

**FEDERAL STATE BUDGET EDUCATIONAL  
HIGHER EDUCATION INSTITUTION  
"ROSTOV STATE MEDICAL UNIVERSITY"  
MINISTRY OF HEALTH OF THE RUSSIAN FEDERATION**

**FACULTY OF TREATMENT AND PREVENTION**

Assessment materials for the discipline

"Physics mathematics"

(appendix to the work program of the discipline)

Specialty 05/31/01 General Medicine

**1. List of competencies formed by the discipline (in full or partially)\***

***general professional (OPK):***

Code and name general professional competence	Indicator(s) of achieving general professional competence
OPK 4 Able to use medical devices provided for in the procedure for providing medical care, as well as conduct examinations of the patient in order to establish a diagnosis	ID1 OPK-4 Able to use medical devices during diagnostic studies provided for in the procedures for providing medical care  ID2 OPK-4 Able to apply diagnostic methods, including the use of instrumental methods, when examining a patient in order to establish a diagnosis

**2. Types of assessment materials in accordance with the competencies being developed**

Name competencies	Types of assessment materials	number of tasks <b>for 1 competency</b>
OPK-4	Closed tasks	25 with sample answers
	Open type tasks: Situational tasks Interview questions Add-on tasks	75 with sample answers

Closed type tasks:

Task 1. Instructions: Choose **one** correct answer. The probability of a reliable event is 1.  $P = 0$

2.  $P = 1$
3.  $0 \leq P \leq 1$
4.  $P = 100$
5.  $-1 \leq P \leq 1$

*Correct answer: 2*

Task 2. Instructions: Choose **one** correct answer. Probability of a random event 1.  $P = 0$

2.  $P = 1$
3.  $0 < P < 1$
4.  $-1 < P < 1$
5.  $1 < P < 100$

*Correct answer: 3*

Task 3. Instructions: Choose **one** correct answer. The variance of a random variable characterizes

1. mathematical expectation
2. average value
3. the most probable value of a random variable
4. scattering of random variables *Correct answer:4*

Task 4. Instructions: Choose **one** correct answer.

The random variable is measured in meters [m]. In this case, the variance has units of measurement

- 1m
2.  $m^2$
- 3  $m^{-1}$
4.  $m^3$
5. has no units of measurement

*Correct answer:2*

Task 5. Instructions: Choose **one** correct answer. An

example of a continuous random variable is 1. the number of students in the classroom

2. growth of students
3. patient's blood pressure during the day
4. number of patients seen by a doctor during the day
5. number of operations in the clinic per day

*Correct answer:3*

Task 6. Instructions: Choose **one** correct answer.

The product of two random events  $A \cdot B$  is an event in which 1. event A or event B occurs

2. event A and event B
3. event A provided that event B occurred
4. event B provided that event A occurred

*Correct answer:2*

Task 7. Instructions: Choose **one** correct answer. The closeness (strength) of a linear correlation relationship is determined by: 1. the value of the correlation coefficient

2. minimum value of the error of the correlation coefficient
3. Student's t-test
4. null hypothesis
5. linear regression equation

*Correct answer:1*

Task 8. Instructions: Choose **one** correct answer.

If all values of a variable in a two-dimensional sample are doubled, then the correlation coefficient is:

1. will increase 2 times
2. will not change
3. will increase by 0.2
4. will decrease by 2

times *Correct answer:2*

Task 9. Instructions: Choose **one** correct answer.

The pitch of the sound depends

on: 1. timbre

2. frequencies

3. acoustic spectrum

4. intensity

*Correct answer:*2. frequencies

Task 10. Instructions: Choose **one** correct answer.

What is the sign of the potential difference between the cytoplasm and the environment in an unexcited cell?

1. positive

2. negative

3. equal to zero

*Correct answer:*2

Task 11. Instructions: Choose **one** correct answer. Name the bottleneck in the cardiovascular system:

1. aorta

2. arteries

3. capillaries

4. veins

*Correct answer:*1

Task 12. Instructions: Choose **one** correct answer.

Compare the permeability of the membrane in the steady state for potassium ions and sodium ions:

1. the same

2. for potassium 25 times less than for sodium

3. for sodium 20 times more than for potassium

4. for potassium 25 times more than for sodium

*Correct answer:*4

Task 13. Instructions: Choose **one** correct answer.

The linear correlation coefficient between characteristics x and y is -0.67. Then the correlation coefficient characterizing the relationship between characteristics y and x is equal to 1. can be any

2. 0.67

3. 1

4. - 0.67

*Correct answer:*4

Task 14. Choose **some** correct answers. Which ions make the main contribution to the resting potential? 1.

potassium

2. sodium

3. chlorine

4. calcium

5. magnesium

*Correct answer:*1, 2, 3

Task 15. Establish a correspondence between the numbers of standard ECG leads and points on the surface of the human body:

eieven	A. Between the left arm and left leg
2.2	B. Between right hand and left hand
3.3	B. Between the right arm and left leg

*Correct answer: 1-B, 2-B, 3-A*

Task 16. Indicate the sequence of arrangement of mechanical vibrations and waves on the frequency scale in the direction of increasing frequency:

1. Sound
2. Hypersound
3. Ultrasound
4. Infrasound

*Correct answer:4-1-3-2*

Task 17. Indicate the sequence of arrangement of substances in order of increasing viscosity:

1. Blood plasma
2. Water
3. Blood
4. Air
5. Blood serum

*Correct answer:4-2-5-1-3*

Task 18. Chooses**some**correct answers.

Examples of correlation dependencies:

1. chest height and volume
2. radius and circumference
3. diameter and volume of the ball
4. age and body weight
5. Poiseuille's law

*Right answers:14*

Task 19. Selects**some**correct answers.

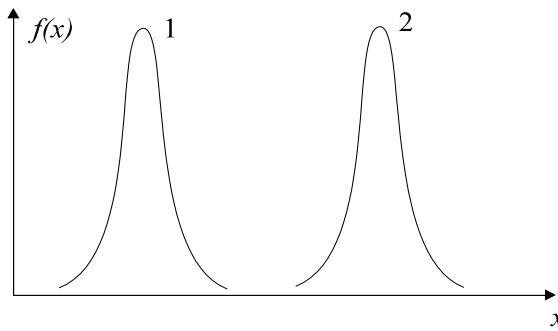
Examples of functional dependencies:

1. body weight and shoe size
2. age and blood pressure
3. current and voltage
4. season and leaf color
5. Fick's equation describing diffusion *Right*

*answers:3, 5*

Task 20. Chooses**some**correct answers.

Parameters for normal distribution graphs.  $\mu$  - mathematical expectation of random variables,  $\sigma$  - standard deviation.



- 2. -1--2
- 3. -2--1
- 4. -1=-2
- 5. -1--2
- 2--1

Right answers: 3, 4

Task 21. Choose **some** correct answers.  
Methods for specifying statistical distribution

- 1. tabular
- 2. analytical
- 3. graphic
- 4. operator
- 5. selective

Right answers: 1, 2, 3

Task 22. Establish a correspondence between the statistical criterion and the problem being solved.

1. Student's t-test	A. comparison of general means with normal distribution of random variables
2. Pearson criterion	B. comparison of general averages with an unknown law of distribution of random variables
3. Fisher criterion	B. determining the significance of differences in general variances
4. Wilcoxon test	D. comparison of distribution laws of random variables

Correct answer: 1-A, 2-D, 3-B, 4-B.

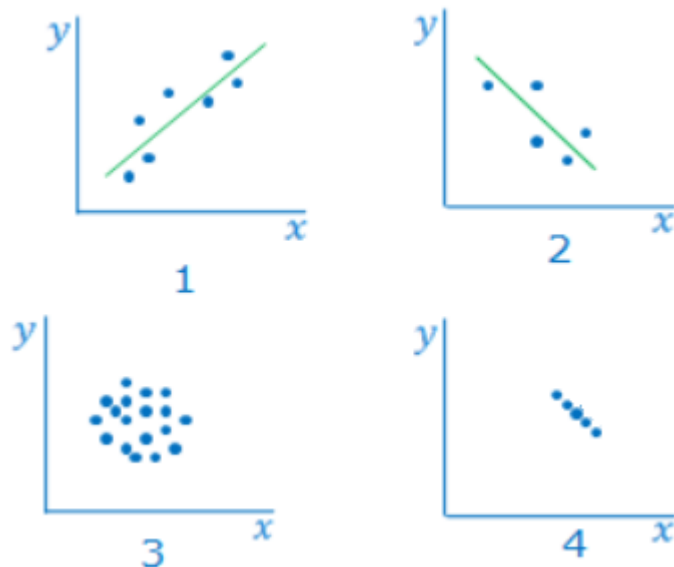
Task 23. Establish a correspondence between the designation and the name of the quantity in the table to conduct one-way analysis of variance.

N	A <sub>1</sub>	A <sub>2</sub>	....	A <sub>m</sub>
1	$x_{11}$	$x_{12}$	....	$x_{1m}$
2	$x_{21}$	$x_{22}$	....	$x_{2m}$
...	...	...	....	....
n	$x_{n1}$	$x_{n2}$	....	$x_{nm}$
	$\bar{x}_1$	$\bar{x}_2$	....	$\bar{x}_m$

1. $\bar{x}_1, \bar{x}_2, \dots, \bar{x}_m$	A. factor levels
2. $x_{11}, x_{21}, \dots, x_{nm}$	B. group sample means
3. A <sub>1</sub> , A <sub>2</sub> , ..., A <sub>m</sub>	B. values of random variables
4. 1, 2, 3, ...n	G. test numbers

Correct answer: 1-B, 2-C, 3-A, 4-D.

Task 24. The figures show correlation fields. Establish a correspondence between the picture and the corresponding value of the linear correlation coefficient:



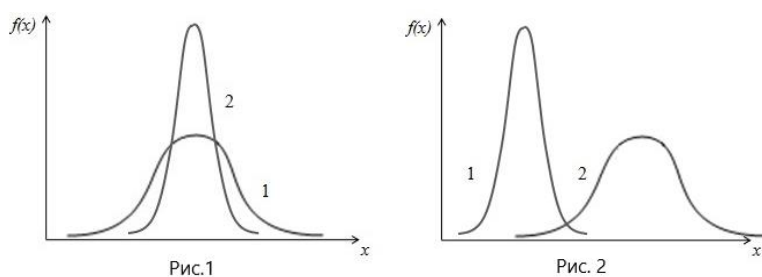
1	A. $r = -1$
2	B. $r = 0$
3	V. $r = 0.8$
4	G. $r = -0.7$

Correct answer: 1-B, 2-D, 3-B, 4-A.

Task 25. The figures show graphs of the laws of distribution of random variables. Establish a correspondence between the graphs and the distribution parameters.

$\mu$  - mathematical expectation of random variables;

$\sigma$  - standard deviation.



1 drawing	A. $\sigma_1 < \sigma_2$
2 drawing	B. $\mu_1 < \mu_2$
	V. $\sigma_1 > \sigma_2$
	G. $\mu_1 = \mu_2$
	D. $\mu_1 > \mu_2$

Correct answer: 1-B, D, 2-A, B.

Open type tasks:

### Addition tasks

Instructions for addition tasks: instead of a dash, write only one word or number.

1. Instructions. Instead of a dash, enter a number.

The probability of having a boy is 0.5. The probability that there are two girls in a family is \_\_\_\_\_.

**Correct answer:**0.25

2. Instructions. Instead of a dash, enter a number.

There are 100 balls in a box: 18 black, 50 blue, 20 yellow and 12 white.

The probability of getting a colored ball is

\_\_\_\_\_. **Correct answer:**0.7

3. Instructions. Instead of a dash, enter a number.

The distribution law of a discrete random variable X is given by a table.

$X_i$	2	3.8	4	5.5	9
$R_i$	0.1	0.1	0.35	0.25	?

The probability corresponding to the random variable 9 is \_\_\_\_\_.

**Correct answer:**0.2

4. Instructions. Instead of a dash, enter a number.

The table presents discrete random variables X and their frequencies of occurrence ( $n_i$ ) in a variety of observations.

$X_i$	2	2.5	4	7	9
$n_i$	9	19	16	25	17

The mode in this set of observations is the number\_\_\_\_\_.

**Correct answer:**7

5. Instructions. Instead of a dash, enter only one word: A

sphygmomanometer is a device for measuring \_\_\_\_\_

blood. **Correct answer:**pressure

6. Instructions. Instead of a dash, enter a number.

One letter is selected at random from the word "statistics". What is the probability that this letter will be a consonant?

**Correct answer:**0.6.

7. Instructions. Instead of a dash, enter a number.

If a certain disease is suspected, the patient is sent for a PCR test. If the disease really exists, the test confirms it in 88% of cases. If there is no disease, then the test reveals the absence of the disease in an average of 94% of cases. What is the probability of a false positive result?

**Correct answer:**0.06

8. Instructions. Instead of a dash, enter only one word.



When performing analysis of variance, the values of the factor and residual values were calculated dispersions:  $S_2 \text{ FACT} = 3.8$ ,  $S_2 \text{ OST} = 14$ . From the data obtained it follows that the influence factor for the sign of \_\_\_\_\_. **Correct answer:** insignificant (no)

9. Instructions. Instead of a dash, enter only one word. The myelin sheath of the nerve fiber contributes to \_\_\_\_\_ the speed of propagation of excitation in \_\_\_\_\_ once. **Correct answer:** increase

10. Instructions. Instead of a dash, enter only one word:

The gradient of ion concentrations between the inner and outer surfaces of a biological membrane creates \_\_\_\_\_ transport.

**Correct answer:** active

### **Situational tasks**

Task 1. Given a discrete series of even numbers: 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26. How to find the median of this series?

**Correct answer:** + = \_\_\_\_\_

Problem 2. The probability of the first radionuclide entering the target tumor cell is  $P_1 = 0.7$ . Probability that the second radionuclide will enter the tumor cell  $P_2 = 0.8$ . Find the probability of damaging the target cell if both drugs were used simultaneously.

**Correct answer:** 0.94.

Problem 3: The nurse is caring for three patients. The probability that a patient will require the nurse's attention within an hour is equal for the first patient - 20%, for the second - 50%, for the third - 70%. Find the probability that at least one of the patients does not require the nurse's attention within an hour.

**Correct answer:** 0.93

Problem 4. There are 80 test tubes in a box, 4 of which have cracks. Find the probability that two test tubes taken out one after another will end up with cracks.

**Correct answer:** 0.0019.

Problem 5. The box contains 10 white, 5 pink and 5 yellow tablets. Each trial consists of removing one tablet at random without returning it to the box. Find the probability that on the first trial a white pill will appear, on the second trial a pink pill will appear, and on the third trial a yellow pill will appear.

**Correct answer:** \_\_\_\_\_

Task 6. Students from three cities came to the conference: 5 from Astrakhan, 4 from Voronezh and 6 from Rostov-on-Don. Each of them makes one report at the conference.

The order of reports is determined by drawing lots. Find the probability that the report of a student from Rostov-on-Don will be tenth.

**Correct answer:0.4**

Task 7. We studied the difference in the average height of male students in the 1st and 2nd years of medical university. As a result of measuring the height of twenty randomly selected 1st year students ( $n_x=20$ ) and twenty-two 2nd year students ( $n_y=22$ ) the following results were obtained: the average height of 1st year students was 178 cm, and that of 2nd year students was 181 cm. Estimates of student growth variances turned out to be equal. Random variables are distributed according to a normal law. The experimental value of the Student's test turned out to be equal to  $t_{exp}=1.9$ . Based on the results obtained, can it be stated that the height of all 2nd year students at a medical university (representing the general population) is on average greater than that of 1st year students, or is the result obtained random and due to the characteristics of the sample populations taken?

Таблица критических значений t-критерия Стьюдента

Число степеней свободы f	Уровни значимости $\alpha$ , % (двустороннее ограничение)			Число степеней свободы f	Уровни значимости $\alpha$ , % (двустороннее ограничение)		
	5	1	0,1		5	1	0,1
1	12,71	63,66	64,60	18	2,10	2,88	3,92
2	4,30	9,92	31,60	19	2,09	2,86	3,88
3	3,18	5,84	12,92	20	2,09	2,85	3,85
4	2,78	4,60	8,61	21	2,08	2,83	3,82
5	2,57	4,03	6,87	22	2,07	2,82	3,79
6	2,45	3,71	5,96	23	2,07	2,81	3,77
7	2,37	3,50	5,41	24	2,06	2,80	3,75
8	2,31	3,36	5,04	25	2,06	2,79	3,73
9	2,26	3,25	4,78	26	2,06	2,78	3,71
10	2,23	3,17	4,59	27	2,05	2,77	3,69
11	2,20	3,11	4,44	28	2,05	2,76	3,67
12	2,18	3,05	4,32	29	2,05	2,76	3,66
13	2,16	3,01	4,22	30	2,04	2,75	3,65
14	2,14	2,98	4,14	40	2,02	2,70	3,55
15	2,13	2,95	4,07	60	2,0	2,66	3,46
16	2,12	2,92	4,02	120	1,98	2,62	3,37
17	2,11	2,90	3,97	$\infty$	1,96	2,58	3,29

**Correct answer:The general averages differ insignificantly.**

Problem 8. Two independent samples with a volume of 30 patients each who underwent heart surgery. Two methods of anesthesia were used. In patients of the first sample (first method of anesthesia), the minimum average diastolic pressure amounted  $\bar{t}_p x = 67$  mmHg Art., and the standard deviation  $S_1 = 12.2$  mm Hg. Art. In patients of the second group (another drug was used as anesthesia),  $\bar{x} = 73$  mmHg Art., and  $S_2 = 14.4$  mm Hg. Art. Observed t-test value  $t_{observable} = 1.9$ .

Does drug #1 actually lower blood pressure to a greater extent? Assess the statistical significance of the difference in means at a significance level of 0.05.

Таблица критических значений t-критерия Стьюдента

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1	12,71	63,66	64,60	18	2,10	2,88	3,92
2	4,30	9,92	31,60	19	2,09	2,86	3,88
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5	2,57	4,03	6,87	22	2,07	2,82	3,79
6	2,45	3,71	5,96	23	2,07	2,81	3,77
7	2,37	3,50	5,41	24	2,06	2,80	3,75
8	2,31	3,36	5,04	25	2,06	2,79	3,73
9	2,26	3,25	4,78	26	2,06	2,78	3,71
10	2,23	3,17	4,59	27	2,05	2,77	3,69
11	2,20	3,11	4,44	28	2,05	2,76	3,67
12	2,18	3,05	4,32	29	2,05	2,76	3,66
13	2,16	3,01	4,22	30	2,04	2,75	3,65
14	2,14	2,98	4,14	40	2,02	2,70	3,55
15	2,13	2,95	4,07	60	2,0	2,66	3,46
16	2,12	2,92	4,02	120	1,98	2,62	3,37
17	2,11	2,90	3,97	$\infty$	1,96	2,58	3,29

**Correct answer:**The general averages differ insignificantly, the drug No. 1 does not reduce blood pressure to a greater extent than drug No. 2.

Problem 9. When studying the effect of smoking on the development of coronary heart disease platelet aggregation was studied. 111 volunteers smoked a cigarette. Before and after smoking, blood samples were taken from them and platelet aggregation was determined. Using the sign criterion, we obtained the following results: 86 differences – positive; 4 - zero and 20 are negative. Critical Criterion Value  $n_{crit} = 44.6$  at  $\alpha =$

0.05. What can we say: is the change in platelet aggregation statistically significant or not?

**Correct answer:**The change in platelet aggregation is statistically significant.

Problem 10. To test the effectiveness of the new drug A, two groups of patients. One group ( $n_1 = 50$  people) control, which received placebo, and the second group ( $n_2 = 70$  people) received drug A. The average value of some hemodynamic indicator was  $\bar{x}_1 = 78.5$  in the first group and  $\bar{x}_2 = 85$  in second. The difference in general variances is insignificant. At significance level  $\alpha = 0.05$  find out if the drug is really effective? Observed value  $t$ - criteria Student's test  $t_{observable} = 4$ .

Таблица критических значений t-критерия Стьюдента

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	5	1	0,1		5	1	0,1
	1	12,71	63,66		64,60	18	2,10
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7	2,37	3,50	5,41	24	2,06	2,80	3,75
8	2,31	3,36	5,04	25	2,06	2,79	3,73
9	2,26	3,25	4,78	26	2,06	2,78	3,71
10	2,23	3,17	4,59	27	2,05	2,77	3,69
11	2,20	3,11	4,44	28	2,05	2,76	3,67
12	2,18	3,05	4,32	29	2,05	2,76	3,66
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16	2,12	2,92	4,02	120	1,98	2,62	3,37
17	2,11	2,90	3,97	$\infty$	1,96	2,58	3,29

**Correct answer:**The drug is effective.

Problem 11. Construct a discrete variation series for the distribution of 10 applicants according to the number of points they received on the Unified State Exam:

39; 50; 40; 90; 42; 42; 50, 50; 50; 42.

Indicate the relative frequency of occurrence of variants.

**Correct answer:**

$X_i$	39	40	42	50	90
$p_i$	0.1	0.1	0.3	0.4	0.1

Problem 12. Street noise with an intensity level of 80 dB is perceived in the room as noise with an intensity level of 30 dB. Calculate the ratio of sound intensities outside and in the room. The sound intensity level is determined by the formula  $L = 10 \cdot \log_{10} \frac{I}{I_0}$

Where  $I$  – sound intensity,  $I_0$  – hearing threshold.

**Correct answer:** = —

Problem 13. The table shows the empirical and normal frequency distributions of foot length in 287 newborns. From the data presented it is clear that there is no complete coincidence between these frequencies. At  $\alpha \leq 0.05$  it is necessary to establish whether these differences are random or natural, i.e. whether this distribution follows a normal law. Calculation of  $\chi^2$ - the criterion gave a value of 1.58.

Empirical frequencies	3	9	12	31	71	82	46	19	8	6
Theoretical frequencies	1.6	10	12	34	68	78	51	20	9	5

Значения  $\chi^2$  критерия Пирсона.

Числа степеней свободы f	Уровни значимости, %				
	10	5	2	1	0,1
1	2,71	3,84	5,41	6,64	10,83
2	4,60	5,99	7,82	9,21	13,82
3	6,25	7,81	9,84	11,34	16,27
4	7,78	9,49	11,67	13,28	18,46
5	9,24	11,07	13,39	15,09	20,52
6	10,64	12,59	15,03	16,81	22,46
7	12,02	14,07	16,62	18,48	24,32
8	13,36	15,51	18,17	20,09	26,12
9	14,68	16,92	19,68	21,67	27,88
10	15,99	18,31	21,16	23,21	29,59
11	17,28	19,68	22,62	24,72	31,26

**Correct answer:**The distribution of random variables is described by normal by law.

Problem 14. A discrete random variable is given by a distribution law nia:

$X_i$	3	4	4.2	5	6
$P_i$	0.1	0.2	0.2	0.4	0.1

Calculate the expected value for a given distribution. **Correct answer:4.54**

Problem 15. Pulse measurements of 20 patients, carried out after a certain procedure, and 18 patients in the control group gave the following results: for group I  $X = 88$  beats/min, for group II  $Y=68$  beats/min; the variance estimates are respectively equal to:  $S_x^2 = 19$  (bpm) $^2$ ,  $S_y^2=4$  (bpm) $^2$ . The calculated value of t criterion was  $t_{observable} = 3.87$ . At level significance -- 0.05 determine whether the average pulse values in patients of these two groups differ significantly?

Таблица критических значений t-критерия Стьюдента

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5	2,57	4,03	6,87	22	2,07	2,82	3,79
6	2,45	3,71	5,96	23	2,07	2,81	3,77
7	2,37	3,50	5,41	24	2,06	2,80	3,75
8	2,31	3,36	5,04	25	2,06	2,79	3,73
9	2,26	3,25	4,78	26	2,06	2,78	3,71
10	2,23	3,17	4,59	27	2,05	2,77	3,69
11	2,20	3,11	4,44	28	2,05	2,76	3,67
12	2,18	3,05	4,32	29	2,05	2,76	3,66
13	2,16	3,01	4,22	30	2,04	2,75	3,65
14	2,14	2,98	4,14	40	2,02	2,70	3,55
15	2,13	2,95	4,07	60	2,0	2,66	3,46
16	2,12	2,92	4,02	120	1,98	2,62	3,37
17	2,11	2,90	3,97	$\infty$	1,96	2,58	3,29

**Correct answer:**The difference in average heart rate values is significant and is due to influence of the procedure.

Problem 16. Pulse measurements of 10 patients carried out after some procedure, and 12 patients who did not receive the procedure, gave the following results: for group I  $\bar{X} = 70$  beats/min, for group II  $\bar{Y} = 68$  beats/min; the variance estimates are respectively equal to:  $S_1^2 = 9$  (bpm)<sup>2</sup>,  $S_2^2 = 4$  (bpm)<sup>2</sup>. At a significance level of 0.05, test the hypothesis of equality general variances according to the above studies.

Таблица критических значений распределения Фишера-Снедекора  $\alpha = 5\%$  (верхняя строка) и  $\alpha = 1\%$  (нижняя строка)

$f_2$	$f_1$ – степени свободы для большей дисперсии											
	1	2	3	4	5	6	7	8	9	10	11	12
1	161 4052	200 4999	216 5403	225 5625	230 5764	234 5889	237 5928	239 5981	241 6022	242 6056	243 6082	244 6106
2	18,5 98,5	19,0 99,0	19,2 99,2	19,3 99,3	19,3 99,3	19,4 99,3	19,4 99,3	19,4 99,4	19,4 99,4	19,4 99,4	19,4 99,4	19,4 99,4
3	10,1 34,1	9,6 30,8	9,3 29,5	9,1 28,7	9,0 28,2	8,9 27,9	8,9 27,7	8,8 27,5	8,8 27,3	8,8 27,2	8,8 27,1	8,7 27,1
4	7,7 21,2	6,9 18,0	6,6 16,7	6,4 16,0	6,3 15,5	6,2 15,2	6,1 15,0	6,0 14,8	6,0 14,7	6,0 14,5	5,9 14,5	5,9 14,4
5	6,6 16,3	5,8 13,3	5,4 12,1	5,2 11,4	5,1 11,0	5,0 10,7	4,9 10,5	4,8 10,3	4,8 10,2	4,7 10,1	4,7 10,0	4,7 9,9
6	6,0 13,7	5,1 10,9	4,8 9,8	4,5 9,2	4,4 8,8	4,3 8,5	4,2 8,3	4,2 8,1	4,1 8,0	4,1 7,9	4,0 7,8	4,0 7,7
7	5,6 12,3	4,7 9,6	4,4 8,5	4,1 7,9	4,0 7,5	3,9 7,2	3,8 7,0	3,7 6,8	3,7 6,7	3,6 6,6	3,6 6,5	3,6 6,5
8	5,3 11,3	4,5 8,7	4,1 7,6	3,8 7,0	3,7 6,6	3,6 6,4	3,5 6,2	3,4 6,0	3,4 5,9	3,3 5,8	3,3 5,7	3,3 5,7
9	5,1 10,6	4,3 8,0	3,9 7,0	3,6 6,4	3,5 6,1	3,4 5,8	3,3 5,6	3,2 5,5	3,2 5,4	3,1 5,3	3,1 5,2	3,1 5,1
10	5,0 10,0	4,1 7,6	3,7 6,6	3,5 6,0	3,3 5,6	3,2 5,4	3,1 5,2	3,1 5,1	3,0 5,0	3,0 4,9	2,9 4,8	2,9 4,7
11	4,8 9,9	4,0 7,2	3,6 6,2	3,4 5,7	3,2 5,3	3,1 5,1	3,0 4,9	3,0 4,7	2,9 4,6	2,9 4,5	2,8 4,5	2,8 4,4
12	4,8 9,3	3,9 6,9	3,5 6,0	3,3 5,4	3,1 5,1	3,0 4,8	2,9 4,7	2,9 4,5	2,8 4,4	2,8 4,3	2,7 4,2	2,7 4,2
13	4,7 9,1	3,8 6,7	3,4 5,7	3,2 5,2	3,0 4,9	2,9 4,6	2,8 4,4	2,8 4,3	2,7 4,2	2,7 4,1	2,6 4,0	2,6 4,0

**Correct answer:**We accept the hypothesis of equality of general variances.

Problem 17. The figure shows a fragment of an electrocardiogram on graph paper. The tape pulling speed is 25 mm/s. Determine the duration of the RR interval in seconds.



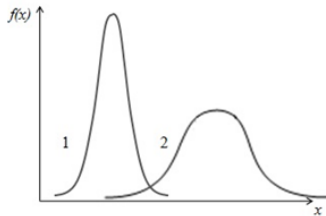
**Correct answer:**0.72 s

Problem 18. When recording an electrocardiogram on graph paper, the height of the R wave turned out to be equal to 14 mm. Determine the amplitude of the R wave in mV if the calibration signal with an amplitude of 1 mV has a height of 10 mm.

**Correct answer:**1.4 mV

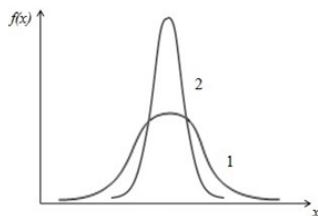
Task 19. In the experiment, hemograms of patients with anemia were studied ( $n_1=70$ ) and healthy patients ( $n_2=50$ ). In the first group, the average hemoglobin level turned out to be equal to  $\bar{X}_{in 1}=90$  g/l, corrected dispersion value  $\sigma^2_1= 10$  (g/l)<sup>2</sup>. In the second group these indicators took the values  $\bar{X}_{at 2}=120$  g/l,  $\sigma^2_2= 30$  (g/l)<sup>2</sup>. Distribution of random quantities in both groups are described by the normal law. Draw schematically the graphs of the laws of distribution of hemoglobin levels in the first and second groups.

**Correct answer:**



Task 20. We studied the effect of immunosuppressants on platelet aggregation. Mean platelet concentration in the group taking immunosuppressants turned out to be equal to  $\bar{X}_{in 1}=200$  (10<sup>9</sup>/l), corrected variance value  $\sigma^2_1= 990$  (10<sup>9</sup>/l)<sup>2</sup>. IN in the control group of patients not taking the medicine, these indicators were  $\bar{X}_{at 2}=200$  (10<sup>9</sup>/l),  $\sigma^2_2= 500$  (10<sup>9</sup>/l)<sup>2</sup>. Testing using the Pearson criterion established normal distribution law of random variables in both groups. Draw schematically the graphs of the laws of distribution of platelet concentrations in the first and second groups.

**Correct answer:**



Problem 21. Calculate the sample mean value of the weight of newborn children from a set of sample data. What is the size of the presented sample?  
Weight in kg: 3; 2.5; 3.5; 3; 3; 3.5; 3.5; 2.5; 3;  
2.5. **Correct answer:** kg

### Interview Questions

1. Classic definition of the probability of a random event.

**Correct answer:**  $P(A) = \frac{m}{n}$ , Where  $m$ -number of cases favorable event A,  $n$ - the total number of possible outcomes.

2. Statistical determination of probability.

**Correct answer:**  $P(A) = \lim_{n \rightarrow \infty} \frac{m}{n}$ , Where  $m$ -number of experiments in which an event appeared  $A$ ;  $n$ - the number of all experiments performed.

3. What events are called incompatible?

**Correct answer:** Events  $A$  and  $B$  are called incompatible if the occurrence of one event excludes the occurrence of another.

4. The theorem for adding probabilities for incompatible events.

**Correct answer:**  $R(A+IN) = R(A)+P(IN)$

5. What events are called joint?

**Correct answer:** Events  $A$  and  $B$  are simultaneous if the occurrence of one of them does not exclude the appearance of another in the same trial.

6. Probability addition theorem for joint events.

**Correct answer:**  $R(A+IN) = R(A)+(IN)-R(AB)$ .

7. What events are called independent?

**Correct answer:** Two events are said to be independent if the probability of one one of them does not change from the appearance of the other.

8. Probability multiplication theorem for independent events.

**Correct answer:**  $R(A \cdot B) = R(A) \cdot R(IN)$ .

9. What events are called dependent?

**Correct answer:** Two events are called dependent if the probability of one of them them changes from the occurrence of another event.

10. Probability multiplication theorem for dependent events.

**Correct answer:**  $R(A \cdot B) = R(A) \cdot R(V/A)$ .



eleven. Mathematical expectation of a random variable.

**Correct answer:** The mathematical expectation of a random event is the most expected value when testing multiple times (meaning the average).

12. General population as a concept of mathematical statistics.

**Correct answer:** The population is the set of all conceivable values of observations, homogeneous with respect to some characteristic, that could be made.

13. What does the graph look like? normal distribution law of continuous random variables?

**Correct answer:** bell-shaped curve symmetrical with respect to mathematical expectation.

14. Calculations sample mean.

**Correct answer:**  $\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$

15. Significance level.

**Correct answer:** The significance level is the probability of rejecting the null hypothesis, provided that it is true.

16. Possible values of the significance level.

**Correct answer:** In biology, pharmacy and medicine the most common value is 0.05. Other small values are also possible: 0.01, 0.001.

17. Sampling as a concept of mathematical statistics.

**Correct answer:** Sample - part of the population that is covered experiment.

18. Sample size.

**Correct answer:** Sample size is the number of variants (number of cases) in sample. Sample sizes less than 30 are considered small.

19. Representativeness of the sample.

**Correct answer:** Representativeness is a property of sampling correctly represent the parameters of the general population.

20. Ways to ensure representativeness of the sample.

**Correct answer:**Increasing the sample size and random selection of elements from general population.

21. Indicate the direction of the correlation if the sample linear correlation coefficient  
1)  $r > 0$ , 2)  $r < 0$ .

**Correct answer:**1) direct, 2) reverse

22. Within what limits does the sample linear correlation coefficient vary?

**Correct answer:**From -1 to +1.

23. Conditions for the applicability of Student's t-test for comparison of general means.

**Correct answer:**1) normal distribution law for general populations 2) equality of general variances.

24. Name the main features of variance analysis.

**Correct answer:** 1) Comparison of general means of several general populations 2) Assessment of the influence of factors on characteristics

25. Types of analysis of variance.

**Correct answer:**Single-factor, two-factor and multi-factor

26. The concept of evidence-based medicine.

**Correct answer:**An approach to medical practice in which decisions are adopted on the basis of available evidence of their effectiveness and safety.

27. What is a histogram?

**Correct answer:**A histogram is a stepped figure consisting of adjacent rectangles with identical bases equal to the width of the class. The height of the rectangles is equal to the frequency of occurrence.

28. Confidence interval as an interval estimate of the parameters of the general population.

***Correct answer:***The interval in which, with one or another predetermined probability is the general parameter.

29. For what sample size are point and interval estimates of the parameters of the general population used?

***Correct answer:***Accurate estimation – for large samples, interval estimation - for small samples.

30. How does sample size affect the width of the confidence interval?

***Correct answer:***As the sample size increases, the width of the confidence level interval decreases.

31. List the basic concepts of variance analysis.

***Correct answer:***Factor, factor levels, sign.

32. Give the concept of inverse correlation between characteristics.

***Correct answer:***A correlation dependence is called inverse if An increase in one characteristic leads to a decrease in the average value of another.

33. What is residual variance?

***Correct answer:***The residual variance is within group and determined by the influence of random causes.

34. Give the concept of factor dispersion.

***Correct answer:***Intergroup variance is determined by the influence adjustable factor.

35. Indicate a feature of nonparametric tests.

***Correct answer:***Nonparametric tests can be used regardless of the shape of the distribution of random variables.

36. Spearman's rank correlation coefficient.

***Correct answer:***Nonparametric measure of presence or absence correlation connection.

37. In what case do the sample mean and median coincide?

**Correct answer:** If the distribution of random variables is described normal law.

38. What is auscultation?

**Correct answer:** Auscultation is a method of examining internal organs, based on listening to sound phenomena that occur during the physiological activity of internal organs.

39. Application of the Doppler effect in medicine.

**Correct answer:** In medicine, the Doppler effect is used to determine speed of blood movement, red blood cells, heart valves, etc.

40. Why is the surface used during ultrasound examination or ultrasound therapy? Should the patient's body be lubricated with gel?

**Correct answer:** To remove air gaps and leveling acoustic resistance.

41.4. What instruments are used to perform auscultation? **Correct answer:** Auscultation is performed using a phonendoscope and stethoscope.

42. Give the concept of direct (positive) correlation between characteristics.

**Correct answer:** A correlation relationship is called direct if An increase in one characteristic leads to an increase in the average value of another.

43. What is the Doppler effect?

**Correct answer:** The Doppler effect is a change in the frequency of oscillations, perceived by the observer due to the relative motion of the wave source and the observer.

44. A narrowing of the vessel has occurred. How will the speed of blood flow change?

**Correct answer:** Will increase.

**CRITERIA for assessing competencies and rating scales**

Grade "unsatisfactory" (not accepted) or absence formation competencies	Grade "satisfactorily" (passed) or satisfactory (threshold) level of development competencies	Rated "good" (passed) or sufficient level development competencies	Excellent rating (passed) or high level development competencies
failure to student on one's own demonstrate knowledge when solving assignments, lack independence in application of skills. Absence availability confirmation formation competencies indicates negative development results academic discipline	student demonstrates independence in application of knowledge skills and abilities to solve educational tasks in full According to sample given teacher, by tasks, solution of which there were shown teacher, it should be considered that competence formed on satisfactory level.	student demonstrates independent application of knowledge, skills and abilities when deciding tasks, tasks similar samples that confirms Availability formed competencies for higher level. Availability such competence on sufficient level indicates sustainable fixed practical skill	student demonstrates ability to full independence in choosing a method solutions non-standard assignments within disciplines with using knowledge, skills and skills, received as in development progress of this discipline, and adjacent disciplines should count competence formed on high level.

***Criteria for assessing test control:***

percentage of correct answers	Marks
91-100	Great
81-90	Fine
70-80	satisfactorily
Less than 70	unsatisfactory

When grading tasks with multiple correct answers, one error is allowed.

***Interview assessment criteria:***

Mark	Descriptors		
	strength of knowledge	ability to explain (introduce) the essence of phenomena, processes, do conclusions	logic and subsequence answer
Great	strength of knowledge, knowledge of basic processes subject matter being studied	high skill explain the essence phenomena, processes,	high logic and subsequence answer

	areas, the answer differs in depth and completeness disclosure of the topic; possession terminological apparatus; logic and consistency answer	events, draw conclusions and generalizations, give reasoned answers, give examples	
Fine	solid knowledge of the basic processes of the studied subject area, differs in depth and completeness of the topic; possession terminological apparatus; free mastery of monologue speech, but one or two inaccuracies in the answer are allowed	ability to explain essence, phenomena, processes, events, draw conclusions and generalizations, give reasoned answers, give examples; however one or two inaccuracies in the answer are allowed	logic and subsequence answer
satisfactory really	satisfactory process knowledge subject matter being studied areas, answer, different insufficient depth and completeness of the topic; knowledge of basic theoretical issues. Several are allowed errors in content answer	satisfactory ability to give reasoned answers and provide examples; satisfactorily formed analysis skills phenomena, processes. Several are allowed errors in content answer	satisfactory logic and subsequence answer
will not satisfy really	poor knowledge of the subject area being studied, shallow opening Topics; poor knowledge basic theoretical issues, poor analysis skills phenomena, processes. Serious errors in content answer	inability to give reasoned answers	absence logic and sequences answer

***Criteria for assessing situational tasks:***

Mark	Descriptors			
	understanding Problems	analysis situations	skills solutions situations	professional thinking
Great	complete implication problems. All requirements, submitted to	high benefit analyze situation, draw conclusions	high benefit select method solutions problems,	high level professional thoughts

	adania, completed		faithful solution skills situations	
Fine	complete implication problems. All requirements, submitted to adania, completed	benefit analyze situation, draw conclusions	benefit select method solutions problems faithful solution skills situations	residual level professional thoughts. drops one or two precision in the answer
satisfactory really	astastic implication problems. majority requirements declared to adania, completed	satisfactory 1st ability analyze situation, draw conclusions	satisfactory e skills solutions situations, falsity with choosing a method solutions to the problem	residual level professional thoughts. falls more a bunch of inaccuracies in answer or there is an error in the sequence solutions
will not satisfy really	misunderstanding problems. legs requirements, submitted to I hope not completed. No Tveta. Did not have experiments to solve hello	izkaya benefit analyze situation	insufficient solution skills situations	missing