Note: This is a sample exam only. Do not treat it as an exact indication of any future exam.

DEAKIN UNIVERSITY
FACULTY OF BUSINESS AND LAW
SAMPLE EXAMINATION

Unit Code: MIS775
Unit Name: Decision Modelling for Business Analytics

Instructions for candidates:

The final assessment will be an Open-book CloudDeakin Online Exam Quiz.

Late submissions will not be marked.

Answer all the questions in this exam.

Please note that the exam carries a total of 100 marks and constitutes 50% of your assessment in this unit.

You will have 2.5 hours to complete and submit the quiz.

It is anticipated that the quiz will involve approximately 2 hours of working time although you will have 2.5 hours to complete and submit your work. The additional 30 minutes allow for time taken to read through the quiz questions and provide time to address any minor technical issues you may experience during the quiz.

If you encounter any technical issues with CloudDeakin, please contact the IT Service Desk online or via phone (1800 463 888; +61 5227 8888 if calling from outside Australia) and record your ticket number as evidence of technical issues during the examination period.

Please do not contact the Unit team during the examination period for any reason. Academic staff are not allowed to communic

QUESTION 1 ***(10 marks)***

A chemical manufacturer produces three chemicals: A, B and C. These chemicals are produced via two production processes: 1 and 2. Running process 1 for an hour costs $4 and yields 3 units of A, 1 unit of B and 1 unit of C. Running process 2 for an hour costs $1 and produces 1 unit of A and 1 unit of B. To meet customer demands, at least 10 units of A, 5 of B, and 3 of C must be produced daily.

The manufacturer wants a daily production plan that minimises the cost of meeting the chemical's daily demands. Assume a daily production plan is for 7 hours of working.

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

QUESTION 2 ***(7 + 3 = 10 marks)***

Consider the following linear program problem.

Minimise 2X + 3Y subject to the following constraints:

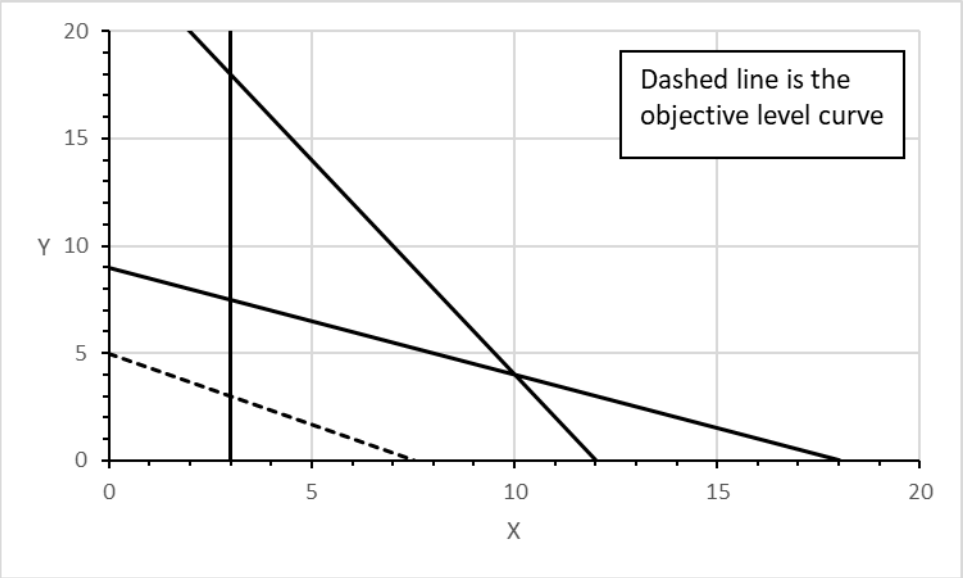
5X + 10Y ≥ 90 (constraint 1)

4X + 2Y ≥ 48 (constraint 2)

0.5X ≥ 1.5 (constraint 3)

X, Y ≥ 0.

A graphical representation follows:



a. Solve the problem. Show all working in obtaining the answer. ***(7 marks)***

b. Find the slack, or surplus, or both, for each of the three labelled constraints. ***(3 marks)***

QUESTION 3 ***(5 + 5 + 5 + 5 = 20 marks)***

Consider the following problem:

Maximize total profit ($) = $2X_1 + 4X_2$
Subject to constraints:

$X_1 + 3X_2 \leq 10$ (constraint 1)
$2X_1 + X_2 \leq 8$ (constraint 2)
$X_1 \leq 3$ (constraint 3)
$X_1, X_2 \geq 0$.

The following solution output is provided:

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
C3	X1	2.8	0	2	6	0.67
D3	X2	2.4	0	4	2	3

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
E9	Constraints LHS	10	1.2	10	14	1
E10	LHS	8	0.4	8	0.33	4.67
E11	LHS	2.8	0	3	1E+30	0.2

a. What is the optimal solution, including the optimal value of the objective function? ***(5 marks)***

b. Suppose the profit on X_1 is increased to $7. Is the above solution still optimal? What is the value of the objective function when this unit profit is increased to $7? ***(5 marks)***

c. If the unit profit on X_2 was $2 instead of $4, would the optimal solution change? ***(5 marks)***

d. Assume the new capacity for constraint 1 is increased to 12, what is the value of objective function? ***(5 marks)***

QUESTION 4 ***(15 + 5 = 20 Marks)***

A Company has a contract to produce 10,000 garden hoses for a large discount chain. This company has four different machines that can produce this kind of hose. Because these machines are from different manufacturers and use differing technologies, their specifications are not the same.

Machine	Fixed Cost to Set Up Production Run	Variable Cost Per Hose	Capacity
1	750	1.25	6000
2	500	1.50	7500
3	1000	1.00	4000
4	300	2.00	5000

The company wants to minimise the total cost.

a. Formulate the algebraic model by writing down the decision variables, objective function, and constraints. ***(15 marks)***

b. Add a constraint to ensure that if machine 1 is not used, then machines 2 is used. ***(5 marks)***

QUESTION 5 ***(15 + 5 = 20 Marks)***

a. A transportation company is to move goods from three factories to three distribution centres. Information about the move is given below.

Source	Supply	Destination	Demand
A	200	X	250
B	100	Y	125
C	150	Z	125

Shipping costs are:

	Destination		
Source	X	Y	Z
A	3	2	5
B	9	10	--
C	5	6	4
	(Source B cannot ship to destination Z)		

The transportation company is interested in scheduling its material flow at the minimum possible cost.

Formulate the algebraic model for this problem by writing down the decision variables, objective function, and constraints. ***(15 marks)***

b A Skateboard manufacturer produces two models of skateboards, the *FX* and the *ZX*.

Let PF denote the price charged for an *FX* and PZ denote the price charged for a *ZX*. The demand for *FX* skateboards per week, DF, and the demand for *ZX* skateboards per week, DZ, are

$$DF = 1{,}000 - 5PF$$

$$DZ = 500 - 2PZ.$$

The cost of producing an *FX* is \$75 and the cost of producing a *ZX* is \$100.

The company has 80 labour-hours available per week in its workshop. Each *FX* skateboard requires 2 labour-hours and each *ZX* skateboard requires 3 labour-hours.

The manufacturer wants to maximise the total profit per week. Formulate the algebraic model for this production planning problem by writing down the decision variables, objective function, and constraints. In your answer, express the objective function in its simplest form, containing only the decision variables. ***(5 marks)***

QUESTION 6 ***(6 + 2 + 2 = 10 Marks)***

Sales of a new product are expected to have the following distribution:

Units Sold	Probability
600	0.35
800	0.45
1000	0.20

a. Use the random numbers 0.513, 0.977, 0.587, 0.221, and 0.163 to generate five simulation trials from this distribution. ***(6 marks)***

b. Calculate the average demand based on the simulated sales from part (a), and the expected demand based on the probability distribution. ***(2 marks)***

c. Should the two answers in part (b) be the same? Discuss why or why not. ***(2 marks)***

QUESTION 7 ***(2 + 2 + 2 + 2 + 2 = 10 Marks)***

The reference desk at a university library receives requests for assistance. Assume that a Poisson probability distribution with an arrival rate of 10 requests per hour can be used to describe the arrival pattern and that service times follow an exponential probability distribution with a service rate of 12 requests per hour.

a. What is the probability that no requests for assistance are in the system? ***(2 marks)***

b. What is the average number of requests that will be waiting for assistance? ***(2 marks)***

c. What is the average waiting time in minutes before service begins? ***(2 marks)***

d. What is the average time at the reference desk in minutes (waiting time plus service time)? ***(2 marks)***

e. What is the probability that a new arrival has to wait for service? ***(2 marks)***