DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2010/11

COURSE TITLE:	**OPERATIONS RESEARCH I**
COURSE CODE:	**ST 307**
TIME ALLOWED:	**TWO (2) HOURS**
INSTRUCTION:	**ANSWER ANY THREE QUESTIONS** **ALL QUESTIONS CARRY EQUAL MARKS (20 MARKS)**
SPECIAL REQUIREMENTS:	**SCIENTIFIC CALCULATORS AND GRAPH PAPER**

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Question 1

Consider the following linear programming problem:

Maximise $z = 2x_1 + 3x_2$

Subject to

$x_1 + 2x_2 \leq 10$

$3x_1 + x_2 \leq 15$

$x_2 \leq 4$

$x_1, x_2 \geq 0$

(a) Solve the problem using the graphical method **(15 marks)**

(b) Find the range of values for the objective function coefficients for which the current optimal solution will remain optimal. **(5 marks)**

Question 2

(a) Briefly define the following terms as used in linear programming

(i) Infeasible solution

(ii) Degeneracy

(iii) Alternative optimal solution **(6 marks)**

(b) (i) Solve the following linear program using the simplex method.

Maximise $Z = 3x1 + 2x2 + 5x3$

Subject to

$x_1 + 2x_2 + x_3 \leq 430$

$3x_1 + 2x_3 \leq 460$

$x_1 + 4x_2 \leq 420$

$x_1, x_2, x_3 \geq 0$ **(10 marks)**

(ii) Identify shadow prices for the resources and explain their significance. **(4 marks)**

Question 3

A product is produced at three plants and shipped to three warehouses. The transportation cost per unit are shown in the following table.

	Warehouse			
Plant	W1	W2	W3	Plant capacity/Supply
P1	20	16	24	300
P2	10	10	8	500
P3	12	18	10	100
Warehouse Demand	200	400	300	

(a) Use the Northwest Corner Rule and the Stepping-Stone Method to find the initial basic feasible solution.
(b) Find the optimal solution to this problem **(20 marks)**

OR

(a) Use the Vogel's Approximation method (VAM) to obtain a starting solution and test for optimality using the MODI method.
(b) Find the optimal solution to the problem. **(20 marks)**

Question 4

A manufacturing firm discontinued production of a certain unprofitable production line. This created considerable excess production capacity. Management is considering devoting this excess capacity to one or more of these products A, B, and C. The availability and capacity of the machines that limit output is summarised in the table.

Machine Type	Product A	Product B	Product C	Available machine Time
Milling Machine	9	3	5	3500
Lathe	5	4	6	1750
Grinder	3	7	2	750

The unit profits for the products A, B and C are E30.00, E12.00 and E15.00 respectively. Formulate and solve the problem, as a linear program aimed at obtaining the number of each product the company will produce in order to maximise profit. **(20 marks)**

Given the following primal problem

$$\begin{aligned} \text{Minimise} \quad & Z = 10x_1 + 5x_2 + 4x_3 \\ \text{Subject to} \quad & 3x_1 + 2x_2 - 3x_3 \geq 3 \\ & 4x_1 \qquad + 2x_3 \geq 10 \\ & x_1, x_2, x_3 \geq 0. \end{aligned}$$

(a) Obtain the dual for this problem **(5 marks)**

(b) Solve the dual problem using the simplex method **(10 marks)**

(c) Use the dual solution to identify the optimal solution to the original primal problem. **(5 marks)**

END OF EXAM!!

Simplex Tableau

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Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				

Plant	Warehouse			Supply
	W1	W2	W3	
P1				
P2				
P3				
Demand				