

**OPERATIONS RESEARCH II 21-393**

Homework 2: Due Monday October 24.

1. Formulate the following as an integer program: There are  $n$  students and exams  $E_1, E_2, \dots, E_m \subseteq [n]$  need to be scheduled. There are  $s$  rooms available and each room can hold  $r$  students. The rules are (i) A student must not be asked to take more than one exam per day; (ii) Several different exams can be held in the same room provided there is capacity in the room to hold the students. The problem is to minimise the number of days needed to carry out all of the exams.
2. Solve the following problem by a cutting plane algorithm:

$$\begin{array}{llllll} \text{minimise} & 4x_1 & + & 5x_2 & + & 3x_3 \\ \text{subject to} & & & & & \\ & 2x_1 & + & x_2 & - & x_3 & \geq & 2 \\ & x_1 & + & 4x_2 & + & x_3 & \geq & 13 \end{array}$$

$$x_1, x_2, x_3 \geq 0 \text{ and integer.}$$

3. Solve the following problem by a branch and bound algorithm:

$$\begin{array}{llllll} \text{Maximise} & 4x_1 & - & 2x_2 & + & 7x_3 & - & x_4 \\ \text{subject to} & & & & & & & \\ & x_1 & & & + & 5x_3 & & \leq 10 \\ & x_1 & + & x_2 & - & x_3 & & \leq 1 \\ & 6x_1 & - & 5x_2 & & & & \leq 0 \\ & -x_1 & & & + & 2x_3 & - & 2x_4 \leq 3 \end{array}$$

$$x_1, x_2, x_3, x_4 \geq 0.$$

$$x_1, x_2, x_3 \text{ integer.}$$