SYLLABUS

1. General information on the course

Full course name	Numerical Methods in Economics
Full official name of a higher education institution	Sumy State University
Full name of a structural unit	Academic and Research Institute of Business, Economics and Management. Department of Economic Cybernetics
Author(s)	Kashcha Mariia Oleksiivna
Cycle/higher education level	The First Level Of Higher Education, National Qualifications Framework Of Ukraine – The 6th Level, QF-LLL – The 6th Level, FQ-EHEA – The First Cycle
Semester	8 тижнів протягом 8-го семестру
Workload	Обсяг навчальної дисципліни становить 5 кредитів ЄКТС, 150 годин, з яких 48 годин становить контактна робота з викладачем (16 години лекцій,32 години практичних робіт), 102 години становить самостійна робота
Language(s)	English

2. Place in the study programme

Relation to curriculum	Compulsory course available for study programme "Business Analytics"
Prerequisites	Modeling the economy
Additional requirements	There are no specific requirements
Restrictions	There are no specific restrictions

3. Aims of the course

Formation of basic abilities to apply economic and mathematical methods to the formation and substantiation of effective business strategies, which are now based on accurate analysis and numerical calculation; formation of a system of theoretical knowledge and practical skills of application of various mathematical and statistical models, basic methods of quantitative measurement of factors influencing economic processes.

4. Contents

Topic 1 Introduction. Data presentation Frequency distribution. Distribution center indicators. RMS. Covariance. Effects of diversification. Choice of the weighing method.

Topic 2 Application of differential calculus The rate of change of the indicator. Taylor's schedule. Finding the maximum and minimum values. Partial derivatives. Lagrange operator.
Topic 3 Numerical methods The method of division in half. Newton Rafson's method. Simpson's rule. The Mon-te-Carlo method. Method of control of random variable.
Topic 4 Optimization Optimization under constraints in the form of equations (Lagrange factors). Quadratic programming with inequalities. Kuhn-Tucker conditions. Danzig-Wolf method.
Topic 5 Analysis of the main components Analysis of the main components. Application. Factor analysis. Arbitrage pricing theory.

5. Intended learning outcomes of the course

After successful study of the course, the student will be able to:

LO1	Know and apply numerical methods to solve economic problems.
LO2	Solve some problems and check the adequacy of their solution.
LO3	Build mathematical models related to solving applied problems
LO4	Analyze results and develop practical recommendations

6. Role of the course in the achievement of programme learning outcomes

Programme learning outcomes achieved by the course.
For 051 Economics:

PO12	Carry out a comprehensive analysis of complex economic systems, compare and contrast their components, evaluate and justify evaluations of the effectiveness of their functioning.
PO13	Select and apply analytical tools to study the state and prospects of development of certain segments of international markets for goods and services using modern knowledge of methods, forms, and tools of international trade regulation.
PO14	Understand and apply theories, principles, tools, and instruments for the implementation of international monetary, financial and credit relations.
PO24	Justify the choice and apply information and analytical tools, economic and statistical methods of calculation, complex analysis techniques, and methods of monitoring world markets.

7. Teaching and learning activities

7.1 Types of training

Topic 1. Introduction. Data presentation

lect.1 "Introduction. Data presentation" (full-time course) Frequency distribution. Distribution center indicators. RMS. Covariance. Effects of diversification. Choice of weighing method.Frequency distribution. Distribution center indicators.
lect.2 "Introduction. Data presentation" (full-time course) RMS. Covariance. Effects of diversification. Choice of weighing method.Frequency distribution. Distribution center indicators.
lab.w.1 "Frequency distribution. Distribution center indicators." (full-time course) Presentation of data and descriptive statistics
lab.w.2 "Covariance. Effects of diversification. Choice of weighing method." (full-time course) Presentation of data and descriptive statistics. Test
Topic 2. Application of differential calculus
lect.3 "Application of differential calculus" (full-time course) The rate of change of the indicator. Taylor's schedule.
lect.4 "Application of differential calculus" (full-time course) Finding the maximum and minimum values. Partial derivatives. Lagrange operator.
lab.w.3 "The rate of change of the indicator." (full-time course) Differential calculus
lab.w.4 "Taylor's schedule. Finding the maximum and minimum values." (full-time course) Differential calculus. Test
lab.w.5 "Partial derivatives." (full-time course) Partial derivatives.
lab.w.6 "Lagrange operator." (full-time course) Lagrange operator.
Topic 3. Numerical methods
lect.5 "Numerical methods" (full-time course) The method of division in half. Newton Rafson's method.
lect.6 "Numerical methods" (full-time course) Simpson's rule. The Monte-Carlo method. Method of control of random variable.

lab.w.7 "The method of division in half." (full-time course) Numerical methods. Equation solving. The method of division in half.
lab.w.8 "Newton Rafson's method." (full-time course) Numerical methods. Equation solving. Newton Rafson's method.
lab.w.9 "Simpson's rule." (full-time course) Numerical methods. Equation solving
lab.w.10 "The Monte-Carlo method. Method of control of random variable." (full-time course) Numerical methods. Equation solving. The Monte-Carlo method. Test
Topic 4. Optimization
lect.7 "Optimization" (full-time course) Optimization under constraints in the form of equations (Lagrange factors). Quadratic programming with inequalities.Kuhn-Tucker conditions. Danzig-Wolf method.
lab.w.11 "Lagrange factors" (full-time course) Optimization under constraints in the form of equations (Lagrange factors).
lab.w.12 "Quadratic programming with inequalities." (full-time course) Quadratic programming with inequalities.
lab.w.13 "Kuhn-Tucker conditions." (full-time course) Kuhn-Tucker conditions.
lab.w.14 "Danzig-Wolf method." (full-time course) Danzig-Wolf method.
Topic 5. Analysis of the main components
lect.8 "Analysis of the main components" (full-time course) Analysis of the main components
lab.w.15 "Analysis of the main components" (full-time course) Analysis of the main components
lab.w.16 "Application. Factor analysis." (full-time course) Application. Factor analysis. Arbitrage pricing theory

7.2 Learning activities

LA1	Essay
LA2	Laboratory task

LA3	Abstract (Individual control task)
LA4	Tests

8. Teaching methods

Course involves learning through:

TM1	Lectures
TM2	Practical tasks
TM3	Discussions
TM4	Consultations

Survey and oral comments of the teacher on his results (TM1, 4), ongoing testing (TM2,3), assessment of completed practical tasks (TM2, 4)

Communication skills are formed through the preparation and defense of individual work. The ability to think logically and systematically is formed by writing a report to an individual task. Creativity forms problem-oriented learning and brainstorming.

9. Methods and criteria for assessment

9.1. Assessment criteria

ECTS	Definition	National scale	Rating scale
A	Outstanding performance without errors	5 (Excellent)	$90 \leq RD \leq 100$
B	Above the average standard but with minor errors	4 (Good)	$82 \leq RD < 89$
C	Generally sound work with some errors	4 (Good)	$74 \leq RD < 81$
D	Fair but with significant shortcomings	3 (Satisfactory)	$64 \leq RD < 73$
E	Performance meets the minimum criteria	3 (Satisfactory)	$60 \leq RD < 63$
FX	Fail – some more work required before the credit can be awarded	2 (Fail)	$35 \leq RD < 59$
F	Fail – considerable further work is required	2 (Fail)	$0 \leq RD < 34$

9.2 Formative assessment

FA1	Mini-tests
FA2	Protection of individual works
FA3	Interviews and oral comments of the teacher on his results

9.3 Summative assessment

SA1	Module control work
SA2	Laboratory work
SA3	Mini - tests

SA4	Exam

Form of assessment:

8 semester		**100 scores**
SA1. Module control work		**10**
		10
SA2. Laboratory work		**30**
	5x6	30
SA3. Mini - tests		**20**
	5x4	20
SA4. Exam		**40**
		40

Form of assessment (special cases):

8 semester		**100 scores**
SA1. Module control work		**20**
		20
SA2. Laboratory work		**15**
	3x5	15
SA3. Mini - tests		**25**
	5x5	25
SA4. Exam		**40**
		40

Successful completion of the discipline is possible only if all tasks are completed by at least 60%

10. Learning resources

10.1 Material and technical support

MTS1	Computers, computer systems and networks
MTS2	Application software (MS Word, Excel, Statistica)

10.2 Information and methodical support

Essential Reading	
1	Watsham, Terry J., Quantitative Methods in Finance/Cengage Learning, 2016
2	Hector Guerrero, Excel Data Analysis. Modeling and Simulation, Second Edition, Springer Nature Switzerland AG 2019. - URL: https://doi.org/10.1007/978-3-030-01279-3

3	Trinidad-Segovia, J.,E.& Miguel Sanchez-Granero(2021)Quantitative Methods for Economics and Finance. – P:418. (PDF)https://doi.org/10.3390/books978-3-0365-0197-0
4	Simone Cerreia-Vioglio, Massimo Marinacci, Elena Vigna (2021) Principles of Mathematics for Economics. Springer International Publishing, P.- 1505
Supplemental Reading	
1	J.-M. Marin and C.P. Robert,Bayesian Essentials with R, Springer Texts in Statistics/ Springer Science+Business Media New York 2014
Web-based and electronic resources	
1	Course BigData, URL: https://courses.prometheus.org.ua/courses/Prometheus/BigData101/2017_T1/about
2	Course Mathematics for economists, URL: https://www.coursera.org/learn/mathematics-for-economists/