NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Economic Cybernetics

PROGRAM OF THE COURSE

"Probability Theory and Statistics":
Probability Theory and Mathematical Statistics

Specialty: 075 "Marketing "
Educational program "Marketing"
The Faculty of agrarian management
Developer: Galaieva L.V. Associate Professor, Ph.D.

Kyiv – 2023

1. Description of the course
"Probability Theory and Statistics":
Probability Theory and Mathematical Statistics

Educational program, Specialty, Educational level	
Educational degree	"Bachelor"
Specialty	075 "Marketing
Educational program	« Marketing »
Characteristics of the course	
Type	Normative
Total number of hours	150 (60)
Number of ECTS credits	5 (2)
Number of content modules	1
Form of assessment	Exam
Indicators of the course for full-time and part-time forms of study		
	Full-time form of study	Part-time form of study
Course (year of study)	1	-
Semester	2	-
Lecture classes	15 h.	-
Practical, seminar classes		-
Laboratory classes	15 h.	-
Self-study	30 h	
Individual assignments		
Number of weekly classroom hours for the full-time form of study	2 h.	-

2. Purpose, objectives, and competencies of the course
"Probability Theory and Statistics": Probability Theory and Mathematical Statistics

Purpose of discipline – to acquaint students with basic knowledge of the Probability Theory and Mathematical Statistics to solve the theoretical and practical economic problems.

Objectives
- to acquaint students with knowledge of basic definitions, theorems, rules, theorem proving;
- to develop practical skills for fulfill qualitative and quantitative mathematical analysis of random events, random variables and systems of values.
- to provide the prospective specialist in agricultural management with theoretical knowledge and practical skills in applying Probability Theory in economic-mathematical modeling. The final aim is to enable them to make analysis of results of farming industry and agrarian business.

The primary goals of the course are (tasks):
- To learn of main concepts of the Probability Theory and their data characteristics;
- To develop of logical thought and skills to solve a practical tasks;
- To define the special probability distributions, to analyze and to make decision.

Learning Outcomes:
The student should be competent in:
- the modern probability theory;
- theorems, methods and models;

The student should be able to:
- apply the probability to make a prognosis in economics.

Form of control: Exam.

Acquisition of competencies:
Integrated competency (IC): ability to solve complex specialized and practical tasks problems in the field of marketing activity or in the process training involving the application of relevant theories and methods and is characterized by complexity and uncertainty conditions.

General Competencies (GC):
GC 4. Ability to learn and master modern knowledge.

GC 5. Determination and persistence in relation to assigned tasks and assumed responsibilities.

GC 6. Knowledge and understanding of the subject area and understanding of professional activity.

GC 10. Ability to communicate in a foreign language.**Professional (special) competencies (PC):**
PC 3. The ability to determine the prospects for the organization's development

Program Learning Outcomes (PLO):
PLO 5. Identify and analyze the key characteristics of marketing systems of various levels, as well as the peculiarities of the behavior of their subjects.

PLO 9. Assess the risks of conducting marketing activities, establish the level of uncertainty of the marketing environment when making management decisions.

PLO 10. Explain information, ideas, problems and alternative options for making managerial decisions to specialists and non-specialists in the field of marketing, representatives of various structural units of the market entity.

3. Program and structure of the course

For Full-time education form of study

Names of content modules and topics	Number of hours											
	Full-time form						Part-time form					
	total	including					total	including				
		l	s	lab	ind	ss		l	s	lab	ind	ss
1	2	3	4	5	6	7	8	9	10	11	12	13
Content Module 1. «Probability Theory and Mathematical Statistics »												
Topic 1. Concepts of Probability Research.	10	3	3		4							
Topic 2. Conditional Probability; the Law of Total Probability and Bayes' Theorem.	4	1	1		2							
Topic 3. Rules of Probability Distributions**.	6	2	2		2							
Topic 4. Discrete Random Variables (DRV) and Continuous Random Variables (CRV)	10	3	3		4							
Topic 5. Probability Distributions. . Law of large numbers and central limit theorem.	10	3	3		4							
Topic 6. Systems of independent random variables.	8	Self study.		Self study.	8							
Topic 7. Elements of Mathematical Statistics	12	3	3		6							
Total Hours	**60**	**15**	**15**		**30**							

4. Laboratory class topics

№	Name	Hours
1	Topic 1. Introduction to Probability. Concepts of Probability Research.	3
2	Topic 2. Conditional Probability; the Law of Total Probability and Bayes' Theorem.	2
3	Topic 3. Rules of Probability Distributions.	2
4	Topic 4. Discrete Random Variables (DRV).	2
5	Topic 5. Continuous Random Variables (CRV).	2
6	Topic 6. Probability Distributions.	3
7	Topic 7. Systems of independent random variables.	-
8	Topic 8. Law of large numbers and central limit theorem.	1
Total Hours		15

5. Self-study topics

№	Name	Hours
1	Topic 1. Introduction to Probability. Concepts of Probability Research.	5
2	Topic 2. Conditional Probability; the Law of Total Probability and Bayes' Theorem.	5
3	Topic 3. Rules of Probability Distributions.	10
4	Topic 4. Discrete Random Variables (DRV).	10
5	Topic 5. Continuous Random Variables (CRV).	10
6	Topic 6. Probability Distributions.	5
7	Topic 7. Systems of independent random variables.	10
8	Topic 8. Law of large numbers and central limit theorem.	5
Total Hours		60

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE			
Educational level "Bachelor" Faculty of Agrarian Management Specialty, educational programmes 073 Management; 075 Marketing	**Department of Statistics and Economic Analysis & Department of Economy Cybernetics** 2022-2023 educational year	**Exam variant № __1__** From the discipline "Probability Theory and Statistics"	**Approved** Head of the Department of Statistics and Economic Analysis _____(I.D.Lazaryshyna) (signature) Head of the Department of Economy Cybernetics _____(D.M. Zherlitsyn) (signature) _____2023

Questions (Tasks)

1. Conditional Probability. Independence of Events. **(10b)**

2. (5 b)

Calculate expected value (M(x)) if the probability distribution of marks at the exam for some students is defined with the table:

X_i	2	3	4	5
P_i	0,1	0,5	0,3	0,1

3. (5 b) .

Unemployment. A sample of the employment status of the residents in a certain town is given in the following table.

	Employed	Unemployed
Male	1000	40
Female	800	160

Assign a probability that each of the following is true.

a. An unemployed person is female.
b. An unemployed person is male.
c. A male is unemployed.
d. A female is employed.

Test (max 10 b)

1. The function $F^*(x)$ has all the properties of distribution function $F(x)$.

1	True
2	False

2. What does the name graph of relative frequency from values of options?

1	Polygon
2	Ogive
3	Polygon distribution
4	Cumulate

3. To place under the function.

1. Selective medium - $\overline{X}_в$. For non grouped data selective medium is count using the formula:	a) $\overline{X}_в = \dfrac{\sum\limits_{i=1}^{k} x_i n_i}{n}$
2. Sample variance - S^2 . For non grouped data random variance is calculated by the formula:	b) $D_в = \dfrac{\sum\limits_{i=1}^{n}(x_i - \overline{X}_в)^2 n_i}{n}$
3. Selective medium - $\overline{X}_в$. For the grouped data:	c) $\overline{X}_в = \dfrac{\sum\limits_{i=1}^{n} x_i}{n}$

4. Sample variance - S^2. For the grouped data:	d) $S^2 = \dfrac{n}{n-1} D_в$,

4. Random variable is

1.	The quantitative characteristic of researches.
2.	Size which is a result of researches can be that or another numerical value.
3.	Root quadratic from a dispersion

5. What is designation of expected value?

(In the form of answers to give in a word)

6. What formula is used for expected value of random variable:

1.	$M(X) = m_x = x_1 \cdot p_1 + x_2 \cdot p_2 + \cdots + x_n \cdot p_n = \sum_{i=1}^{n} x_i \cdot p_i$
2.	$D(X) = M\left[(X - m_x)^2 \right] = \sum_{i=1}^{n} (x_i - m_x)^2 \cdot p_i$
3.	$D(X) = M(X^2) - (M(X))^2$
4.	$\sigma(X) = \sigma_x = \sqrt{D(X)}$

7. Qualitative - Categorical or Nominal: Examples are-

|	
1.	Temperatures, Salaries
2.	Color, Gender, Nationality
3.	Number of points scored on a 100 point exam, Scales of Measurement
4.	Temperatures, Salaries, Nationality

8. A _____ is a subset of the measurements selected from the population.

1	sample
2	census
3	simple random sample
4	random sample

9. Random Variables includes:

1.	Discrete random variable
2.	Continuous random variable
3.	Discrete and continuous random variable

. **10.What is this?**
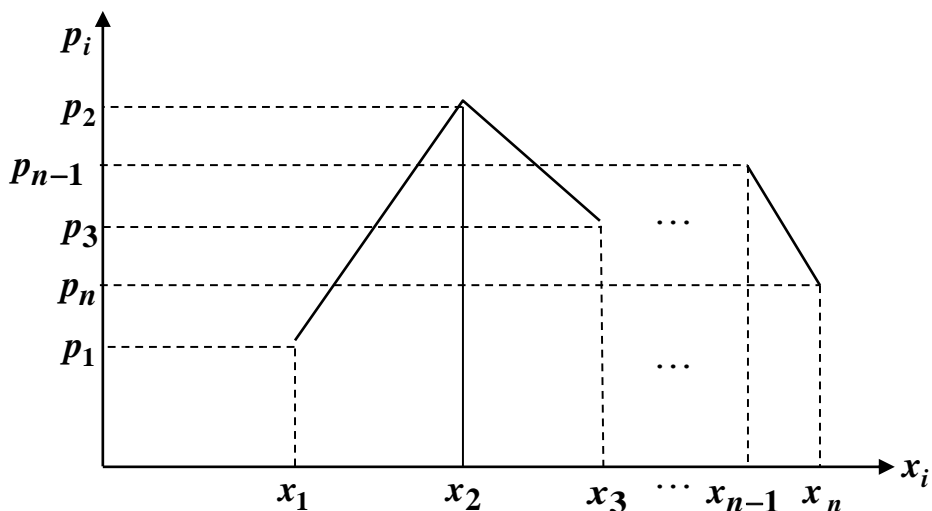
1. Polyhedron of distribution
2. A number of distribution

_____ (

7. **Samples of control questions, tests for assessing the level of knowledge acquisition by students**
Module 1

1. Basic Definitions: Events, Sample Space, and Probabilities.
2. Types of Probability. Objective or Classical Probability. Subjective Probability.
3. The Random Events. Definition.
4. Basic Definitions.
5. Combinatorial Concepts. Factorial. Permutations. Combinations.
6. The basic theorem: Intersection. Union. Definition.
7. Mutually exclusive sets. Definition.
8. Partition. Definition.
9. Sets: Diagrams.
10. Experiment. Definition.
11. Events: Definition.
12. Equally-likely Probabilities (Hypothetical or Ideal Experiments).
13. Basic Rules for Probability. Conditional Probability. Independence of Events.
14. The Law of Total Probability and Bayes' Theorem.
15. Random Variables. Definition.
16. Discrete and Continuous Random Variables.
17. Probability Density Function and Cumulative Distribution Function of Discrete Random Variables.
18. The numerical characteristics of Discrete Random Variables (Expected Values, Variance and Standard Deviation of a Random Variable).
19. Rules of Discrete Probability Distributions.
20. The Binomial Probability Distribution.
21. Mean (Expected Values – $E(x)$), Variance, and Standard Deviation of the Binomial Distribution.
22. Discrete Probability Distributions.
23. Continuous Random Variables.
24. Probability Density Function and Cumulative Distribution Function of Continuous Random Variables.
25. The numerical characteristics of Continuous Random Variables (Expected Values, Variance and Standard Deviation of a Random Variable).
26. Uniform Distribution.
27. Exponential Distribution.
28. The normal distribution.
29. Basic Definitions of Math Statistics

8. Teaching methods

- Lectures and Seminars (the use of modern information technology).
- Individual-study and module work (the use of modern information technology).

9. Forms of assessment

- Individual tasks.
- Module test.
- Exam

10.Rating grades according to modules

Distribution of grades received by students. The student's assessment is carried out in accordance with the Regulation "On Examinations and Credits at NULES of Ukraine" dated 26.04.2023, Protocol No. 8 from the Table.

Correlation between national and rating of the discipline

National grade based on exam results	Student rating, points
"Excellent"	90 - 100
"Good"	74 - 89
"Satisfactory"	60 - 73
"Unsatisfactory"	0 - 59

To determine the rating of the student (listener) for mastering the discipline R_{DIS} (up to 100 points) the obtained rating for certification R_{AT} (up to 30 points) is added to the rating of the student (listener) for academic work R_{AW} (up to 70 points): $R_{DIS} = R_{AW} + R_{AT}$

STUDENT ASSESSMENT CRITERIA

The "Excellent" grade is to be awarded to a student who has completely acquired the educational material and is able to present it logically and thoroughly. The theory would be related to practice. The student provides a background to correct answers, possesses different methodological skills and is able to solve additional tasks.

The "Good" grade is given to a student who has acquired the educational material, provides mostly correct answers, being able to use theoretical approaches at solving practical cases.

The grade "Satisfactory" is to be conferred to a student who has learned only educational material, but not in details; there are some mistakes made, not thorough implementation in doing tasks, being non-consecutive in responses.

To be evaluated with the grade "Unsatisfactory", a student should fail to have learnt a most of educational material, makes fatal errors, being slow in solving practical tasks.

11.Methodological Support

1. Galaieva L. Mathematics for economists, section "The Theory of Probability and Mathematical Statistics". Methodical textbook. K.: NULESU, 2022. 91p.
2. Галаєва Л.В., Глаголєва І.І., Шульга Н.Г. Теорія ймовірностей та математична статистика. Методичний посібник. К: НУБіП України, 2009. 56 с. http://elibrary.nubip.edu.ua/16959/
3. Скрипник А.В., Галаєва Л.В., Коваль Т.В., Шульга Н.Г. «Теорія ймовірностей ймовірнісні процеси та математична статистика». К.: ТОВ»Аграр Медіа Груп», 2017. 265 с. http://elibrary.nubip.edu.ua/16947/
4. Скрипник А.В., Галаєва Л.В., Кравченко К.Я. «Вища та прикладна математика» Розділ «Теорія ймовірностей та математична статистика» Методичний посібник. К: «Аграр Медіа Груп». 2012. 144 с. http://elibrary.nubip.edu.ua/16947/

12. Educational and methodological support

Basic literature

1. Cox Dennis, Cox Michael. The Mathematics of Banking and Finance. The Atrium, Southern Gate, Chichester , John Wiley & Sons Ltd, 2016. 332 p.
2. John E. Freund's. Mathematical Statistic, USA, 2014
3. Devore Jay L., Berk Kenneth N. Modern mathematical statistics with applications. Belmont, Calif.: Thomson Brooks/Cole, 2007. 810p.
4. Drury C. Management and cost accounting. C&C Offset, China, 2016. 775p.
5. Keller, Gerald. Essentials of business statistics / Gerald Keller, Brian Warrack. Wadsworth, Inc., 2014. 593p.
6. Kennedy Peter. A guide to econometrics. Massachusetts: The MIT Press, 2015. 468p.
7. Morris R. Studies in mathematics education: The teaching of statistics. Unesko, 2016. 258 p.
8. Simon Carl P., Blume Lawrence. Mathematics for economists. New York, London: W.W.Norton & Company, 2017. 930p.
9. Ruric E. Wheeler, W.D.Peeples, Jr. Modern Mathematics. Brooks: Cole Publishing Company, 2016. 707p.
10. Studies in mathematics education. The teaching of statistics / R.Morris. Unesco, 2015. 258p.

Additional literature

11. Carl P. Simon, Lawrence Blume. Mathematics for economists. New York, London: W.W.Norton & Company, 1994. 930p.
12. Peter Kennedy. A guide to econometrics. Massachusetts: The MIT Press, 1998. 468.
13. Барковський В.В., Барковська Н.В., Лопатін О.К. Теорія ймовірностей та математична статистика. К.: ЦУЛ, 2012. 448 с.
14. Бугір М.К. Теорія ймовірностей та математична статистика. Тернопіль: Підручники та посібники, 1998 . 176 с.

13. Recommended sources of information

Electronic Resources

- MOODLE: https://elearn.nubip.edu.ua/course/view.php?id=1827
- Food and Agriculture Organization Corporate Statistical Database http://faostat.fao.org
- Державна служба статистики України http://www.ukrstat.gov.ua/
- Market outlook report: http://www.agr.gc.ca/pol/mad-dam/index_e.php?s1

14.Non formal education

You can earn additional points in Probability Theory and Mathematical Statistics by completing the special courses. Completion of each course (if it has been certified) is assessed at 10 points and added to the points for educational work. Points added cannot exceed 20!

Probability and Statistics: To p or not to p?
https://www.coursera.org/learn/probability-statistics
Linear Regression for Business Statistics:
https://www.coursera.org/learn/linear-regression-business-statistics#syllabus
Introduction to Probability and Data:
https://www.coursera.org/learn/probability-intro#syllabus
Basic Statistics:
https://www.coursera.org/learn/basic-statistics#syllabus
Business Applications of Hypothesis Testing and Confidence Interval Estimation:
https://www.coursera.org/learn/hypothesis-testing-confidence-intervals