective and subjective nature, stochastic and not stochastic

nature; and, finally, fifth, by avoidance of certain students of the true expression of opinions based on fears of possible social punishment. That is why seven respondents have given 1-2 places to H_{20} i H_{21}, that are either obvious lapses or less obvious nonsense, because such a behavior despite the evidence of misbehavior, does not prevent the teacher to the great extent from effective implementation of the teaching and educational process (TEP). Having deleted those opinions, we already get such PS in the group $m = 172$ (of tested students (whose poll is represented in table 2):

$$\begin{array}{l} H_3 \underset{m=172}{\succ} H_1 \underset{m=172}{\succ} H_2 \underset{m=172}{\succ} H_4 \underset{m=172}{\succ} H_{19} \underset{m=172}{\succ} H_{12} \underset{m=172}{\succ} H_{16} \underset{m=172}{\succ} \\ \underset{m=172}{\succ} H_{11} \underset{m=172}{\succ} H_{18} \underset{m=172}{\succ} H_8 \underset{m=172}{\succ} H_{17} \underset{m=172}{\succ} H_{15} \underset{m=172}{\succ} H_{14} \underset{m=172}{\succ} H_{10} \underset{m=172}{\succ} \\ \underset{m=172}{\succ} H_{13} \underset{m=172}{\succ} H_7 \underset{m=172}{\succ} H_6 \underset{m=172}{\succ} H_5 \underset{m=172}{\succ} H_9 \underset{m=172}{\succ} H_{20} \underset{m=172}{\succ} H_{21} \end{array}, \qquad (8)$$

where $\underset{m=172}{\succ}$ is a mark of the preference of *i*-th of TTM compared to *j*-th one in the group of *m=172* students.

Empirical value of Kendall's concordance coefficient for the group PS (8), that equals to the quantity $W_{m=172} = 0,2379$ and is considerably greater than previous value (by 6 %), is statistically reliable, because $\chi^2_{emp} = 819,724 \gg \chi^2_{k=20;\alpha=0,2\%} = 45,31.$ However, the requirement (6) isn't fulfilled again. Thus, considering the given and experience of researches [8; 22], it is necessary to develop and realize methods of increase in uniformity of opinions of experts and deprivation of marginal results. The attractiveness of this approach, which is considered in the specified works, is the establishment of competence of experts in their evaluation of objects, namely, on the impact on group opinion. So, such an influence of judgments of the certain additional expert on a group assessment is considered normal, when the deviation of a new group assessment differs from the previous one in 5–10 %. Such an influence is considered for the justification of size of the group. In the same time it is accepted that:

$$\begin{array}{l} 1,05 \le C \le 1,10, \quad \text{if} \quad b > \overline{a}_m; \\ 0,90 \le C \le 0,95, \quad \text{if} \quad b < \overline{a}_m, \end{array} \qquad (9)$$

where

$$C = \frac{\overline{a}_{m+1}}{\overline{a}_m}, \qquad (10)$$

$\overline{a}_m$ – arithmetic mean assessment of the group consisting of *m* persons; $\overline{a}_{m+1}$ – arithmetic mean assessment of the group consisting of (*m*+1) persons; *b* – assessment of (*m*+1)'s expert, which can be theoretically involved in group work.

It is understandable that

$$\begin{cases} C = 1, \ \text{when} \ \ \overline{a}_n = b; \\ C > 1, \ \text{when} \ \ \overline{a}_n > b; \\ C < 1, \ \text{when} \ \ \overline{a}_n < b. \end{cases} \qquad (11)$$

These considerations are concerning the analysis of expert assessments on specific indicators which are examined, as well as for already obtained vector (integral) performance evaluation. Besides, it refers to the quantity evaluation of methods, in spite of the fact that methods of quality are the most inherent for human thinking, including comparative rank evaluation. Hence, in general case it is necessary to identify the methods and procedures of identification of the competency of experts on a set of indicators that are evaluated. The possibility of applying methods of pattern recognition theory to determine the competence of experts follows from the analysis of papers [23 – 27].

Let us introduce the concept of risk recognition – as the mathematical expectation value of information loss from mistaken recognition/non-recognition of competent/not competent experts:

$$r(\delta) = \int_X \sum_{i=1}^{I} L\left[i, k = \delta(x) P(i)\, p(x/i) dx\right], \tag{12}$$

where X – the area of signals x (evaluation characteristics provided by experts to the studied objects); i = 1, 2, ..., I – numbers of classes of assessments; k = 1, 2, ..., K – numbers of recognition variants $\delta(x)$; $L(i, k)$ – information loss while assessment of i class as k class; $P(i)$ – known as a priori probabilities of classes; $p(x/i)$ – known as a priori density of probability of each class.

So, it goes about determination of the distances between points in the space of images. And belonging of the given implementation to one or another class is determined by the distance between the reference point and the one that was submitted for classification. Implementations that belong to one class create a compact area in the space of system parameters. The following index is used in the capacity of generalized distance:

$$L = \sum_{i=1}^{n} \left| x_i - x_i^* \right|, \quad i = \overline{1, n}, \tag{13}$$

where i – the number of indication; x_i – numerical quantity of i indication; x_i^* – numerical quantity of i indication for reference expert.

The quantity L can be standardized in such way

$$L_j^* = \frac{L_j}{L_{\max j}}, \tag{14}$$

which makes its analysis more convenient. Then, considering (9), let's introduce the standard of determining the admissibility of examinees' opinions:

$$L_j^* \le 1{,}1 \cdot \vec{L}^*, \tag{15}$$

where $\vec{L}^*$ – mean error:

$$\vec{L}^* = \frac{\sum_{j=1}^{m} L_j^*}{m}. \tag{16}$$

The approach has been adapted to determine the homogeneity of expert opinion in the educational, economic and technical fields of research [8; 22; 23; 28 – 31]. And if for any sample of experts we identify those with marginal opinions according to the formulas (13) – (16), calculate the Kendall's coefficient of concordance, getting rid of them (opinions), and check it for statistical reliability, then, these procedures should be gradually, iteratively, repeated for each new reduced according to the criterion (15) selection, until the condition (6) is fulfilled. The above corresponds to the algorithm which is presented in fig. 1. So, applying procedures (13) – (16) to individual PS (m = 172) of students, we obtain the following transformation of these formulas:

$$L_j = \sum_{i=1}^{n=21} \left| r_{ij} - r_i \right|; \tag{17}$$

$$L_j^* = \frac{L_j}{L_{\max j} = L_2 = 175}. \tag{18}$$

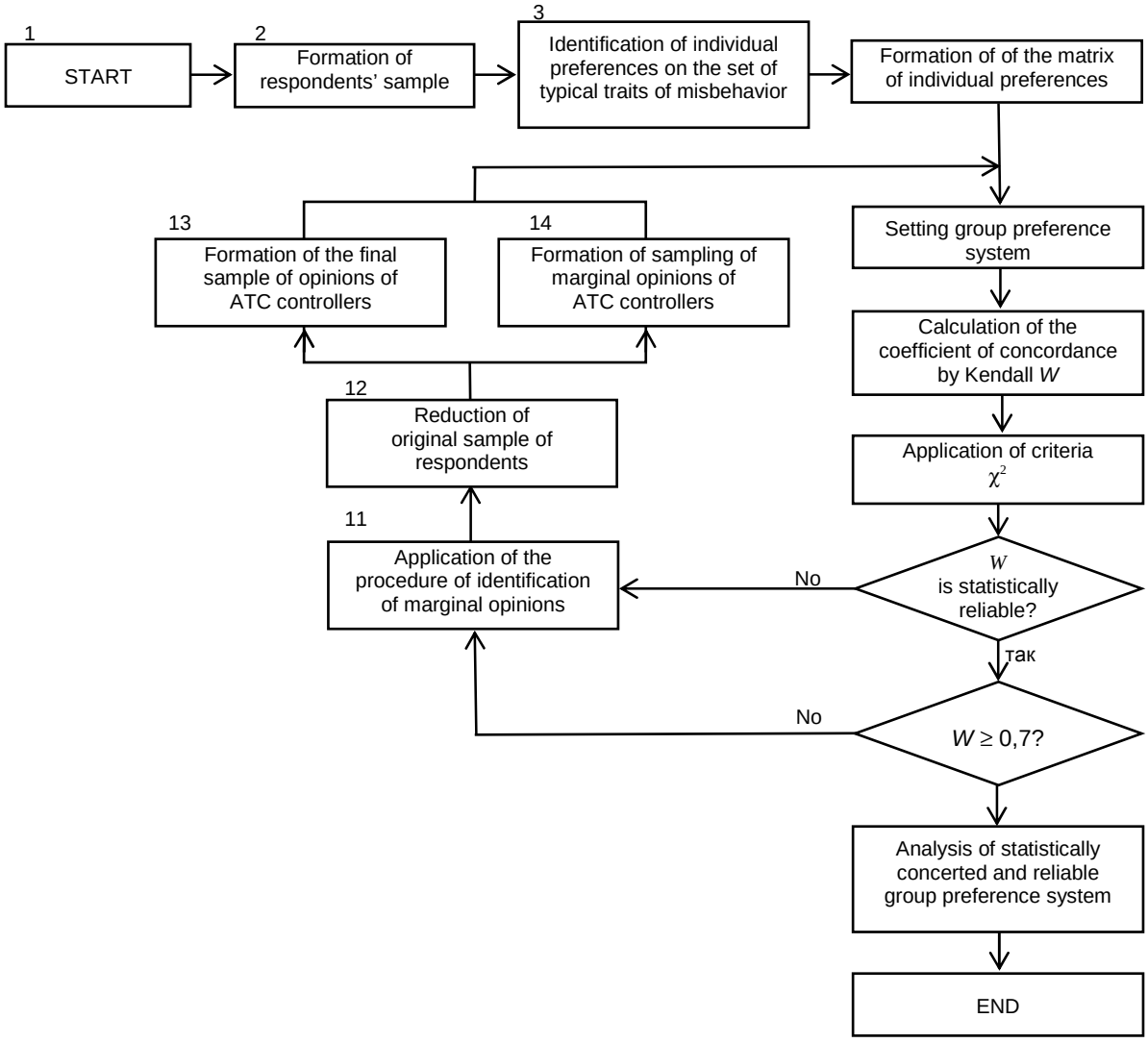

Fig. 1. Multistep iterative algorithm for detecting a group preferences system of students on the set of typical traits of misbehavior

The results of calculations according to formulas (17), (18) are presented in the penultimate and last line of the table 2. They show that $\vec{L}^* = 0,57$. Then, the standard (15) of the admissibility of opinions of respondents will have the following form:

$$L_j^* \le 1,1 \cdot 0,5757 = 0,63. \qquad (19)$$

Figure 2 shows a histogram that gives a visual representation of the distribution of the normalized deviations of opinions of students about the significance of TTM from mean group opinion.

According to the results of calculations that were conducted, it was found that the number of students with marginal thoughts is m_{marg} = 66 people. That is why they were excluded from further consideration. And for m = 106 students who remained, all previous treatments were repeated. The calculated empirical coefficient of concordance for this reduced sample does not satisfy the requirement (6): $W_{m=106}$ = 0,4292 < 0,7, so iterative procedure of identifying more homogeneous opinions about the significance TTM for students is continuing. Column 2, 3 in table 3 give a visual representation of the dynamics of the algorithm that is presented in fig. 1. Thus, the original sample of examinee is reduced to m = 36 people, whose opinions about the significance of TTM when generalizing create statistically reliable group PS, concordance of which satisfies condition (8):

$$H_3 \underset{m=36}{\succ} H_1 \underset{m=36}{\succ} H_{12} \underset{m=36}{\succ} H_2 \underset{m=36}{\succ} H_{11} \underset{m=36}{\succ} H_{19} \underset{m=36}{\succ} H_{18} \underset{m=36}{\succ} H_8 \underset{m=36}{\succ} H_4 \underset{m=36}{\succ} H_{16} \underset{m=36}{\succ}$$
$$\underset{m=36}{\succ} H_{10} \underset{m=36}{\succ} H_{13} \underset{m=36}{\succ} H_7 \underset{m=36}{\succ} H_{15} \underset{m=36}{\succ} H_5 \underset{m=36}{\succ} H_6 \underset{m=36}{\succ} H_{17} \underset{m=36}{\succ} H_9 \underset{m=36}{\succ} H_{20} \underset{m=36}{\succ} H_{14} \underset{m=36}{\succ} H_{21}, \quad (20)$$

where $\underset{m=36}{\succ}$ is a denotation of preference of one of the TTM over another in the generalized opinions of students of the main group.

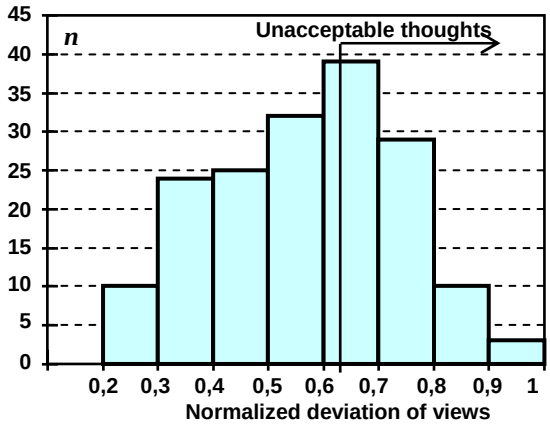

Fig. 2. The histogram of distribution of the normalized deviation of students' opinions about the significance of the set of typical misbehavior in comparison with the mean group opinion

Table 3

The dynamics of multistep procedures for identifying students' marginal opinions about the significance of the misbehavior traits

Iterations	The main group			The marginalized group		
	Number, *m*	Coefficient of concordance, *W*	χ^2_{emp}	Number, *m*	Coefficient of concordance, *W*	χ^2_{emp}
1	2	3	4	5	6	7
I	172	0,2383	819,724	136	0,1803	490,414
II	106	0,4281	907,624	97	0,3030	587,8
III	57	0,6550	746,724	71	0,3920	556,695
IV	36	0,7988	575,132	51	0,4833	492,986
V	–	–	–	34	0,5532	376,154
VI	–	–	–	26	0,6102	317,316
VII	–	–	–	20	0,6567	262,661
VIII	–	–	–	15	0,6924	207,712
IX	–	–	–	8	0,7786	124,571
NOTE: terms of reliability of concordance coefficient $\chi^2_{emp} \gg \chi^2_{table} = \chi^2_{20;\ 0,2\%} = 45,31$						

In this case (see table 3) 136 students' opinions were assigned to marginal at the beginning. Applying the same procedures to them which are provided by the algorithm in fig. 1, there have been nine consecutive iterations consistently held, which helped to reduce the specified sample of marginal-students up to m = 8 persons. And it is specially for them statistically reliable GPS is obtained that satisfies condition (8):

$$H_4 \underset{m=8}{\succ} H_3 \underset{m=8}{\succ} H_{14} \underset{m=8}{\succ} H_{17} \underset{m=8}{\succ} H_{13} \underset{m=8}{\succ} H_8 \underset{m=8}{\succ} H_2 \underset{m=8}{\succ}$$
$$\underset{m=8}{\succ} H_6 \underset{m=8}{\succ} H_{16} \underset{m=8}{\succ} H_{10} \underset{m=8}{\succ} H_{12} \underset{m=8}{\succ} H_7 \underset{m=8}{\succ} H_{15} \underset{m=8}{\succ} H_5 \underset{m=8}{\succ}, \quad (21)$$
$$\underset{m=8}{\succ} H_1 \underset{m=8}{\succ} H_{11} \underset{m=8}{\succ} H_{19} \underset{m=8}{\succ} H_{18} \underset{m=8}{\succ} H_{20} \underset{m=8}{\succ} H_9 \underset{m=8}{\succ} H_{21}$$

where $\succ_{m=8}$ is a denotation of group preference in the PS of marginal-students.

Figure 3 visualizes representation of a match/no match of students' opinions of basic and marginal groups on the significance of TTM. And since the received empirical value of the Spearman's rank correlation coeficient R_S = 0,187 is not statistically reliable, then it goes about different GPS, in which coincidence of opinions (sameness or proximity of values of ranks of TTM) is accidental and no coincidence – is regular. In the same time clarification of the question, which one is "correct", is possible only after their comparison with the group PS of instructors. Obtaining statistically probable GPS of students of the main (20) and marginal (21) groups opens new perspectives for the application of classical DM criteria for the assessment of the risks in decisions on the final PS.

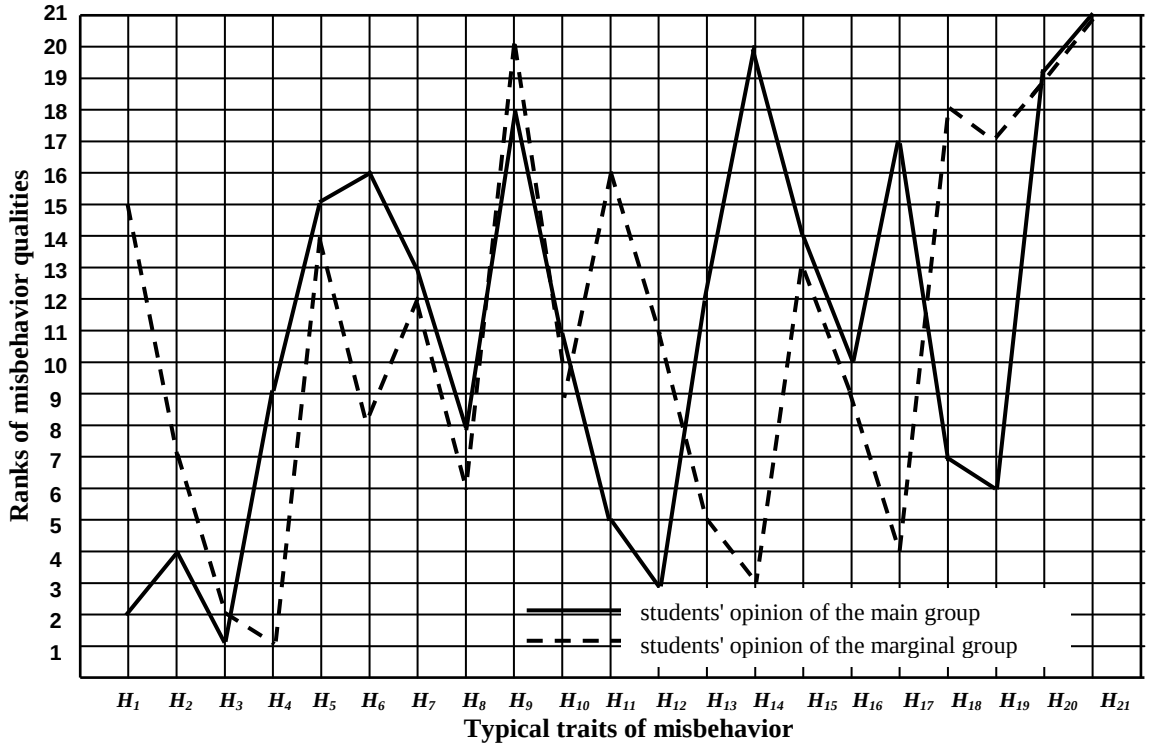

Fig. 3. Comparison of generalized preferences of students of basic and marginal groups on the set of typical traits of misbehavior

Conclusions. Summing up the obtained and presented in this article new research results, the following most significant positions should be noted.

1. The procedure of nonparametric marginal detection of expert opinions, which is based on the methods of pattern recognition theory, has been developed. The procedure underlies in the multistep procedure of obtaining of statistically reliable GPS of experts, the concordance of which meets the criteria value of the Kendall's concordance coefficient.

2. The application of the procedure is illustrated on the example of the students GPS on the set of TTM. It has been found that their initial sample of m = 172 students should be reduced to the quantitative composition of m = 36 persons. Among m = 136, which were conventionally referred to marginals, through the implementation of nine successive iterative procedures it was found that there are only m_{marg} = 8 persons with statistically concerted GPS. In the same time, the found GPSs do not coinside, since Spearman rank correlation quotient has a small absolute value of R_S = 0,187 and is not statistically reliable.

3. Further studies on the improvement of EP should be made in the areas of application of classical DM criteria for nonparametric detection of GPS of experts.

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В. В. Камишин

Реалізація багатокрокової процедури формування статистично-узгодженої групової системи переваг

Ураховуючи те, що узгоджена групова система переваг – це найбільш розповсюджений спосіб здійснення об'єктивного вибору, та орієнтуючись на встановлене мінімально-необхідне критеріальне значення коефіцієнта конкордації за Кендалом, розроблено багатокрокову процедуру послідовного відкидання маргінальних думок, виявлення яких відбувається за допомогою методів теорії розпізнавання образів. Прикладом застосування процедури є побудова групової системи переваг студентів на множині характерних рис недисциплінованості.

В. В. Камышин

Реализация многошаговой процедуры формирования статистически согласованной групповой системы предпочтений

Учитывая, что согласованная групповая система предпочтений – это наиболее распространенный способ проведения объективного выбора, и, ориентируясь на установленное минимально-необходимое критериальное значение коэффициента конкордации по Кендаллу, разработана многошаговая процедура последовательного отбрасывания маргинальных мнений, выявление которых осуществляется методами теории распознавания образов. Примером применения процедуры является построение групповой системы предпочтений студентов на множестве характерных черт недисциплинированности.