M020	FIN,MR,IPM-elective - Year 1	**Linear Programming**	L+P+S 2+2+0	ECTS 5

Course objectives. To introduce students to modeling, solving and interpreting real problems which can be reduced to a problem of linear programming. Analyze known numerical methods for solving linear programming problems and present corresponding geometric interpretation.

Course prerequisites. Bachelor level knowledge of mathematics.

Syllabus.

1. Introduction: Definition of a linear programming problem. Linear programming problem examples. Piecewise linear convex function. Graphical method for solving two-dimensional linear programming problems.
2. Linear programming geometry: Polyhedron and convex sets. Extreme point, vertices, basic feasible solution. Polyhedron standard form. Degeneration. Existence and optimality of the extreme point.
3. Simplex method: Optimality condition. Derivation and implementation of the Simplex Method. Bland's rule. Determining the initial basic feasible solution. Complexity analysis of Simplex methods.
4. Duality theory: The strong and weak duality theorems. Farkas's lemma and linear inequalities. Separation theorems. Dual simplex method.
5. Sensitivity analysis: Local sensitivity analysis. Global sensitivity analysis. Interpretation.
6. Ellipsoidal method: Geometrical interpretation.

Expected learning outcomes.

After completing the course, students are expected to:

- create an objective function and area of minimization for real problems that can be reduced to a problem of linear programming;
- implement the simplex method for solving linear programming problems and interpret results;
- understand the possible application and limitations of linear programming problem;
- understand the concept of the dual problem;
- understand and reproduce the correct mathematical proof of claim applying basic forms of mathematical and logical inference;
- use mathematics literature from various sources and apply at least one programming tool for illustration of different examples.

Teaching methods and student assessment.

Exercises are partially auditory, and partially performed in a computer lab with the help of these software systems. Lectures and exercises are obligatory. The exam consists of a written and an oral part. After completion of lectures and exercises student can take the exam. Acceptable mid-term exam scores replace the written examination. Students can do homework or write a seminar paper, and thus improve their final grades.

Can the course be taught in English: Yes.

Basic literature:

1. D. Bertsimas, J. N. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific, 1997.

Recommended literature:

1. K. G. Murty, Linear and Combinatorial Programming, John Wiley & Sons, Inc., 1983.
2. L. Neralić, Uvod u matematičko programiranje 1, Element, Zagreb, 2003.
3. G. Sierksma, Linear and Integer Programming, Marcel Dekker, Inc., Nemhauser, 1999.
4. D. Kincaid, W.Cheney, Numerical Analysis, Brooks/Cole Publishing Company, New York, 1996.
5. A. Schrijver, Theory of Linear and Integer Programming, John Wiley & Sons, Inc., NY, SAD, 1999.