Coursework 2:
343 OPERATIONS RESEARCH

Autumn 2016

INSTRUCTIONS

1. The coursework consists of three questions. Please answer all of them.

2. Make sure that each sheet has your name and the number of the question you are answering.

Question 1 *3 points*

Formulate the following optimisation problem as a linear program in standard form:

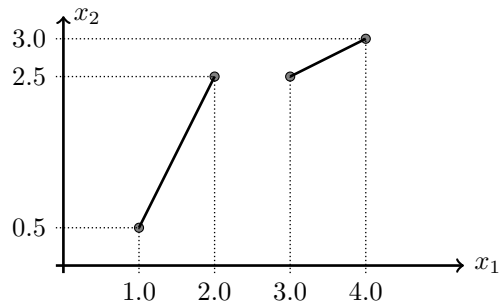$$\min \ \max \ \{ \ 3x_1 + x_2, \ |x_1 - x_3|, \ 3x_2 + x_3 \ \}$$

subject to

$$
\begin{array}{rcrcrcr}
x_1 & & & + & x_3 & \leq & 5 \\
x_1 & + & x_2 & + & x_3 & \geq & 1 \\
x_1 & + & x_2 & & & \leq & 4
\end{array}
$$

and

$$x_1, x_2, x_3 \geq 0$$

Question 2 *3 points*

Using integer variables, develop constraints restricting the feasible set to the piecewise-defined function shown in the figure.

In words, the function x_2 is defined on $x_1 \in [1.0, 2.0]$ as $x_2 = 2x_1 - 1.5$ and on $x_1 \in [3.0, 4.0]$ as $x_2 = 0.5x_1 + 1$.

Question 3 *4 points*

Consider the mixed integer programming problem:

$$
\begin{aligned}
\max \ x_0 &= 9x_1 + 6x_2 + 5x_3 \\
\text{s.t.} \quad & 2x_1 + 3x_2 + 7x_3 \leq 35/2 \\
& 4x_1 \qquad \ + 9x_3 \leq 15 \\
& x_1, x_2, x_3 \geq 0 \\
& x_1 \in \mathbb{Z}
\end{aligned}
$$

Solve this problem using the branch and bound technique.

Hint: *If the above problem is solved without the integer restriction on x_1 as a linear program, we have the solution $[x_0, x_1, x_2, x_3] = [215/4, 15/4, 10/3, 0]$*