MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF ENGINEERING APPLIED SCIENCES AND TECHNOLOGY

DEPARTMENT: Computer Science and Information Systems

Computational Mathematics for Information Systems

CODE: INSY 121

SESSIONAL EXAMINATIONS
APRIL 2024

DURATION: 3 HOURS

EXAMINER: MR. W. NKOMO

INSTRUCTIONS

1. *Answer **All** questions in Section A*
2. *Answer **any three** questions in Section B*
3. *Start a new question on a fresh page*
4. *Total marks 100*

Additional material(s): *Non-programmable electronic scientific calculator. Statistical tables and graph paper*

SECTION A: [40 MARKS]

Answer **all** questions in this section.

A1 a) State four characteristics of a normal distribution.

b) The average admission charge for a movie is 5.81. If the distribution of movie admission charges is approximately normal with a standard deviation of 0.81, find the probability that a randomly selected admission charge is

i) less than 3.50.

ii) between 4.30 and 5.10.

c) Of the members of a bowling league, 10% are widowed. if 200 bowling league members are selected at random, find the probability that 10 or more will be widowed.

[4,(4,5),5]

A2 a) Find the derivative of the following functions with respect to x.

i) $f(x) = 4x^3 - \frac{3}{x^2} + 2$.

ii) $3y = 5x^2 - 4xy + 2$.

b) Evaluate $\int_1^4 \big(2x^2 - 4x + 3\big)dx$.

[(3,4),5]

A3 a) Given that

$$\mathbf{A} = \begin{bmatrix} 3 & a & 1 \\ 2 & 3 & -2 \\ 3 & 4 & x \end{bmatrix},$$

and $\mid A \mid$ =25, find the value of x.

b) Solve the differential equation, $x\frac{dy}{dx} = y + 1$ given that $x = 2$ when $y = 3$.

[4,6]

SECTION B: [60 MARKS]

Answer any **three** questions in this section.

B4 A manufacturer of Puma clothing makes Puma pants and Puma jackets. The profit on a pair of Puma pants is $2.00 and on a Puma jacket, is $1.50. Both pants and jackets require the work of sewing operators and cutters. There are 60 minutes of sewing operator time and 48 minutes of cutter time available. It takes 8 minutes to sew one pair of Puma pants and 4 minutes to sew one Puma jacket. Cutters take 4 minutes on pants and 8 minutes on a jacket. Find the maximum profit and the amount of pants and jackets to maximize the profit.

a) Let x=Puma pants and y=Puma jackets. Write four inequalities to represent the situation.

b) Write an equation for the anticipated profit.

c) Graph the constraints.

d) How many Puma pants and Puma jackets have to be made to maximize profits?

d) Determine the maximum profit.

[4,2,7,3,4]

B5 a) Given that

$$\mathbf{Z} = \begin{bmatrix} 1 & 4 & -2 \\ 2 & 5 & 1 \\ -1 & 3 & -3 \end{bmatrix}$$

i) Evaluate $\mid Z \mid$ and hence find Z^{-1}.

ii) Evaluate $Z^2 - 2Z$.

iii) Use the method of Cramérs' rule to solve $ZX = (2, 5, 1)^T$.

iv) Prove that $\det(Z^{-1}) = \frac{1}{det(Z)}$.

[(6,4,6,4)]

B6 a) Outline the simplex method algorithm.

b) Use simplex method to maximize $f = 5x + 3y$ subject to

$$x \geqslant 0, y \geqslant 0$$
$$x + y \leq 7$$
$$3x + y \leq 15.$$

c) When a uniform rod is heated, it expands so that the rate of increase of its length, l, with respect to the temperature, $\theta^0 C$ is proportional to the length. When the temperature is $0^0 C$, the length of the rod is L. Form and solve the differential equation that models this data. Give a reason why the model may not be appropriate for very high temperatures.

[5,9,6]

B7 a) Suppose the array

$$\begin{bmatrix} 4 & 3 & 3 \\ 2 & 1 & 0 \\ 4 & 4 & 2 \end{bmatrix}$$

represents the orders placed by three individuals at a Nandos outlet. The first-person orders 4 burgers, 3 pet drinks, and 3 fries; the second orders 2 burgers and 1 pet drink, and the third orders 4 burgers, 4 pet drinks, and 2 fries, burgers cost $\$2$ each, pet drinks $\$1$ each and fries $\$1.50$ each.

i) Show that the amounts owed by these persons may be represented as a function $y = f(x)$, where $f(x)$ is equal to the array given above times a certain vector.

ii) Compute the amounts owed in this case by performing the appropriate multiplication.

iii) Change the matrix for the case in which the second person orders an additional pet drink and 2 fries, and recompute the costs.

b) Of the 500 registered voters in a town, some are conservatives, some moderates and others liberals; 20 % of the conservatives,

30 % of the moderates and 60 % of the liberals and, a total of 175 people in all favour deep-sea dumping. There are 50 more liberals than conservatives. How many people are in each group?

[(4,4,4),8]