DEAKIN BUSINESS SCHOOL
DEPARTMENT OF INFORMATION SYSTEMS AND BUSINESS ANALYTICS

MIS775 Decision Modelling for Business Analytics
Week 11 Revision Questions

QUESTION 1

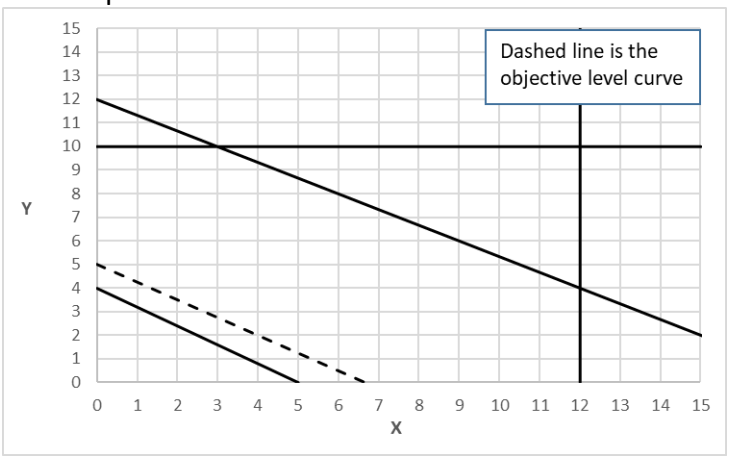
Formulate a linear programming model for this problem.
Bill's Grill is a popular restaurant that is famous for its hamburgers. The owner mixes fresh ground beef and pork in its hamburgers that have no more than 25% fat. The beef contains 80% meat and 20% fat, and costs $3 a kilo, while the pork contains 70% meat and 30% fat, and costs $2.5 a kilo. The owner wants to determine the minimum cost mixture of beef and pork that will have no more than 25% fat. (You must show your workings).

QUESTION 2

Consider the following linear programming model. Write down the coordinates of the feasible region, and derive the optimal solution. You must show your workings.

$$
\begin{aligned}
\text{Maximise} \quad & 3X + 4Y \\
\text{Subject to:} \quad & X \le 12 \\
& Y \le 10 \\
& 4X + 6Y \le 72 \\
& 4X + 5Y \ge 20 \\
& X, Y \ge 0.
\end{aligned}
$$

A graphical representation follows:



QUESTION 3

Consider the following linear program:

Maximize total profit ($) = $10X_1 + 6.2X_2$

Subject to: $X_1 + X_2 \geq 1$

$X_2 \leq 5$

$X_1 \leq 6$

$7X_1 + 9X_2 \leq 63$

$X_1, X_2 \geq 0.$

The following solution output is provided:

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
C5	X1	6	0	10	1E+30	5.178
D5	X2	2.3	0	6.2	6.657	6.2

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
C12	Constraint 1 LHS	8.3	0	1	7.333	1E+30
C13	Constraint 2 LHS	2.3	0	5	1E+30	2.667
C14	Constraint 3 LHS	6	5.178	6	3	3.429
C15	Constraint 4 LHS	63	0.689	63	24	21

a. What is the optimal solution, and the optimal value of the objective function? Show all working in obtaining the answer.

b. Which constraints are non-binding? Explain your reasoning.

c. Suppose the profit per unit of X_1 is increased to $16, is the above solution still optimal? Explain your reasoning. What is the value of the objective function when this unit profit is increased to $16? Show all working in obtaining the answer.

d. What is the optimal objective function value if the RHS of constraint 4 is increased to 73? Explain your reasoning and show all working in obtaining the answer.

QUESTION 4

Daylesford Manufacturing is planning its next production cycle. The company can produce three products, each of which must undergo machining, grinding, and assembly operations. The following table summarises the hours of machining, grinding, and assembly required by each unit of the product, the total hours of capacity available for each operation, and the maximum number of units that can be produced, given the total hours available.

	Hours required by			
Operation	**Product 1**	**Product 2**	**Product 3**	**Total hours available**
Machining	3	2	5	500
Grinding	4	3	7	300
Assembly	9	6	8	350
Maximum number of units	50	67	75	

The cost accounting department has estimated that each unit of product 1 manufactured and sold will contribute $48 to profit, and each unit of products 2 and 3 contributes $55 and $50, respectively. However, manufacturing a unit of product 1 requires a setup operation on the production line that costs $500. Similar setups are required for products 2 and 3 at costs of $700 and $600, respectively. The marketing department believes that it can sell all the products produced. Therefore, the management of Daylesford wants to determine the most profitable mix of products to produce.

a. Formulate the model by writing down the decision variables, objective function, and constraints.

b. Add a constraint to ensure that no more than two of the products are produced. Explain your reasoning.

QUESTION 5

For each of the scenarios below, choose an "appropriate" distribution, with its parameters, where possible, and justify your choice.

a. A company is about to develop and market a new product. It wants to build a simulation model for the entire process. The company experts believe the distribution of their development cost is somewhere between $300,000 and $600,000, but is most likely to be around $500,000."

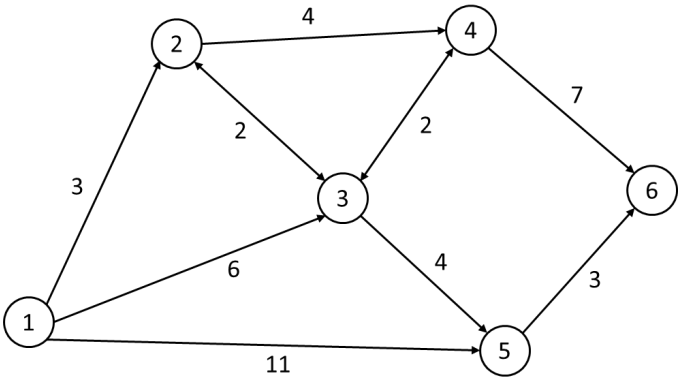
b. A queuing system has an arrival rate of 4 customers per hour and a service rate of 7 customers per hour. You decide to build a simulation model to describe the service time per customer.

c. The mean time between arrivals of cars at a service station is 4 minutes. We would like to know the probability distribution of the number of cars to arrive within an hour.

QUESTION 6

Formulate the algebraic model for this problem by writing down the decision variables, objective function, and constraints.

Alternative travel times between six locations are as shown on the following diagram. A traveller wants to minimise the overall travel time between locations 1 and 6.

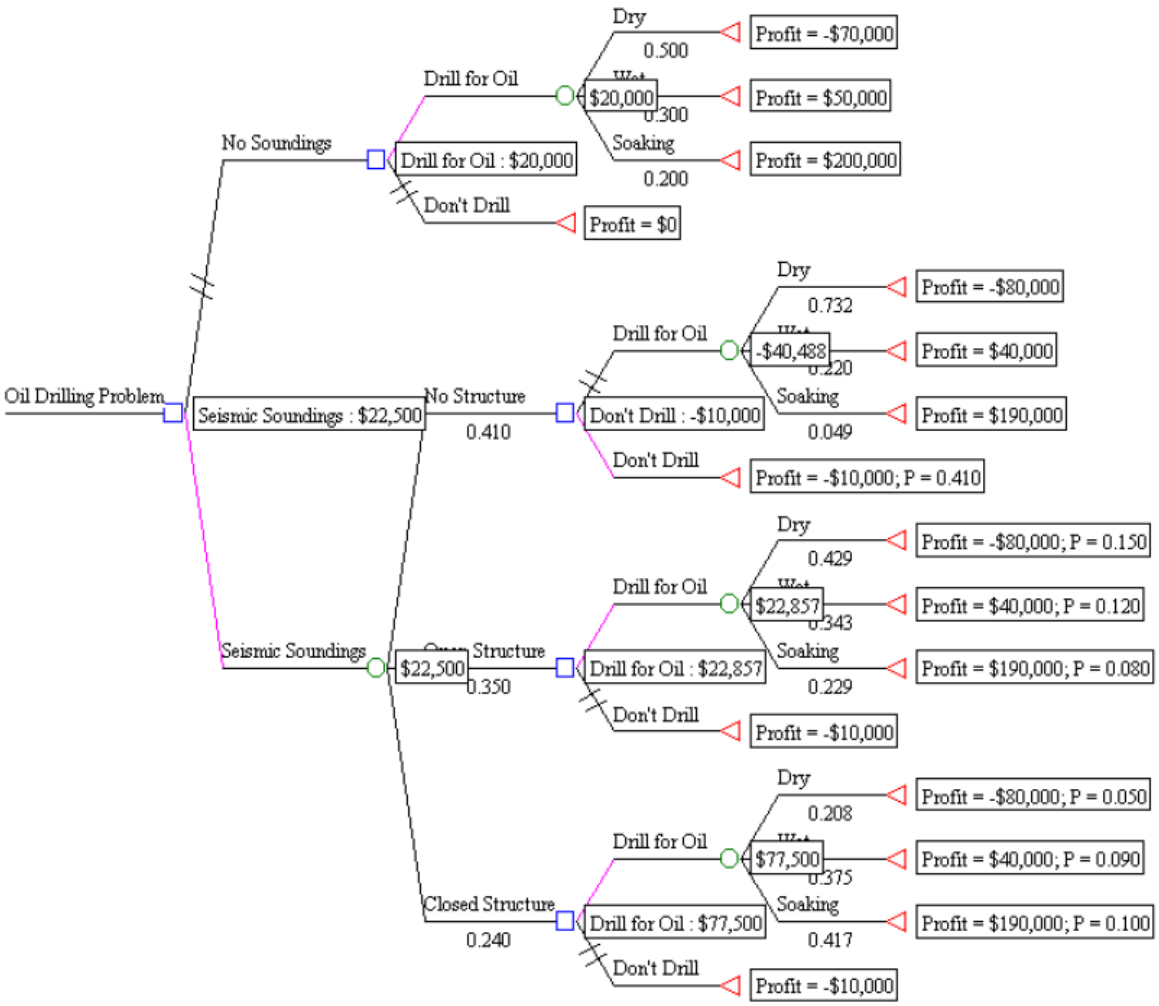


QUESTION 7

You have been invited to provide consulting advice to an oil exploration company. They have found a site and, after some discussions, they provided you with the following information. The well will be Dry, Wet or Soaking, with associated probabilities 0.5, 0.3 and 0.2 respectively, and respective profits of -$70,000, $50,000 and $200,000. There is an option of conducting seismic soundings, at a cost of $10,000. The outcomes from the Soundings are either that there is No Structure, an Open Structure or a Closed Structure. They estimate that the probabilities of the eventual state of the well given these soundings are as follows:

	Dry	Wet	Soaking
No Structure	0.6	0.3	0.1
Open Structure	0.3	0.4	0.4
Closed Structure	0.1	0.3	0.5

The above information was entered into a Decision Analysis software package, resulting the decision tree shown below:



a. Provide management of the oil exploration company with a detailed interpretation of the decision tree. Note that, in this part of the question, you are not required to verify any of calculations.
b. Find the posterior probabilities of all states of nature.
c. Show how the figure -$40,488 is calculated.
d. What is the most that you are willing to pay for the seismic soundings?
e. Determine the expected value of perfect information.
f. What is the risk profile if seismic soundings are undertaken and the optimal drilling decision is made?