

Course Code	Course Name	Semester	Theory	Practice	Lab	Credit	ECTS
IND375	Applied Mathematical Modeling	6	3	0	0	3	4
Prerequisites	IND371						
Admission Requirements	IND371						
Language of Instruction	French						
Course Type	Elective						
Course Level	Bachelor Degree						
Objective	<p>This course introduces several different types of mathematical models, which can be used to formulate real-life problems, and the softwares GAMS and MATLAB, which can be used to solve different types of problems including linear, non-linear, integer, etc. The aim is to introduce the logic of modeling, which can further be useful for academic studies and in industry. Hence, the objectives of the course are determined as follows:</p> <ul style="list-style-type: none"> <li>• Introduce how to build mathematical models of the real-life problems.</li> <li>• Enable students to use the softwares GAMS and MATLAB for programming and optimization.</li> <li>• Enable students to analyze and interpret the results of the optimization.</li> </ul>						
Content	<p>Introduction to GAMS and solution of a simple transportation problem through GAMS  Modeling of linear programming problems (Bazaraa, Jarvis &amp; Sherali, Chapter 1, Bertsimas &amp; Tsitsiklis, Chapter 1) and solving linear programming problems through GAMS  Sensitivity analysis in linear optimization and analysis of the results of GAMS (Bazaraa, Jarvis &amp; Sherali, Chapter 6)  Modeling of integer and mixed integer programming problems (Wolsey, Chapter 1) and solving these problems through GAMS  Introduction to MATLAB and the optimization toolbox  Introduction to quadratic programming (Fletcher, Chapter 2) and solving these problems through MATLAB, Markowitz Portfolio Model  Introduction to unconstrained non-linear optimization (Fletcher, Chapter 2) and solving these problems through MATLAB  Karush-Kuhn-Tucker optimality conditions, Lagrange multipliers, and applications for quadratic programming (Fletcher, Chapter 9)  Modeling of stochastic programming problems (Birge &amp; Louveaux, Chapter 1) and solving these problems through GAMS</p>						
References	<p>Bazaraa, M.S., Jarvis, J.J., Sherali, H.D., "Linear Programming and Network Flows", 4. Edition, Wiley, New Jersey, 2010  Bertsimas, D., Tsitsiklis, J.N., "Introduction to Linear Optimization", Athena Scientific Series in Optimization and Neural Computation, Massachusetts, 1997  Wolsey, L.A., "Integer Programming", Wiley, New Jersey, 1998  Fletcher, R., "Practical Methods of Optimization", 2. Edition, Wiley, Chichester, 2000  Birge, J.R., Louveaux, F., "Introduction to Stochastic Programming", Springer, New York, 1997  Williams, H.P., "Model Building in Mathematical Programming", 6. Edition, Wiley, Chichester, 2013  GAMS Manual, downloadable from <a href="http://www.gams.com/">http://www.gams.com/</a></p>						

## Theory Topics

Week	Weekly Contents
1	Introduction to GAMS and solution of a simple transportation problem through GAMS
2	Modeling of linear programming problems (Bazaraa, Jarvis & Sherali, Chapter 1, Bertsimas & Tsitsiklis, Chapter 1) and solving linear programming problems through GAMS
3	Modeling of linear programming problems (Williams, Part 2) and solving linear programming problems through GAMS
4	Sensitivity analysis in linear optimization and analysis of the results of GAMS (Bazaraa, Jarvis & Sherali, Chapter 6)
5	Modeling of integer and mixed integer programming problems (Wolsey, Chapter 1) and solving these problems through GAMS
6	Modeling of integer and mixed integer programming problems (Williams, Part 2) and solving these problems through GAMS
7	Introduction to MATLAB and the optimization toolbox
8	Midterm
9	Introduction to quadratic programming (Fletcher, Chapter 2) and solving these problems through MATLAB, Markowitz Portfolio Model
10	Introduction to unconstrained non-linear optimization (Fletcher, Chapter 2) and solving these problems through MATLAB
11	Introduction to unconstrained non-linear optimization (Fletcher, Chapter 2) and solving these problems through MATLAB

**Week****Weekly Contents**

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| 12 | Karush-Kuhn-Tucker optimality conditions, Lagrange multipliers, and applications for quadratic programming (Fletcher, Chapter 9) |
| 13 | Modeling of stochastic programming problems (Birge & Louveaux, Chapter 1) and solving these problems through GAMS                |
| 14 | Modeling of stochastic programming problems (Birge & Louveaux, Chapter 1) and solving these problems through GAMS                |