ADM2302 Assignment 1
(Graphical method for Linear Programming)

Question 1
An investor has 10 dollars to invest in stock A and stock B. She estimates that every dollar invested in stock A can generate 2 dollars of profit, whereas every dollar invested in stock B generates 1.5 dollars of profit. The investor understands that higher profit always comes with higher risk. She finds in the past records that in a bad market, stock A can potentially lose 30% of its value for every dollar invested, whereas stock B 20% of its value.

The investor would like to know how much money she should invest in each of the stocks so that the total profit can be maximized. She needs to make sure that the total amount she invests does not exceed the money she has, and the total potential loss of the investment cannot exceed 2.5 dollars.

(a) Develop a Linear programming formulation for the above problem. (4 points)

(b) Draw the feasible region and objective function for the formulation. (2 points)

(c) Find the optimal solution(s) and optimal value for the LP model. Describe verbally how the investor should invest. (2 points)

Question 2
Consider the following Linear Programming model:
Maximize 3x+y
Subject to 2x-y<=4
2x+3y<=12
x>=1
y<=2.5
x+y>=1.5
y-x<=1
x>=0, y>=0

(a) Draw the feasible region and objective function for the model. Show the optimal solution and optimal value. Justify why the solution is optimal. (2 points)

(b) Change the objective function in the LP model to "minimize 3x+y". Draw the objective function. Report what you find about the optimal solution(s) and the optimal value. Justify your finding. (2 points)

Question 3
Consider the following Linear Programming model:
Maximize $4x+y$
Subject to $2x-y<=4$
$x+10y<=100$
$x+y<=14$
$x>=3, y>=0$

(a) Draw the feasible region and objective function for the model. Report what you find about the optimal solution(s) and the optimal value. Justify your finding. (2 points)

(b) Now, add the constraint “$x+y<=0$” to the model. Report what you find about the optimal solution(s) and the optimal value. Justify your finding. (2 points)

Question 4
Consider the following Linear Programming model:
Minimize $4x+2y$
Subject to $2x+y>=3$,
$y-2x<=1$,
$x>=1$,
$y<=4$,
$y>=0$

(a) Draw the feasible region and objective function for the model. Report what you find about the optimal solution(s) and the optimal value. Justify your finding. (2 points)

(b) Change the objective function in the LP model to “maximize $4x+2y$”. Report what you find about the optimal solution(s) and the optimal value. Justify your finding. (2 points)

Question 5
Consider the following Linear Programming model:
Maximize $3x-y$
Subject to $x-y>=0$,
$x+4y<=10$,
$x-2y<=6$,
$x+3y<=9$,
$x+5y<=12$.
$x>=0, y>=0$.

(a) Draw the feasible region for the model, but DO NOT draw the objective function. Without graphing the objective function, find the optimal solution(s) and the optimal value. Justify your method and why the solution(s) you obtain is (are) optimal. (2 points)

(b) Is there any redundant constraint? Which one(s) and why? (1 point)

(c) Is there any constraint that can be removed without changing the optimal solution(s) you obtained in (a) and why? (2 points)

Question 6

Consider the following Linear Programming model:

Maximize $2x+6y$

Subject to $x-y>=2$

$x-3y<=2,$

$5x+4y = 15,$

$x>=0, y>=0.$

(a) Draw the feasible region for the model, but DO NOT draw the objective function. Highlight the feasible region precisely by filling it with a dark color. (2 points)

(b) Without graphing the objective function, find the optimal solution(s) and the optimal value. Justify your method and why the solution(s) you obtain is (are) optimal. (2 points)

(c) Change the objective function to “minimize $2x+6y$”. Solve (b) again. (1 point)