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Special software for expert's competence evaluation

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Abstract

Possibilities of offered software for the quantitative evaluation of expert's competence with the use of methodologies based on method of analysis of hierarchies and taking into account the data uncertainties are considered. Application of such special software allows promoting reliability of determination of level of expert's competence and more reasonably to do the choice of the most competent from them for forming groups of experts in the different fields of activities.

Keywords: EXPERT, COMPETENCE OF EXPERT, SOFTWARE, EVALUATION, METHODOLOGY

The evaluations of expert's competence are conducted in various fields of activities of modern society with the aim of receipt of independent information on the competence of expert. A receipt of reliable evaluations is based on different questionnaire for experts. For this purpose, it is necessary correctly to prepare down questionnaires for experts that attract for research or realization of scientific and technical examination on certain questions [1–4]. The increase of reliability of evaluations of expert competence is assisted by development of both algorithm of such evaluation and development of the special software for automation and simplification of such evaluation.

In [5] methodology of competence evaluation of experts is offered on the basis of Analytic Hierarchy Process (AHP) [6]. A methodology belongs to the field of comparative evaluation of competence level of experts in various fields of activities and qualified forming of expert group of certain competence. A task in relation to determination of expert competence with application of AHP decides by means of three hierarchical levels: the first (overhead) level of hierarchy answers the aim of task – to define the competence of experts; the second level contains criteria after that the expert competence is determined; at third (lower) level is an expert (expert group), the competence of that is necessary to be defined or compared. The result of realization of the offered methodology is a quantitative evaluation of expert's competence by means of establishment of necessary level of competence [5, 7–9].

On the basis of the indicated methodology authors

worked out the software “Competence AHP 1.1”. The environment of development of this software is Borland C Builder 6.0. The working algorithm of this

software is brought around to Figure 1. In “Window 1” of software “Competence AHP 1.1”, criteria are entered after the competence of experts, who will be evaluated, is appraised. In “Window 2” of software values of select criteria are entered (for example, K1 is education; K2 is general experience of work; K3 is experience in the field of certain activity; K4 is experience of expert in the field of certain activity; K5 is held a position), after that the competence of experts will be appraised for their pairwise comparisons. The numerical values of criteria are set from 1 to 9.

Verification of consistency of global priorities comes true after the expected values of relations of consistency C_d [5]. Insertion of criteria recurs in case of non-fulfillment of consistency condition, and in case of its implementation – work of the program proceeds after a next step.

In “Window 3” – “Window 7” of software in relation to pairwise comparisons of experts (Figure 2) concrete values are entered for all select criteria for each of the compared experts. The numerical values of select criteria are also set from 1 to 9.

In “Window 8” of software the results of got evaluation are represented: results of pairwise comparisons for criteria (vectors of priorities for criteria; maximal actually number; index of consistency and relation of consistency) and results of pairwise comparisons for experts (vectors of priorities for criteria; maximal actually number; index of consistency and relations of consistency) [5].

Standardization

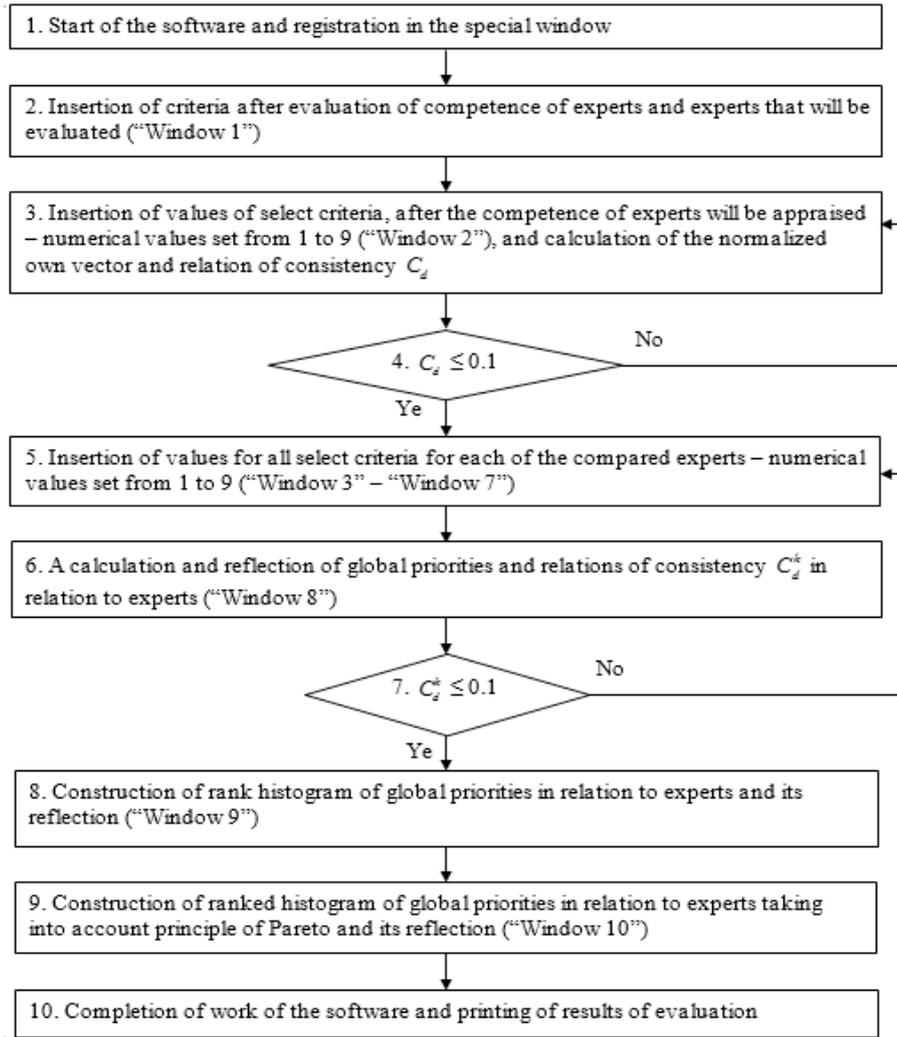


Figure 1. The working algorithm of software “Competence AHP 1.1”

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20
E1	1.000	1.000	5.000	5.000	5.000	5.000	3.000	5.000	3.000	3.000	5.000	3.000	1.000	5.000	5.000	3.000	3.000	3.000	3.000	5.000
E2	1.000	1.000	5.000	5.000	5.000	5.000	3.000	5.000	3.000	3.000	5.000	3.000	1.000	5.000	5.000	3.000	3.000	3.000	3.000	5.000
E3	0.200	0.200	1.000	1.000	1.000	1.000	0.333	1.000	0.333	0.333	1.000	0.333	0.200	1.000	1.000	0.333	0.333	0.333	0.333	1.000
E4	0.200	0.200	1.000	1.000	1.000	1.000	0.333	1.000	0.333	0.333	1.000	0.333	0.200	1.000	1.000	0.333	0.333	0.333	0.333	1.000
E5	0.200	0.200	1.000	1.000	1.000	1.000	0.333	1.000	0.333	0.333	1.000	0.333	0.200	1.000	1.000	0.333	0.333	0.333	0.333	1.000
E6	0.200	0.200	1.000	1.000	1.000	1.000	0.333	1.000	0.333	0.333	1.000	0.333	0.200	1.000	1.000	0.333	0.333	0.333	0.333	1.000
E7	0.333	0.333	3.000	3.000	3.000	3.000	1.000	3.000	1.000	1.000	3.000	1.000	0.333	3.000	3.000	1.000	1.000	1.000	1.000	3.000
E8	0.200	0.200	1.000	1.000	1.000	1.000	0.333	1.000	0.333	0.333	1.000	0.333	0.200	1.000	1.000	0.333	0.333	0.333	0.333	1.000
E9	0.333	0.333	3.000	3.000	3.000	3.000	1.000	3.000	1.000	1.000	3.000	1.000	0.333	3.000	3.000	1.000	1.000	1.000	1.000	3.000
E10	0.333	0.333	3.000	3.000	3.000	3.000	1.000	3.000	1.000	1.000	3.000	1.000	0.333	3.000	3.000	1.000	1.000	1.000	1.000	3.000
E11	0.200	0.200	1.000	1.000	1.000	1.000	0.333	1.000	0.333	0.333	1.000	0.333	0.200	1.000	1.000	0.333	0.333	0.333	0.333	1.000
E12	0.333	0.333	3.000	3.000	3.000	3.000	1.000	3.000	1.000	1.000	3.000	1.000	0.333	3.000	3.000	1.000	1.000	1.000	1.000	3.000
E13	1.000	1.000	5.000	5.000	5.000	5.000	3.000	5.000	3.000	3.000	5.000	3.000	1.000	5.000	5.000	3.000	3.000	3.000	3.000	5.000
E14	0.200	0.200	1.000	1.000	1.000	1.000	0.333	1.000	0.333	0.333	1.000	0.333	0.200	1.000	1.000	0.333	0.333	0.333	0.333	1.000
E15	0.200	0.200	1.000	1.000	1.000	1.000	0.333	1.000	0.333	0.333	1.000	0.333	0.200	1.000	1.000	0.333	0.333	0.333	0.333	1.000
E16	0.333	0.333	3.000	3.000	3.000	3.000	1.000	3.000	1.000	1.000	3.000	1.000	0.333	3.000	3.000	1.000	1.000	1.000	1.000	3.000
E17	0.333	0.333	3.000	3.000	3.000	3.000	1.000	3.000	1.000	1.000	3.000	1.000	0.333	3.000	3.000	1.000	1.000	1.000	1.000	3.000
E18	0.333	0.333	3.000	3.000	3.000	3.000	1.000	3.000	1.000	1.000	3.000	1.000	0.333	3.000	3.000	1.000	1.000	1.000	1.000	3.000
E19	0.333	0.333	3.000	3.000	3.000	3.000	1.000	3.000	1.000	1.000	3.000	1.000	0.333	3.000	3.000	1.000	1.000	1.000	1.000	3.000
E20	0.200	0.200	1.000	1.000	1.000	1.000	0.333	1.000	0.333	0.333	1.000	0.333	0.200	1.000	1.000	0.333	0.333	0.333	0.333	1.000

Figure 2. . View of window “Matrixes of pairwise comparisons of experts” of software “Competence AHP 1.1”

Verification of consistency of global priorities comes true after the expected values of relations of consistency C_d^k [5]. In case of non-fulfillment of terms of consistency insertion of data recurs in relation to experts, and in case of its implementation – work of the program proceeds after a next step.

In “Window 9” of software the histogram of ranked results of global priorities is built in relation to experts. For the selection of experts principle of Pareto is used with the use of Lorenz curve [8]. In “Window 10” of software the histogram of ranked results of evaluation is built for experts with the use of marked principle of Pareto (Figure 3). According to

results, evaluation of one of experts has an unsatisfactory competence (it is inundated by yellow).

Work of the software is thereon completed and the results of the conducted evaluation are printed.

In [9, 10] methodology of evaluation of expert’s competence is offered taking into account descriptions of data uncertainties that belong to the field of comparative evaluation of level of expert’s competence in various fields of activities. For realization of the offered methodology, corresponding criteria are set for the point evaluation of expert’s competence of certain field of activity.

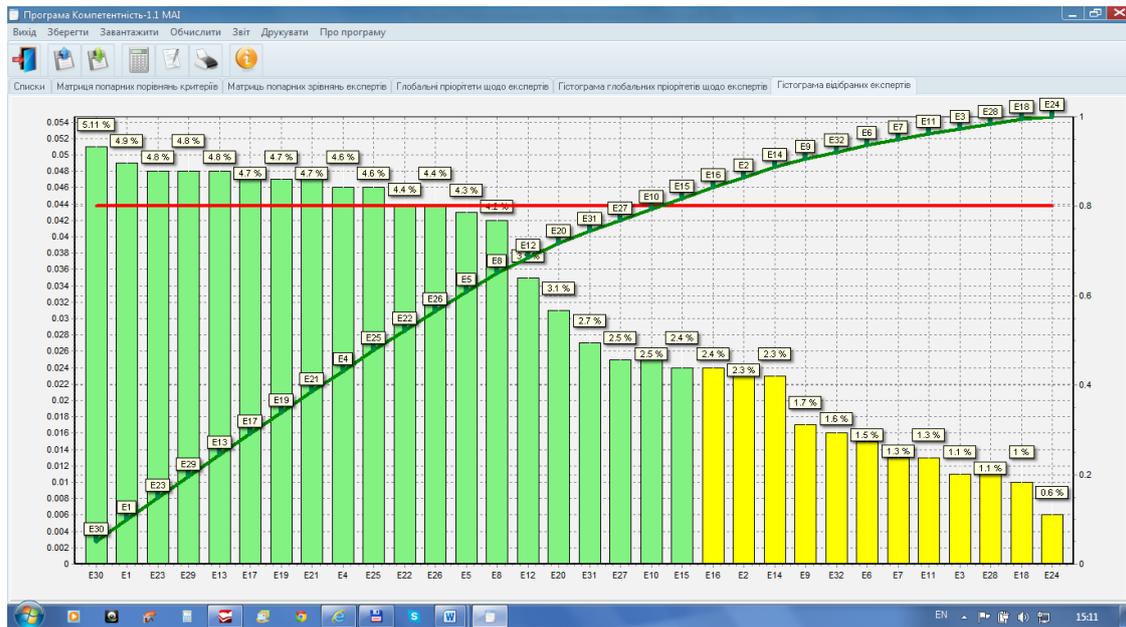


Figure 3. View of window “Histogram of selected experts” of software “Competence AHP 1.1”

In this methodology the special algorithm of calculation of row of mathematical indexes is used for every expert, and also reference value of evaluation and its total standard uncertainty. The result of its realization is a quantitative evaluation of expert’s competence by means of establishment of necessary level of competence taking into account the data uncertainties. For the eventual forming of group of experts except χ^2 -criterion, principle of Pareto can also be applied [8].

Based on the indicated methodology authors worked out the software “Competence UD 1.0”. The environment of development of this software is Borland C Builder 6.0. The working algorithm of this software is brought around to Figure 4.

In “Window 1” of software experts, who are going to be evaluated, are entered, and criteria are brought and after that their competence will be appraised taking into account of data uncertainties (for example,

K1 is education; K2 is general experience; K3 is experience in the field of certain activity; K4 is experience of expert in the field of certain activity; K5 is held a position). In “Window 2” of software true choice of necessary descriptions in relation to select criteria for each of experts comes (Figure 5).

In “Window 3” of software numerical results of evaluation for each of experts are brought: average values, relative average values and normalized average values numerical score, total standard uncertainties for every expert on all criteria, reference value and its total standard uncertainty; consistency of the obtained data.

Verification of consistency of the obtained data comes true in relation to experts with application of χ^2 -criterion [9, 10] at the level of trust 0.01 after the preliminary expected values of criterion for every expert (M is a common amount of experts that is evaluated). In case of non-fulfillment of terms of consis-

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tency insertion of data recurs in relation to experts, proceeds after a next step. and in case of its implementation –

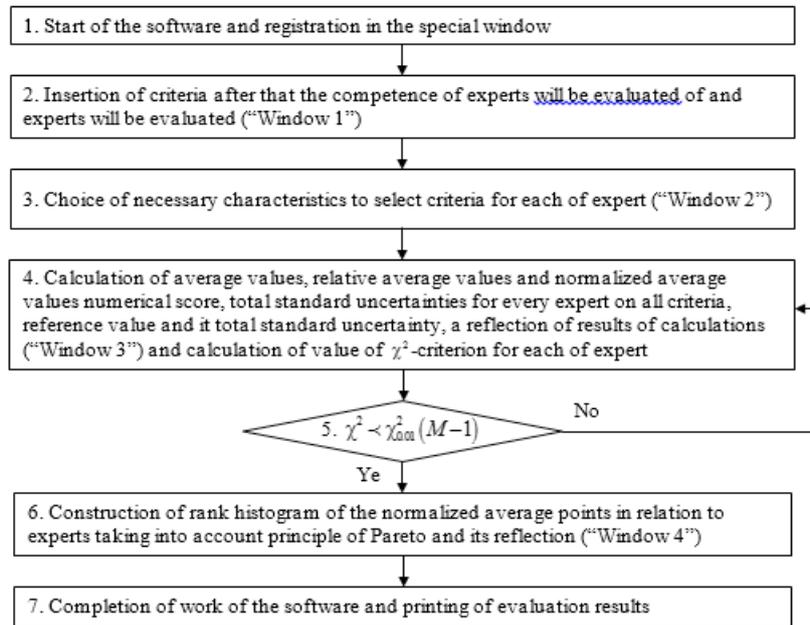


Figure 4. The working algorithm of software “Competence UD 1.0”

Эксперти	K1	K2	K3	K4	K5	середній бал	відносний середній бал	нормований середній бал	загальна стандартна не
1	докторантура	більше 25 років	більше 20 років	більше 15 років	керівник (заступник кері 8.800	0.038	1.000	0.00000	
2	докторантура	більше 25 років	від 10 до 15 років	від 10 до 15 років	керівник (заступник кері 8.200	0.035	0.932	0.00682	
3	вища (спеціаліст/магістр: від 10 до 12 років	більше 25 років	від 8 до 10 років	від 8 до 10 років	керівник (заступник кері 5.800	0.025	0.659	0.03409	
4	вища (спеціаліст/магістр: більше 25 років	більше 25 років	більше 20 років	більше 15 років	керівник (заступник кері 7.800	0.034	0.886	0.01136	
5	вища (спеціаліст/магістр: більше 25 років	більше 25 років	більше 20 років	більше 15 років	керівник (заступник кері 7.800	0.034	0.886	0.01136	
6	вища (спеціаліст/магістр: більше 25 років	від 10 до 15 років	від 10 до 15 років	від 10 до 15 років	провідний інженер	6.400	0.028	0.727	0.02727
7	аспірантура	більше 25 років	від 5 до 8 років	від 5 до 8 років	провідний інженер	6.000	0.026	0.682	0.03182
8	вища (спеціаліст/магістр: більше 25 років	більше 25 років	більше 20 років	більше 15 років	науковий співробітник	7.400	0.032	0.841	0.01591
9	аспірантура	більше 25 років	від 8 до 10 років	від 8 до 10 років	науковий співробітник	6.800	0.029	0.773	0.02273
10	аспірантура	більше 25 років	від 10 до 15 років	від 10 до 15 років	керівник (заступник кері 8.000	0.034	0.909	0.00909	
11	вища (спеціаліст/магістр: більше 25 років	більше 25 років	від 8 до 10 років	від 8 до 10 років	провідний інженер	6.000	0.026	0.682	0.03182
12	аспірантура	більше 25 років	більше 20 років	від 5 до 8 років	керівник (заступник кері 7.600	0.033	0.864	0.01364	
13	докторантура	більше 25 років	більше 20 років	більше 15 років	керівник (заступник кері 8.600	0.037	0.977	0.00227	
14	вища (спеціаліст/магістр: від 15 до 18 років	більше 25 років	від 10 до 15 років	від 8 до 10 років	керівник (заступник кері 6.400	0.028	0.727	0.02727	
15	вища (спеціаліст/магістр: від 15 до 18 років	більше 25 років	від 15 до 20 років	від 10 до 15 років	науковий співробітник	6.400	0.028	0.727	0.02727
16	аспірантура	більше 25 років	від 10 до 15 років	від 10 до 15 років	керівник (заступник кері 8.000	0.034	0.909	0.00909	
17	аспірантура	більше 25 років	більше 20 років	більше 15 років	керівник (заступник кері 8.200	0.035	0.932	0.00682	
18	аспірантура	від 5 до 10 років	від 5 до 8 років	від 5 до 8 років	науковий співробітник	5.200	0.022	0.591	0.04091
19	аспірантура	більше 25 років	більше 20 років	більше 15 років	керівник (заступник кері 8.200	0.035	0.932	0.00682	
20	вища (спеціаліст/магістр: більше 25 років	більше 25 років	від 10 до 15 років	від 10 до 15 років	керівник (заступник кері 7.600	0.033	0.864	0.01364	
21	аспірантура	більше 25 років	більше 20 років	більше 15 років	керівник (заступник кері 8.200	0.035	0.932	0.00682	
22	вища (спеціаліст/магістр: більше 25 років	більше 25 років	більше 20 років	більше 15 років	керівник (заступник кері 7.600	0.033	0.864	0.01364	
23	докторантура	більше 25 років	більше 20 років	більше 15 років	науковий співробітник	8.200	0.035	0.932	0.00682
24	вища (спеціаліст/магістр: від 10 до 12 років	більше 25 років	від 3 до 5 років	від 3 до 5 років	провідний інженер	4.200	0.018	0.477	0.05227

Figure 5. View of window “Data concerning experts” of software “Competence UD 1.0”

For the selection of experts, principle of Pareto is used applying Lorenz curve [8]. In “Window 4” of software histograms of ranked results of evaluation of experts with the use of the marked principle of Pareto (Figure 6) are built. According to results the conducted evaluation of ten experts has an unsatisfactory competence (it is inundated by yellow).

For realization of evaluation of expert’s competence it is possible to apply universal software for statistical analysis, in particular IBM SPSS Statistics 20 (Figure 7) and Microsoft Excel 2010 (Figure 8). As

results it is possible to get the results of such evaluation with application of the same criteria of evaluation, as well as in the described specialized software. However, it requires both the special insertion of the marked criteria and limits a resulting evaluation of only simple average arithmetic or frequency on all criteria for every expert without corresponding rank of got results.

The special software for the evaluation of expert’s competence considerably simplifies realization of such evaluation, promote its reliability and have a row

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of advantages in relation to application of universal statistical software. Their combination allows carry out the selection of the most competent experts for

forming of group from the evaluation of certain problem questions in certain fields of activities more reasonably.



Figure 6. View of window “Histogram of selected experts” of software “Competence UD 1.0”

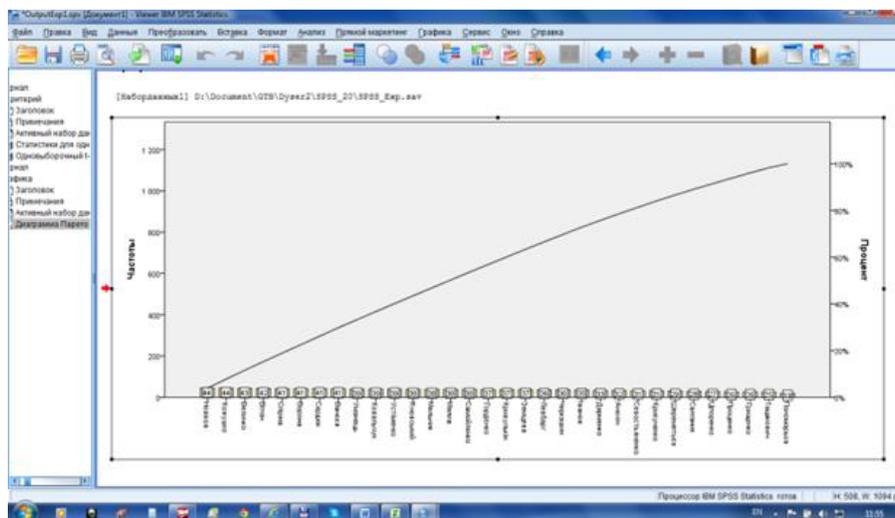


Figure 7. View of results in window of software IBM SPSS Statistics 20

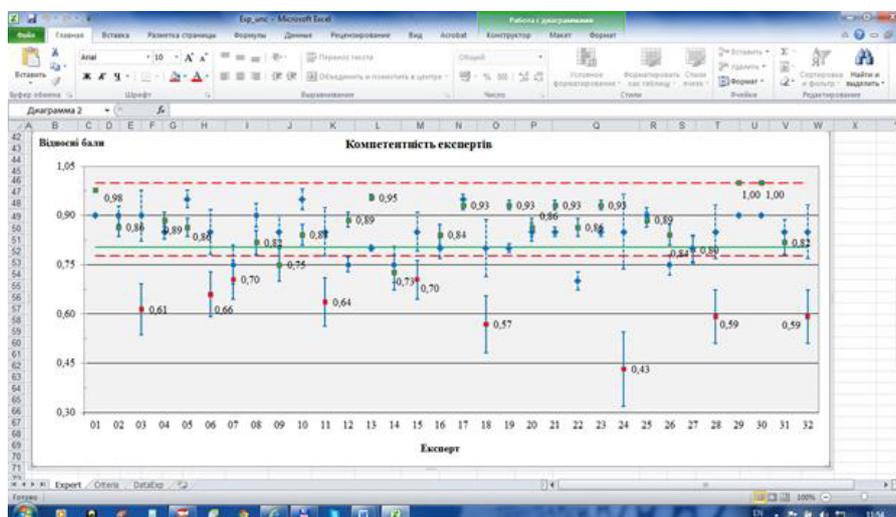


Figure 8. View of results in window of software Microsoft Excel 2010

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