

KAZAKH-BRITISH TECHNICAL UNIVERSITY

SCHOOL OF APPLIED MATHEMATICS

Approved by
Dean of School of
Applied Mathematics

_____A.V. Sinita

Syllabus

Probability Theory and Mathematical Statistics

Semester: Spring 2024
2023/2024 Academic Year
3 credits (2/0/1)

Instructor: Beibut Shaiykovich Kulpeshov, professor

Personal Information about the Instructor	Time and place of classes		Contact information	
	Lessons	Office Hours	Tel.:	e-mail
professor	According to the schedule			b.kulpeshov@kbtu.kz

COURSE DURATION: 3 credits, 15 weeks, 45 class hours

COURSE DESCRIPTION

The goals of the course are to familiarize students with the important branches of probability theory and mathematical statistics. The main topics of the discipline "Probability Theory and Mathematical Statistics" are the following: basic concepts of probability theory, theorems of addition and multiplication, independent events, random variables and their laws of distribution, combinatorial analysis, method of moments, estimations, and testing statistical hypotheses.

Course Objectives:

During the educational process students should become familiar with and able to apply mathematical tools to solve a variety of applied problems in topics such as basic concepts of probability theory, theorems of addition and multiplication, independent events, random variables and their laws of distribution, combinatorial analysis, methods of moment, estimations, and testing statistical hypotheses.

The objectives of the course are to develop:

- Statistical and mathematical skills;
- skills to process and evaluate effectively both theoretical and real-life quantitative data;
- skills to apply the main methods of problem solving to the situations connected with the major.

Competencies (learning outcomes):

- Know basic notions of probability theory and mathematical statistics;
- Be able to demonstrate mastery of mathematical concepts, analysis and techniques to the advanced level;
- Understand and create mathematical arguments; use computer technologies and techniques;
- Be able to think clearly, sequentially and logically, as required for critical analysis of mathematical problems;
- Be qualified in processing and evaluating effectively both theoretical and real-life quantitative data;
- Be qualified in selecting suitable mathematical methods and algorithms for the solution of a problem; carrying out qualitative mathematical research.

Prerequisites: Calculus, Discrete Mathematics

Post-requisitions: Algorithms and Programming Languages, Data Analysis

REFERENCES

Main:

1. B.Sh. Kulpeshov, An Introduction to Probability Theory and Mathematical Statistics, Almaty, 2021, 159 pages.
2. Gmurman V.E., Probability Theory and Mathematical Statistics. The seventh issue, stereotypical, Moscow: «Higher school», 2000 (in Russian).
3. Gorelova G.V., Katsko I.A., Probability Theory and Mathematical Statistics in examples and exercises with using Excel. – The fourth issue, Rostov upon Don: «Fenix», 2006 (in Russian).
4. Sheldon Ross, A First Course in Probability, seventh edition, University of Southern California, Pearson Education International, 2006, 561 pages.

Supplementary:

1. Danko P.E., Popov A.G., Kozhevnikova T.Ya., Higher Mathematics in Exercises. The fifth issue, revised. – Moscow: «Higher school», 1999, part 2 (in Russian).
2. Olav Kallenberg, Foundations of Modern Probability, second edition, Springer Series in Statistics, 2002, 650 pages.

COURSE CALENDAR

Week	Class work				SIW (student's individual work)
	Topic	Lectures	Seminars	Chapters for reading	
1	Introduction. Basic concepts of probability theory. Classical definition of probability.	2	1	according to the lecture notes	
2	Basic formulas of combinatorial analysis. Relative frequency. Geometric probabilities.	2	1	according to the lecture notes	
3	Actions over events. Theorem of addition of probabilities of incompatible events. Complete group of events. Opposite events. Conditional probability.	2	1	according to the lecture notes	
4	Theorem of multiplication of probabilities. Independent events.	2	1	according to the lecture notes	
5	Probability of appearing at least one event. Theorem of addition of probabilities of compatible events. Formula of total probability. Probability of hypotheses. Bayes's formulas.	2	1	according to the lecture notes	
6	Repetition (recurrence) of trials. Bernoulli formula. Local theorem of Laplace. Integral theorem of Laplace.	2	1	according to the lecture notes	

7	Random variables. The law of distribution of a discrete random variable. Mathematical operations over random variables. (Mathematical) expectation of a discrete random variable. Dispersion of a discrete random variable.	2	1	according to the lecture notes	
8	Function of distribution of a random variable. Properties of a function of distribution. Continuous random variables. Probability density. Properties of probability density.	2	1	according to the lecture notes	
9	Basic laws of distribution of discrete random variables	2	1	according to the lecture notes	
10	Basic laws of distribution of continuous random variables	2	1	according to the lecture notes	
11	The law of large numbers and limit theorems	2	1	according to the lecture notes	
12	Mathematical statistics. Variation series and their characteristics.	2	1	according to the lecture notes	
13	Methods of finding estimations.	2	1	according to the lecture notes	
14	Interval estimators of parameters	2	1	according to the lecture notes	
15	Testing of statistical hypotheses.	2	1	according to the lecture notes	

COURSE ASSESSMENT PARAMETERS

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Attendance	8 %
Homework	14 %
Quizzes (midterm, endterm)	38 %
Final exam	40 %
Total	100 %

No	Assessment criteria	Lessons																Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16 - 17	
1.	Attendance	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3		8
2.	Quizzes (midterm, endterm)				9			10			9				10			38
3.	Homework		1	1	1	1	1	1	1	1	1	1	1	1	1	1		14
4.	Final examination																40	40
	Total																	100

Lectures are conducted in the form of explaining the theory given in the course that is why students supplied with handouts uploaded into the intranet. Activity and attendance on lessons is mandatory. Mandatory requirement is preparation for each lesson.

Homework requirements: Homework must be submitted on time. For example, if a homework is given at a practical lesson, it must be completed and submitted before the start of the next practical lesson (that is, exactly 1 week is given to complete the homework). A homework completed and submitted on time is estimated at exactly 1 point. If the work is not submitted on time, then the mark for homework is reduced: if the delay is up to one week, then the work is estimated at 0.5 points; if the delay is more than one week to two weeks - 0.25 points, etc. If a homework is not submitted at all, then one point is subtracted from the overall grade for the discipline for each non-submitted homework.

Grading policy:

Intermediate attestations (on 4th, 7th, 10th and 14th lessons) join topics of all lectures, homework, quiz and materials for reading discussed to the time of attestation. All the methods of monitoring the current progress of students (quizzes, midterm, endterm and final exam) will be carried out using the proctoring system Proctor Edu. Maximum number of points for each attestation is 9-10 points.

Final exam joins and generalizes all course materials, is conducted in written form with exercises. Final exam duration is 120 minutes. Maximum number of points is 40. At the end of the semester you receive overall total grade (summarized index of your work during semester) according to conventional KBTU grade scale.

ACADEMIC POLICY

Students are required:

- to be respectful to the teacher and other students;
- to switch off mobile phones during classes;
- DO NOT cheat. Plagiarized papers shall be graded with zero points!
- to come to classes prepared and actively participate in classroom work; to meet the deadlines;
- to enter the room before the teacher starts the lesson;
- to attend all classes. No make-up tests or quiz are allowed unless there is a valid reason for missing it;
- to follow KBTU academic policy regarding **W, AW, I, F** grades.
- When students are absent for 20% of the lessons or more (without Certificate of temporary disability), then their grade is F.
- When students have a score of 29 or less for attestation 1 added to attestation 2, then their grade is F.
- When students have a score of 19 or less (less than 50%) for their final exam, then their grade is F.
- When students do not come for their final exam, then their grade is F.

Students are encouraged to

- consult the teacher on any issues related to the course;
- make up within a week's time for the works undone for a valid reason without any grade deductions;

Professor of School of Applied Mathematics
On 11.01.2024, protocol No. 10

B.Sh. Kulpeshov