Examination Period 3: 2018/19

ECN201319N

Module Title  Intermediate Microeconomics
Level      Five
Time Allowed Two hours

Instructions to students:

• Enter your student number not your name on all answer books.
• Answer four questions: two from Section A and two from Section B.
• Begin each question in a separate answer book; label each answer book clearly with the number of the question you are answering.
• The use of a calculator is permitted.

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<th>No. of Pages</th>
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Section A

Answer **both** the compulsory questions.

**Question 1**

Boudica and Arthur are both Homo economicus engaging in exchange. Their utility functions are given by **Equations 1** and **2**:

\[
Boudica \ u^B = \frac{1}{2} \ln X^B + \frac{1}{2} \ln Y^B (1)
\]

\[
Arthur \ u^A = \frac{1}{2} \ln X^A + \frac{1}{2} \ln Y^A (2)
\]

They are working out an exchange of archers \(x\) and knights \(y\) for the defence of their respective realms. Boudica currently has 40 archers and 40 knights. Arthur has 20 archers and 60 knights.

State if the following is true or false and explain your answer: Boudica and Arthur’s initial allocations (endowments) are not Pareto efficient.

(18 marks)

**Question 2**

Consider the following matrix, Game 1:

<table>
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<tr>
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<th>Player 2</th>
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<tr>
<td>Player 1</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>3, 3</td>
</tr>
<tr>
<td>B</td>
<td>1, 4</td>
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State if the following is true or false and explain your answer: With \(P\) being the probability that a player will play strategy A and \((1 - P)\) the probability that a player will play strategy B, we can deduce that all players among a population playing either A or B will play the risk-dominant strategy B. [Hint: use a graph in your explanation].

(18 marks)
Section B

Answer two out of four questions.

Question 3

Starry has a utility function for grams of hot chocolate \((x)\) and money \((y)\). Her preferences for hot chocolate and money can be represented by the following utility function, **Equation 1**.

\[
U(x, y) = y + 20x - 1/2x^2 \quad (1)
\]

a. Using Equation 1, calculate the marginal rate of substitution of money for coffee by finding the marginal utilities for each good. Then Sketch the marginal rate of substitution and explain its shape and intercepts. Note: Starry’s marginal rate of substitution (on the vertical axis) and quantity of the good (on the horizontal axis).

(16 marks)

b. On the axes provided put money \((y)\) on the vertical axis and grams of hot chocolate \((x)\) on the horizontal axis.

i. Sketch three indifference curves for three levels of utility. Explain your figure. Note: For the sketches of the figures, you do not to have to identify every single point or take derivatives to identify the slopes; sketch them as they ought to look and explain the intuitions.

(8 marks)

ii. What happens to the marginal rate of substitution along an indifference curve as Starry goes from having lots of money \((y)\) and little hot chocolate \((x)\) to having little money \((y)\) and lots of hot chocolate \((x)\)?

(8 marks)

Total: 32 marks
Question 4

Sophia and Theo are two Homo economicus engaged in exchange over sour snakes \((x)\) and peanut butter cups \((y)\) – it’s close to Halloween after all. Their utility functions are given by the following:

Sophia \[ u^s = (x^T)^{\frac{1}{4}} \cdot (y^T)^{\frac{3}{4}} \]  
(Theo) \[ u^T = (x^T)^{\frac{1}{4}} \cdot (y^{sT})^{\frac{3}{4}} \]

Sophia has an initial endowment of 5 peanut butter cups \((y^s_z)\) and 13 sour snakes \((x^s_z)\). Theo has an initial endowment of 10 peanut butter cups \((y^T_z)\) and 7 sour snakes \((x^T_z)\).

a. What is Sophia’s marginal rate of substitution of peanut butter cups for sour snakes \((mrs^s)\)?

(b) What is Theo’s marginal rate of substitution of peanut butter cups for sour snakes \((mrs^T)\)?

(c) Using their marginal rates of substitution, find the equation for the Pareto-efficient curve. What is Sophia’s utility at her endowment, \((x^s_z, y^s_z)\)? What is Theo’s utility at her endowment, \((x^T_z, y^T_z)\)? Is the allocation at their endowments Pareto-efficient? Explain.

(d) Graph the Edgeworth Box depicting the exchange between Sophia and Theo. Show their initial allocations, their participation constraints, the Pareto-efficient curve, the Pareto-improving lens, and each player’s most preferred allocation that they can feasibly achieve. Briefly explain your graph.

Total: 32 marks
Question 5

Two herders, Camryn and Danielle, herd their dairy cows on the common land of Chapin Lawn (and similar grassy locations on campus). Each player derives utility from the amount of milk that they consume while disliking the effort that they need to exert herding their cattle. They make their decisions simultaneously. The amount of milk, \( y \), that each will obtain from their cows (\( y^C \) and \( y^D \)) depends on the amount of time (\( h \)) that each puts in each day herding their cows on the lawn (\( h^C \) and \( h^D \)) and on the amount of time that the other spends herding each day. Each player derives utility from the milk they obtain in production (\( y^C \) and \( y^D \)) which is affected by the other herder having their cows eat grass from the lawn, and from which they must deduct the disutility of time spent herding:

\[
\begin{align*}
\text{Camryn:} & \quad u^C(h^C, h^D) = h^C \left( 20 - \frac{1}{2}(h^C + h^D) \right) - \frac{1}{2}(h^C)^2 \quad (4) \\
\text{Danielle:} & \quad u^D(h^C, h^D) = h^D \left( 20 - \frac{1}{2}(h^C + h^D) \right) - \frac{1}{2}(h^D)^2 \quad (5)
\end{align*}
\]

a. Using Equations 4 and 5, explain what a best response function (BRF) is and confirm that the following are Camryn and Danielle’s best response functions:

Camryn’s BRF: 
\[ h^C = 10 - \frac{1}{4} h^D \]

Danielle’s BRF: 
\[ h^D = 10 - \frac{1}{4} h^C \]  

(12 marks)

b. Graph the players’ best-response functions (BRFs) and show how the Nash equilibrium levels of effort will result in each player herding for eight hours a day, i.e. \( h^C = 8 \) and \( h^D = 8 \) (put \( h^C \) on the x-axis and \( h^D \) on the y-axis). Do not worry if your BRFs are not exactly to scale.

(10 marks)

Question 5 continues overleaf
c. An impartial spectator (or social planner) wants to maximize total utility:

\[
\text{Total utility } W = u^C + u^D
\]

Show that with this social welfare function, the impartial spectator will tell Camryn and Danielle to reduce the hours they spend herding their cattle to \( h^C_* = h^D_* = \frac{20}{3} = 6 \frac{2}{3} \). Why is the time they spend herding lower?

(10 marks)

Total: 32 marks

Question 6

Suppose that the market inverse demand function is \( P(X) = \bar{P} - BX = 20 - 0.5X \) (Given that the total quantity supplied \( X = x^A + x^B \)) and that the firms’ cost functions are; A’s Costs = \( c_1(x^A) \) and B’s Costs = \( c_1(x^B) \). Then for given \( x^A \),

Firm A’s profit function is \( \pi^A = (\bar{P} - BX^A - BX^B)x^A - c_1x^A \)

Firm B’s profit function is \( \pi^B = (\bar{P} - BX^A - BX^B)x^B - c_1x^B \)

a. Find each firm’s profit-maximizing output given the other firm’s output from the principle of profit-maximization.

(10 marks)

b. Find the Nash equilibrium quantity for each firm.

(10 marks)

c. How much profit does each firm make?

(12 marks)

Total: 32 marks