Mathematics and Statistics (YEAR I, SEMESTER I and II)

Credite (ECTS): 3 + 2

Course category:
Compulsory (Fundamental Discipline)

Discipline Code: A.EMIAIA.F.101

Course holder:
Assoc. Prof. Dr. Ciprian CHIRUŢĂ

Course objectives (course and seminar)

To become familiar with the main types of problems and approaches in the field of linear algebra and the application of mathematical concepts in the economic and agricultural field.

Mathematical modeling of practical problems frequently used in biological and agricultural research and the acquisition of probabilistic laws and optimization techniques.

Formation of skills to use rigorous reasoning as well as individual study skills;

Formation of a systemic conception of the discipline and the mathematical apparatus;

Formation of the calculation skills necessary to master mathematical reasoning in the use of statistical tests;

Understand the notions of probability theory and linear programming with the help of appropriate practical examples;

Applying the theoretical notions exposed in the course in solving specific problems and modeling processes.

Knowledge of statistical research methods in the field, as well as their application in the disciplines of the field.

Acquisition of mathematical (linear) programming models.

Curriculum

Course (chapters/subchapters)
Sem I. Elements of Abstract Algebra
Vector spaces, linear dependence and independence, generator system, the basis of a vector space, the change of coordinates of a vector when moving from one base to another, the lemma of substitution, applications to the lemma of substitution.
Linear transformations, the matrix associated with a linear transformation, the nucleus and image of a linear transformation, eigenvalues and eigenvectors.
Linear programming elements
Examples leading to linear programming problems. Graphical method of solving linear programming problems.
Simplex method of solving linear programming problems.
The two-phase method of solving linear programming problems.
Elements of probability theory
Events. Operations with events. Event field. Probabilities - definitions, examples. Conditional probabilities. Calculation formulas for probabilities.

Classical probabilistic schemes, Discrete and continuous random variables. Operations with random variables. The distribution function of a random variable. Typical values of a random variable.
Usual discrete distributions. Usual continuous distributions. The law of large numbers. The central limit theorem.
Elements of mathematical statistics
Statistical series, organization and description of data. Grouping and graphical representation of statistical series. Numerical characteristics of statistical series. Absolute frequency, relative frequency, cumulative frequencies. The regression method, the correlation method.
Estimation theory. Point estimates. Estimates by confidence intervals.
Verification of statistical assumptions. Parametric and non-parametric statistical tests.
Without II. Functions of a real variable.
The limit and continuity of a real function of a real variable. Continuous functions, limits and continuity, properties of continuous functions over a range. Discontinuity points and their classification. Monotonous functions.
Differential calculus.
The derivative and differential of a real function from a real variable. Operations with derivable functions. The derivability of compound functions and inverse functions. The fundamental theorems of differential calculus (Fermat's theorem, Rolle's theorem, mean theorems) and their consequences.
Characterization of monotony with the help of derivative. The Rule of the Hospital. Higher-order derivability. Characterization of convexity with the help of the sign of the second-order derivative.
Taylor's formula. Characterization of optimal points with the help of derivatives. Applications of differential and integral calculus in biology.
Multi-variable functions
The notion of a multivariable function. Limit and continuity for multivariable functions. Derivatives and differentials of multivariable functions. Extremes of multivariable functions.
Series of numbers. Feature series.
Series of numbers. Series with positive terms. Criteria for convergence of series with positive terms.
Strings and series of functions. Series of powers. Development of a function in a series of powers.
Integral calculation
The primitive and the undefined integral. Integration methods: The formula of integration by parts and the formula of variable change. Riemann integrability of a function and Riemann integral.
Integratable Riemann functions. Properties of embeddable functions. Newton-Leibniz formula. The formula of integration by parts and the formula of variable change. Improper integrals.
Differential equations
Differentiable equations with separable variables. First-order homogeneous differential equations. First-order linear differential equations.

Seminars
Without I. Matrices and determinants. Matrix operations. Determinants.
Systems of linear equations, the Gauss method, the Gauss-Jordan method, the inverse of a matrix.

Independent linear system, dependent linear system, generator system, base, changing the coordinates of a vector when passing from one base to another.
Linear transformations, the matrix associated with a linear transformation, the nucleus and image of a linear transformation, eigenvalues and eigenvectors.
Solving linear programming problems by graphical method.
Use of the primal simplex algorithm in determining the optimal solution of a linear programming problem.
Solving linear programming problems by the two-phase method.
Events, operations with events, probabilities, conditional probabilities, total probability formula, Bayes' formula.
Classical probabilistic schemes (Bernoulli, Poisson, Hypergeometric, Generalized Hypergeometry)
Random variables. The function of distributing a random variable. Numerical characteristics of random variables: mean, median, modal value, quantiles, simple and centered momentum, amplitude, dispersion, mean squared deviation, Pearson coefficient of variability, Fisher's coefficient of asymmetry, coefficient of vaulting and flattening.
Statistical series. Graphical representation of statistical series, absolute frequencies, relative frequencies, cumulative frequencies.
The regression method, the correlation method.
Point estimates. Estimates by confidence intervals. The Student test and the Fisher test.
Without II.
Derivative of a function of a real variable (recapitulation), applications of derivatives.
Derivative of order n, Rolle's string, evolution of a function, differentiability, and endpoints for functions of a real variable,
First-order derivative, second-order, mixed derivatives of a function of two real variables.
Differential of first order and second order for functions of two real variables.
Local extreme points for functions of two real variables, gradient, rotor.
Series of numbers, criteria for convergence of series with positive terms.
Series of numbers, criteria for the convergence of series with any terms.
Feature series. Taylor series decomposition, Maclaurin's formula.
Metode de interpolare. Polinoame de interpolare Lagrange, Newton.
The method of the smallest squares.
Primitive. Calculation methods.
Definite integrals, Applications of integrals, length, area, volume.
Differential equations with separable variables
Homogeneous differential equations of the first order.

Bibliography

1. Aldea Florica, *Applied Mathematics in Agricultural and Forestry Sciences*, Risoprint Publishing House, Cluj Napoca, 2006.
2. Bunu I. coord. collective of authors, *Economic Mathematics*, Polygraphic Editorial Department of the Academy of Economic Studies of Moldova, Chisinau, 2012.
3. Burdujan I., *Elements of Algebra with Applications in Biology*, Ed. Pim, Iaşi, 2006.
4. Diaconiţa V., Spînu M., Rusu Ghe., *Mathematici applicate în economie*, Ed. Sedcom Libris, Iaşi, 2004.
5. Jaba Elisabeta, *Statistics* - second edition - Economic Publishing House, Bucharest, 2000.

6. Jaba Elisabeta, *Descriptive Statistics - Manual for Open Distance Learning*, Ed. Univ. Al. I. Cuza, Iaşi, 2005
7. Anca Precupanu, The Basics of Mathematical Analysis", Polirom Publishing House, 3rd edition, revised and added, Iaşi, 1999.
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9. Chiriţă, S., *Problems of Higher Mathematics*, Didactic and Pedagogical Publishing House, Bucharest, 1989
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11. Donciu N., Flondor D., Simionescu, Gh., *Algebra and Mathematical Analysis - Problem Collection*, vol. 2, Didactic and Pedagogical Publishing House, Bucharest, 1965.
12. Ganga, M., Elements of Mathematical Analysis for the Eleventh Class, Part One, Mathpress Publishing House, Ploiesti, 2000,
13. Ganga, M., Elements of Mathematical Analysis for the Eleventh Class, Part Two, Mathpress Publishing House, Ploiesti, 1999,
14. Gh. Siretchi: Differential and Integral Calculus, vol. I and vol. II, Scientific and Encyclopaedic Publishing House, Bucharest, 1985
15. Chiruţă C., *Elements of Mathematics. Linear Programming and Mathematical Statistics*, "Ion Ionescu de la Brad" Publishing House, Iasi, 2019

Assessment

Assessment	Evaluation methods	Percentages of the final grade
Examination	Written and oral examination	60% + 10%
Evaluation during the semester	Attendance at seminars and verification test.	10% + 20%

Contact

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