TTK4135 - Exercise 4 - Problem 2

February 2023

This problem is meant to be solved using the template found at: GitHub: QP - Production Planning. The problem is an old problem that appeared as problem 2 in exercise 4 for the course *TTK4135 - Optimization and Control* at NTNU.

Problem 2 - Reactor Production Planning

Two reactors, R_I and R_{II}, produce two products A and B. To make 1000 kg of A, 2 hours of R_I and 1 hour of R_{II} are required. To make 1000 kg of B, 1 hour of R_I and 3 hours of R_{II} are required. The order of R_I and R_{II} does not matter. R_I and R_{II} are available for 8 and 15 hours, respectively. We want to maximize the profit from selling the two products.

The profit now depends on the production rate:

- the profit from A is $3 - 0.4x_1$ per tonne produced,
- the profit from B is $2 - 0.2x_2$ per tonne produced,

where x_1 is the production of product A and x_2 is the production of product B (both in number of tonnes).

a) Formulate this as a quadratic program.

b) Make a contour plot and sketch the constraints (try using the QP class).

c) Find the production of A and B that maximizes the total profit. Is the solution found at a point of intersection between the constraints? Are all constraints active? Mark the iterations on the plot made in b), as well as the iteration number.

d) The solution is calculated by an active-set method. Explain how this method works based on the sequence of iterations from c).