UNIVERSITY OF ESWATINI

FIRST SEMESTER MAIN EXAMINATION PAPER, APRIL 2021

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

COURSE CODE: BUS611

TITLE OF PAPER: BUSINESS QUANTITATIVE METHODS

TIME ALLOWED: 3 HOURS

Instructions

Answer any four questions.

Special Requirements

Scientific calculator.

Additional Material (s)

Graph paper.

Candidates may complete the front cover of their answer book when instructed by the Chief Invigilator and sign their examination attendance cards but must **NOT** *write anything else until the start of the examination period is announced.*

No electronic devices capable of storing and retrieving text, including electronic dictionaries and any form of foreign material may be used while in the examination room.

DO NOT turn examination paper over until instructed to do so.

Question 1

[25 marks, 5+16+4]

(a) What are the steps involved when using the Hungarian method?

(b) An accounting firm has three new clients. Project leaders will be assigned to the three clients. The firm has four available project leaders who could be assigned to these three clients. Based on the different backgrounds and experiences of the leaders, the various leader-client assignments differ in terms of projected completion times. The data in table 1 show the possible assignments and the estimated completion times in days.

Table 1: Projected completion times

Project	Clients		
leader	A	B	C
1	10	15	9
2	9	18	5
3	6	14	3
4	8	16	6

How should the clients be allocated to the project leaders so as to minimize the total time?

(c) An operations research team must decide whether to incorporate the predictions of the 10 leading investment advice newsletters in the information system the team is building. The cost of including the predictions is SZL150 000 per year. The research team estimates that in 20 decisions to be made in the year, the added information would result in a new decision only once. However, the decision change would result in an average saving of SZL2 600 000.

Should the team include the newsletters in its information system?

Question 2

[20 marks, 2+2+4+6+6+5]

The manager of a bus company that operates between Manzini and Nhlangano is debating whether to add one or two early morning bus to the company's current schedule. The company management has calculated that 25 people must use this route each day for the company to break even. Management feels that there is a 30% chance that fewer than 100 people will use the route. The following payoff values (in Emalangeni) were developed over a one-month period and summarized in Table 2.

Table 2: Payoff values (in SZL)

Decision	Demand for early morning route	
	Fewer than 100 people use the route	100 people or more use the route
Add one bus	-5000	80000
Ad. two buses	-30000	45000
Do not add bus	0.0	0 0

(a) Determine management's optimal decision using the

  (i) Maximax criterion;

(ii) Maximin criterion;

(iii) Minimax regret criterion.

(b) Determine the optimal decision if management was to use the expected monetary value criterion?

(c) Calculate the expected opportunity loss for each decision, and hence determine management's optimal decision.

(d) The bus company considers hiring a private consulting firm to conduct a study to obtain a better estimate of the demand for this early morning route. Determine the amount that the bus company should be willing to pay for this study.

Question 3   [25 marks, 2+3+7+8+5]

(a) What is linear programming?

(b) What are three basic components of an LP model?

(c) Premium Pizza, Inc. is a producer of frozen pizza products. The company makes a net income of SZL10 for each regular pizza and SZL15 for each deluxe pizza produced. The firm currently has 150 pounds of dough mix and 50 pounds of topping mix. Each regular pizza uses 1 pound of dough mix and 4 ounces (16 ounces = 1 pound) of topping mix. Each deluxe pizza uses 1 pound of dough mix and 8 ounces of topping mix. Based on the past demand per week, the maximum number of pizzas that Premium can sell is 70 regular pizzas and that of deluxe pizzas is 80 respectively.

   (i) Formulate this LP problem.

   (ii) Determine, graphically, the number of regular and deluxe pizzas the company should make to maximize net income.

   (iii) Do any of the constraints have slack or surplus? If yes, which one(s) and how much slack or surplus does each have?

Question 4   [25 marks, 16+9]

(a) A company has four warehouses and six stores. The warehouses altogether have a surplus of 22 units of a given commodity, divided among them as follows:

Warehouses	1	2	3	4
Surplus	5	6	2	9

The six stores altogether need 22 units of the commodity. Individual requirements at stores 1, 2, 3, 4, 5 and 6 are 4, 4, 6, 2, 4 and 2 units respectively. Cost of shipping one unit of commodity from warehouse i to store j in Emalangeni is given in the matrix below:

	Stores					
Warehouses	1	2	3	4	5	6
1	9	12	9	6	9	10
2	7	3	7	7	5	5
3	6	5	9	11	3	11
4	6	8	11	2	2	10

Determine a starting feasible solution using the Least Cost Method.

(b) Consider a game with the following pay-off matrix

		Company B				
		1	2	3	4	5
Company A	1	3	-1	4	6	7
	2	-1	8	2	4	12
	3	16	8	6	14	12
	4	1	11	-4	2	1

Without using the <u>maximin-minimax criterion</u> find the value of the game.

Question 5 [25 marks, 3+5+10+2+5]

The following table provides information about a particular project:

Activity	Duration (Days)	Preceding Activity
A	5	
B	6	
C	4	A
D	3	A
E	1	A
F	4	E
G	14	D,E
H	12	B,C
I	2	G,H

(a) By looking at the precedence table can you identify whether or not a dummy activity will be necessary when drawing the network. Explain.

(b) Represent the project by means of a simple network diagram.

(c) Prepare in tabular form, an activity schedule showing the following details: Earliest-start, earliest-finish, latest-start, latest-finish and slack times.

(d) Identify the critical path(s) through the network.

(e) Briefly describe what is meant by a 'Gantt Chart' and explain its uses in relation to a project such as the one above.

Question 6 [25 marks, 12+8+5]

(a) Use the Simplex tabular method, solve the following maximization problem showing clearly the following:

(i) The entering variable

(ii) The leaving variable

(iii) The pivot row

(iv) The pivot column

(v) The pivot element

$$\begin{aligned} \text{maximize} \quad &= \quad 6x_1 + 5x_2 \\ \text{subject to} \quad & \quad x_1 + x_2 \le 5 \\ & \quad 3x_1 + x_2 \le 12 \\ & \quad x_1, x_2 \ge 0 \end{aligned}$$

(b) Determine the shortest path from the 'factory' to the 'warehouse' for the following network:
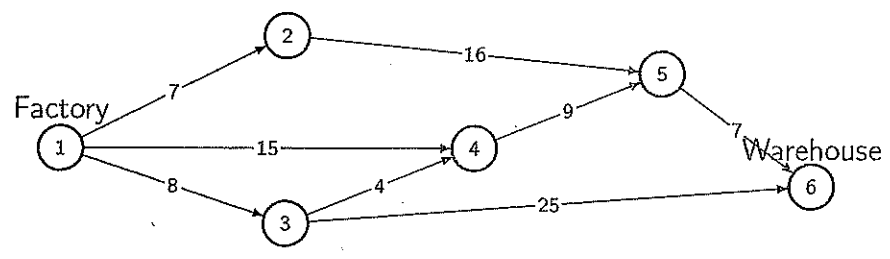
(c) Use Gauss-Jordan elimination to find the solution to the following system of equations

$$\begin{aligned} 3x_1 + 6x_2 - 9x_3 &= 0 \\ 2x_1 + 5x_2 - 3x_3 &= -1 \\ -4x_1 + x_2 + 10x_3 &= 3 \end{aligned}$$