

OPTIMIZATION METHODS AND MODELS

COURSE SYLLABUS

Code and name of specialty	071 – Accounting and Taxation	Institute	Institute of Education and Science in Economics, Management and International Business
Program name	Accounting, Audit and Taxation	Department	Business Intelligence, Accounting, and Hotel and Restaurant Business
Type of program	Educational and Professional	Language of instruction	English

Lecturer

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PhD in Economics, Associate Professor of Business Intelligence, Accounting and Hotel and Restaurant Business, NTU KhPI. Tetiana Chaika has authored or co-authored more than 60 scientific publications. She has more than 22 years of academic experience. She teaches courses in Optimization methods and models, Digitalization in accounting, Introductory course and introductory practice, Economic statistics, Economic analysis, Statistical methods in scientific research, Decision-making models and methods in analysis.

General description of the course

Summary	This course covers optimization models and solution methods used in applied economics. Particular attention is paid to the formation of the ability to select and use the proper mathematical modeling tools in accordance with the task of optimization and decision making. Both deterministic and stochastic modeling will be discussed.					
Course objectives	<ul style="list-style-type: none"> - to introduce to various models and methods of optimization, as well as their application in solving practical problems; - to master to formulate, analyze and solve real-life decision problems using optimization techniques; - to have a proper understanding of the process of obtaining and implementing optimization results when solving practical problems in economics. 					
Types of classes and control	Lectures, workshops, consultations. The course ends with a final exam.					
Term	4					

Student workload (credits) / Type of course	4 / Mandatory	Lectures (hours)	32	Workshops (hours)	16	Self-study (hours)	72
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Program competences	GC 02	The ability to abstract thinking, analysis, synthesis.
	GC 13	The ability to carry out research at an appropriate level.
	SC 02	The ability to use mathematical tools for research of socio-economic processes, solving applied problems in the field of accounting, analysis, control, audit, taxation.
	SC 08	The ability to identify and assess the risks of failure to achieve the management objectives of the company, non-compliance with legislation and regulation of activities, inaccurate reporting, conservation and use of its resources.

Learning outcomes

Code	Content
LO 14	Be able to apply economic and mathematical methods in the chosen profession.

Topics covered:

Topic 1. Definition and basic components of an optimization problem. General procedure for solving optimization problems.

Topic 2. Classification of optimization problems. Types of techniques for optimization.

Topic 3. Linear programming in optimization problems in economics. Graphical method. Simplex method. Dual simplex method.

Topic 4. Transportation problem as a special type of linear programming problem. Its explanation and solving.

Topic 5. Dynamic programming in economic problems. Optimization of multi-stages processes.

Topic 6. Graph theory and its application in optimization problems in economics.

Topic 7. Integer programming. Examples of integer programming problems in economics. Methods for solving integer programming problems.

Topic 8. Decision making under risk and uncertainty. Optimization criteria under uncertainty. Optimization criteria under risk.

Topic 9. Decision tree method in optimal decision making.

Topic 10. Expert evaluation methods in business process assessment and optimization.

Topic 11. Game theory and decision making.

Forms and methods of teaching.

The leading **form of teaching** in this course is interactive learning.

Interactive learning is a special form of organization of cognitive activity, a method of cognition implemented in the form of joint activities of students, in which all participants interact with each other, exchange information, jointly solve problems, simulate situations, evaluate the actions of others and their own behavior, immerse themselves in real atmosphere of business cooperation to solve the problem.

The leading **teaching methods** in this course are lectures, with an emphasis on problem lectures; case method; discussion methods, and visualization.

Lecture is an organized verbal presentation of subject matter often augmented by visual aids. Lectures are the best teaching method in many circumstances; especially for communicating conceptual knowledge, and where there is a significant knowledge gap between lecturer and audience. Lectures are so effective because they exploit the spontaneous human aptitude for learning from spoken (rather than written) information. Used in conjunction with active learning teaching strategies, the traditional lecture can be an effective way to achieve instructional goals. The advantages of the lecture approach are that it provides a way to

communicate a large amount of information to many listeners, and maximizes instructor control. The most significant disadvantage of traditional lectures is that such lectures minimize feedback from students. In this regard, when teaching this course, where possible, preference is given to problematic lectures.

Problem lecture begins with the statement of the problem, which must be solved in the course of the presentation of the material. There is no ready solution in this case. That is, the student's activity is coming to the search and research ones. On such lectures, a dialogue between the teacher and students is required. Students actively participate in the discussion and search for certain solutions.

Case method. Providing an opportunity for students to apply what they learn in the classroom to real-life experiences has proven to be an effective way of both disseminating and integrating knowledge. The case method is an instructional strategy that engages students in active discussion about issues and problems inherent in practical application. It can highlight fundamental dilemmas or critical issues and provide a format for role playing ambiguous or controversial scenarios. The case study approach works well in cooperative learning or role playing environments to stimulate critical thinking and awareness of multiple perspectives.

Discussion methods are a variety of forms for open-ended, collaborative exchange of ideas among a teacher and students or among students for the purpose of furthering students thinking, learning, problem solving and understanding. Participants present multiple points of view, respond to the ideas of others, and reflect on their own ideas in an effort to build their knowledge, understanding, or interpretation of the matter at hand. A defining feature of discussion is that students have considerable agency in the construction of knowledge, understanding, or interpretation.

Visualization teaches the student to convert oral and written information into a visual form, highlighting the most significant and essential elements. The visualization method uses diagrams, figures, drawings, etc., including those performed by students. At the same time, the logic and rhythm of the teaching material is important. Visual presentation of the material helps to develop a clearer understanding of most topics of the course.

Assessment types and methods.

The course involves a formative and summative assessment.

Formative assessment (during course to test progress and mastery of concepts) provides information to students as well as instructors about how well students understand specific course concepts. The goal of formative assessment is to monitor student learning to provide feedback. This type of classroom assessment focuses upon the daily opportunities and interactions afforded to teachers and students for collecting information about student work and understandings, then uses that information to improve both teaching and learning.

Formative assessments include: tutorial exercises; spot check questions; in-class writing assignment; short regular quizzes; in-class tests; homework task discussions; etc.

Summative assessment (to confirm whether students have mastered the material covered in the course, as outlined in the learning outcomes) is aimed at assessing the extent to which the most important outcomes at the end of the instruction have been reached.

Summative assessment include: mid-term problem sets; individual report paper; activity in the classroom (participating in class discussion); examination.

Explanation of Criteria and Grading System. The grading scheme.

All judgments relating to students’ grades must be fair, objective and reasonable. Making objective decisions is fundamental to fulfilling the principle aims of assessment: fairness, reliability and validity. Objectivity in the context of assessment is necessary to get an accurate judgement of what a student knows, understands and can do. It’s important that grades accurately reflect the quality of student work and that student work is graded fairly.

Criterion-referenced assessment is used for the summative assessment of the course. It measures student’s performances against a fixed set of predetermined criteria or learning standards.

The Grading Criteria are intended to promote fair and uniform standards for determining final grades. Establishing fair and transparent grading criteria ensures the efficiency and consistency of the grading process.

Students must fulfil all required assignments and control activities to successfully pass the course. Table 1 presents the grading scheme (the final grade components).

Table 1 – Final grade components

Mid-term problem sets		Individual report paper	Activity in the classroom (participating in class discussion)	Examination	Maximum amount
№1	№2				
0-15	0-15	0-20	0-15	0-35	100

The amount of workload while completing the course is measured in terms of credits. Upon successful completion of the course, the student is awarded 4 academic credits.

Apart from the quantitative measure of the Credit, there is the Grade which represents a qualitative measure of a student's accomplishment.

The grading system of the course have developed utilizing the Ukrainian national grading system and the European credit transfer system (ECTS), and corresponds to the grading system of NTU "KhPI". The use of the ECTS grading system provides universal-applicability and transferability of grading. The ECTS grading scale provides information on the student’s performance in addition to that provided by the institution’s grade; it does not replace the local grade.

Table 2 presents grading system of NTU “KhPI”, as well as the criteria for awarding grades in the course.

Table 2 – Grading system of NTU “KhPI” and the criteria for awarding grades in the course

ECTS grade	Points	Ukrainian evaluation	Criteria for awarding grades in the course
A	90-100	Excellent	Excellent, outstanding performance with only minor inaccuracies. A student has perfectly mastered the theoretical material, demonstrates profound and comprehensive knowledge of a relevant topic or discipline, and a high proficiency in analytical, critical and creative thinking; freely uses theoretical knowledge and possesses a high level of practical skills; exhibits a high level of independent and self-regulatory learning skills.
B	82-89	Good	Very good, above average standards, with minor errors. A student demonstrates strong performance, considerable mastery of the essential facts, concepts, principles, and theories; significant proficiency in analytical, critical and creative, and problem solving skills; possesses the ability to correctly apply this knowledge to the problems assigned during the learning; exhibits an above average level of independent and self-regulatory learning skills.
C	75-81	Good	Good, generally acceptable performance, but with some errors. A student has intermediate mastered the essential facts, concepts, principles, and theories, but there are recognizable areas of deficiency; has practical skills and expresses opinion on this or that issue yet may be inaccurate and erroneous when presenting theoretical material or when applying practical skills; exhibits an ample level of independent and self-regulatory learning skills.
D	64-74	Satisfactory / Pass	Satisfactory, fair but with significant shortcomings. A student demonstrates elementary mastery of the concepts and principles of the course; a certain proficiency in analytical, critical and creative, and problem solving skills; however additional questions cause him/her to give an unclear answer or no answer at all; exhibits a somewhat low level of independent and self-regulatory learning skills.
E	60-63	Satisfactory / Pass	Sufficient, performance meets minimum criteria. A student demonstrates minimal mastery of the concepts and principles of the course, and minimal proficiency in analytical, critical and creative, and problem solving skills; exhibits a low level of independent and self-regulatory learning skills. A pass grade is assigned to the student who knows the significant parts of the course on a satisfactory level and is able to demonstrate an acceptable level of familiarity in the application of the content of the course.
FX	35-59	Unsatisfactory	Unsatisfactory, failed with possibility to retake the course within the timeframe provided by the syllabus. A fail grade is assigned to the student who does not command sufficient knowledge and

			demonstrate skill in applying the practices of his/her chosen field. Knowledge of the course is below the minimum level.
F	1-34	Unsatisfactory	Unsatisfactory, course repetition is required. A student has not mastered the educational material of the topic, does not know the basic definitions, concepts; gives the wrong answer to the questions. Considerable further work is required.

Recommended reading (learning resources)

Essential reading:

- 1 Chaika T. (2015). Adaptive management of uncertainty in making management decisions. *Business Inform.* 2, 283-288. (in Ukrainian).
- 2 Chaika T. (2020). Optimization of the material flow indicators system in the hotel and restaurant business: the logistics aspect. *Internauka*, 11(43), 9-13. doi.org/10.25313/2520-2294-2020-11-6577. (in Ukrainian).
- 3 Chaika T. (2019). Optimization of the structural and dynamic characteristics of the balance sheet based on its horizontal analysis. *Problems of systemic approach in the economy*. 6(74), 124-133. (in Ukrainian).
- 4 Cornuejols, G., Pena, J., & Tutuncu, R. (2018). *Optimization Methods in Finance*. Cambridge: Cambridge University Press. doi: 10.1017 / 9781107297340
- 5 Cominetti R., Facchinei F., Lasserre J., Daniiladis A. (2012). *Modern Optimization Modeling Techniques*. Basel: Birkhäuser.
- 6 Craven B., Islam S. (2011). *Optimization in Economics and Finance: Some Advances in Non-Linear, Dynamic, Multi-Criteria and Stochastic Models*. Boston, MA: Springer. doi: https://doi.org/10.1007/b105033
- 7 Dixit A. (1990). *Optimization in Economic Theory*. Oxford, United Kingdom: Oxford University Press.
- 8 Guenin B., Konemann J., Tuncel L. (2014). *A Gentle Introduction to Optimization*. Canada, Ontario: University of Waterloo. doi: https://doi.org/10.1017/CBO9781107282094
- 9 Leonard D., van Long N. (1991). *Optimal Control Theory and Static Optimization in Economics*. Cambridge: Cambridge University Press.
- 10 Luptacik M. (2010). *Mathematical Optimization and Economic Analysis*. Boston, MA: Springer.
- 11 Osborne M. (2007). *Mathematical methods for economic theory*. Toronto, Canada: University of Toronto.
- 12 Panik M. (2021). *Mathematical Analysis and Optimization for Economists*. London, GB: Chapman and Hall/CRC.
- 13 Royset J., Wets R. (2021). *An Optimization Primer*. Switzerland, Bern: Springer International Publishing
- 14 Sarker A., Newton Ch. (2008). *Optimization Modeling. A Practical Approach*. Boca Raton, Florida, USA: CRC Press.
- 15 Wainwright K., Chiang A. (2005). *Fundamental Methods of Mathematical Economics*. Boston, USA: McGraw-Hill.

16 Yakimenko-Tereshchenko N. (Ed.). (2019). *Research and optimization of economic processes in the hotel and restaurant business: collective monograph*. Kharkiv: NTU “KhPI”. (in Ukrainian).

Optional reading:

1 Allman-Ward M., Allman-Ward P. (2007). *Optimizing company cash: a guide for financial professionals*. Oxford, Mississippi, USA: University of Mississippi.

2 Bradley T. (2013) *Essential Mathematics for Economics and Business*. New York: Wiley Textbooks.

3 Carter M., Price C. (2001). *Operations research. A practical introduction*. Boca Raton, Florida, USA: CRC Press.

4 Chaika T. (2017). Possibilities and scope of application of the hierarchy analysis method in accommodation logistics in the hospitality industry. *Challenges and prospects for entrepreneurial development*. 3(18), 79-87. (in Ukrainian).

5 Chaika T. (2014). The problem of selecting experts to the expert group when making management decisions. *Scientific Bulletin of Kherson State University. Ser.: Economic Sciences*. 8(7), 142-146. (in Ukrainian).

6 Khan A. (2017). *Cost and Optimization in Government. An Introduction to Cost Accounting, Operations Management, and Quality Control*. Milton Park, Abingdon, Oxfordshire, England: Routledge.

7 Gilli M., Maringer D., Schumann E. (2019). *Numerical Methods and Optimization in Finance*. Amsterdam, Netherlands: Elsevier.

8 Jacques I. (2018). *Mathematics for Economics and Business*. Edinburgh, GB: Pearson Education Limited.

9 Malinic S. Janjic V., Todorovic M., Jovanovic D. (2011). Management accounting information support in optimizing product mix using linear programming. *Economic Themes*, 49 (3) 5, 415-432.

10 Nayak S. (2021). *Fundamentals of Optimization Techniques with Algorithms*. Coimbatore, India: Academic Press. doi: <https://doi.org/10.1016/C2019-1-02539-9>

11 Ozdemir B. (2019). *Balance Sheet Optimization. From risk compliance to strategic risk management*. Edmonton, Alberta, Canada: CWB Financial group.

12 Lubinska B. (2020). *Asset liability management optimisation: a practitioner's guide to balance sheet management and remodelling*. Hoboken, New Jersey, USA: John Wiley & Sons.

13 Simon C., Blume L. (2010). *Mathematics for Economists. International student edition*. New York, N.Y.: W. W. Norton & Company Inc.

14 Sydsaeter K., Hammond P., Strom A., Carvajal A. (2016). *Essential Mathematics for Economic Analysis*. Edinburgh, GB: Pearson Education Limited.

15 Sydsaeter K., Hammond P., Seierstad A., Strom A. (2008). *Further Mathematics for Economic Analysis*. Edinburgh, GB: Pearson Education Limited.

Prerequisites and course sequences

Table 3 presents the programme courses that stand in sequential relationship to this course.

Table 3 – Programme courses that stand in sequential relationship to this course

Programme courses that precede this course (prerequisites)	Programme courses to be taken after this course
Further Mathematics Business Informatics	Accounting Financial Accounting I Taxation Financial Accounting II

Lead instructor: Ass. Prof. Tetiana Chaika _____