Course syllabus «Contemporary Decision Sciences: an Integrated Perspective»

Approved by
Programme Academic Council
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Number of credits	4
Contact hours	48
Self-study hours	104
Course	1
Educational format	Without use of online course

I. Goals and Results of Mastering the Discipline; Prerequisites

This course is a required foundational course for masters' students in "Applied Statistics with Network Analysis" program, designed to familiarize them with the most recent developments in interdisciplinary decision sciences. This course covers many approaches to solving real-life problems from the mathematical point of view – in other words, we are using available mathematical tools to make good decisions. Various optimization techniques are surveyed with an emphasis on the why and how of these types of models as opposed to a detailed theoretical approach. Students develop optimization models which relate to their areas of interest. Spreadsheets are used extensively to accomplish the mathematical manipulations. Emphasis is placed on input requirements and interpretation of results.

As a result, students should:

Know:
- the role of the modeling in decision-making and different model components
- different decision-structuring techniques
- model-building and model validation techniques.

Be able to:
- understand and explain in your own words ways in which model-based support systems are needed and can be utilized in managerial decision processes.
- explain how and why modeling is used in the support system environment.
- identify and differentiate different model components.
- to criticize constructively and determine existing issues with the use of statistical methods in published work

Have:
- a working knowledge of mathematics of decision sciences
- a working knowledge of different ways of using software programs for data analysis
- an ability to use model-based management solution using a variety of software packages

Basic knowledge of introductory statistics are required for this course.

The basics of this discipline should be used in all of the program-related courses.

The course is strongly related and complementary to other compulsory courses provided in the first year (e.g. Applied Linear Models II, networks) and sets a crucial prerequisite for later courses and research projects as well as for the master thesis. The course gives students an important foundation to develop and conduct their own research as well as to evaluate research of others.

II. Content of the Course

SESSION ONE: Introduction to DS

The first session will introduce the main concepts of problem solving and decision-making, quantitative analysis, management science techniques.

SESSION TWO: The basics – spreadsheet techniques

The session will demonstrate the use of spreadsheets for modeling, review of the key Excel functions, examples of macro writing and advanced Visual Basic coding.

SESSION THREE: Linear programming methods I

The session introduces the basic maximization model with its solutions, including graphical; extremums and optima, minimization problems, special cases.

SESSION FOUR: Linear programming methods II

This session continues with linear programming, moving to sensitivity analysis and interpretation of solutions. It will also look at a variety of applications of linear programming to real-life data (in marketing, financial sector, operations management)

SESSION FIVE: Advanced linear programming techniques

This session covers more advanced forms of linear programming, including data envelopment analysis, revenue management and portfolio models.

SESSION SIX: Distribution and network models

This session will discuss transportation models, assignment models, minimum cost network flow models, and shortest path models. It will also make a connection to the various network-analytic methods that are being taught elsewhere in the program.

SESSION SEVEN: Integer linear programming

This session will discuss types of integer linear programming models, graphical and computer solutions for ALP, and also applications involving binary variables.

SESSION EIGHT – Nonlinear optimization models

This session will discuss basic ideas of nonlinear optimization, pricing models, advertising response and selection models, production application, facility location models, Markowitz portfolio optimization models.

SESSION NINE – Project scheduling: PERT/CPM

This session will focus on project scheduling with known and unknown activity times and time-cost tradeoffs.

SESSION TEN - Inventory models

This session will look at basic inventory models, including Economic Order Quantity, Economic Production Lot Size Model, single-period inventory model with probabilistic demand, order-quantity- reorder point model with probabilistic demand

SESSION ELEVEN – Simulation modeling

This session will look at real applications of simulation, probability distributions for input variables, the effects of input distributions on results, operations models, financial models, simulating games of chance.

SESSION TWELVE – Conclusion: overview of the field

This session is designed to give the final look at the vast field of decision sciences, with most up-to-date methods reviewed and put together into a one coherent whole.

III. Grading

Course grade will be completed as follows:

Course Element	**% Towards Final Grade**
Final Exam	**50%**
Final In-Class or Take-home exam (at the discretion of the instructor)	*50%*
Participation and responsibility grade	**50%**
Homework Assignments (5 x Varied points)	*20%*
In-Class Labs (9-10 x Varied points)	*20%*
Quizzes (Best 9 of 10, Varied points)	*10%*
Extra credit	As assigned
Total	100%

If the final grade is non-integer, it is rounded according to algebraic rules. If has a half (.5) at the end, we are rounding upward. Rounding of cumulative grades and other rounding issues are performed according to the HSE rules.

IV. Grading Tools

This class contains several assignments that test student knowledge and understanding throughout the course.

Quizzes
You cannot meaningfully participate in the seminar if you have missed my lecture and did not do any reading. Therefore, to encourage you to prepare for seminars, every seminar will have a quiz on the lecture material and all assigned readings for the week. This includes the very first seminar, which will focus on Lecture 1 material. You are allowed to miss any one quiz (skip a seminar, not prepare, etc.) – in other words, I will count the best 9 out of 10 quizzes that we will have. If you submit all ten, I will count best nine. All quizzes will be done online and submitted to me via SurveyMonkey (links will be given in class).

Important: I record IP addresses and only accept quizzes submitted from with the HSE IP address. Quizzes submitted from other locations are NOT counted towards your grade. In other words, to participate in a quiz, you have to be present in class.

In-class Labs
There will be a lab assignment in almost every seminar, depending on our progress. Since we will be learning SAS, and learning quickly, you will need to devote a substantial time to it. Seminar labs should help you with this task. At the end of the lab, you will submit your completed assignment for the day (or as much as you were able to complete) to me via LMS.

Homework assignments
There will be several homework assignments that will provide additional hands-on practice for the concepts we've learned in class and practiced during the seminar. Homeworks will be assigned as needed throughout the semester. All homework submissions must be done by the stated deadline via the LMS system.

Final exam
Final exam will be comprehensive and will involve analysis of a real-life dataset. The students will be asked to establish a research question and propose the most logical methodology for finding the answer to this question. In doing so, they need to propose at least two different ways of examining the data. Additional instructions will be provided in class.

V. Resources

5.1 Main Literature

1. Applications of Management Science, edited by Kenneth D. Lawrence, and Gary Kleinman, Emerald Publishing Limited, 2015. ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=1953299.
2. Ravindran, A.. Operations Research and Management Science Handbook, edited by A. Ravi Ravindran, Chapman and Hall/CRC, 2007. ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=332795.
3. Management Science : Current Researches and Developments - Part I, edited by Brian H. Rudall, Emerald Publishing Limited, 2007. ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=306229.
4. Management Science : Current Researches and Developments - Part II, edited by Brian H. Rudall, Emerald Publishing Limited, 2007. ProQuest Ebook Central, https://ebookcentral.proquest.com/lib/hselibrary-ebooks/detail.action?docID=306230.
5. Encyclopedia of Operations Research and Management Science. 2013 Edition. Editors: Saul I. Gass, Michael C. Fu. URL https://proxylibrary.hse.ru:2176/referencework/10.1007/978-1-4419-1153-7. Springer Link.

5.2 Additional Literature

1. Taudes, Alfred, ed. *Adaptive information systems and modelling in economics and management science*. Springer-Verlag/Wien, 2005. URL https://proxylibrary.hse.ru:2176/book/10.1007/3-211-29901-7. Springer Link.
2. Mingers, John. *Realising systems thinking: Knowledge and action in management science*. Springer Science & Business Media, 2006. URL https://proxylibrary.hse.ru:2176/book/10.1007/0-387-29841-X. Springer Link.
3. Ouardighi, Fouad El, and Konstantin Kogan. *Models and Methods in Economics and Management Science*. Springer, 2014. URL https://proxylibrary.hse.ru:2176/book/10.1007/978-3-319-00669-7. Springer Link.

5.3 Software

№ п/п	Name	Access conditions
1.	MicrosoftWindows 7 Professional RUS MicrosoftWindows 10 MicrosoftWindows 8.1 Professional RUS	*From the university's internal network (contract)*
2.	Microsoft Office Professional Plus 2010	*From the university's internal network (contract)*
3.	R, R studio	*Open access. URL: https://www.r-project.org/*
4.	SAS	*Open access University Edition. URL: https://www.sas.com/ru_ru/software/university-edition.html*

5.3 Material and technical support

Classrooms for lectures on the discipline provide for the use and demonstration of thematic illustrations corresponding to the program of the discipline, consisting of:

- PC with Internet access (operating system, office software, antivirus software);
- multimedia projector with remote control.