UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMME: BSc. in Agricultural Economics and Agribusiness Management Year III

COURSE CODE: AEM 307

TITLE OF PAPER: QUANTITATIVE METHODS FOR AGRIBUSINESS DECISIONS

TIME ALLOWED: 2: 00 HOURS

INSTRUCTION: 1.ANSWER ANY FOUR QUESTIONS
2. EACH QUESTIONS CARRIES 25 MARKS

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Question 1.

Explain the following terms

A. Linear programming
B. Dual theorem.
C. The assignment problem.
D. Sensitivity analysis.
E. Northwest corner rule

Question 2.

A. A firm manufactures two products A and B, the market for each being virtually unlimited. Each product is processed on each of the machines I,II and III. The processing times in hours per item of A or B on each machine are given in the table.

	I	II	III
A	0.5	0.4	0.2
B	0.25	0.3	0.4

The available production time of the machines I II and Ii is 40 hours,36 hours and 36 hours respectively each week. The profit per item of A and B is E5 and E3 respectively .

The firm wishes to determine the weekly production of items of A and B which will maximize its profit. Formulate this problem as a linear programming problem only.

Question 3. .

Consider the problem

Maximize Z = 6x1 + 8x2,

Subject to 5x1 + 2x2 <= 20

X1 + 2x2 <= 10

And x1 >= 0,x2 >= 0.

a) Construct the dual problem for this problem.
b) Solve both the primal and dual problem graphically. Identify the corner-point feasible solutions and corner-point infeasible solutions for both problems.
c) Use the information obtained in part (b) to construct a table listing the complementary basic solution and so forth for this problem. For the dual problem..
d) Solve the primal problem by the simplex method. After each iteration (including iteration 0), identify the basic feasible solution for this problem and the complementary basic solution for the dual problem. Also identify the corresponding corner-point solutions

Question 4.

A company has three plants producing a certain product that is to be shipped to four distribution centers.Plants1,2 and 3 produce 18,16 and 12 shipments per month, respectively. Each distribution center needs to receive 12 shipments per month. The distance from each plant to the respective distributing centers is given in miles:

	1	2	3	4
Plant 1	700	800	300	600
Plant 2	200	100	200	900
Plant 3	300	650	700	500

The freight cost for each shipment is $200 plus 20 cents per mile.

The company wishes to determine how much should be shipped from each plant to each of the distribution centers to minimize the total shipping costs.

A) Formulate this problem as a transformation problem by constructing the appropriate cost and requirements table.

B) Use the northwest corner rule to obtain an initial basic feasible solution.

Question 5.

Consider the problem

Maximize $Z = 6x_1 + 8x_2$,

Subject to $5x_1 + 2x_2 <= 20$

$X_1 + 2x_2 <= 10$ and $x_1 >= 0, x_2 >= 0$.

A) Construct the dual problem for this primal problem.
B) Solve both the primal problem and dual problem graphically.
C) Find the optimal solution of the dual problem using the simplex method.
D) Use the information obtained in part C to find the optimal solution for the dual problem.
E) Verify the dual theorem using the optimal solutions in C and D above.

Question 6

Consider the problem

Maximize Z = -5x1 +5 x2 + 13x3,

Subject to -x1 +x2 + 3x3 <= 20

12x1+ 4x2 +10 x3 <= 90

and x1 >=0,x2>=0,x3>=0.

Letting x4, and x5 be the slack variables for the respective constraints, the simplex method yields the following final set of equations:

(0)	z	+ 2x3 + 5x4	= 100
(1)		-x1+x2 + 3x3 + x4	= 20
(2)		16x1 - 2x3- 4x4+ x5	= 10

You are now to conduct sensitivity analysis by independently investigating each of the nine changes in the original model indicated below. For each changes, use the sensitivity analysis procedure to convert this set of equations (in tableau form) the proper form for identifying and evaluating the current basic solution , and then test this solution for feasibility and for optimality.

(a) Change the right – hand side of constraint 1 to b1 = 30..

(b) Change the right – hand side of constraint 2 to b2 = 70.

(c) Change the right-sides to $\begin{bmatrix} b1 \\ b2 \end{bmatrix} = \begin{bmatrix} 10 \\ 100 \end{bmatrix}$.

(d) Change the coefficient of x3 in the objective function to c3 =8

(e) Change the coefficient of x1

$$\begin{bmatrix} c1 \\ a11 \\ a21 \end{bmatrix} = \begin{bmatrix} -2 \\ 0 \\ 5 \end{bmatrix}.$$

FORMULAE:

$\Delta y^*_0 = \sum \Delta b_i s_{ki}$,

$\Delta b^*_k = \sum \Delta b_i s_{ik}$, for i = 1,2,3,…,m and j = 1,2,3,…n.

$\Delta(z^*_j - c_j) = -\Delta c_j + \sum \Delta a_{ij} y_i$, for i =1,2,3,…m and j = 1,2,3,…,n.

$\Delta a^*_{kj} = \sum \Delta a_{ij} s_{ki}$

SIMPLEX METHOD DUMMY TABLE.

			Coefficient of						
Iteration	Basic v.	Eq.no	Z	X1	X2	X3	X4	X5	Right side
	Z								

Destination

	1	2	3	4	5	6	supply	
Plant 1								
Plant 2								
Plant 3								
Plant 4								
Plant 5								
Plant 6								
Demand								