Programming Exercise 1

Applied Numerical Optimazation

Wintersemester 2012/13

Linear Programming Example

Problem description

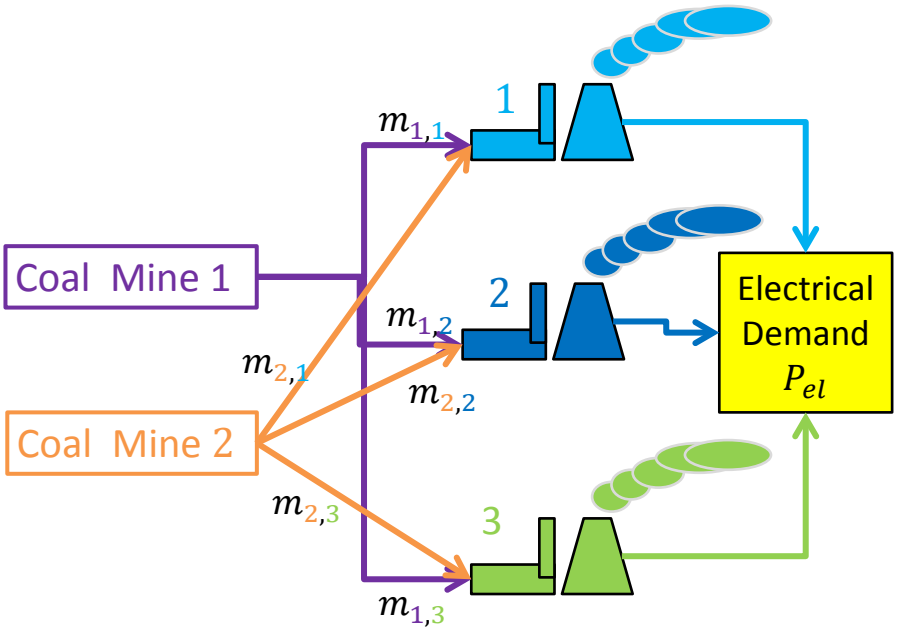

Figure 1: Schematic sketch of the process with 2 coal mines and 3 power plants.

There are $n_p \in N$ (in Figure 1 $n_p = 3$) coal-fired electric power plants and $n_s \in N$ (in Figure 1 $n_p = 2$) different coal mines. Each power plant is denoted by $p \in \{1, ..., n_p\}$, the coal mines by $s \in \{1, ..., n_s\}$. We want to determine the amount of purchased coal s, which has to be delivered to each power plant p. Thereby, $m_{s,p}$ denotes the mass of coal in tons delivered from mine s for power plant p.

Each coal from mine s has a price q_s in \$/ton and a heating value H_s in Joule/ton. Each mine s can not deliver more than a_s^{max} tons of coal.

The overall electric power, produced by all power plants, has to be at least P_{el} Joule. The efficiency η_p of the conversion of thermal energy content to electricity is given for each plant p. The conversion of a coal from mine s to electricity at plant p is given by the factor $H_s \cdot \eta_p$.

The goal is to pay as less as possible for the purchased coal.

Specifics

Input data

The input data of your function are:

- P_{el} in Joule
- number of coal mines n_s, number of power plants n_p
- vector of length n_p for the efficiency η_p of each plant p
- vector of length n_s for the heating value H_s for each mine s
- vector of length n_s for the price q_s in \$/ton of coal from each mine s
- vector of length n_s for the maximal production a_s^{max} in tons for each mine s

Output date

Your function should return:

- the total costs (objective value)
- a matrix with n_s rows and n_p columns for the amount of mass $m_{s,p}$ delivered from the coal mine s to plant p

Programming language and tools

Your task is to formulate the above problem as a linear programming problem (LP) and solve it using Matlab and its linear programming solver 'linprog'.