DAT600: Algorithm Theory

Assignment - 2: Linear Programming

Submission Deadline:	

Problem-1: Exam question, Dec 2012

A manufacturing plant produces two products (X and Y). There are two types of resources needed to produce X and Y: machine resource for machining the product automatically, and human resource (craftsman) for hand finishing. The table below gives the number of minutes required to produce each product:

	Machine time	Craftsman time
Product X	15	20
Product Y	20	30

- Production capacity: On weekly basis, the manufacturing plant has 40 hours of machine time available and 35 hours of craftsman time.
- Costs: machine time costs £100 per hour and craftsman time costs £20 per hour.
- Revenues (sales price) of the products: £200 for X and £300 for Y.
- Constraints: the plant must produce at least 10 products of X per week for a particular customer.

Formulate the problem as a LP, in order find how much of X and Y to produce per week. **You do not need to solve the LP**.

Problem-2: Exam question, June 2013

A company manufactures two products ***A*** and ***B*** on a specific machine.

- Production capacity: On weekly basis, the machine has 30 hours of machining time available.
- Production time: unit of ***A*** takes 12 minutes of machining time, whereas unit of ***B*** takes 25 minutes of machining time.
- Profits from the products: £3 for ***A*** and £5 for ***B***.
- Constraints: for every five units of ***A*** produced, at least two units of ***B*** must be produced by the machine.

5a. (20%) Formulate the problem as a Linear Program. Solve the problem using graph technique.

The company is planning to hire an extra machine in order to double the effective machining time available (weekly machining time becomes 60 hours).

5b. (10%) What is the maximum amount the company would be prepared to pay (per week) for hiring the extra machine?

Problem-3: Exam question, May 2015

A military infantry regiment is to be transported by air. All the members of the regiment numbering to 300 soldiers and their 9000 kg equipment has to be transported.

The military has to determine the number and type of aircrafts that are to be used for the transportation of the personnel and equipment, so that the total cost of the transportation is minimized.

- There are two types of aircrafts available for transportation: Aircraft type-A can transport a maximum of 30 passengers and 500 of kg equipment in one flight; Aircraft type-B can transport a maximum of 15 passengers and 750 of kg of equipment in one flight.
- Total number of flights: the military cannot use more than 16 flights, using any combinations of types A and B.
- Cost of transportation: aircraft type-A costs NOK 10000 per flight, whereas aircraft type-B costs NOK 12000 per flight.

2a. (10%) Formulate the problem as a linear programming problem.
2b. (15%) Solve the problem.

Problem-4: Practicing the Simplex Algorithm

Given the objective function:

Maximize: $\mathbf{3x_1 + 5x_2}$

Subject to the constraints:

$$\begin{aligned} \mathbf{x_1 + 2x_2} &\leq \mathbf{50} \\ \mathbf{8x_1 + 3x_2} &\leq \mathbf{240} \\ \mathbf{x_1,\ x_2} &\geq \mathbf{0} \end{aligned}$$

a) Solve the problem by graph method.
b) Solve the problem by the Simplex Algorithm.
c) With the help of MATLAB ***linprog***, verify whether the answers you got in a) and b) are correct.