

## Course Syllabus for the 1<sup>st</sup> module

Title of the course		<b>Simulations, Experiment and Predictive Theories of Behaviour in Social Sciences (offered in English)</b>			
Title of the Academic Programme		MA program Modern Social Analysis			
Type of the course		Elective			
Prerequisites		Sociological Theory, Quantitative methods			
ECTS workload		4			
Total indicative study hours		Directed Study	Self-directed study	Total	
		64	240	304	
Course Overview		<p>The course aimed at equipping students with tools to transform ideas into formal theories and computational models of different nature.</p> <p>Based on concepts from Computational Social Science, students will get experience in working with theoretical constructs and relationships in order to progress from theory and data to model. The main focus is on the progression from modelling individual and group decision making to mechanism-based explanation in social science using agent-based models and experimental studies.</p> <p>The course includes a large practical part which covers working with different decision modelling approaches. The course is targeted to students considering research or analytical career</p>			
Intended Learning Outcomes (ILO)		<p>As a result of this course, students will:</p> <ul style="list-style-type: none"> <li>● Thoroughly understand the role of theory in sociological research</li> <li>● Understand the link between theorizing and modelling</li> <li>● Generate research ideas</li> <li>● Translate research ideas into formal theories</li> <li>● Appropriately apply decision modelling approaches to research and analytics tasks</li> <li>● Interpret modelling results in sociological terms</li> </ul>			
Teaching and Learning Methods		Teaching and learning methods include seminars, group work, practical home assignments (NetLogo, R, Python, spreadsheets).			
<b>Content and Structure of the Course</b>					
№	Topic / Course Chapter	Total	Directed Study		Self-directed Study
			Lectures	Tutorials	
<b>Thematic Block I: Simulation and Experiments</b>					
1	Course Intro. Theory, Decisions and Models. Simulations and experiments. Digital Social	19	4		15

	Research.				
2	Observing Behavior using Digital Data	19	4		15
3	Research Questions and Methods. Experiments	19	4		15
4	Individual Decision Making - Optimization, Rationality, Utility, Cognitive Biases. Tools for Modelling Individual Decisions.	19	4		15
5	Desire-Belief-Opportunity framework. Decisions and Influence in Dyads. Networks. Emergence of Friendship	19	4		15
6	Micro-Macro links in Complex Adaptive Systems. What is Agent-Based Model? Introduction to NetLogo - My first ABM. Creating ABM from scratch. Design Principles	19	4		15
7	ABM-based Theory Construction and validation.	19	4		15
8	Micro-Macro Link and Sociological Explanation.	19	4		15
<b>Total study hours</b>		152	32		120
<b>Indicative Assessment Methods and Strategy</b>		<ul style="list-style-type: none"> <li>• Preparation for Seminars and in-class Participation (30% of the grade)</li> <li>• Essay I (Research Design Proposal) (10% of the grade)</li> <li>• Essay II (Individual Decisions, Theoretical Essay or ABM Simulation) (20% of the grade)</li> </ul> <p>There are no blocking grades.</p> <p><b>Missed seminars policy:</b> Seminars preparation and participation can not be retaken, but up to 1/3 of seminar preparation and participation grade FOR MODULE I can be compensated by an additional task on the seminar topic. Student should request such task by e-mail not later than by the next seminar after the missed one and submit not later than three days after that. If a student has valid excuse to miss seminars confirmed by the study office, they can compensate the whole participation grade provided that they submitted all the compensating tasks not later than one week before the start of the relevant exam period (or one week before the date they need to be graded if it was changed).</p> <p><b>Late submission policy:</b></p>			

	<p>If the task was submitted up to an hour after the deadline, the score for it is reduced by 10%, up to 6 hours - by 30%, up to 24 hours – by 60%, after that the task or its part is not accepted resulting in 0 grade.</p>		
Readings / Indicative Learning Resources	<p><u>Mandatory:</u></p> <ul style="list-style-type: none"> <li>• Cioffi-Revilla, Claudio. 2014. Introduction to Computational Social Science: Principles and Applications. 2014 edition. London ; New York: Springer.  <a href="https://link.springer.com/book/10.1007%2F978-1-4471-5661-1">https://link.springer.com/book/10.1007%2F978-1-4471-5661-1</a></li> <li>• Manzo, Gianluca, ed. 2014. Analytical Sociology: Actions and Networks. 1 edition. Hoboken: Wiley.  <a href="https://ebookcentral.proquest.com/lib/hselibraryebooks/detail.action?docID=1650830">https://ebookcentral.proquest.com/lib/hselibraryebooks/detail.action?docID=1650830</a></li> <li>• Wilensky, Uri, and William Rand. 2015. An Introduction to Agent-Based Modeling: Modeling Natural, Social, and Engineered Complex Systems with NetLogo. MIT Press.  <a href="https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=3339969">https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=3339969</a></li> </ul> <p><u>Internet Resources:</u></p> <ul style="list-style-type: none"> <li>• Bit By Bit: Social Research at the digital age  <a href="http://bitbybitbook.com">http://bitbybitbook.com</a></li> <li>• MOOC Model Thinking  <a href="https://www.coursera.org/learn/model-thinking">https://www.coursera.org/learn/model-thinking</a></li> </ul>		
Indicative Self- Study Strategies	<b>Type</b>	<b>+/-</b>	<b>Hours</b>
	Reading for seminars / tutorials (lecture materials, mandatory and optional resources)	+	100
	Assignments for seminars / tutorials / labs	+	80
	E-learning / distance learning (MOOC / LMS)	-	
	Fieldwork	-	
	Project work	+	60
	Other (please specify)	-	
	Preparation for the exam	-	
Academic Support for the Course	Academic support for the course is provided via e-mail.		
Facilities, Equipment and Software	A computer class with NetLogo, R, MS Excel and Python		
Course Instructor	<p><b>Sr. Lecturer Ilya Musabirov MA MSc, Department of Informatics</b>  <b>Associate Professor Sergey Koltsov PhD, Department of Applied Mathematics and Business Informatics</b></p>		

## Intended Learning Outcomes (ILO) Delivering

Programme ILO(s)	Course ILO(s)	Teaching and Learning Methods for delivering ILO(s)	Indicative Assessment Methods of Delivered ILO(s)
SC-6	Applies modern social research methods and models to study behavior, decision making and complex social phenomena using tools of computational social science	Seminars	Essay I, Essay II, Seminar Participation
PC-3	Formulates goals and research questions to observational, experimental and computational studies using modern tools of computational social science	Seminars	Essay I, Essay II, Seminar Participation

## Course Content

*Introduction to the course. Digital research design. Statistics, Experiment, Simulation*

Big data and social research at the digital age. Modern approaches to social research. Research Designs. Social Informatics and its research and applied problematics. Statistical inference as a foundation of scientific decisions. Biases. Errors. Paradoxes of statistical decisions. Inferential and predictive models. Inference based on observation and experimental data. Causality. Simulation.

*Observing Behavior using Digital Data*

Types and sources of digital data. Social media and applications as data sources. Validity issues. Survey data. Limitations of behavioural data.

*Research Questions and Methods. Experiments*

Goal – RQ mapping for digital research. Match between questions and methods. Observational vs Experimental data. Experimental and Quasi-experimental settings. Crowdsourcing.

*Individual Decision Making - Optimization, Rationality, Utility, Cognitive Biases. Tools for Modelling Individual Decisions.*

Course Intro. Theory, Decisions and Models

When we study decision making; What is ABM in principle; Agent-Based Models vs. Other Modeling Forms; When is ABM the most beneficial; Trade-offs of ABM

Individual Decision Making - Optimization, Rationality, Utility, Cognitive Biases

Theories of decision making; Models of cognition; Rationality and bounded rationality; Ways to compute utility: decisions under risk, the decision under uncertainty, marginal utility, relative utility; Ways to implement cognitive biases in modelling

*Desire-Belief-Opportunity framework. Decisions and Influence in Dyads. Networks. Emergence of Friendship*

A transition of agent behaviour from the individual level to a level of groups, and farther to macro level of the community; Middle-range theory. Desires Beliefs Opportunities. Dyadic Interactions. Networks. Emergence of Friendship Mechanisms of friendship formation: Transitivity, Reciprocity and Homophily

*Micro-Macro links in Complex Adaptive Systems. What is Agent-Based Model? Introduction to NetLogo - My first ABM. Creating ABM from scratch. Design Principles*

Micro-Meso and Micro-Macro links in Complex Systems. What is ABM? Introduction to NetLogo - My first ABM. Introduction to NetLogo; First look at Agent-Based Models and its' basic elements; The interface; Basic syntax. Creating ABM from scratch. Design Principles

A brief introduction to the algorithm of creating Agent-Based model: 1. Motivation, stating the research questions, 2. Formulation of conceptual, formal models, 3. Implementation, operationalization and writing code, 4. Debugging, verification and validation, 6. Analysis;

*ABM-based Theory Construction and validation.*

Analysing ABM. Verification, Validation and Replication

How to add analytical graphs to the User Interface; Types of Measurements; The necessity of multiple runs in ABM (stochasticity); Extracting the raw data from ABM runs; Statistical analysis of the Spread of Disease model; Special cases: 1. Network analysis, 2. Environmental and GIS data; Sensitivity Analysis and Robustness, Macrovalidation vs. Microvalidation

*Micro-Macro Link and Sociological Explanation:*

Micro-Macro Link and Sociological Explanation. Theories of (individual) micro-behaviour transition to macro-outcomes

*Topic 8 - Modelling Emergence of Inequality. Advanced Topics - ML, Networks, Maps, Extensions, Reinforcement learning:*

### Assessment Methods and Criteria

#### Assessment Methods

Types of Assessment	Forms of Assessment	Modules	
		1	2

Formative Assessment	Seminar Preparation and Participation	*	*
	Essay I	*	
	Essay II	*	
	Project		

### Assessment Criteria

#### Preparation for Seminars and in-class Participation

Students are expected to be prepared and actively participate in each of the seminars. Each seminar is assessed by small oral or written tasks and groupwork activities and is graded on the scale from 0 to 1 with a possible intermediary grades, based on student's demonstrated level of preparation, participation and critical analysis based on the following criteria:

Grades	Assessment Criteria
0,8-1	A critical analysis which demonstrates original thinking and shows strong evidence of preparatory research and broad background knowledge.
0,6-0,7	Shows strong evidence of preparatory research and broad background knowledge. Excellent oral or written expression.
0,3-0,5	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.
0-0,2	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.

Grades for each seminar equally contribute to the Preparation for Seminars and in-class Participation grade.

#### Written Essays

##### *Essay I (Research Design Proposal)*

In this task student connects course materials to their own research, either connected to the thesis topic, or student's topic of interest, and demonstrates an ability to produce digital research design extending the project by including digital data gathering and/or methods and open science guidelines. Student first submits the draft of RDP (40% of RDP grade), participates in peer discussion session (20% of RDP grade), and then presents reworked RDP on the seminar (40% of RDP grade). Each part is assessed taking into account the following criteria.

Grades	Assessment Criteria
«Excellent» (8-10)	A well-structured, analytical presentation of RDP. Shows strong evidence and broad background knowledge, connecting to the course materials and research literature on the topic. Demonstrates excellent knowledge of digital research methods, their opportunities and limitations. Compares and contrasts different approaches, fully motivating choice of the method or method mix, highlighting areas of complement. Shows strong critical analysis of the issue.

	In Final presentation also: Answers to follow-up questions reveal a good range and depth of knowledge beyond that covered in the presentation and show confidence in a discussion.
«Good» (6-7)	Clearly organized analysis, showing evidence of a good overall knowledge of the course materials and RL on the topic. Demonstrates good knowledge of digital research method and their opportunities and limitations. Aware of pros and cons of different approaches, motivating choice. Shows critical analysis of the issue. In Final presentation also: The presenter of the project work fully highlights key points and responds to follow up questions appropriately.
«Satisfactory» (4-5)	Takes a very basic approach to the topic, using broadly appropriate material but lacking focus or connection to the RL on the topic or course materials. 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 a basic misunderstanding. Student is limited or unable to maintain discussion. Project and presentation or discussion have some discrepancy in key aspects.
«Fail» (0-3)	Fails to demonstrate any appropriate knowledge

### ***Essay II (1500-2200 words)***

#### ***Example Question I***

You have to write a short paper on the decision models you developed for the last class. You can continue to expand the case, that you started on the seminar in groups, but now finish them individually. You have to choose some theories, that are relevant to your case. Discuss key assumption for each of them. Find other papers for implementation in your field, and/or explain why possible to use it, and quote them.

The text should contain:

1. Hypothesis
2. A framework of decision models you have to choose 3-4
3. conceptual map/diagram for each of them
4. operationalizations of the variables
5. Comparison
6. Conclusion (which one is better)

Your answer should be ~500-1000 words long

#### ***Example Question II***

You have read “Explaining Social Change: An Analytical Approach” by Peter Hedström, where he described the idea of mechanism-based explanation and DBO model. In the article, he gave some examples of action- and interaction-related mechanisms (See Figure 3.)

Choose any social phenomena, which was not mentioned in the article, and try to come up with a mechanism-based explanation, using DBO vocabulary, and going through a “long way” of Coleman’s boat.

1. Briefly describe the phenomenon you chose, start and end points on the macro level
2. Describe what is individual-level action
3. Provide desire-only, belief-only and opportunity-only based explanations of action where possible
4. How “desires”, “beliefs” and “opportunities” are connected with each other and with “action” in your example? Describe and draw the scheme (or choose an appropriate one from Figure 3).
5. How many individual actors are included in your explanation?

6. What is the link between the individual and the social (collective)? Describe emergent outcomes which might appear on macro level

7. What ideas from Schelling's notion of micromotives and macrobehavior you can use in your model and how?

Your answer should be ~1000-1200 words long

<b>Grades</b>	<b>Assessment Criteria (for each task)</b>
«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; a well structured, analytical paper; references to theoretical background
«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» (0-3)	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.