QUEEN'S UNIVERSITY FINAL EXAMINATION
FACULTY OF ARTS AND SCIENCE
DEPARTMENT OF ECONOMICS

ECON 212 001-002 – Professors: Mohsen Bakhshi-Moghaddam and Rajni Dogra
December 18, 2023

INSTRUCTIONS TO STUDENTS:

This examination is 3 HOURS in length.

The exam consists of 4 long questions. Each question is worth 25 marks for a total of 100 marks. You should answer all the long questions. Marks will be awarded on the basis of the logical arguments given to support your answers.

Please answer all questions in the answer booklets.

The following aids are allowed:

Casio FX-991 calculator

Put your student number on all pages of all answer booklets, including the front.
GOOD LUCK!

PLEASE NOTE:
Proctors are unable to respond to queries about the interpretation of exam questions.
Do your best to answer exam questions as written.

1. Anusha runs tiffin services in Kingston and Brockville, Ontario. She uses two inputs in the production of tiffin: labour, x_1, and capital, x_2. Her production function is $f(x_1, x_2) = 5x_1^{\frac{2}{3}}x_2^{\frac{1}{3}}$. The price of tiffin is \$10, the cost of labour is \$4, and the cost of capital is \$1.
   a) Are returns to scale increasing, decreasing, or constant for her business? **(4 points)**
   b) Is the marginal product of labour and capital increasing or decreasing for her company? What is the technical rate of substitution of production function? **(7 points)**
   c) Suppose that, in the short run, the level of capital is fixed at 27. How much labour should she use? How many tiffins will she make? What will her profit be? **(7 points)**
   d) To support local businesses, the Kingston government provides a wage subsidy of \$2 per unit of labour to businesses. Assuming the level of capital is still fixed at 27, what will Anusha's profit-maximizing amount of labour be? How much profit will her business make? **(7 points)**

2. Samurai Construction Company has 1000 workers on their payroll.
   a) The payroll work can be done either by using 10 hours of clerical time, x_1, or by 1 hour of computer time, x_2. Write down the production function, $f(x_1, x_2)$, for the payroll process of 1000 employees. Show your steps. **(5 points)**
   b) Suppose the cost of clerical time is w_1 and the cost of computer time is w_2. Write down Samurai Construction Company's conditional demand function for clerks. Also, write down the conditional demand function for computers. **(8 points)**
   c) What is Samurai Construction Company's cost function for processing y payrolls if the cost of clerical time is w_1 and the cost of computer time is w_2? **(6 points)**
   d) Computer time costs \$5 per hour, and clerical time costs \$7.50 per hour. Draw a diagram of the isoquant for processing 1000 payroll. On the same diagram, draw an isocost line showing the lowest cost for processing the payroll of 1000 workers. Label the X-axis as clerks and the Y-axis as computers. Clearly show slopes and intercepts. **(6 points)**

3. A firm produces its output using two inputs: labour, l, and capital, k. The firm needs to use labour and capital in fixed proportions to produce output. In particular, to produce 2 units of output, the firm needs to combine 2 units of labour with 1 unit of capital.

a) What is the firm's production function, $f(l,k)$? **(5 points)**

b) Suppose the firm wants to produce y units of output, and the cost of using per unit of labour and capital is w_l and w_k, respectively. What are the firm's conditional factor demand functions for labour, $l(w_l, w_k, y)$, and capital $k(w_l, w_k, y)$? **(6 points)**

c) What is the firm's cost function, $c(w_l, w_k, y)$? **(6 points)**

d) Imagine $w_l = 4$ and $w_k = 8$. Draw a diagram of an isoquant for producing 2 units of output, as well as an isocost line representing the lowest cost of producing this output level. Show the optimum point on the diagram. Place labour, l, on the X-axis and capital, k, on the Y-axis. Be sure to label the axes, all the intercepts, the kink point and the slope of the isocost line. **(8 points)**

4. Earl sells lemonade in downtown Toronto. His production function is $f(x_1, x_2) = x_1^{\frac{1}{3}} x_2^{\frac{1}{3}}$, where x_1 is the number of pounds of lemons he uses and x_2 is the number of hours he spends squeezing them. Let w_1 denote the price of lemon per pound and w_2 denote the hourly wage rate. Let p denote the market price of lemonade.

a) Given w_1 and w_2, derive Earl's cost function $c(w_1, w_2, y)$. **(7 points)**

b) Let $w_1 = 1$ and $w_2 = 4$. Suppose the lemonade market in downtown Toronto is competitive. What is Earl's supply function $S(p)$? **(8 points)**

c) The market price of lemonade is \$3. How much lemonade should Earl produce to maximize his profit? How much profit does he make at this optimum? **(5 points)**

d) Suppose Earl has to pay a fixed cost of \$4 for electricity only when he produces a positive amount of lemonade. Also, the market price of lemonade changes from \$3 to \$6. How much lemonade should Earl produce to maximize his profit? How much profit does he make at this optimum? **(5 points)**