Appendix to the working program

Federal State Budgetary Educational Institution of Higher Education
"Privolzhsky Research Medical University"
Ministry of Health of the Russian Federation

BANK OF ASSESSMENT TOOLS FOR DISCIPLINE

«MATHEMATICS»

Training program (specialty): **33.05.01 PHARMACY**

Department: **MEDICAL BIOPHYSICS**

Mode of study: **FULL-TIME**

Nizhniy Novgorod
2021

1. Bank of assessment tools for the current monitoring of academic performance, mid-term assessment of students in the discipline / practice

This Bank of Assessment Tools (BAT) for the discipline "Mathematics " is an integral appendix to the working program of the discipline "Mathematics". All the details of the approval submitted in the WPD for this discipline apply to this BAT.

(Banks of assessment tools allow us to evaluate the achievement of the planned results stated in the educational program.

Assessment tools are a bank of control tasks, as well as a description of forms and procedures designed to determine the quality of mastering study material by students.)

2. List of assessment tools

The following assessment tools are used to determine the quality of mastering the academic material by students in the discipline "Physics, mathematics":

No.	Assessment tool	Brief description of the assessment tool	Presentation of the assessment tool in the BAT
1.	Test №1 Test №2	A system of standardized tasks that allows you to automate the procedure of measuring the level of knowledge and skills of a student.	Bank of test tasks
2.	Situational tasks	A method of control that allows you to assess the criticality of thinking and the degree of the material comprehension, the ability to apply theoretical knowledge in practice.	List of tasks
3.	Individual survey	A control tool that allows you to assess the degree of comprehension of the material	List of questions
4.	Control work	A tool of checking the ability to apply acquired knowledge for solving problems of a certain type by topic or section	Set of control tasks in variants
5.	Colloquium	A tool of controlling the mastering of study materials of a topic, section or sections of a discipline, organized as a class in the form of an interview between a teacher and students.	Questions on topics/sections of the discipline

3. A list of competencies indicating the stages of their formation in the process of mastering the educational program and the types of evaluation tools

Code and formulation of competence*	Stage of competence formation	Controlled sections of the discipline	Assessment tools
UC-1 Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy. GPC-1 Able to use basic biological, physico-chemical, mathematical methods for the development, research and examination of medicines.	Current	**Section 1.** *Fundamentals of mathematical analysis. The simplest differential equations.*	Situational tasks Individual survey Control work

UC-1 Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy. GPC-1 Able to use basic biological, physico-chemical, mathematical methods for the development, research and examination of medicines.	Current	**Section 2.** *Fundamentals of probability theory and descriptive statistics.*	Situational tasks Individual survey Control work Colloquium
UC-1 Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy. GPC-1 Able to use basic biological, physico-chemical, mathematical methods for the development, research and examination of medicines.	Current	**Section 3.** *Statistical methods of research and data processing.*	Situational tasks Individual survey Colloquium
UC-1 Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy. GPC-1 Able to use basic biological, physico-chemical, mathematical methods for the development, research and examination of medicines.	Current	**Section 4.** *Mathematical optimization methods.*	Situational tasks Individual survey Control work Colloquium
Credit		***All Sections***	***Credit Test***

4. The content of the assessment tools of entry, current control

Entry /current control is carried out by the discipline teacher when conducting classes in the form of: Test, Situational tasks, Individual survey, Control work, Colloquium.

4.1. Tasks for the assessment of competence “UC-1”, “GPC-1” *(the competence code):*

PROBABILITY THEORY

Task 1. Calculate the probability that have the numbers 2 or 5 in a trial of the experiment consisting of tossing up the hexahedral dice.

Task 2. Calculate the probability of failure of the following pairs of the three independent electrical batteries (№№ 1, 2, and 3) operating in an electrical circuit: № 1 and № 3, № 2 and№ 3, № 1 and № 3, if the probabilities of the individual failure of the batteries are p(№ 1) = 0.3, p(№ 2) = 0.2 and p(№ 3) = 0.5.

Task 3. There are 11 balls in a box, 2 of them are green, 3 are black, 5 are red and 1 is a blue ball. What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

Task 4. There are 11 balls in a box, 1 of them is a green ball, 5 are black, 3 of them are red and 2 of them are blue. What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

Task 5. There are 21 balls in a box, 12 of them are green, 3 are black, 5 are red and 1 is a blue ball. What is the probability to take a black ball and a green one in two consequent trials, if the black ball is not put back into the box after the first trial?

THE DISTRIBUTIONS OF RANDOM VARIABLES

Task 6. Find the variance and the standard deviation of a random variable, if the random variable has the following distribution law:

x	0,35	0,55	0,77	0,89
p	0,2	0,3	0,3	0,2

Task 7. Find the variance and the standard deviation of a random variable, if the random variable has the following distribution law:

x	5	7	10
p	0,3	0,4	0,3

Task 8. A discrete random variable is represented by the distribution

x	4	2	5
p	0,3	?	0,4

Find the mathematical expectation

Task 9. A discrete random variable is represented by the distribution

x	10	8	9	11
p	0,3	?	0,1	0,2

Find the mathematical expectation

Task 10. A discrete random variable is represented by the distribution

x	5	7	?
p	0.4	0.2	?

Find the x_3 and p_3, if the mathematical expectation M(X) = 4.6.

Task 11. A discrete random variable is represented by the distribution

x	21	15	10	2	?

Find the x_4 and p_4, if the mathematical expectation M(X) = 18.

Task 12. There is another sample of experimental results:

37, 39, 40, 39, 38, 39, 40, 40, 41, 38, 39, 42, 38, 40, 37, 42, 39, 39, 41, 42

a) draw three graphs that characterize the variation series: a frequency polygon, a histogram, and a cumulative curve;

b) calculate the mean value, variance and standard deviation.

Task 13. There is another sample of experimental results:

x_i	3	6	9	12
m_i	9	16	12	8

a) fine the mode;

b) calculate the mean value, variance and standard deviation.

4.2. Control work for the assessment of competence “UC-1”, “GPC-8”:

Fundamentals of mathematical analysis

VARIANT № 1

1.	Find the derivatives	
	$y = x^3 + 2x$	$y=\sqrt[3]{x}\,lg\,x$
2.	Find the differentials	
	$y = x$	$y = cos\ x/(3x)$
3.	Find the derivatives (The chain rule)	
	$y = cos\ 3x$	$y=\frac{1}{(1+cos5x)^5}$
4.	Find the total differentials	
	$F = x + z^2$	$F(x,y)=\frac{2x+3y^2}{\sqrt[3]{xy}}$
5.	Calculate the indefinite integrals	
	$\int 4x^2 dx$	$\int e^{Cos\,x} Sin\,xdx$
6.	Calculate the definite integrals	
	$\int_0^2 (2x+1)dx$	$\int_4^9 \sqrt{x}dx$
7.	Find the general solution of the differential equations with separable variables	
	$y' + 2 = 0$	$(x+1)dx – 2xydy = 0$
8.	Find the partial solution of the differential equations with separable variables	
	$2y' - x = 0$ $y = 2,\ if\ \ x=-1$	$ydx + cotan\ x\ dy = 0;$ $y = -1,\ if\ \ x = \pi/3$

VARIANT № 2

1.	Find the derivatives	
	$y = 5x^3 + 2x$	$y=\frac{1-\sin x}{1+\sin x}$
2.	Find the differentials	
	$y = Sin\ x$	$y = cotan\ x/(2x)$

3.	Find the derivatives (The chain rule)	
	$y = (\cos x)^4$	$y = \sqrt[3]{4x + \sin 4x}$
4.	Find the total differentials	
	$F = 5 \tan x + \ln y$	$F(x, y) = \ln\left(x^2 y^3\right)$
5.	Calculate the indefinite integrals	
	$\int \frac{dx}{x^2}$	$\int x^2 \, Sin 3x^3 dx$
6.	Calculate the definite integrals	
	$\int_0^{\pi} Sinx dx$	$\int_0^{\pi/2} Sinx \, Cos^4 x \, dx$
7.	Find the general solution of the differential equations with separable variables	
	$Sin\, x\, dx = -\, dy$	$e^x y` = 1$
8.	Find the partial solution of the differential equations with separable variables	
	$xdx - ydy = 0$ $y = 2,\ if\ \ x = 0$	$ydx - \tan x\, dy = 0;$ $y = 1,\ if\ \ x = \pi/6$

VARIANT № 3

1.	Find the derivatives	
	$y = x^4 - 3x^2$	$y = \frac{ln\, x - \sqrt[7]{x}}{sin\, x}$
2.	Find the differentials	
	$y = Cos\, x$	$y = \sqrt{x}\, cotan\, x$
3.	Find the derivatives (The chain rule)	
	$y = Sin\, 5\, x$	$y = \frac{x^2 \sin(x - 3)}{ln\, x}$
4.	Find the total differentials	
	$F = 7cotan\, x - e^y$	$F(x, y) = (Sin x^2) \times y^3$
5.	Calculate the indefinite integrals	
	$\int 3^t dt$	$\int \frac{\ln^3 x}{x} dx$
6.	Calculate the definite integrals	

	$\int_{-\pi/2}^{\pi/2} Cosxdx$	$\int_{0}^{\frac{\pi}{2}} Sin^3 x Cos\, x\, dx$
7.	Find the general solution of the differential equations with separable variables	
	$e^y y` =1$	$y'(x+3) = (y+2)$
8.	Find the partial solution of the differential equations with separable variables	
	$Sin\ x\ dx\ -\ dy = 0$ $y = 1,\ if\ \ x=\pi/3$	$y'= cos\ (3x - \pi/4);$ $y=1,\ if\ \ x=\pi/4$

VARIANT № 4

1.	Find the derivatives	
	$y\ = 1/x^3 + ln\ x$	$y = \dfrac{x^3 + \sqrt{x}}{e^x}$
2.	Find the differentials	
	$y = tan\ x$	$y = \dfrac{Sin x + \sqrt{x}}{e^x}$
3.	Find the derivatives (The chain rule)	
	$y = (\ Sin\ x)^{\ 5}$	$y = tan\left(ln x^2\right) \times e^x$
4.	Find the total differentials	
	$F\ = 5\ tan\ x\ + 2e^{\ y}$	$F(x,y) = (Sin x^5)\ /\ y^2$
5.	Calculate the indefinite integrals	
	$\int \dfrac{dx}{2x^3}$	$\int \dfrac{\sqrt{1+\ln x}}{x} dx$
6.	Calculate the definite integrals	
	$\int_0^1 \sqrt[3]{x}$	$\int_1^2 \dfrac{2x^2+1}{x} dx$
7.	Find the general solution of the differential equations with separable variables	
	$5tan\ x\ dx - dy = 0$	$(1+y^2)\ \ dx\ \ -\ \ \sqrt{x}\ \times ydy\ = 0$
8.	Find the partial solution of the differential equations with separable variables	
	$(x^2 + 4x)dx = dy$ $y = 3,\ if\ \ x = 0$	$(1+y)dx - (1- x)\ dy = 0;$ $y=3,\ if\ \ x=0,5$

VARIANT № 5

1.	Find the derivatives	
	$y = log_7 x + e^x$	$y = \frac{e^x}{lg\,x + 2x}$
2.	Find the differentials	
	$y = cotan\,x$	$y = \sqrt[3]{x}\,\lg x$
3.	Find the derivatives (The chain rule)	
	$y = (\,tan\,x)^{\,5}$	$y = \cos(\sqrt{1+\sin^2 x})$
4.	Find the total differentials	
	$F = 3\ cotan\ x - 5\ ln\ y$	$F(x,y,z) = \frac{x^4}{\sqrt{yz}}$
5.	Calculate the indefinite integrals	
	$\int \sqrt[3]{t}\,dt$	$\int Cos^5 x \times Sin\,x dx$
6.	Calculate the definite integrals	
	$\int_4^9 \sqrt{x}dx$	$\int_0^{\frac{\pi}{2}} (Sin\,x^3)\ x^2\ dx$
7.	Find the general solution of the differential equations with separable variables	
	$4x - 3y^2 y` = 0$	$y' = 2\cos(2x+3)$
8.	Find the partial solution of the differential equations with separable variables	
	$5tan\ x\ dx - dy = 0$ $y = 5,\ if\ \ x = 0$	$y' + y\ tan\ x = 0;$ $y=2,\ if\ x=0$

VARIANT № 6

1.	Find the derivatives	
	$y = lgx + x^5$	$y = ln\,x\,\frac{x^4}{7}$
2.	Find the differentials	

	$y = x^6 + 3x^3 - 10$	$y = \dfrac{tan\, x + x^2}{cosx}$
3.	Find the derivatives (The chain rule)	
	y = ln $(x - 2)$	$y = \sqrt[5]{(4x^2 - 3x + 1)^3}$
4.	Find the total differentials	
	$F(x,t) = x^2 + t - 5$	$F(x, y, t) = \dfrac{xy^2}{t^3}$
5.	Calculate the indefinite integrals	
	$\int \dfrac{5dt}{t^3}$	$\int Sin^5 x\, Cos\, x\, dx$
6.	Calculate the definite integrals	
	$\int_0^{\pi} Sinxdx$	$\int_0^4 \dfrac{x\,dx}{\sqrt{x^2 + 9}}$
7.	Find the general solution of the differential equations with separable variables	
	$y` - x = 5x^4$	$y' = cos\ x \times cotan\ y$
8.	Find the partial solution of the differential equations with separable variables	
	$y' = 2xy$ $y = e,\ if\ \ x = -3$	$y' = y \times Sin\ x$ $y = 1,\ if\ \ x = \pi$

VARIANT № 7

1.	Find the derivatives	
	$y = 3x^2 + 7^x + 5$	y = $lg\ x \times ln\ x$
2.	Find the differentials	
	$y = x^2\ Sin\ x$	$\mathrm{y} = \dfrac{\sin \mathrm{x} - \cos \mathrm{x}}{\sqrt[3]{\mathrm{x}}}$
3.	Find the derivatives (The chain rule)	
	$y = ln\ (x^3)$	$y = \ln cotan\,(x + 1)$
4.	Find the total differentials	
	$F(x,z,t) = ln\ x + z \times t$	$F(x, y, z) = \dfrac{x^5 y^2}{z^4}$

5.	Calculate the indefinite integrals	
	$\int (3x^2+2x-1)dx$	$\int \frac{\ln x+5}{x}dx$
6.	Calculate the definite integrals	
	$\int_{-\pi/2}^{\pi/2} Cosxdx$	$\int_{\frac{\pi}{2}}^{\pi} \frac{Sin\,x\,dx}{(1-Cos\,x)^2}$
7.	Find the general solution of the differential equations with separable variables	
	$dy + 3ydx = 0$	$yy' = \sin x + \cos x$
8.	Find the partial solution of the differential equations with separable variables	
	$y'\cot an\, x = 1$ $y = 7$, if $x = 0$	$ydx + \cot an\, x\, dy = 0;$ $y = 1$, if $x = \pi/3$

VARIANT № 8

1.	Find the derivatives	
	$y = 3\ln x + lg\, x + 4x$	$y = \frac{\sqrt{x}+lg\,x}{\cos x}$
2.	Find the differentials	
	$y = lg\,x + \frac{4}{\sqrt[4]{x}}$	$y = \frac{\sqrt{x}+lg\,x}{\cos x}$
3.	Find the derivatives (The chain rule)	
	$y = \ln(\ln x)$	$y = \sin lg(x^2)$
4.	Find the total differentials	
	$F(x,u) = \frac{u^3 \times x^5}{4}$	$F(x,y) = \ln cotan(xy)$
5.	Calculate the indefinite integrals	
	$\int \frac{dx}{2x^3}$	$\int \frac{Cos\,2x}{1+Sin\,2x}$
6.	Calculate the definite integrals	
	$\int_{-\pi/2}^{\pi/2} 2Cosxdx$	$\int_{5}^{1} \frac{t\,dt}{\sqrt{5+4t^2}}$

7.	Find the general solution of the differential equations with separable variables	
	$yy` = 3x^2+8x$	$y'(x+3) = (y+2)$
8.	Find the partial solution of the differential equations with separable variables	
	$2xyy' = 5;$ $y = 4\ ,\ \ if\ \ x = 1$	$cos\ x\ sin\ y\ dy – cos\ y\ sin\ x\ dx = 0;$ $y = \pi/4,\ if\ \ x = \pi/3$

VARIANT № 9

1.	Find the derivatives	
	$y = 2x^4 + 1/x + 3x$	$y = x^{\frac{2}{3}} \times \dfrac{\sin x}{2}$
2.	Find the differentials	
	$y = lg\,x + \dfrac{4}{\sqrt[4]{x}}$	$y = \dfrac{x^3 - 2e^x}{\sqrt{x}}$
3.	Find the derivatives (The chain rule)	
	$y = ln\ (\ x^4\ )$	$y = \mathbf{ln(}\ e^{\frac{2}{5}x} + \sqrt{x}\ \mathbf{)}$
4.	Find the total differentials	
	$F(x,u) = \dfrac{2u^3 \times x^4}{3}$	$F(x,y) = \dfrac{\sin 2x^2 y^3}{e^{xy}}$
5.	Calculate the indefinite integrals	
	$\int (3x^2 \quad - 2Cosx)dx$	$\int \sqrt{2x^2+1}\ x\,dx$
6.	Calculate the definite integrals	
	$\int_0^{\pi} tan\,x\,dx$	$\int_{\frac{\pi}{2}}^{\pi} \dfrac{Sin\,x\,dx}{(1 - Cos\,x)^2}$
7.	Find the general solution of the differential equations with separable variables	
	$yy` = 5x^4+6x+7$	$y' = 2\ cos\ (2x + 3)$
8.	Find the partial solution of the differential equations with separable variables	
	$xdy = ydx;$ $y = 8\ ,\ \ if\ \ \ x = 2$	$2(1 + e^x)yy' = e^x;$ $y = 0,\ if\ \ \ x = 0$

VARIANT № 10

1.	Find the derivatives	
	$y = 3/x^3 + 5x$	$y = \frac{2x^4 - 4x^2}{3\ln x}$
2.	Find the differentials	
	$y = \frac{x^3}{3} - 2x^2 + 4x - 5$	$y = \frac{3 - \sqrt[3]{x}}{\sqrt[3]{x} + 3}$
3.	Find the derivatives (The chain rule)	
	$y = Sin\ (3x^3)$	$y = \frac{x^2 \sin(x-3)}{\ln x}$
4.	Find the total differentials	
	$F(x,y,t) = x^6\, y^2\, t$	$F(x,y) = \frac{xy^2 - 3x^2}{\sqrt{xy}}$
5.	Calculate the indefinite integrals	
	$\int (4x^3 - 2Sinx)dx$	$\int \frac{dx}{x\sqrt{1 - \ln x}}$
6.	Calculate the definite integrals	
	$\int_{-\pi/2}^{\pi/2} cotan\, x\, dx$	$\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \frac{Cos\, x\, dx}{Sin^3 x}$
7.	Find the general solution of the differential equations with separable variables	
	$yy` = 8x^7 + 5x + 10$	$3y\, dx = 2\sqrt{x}\, dy$
8.	Find the partial solution of the differential equations with separable variables	
	$y` = (Sinx + Cos\ x)$; $y = 3$, if $x = \pi$	$y\ dx + cotan\ x\ dy = 0$; $3\ y = -1$, if $x = \pi/3$

Fundamentals of probability theory and mathematical statistics

Variant № 1

1. Find conditional probability of the event:
There are 10 balls in a box, 2 of them are green, 3 of them are black, 3 of them are red and 2 of them are blue.

What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

2. Draw the distribution of probabilities to find m = 0,1,2,3,4 healthy patients in the group of 4 participants of this experiment, when the probability to have this disease is 0.2.

3. Estimate the error of indirect measurement, here Q is result of the indirect measurement and the scores υ and S represent the results of the direct measurements:

$$Q = \upsilon * S$$

$\upsilon_1 = 5$ m/s, $\upsilon_2 = 6$ m/s, $\upsilon_3 = 6$ m/s, $\upsilon_4 = 5$ m/s, $\Delta\upsilon_{in} = 0.01$ m/s
$S_1 = 12\ m^2$, $S_2 = 13\ m^2$, $S_3 = 11\ m^2$, $S_4 = 10\ m^2$, $\Delta S_{in} = 0.2\ m^2$
Confidence probability $\alpha = 0.95$.

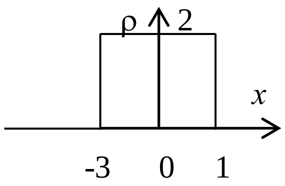
4. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the discrete variable

x	5	7	10
p	0.3	0.4	0.3

5. *Find*: the unknown variable and probability, if mean (M) equal to 10.8

x	12	x_2	9	11	13
p	0.2	0.2	0.3	p_4	0.2

6. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the continuous variable



7. The normal distribution (the properties, the formula, the parameters of the distribution, the graph); the standard distribution.
The standard intervals and confidence probabilities; 1 - σ rule, 2 - σ rule, 3 - σ rule.

Variant № 2

1. Find conditional probability of the event:
There are 11 balls in a box, 1 of them are green, 1 of them are black, 2 of them are red and 7 of them are blue.

What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

2. Calculate the probabilities to find 0, 1, 3 and 4 healthy patients among the group of 4 participants and create a chart, demonstrating the distribution of the probabilities (here probability of the disease is 0,2).

3. Estimate the error of indirect measurement, here F is result of the indirect measurement and the scores m, r and ν represent the results of the direct measurements:

$$F = \omega^2 * m * r:$$

$m_1 = 10.0g$, $m_2 = 10.2g$, $m_3 = 10.1g$
$r_1 = 0,12$ m, $r_2 = 0,13$ m, $r_3 = 0,11$ m
$\nu = 10^3$ Hz – Const ($\omega=2\pi\nu$)
$\Delta m_{in} = 5*10^{-4}$ kg, $\Delta r_{in} = 10^{-3}$ m
Confidence probability $\alpha = 0.95$.

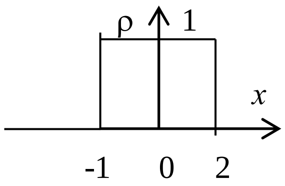
4. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the discrete variable

x	0.6	0.5	0.7
p	0.2	0.5	0.3

5. *Find*: the unknown variable and probability, if mean (M) equal to 15.2

x	14	x_2	13	15	17
p	0.2	0.2	0.3	p_4	0.2

6. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the continuous variable



7. Binomial distribution (the properties, the formula, the parameters of the distribution, the graph).
Poisson distribution (the properties, the formula, the parameters of the distribution, the graph).

Variant № 3

1. Find conditional probability of the event:
There are 21 balls in a box, 1 of them are red, 1 of them are blue, 10 of them are green and 9 of them are black.

What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

2. Calculate the probabilities to take out 0, 1, 3 and 4 independent trials if the urn contains 8 blue balls and 4 green balls (a ball is put back into the urn after each trial) and create a chart, demonstrating the distribution of the probabilities.

3. Estimate the error of indirect measurement, here Q is result of the indirect measurement and the scores I, R, and t represent the results of the direct measurements:

$$Q = I^2 * R * t, \text{ где:}$$

$I_1 = 5,0$ A , $I_2 = 5.2$ A, $I_3 = 5.1$ A
$R_1 = 12,4\ \Omega$, $R_2 = 12,2\ \Omega$, $R_3 = 12,3\ \Omega$
$t_1 = 10.0$ s, $t_2 = 10.1$ s, $t_3 = 10.5$ s
$\Delta I_{пр} = 0.3$ A, $\Delta R_{in} = 0.12\ \Omega$, $\Delta t_{in} = 0.01$ s
Confidence probability $\alpha = 0.98$.

4. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the discrete variable

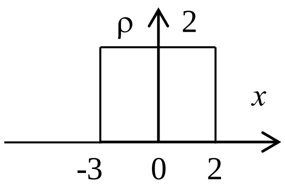
x	4.4	5.3	8.1	9.6

p	0.2	0.3	0.4	0.1

5. *Find*: the unknown variable and probability, if mean (M) equal to 3.9

x	4	x_2	3	5	7
p	0.2	0.3	p_3	*0.3*	0.1

6. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the continuous variable



7. Enumerate and explain the statistical meaning of parameters of parent population and characteristics of a sample. Set up conformance between the population parameters and characteristics of a sample.

Variant № 4

1. Find conditional probability of the event:
There are 12 balls in a box, 2 of them are green, 4 of them are black, 1 of them are red and 5 of them are blue.

What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

2. Draw the probability distribution of $P_n(m)$ to take 0,1,2,3,yellow balls in 5 trials (the box contains 8 yellow and 8 green balls).

3. Estimate the error of indirect measurement, here ε is result of the indirect measurement and the scores L and I represent the results of the direct measurements:

$$\varepsilon = L \times I^2/2$$

$L_1 = 0.3$ H, $L_2 = 0.4$ H, $L_3 = 0.4$ H, $L_4 = 0.5$ H
$I_1 = 1{,}2$ A, $I_2 = 1{,}3$ A, $I_3 = 1{,}1$ A, $I_4 = 1{,}0$ A
$\Delta L_{in} = 0.01$ H, $\Delta I_{in} = 0.2$ A
Confidence probability $\alpha = 0.95$.

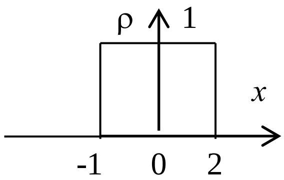
4. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the discrete variable

x	0.35	0.55	0.77	0.89
p	0.2	0.3	0.3	0.2

5. *Find*: the unknown variable and probability, if mean (M) equal to 5.0

x	3	x_2	6	5	7
p	0.1	0.3	p_3	*0.2*	0.1

6. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the continuous variable



7. Kinds of errors of measurements. Define possible sources for all of error`s types. The methods of elimination of crude and systematic errors; the examples.

Variant № 5

1. Find conditional probability of the event:
There are 18 balls in a box, 3 of them are green, 4 of them are black, 5 of them are red and 6 of them are blue.

What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

2. Draw the probability distribution of $P_n(m)$ to take 0,1,2,3,4 yellow balls in 5 trials (the box contains 8 yellow and 8 green balls).

3. Estimate the error of indirect measurement, here p is result of the indirect measurement and the scores ρ, c and υ represent the results of the direct measurements:

$$p = \rho * c * \upsilon$$

$\rho_1 = 10.2$ kg/m^3 , $\rho_2 = 10.4$ kg/m^3, $\rho_3 = 10.3$ kg/m^3
$\upsilon_1 = 2.0$ m/s , $\upsilon_2 = 2.0$ m/s, $\upsilon_3 = 2.3$ m/s
c = 330 м/c - Const
$\Delta \rho_{in} = 0.13$ kg/m^3, $\Delta\upsilon_{in} = 0.2$ m/s.
Confidence probability $\alpha = 0.95$.

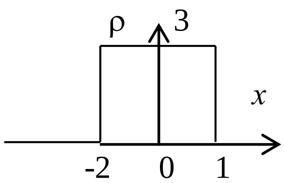
4. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the discrete variable

x	1.7	4.5	6.1	7.0
p	0.2	0.3	0.3	0.2

5. *Find*: the unknown variable and probability, if mean (M) equal to 3.8

x	3	1	6	x_4	7
p	0.2	p_2	0.2	*0.2*	0.1

6. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the continuous variable



7. The normal distribution (the properties, the formula, the parameters of the distribution, the graph); the standard distribution.
The standard intervals and confidence probabilities; 1 - σ rule, 2 - σ rule, 3 - σ rule.

Variant № 6

1. Find conditional probability of the event:
There are 12 balls in a box, 3 of them are green, 2 of them are black, 3 of them are red and 4 of them are blue.

What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

2. Find the probability to diagnose the disease “D” in 2 patients per day in the group of 292 participants, if the disease is diagnosed in 7 patients per year.

3. Estimate the error of indirect measurement, here Q is result of the indirect measurement and the scores *I*, *R* and *t* represent the results of the direct measurements:

$$Q = I^2 \times R \times t$$

$I_1 = 4{,}0$ A , $I_2 = 4.2$ A, $I_3 = 4.1$ A
$R_1 = 11{,}4\ \Omega$, $R_2 = 11{,}2\ \Omega$, $R_3 = 11{,}3\ \Omega$
$t_1 = 9.0$ s, $t_2 = 9.1$ s, $t_3 = 9.5$ s
$\Delta I_{in} = 0.09$ A, $\Delta R_{in} = 0.11\Omega$, $\Delta t_{in} = 0.01$ s
Confidence probability $\alpha = 0.98$.

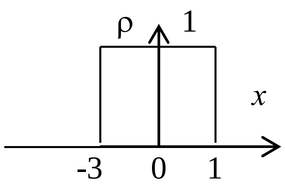
4. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the discrete variable

x	1.6	1.2	1.6	2.3	1.5
p	0.2	0.1	0.3	0.2	0.2

5. *Find*: the unknown variable and probability, if mean (M) equal to 6.6

x	x_1	8	5	6	7
p	p_1	0.3	0.2	0.1	0.2

6. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the continuous variable



7. Binomial distribution (the properties, the formula, the parameters of the distribution, the graph).
Poisson distribution (the properties, the formula, the parameters of the distribution, the graph).

Variant № 7

1. Find conditional probability of the event:
There are 20 balls in a box, 4 of them are green, 5 of them are black, 8 of them are red and 3 of them are blue.

What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

2. Draw the probability distribution of $P_n(m)$ to take 0,1,2,3,4 yellow balls in 5 trials (the box contains 7 yellow and 7 green balls).

3. Estimate the error of indirect measurement, here p is result of the indirect measurement and the scores ω, S and υ represent the results of the direct measurements:

$$\Phi = \omega \times S \times \upsilon$$

υ_1 = 3 m/s, υ_2 = 4м/с, υ_3 = 4 m/s, υ_4 = 5 m/s
S_1 = 1,2 m^2, S_2 =1,3 m^2, S_3 =1,1 m^2, S_4 =1,0 m^2
ω_1 = 20 W/m^3 , ω_2 = 22 W/m^3, ω_3=21 W/m^3
$\Delta\upsilon_{in}$ = 0.01 m/s, ΔS_{in} = 0.2 m^2, $\Delta\omega_{in}$ = 0.02 W/m^3
Confidence probability α = 0.95.

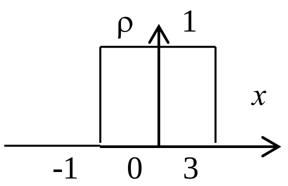
4. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the discrete variable

x	1.75	1.81	1.79	1.84
p	0.3	0.2	0.2	0.3

5. *Find*: the unknown variable and probability, if mean (M) equal to 6.5

x	x_1	8	5	6
p	p_1	0.3	0.3	0.2

6. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the continuous variable



7. Enumerate and explain the statistical meaning of parameters of parent population and characteristics of a sample. Set up conformance between the population parameters and characteristics of a sample.

Variant № 8

1. Find conditional probability of the event:
There are 17 balls in a box, 3 of them are green, 4 of them are black, 7 of them are red and 3 of them are blue.

What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

2. Draw the probability distribution of $P_n(m)$ to take 0,1,2,3,4 yellow balls in 4 trials (the box contains 6 yellow and 8 green balls).

3. Estimate the error of indirect measurement, here Q is result of the indirect measurement and the scores υ and S represent the results of the direct measurements:

$$Q = \upsilon * S$$

υ_1 = 10 m/s, υ_2 = 9 m/s, υ_3 = 11 m/s, υ_4 = 12 m/s, $\Delta\upsilon_{in}$ = 0.1 m/s
S_1 = 8 m^2, S_2 =9 m^2, S_3 =7 m^2, S_4 =8 m^2 , ΔS_{in} = 0.01 m^2
Confidence probability α = 0.98.

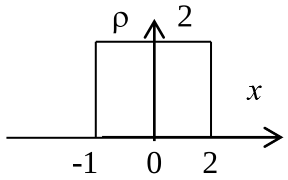
4. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the discrete variable

x	0.9	1.1	0.8	0.7
p	0.1	0.4	0.3	0.2

5. *Find*: the unknown variable and probability, if mean (M) equal to 0.79

x	0.7	0.8	x_3	0.6
p	p_1	0.3	0.3	0.2

6. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the continuous variable



7. Kinds of errors of measurements. Define possible sources for all of error\`s types. The methods of elimination of crude and systematic errors; the examples.

Variant № 9

1. Find conditional probability of the event:
There are 12 balls in a box, 3 of them are green, 2 of them are black, 3 of them are red and 4 of them are blue.

What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

2. Find the probability to diagnose the disease "D" in 2 patients per day in the group of 292 participants, if the disease is diagnosed in 7 patients per year.

3. Estimate the error of indirect measurement, here Q is result of the indirect measurement and the scores *I*, *R* and *t* represent the results of the direct measurements:

$$Q = I^2 \times R \times t$$

$I_1 = 4{,}0$ A , $I_2 = 4.2$ A, $I_3 = 4.1$ A
$R_1 = 11{,}4\ \Omega$, $R_2 = 11{,}2\ \Omega$, $R_3 = 11{,}3\ \Omega$
$t_1 = 9.0$ s, $t_2 = 9.1$ s, $t_3 = 9.5$ s
$\Delta I_{in} = 0.09$ A, $\Delta R_{in} = 0.11\Omega$, $\Delta t_{in} = 0.01$ s
Confidence probability $\alpha = 0.98$.

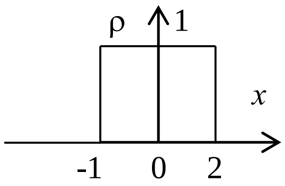
4. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the discrete variable

x	0.51	0.55	0.67
p	0.3	0.5	0.2

5. *Find*: the unknown variable and probability, if mean (M) equal to 15.2

x	14	x_2	13	15	17
p	0.2	0.2	0.3	p_4	0.2

6. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the continuous variable



7. The normal distribution (the properties, the formula, the parameters of the distribution, the graph); the standard distribution.
The standard intervals and confidence probabilities; 1 - σ rule, 2 - σ rule, 3 - σ rule.

Variant № 10

1. Find conditional probability of the event:
There are 17 balls in a box, 3 of them are green, 4 of them are black, 7 of them are red and 3 of them are blue.

What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

2. Draw the probability distribution of $P_n(m)$ to take 0,1,2,3,4 yellow balls in 4 trials (the box contains 6 yellow and 8 green balls).

3. Estimate the error of indirect measurement, here Q is result of the indirect measurement and the scores υ and S represent the results of the direct measurements:

$$Q = \upsilon * S$$

$\upsilon_1 = 10$ m/s, $\upsilon_2 = 9$ m/s, $\upsilon_3 = 11$ m/s, $\upsilon_4 = 12$ m/s, $\Delta\upsilon_{in} = 0.1$ m/s
$S_1 = 8\ m^2$, $S_2 = 9\ m^2$, $S_3 = 7\ m^2$, $S_4 = 8\ m^2$, $\Delta S_{in} = 0.01\ m^2$
Confidence probability $\alpha = 0.98$.

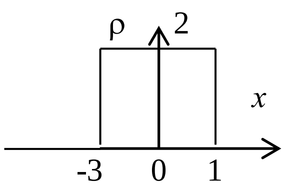
4. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the discrete variable

x	9	11	10
p	0.4	0.4	0.2

5. *Find*: the unknown variable and probability, if mean (M) equal to 10.8

x	11	x_2	9	10	12
p	0.3	0.1	0.3	p_4	0.1

6. *Find*: mean (***M***), variance (***D***), standard deviation (S_x) for the continuous variable



7. Binomial distribution (the properties, the formula, the parameters of the distribution, the graph).
Poisson distribution (the properties, the formula, the parameters of the distribution, the graph).

4.3. Questions for colloquium *(the competence code "UC-1", "GPC-1"):*

1. Definition of probability (statistical and classical). Properties of probabilities.
2. Conditional probability. The additivity principle and the principle of multiplication of probabilities. Bayes's theorem.
3. The Normal distribution. (The properties, the main parameters of the distribution, graphical and analytic representation).
4. The Binomial distribution. (The properties, the main parameters of the distribution, graphical and analytic representation).
5. The Poisson distribution. (The properties, the main parameters of the distribution, graphical and analytic representation).
6. The mean and the variance of discrete and continuous variables. (The formulas and their statistical meaning).
7. A confidence probability. Confidence intervals. The parent population and samples. Enumerate and explain the meaning of the parameters of the parent population and the characteristics of samples.
8. The problem of hypothesis testing. The H0 - hypothesis (or the Null - hypothesis), the alternative hypothesis. Describe the difference between the parametric and the non-parametric methods. Explain the method of confidence intervals.
9. The problem of correlation and a regression function. A coefficient of correlation, its features. A scatter diagram, linear and non-linear plots.
10. Explain the Pirson's coefficient method and its features.
11. Describe the difference between the parametric and the non-parametric methods. Explain the Fechner's coefficient method and its features.

4.4. Tasks (assessment tools) for the credit *(the competence code "UC-1", "GPC-1"):*

DIFFERENTIAL CALCULUS

PROBLEMS

I. Calculate the derivative of the product of functions

1. $y = \frac{x^2}{2} \cdot \cos x$	6. $y = Sin\, x \cdot Cos\, x$
2. $y = \sqrt[3]{x} \cdot lg\, x$	7. $y = x \cdot ln\, x$
3. $y = ln\, x \cdot tg\, x$	8. $y = Cos\, x \cdot ln\, x$
4. $y = e^x Sinx$	9. $y = log_a x \cdot Sin\, x$
5. $y = \sqrt{x} \cdot ctg\, x$	10. $y = a^x \cdot \sqrt[3]{x}$

II. Calculate the derivative of a fraction

1. $y = \frac{tg\, x + x^2}{\cos x}$	3. $y = \frac{4x^3 - lg\, x}{4}$

2. $y=\frac{1-Sinx}{1+Sinx}$	4. $y=\frac{x^2-4}{x^2+4}$

III. Find derivatives of the following functions

1. $y=x+3x^2-\frac{x^3}{3}$	5. $y=\left(\sqrt{x}-\sqrt{a}\right)^2$
2. $y=\frac{x^3}{3}-2x^2+4x-5$	6. $y=x^6+3x^3-10$
3. $y=5Sinx+\ln x$	7. $y=\frac{x^3}{3}-2\sqrt{x}+\frac{1}{x}+2$
4. $y=\sqrt[7]{x}-\frac{tgx}{3}$	8. $y=\frac{1}{x}+\frac{1}{x^2}+a^x$

IV. Calculate the differentials of the following functions

1. $y=\frac{Sinx-Cosx}{\sqrt[3]{x}}$	4. $y=e^{-(1/x)}$
2. $y=\frac{x^3+\sqrt{x}}{e^x}$	5. $y=\sqrt{x}\, tg\, x$
3. $y=\frac{x^3}{x^2+1}$	6. $y=\sqrt[3]{Sin2x}$

V. Find partial derivatives of functions with respect to independent variables

1. $f(x,z)=Sinx-Cosz$	4. $f(x,z,t) = \ln x(z+t)$
2. $f(x,t) = x^2+t-5$	5. $f(x,u,t) = \cos x/(u-\ln t)$
3. $f(x,u)=\frac{u^3}{x^2+1}$	6. $f(x,y,z)=\sqrt{x^2-3y^3+5z^5}$

INTEGRALS CALCULUS

PROBLEMS

I. **Find the integrals by a direct integration**

1. $\int\frac{dx}{x^3}$	6. $\int\frac{x^2+\sqrt{x^3}+3}{\sqrt{x}}dx$
2. $\int\frac{dx}{\sqrt{x^3}}$	7. $\int 7^x dx$
3. $\int 3^t dt$	8. $\int\left(\frac{2+x}{x}\right)^2 dx$

4. $\int \sqrt{y}\, dy$	9. $\int \frac{(x+1)^2}{\sqrt{x}} dx$
5. $\int \left(\frac{1}{Cos^2 x} + \frac{1}{Sin^2 x} \right) dx$	10. $\int \frac{4-x}{2+\sqrt{x}} dx$

II. Find integrals by the method of variable substitution

1. $\int Cos\, 3x\, dx$	6. $\int e^{x^2}\, x\, dx$
2. $\int \left(Sin\frac{x}{2} + Cos\, 3x \right) dx$	7. $\int e^{-\frac{1}{x}} \frac{dx}{x^2}$
3. $\int \left(e^x + e^{-x}\right) dx$	8. $\int e^{\cos x}\, Sin\, x\, dx$
4. $\int \frac{a}{2}\left(e^{\frac{x}{a}} + e^{-\frac{x}{a}} \right) dx$	9. $\int \frac{Cos\, x}{1+2Sin\, x} dx$
5. $\int \frac{x\, dx}{x^2+3}$	10. $\int \frac{dx}{x \ln x^2}$

III. Calculate the integrals

1. $\int_0^1 \frac{2\, x\, dx}{(x^2+1)}$	6. $\int_0^{\pi/2} Sin^3 x\, dx$
2. $\int_0^1 \frac{e^x}{e^x+1} dx$	7. $\int_1^e \frac{\ln x\, dx}{x}$
3. $\int_{\sqrt{3}}^{\sqrt{7}} \frac{x^3\, dx}{\sqrt[3]{x^4+1}}$	8. $\int_0^{\frac{\pi}{2}} Sin\, x\, Cos\, x\, dx$

4. $\int_1^e \frac{\sqrt{1+\ln x}}{x} dx$	9. $\int_0^{\frac{\pi}{2}} (Sin\, x^3)\ x^2\ dx$
5. $\int_0^4 \frac{x\,dx}{\sqrt{x^2+9}}$	10. $\int_1^e \frac{1+\ln x^5}{x} dx$

DIFFERENTIAL EQUATIONS

PROBLEMS

I. **Find general solutions to differential equations with separable variables**:

1. $y' + 2 = 0$	6. $y' = -5 \sin (5x - 2)$
2. $Sin\ x\ dx = -dy$	7. $(2x + 3)dx - 2ydy = 0$
3. $e^y y' = 1$	8. $(\cos y)\ y' = tg\ x\ Sin\ y$
4. $y' = e^x \cdot ctg\ y$	9. $y' = 5^{x-y}$
5. $3y\,dx = 2\sqrt{x}\,dy$	10. $(x+1)dx - 2xydy = 0$

II. Find partial solutions to differential equations with separable variables satisfying the initial conditions

1. $(1+y^2)\ dx - \sqrt{x} \cdot ydy = 0;\ y = 0$ при $x = 1$
2. $y' + y\ tg\ x = 0;\ y = 2$ при $x = 0$
3. $\cos x \sin y\ dy - \cos y \sin x\ dx = 0;\ \ y = \pi/4$ при $x = \pi/3$
4. $y\ dx + ctg\ x\ dy = 0;\ \ \ y = 1$ при $x = \pi/3$
5. $y^2 + x^2 y' = 0;\ \ \ y = 1$ при $x = -1$

PROBABILITY THEORY

1. Calculate the probability that have the numbers 2 or 5 in a trial of the experiment consisting of tossing up the hexahedral dice.

2. Calculate the probability of failure of the following pairs of the three independent electrical batteries (№№ 1, 2, and 3) operating in an electrical circuit: № 1 and № 3, № 2 and№ 3, № 1 and №

3, if the probabilities of the individual failure of the batteries are p(№ 1) = 0.3, p(№ 2) = 0.2 and p(№ 3) = 0.5.

3. There are 11 balls in a box, 2 of them are green, 3 are black, 5 are red and 1 is a blue ball. What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

4. There are 11 balls in a box, 1 of them is a green ball, 5 are black, 3 of them are red and 2 of them are blue. What is the probability to take (a) a black ball, if you have taken out a green one before it? (b) a red ball, if you have taken out a green one before it? (c) a blue ball, if you have taken out a green one before it?

5. There are 21 balls in a box, 12 of them are green, 3 are black, 5 are red and 1 is a blue ball. What is the probability to take a black ball and a green one in two consequent trials, if the black ball is not put back into the box after the first trial?

THE DISTRIBUTIONS OF RANDOM VARIABLES

6. Find the variance and the standard deviation of a random variable, if the random variable has the following distribution law:

x	0,35	0,55	0,77	0,89
p	0,2	0,3	0,3	0,2

7. Find the variance and the standard deviation of a random variable, if the random variable has the following distribution law:

x	5	7	10
p	0,3	0,4	0,3

STATISTICAL METHODS OF DATA PROCESSING

ERRORS OF MEASUREMENTS

8. Estimate the error of direct measurements:
75, 73, 79, 80, 78, 76, 69, 80, 74, 75, (α=0.95)
2. Estimate the error of direct measurements:
20, 22, 19, 21, 21, 20, 18, 20, 19, 20, (α=0.99)

9. Estimate the error of an indirect measurement: $F = x^2 \cdot y/z$, where F is the result of indirect measurement and the values x, y and z represent the results of three direct measurements:
x: 2.5; 2.6; 2.4; $\Delta x_{inst} = 0.2$
y: 11.9; 12.5; 12.4; 12.4; $\Delta y_{inst} = 0.9$
z: 1.5; 1.7; 1.6; $\Delta z_{inst} = 0.01$
The confidence probability (α) is here 95%.
10. Estimate the error of an indirect measurement: $F = x^2 \cdot y/z^3$, where F is the result of indirect measurement and the values x, y and z represent the results of three direct measurements:
x: 1.4; 1.5; 1.3; $\Delta x_{inst} = 0.1$
y: 20.5; 21.3; 21.2; 21.2; $\Delta y_{inst} = 0.5$
z: 0.5; 0.7; 0.6; $\Delta z_{inst} = 0.01$
The confidence probability (α) is here 95%.

11. Estimate the error of an indirect measurement of the value F, represent the results of the indirect measurement of the value F in the standard form: $F_0 = \overline{F} \pm \Delta F$ where F is calculated according to the following mathematic formula: $F = x^2 \times y^4 \times z^7$ and the values x,y and z represent the results of the direct measurements, x= 2.2, 2.4, 2.3, y = 11, 14, 12, z = 0.9, 0.6, 0.7; the errors of the

measurement instruments are 0.03, 0.1 and 0.02, respectively. Assume that the confidence probability (α) is 95%.

STATISTICAL HYPOTHESES AND THEIR ESTIMATION

12. Determine the mode, the median, the mean value and the standard deviation of the variation series.

24, 30, 22, 26, 20, 28, 24, 28, 26, 22.

13. Find the mode, the mean value and the standard deviation of a sample, if a sample has the volume n = 70. This sample is drawn from the general population. It is characterized by the following distribution:

x_i	33	26	29	28	31
m_i	19	11	13	17	10

14. Solve the problem of H_0 - hypothesis by using a method of confidence intervals, if the sample X represents the results of measurements of a physical factor in a group of sick patients and Y represents the results of measurements of the physical factor in a group of healthy persons α = 95%:
X: 37, 39, 38, 38, 40, 37, 39.
У: 40, 47, 48, 41, 41, 45, 40.

15. Solve the problem of H_0 - hypothesis by using the method of **X criterion**; a set of experimental results $\boldsymbol{x}_{1,}$ represents here the result of measurements of the body mass in an experimental group of laboratory animals and $\boldsymbol{x}_2$ represents the results of measurements of the body mass in a control group of animals α_1 = 95%, α_2 = 99%.
$\boldsymbol{x}_1$: 6.7, 5.9, 5.9, 6.1, 6.4, 6.2, 6.2, 6.1, 6.3, 6.2
$\boldsymbol{x}_2$: 6.4, 6.2, 6.1, 6.3, 6.0, 6.9, 6.0, 6.1, 6.2, 6.0.

16. Solve the problem of H_0 - hypothesis by using the method of **U - criterion**, a set of experimental results $\boldsymbol{x}_1$ represents the result of measurements of a blood parameter in an experimental group of laboratory animals and $\boldsymbol{x}_2$, represents here the results of measurements of the blood parameter in a control group of animals, α = 99%.
$\boldsymbol{x}_1$:75,70, 64, 68,72, 79, 76, 83, 80;
$\boldsymbol{x}_2$:71, 70, 66, 60, 62,69, 73, 69, 60, 80, 78.

CORRELATION AND REGRESSION

17. Solve the problem of correlation between two sets of data by using the **Pearson's coefficient** method; characterize the result qualitatively; check the statistical confidence of a conclusion about correlation (α = 95%). See two paired samples below:
X: 40.00; 37.00; 36.50; 38.00; 38.30; 39.90; 37.10
Y: 0.95; 0.90; 0.86; 0.80; 0.95; 0.97; 0.98.

18. Find the **equation of regression** for two correlated scores and draw a **linear diagram**. See two paired samples below:
X: 120, 125,127, 134, 142, 149, 153, 159, 161, 167;
Y: 90, 120,190, 270, 220, 250, 290, 340, 440, 480.

5. The content of the assessment tools of mid-term assessment

Mid-term assessment is carried out in the form of a credit.

5.1 The list of control tasks and other materials necessary for the assessment of knowledge, skills and work experience.

5.1.1. Questions for the discipline exam

FSES are not provided

5.1.2. Questions for the credit in the discipline “Mathematics”
https://sdo.pimunn.net/mod/resource/view.php?id=205159

Question	Competence code (according to the WPD)
1. THE DERIVATIVE OF A CONSTANT VALUE IS… 1) *0* 2) – 1 3) + 1 4) ∞	UC-1, GPC-1
2. FIND THE DERIVATIVE OF THE FUNCTION $y = ln3x$ 1) $y' = 1/x$ 2) $y' = 1/(3x)$ 3) $y' = x/ln\ 3$ 4) $y' = 3/ ln\ x$	UC-1, GPC-1
3. CHOOSE THE TOTAL DIFFERENTIAL df OF THE FUNCTION $f(x,y) = Sin\ x + Cos\ y$ 1) $df = Cos\ x\ dx - Sin\ y\ dy$ 2) $df = Cos\ x\ dx + Sin\ y\ dy$ 3) $df = Cos\ y\ dx - Sin\ x\ dy$ 4) $df = Cos\ y\ dx + Sin\ x\ dy$	UC-1, GPC-1
4. FIND THE INTEGRAL $\int x^3\,dx$ 1) $3x^2 + C$ 2) $\frac{x^4}{4} + C$ 3) $-\frac{x^4}{4} + C$ 4) $\frac{1}{4x^4} + C$	UC-1, GPC-1
5. CALCULATE THE DEFINITE INTEGRAL $\int_3^{24} dx$ 1) 0 2) 1 3) 8 4) 21	UC-1, GPC-1
6. CHOOSE THE GENERAL SOLUTION OF THE DIFFERENTIAL EQUATION $y'Cos\ y= Sin\ x$ 1) $Sin\ y = -Cos\ x + C$ 2) $Sin\ y = -Cos\ x\cdot C$ 3) $Sin\ y = Cos\ x+ C$ 4) $Sin\ y = Cos\ x\cdot C$	UC-1, GPC-1

7. A DISCRETE RANDOM VARIABLE IS REPRESENTED BY THE DISTRIBUTION <table><tr><td>x</td><td>5</td><td>7</td></tr><tr><td>p</td><td>0.4</td><td>?</td></tr></table>CHOOSE THE MATHEMATICAL EXPECTATION 1) 4.8 2) 2.4 3) 1.6 4) 6.2 5) 7.8	UC-1, GPC-1
8. THE NORMAL LAW GRAPH HAS THE FORM OF THE…. 1) straight line 2) hyperbola 3) bell-shaped curve 4) exponent 5) parabola	UC-1, GPC-1
9. CHOOSE THE ANALYTICAL FORM OF THE POISSON'S LAW 1) $p_n(m) = \frac{\mu^m}{m!} e^{-\mu}$ 2) $p_n(m) = \frac{\mu^m}{m!} e^{\mu}$ 3) $p_n(m) = \frac{\mu^m}{(m-\mu)!} e^{m-\mu}$ 4) $p_n(m) = \frac{n!}{m!(n-m)!} p^m (1-p)^{n-m}$ 5) $p_n(m) = \frac{n!}{m!(n-m)!} p^m (n-p)^{n-m}$	UC-1, GPC-1
10. CHOOSE THE MINIMUM VOLUME OF A REPRESENTATIVE SAMPLE 1) 10 2) 8 3) 5 4) 3 5) 1	UC-1, GPC-1
11. THE H_0 HYPOTHESIS CAN BE REJECTED IN THE STUDENT'S CRITERION, IF… 1) $t_{exp} \geq t_{crit}$ 2) $t_{exp} < t_{crit}$ 3) $t_{a\ priori} > t_{crit}$ 4) $t_{a\ priori} < t_{a\ posteriori}$ 5) $t_{a\ posteriori} > t_{crit}$	UC-1, GPC-1
12. THE H_0 HYPOTHESIS CAN BE REJECTED IN THE SIGNS CRITERION (Z-CRITERION), IF… $Z_{a\ priori} > Z_{crit}$ $Z_{a\ priori} < Z_{a\ posteriori}$	UC-1, GPC-1

$Z_{\text{a posteriori}} > Z_{\text{crit}}$ $Z_{\text{exp}} \geq Z_{\text{crit}}$ $Z_{\text{exp}} < Z_{\text{crit}}$	
13. THE CORRELATION COEFFICIENT LIES BETWEEN… 1) $-\infty < r < +\infty$ 2) $0 < r < 1$ 3) $-\infty < r < -1$ 4) $1 < r < +\infty$ 5) $-1 < r < 1$	UC-1, GPC-1
14. CHOOSE THE NON-PARAMETRIC CORRELATION INDICATOR 1) the correlation coefficient 2) the regression coefficient 3) the Fisher coefficient 4) the Fechner coefficient 5) the coefficient signs	UC-1, GPC-1

Theoretical Questions for the test

Question	Competence code (according to the WPD)
1. A random event. Probability determination (statistical and classical). The concept of joint and incompatible, dependent and independent, equally and unequally probable events. Examples.	UC-1, GPC-8
2. Theorems of addition and multiplication of probabilities. Conditional probabilities.	UC-1, GPC-8
3. Total probability. Bayes' theorem.	UC-1, GPC-8
4. Discrete and continuous random variables. Numerical characteristics of continuous and discrete random variables (mathematical expectation, variance, mean square deviation).	UC-1, GPC-8
5. The normal distribution law of continuous random variables. Analytical and graphical types of the normal law. Examples of random variables described by a normal law. Probability density. Standard intervals. Mathematical expectation and variance, for the corresponding quantities. Examples.	UC-1, GPC-8
6. Properties of binomial distribution, Bernoulli formula. Distribution parameters. Examples.	UC-1, GPC-8
7. Poisson distribution, its properties. Distribution parameters. Examples.	UC-1, GPC-8
8. The confidence interval and confidence probability. Student's coefficient. Calculation of the confidence interval. The probability of a random variable falling into the confidence interval. Standard intervals.	UC-1, GPC-8
9. Variation series. Ranking. Methods of plotting variation series: histograms, frequency polygons, cumulates.	UC-1, GPC-8
10. The parent population and sample. Sample volume, representativeness. Estimation of the parameters of the general population according to the characteristics of the sample	UC-1, GPC-8
11. Direct and indirect measurements (definitions, examples). Types of measurement errors. Absolute and relative measurement errors. Examples.	UC-1, GPC-8
12. Statistical hypotheses and their verification. The concept of the null hypothesis. Parametric Student's criterion (Student's t - criterion), its properties.	UC-1, GPC-8

Conditions of its application.	
13. The problem of Statistical hypotheses testing. The “interval method”. Parametric and non-parametric methods. The concept of the null hypothesis. Metods based on rank order: the Van der Varden X-test; the Mann -Whitney U test; the Z sign criterion.	UC-1, GPC-8
14. Correlation, correlation and functional relationships. Differences between correlation and functional. Correlation coefficient – the Pirson’s coefficient of correlation.	UC-1, GPC-8
15. Correlation, correlation and functional relationships. Differences between correlation and functional. The Fechner correlation coefficient.	UC-1, GPC-8
16. Regression analysis. Regression lines. Linear regression equations, regression coefficients. The linear correlation coefficient, its properties.	UC-1, GPC-8

5.1.3. The subject of term papers *(if provided by the curriculum)*
FSES are not provided

6. Criteria for evaluating learning outcomes

For the credit

Learning outcomes	Evaluation criteria	
	Not passed	**Passed**
Completeness of knowledge	The level of knowledge is below the minimum requirements. There were bad mistakes.	The level of knowledge in the volume corresponding to the training program. Minor mistakes may be made
Availability of skills	Basic skills are not demonstrated when solving standard tasks. There were bad mistakes.	Basic skills are demonstrated. Typical tasks have been solved, all tasks have been completed. Minor mistakes may be made.
Availability of skills (possession of experience)	Basic skills are not demonstrated when solving standard tasks. There were bad mistakes.	Basic skills in solving standard tasks are demonstrated. Minor mistakes may be made.
Motivation (personal attitude)	Educational activity and motivation are poorly expressed, there is no willingness to solve the tasks qualitatively	Educational activity and motivation are manifested, readiness to perform assigned tasks is demonstrated.
Characteristics of competence formation*	The competence is not fully formed. The available knowledge and skills are not enough to solve practical (professional) tasks. Repeated training is required	The competence developed meets the requirements. The available knowledge, skills and motivation are generally sufficient to solve practical (professional) tasks.
The level of competence formation*	Low	Medium/High

For testing:

Mark "5" (Excellent) - points (100-90%)
Mark"4" (Good) - points (89-80%)
Mark "3" (Satisfactory) - points (79-70%)

Less than 70% – Unsatisfactory – Mark "2"

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