



Aalto University
School of Business



Simulation 30E00400

Course syllabus

2023

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Overview and prerequisites

- This course provides an introduction to simulation methods relevant to business analytics, managerial decision making, operations management, industrial engineering, supply chains, logistics, marketing, finance and accounting, as well as economics in general.
- The course is aimed at second-year Master's students at Aalto Business School, but could be taken by students from other schools, assuming they have a relevant background and interests.

Course prerequisites

- **Fundamentals of Business Knowledge**, as required in the Bachelor's Program at Aalto Biz, especially:
- **Basic knowledge in statistics and probability as well as in matrix algebra, differential and integral calculus**, are essential! Three courses in university statistics, probability, data analytics or mathematics is the minimum.
- **Good knowledge of Excel**
- **If taken before, other quantitative courses would be helpful, especially courses covering probability, as well as those including mathematical analysis and modelling, and those where Excel is employed. E.g. Management Science, Operations research etc.**

Learning objectives and outcomes

1. To learn the logic of mathematical modeling using simulation techniques which can be used to support management decision making, especially in operations management, finance, and logistics, when uncertainty is involved.
2. The course emphasizes random event simulation (stochastic or Monte Carlo simulation).
3. To learn when simulation is useful and when not.
4. To develop expertise in using simulation models with computers and related software, especially Excel.
5. To give experience in analyzing results and making decisions through assigned homework exercises and case analyses.

Teachers

- **Instructor (lectures):**
 - **Tomi (tomi.seppala at aalto.fi)**

Course assistant:(exercises and grading)

- **Ellis Saavalainen(ellis.saavalainen at aalto)**

All course information, materials and the latest course news will be stored on the course home page in MyCourses:

<https://mycourses.aalto.fi/course/view.php?id=40810>

- **You should follow MyCourses permanently for announcements and updates**

Course essentials

- Teaching **on Campus** during period 1
 - Lectures: Mondays 10:15-11:45; Tuesdays 9:30-12:00. The lecture rooms will be changing from week to week; lectures are not recorded
 - Hands-on exercise sessions and homework solutions: Fridays 10:15-12:00
 - 5 homework assignments will be graded: Deadline is on every Friday by 10:00 am (starting second week)
 - Students need to finish MyCourses weekly quizzes before being able to access weekly homework assignments
 - On week 1 you need to pass the pretest, which is required to be able to continue the course; it is due Friday Sept. 8 at 10:00 am.
 - Guidelines for the homework solutions – but not full solutions – will be published in the Friday exercise sessions and sometimes partially on the course page
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Completing the course

On-campus exam (75 %): (pencil & paper exam; calculator is provided by the school) :

Course Exam 20.10.2022, 13:00-16:00

Make-up exam : 12.12.2023

Individual Homework Assignments (25 %)

- **No copying** is accepted
- **Free-riders will not be able to pass the exam anyway, so the best strategy to learn and understand is to do the homework carefully and as individually as possible and discuss issues when needed.**
- **Assistant or teacher will answer questions related to the material during the class or help session (or to some extent by email)**
- **1 % bonus for submitting the course evaluation**

Completing the course

Teaching

- **Lectures** (not compulsory, but highly recommended; lectures are not recorded)
 - **Exercise sessions** (not compulsory, but highly recommended)
 - Attendance will be kept on participation of the events, but no extra points are given for attendance
 - Everyone has to do the **pretest** and fill a **background questionnaire** during the first week
 - To check that you have studied the lecture material before starting each **homework assignment**, you need to complete **weekly quizzes** before being able to access the homework assignments
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Approximate Workload (for an average student to obtain grade 3/5):

- Lectures 30 h (5 h/ week)
- Exercise sessions 12 h (2 h/ week)
- Independent study and Homework preparation
66 h (11 h/ week)
- Preparation for the exam 51 h
- Exam 3 h
- Total 161 h (average student to obtain grade 3)
- Theoretically workload in seven weeks is
 $161/7=23$ hours per week (for 7 weeks)

Preliminary timetable and topics

Week 1

- **Introduction to simulation models**
- **Probability and Statistics**
- **Spreadsheet modeling**
- **Generating random numbers in Excel**
- **Simulation of discrete random variables**

Week 2

- **Simulation of continuous random variables with Inverse function method**
- **Theory of generating random numbers**

Week 3

- **Input modeling: Special methods for Generating random variables**
- **Waiting time distributions**

Preliminary timetable and topics

Week 4

- **Multivariate probability distributions and their simulation**

Week 5

- **System simulation of service processes, including inventory and queuing models**

Week 6

- **Stochastic processes, random walk models and their simulation**

Week 7

- **Exam**

Purpose of each teaching activity

Pretest

- To make sure that you have the preknowledge required for the course

Lectures

- Explain theory and how it can be applied in practice
- Some examples
- Students can ask questions related to theory

Exercises

- Learn to use Excel for simulation
- More examples
- Students can ask questions related to Excel

Quizzes

- To check weekly that you have understood the main concepts

Homework assignments

- Practice to understand and how to use theory to develop simulation models
- Practice Excel to develop simulation models
- To deepen your understanding through practical problems

Help Sessions

- Help is provided especially related to the homework assignments

Exam (You have to pass!)

- Check what you have learned and understood
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Other: students' own study

Textbooks

- **Help you to deepen your knowledge**
- **Give you a broader understanding of theory**
- **Give you a broader understanding of applications**
- **You do not need to sit in front of computer all the time**
- **Pages of the textbooks related to each lecture given**

Internet:

- **You can find information on specific topics and concepts
e.g. from Wikipedia**
- **You may find other study materials**
- **You can find out about different applications**
- **Discuss forums: but be careful, the information may not
always be correct (same applies to AI!)**

Textbooks that the course is based on

- **Theory** will be mostly taken from the book
- **Ross, S.: *Simulation***. 4th edition (or later), Academic Press 2006, selected parts from Chapters 1-7 (more mathematical approach)
- **Excel instructions and practical examples can be found in**
- **Evans, J.R. & Olson, D.L. *Introduction to simulation and risk analysis***. 2nd edition. Prentice Hall 2002. Chapters 1-6.
- **Newer editions of both books may be used**
- **Reading books is useful for learning the principles and deepens your understanding of the material**

Why is Excel used in the course

Pros:

- **Excel is a good visual tool for teaching and learning purposes**
- **Excel is familiar beforehand to most students**
- **Surprisingly, Excel has many capabilities useful for modelling and simulation that most people do not know**

Cons

- **Excel is not very flexible for programming loop like structures**
- **Excel is slow for complicated simulations**

Some other simulation tools:

- **R, Matlab&Simulink, Python**
- **Other specific simulation software**

Grading

Percentage	Grade
86%	5
77%	4
68%	3
59%	2
50%	1
Below 50 %	Fail