

Документ подписан простой электронной подписью
Информация о владельце:
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MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution
Higher Education
"NORTH CAUCASUS FEDERAL UNIVERSITY"

APPROVED BY
Acting Director of the Institute
Advanced Engineering
A.A. Porokhnya

DISCIPLINE ASSESSMENT TOOLS FUND
"Probability Theory and Mathematical Statistics"

Field of study	11.03.02 Infocommunication Technologies and Communication Systems
Profile	Intelligent Data Processing in Infocommunication Systems and Networks
Year of start of training	2026
Form of study	Full-time
Implemented in a semester	3

Introduction

1. Purpose: conducting current monitoring of progress and intermediate certification in the discipline "Probability Theory and Mathematical Statistics".

2. FOS is an appendix to the program of the discipline "Probability Theory and Mathematical Statistics".

3. Developer: Tarasenko Elena Olegovna, Associate Professor of the Department of Computational Mathematics and Cybernetics, Candidate of Physical and Mathematical Sciences, Associate Professor

4. An examination of the FAT was carried out.

Chairman:

Kopytkova L.B. – Chairman of the CMT FM&CN named after N.I. Chervyakov.

Members of the Commission:

Babenko M.G. – Head of the Department of Computational Mathematics and Cybernetics.

Oblasova I.N. – Associate Professor of the Department of Computational Mathematics and Cybernetics.

Representative of the employer's organization:

Mironov V.A., General Director of Orintex LLC.

Expert opinion: The FAT for the discipline allows you to assess the level of competence formation. Start approbation.

5. The validity period of the FAT shall be determined by the period of implementation of the educational programme.

1. Description of the criteria for assessing competence at various stages of their formation, description of assessment scales

Levels of competence formation(s), indicator(s)	Levels of competence formation(s)			
	The minimum level has not been reached (Unsatisfactory) 2 points	Minimum level (satisfactory) 3 points	Intermediate level (good) 4 points	High level (excellent) 5 points
<i>Competence:</i> OPK-1. Able to use the provisions, laws and methods of natural sciences and mathematics to solve problems of engineering activities				
Learning outcomes in the discipline (module): <i>Indicator:</i> ID-1 OPK-1 understands the fundamental laws of nature and the basic physical mathematical laws and methods of accumulating, transmitting and processing information.	Does not know and does not understand the fundamental laws of nature and the basic physical mathematical laws and methods of accumulating, transmitting and processing information.	Satisfactorily knows and understands the fundamental laws of nature and the basic physical mathematical laws and methods of accumulating, transmitting and processing information.	Knows and understands well the fundamental laws of nature and the basic physical mathematical laws and methods of accumulating, transmitting and processing information.	He knows and understands the fundamental laws of nature and the basic physical mathematical laws and methods of accumulating, transmitting and processing information.
<i>Indicator:</i> ID-2 OPK-1 applies physical laws and mathematical methods to solve problems of a theoretical and applied nature.	Does not know how to apply physical laws and mathematical methods to solve problems of a theoretical and applied nature.	He is poorly able to apply physical laws and mathematical methods to solve problems of a theoretical and applied nature.	He is good at applying physical laws and mathematical methods to solve problems of a theoretical and applied nature.	He is perfectly able to apply physical laws and mathematical methods to solve problems of a theoretical and applied nature.
<i>Indicator:</i> ID-3 OPK-1 uses knowledge of physics and mathematics to solve practical problems	Does not use knowledge of physics and mathematics in solving practical problems	Poorly uses knowledge of physics and mathematics in solving practical problems	Uses knowledge of physics and mathematics well in solving practical problems	Perfectly uses knowledge of physics and mathematics in solving practical problems

Assessment of the level of competence in the discipline is carried out on the basis of the "Regulation on the current monitoring of progress and intermediate certification of students in educational programs of higher education - bachelor's programs, specialist programs, master's programs - in the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University" in the current edition.

ASSESSMENT TOOLS TO CHECK THE LEVEL OF FORMATION OF COMPETENCIES

Job Number	Correct answer	Content of the question	Competence	Time to complete the task
1.	The probability of a random event A is the ratio of the number of outcomes favorable to event A to the total number of outcomes $P(A)=m/n$	Formulate a classic definition of the probability of a random event	OPK-5	2 minutes
2.	1 3 4	Specify the probability properties of an event 1) the probability of an impossible event is zero 2) the probability of an extraordinary event is equal to one 3) the probability of a reliable event is equal to one 4) the probability of a random event is a positive number enclosed between zero and one 5) the probability of an amazing event is one hundred	OPK-5	1 minute
3.	The main disadvantage of the statistical determination of probability is its ambiguity as a result of conducting an experiment	Point out the main disadvantage of statistical probability	OPK-5	2 minutes
4.	1 – A 2 – B 3 – B	Establish a correspondence between the types of events when rolling a dice 1) Authentic Event 2) Impossible event 3) Random Event A) A number of points not exceeding 6 B) Getting 3 points C) Getting 10 points	OPK-5	2 minutes
5.	The probability of the sum of two events is equal to the sum of the probabilities of each of them without the probability of their occurrence together $P(A+B)=P(A)+P(B)-P(AB)$	Formulate the addition theorem (for the case of two events)	OPK-5	5 minutes

6.	The probability of the product of two events is equal to the product of the probability of one of them by the conditional probability of the other, provided that the first occurred $P(AB)=P(A)*P(B A)$	Formulate the multiplication theorem (for the case of two events)	OPK-5	5 minutes
7.	1 – B 2 – B 3 – A	Establish a correspondence between the formulations of the basic theorems of probability theory 1) The probability of the product of two events is equal to the product of the probability of one of them by the conditional probability of the other, provided that the first event occurred 2) The sum of the probabilities of opposite events is equal to 1 3) The probability of the sum of events A and B is equal to A) $p(A + B) = p(A) + p(B) - p(AB)$ B) $p(A) + p(\bar{A}) = 1$ C) $p(AB) = p(A)p(B A)$	OPK-5	2 minutes
8.	Combinations	Fill in the missing word. _____ are unordered sets of m elements of a set containing n different elements (that is, sets that differ only in the composition of the elements)	OPK-5	1 minute
9.	3 - probability k occurrences of event A for mass (n large) and rare (p few) events	Poisson's formula allows you to find 1) the probability k occurrence of event A for dependent (n is large) and reliable ($p=1$) events 2) probability k occurrences of event A for joint (n few) and impossible ($p=0$) events 3) probability k occurrences of event A for mass (n large) and rare (p few) events 4) probability k occurrences of event A for few (n few) and frequent (p large) events	OPK-5	2 minutes

10.	Bayes' formula is used to overestimate the probabilities of hypotheses given a known result of the experiment	What is Bayes' formula used for?	OPK-5	2 minutes								
11.	The law of distribution of a random variable is the correspondence between the possible values of a random variable and the probabilities with which these values are accepted	Formulate a definition of the law of distribution of a random variable	OPK-5	3 minutes								
12.	$P(0)=0.4*0.3=0.12$ $P(1)=0.6*0.3+0.4*0.7$ $P(2)=0.6*0.7=0.42$ <table><tr><td>x_i</td><td>0</td><td>1</td><td>2</td></tr><tr><td>p_i</td><td>0,12</td><td>0,46</td><td>0,42</td></tr></table>	x_i	0	1	2	p_i	0,12	0,46	0,42	Two biathletes make one shot at the target. The probabilities of their hit with one shot are equal to 0.6 and 0.7, respectively. Make a series of distribution of the random variable X – the number of hits after two shots	OPK-5	5 minutes
x_i	0	1	2									
p_i	0,12	0,46	0,42									
13.	The distribution function of a random variable is the probability that a random variable X will assume a value less than x	Formulate a definition of a random variable distribution function	OPK-5	2 minutes								
14.	$\int_{-\infty}^{+\infty} f(x)dx = 1$	Write down the condition for normalizing the density of distribution of a continuous random variable	OPK-5	2 minutes								
15.	The mathematical expectation of a discrete random variable is the sum of the products of its possible values by their corresponding probabilities $M(x) = x_1p_1 + x_2p_2 + \dots + x_np_n$	Mathematical expectation of a discrete random variable	OPK-5	5 minutes								
16.	$M(X)=(-2)*0,2+2*0,8=1,2$	The random variable X is given by the law of distribution: <table><tr><td>X</td><td>-2</td><td>2</td></tr><tr><td>p</td><td>0,2</td><td>0,8</td></tr></table> Calculate Mathematical Expectation of a Random Variable	X	-2	2	p	0,2	0,8	OPK-5	5 minutes		
X	-2	2										
p	0,2	0,8										
17.	The dispersion (scattering) of a discrete random variable is the mathematical	Dispersion of a discrete random variable	OPK-5	5 minutes								

	expectation of the square of its deviation from its mathematical expectation $D(x) = M(X - M(X))^2$									
18.	$D(X)=(-2-1,2)^2*0,2+(2-1,2)^2*0,8=2,56$	The random variable X is given by the law of distribution: <table><tr><td>X</td><td>-2</td><td>2</td></tr><tr><td>p</td><td>0,2</td><td>0,8</td></tr></table> Calculate Variance of Random Variable	X	-2	2	p	0,2	0,8	OPK-5	5 minutes
X	-2	2								
p	0,2	0,8								
19.	1 – A 2 – B 3 – B	The random variable X is given by the law of distribution: <table><tr><td>X</td><td>-3</td><td>3</td></tr><tr><td>p</td><td>0,4</td><td>0,6</td></tr></table> Establish correspondence between the numerical characteristics of a random variable 1) Mathematical expectation 2) Dispersion 3) Standard Deviation A) 0.6 B) 8.64 C) 2.94	X	-3	3	p	0,4	0,6	OPK-5	10 minutes
X	-3	3								
p	0,4	0,6								

20.	1 3 4 6	List the properties of mathematical expectation of random variables 1) The mathematical expectation of the product of two independent random variables is equal to the product of their mathematical expectations 2) The mathematical expectation of the quotient of two independent random variables is equal to the quotient of their mathematical expectations 3) The mathematical expectation of a constant is equal to the constant itself 4) A constant multiplier can be taken as a sign of mathematical expectation 5) A constant multiplier can be taken out of the variance sign by squaring it 6) The mathematical expectation of the sum of two random variables (dependent or independent) is equal to the sum of the mathematical expectations of the terms	OPK-5	2 minutes
21.	1 3 4 6	List the variance properties of random variables 1) A constant factor can be taken out of the variance sign by squaring it 2) A constant multiplier can be taken out as a variance sign, keeping it 3) The variance of a constant value is zero 4) The variance of the difference between two independent random variables is equal to the sum of their variances 5) The variance of the product of two independent random variables is equal to the product of their variances 6) The variance of the sum of two independent random variables is equal to the sum of their variances	OPK-5	2 minutes
22.	If $X_1, X_2, \dots, X_n, \dots$ are pairwise independent random variables, and their variances are uniformly limited (do not exceed a constant number C), then, no	Formulate Chebyshev's theorem (law of large numbers)	OPK-5	5 minutes

	matter how small the positive number is ε, the probability of inequality $\left \frac{X_1 + X_2 + \dots + X_n}{n} - \frac{M(X_1) + M(X_2) + \dots + M(X_n)}{n} \right < \varepsilon$ will be as close to unity as you like, if the number of random variables is large enough			
23.	If the probability of the occurrence of an event n is constant in each of the p independent tests A, then the probability that the deviation of the relative frequency from the p absolute probability will be arbitrarily small if the number of trials is large enough, is as close as you like: $\lim_{n \rightarrow \infty} P\left(\left \frac{m}{n} - p\right < \varepsilon\right) = 1.$	Formulate Bernoulli's theorem (a special case of the law of large numbers)	OPK-5	5 minutes
24.	The median sample is the mean element of the variation series if n is odd; or the half-sum of the two middle elements if n is even	Define the concept of "median sample"	OPK-5	2 minutes
25.	The essence of the method of moments for obtaining estimates of the parameters of general distribution is as follows: sample and general moments of the same order are equated. The solution of this system provides estimates of unknown parameters	Describe the essence of the method of moments of obtaining estimates of the parameters of general distribution	OPK-5	5 minutes
26.	The main idea of the maximum likelihood method for obtaining estimates of the parameters of the general distribution is to find the maximum of the likelihood	Describe the main idea of the method of maximum likelihood of obtaining estimates of the parameters of the general distribution	OPK-5	5 minutes

	function. Construction of the likelihood equation. Its solution will be the estimate of maximum likelihood			
27.	trust	Enter the missing word in the right case. If the relation , $P(\Theta_1 < \Theta < \Theta_2) = \gamma$ then the interval (Θ_1, Θ_2) is called _____, which covers the unknown general characteristic Θ with a confidence probability γ .	OPK-5	1 minute
28.	A statistical hypothesis is an assumption about the type or properties of a general or sample distribution, which can be tested by statistical methods on the basis of an existing sample	Formulate a definition of a statistical hypothesis	OPK-5	2 minutes
29.	The fallacy of rejecting a correct statistical hypothesis is a mistake of the first kind. The mistake of accepting an incorrect statistical hypothesis is a mistake of the second kind.	Errors of the first and second types	OPK-5	5 minutes
30.	1 – B 2 – B 3 – A 4 – G	Map Random Variable Convergence Types 1) If the sequence $X_1, X_2, \dots, X_n, \dots$ of random variables satisfies the condition $P(A) = 1$, then we say ... 2) If a sequence $X_1, X_2, \dots, X_n, \dots$ of random variables for any $\varepsilon > 0$ satisfies the condition $\lim_{n \rightarrow \infty} P\{ X_n < \varepsilon\} = 1$, then they say... 3) If the sequence $X_1, X_2, \dots, X_n, \dots$ of random variables satisfies the condition $\lim_{n \rightarrow \infty} M(X_n^2) = 0$, then we say ...	OPK-5	10 minutes

		4) The sequence of distribution functions $F_1(x), F_2(x), \dots, F_n(x), \dots$ converges to the limiting distribution function $F(x)$ if $\lim_{n \rightarrow \infty} F_n(x) = F(x)$, for any x, which are points of continuity $F(x)$. Then they say ... A) on the convergence of this sequence to zero in the mean square B) about the convergence of this sequence to zero with a probability of 1, or almost certain C) the convergence of this sequence to zero in probability D) on the weak convergence of the sequence of distribution functions		
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2. Description of the rating scale

Rating assessment of knowledge is not provided

3. Criteria for assessing competencies

An "excellent" grade is given to a student if the theoretical content of the topic is mastered completely, without gaps; exhaustively, consistently, clearly and logically coherently presents the material; freely copes with tasks, questions and other types of application of knowledge; uses additional material in the answer all the tasks provided for by the program are completed, the quality of their performance is evaluated by the number of points close to the maximum; analyzes the results obtained; shows independence in the performance of tasks.

A grade of "good" is given to a student if the theoretical content of the topic is fully mastered, the necessary practical competencies are basically formed, all the educational tasks provided for by the training program are completed, the quality of their performance is quite high. The student knows the material firmly, presents it competently and to the point, without making significant inaccuracies in answering the question.

The grade "satisfactory" is given to a student if the theoretical content of the topic is partially mastered, but the gaps are not significant, most of the tasks provided for by the program are completed, but there are errors in them, when answering the question, the student makes inaccuracies, insufficiently correct wording, there are violations of the logical sequence in the presentation of the program material.

An "unsatisfactory" grade is given to a student if he does not know a significant part of the program material, makes significant mistakes, performs practical work unconfidently, with great difficulty, the necessary practical competencies are not formed, most of the educational tasks are not completed, the quality of their performance is evaluated by the number of points close to the minimum.