

**Санкт-Петербургский филиал федерального государственного  
автономного образовательного учреждения высшего образования  
"Национальный исследовательский университет  
"Высшая школа экономики"**

Факультет Санкт-Петербургская школа экономики и менеджмента

Департамент экономики

**Рабочая программа дисциплины  
«Инструментальные методы экономического анализа»  
(преподается на английском языке)**

для образовательной программы «Прикладная экономика и математические методы»  
направления подготовки 38.04.01 «Экономика»  
уровень магистратура

для образовательной программы «Финансы»  
направления подготовки 38.04.08 «Финансы и кредит»  
уровень магистратура

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Согласована начальником ОСУП

« \_\_\_\_ » \_\_\_\_\_ 2017 г.

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Санкт-Петербург, 2017

*Настоящая программа не может быть использована другими подразделениями университета и другими вузами без разрешения кафедры-разработчика программы.*

## Course Syllabus

Title of the course	<b>Instrumental Methods of Economic Analysis</b>				
Title of the Academic Programme	Masters in Economics (1st year), Masters in Finance (1st year)				
Type of the course	Adapting; available to foreign students				
Prerequisites	Calculus, Linear algebra				
ECTS workload	2				
Total indicative study hours	Directed Study	Self-directed study	Total		
	24	52	76		
Course Overview	The purposes of the discipline "Instrumental Methods of Economic Analysis" are: understanding the basic concepts of mathematical analysis and linear algebra; and acquiring skills in solving optimization problems of various types.				
Intended Learning Outcomes (ILO)	<p>Understand the theory of elementary functions, methods of calculus related to the differentiation of single and multiple variable functions.</p> <p>Know the necessary and sufficient conditions for concavity/convexity of the function and maximum/minimum.</p> <p>Be able to solve unconstrained and constrained optimization problems.</p> <p>Have an understanding of the envelope theorem and be able to use it in the optimization problems.</p>				
Teaching and Learning Methods	The course consists of lectures (8 hours) and tutorials (16 hours). The tutorials involve studying calculus and linear algebra methods and their application to solving constrained and unconstrained optimization problems using terms and concepts studied in class.				
<b>Content and Structure of the Course</b>					
№	Topic / Course Chapter	Total	Directed Study		Self-directed Study
			Lectures	Tutorials	
1	Linear algebra: operation with matrices, square matrices, determinant, eigenvalues and eigenvectors	11	1	2	8
2	Functions of one variable: derivative of the function, necessary and sufficient conditions for increasing/decreasing,	11	1	2	8

	concavity/convexity, extremum and inflection points.				
3	Functions of multiple variables: first and second order partial derivatives, Schwarz theorem, necessary and sufficient conditions for concavity/convexity and extremum points	16	2	4	10
4	Unconstrained optimization of multiple variables functions: necessary and sufficient conditions for local/global maximum/minimum, envelope theorem	18	2	4	12
5	Constrained optimization of multiple variable functions. Equality constrains: necessary and sufficient conditions for maximum/minimum, relationship between concavity/convexity of the function with the type of extremum. Inequality constrains: Kuhn-Tucker theorem, relationship between concavity/convexity of the function with the type of extremum	20	2	4	14
<b>Total study hours</b>		76	8	16	52
<b>Indicative Assessment Methods and Strategy</b>		Students' progress will be measured by in-class quizzes (40% of the final grade), class participation (10%), and an 80-minute written final exam (50%).			
<b>Readings / Indicative Learning Resources</b>		<p><u>Mandatory</u></p> <p>Luptácik, M. Mathematical Optimization and Economic Analysis [Electronic Resource] / Mikuláš Luptácik. – Springer, New York, NY, 2010. – 299 p. – Authorized access: <a href="https://link.springer.com/book/10.1007/978-0-387-89552-9">https://link.springer.com/book/10.1007/978-0-387-89552-9</a> – (Springer Optimization and Its Applications book series).</p> <p><u>Optional</u></p> <p>Snyman, J.A. Practical Mathematical Optimization [Electronic Resource] / Jan A. Snyman. – Springer, Boston, MA, 2005. – 271 p. – Authorized access: <a href="https://link.springer.com/book/10.1007/b105200">https://link.springer.com/book/10.1007/b105200</a> – (Springer Applied Optimization book series).</p>			

Indicative Self- Study Strategies	Type	+/-	Hours
	Reading for seminars / tutorials (lecture materials, mandatory and optional resources)	+	14
	Assignments for seminars / tutorials / labs	+	20
	E-learning / distance learning (MOOC / LMS)	-	0
	Fieldwork	-	0
	Project work	-	0
	Other (please specify)	-	0
	Preparation for the exam	+	18
Academic Support for the Course	Academic support for the course is provided via LMS, where students can find: guidelines and recommendations for doing the course; guidelines and recommendations for self-study; samples of assessment materials		
Facilities, Equipment and Software	Projector, white board.		
Course Instructor	Sergey Kichko		

**Course Content**

1. Linear algebra: operation with matrices, square matrices, determinant, eigenvalues and eigenvectors.
2. Functions of one variable: derivative of the function, necessary and sufficient conditions for increasing/decreasing, concavity/convexity, extremum and inflection points.
3. Functions of multiple variables: first and second order partial derivatives, Schwarz theorem, necessary and sufficient conditions for concavity/convexity and extremum points.
4. Unconstrained optimization of multiple variables functions: necessary and sufficient conditions for local/global maximum/minimum, envelope theorem.
5. Constrained optimization of multiple variable functions:
  - a. Equality constrains: necessary and sufficient conditions for maximum/minimum, relationship between concavity/convexity of the function with the type of extremum.
  - b. Inequality constrains: Kuhn-Tucker theorem, relationship between concavity/convexity of the function with the type of extremum.

## Assessment Methods and Criteria

### Assessment Methods

Types of Assessment	Forms of Assessment	Modules			
		1	2	3	4
Formative Assessment	Test	*			
	In-class Participation	*			
	In-class quizzes	*			
Summative Assessment	Exam	*			

### Assessment Criteria

#### In-class Participation

Grades	Assessment Criteria
«Excellent» (8-10)	A critical analysis which demonstrates original thinking and shows strong evidence of preparatory research and broad background knowledge.
«Good» (6-7)	Shows strong evidence of preparatory research and broad background knowledge. Excellent oral expression.
«Satisfactory» (4-5)	Satisfactory overall, showing a fair knowledge of the topic, a reasonable standard of expression. Some hesitation in answering follow-up questions and/or gives incomplete or partly irrelevant answers.
«Fail» (0-2)	Limited evidence of relevant knowledge and an attempt to address the topic. Unable to offer relevant information or opinion in answer to follow-up questions.

#### Written Assignments (Essay, Test/Quiz, Written Exam, etc.)

Grades	Assessment Criteria
«Excellent» (8-10)	Has a clear argument, which addresses the topic and responds effectively to all aspects of the task. Fully satisfies all the requirements of the task; rare minor errors occur;
«Good» (6-7)	Responds to most aspects of the topic with a clear, explicit argument. Covers the requirements of the task; may produce occasional errors.

«Satisfactory» (4-5)	Generally addresses the task; the format may be inappropriate in places; display little evidence of (depending on the assignment): independent thought and critical judgement include a partial superficial coverage of the key issues, lack critical analysis, may make frequent errors.
«Fail» (0-2)	Fails to demonstrate any appropriate knowledge.

### **Recommendations for students about organization of self-study**

Self-study is organized in order to:

- Systemize theoretical knowledge received at lectures;
- Extending theoretical knowledge;
- Learn how to use legal, regulatory, referential information and professional literature;
- Development of cognitive and soft skills: creativity and self-sufficiency;
- Enhancing critical thinking and personal development skills;
- Development of research skills;
- Obtaining skills of efficient independent professional activities.

Self-study, which is not included into a course syllabus, but aimed at extending knowledge about the subject, is up to the student's own initiative. A teacher recommends relevant resources for self-study, defines relevant methods for self-study and demonstrates students' past experiences. Tasks for self-study and its content can vary depending on individual characteristics of a student. Self-study can be arranged individually or in groups both offline and online depending on the objectives, topics and difficulty degree. Assessment of self-study is made in the framework of teaching load for seminars or tests.

In order to show the outcomes of self-study it is recommended:

- Make a plan for 3-5 presentation which will include topic, how the self-study was organized, main conclusions and suggestions and its rationale and importance.
- Supply the presentation with illustrations. It should be defined by an actual task of the teacher.

### **Special conditions for organization of learning process for students with special needs**

The following types of comprehension of learning information (including e-learning and distance learning) can be offered to students with disabilities (by their written request) in accordance with their individual psychophysical characteristics:

- 1) *for persons with vision disorders*: a printed text in enlarged font; an electronic document; audios (transferring of learning materials into the audio); an individual advising with an assistance of a sign language interpreter; individual assignments and advising.
- 2) *for persons with hearing disorders*: a printed text; an electronic document; video materials with subtitles; an individual advising with an assistance of a sign language interpreter; individual assignments and advising.
- 3) *for persons with muscle-skeleton disorders*: a printed text; an electronic document; audios; individual assignments and advising.

**Аннотация дисциплины на русском языке**

**Инструментальные методы экономического анализа**

Целями дисциплины являются:

- \* понимание основных понятий математического анализа и линейной алгебры;
- \* приобретение навыков решения оптимизационных задач различного типа;
- \* понимать теорию элементарных функций, методы исчисления, связанные с дифференцированием одной и нескольких переменных функций.

По окончании изучения курса студенты должны знать необходимые и достаточные условия вогнутости/выпуклости функции и максимума/минимума; уметь решать неограниченные и ограниченные задачи оптимизации, иметь представление о теореме об огибающей и уметь использовать ее в задачах оптимизации.

Курс состоит из лекций (8 часов) и семинаров (16 часов).