ZCAS University

SEC 2162 MATHEMATICAL ECONOMICS

MID SEMESTER TESTS

20th October 2023

TIME 12:30-15:30HRS

TIME ALLOWED: READING AND WRITING – THREE HOURS

INSTRUCTIONS:

1. Section A: this question is compulsory and must be attempted.

2. Sections B: Answer THREE (3) questions from this section.

3. This examination paper carries a total of 100 marks.

4. Candidates must not turn this page until the invigilator tells them to do so.

SECTION A: Question 1 is compulsory and must be attempted

Question 1

a. Find the inverse of the matrices

$$\begin{bmatrix} 1 & -4 & 7 \\ 0 & -5 & 1 \\ 3 & -3 & 3 \end{bmatrix}$$

[13marks]

b. Using elementary row operations, calculate the determinant of the matrix.

$$\begin{pmatrix} 1 & 1 & 1 & 2 \\ 1 & 3 & 7 & -2 \\ 2 & 6 & 8 & -6 \\ 2 & 9 & 6 & -1 \end{pmatrix}$$

(13marks)

C. A closed economy is given below

$$Y = C + I + G$$
$$C = 100 + 0.45Y_d$$
$$T = 10 + 0.12Y$$
$$G = 150$$
$$I = 250$$

Find the equilibrium level of Y, C and T. if government implements a fiscal expansion of increasing spending by 20%, what is the new equilibrium Y, C and T. use matrices.
[14marks]
[total:40marks]

SECTION B: Attempt any THREE questions in this section

Question 2

A local government wants to build a new bridge and needs to justify the cost of the investment. To do so, it hires an economist to conduct an I-O study. The economist talks to engineers and construction companies to estimate how much the bridge will cost, the supplies needed, and how many workers will be hired by the construction company. The economist converts this information into dollar figures and runs numbers through an I-O model, which produces the three levels of impacts. The direct impact is simply the original numbers put into the model - for example, the value of the raw inputs (cement, steel, etc.). The indirect impact is the jobs created by the supplying companies, so cement and steel companies. The induced impact is the amount of money that the new workers spend on goods and services. Below is the technical matrix A and final demand vector.

$$A = \begin{bmatrix} 0.3 & 0.4 & 0.2 \\ 0.1 & 0.2 & 0.4 \\ 0.4 & 0.2 & 0.1 \end{bmatrix} \quad d = \begin{bmatrix} 810 \\ 243 \\ 110 \end{bmatrix}$$

a. Find the correct output for the three industries and the required input if they are used in the ratio 3:3:4. [20marks]

Question 3

You need to buy some filing cabinets. You know that Cabinet X costs $15 per unit, requires six square feet of floor space. and holds eight cubic feet of files. Cabinet Y costs $25 per unit, requires eight square feet of floor space, and holds twelve cubic feet of files. You have been given $140 for this purchase, though you don't have to spend that much. The office has room for no more than 72 square feet of cabinets. How many of which model should you buy, in order to maximize storage volume?

cost: $15x + 25y < 140$, or $y < -(1/2)x + 7$

space: $6x + 8y < 72$, or $y < -(3/4)x + 9$

volume: $V = 8x + 12y$

    a. Use the graphical or corner solution to determine the solution.   [20marks]

Question 4

a. Find the area of the region between $y = x^2 - 2x$ and the x-axis ($y = 0$) from $x = 0$ to $x = 5$.   [10marks]

b. Find the integral of $\int_2^4 3x^2(x^3 + 2)^{10}dx$ and $\int_0^1 x(x^2 + 2)^{1/2}dx$ [10marks]

    [20marks]

Question 5

    a. Calculate marginal productivity of labour and capital from the following production function $X = 2L^2 K + LK + 3LK^2$ [10marks]

    b. If a production function is given as

        $Q = 5LK - 2L^2 - K^2$

        Determine the returns to scale using Euler's theorem   [10marks]

                                     [total:20marks]

END OF EXAMINATION