



# FSF3812 Applied Linear Optimization 7.5 credits

Tillämpad linjär optimering

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

## Establishment

Course syllabus for FSF3812 valid from Autumn 2011

## Grading scale

## Education cycle

Third cycle

## Specific prerequisites

A Master degree including at least 30 university credits (hp) in Mathematics (Calculus, Linear algebra, Differential equations and transform method), and further at least 6 hp in Mathematical Statistics, 6 hp in Numerical analysis and 6 hp in Optimization.

## Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

## Intended learning outcomes

The overall goal of the course is on the one hand that the student should master models, methods and theory for different forms of linear optimization and integer linear optimization, on the other hand that the student should be able to model and by a suitable modeling language solve realistic optimization problems, as well as presenting the results orally and in writing.

Upon completion of the course the student should be able to:

- Explain how the simplex method works.
- Explain how primal-dual interior methods for linear programming problems work.
- From a problem description formulate a linear programming problem or an integer linear programming problem and solve it using the modeling language used in the course
- Interpret the solutions of the real problems by fundamental concepts such as sensitivity analysis.
- Explain how branch-and-bound works for solving integer programming problems.
- Given suitable assumptions show fundamental results of linear programming such as strong duality and existence of extreme point solutions.
- Explain what relaxation is.
- Relate the modeling to the student's own field of research.

Students who have acquired deeper knowledge of the course are in addition expected to:

- Use problem structure to solve special classes of linear programming problems, for example Dantzig-Wolfe decomposition.
- Explain how Lagrangian relaxation can be used when solving integer linear programming problems.
- Explain how the subgradient method works applied to dual problems associated with integer linear programs.
- Use column generation for solving special classes of linear programs.
- Use stochastic programming for modeling uncertainty in problem data.

## Course contents

### **Theory and methods:**

The simplex method and interior point methods for linear programming. Utilization of problem structure, e.g., decomposition and column generation. Stochastic programming, methods and utilization of problem structure. Branch-and-bound methods for integer programming. Lagrangian relaxation and subgradient methods for integer programming problems with special structure.

### **Projects:**

This part of the course consists of modeling practical optimization problems and using available optimization software to solve them. The projects are carried out in small groups. An important aspect of the course is cooperation within the group as well as presentations in talking and in writing.

## Disposition

Lectures and project work

## Course literature

To be announced at the beginning of the course. Preliminary literature:

Linear and Nonlinear Optimization, second edition, by I. Griva, S. G. Nash och A. Sofer. SIAM. Additional course material from the department.

## Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

## Other requirements for final grade

Projects

Written examination.

## Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.