

## MTH5114 Linear Programming and Game Theory, Spring 2024 Week 1 Coursework Questions Viresh Patel

These exercises should be completed individually and submitted (together with those of weeks 2 and 3) via the course QMPlus page by 9am on Monday 19 February 2024.

Make sure you clearly write your **name** and **student ID** number at the top of your submission.

1. Say whether or not each of the following is a linear program. If it is a linear program, then reformulate it in standard inequality form, giving the values of the vectors **c** and **b**, and the matrix A. If it is not a linear program, write a sentence or two explaining why.

**Note:** to make your answers easier to mark, please order your vector of variables by subscript. If 2 variables have the same subscript (because you have split a variable  $x_i$  into  $x_i^+$  and  $x_i^-$ ) list  $x_i^+$  first followed by  $x_i^-$ . For example:  $\mathbf{x}^{\mathsf{T}} = (x_1, \bar{x}_2, x_3, x_4^+, x_4^-, x_5)$  is ordered as described.

 $x_1, x_2, x_3 > 0$ 

(a) minimize 
$$5x_1 + 6x_3$$
  
subject to  $2.9x_1 + 6x_2 + 8x_3 \ge 6.2$ ,  
 $(x_1 - x_3)^2 \ge 16$ ,  
 $1.5x_1 - 18x_2 \le 14$ ,  
 $x_1, x_2, x_3 \ge 0$   
(b) maximize  $5x_1(1 - 3x_2 + x_3) - x_2$   
subject to  $x_1 + 3x_2 + x_3 \ge 4$ ,  
 $-x_1 + x_2 - x_3 \le 3$ ,  
 $-2x_1 + x_2 \le 7$ ,

(c) maximize 
$$2x_1 + x_2 - x_3$$
  
subject to  $4x_1 + x_2 + 3x_3 \le 1$ ,  
 $-2x_2 + x_3 \le x_1$ ,  
 $4x_2 + 2x_3 = -7$ ,  
 $x_1$  unrestricted,  
 $x_2 \le 0$ ,  
 $x_3 \ge 0$