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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	ADVANCED LINEAR PROGRAMMING
COURSE CODE	:	BWA 30903
PROGRAMME CODE	:	BWA
EXAMINATION DATE	:	DECEMBER 2019/ JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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Q1 Given **Table Q1** is the optimal tableau of a linear programming problem.

Table Q1

Basic	x_1	x_2	x_3	x_4	x_5	x_6	Solution
z	0	0	12	1	0	1	?
x_2	0	1	2	1	0	-1	16
x_5	0	0	-4	1	1	-3	28
x_1	1	0	5	1	0	$-\frac{1}{2}$	28

If x_4, x_5 and x_6 are the slack variables in the original problem. By using the matrix manipulation, reconstruct the original linear programming and then compute the optimum value.

(7 marks)

Q2 Consider the following linear programming model

$$\begin{aligned} &\text{Minimize } z = 15x_1 + 20x_2 \\ &\text{Subject to} \\ &\quad 5x_1 + 2x_2 \geq 6 \\ &\quad 2x_1 + x_2 \geq 3 \\ &\quad 2x_1 + 4x_2 \leq 5 \\ &\quad x_1, x_2 \geq 0. \end{aligned}$$

(a) Find the optimal solution of the linear programming model by the revised dual simplex method.

(16 marks)

(b) Show that $(\mathbf{P}_1, \mathbf{P}_2, \mathbf{P}_3)$ is the basis of the above linear programming problem. Hence, evaluate the value of z for this choice of basis.

(7 marks)

Q3 Given the following linear programming problem

$$\begin{aligned} &\text{Maximize } z = 2x_1 + 5x_2 + x_3 \\ &\text{Subject to} \\ &\quad x_1 + 3x_2 + 4x_3 \leq 60 \\ &\quad 3x_1 + x_2 + 2x_3 \geq 45 \\ &\quad x_1, x_2, x_3 \geq 0. \end{aligned}$$

(a) Construct its dual problem.

(6 marks)

(b) Verify that the basis $\mathbf{B} = (\mathbf{P}_1, \mathbf{P}_3)$ is feasible for the primal. Next, compute the associated dual value.

(7 marks)

Q4 Use parametric linear programming to find the optimal for the linear programming problem

$$\text{Maximize } z(\theta) = (5-5\theta)x_1 + (2\theta-5)x_2 + (8-5\theta)x_3$$
$$\text{Subject to}$$
$$-x_1 + x_2 + 3x_3 \le 20$$
$$5x_1 + 4x_2 + 10x_3 \le 70$$
$$x_1, x_2, x_3 \ge 0$$

where θ can be assigned any positive and negative values, and given the optimal tableau as in **Table Q4** for the linear programming problem with $0 \le \theta \le \frac{8}{3}$.

Table Q4

Basic	x_1	x_2	x_3	s_1	s_2	Solution
z	0	9	2	0	1	70
s_1	0	$\frac{9}{5}$	5	1	$\frac{1}{5}$	34
x_1	1	$\frac{4}{5}$	2	0	$\frac{1}{5}$	14

provided s_1 and s_2 as the slack variables for the respective constraints.

(16 marks)

Q5 Solve the following linear programming problem by the bounded algorithm.

$$\text{Maximize } z = x + 3y$$
$$\text{Subject to}$$
$$x - 2y \le 1$$
$$3x + 2y \le 8$$
$$-x + 2y \le 2$$
$$1 \le x \le 3,\ 0 \le y \le 1.$$

(17 marks)

Q6 A mother devides the main household chores (vacuuming, cooking, dishwashing and laundering) between her children, Hana and Hael, so that each has two tasks but the total time to spend on the household duties is kept to a minimum. Their efficiencies on these tasks differ, where the time each would need to perform the task is given as in **Table Q6.**

Table Q6

	Time Needed per Week			
	Vacuuming	Cooking	Dishwashing	Laundering
Hana	4.5 hours	7.8 hours	3.6 hours	2.8 hours
Hael	4.8 hours	7.5 hours	4.2 hours	2.5 hours

Formulate the problem as an integer linear programming. (Do not solve the model).

(6 marks)

Q7 Consider the following integer linear programming

Maximize $z = 5x_1 + 8x_2$
Subject to

$$5x_1 + 9x_2 \le 45$$
$$x_1 + x_2 \le 6$$
$$x_1, x_2 \ge 0 \text{ and integers.}$$

Given the slack x_3 and x_4 are for constraint 1 and 2, respectively and the optimum linear programming tableau is given as in **Table Q7.**

Table Q7

Basic	x_1	x_2	x_3	x_4	Solution
z	0	0	$\frac{3}{4}$	$\frac{5}{4}$	$\frac{165}{4}$
x_2	0	1	$\frac{1}{4}$	$-\frac{5}{4}$	$\frac{15}{4}$
x_1	1	0	$-\frac{1}{4}$	$\frac{9}{4}$	$\frac{9}{4}$

Solve the problem using the cutting plane algorithm by choosing x_1 as Cut I.

(18 marks)

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- END OF QUESTIONS -