University of London

## MTH5114 Linear Programming and Game Theory, Spring 2024 <br> Week 1 Coursework Questions <br> 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 $\mathbf{c}$ and $\mathbf{b}$, 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: $\mathbf{x}^{\top}=\left(x_{1}, \bar{x}_{2}, x_{3}, x_{4}^{+}, x_{4}^{-}, x_{5}\right)$ is ordered as described.
(a)

$$
\begin{array}{lr}
\operatorname{minimize} & 5 x_{1}+6 x_{3} \\
\text { subject to } \quad 2.9 x_{1}+6 x_{2}+8 x_{3} & \geq 6.2, \\
\left(x_{1}-x_{3}\right)^{2} & \geq 16 \\
1.5 x_{1}-18 x_{2} & \leq 14 \\
x_{1}, x_{2}, x_{3} & \geq 0
\end{array}
$$

(b)

$$
\begin{array}{cc}
\operatorname{maximize} & 5 x_{1}\left(1-3 x_{2}+x_{3}\right)-x_{2} \\
\text { subject to } & x_{1}+3 x_{2}+x_{3} \geq 4, \\
-x_{1}+x_{2}-x_{3} \leq 3, \\
& -2 x_{1}+x_{2} \leq 7, \\
& x_{1}, x_{2}, x_{3} \geq 0
\end{array}
$$

(c)

$$
\begin{aligned}
& \operatorname{maximize} \quad 2 x_{1}+x_{2}-x_{3} \\
& \text { subject to } \quad 4 x_{1}+x_{2}+3 x_{3} \leq 1 \\
&-2 x_{2}+x_{3} \leq x_{1}, \\
& 4 x_{2}+2 x_{3}=-7, \\
& x_{1} \text { unrestricted, } \\
& x_{2} \leq 0, \\
& x_{3} \geq 0
\end{aligned}
$$

