

## TEMPLATE

### Course Syllabus

Title of the course	<b>Machine Learning in Economics</b>				
Title of the Academic Programme	Masters in Economics				
Type of the course					
Prerequisites	Introduction to Econometrics, Probability Theory and Mathematical Statistics				
ECTS workload	5				
Total indicative study hours	Directed Study	Self-directed study	Total		
	28	162	190		
Course Overview	<p>Using data to make predictions, test hypotheses and estimate models is an important skill on current job market. Many companies collect a lot of data and make their decisions data-driven. Machine learning disrupts many fields and promises to achieve superhuman performance in the coming decades. Statistical analysis allows to test hypothesis and verify which of the models fits the data the best.</p> <p>In this course we will cover different methods for supervised and unsupervised learning to develop a necessary toolkit for a successful data scientist. For some of the methods we will go into details to learn why and how they work. We will revisit concepts like stationarity, consistency, asymptotic normality. Moreover, we will touch on ethical implications of data science in the age of big data and apply learned methods to real business data sets.</p> <p>At the end of the course, I expect students will feel comfortable orienting among different methods of machine learning and develop a feeling of why these methods work and how to extend them.</p>				
Intended Learning Outcomes (ILO)	<p>Understand different methods for supervised learning such as linear regression, logistic regression, classification tools.</p> <p>Understand different methods for unsupervised learning such as principal component analysis, k-means clustering.</p> <p>Understand the concept of data generating process and how it is different to the concept of model.</p> <p>Learn more details on hypotheses testing and concepts like stationarity, and ergodicity.</p>				
Teaching and Learning Methods	The course consists of lectures (18 hours) and tutorials (18 hours). The tutorials involve problems solving and discussions of the Statistical Learning course and presentations from students.				
<b>Content and Structure of the Course</b>					
№	Topic / Course Chapter	Total	Directed Study		Self-directed Study
			Lectures	Tutorials	
1	Opening and Intro to Time-Series Models	58	4	4	50
2	Probability Models and Data	78	4	4	70

	Generating Processes				
3	Practical differences between machine learning and statistical approaches	24	2	2	22
4	Presentations and Questions	50	4	4	42
<b>Total study hours</b>		190	14	14	162
Indicative Assessment Methods and Strategy		<p>Students' progress will be measured by a final exam, a course assignment and a presentation. The presentation and a course assignment will be done in the groups of 3-4 people.</p> <p>The total grade is calculated by the exam grade (70% of the total grade), the grades for presentations (12%) and one assignment (18%).</p> <p>Written part of the exam is 3 hours long and is open-book.</p>			
Readings / Indicative Learning Resources		<p><u>Main textbooks</u></p> <p>Brockwell P.J., Davis R.A. "Introduction to Time Series and Forecasting" [Electronic resource]/ Brockwell P.J., Davis R.A. – Springer International Publishing, 2016. – (Springer Texts in Statistics) – Authorized access: <a href="https://link.springer.com/book/10.1007/978-3-319-29854-2#authorsandaffiliationsbook">https://link.springer.com/book/10.1007/978-3-319-29854-2#authorsandaffiliationsbook</a> (Springer eBooks)</p> <p>Neusser K. Time Series Econometrics [Electronic resource]/ Neusser K. – Springer International Publishing, 2016. – (Springer Texts in Business and Economics) – Authorized access: <a href="https://link.springer.com/book/10.1007/978-3-319-32862-1#about">https://link.springer.com/book/10.1007/978-3-319-32862-1#about</a> (Springer eBooks)</p> <p>Hamilton J., "Time Series Analysis"</p>			
Indicative Self- Study Strategies		<b>Type</b>		<b>+/-</b>	<b>Hours</b>
		Reading for seminars / tutorials (lecture materials, mandatory and optional resources)		+	30
		Assignments for seminars / tutorials / labs		+	20
		E-learning / distance learning (MOOC / LMS)		+	40
		Fieldwork		-	
		Project work		+	30
		Presentation		+	20
		Preparation for the exam		+	22
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		R, Python, Latex			
Course Instructor		Artem Duplinskiy, PhD			

## Course Content

1. Opening and Intro to TS concepts
2. Probability Models and Data Generating Processes
3. Practical differences between machine learning and statistical approaches
4. Presentations and Questions

## Assessment Methods and Criteria

### Assessment Methods

Types of Assessment	Forms of Assessment	Modules			
		1	2	3	4
Formative Assessment	Test		*		
	Essay				
	Report/Presentation		*		
	Project				
	In-class Participation		*		
	Other (write appropriate control forms for the course)				
Interim Assessment (if required)	Assignment (e.g. written assignment)		*		
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.

## Project Work

Grades	Assessment Criteria
«Excellent» (8-10)	A well-structured, analytical presentation of project work. Shows strong evidence and broad background knowledge. In a group presentation all members contribute equally and each contribution builds on the previous one clearly; Answers to follow-up questions reveal a good range and depth of knowledge beyond that covered in the presentation and show confidence in discussion.
«Good» (6-7)	Clearly organized analysis, showing evidence of a good overall knowledge of the topic. The presenter of the project work highlights key points and responds to follow up questions appropriately. In group presentations there is evidence that the group has met to discuss the topic and is presenting the results of that discussion, in an order previously agreed.
«Satisfactory» (4-5)	Takes a very basic approach to the topic, using broadly appropriate material but lacking focus. The presentation of project work is largely unstructured, and some points are irrelevant to the topic. Knowledge of the topic is limited and there may be evidence of basic misunderstanding. In a group presentation, most of the work is done by one or two students and the individual contributions do not add up.
«Fail» (0-2)	Fails to demonstrate any appropriate knowledge.

## 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.

### **Recommendations for essay**

An essay is a written self-study on a topic offered by the teacher or by the student him/herself approved by teacher. The topic for essay includes development of skills for critical thinking and written argumentation of ideas. An essay should include clear statement of a research problem; include an analysis of the problem by using concepts and analytical tools within the subject that generalize the point of view of the author.

Essay structure:

1. *Introduction and formulation of a research question.*
2. *Body of the essay* and theoretical foundation of selected problem and argumentation of a research question.
3. *Conclusion* and argumentative summary about the research question and possibilities for further use or development.

## **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.