

COURSE DESCRIPTION

Course Title: Network science and decision theory

Credits: 5

Responsible teacher: Dr. Eleonóra Stettner, Dr. Gyöngyi Bánkuti, Associate Professors

Pre-requisite courses: None

Recommended textbooks:

Hillier Liebermann: Introduction to Operations Research

Introduction To Operations Research by Frederick S. Hillier, Gerald J. Lieberman VII Edition.pdf

https://books.google.hu/books/about/Introduction_to_operations_research.html?id=1GdRAAAAMAAJ&redir_esc=y

Thomas L. Saaty The Analytic Network Process www.iors.ir/journal/browse.php?a_id=27...1

<http://barabasi.com/book/network-science>

Softwares:

Linx, Maple, GeoGebra, Gephi

Visual PROMETHEE Academic Edition , <http://www.promethee-gaia.net/software.html>

Super Decisions Software (ANP)

Syllabus

The aim of this course is to show decision techniques to the students, to enable them taking part in decision processes. To get familiar with some models and IT Tools, to be able to choose from them when a real life problem occurs. IT Tools: Excel, Gephi, Promethee, Geogebra, Linx, other (mostly free) Tools. The technique of the course is to connect the theory to some real problems, to give examples for the models and to consider the background of the students and build on that – in the time limit.

Course weekly schedule:

No.		
1	Introduction to decision analysis 1: how to formalize objectives, decision alternatives, quantification of subjective considerations, weighting of objectives, scales, ...	Introduction to decision analysis 2: Polano Method, dominancy, MaxMin, MaxMax rules, decision filters, lexicographical order, advantages and disadvantages of the different methods
2	Linear Programing: To brush up the students knowledge, (even Linear Algebra), show how to use IT Tools (Linx, Maple, Geogebra) for it	Multiobjective linear Programing 1: Sequential Optimization, Aggregation (standardization with dimensionless variables)
3	Multiobjective linear Programing 2: Method of barriers, Largest lower barrier (Geogebra)	Multiobjective linear Programing 3: "Better points" Pareto optimal points, methods for creation
4	AHP (Analytic Hierarchy Process) 1: (Theory) pairwise comparison analysis, reciprocal, consistent matrices, rank and eigenvalue of a matrix, eigenvectors,	AHP 2: (Practice) Real file problems. Implementation in Excel inconsistency index, and quotient, using SuperDecisions Program
5	Summary, Practice	1 st Midterm exam
6	ANP Analytic Network Process 1: (Theory) Structure of the Model, comparison with AHP, supermatrix	ANP Analytic Network Process 2: (Practice) Problem solving with Superdecisions Tool

7	Promethee 1: (Theory) Minimizing methods, distributive, ideal, qualification and final selection AHP model	Promethee 2: (Practice) Problem solving with Promethee Tool
8	Network Science 1: Graph Theory	Network Science 2: Random Networks
9	Network Science 3: Scale-Free Property	Network Science 3: Barabási Albert Model
10	Hands-on-class: Network Analysis and Visualization Software	Hands-on-class: Network Analysis and Visualization Software
11	Artificial Intelligence (AI) searching methods: for problem solving, Decision Trees	Dynamic programing: Distribution of limited resources
12	Bayes Decision Theory 1: (Theory) For prior or posterior probabilistic decisions	Bayes Decision Theory 2: (Practice) Decision Tree Technique
13	Summary, Practice	2st Midterm exam

Competences

Knowledge: This subject contains mostly skills and abilities. Even the knowledge they get must be utilized for their scientific paper they must submit and used in the presentation they present at the end of the course. Knowledge is the system of “scientific word”. What kind of scientific meetings, scientometric, bibliometric indicators, journal rank indicators exist. The chapter order of scientific paper, the best journals of their fields. Definitions of data types, ... ?

Ability: The students must know how to choose a reasonable research topic, and to work out the details of a scientific paper. The students must show they are able to utilize their modeling, analyzing, statistical, data science methods - they have learnt. They must be able to implement the principles of the thesis writing, must understand the chapters logical order, to use online and word techniques for reference, table of content, table of figures. They must be able to present a scientific paper and even effective oral presentation supported by a power point or other presentation.

Skills (attitudes, behavior): Their skills make them suitable to the complex scientific thinking; they are able to review the theoretical and practical tasks of a research and to adapt their knowledge for the aims. To find and learn not only lexical knowledge on the internet but get skilled at new fields, like how to use a new program, (find tutorial, to learn it alone).

Examining

The course closes with practical grade. Only that student can get a grade who is active participant of the lecture material processing, has chosen a research topic, collected or produces data for that, analyzed it, and prepared thesis and presentation about it alone or in group. They must submit a research paper give an oral presentation about their work.

Percentage: Data collecting or producing $\frac{1}{4}$, analysis of the data $\frac{1}{4}$, written thesis $\frac{1}{4}$, presentation $\frac{1}{4}$.
Relevance and reasonability of the topic and activity at the lesson can modify the result.