



GREAT ZIMBABWE UNIVERSITY

HSOR 2111

GARRY MAGADZIRE SCHOOL OF AGRIC AND NATURAL SCIENCES

COMPUTER PACKAGES IN APPLIED MATHS

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCES

BSC HONOURS IN STATISTICS AND OPERATIONS RESEARCH: PART 2 SEMESTER 1

Final Exam June 2024

Time : 3 hours

Candidates should attempt **ALL** questions in **SECTION A** and any **TWO** in **SECTION B**.

## SECTION A

Answer ALL questions [40 MARKS]

A1. Provide the MATLAB code for performing the following operations

(a)

$$\int_0^{\infty} 4x^3y^2$$

[6]

(b)

$$\int_0^{\pi} \int_0^{\infty} 4x^3y^2$$

[3]

(c)

$$\frac{d(4x^3)}{dx}$$

[4]

(d)

$$\frac{d^2(5x^2)}{dx^2}$$

[3]

A2. Provide the MATLAB code for generating the following arrays:

(a)

$$\begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{pmatrix}$$

[2]

(b)

$$(1 \ 1 \ 1 \ 1)$$

[2]

(c)

$$\begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \end{pmatrix}$$

[2]

**A3.** A lumber mill can produce pallets of high quality lumber. Its lumber capacity is limited by its kiln size. It can dry 200 mbf per day. Similarly, it can produce a maximum of 600 pallets per day. In addition, it can only process 400 logs per day through its main saw. Quality lumber sells for \$490 per mbf, and pallets sell for \$9 each. It takes 1.4 logs on average to make one mbf of lumber and four pallets can be made from one log. Of course, different grades of logs are used in making each product. Grade 1 lumber logs cost \$200 per log, and pallet-grade logs cost only \$4 per log. Processing costs per mbf of quality lumber are \$200 per mbf and processing costs per pallet are only \$5. Formulate the Lumber Mill Problem as an LP and give an outline on how it is solved in LINGO. [18]

## SECTION B

Answer any TWO questions [60 MARKS]

- B4.** (a) Write a MINITAB program to get a histogram for the data stored in *C1* of the MINITAB worksheet. [3]  
 (b) How would you command MINITAB to arrange data in *C1* in ascending and descending order. [5]  
 (c) Suppose you want a sample of size 20 from the data in *C1*. Write a MINITAB program to get your sample and store it in *C2*. Use sampling without replacement. [2]  
 (d) Outline the uses of any 5 commands found on the Stat menu in MINITAB. [10]  
 (e) Interpret the following MATLAB commands

$$\gg f = [-5; -4; -6];$$

$$\gg A = [1 \ 11; 324; 320];$$

$$\gg b = [20; 42; 30];$$

$$\gg lb = \text{zeros}(3, 1);$$

$$\gg [x, fval, exitflag, output, lambda] = \text{linprog}(f, A, b, \diamond, \diamond, lb);$$

[10]

- B5.** A bank makes four kinds of loans to its personal customers and these loans yield the following annual interest rates to the bank:

First mortgage 14%

Second mortgage 20%

Home improvement 10%

Personal overdraft 10%

The bank has a maximum foreseeable lending capability of \$250 million and is further constrained by the policies:

first mortgages must be at least 55%

second mortgages cannot exceed 25%

to avoid public displeasure and the introduction of a new windfall tax the average interest rate on all loans must not exceed 15%

Formulate the bank's loan problem as an LP so as to maximize interest income whilst satisfying the policy limitations. How would you solve the loan problem using MATLAB? [30]

- B6.** (a) Outline the use of the following commands

- (i) MTB Random 100C1;  
(ii) SUBC Normal 0.01.0.  
(iii) MTB CDF C1;  
(iv) SUBC Normal 0.01.0.  
(v) MTB CDF C1;  
(vi) SUBC Normal 0.01.0 [10]
- (b) LINGO applies the simplex method in solving LPP. Give a detailed outline of this method. [10]
- (c) Consider the LP problem below. How would you solve it using MATLAB? [10]

Maximize

$$3x_1 + 2x_2 + x_3$$

Subject to

$$x_1 - x_2 + x_3 \leq 4$$

$$2x_1 + x_2 + 3x_3 \leq 6$$

$$x_1 + 2x_3 \leq 3$$

$$x_1 + x_2 + x_3 \leq 8$$

$$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0$$