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THE METHOD OF PROFESSIONAL KNOWLEDGE ESTIMATION RESULTS RELIABILITY ANALYSIS

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The Method of Professional Knowledge Estimation Results Reliability Analysis
The methodology determining the validity of the results obtained during the forming stage of the experiment to assess the professional knowledge of the respondents, and sample testing of hypotheses involved are given. The methodology will be useful for postgraduate students and young scientists.
Key words: experiment, variation series, probability analysis, sample, array of values, scale of intervals.

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Every research work requires generalization of results collected after research process. Scientists studying and analyzing represented sample data set can make conclusions about research or students knowledge level under the implementation of new methods of teaching. That is the reason why ordering analysis results realization of student's professional knowledge estimation analysis results of the evaluation with the help of probability sample is very important.

The purpose of the assessment results analysis is obtaining a small amount of key (the most informative) parameters that give an objective and accurate picture of learning groups – professional knowledge and skills, learned during the course. Selective observation is the most common of all types not overall observation. During the sample observation study not all units of the object are studied, but only some part of these selected units. However, observation is organized in such a way that the part of the selected items reflected the whole set but in a reduced scale. Advantages of sampling method lie in the fact that its use enables to organize observation better, provides researching in minimized terms with minimal working and financial inputs. [3, 4, 5].

The purpose of the article is to bring the procedures and algorithms of method for determining the probability of results obtained during the formative stage of the evaluation of professional knowledge of the respondents to the attention of young scientists and graduate students.

Mathematical processing of the results of forming stage experiment is conducted for additional testing of the main hypothesis of the study.

Statistical analysis or parameters estimation of distribution starts with experimental data samples transformation to the type of a number variations. If as a result of the experiment a sample of any size array of values is received, for example, $u_{min}, u_1, u_2, u_3, \ldots u_{max}$, then:

- to build a number variations of interval it is necessary to define value range due to the sample,
- establish full scale ranges
- according to the chosen intervals scale to group values of sample.

To determine the optimal size of the interval h, or the one where the interval number would not be too cumbersome and at the same time would allow to identify the characteristics of the situation that is under study, Sturges formula can be used:

$$h=(u_{max} - u_{min})/(1 + 3,322\ell gn),$$

where $u_{\max}$, $u_{\min}$ are the highest and lowest values in some samples; n is total number of sample units.

If h is a fractionary number, it is rounded to the nearest integer or to the nearest simple fraction.

As the beginning of the first interval amt $u_{min} - h/2$ is taken .

In this case if a_i is the beginning of $_i$ interval, the interval variation range is $a_1 = u_{min} - h / 2,\ a_2 = a_1 + h;\ a_3 = a_2 + h$ etc.

Construction of intervals continues until the beginning of next following order of the interval will be equal or higher than $u_{\max}$.

- Determination of the number of sample units n_i that got in each halfivinterval (u_{i-1}, u_i) and relative rate of including of random value to corresponding halfinterval $P_i = n_i/n$.
- Variation range is shaped as a table and the sample units that were included to $_i$ interval are given the values $u^*_i = (u_{i-1} + u_i)/2$.

Table 1

Variations range probability distribution

i	(u_{i-1}, u_i)	u^*_i	n_i	P_i
1	$(u_{мін}, u_1)$	u^*_i	n_1	P_1
2	(u_1, u_2)	u^*_2	n_2	P_2
3	(u_2, u_3)	u^*_3	n_3	P_3
4	(u_3, u_4)	u^*_4	n_4	P_4
5	(u_4, u_5)	u^*_5	n_5	P_5
$к$			$\Sigma = n$	$\Sigma = 1$

- Variation range is provided in the form of graphics-histograms Fig. 1, that is empirical or random probability distribution, where the vertical axis lays value P_i / h_i And on the horizontal axis – u^*_i. For the total number of elements of the sample n^*_i that got in the interval h, the probability P_i is considered the same, so the histogram is composed of rectangles.

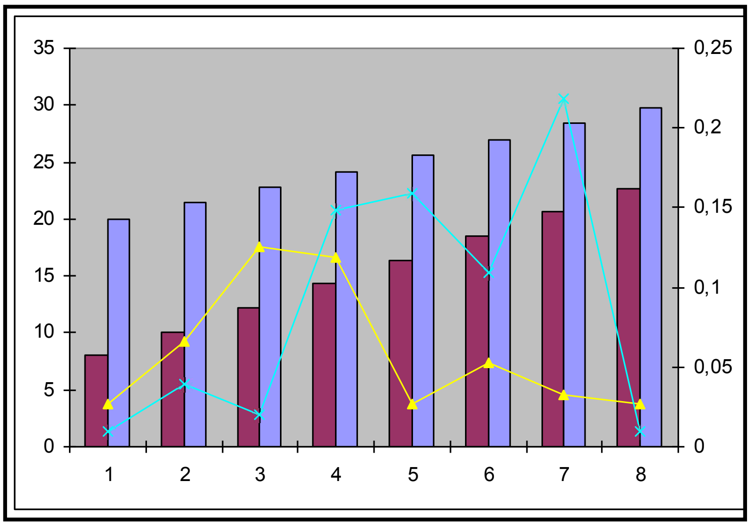

Fig.1 Graphic-histogram of probability distribution

After building a variation range assessment of mathematical expectation of the true quantity value is calculated

$$\bar{u} = \frac{1}{n}\sum_{i=1}^{k} u_i^* n_i = \sum_{i=1}^{k} u_i^* P_i$$

When calculating variance estimation or mean square deviation the value ū is taken with the same number of characters as the value of u_i. Estimation of the variance is

$$S^2 = \frac{1}{n-1}\sum_{i=1}^{k} n_i (u_i^* - \bar{u})^2 = \frac{n}{n-1}\sum_{i=1}^{k} (u_i^* - \bar{u})^2 P_i$$

or for the first interval

$$S_1^2 = \frac{n}{n-1}\left(u_1^* - \bar{u}\right)^2 P_1$$

After calculating variance evaluations it is necessary to examine the degree of their accuracy and reliability. To do this, find the following numbers $\Delta\bar{u}$, in which confidence interval ($\bar{u}-\Delta\bar{u};\ \bar{u} + \Delta\bar{u}$) will cover the unknown true valuation size of variation range $\bar{u}$ with quite high probability of P. This interval is called a confidence with probability confidence P.

Assuming that the initial sudden value u_i has a normal rule of distribution, we can construct a confidence interval for obtaining evaluations of expectation m_i estimated in this case using the average arithmetic value $\bar{u}$, and dispersion general totality, estimated using the sample variance S^2.

Construction of confidence interval for mathematical expectation m_i is based on the determination by a Student's distribution tables number $t_{q\upsilon}$,where interval $(\bar{u} - t_{qv}\frac{S}{\sqrt{n}};\bar{u} + t_{qv}\frac{S}{\sqrt{n}})$ is the confidence interval, which corresponds to a confidence level of probability $P = 1 - \frac{q}{100}$ where q – significant valid quantity value which is chosen within (1…..5)%; $v=n-1$ – the number of degrees of freedom.

Construction of confidence interval on the variance general totality σ_x^2 based on the fact that the value

$$\frac{(n-1)S^2}{\sigma_x^2}$$

is distributed according to the law of χ^2 (xi-square) distribution by Pearson with v = *n-1* degrees of freedom. This is because in some cases it is necessary to define not the average value of the measured value and fractional - some measurements relative to this average value, which is characterized by variance distribution. In this case, the confidence interval for σ_x^2 equals

$$\left[\frac{(n-1)S^2}{\chi_2^2};\frac{(n-1)S^2}{\chi_1^2}\right].$$

Values χ_2^2 and χ_1^2 are found by the tabular data for the known extent freedom v = n-1 and the calculated value of the resulting significance level probability $P_1 = 1 - 0{,}5\frac{q}{100}$ and $P_2 = 0{,}5\frac{q}{100}$.

Defining the mathematical expectation evaluation using the average arithmetical, and the variance general totality – for the sample variance, we accept the hypothesis that the random variable obeys normal distribution rule. It is therefore necessary to examine the statistical hypotheses relative to values of general statistical characteristics and general probability distributions.

Hypothesis testing is carried out by comparing of some statistical indicators – criteria test, calculated according to the sample of values of these parameters determined theoretically by assuming that the hypothesis tested is valid.

For criteria of the checkup we choose the appropriate level of significance *(q = 10%, 5%,2%, etc.)*, which corresponds to the cases that in research are considered to be almost incredible. Later on the area of applicable criteria chance to hit which, if the hypothesis is true, exactly equals that value is defined.

If the criterion belongs to the permissible values it can be assumed that the sample data do not contradict the hypothesis.

Testing hypotheses on the identity of the expectation (m_i) is set to ($\bar{u}$), or "zero" hypothesis is done so. The previously mentioned test methods are built on the assumption that the random value distribution law shape is known and it applies only to values of this law. However, in some cases, the look of the law of normal distribution is hypothetical and needs verification. There is a need for hypothesis test criteria (according to sample) that the given value u_i subjects to the laws of distribution *F(x)*. If the criterion for the case in question extends the norm set, the hypothesis is accepted, if not – vice versa. In this case Pearson criterion (χ^2) is accepted.

If according to the sample a variational series with a number of elements n_i which came to $_i$ halfnterval is constructed, and the probability of getting value u_i to $_i$ halfivinterval is calculated using a hypothetical distribution – P_i, The Pearson criterion is formed as follows:

$$\chi^2 = \sum_{i=1}^{k} \frac{(n_i - n\widetilde{P}_i)^2}{n\widetilde{P}_i}$$

Criteria χ^2 has $v=k - \ell - 1$ degrees of freedom where ℓ is the number of parameters measured in the area of their distribution. For example, if you follow the law of normal distribution of the random variable then an assessment of its variance and expectation $\ell = 2$ is performed.

Penultimate stage of the statistical analysis of the experimental results is an alignment of the empirical probability distribution using the law of normal distribution. Because the sample does not contradict the hypothesis of normally distributed random amounts, it is advisable to express the histogram distribution using the density of the normal law of probabilities distribution:

$$f(x) = \frac{1}{\sqrt{2\pi}} \frac{1}{S} e^{\frac{-(u-\overline{u})^2}{2S^2}} = \frac{1}{S}\left[\frac{1}{\sqrt{2\pi}} e^{\frac{-(u-\overline{u})^2}{2S^2}}\right]$$

where the value in parentheses is tabulated.

At the final stage of statistical analysis a calculation of required volume of sample units (n) for obtaining a degree of evaluation of expectation with the right accuracy δ from 1% to 10% with a confidence probability $P = 0.95$, if we know the score variance S^2 calculated for one small volume of sample and one general totality. Thus, according to confidence probability *P are* F_0 *(t)* $= P/2$. The ammount of t, corresponding to this value of F_0 (t), can be found in the table. The required sample size is $n = \frac{t^2 S^2}{\delta^2}$. Obtained values are reduced to the table (δ, $\Delta\bar{u}$, n) upon the results of which we plot the dependence $n(\delta)$ and define them the right amount elements in the sample.

Example 1. Checking hypothesis H_0: state of knowledge of the respondents (students-ecologists) has not increased after the integrated course. Alternative hypothesis: respondents (students-ecologists) can enhance their professional level of English by means provided for the organization of the learning process principles of integration of the two types of activities: professionally oriented and foreign-language-speech.

1. The results of input and output tests are presented in the form of variation range of probable changes in value obtained from the experiment.

19, 11, 13, 12, 17, 15, 18, 14, 12, 22, 15, 13, 11, 14, 13, 22, 5, 13, 10, 20, 13,

17, 9, 18, 20, 13, 14, 12, 15, 8, 13, 14, 10, 13, 20, 15, 10, 14, 22, 18, 20, 18, 10, 11, 15, 8, 15, 13, 23, 13, 20, 13, 11, 13, 14, 14, 10, 13, 15, 15, 15, 10, 16, 8, 19, 18, 13, 12, 18, 13, 14, 15;

24,25, 26, 24, 26, 23, 24, 26, 26, 27, 22, 28, 27, 23, 22, 30, 26, 27, 24, 29, 28, 24, 25, 25, 25, 28, 24, 24, 27, 24, 27, 28, 29, 24, 28, 26, 27, 26, 29, 24,22, 29, 29, 24, 28, 28, 24, 26, 29, 24, 25, 28, 29, 22, 29, 20, 28, 27, 29, 28, 27, 29, 24, 28, 27, 24, 27, 26, 27, 26, 25, 28.

2. As a result of the formative stage of the experiment the obtained results of the input and output sections provided in a sample of correct responses to the 30 control questions in their native language and English, we will present them in the form of interval variation range. To construct such range we have to determine the interval value inside the sample. To determine the optimal interval size h, or one in which the interval range constructed is not so cumbersome and at the same time would allow to identify the characteristics of the phenomenon, that is under study, we use the formula of Sturges:

$$h=(U_{max} - U_{min})/(1 + 3{,}322\ell gn),$$

where $u_{\max}$, $u_{\min}$ are the highest and lowest values in some samples; n is total number of sample units.

$$h_1 = (23 - 8) / (1+3{,}322 \lg 72) = 2{,}09 \sim 2{,}1;$$

$$h_2 = (30–20) / (1+3,322 \lg 72) = 1,39 \sim 1,4;$$
$$a_1 = U_{min.} – h/2$$
$$a_2 = a_1 + h;$$
$$a_3 = a_2 + h;$$
$$\dots\dots\dots\dots$$
$$a_n = a_{n+1} + h.$$

Construction of interval range lasts as long as the start of following interval will be equal to or greater than U_{max} (input test – a_i, output test – b_i)

$a_1 = 8 – 1,05 = 6,95;$	$b_1 = 20 – 0,7 = 19,3;$
$a_2 = 6,95 + 2,1 = 9,05;$	$b_2 = 19,03 + 1,4 = 20,70;$
$a_3 = 9,05 + 2,1 = 11,15;$	$b_3 = 20,70 + 1,4 = 22,10;$
$a_4 = 11,15 + 2,1 = 13,25;$	$b_4 = 22,10 + 1,4 = 23,50;$
$a_5 = 13,25 + 2,1 = 15,35;$	$b_5 = 23,50 + 1,4 = 24,90;$
$a_6 = 15,35 + 2,1 = 17,45;$	$b_6 = 24,90 + 1,4 = 26,30;$
$a_7 = 17,45 + 2,1 = 19,55;$	$b_7 = 26,30 + 1,4 = 27,70;$
$a_8 = 19,55 + 2,1 = 21,65;$	$b_8 = 27,70 + 1,4 = 29,10;$
$a_9 = 21,65 + 2,1 = 23,75 > 23;$	$b_9 = 29,10 + 1,4 = 30,50 > 30;$

$$K = (1+3,322 \lg 72) = 7,2 \sim 8;$$
$$K_1 = 8;\ K_2 = 8.$$

3. Let’s determine the number of sample units *(n)*, *(i = 1,2.3 .... 72)* that were in each halfivinterval $(u_{i+1};\ u_i)$ and relative frequency of random amounts getting to corresponding halfivinterval $P_i = n_i/n_{i=72}$.

The number of sample units

$n_1 = 4;$	$n_1 = 1;$
$n_2 = 10;$	$n_2 = 4;$
$n_3 = 19;$	$n_3 = 2;$
$n_4 = 18;$	$n_4 = 15;$
$n_5 = 4;$	$n_5 = 16;$
$n_6 = 8;$	$n_6 = 11;$
$n_7 = 5;$	$n_7 = 22;$
$n_8 = 4;$	$n_8 = 1.$

Thus, the relative frequency of getting random amounts to each interval is:

$P_1 = 4 / 72 = 0,0556;$	$P_1 = 1 / 72 = 0,0139;$
$P_2 = 10 / 72 = 0,1389;$	$P_2 = 4 / 72 = 0,0556;$
$P_3 = 19 / 72 = 0,2639;$	$P_3 = 2 / 72 = 0,0278;$
$P_4 = 18 / 72 = 0,2500;$	$P_4 = 15 / 72 = 0,2083;$
$P_5 = 4 / 72 = 0,0556;$	$P_5 = 16 / 72 = 0,2222;$
$P_6 = 8 / 72 = 0,1111;$	$P_6 = 11 / 72 = 0,1528;$
$P_7 = 5 / 72 = 0,0694;$	$P_7 = 22 / 72 = 0,3056;$
$P_8 = 4 / 72 = 0,0556;$	$P_8 = 1 / 72 = 0,0139.$

4. Elements in the sample that are in the $_i$ interval are provided the values:

a_1= 0,5 (a1+ a2) = 8; b_1= 0,5 (b1+ b2) = 20,0;
a_2= 0,5 (a2+ a3) =10,1; b_2= 0,5 (b2+ b3) =21,4;
a_3= 0,5 (a3+ a4) =12,2; b_3= 0,5 (b3+ b4) =22,8;
a_4= 0,5 (a4+ a5) =14,3; b_4= 0,5 (b4+ b5) =24,2.

Data of variation ranges are summarized in Table 2 and Table 3.

Таблиця 2

Data of variation ranges for input test

i	$(u_{i-1}$; u)	u_i	n_i	P_i
1.	(6,95; 9,05)	8	4	0,0556
2.	(9,05; 11,15)	10,1	10	0,1389
3.	(11,15; 13,25)	12,2	19	0,2639
4.	(13,25; 15,35)	14,3	18	0,2500
5.	(15,35; 17,45)	16,4	4	0,0556
6.	(17,45; 19,55)	18,5	8	0,1111
7.	(19,55; 21,65)	20,6	5	0,0694
8.	(21,65; 23,75)	22,7	4	0,0556
k=8	–	–	72	1,0000

Таблиця 3

Data of variation ranges for output test

i	$(u_{i-1}$; u)	u_i	n_i	P_i
1.	(19,3; 20,70)	20,0	1	0,0139
2.	(20,70; 22,10)	21,4	4	0,0556
3.	(22,10; 23,50)	22,8	2	0,0278
4.	(23,50; 24,90)	24,2	15	0,2083
5.	(24,90; 26,30)	25,6	16	0,2222
6.	(26,30; 27,70)	27,0	11	0,1528
7.	(27,70; 29,10)	28,4	22	0,3056
8.	(29,10; 30,50)	29,8	1	0,0139
k=8	–	–	72	1,0000

5. Variation range served in a graph-histogram (Fig. 1) or sample of probability distribution, with $P1/h_i$ plotted along the ordinate axis and u_i – along the x-axis.

Result:

Input Test:

P_1/h_i= 0,0556/2,1 = 0,0265;

P_2/h_i= 0,1389/2,1 = 0,0661;

Output test:

P_1/h_2= 0,0139/1,4 = 0,0099;

P_2/h_i= 0,0556/1,4 = 0,0397;

$P_3/h_i = 0,2639/2,1 = 0,1257;$ $P_3/h_i = 0,0278/1,4 = 0,0199;$

$P_4/h_i = 0,25/\ 2,1 = 0,1190;$ $P_4/h_i = 0,2083/\ 1,4 = 0,1488;$

$P_5/h_i = 0,0556/2,1 = 0,0265;$ $P_5/h_i = 0,2222/1,4 = 0,1587;$

$P_6/h_i = 0,1111/2,1 = 0,0529;$ $P_6/h_i = 0,1528/1,4 = 0,1091.$

6. After building a variation range the score of mathematical expectation of the value of a quantity is calculated

$$\bar{u} = \frac{1}{n}\sum_{i=1}^{k} u_i^* n_i = \sum_{i=1}^{k} u_i^* P_i, \qquad (2)$$

for intput testing:

$$\bar{a} = 8 \cdot 0,0556 + 10,1 \cdot 0,1389 + 12,2 \cdot 0,2639 + 14,3 \cdot 0,25 + 16,4 \cdot 0,0556 + 18,5 \cdot 0,111 + \\ + 20,6 \cdot 0,0694 + 22,7 \cdot 0,0556 = 0,4448 + 1,403 + 3,220 + 3,575 + 0,9118 + 2,0554 + \\ + 1,430 + 1,262 = 14,302$$

for output testing:

$$\bar{b} = 20 \cdot 0,0139 + 21,4 \cdot 0,0556 + 22,8 \cdot 0,0278 + 24,2 \cdot 0,2083 + 25,6 \cdot 0,2222 + 27,0 \cdot 0,1528 + \\ + 28,4 \cdot 0,3056 + 29,8 \cdot 0,0139 = 0,278 + 1,1898 + 0,6338 + 5,041 + 5,6883 + 4,1256 + \\ + 8,6790 + 0,4142 = 26,05$$

7. When calculating variance estimation or mean square deviation, value ū is taken with the same number of characters as the value of u_i. Estimation of the variance is

$$S^2 = \frac{1}{n-1}\sum_{i=1}^{k} n_i (u_i^* - \bar{u})^2 = \frac{n}{n-1}\sum_{i=1}^{k} (u_i^* - \bar{u})^2 P_i \qquad (3)$$

We obtain: For test input:

$$S^2 = \frac{72}{71}[(8-14,3)^2 \cdot 0,0556 + (10,1-14,3)^2 \cdot 0,1389 + (12,2-14,3)^2 \cdot 0,2639 + \\ + (14,3-14,3)^2 \cdot 0,25 + (16,4-14,3)^2 \cdot 0,0556 + (18,5-14,3)^2 \cdot 0,1111 + \\ + (20,6-14,3)^2 \cdot 0,0694 + (22,7-14,3)^2 \cdot 0,0556\ ] = 14,91$$

for output testing:

$$S^2 = \frac{72}{71}[(20,0-26,1)^2 \cdot 0,0139 + (21,4-26,1)^2 \cdot 0,0556 + (22,8-26,1)^2 \cdot 0,0278 + \\ + (24,2-26,1)^2 \cdot 0,2083 + (25,6-26,1)^2 \cdot 0,2222 + (27-26,1)^2 \cdot 0,1528 + \\ + (28,4-26,1)^2 \cdot 0,3056 + (29,8-26,1)^2 \cdot 0,0139\ ] = 4,85$$

8. After calculating variance estimates it is necessary to examine the degree of accuracy and reliability. To do this, find the following numbers $\Delta\bar{u}$, where confidence interval ($\bar{u} - \Delta\bar{u}$; $\bar{u} + \Delta\bar{u}$) covers the unknown true value of amount of $\bar{u}$ variation range of sufficiently high probability of P. This interval is called a confidence with confidential probability P.

Considering that the initial random value u_i has a normal law of distribution, we can construct a confidence interval for obtaining estimates of mathematical expectation m_i estimated in this case using arithmetic mean of value $\bar{u}$, and for the variance general totality, estimated using the sample variance S^2

Construction of a confidence interval for mathematical expectation m_i is based on the determination by a Student's distribution table of numbers t_{qv}, in which the interval

$$(\bar{u} - t_{qv}\frac{S}{\sqrt{n}}; \bar{u} + t_{qv}\frac{S}{\sqrt{n}})$$

$$P = 1 - \frac{q}{100}$$

where q – the significance level of the actual quantity value which is chosen in range (1 ... 5)%; $v = n-1$ is the number of degrees of freedom.

Construction of a confidence interval on the variance general totality σ_x^2 based on the fact that the value

$$\frac{(n-1)S^2}{\sigma_x^2}$$

is distributed according to the law χ^2(xi – square) distribution of Pearson with $v = n-1$ degrees of freedom. Thus, for

$$\bar{a} = 14{,}3; \quad S^2 = 14{,}91; \quad S = 3{,}86$$

we construct confidence interval for mathematical expectation (m_i) With a 95% accuracy. For the Student's table for $v = 71$ and q = 100-95 = 5%, the value $t_{q,v}$ = 1,67 and confidence interval will make

$$(14{,}3 - 1{,}67 \cdot \frac{3{,}86}{\sqrt{72}}; 14{,}3 + 1{,}67\frac{3{,}86}{\sqrt{72}})$$ or (13,5; 15,06).

9. Define when q = 5% or 95% confidence interval for the variance σ_u^2 assuming that the value $\frac{(n-1)S^2}{\sigma_u^2}$ is distributed according by the law χ^2 (xi-square) distribution by Pearson with $v = n-1 = 71$ degrees of freedom.

This is because in some cases it is necessary to determine not the mean value of the measured value but low value - separate measurements relative to this average, which is characterized by the variance of the distribution. In this case the confidence interval for σ_x^2 is:

$$\left[\frac{(n-1)S^2}{\chi_2^2};\frac{(n-1)S^2}{\chi_1^2}\right].$$

Value χ_2^2 and χ_1^2 can be found by tabular data for the known extent freedom $v = n-1$ and calculated for given values of significance probability.

$$P_1 = 1-0{,}5\frac{q}{100} \qquad\qquad P_2 = 0{,}5\frac{q}{100}$$

$$P_1 = 1-0{,}5\frac{5}{100} = 0{,}975 \qquad P_2 = 0{,}025$$

$$\chi_1^2 = 0{,}699\cdot 71 = 49{,}6; \qquad\qquad \chi_2^2 = 1{,}355\cdot 71 = 96{,}2$$

$$\left[\frac{(n-1)S^2}{\chi_2^2};\frac{(n-1)S^2}{\chi_1^2}\right]=\left[\frac{71\cdot 14{,}91}{96{,}2};\frac{71\cdot 14{,}91}{49{,}6}\right]= [11{,}0;\ 21{,}3]$$

$$\left[\frac{(n-1)S^2}{\chi_2^2};\frac{(n-1)S^2}{\chi_1^2}\right]=\left[\frac{71\cdot 4{,}85}{96{,}2};\frac{71\cdot 4{,}85}{49{,}6}\right]=[3{,}6;\ 6{,}9]$$

Input testing:	Output testing:
$11<\sigma_u^2<21{,}3$	$3{,}6<\sigma_u^2<6{,}9$
$3{,}3<\sigma_u^2<4{,}6$	$1{,}9<\sigma_u^2<2{,}6$

10. Defining the evaluation of mathematical expectation using the arithmetic mean and the variance general totality – dispersion sample, we accept the hypothesis that the random variable obeys the normal distribution law. Therefore it is necessary to carry out testing statistical hypotheses relatively to general statistical values characteristics and general probability distributions.

Let's check the hypothesis of "zero" value of mathematical expectation (m_i) of the true amount of 5% level of significance, if the processing of a sample of n = 72 their values obtained, we obtain:

$$\overline{a} = 14,3; S = 3,86;$$
$$\overline{b} = 26,05; \; S = 2,20.$$

Criterion when testing hypotheses we choose *t* Student test: $t = \sqrt{n}\left(\frac{\overline{u} - c}{S}\right)$

We obtain:

for input testing:

$$t = \sqrt{72}\left(\frac{a-0}{S}\right) = \sqrt{72}\left(\frac{14,3}{3,86}\right) = 31,4;$$
$$t = \sqrt{72}\left(\frac{b-0}{S}\right) = = \sqrt{72}\left(\frac{26,05}{2,20}\right) = 100,5;$$

which is much greater than its critical value *t=1,67*, obtained by tabular data with *q=5* and *v=71.*

So in accordance with the rules of decision, the null hypothesis is rejected at level of significance 0.05 and the alternative hypothesis that suggests that students-ecologists will enhance their professional knowledge provided by the organization of the learning process with experimental techniques is accepted .

In order to improve the quality of information about the level of training of students higher school as a result of the curriculum in the future technique can be adapted for implementation of the corresponding calculations for institutional level and also is useful for scientific organizations and educational institutions that conduct research in methodology of sample surveys.

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Вереітіна І. А.

Методика аналізу вірогідності результатів оцінювання професійних знань

Наведено методику визначення вірогідності результатів, отриманих у ході формувального етапу експерименту з оцінювання професійних знань респондентів, і приклад перевірки задіяних гіпотез. Методика буде корисною для аспірантів та молодих науковців.

Ключові слова: експеримент, варіаційний ряд; вірогіднісний аналіз, вибірка, масив значень, шкала інтервалів.

Вереитина И. А.

Методика анализа достоверности результатов оценивания профессиональных знаний

Приведена методика определения достоверности результатов, полученных в ходе формирующего этапа эксперимента по оценке профессиональных знаний респондентов, и пример проверки задействованных гипотез. Методика будет полезной для аспирантов и молодых ученых.

Ключевые слова: эксперимент, вариационный ряд; вероятностный анализ, выборка, массив значений, шкала интервалов.

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