

UNIVERSITY OF WARWICK

Summer Examinations 2018/19

Microeconomics 2

Time Allowed: 3 Hours.

Answer **ALL FOUR** questions in **Section A** (18 marks each), and **ONE** question from **Section B** (28 marks). Answer Section A questions in one booklet and Section B questions in a separate booklet.

Approved pocket calculators are allowed.

Read carefully the instructions on the answer book provided and make sure that the particulars required are entered on each answer book. If you answer more questions than are required and do not indicate which answers should be ignored, we will mark the requisite number of answers in the order in which they appear in the answer book(s): answers beyond that number will not be considered.

Section A: Answer ALL FOUR questions

1. An individual's preferences can be characterised by a strictly increasing, concave von Neumann-Morgenstern utility function $U(X)$, where X is uncertain income (or a lottery over different levels of income).
 - (a) Using a diagram, explain why this individual is risk averse. **(6 marks)**
 - (b) How much would the individual be willing to pay to avoid risk? **(4 marks)**
 - (c) Consider a linear transformation of $U(X)$ such that $V(X) = aU(X) + b$, where $a > 0$ and $b > 0$. Prove that $U(X)$ and $V(X)$ yield the same Arrow-Pratt measure of absolute risk aversion. **(4 marks)**
 - (d) Suppose the individual faces a lottery which yields £9 with probability 0.25 and £100 with probability 0.75. The individual's utility function is now $u(x) = \sqrt{x}$. Calculate the individual's certainty equivalent. **(4 marks)**

(Continued overleaf)

2. Suppose there are two countries labelled Country 1 and Country 2. Let τ_i (in percentage terms) denote the tariff level of country $i = 1, 2$. If Country i selects tariff τ_i and Country j selects τ_j , Country i gets a pay-off equal to:

$$500 + 3\tau_i + \tau_i\tau_j - 2\tau_i^2 - 3\tau_j$$

measured in billions of US dollars.

- (a) Compute the Nash equilibrium of the tariff setting game, assuming the two countries set tariffs simultaneously and independently. **(3 marks)**
- (b) Suppose the two countries had the opportunity to sign a binding agreement to set tariffs at the level which maximises their joint pay-off. Which tariffs would they select? **(4 marks)**
- (c) Suppose country 1 decided not to impose any tariff on the imports of country 2, and that this decision was credible (possibly because country 1 had not invested in customs infrastructure to collect tariffs). What would country 2's optimal tariff be? **(3 marks)**

Assume there are two firms labelled firm 1 and firm 2 who compete in quantities. The inverse demand function is given by:

$$p = 2 - q_1 - q_2.$$

Marginal cost is equal to $c = 1$.

- (d) How much does each firm produce in Nash equilibrium? **(5 marks)**
- (e) Suppose the game between the two firms is played sequentially where firm 1 gets to set output first. How much will the two firms produce in subgame perfect Nash equilibrium? **(3 marks)**

$$q_1 = \frac{1}{2}; \quad q_2 = \frac{1}{4}.$$

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3. Consider the following 2×2 exchange economy where agents' utility functions are:

$$U_1(x_{11}, x_{21}) = (x_{11})^a (x_{21})^{1-a} \text{ with } 0 < a < 1$$

$$U_2(x_{12}, x_{22}) = \min\{x_{12}, bx_{22}\} \text{ with } b > 0$$

where $x_{\ell i}$ is consumer i 's consumption of good ℓ . Suppose the initial endowments of consumers are $\omega_1 = (1, 0)$ and $\omega_2 = (0, 1)$. Find the conditions on a and b for the existence of the Walrasian equilibrium allocation.

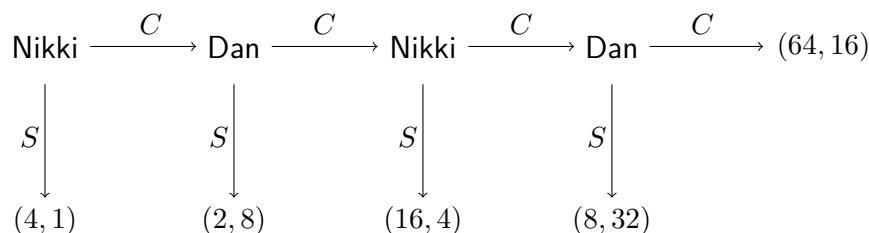
- (a) Find consumers' demands as a function of equilibrium prices. **(12 marks)**
 - (b) When will the Walrasian equilibrium exist? **(6 marks)**
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4. (a) Consider a two-person economy where each person is endowed with 1 unit of a private good, which they can either keep or use to contribute to the public good. Each person has a binary choice, whether or not to contribute their whole endowment of private good to the production of a public good. If both contribute, this will produce 1.2 units of a public good that both will enjoy. If only one contributes, this will produce 0.5 units of the public good. The payoff to each person is the sum of their private good (if any) and public good (if any). Set this decision as a normal form game and find the Nash equilibrium. Is this socially desirable? Discuss. **(6 mark)**
- (b) There are 15 people living in the town of Llanwrtyd who have different preferences over the trees planted on the streets. Trees are public goods. Five individuals have high marginal benefits given by $MB_H = 100 - 0.5Q_T$ and the remaining ten individuals have low marginal benefits $MB_L = 50 - 0.25Q_T$, where Q_T is the number of trees planted on town streets. Marginal cost of planting a tree is constant and is equal to £25 for every individual.
- (i) What is the maximum number of trees that can be potentially privately provided in Llanwrtyd if people do not share costs? **(6 marks)**
 - (ii) What is the socially optimal number of trees that should be planted in Llanwrtyd? **(6 marks)**

Section B: Answer ONE question.
Please use a separate booklet

5. Consider the following sequential-move game. There are two firms - Firm 1 and Firm 2. Firm 1 is a potential entrant and Firm 2 is the incumbent firm in the market. Firm 1 moves first and can play Enter (E) or Not Enter (NE). Firm 2 moves second and can choose Fight (F) or Accommodate (A). If Firm 1 stays out, Firm 2 gets to keep its monopoly windfall profit of 4 and Firm 1 gets nothing. If Firm 1 chooses to enter, Firm 2 gets -2 if it fights, and 2 if it accommodates the entry. Firm 1 gets -3 if Firm 2 fights and 2 if Firm 2 accommodates.
- (a) Write this game in extensive form. **(2 marks)**
- (b) Explain what is meant by a subgame, and why we need to use the subgame perfect equilibrium solution concept to find a solution to this game. **(4 marks)**
- (c) Is there an equilibrium in which Firm 2 announces it will fight entry and Firm 1 does not enter? **(4 marks)**

Consider the following sequential-move game:



Nikki moves first and can play Continue (C) or Stop (S). If Nikki plays S the game ends and she picks up a pay-off equal to 4 and Dan gets 1. If Nikki continues, Dan is called upon to play. If Dan plays S the game ends and he keeps 8 leaving Nikki with 2. If Dan plays C , Nikki gets to play and so on. The rest of the pay-offs are illustrated in the diagram above.

- (d) Construct the normal form table of this game. **(6 marks)**
- (e) Identify all pure-strategy Nash equilibria of the game. **(6 marks)**
- (f) Which equilibrium is subgame perfect and why? **(6 marks)**

(Continued overleaf)

6. Consider a two-country, two-good exchange economy. Assume the utility functions are given by $U_1(x_1, y_1) = x_1 + 4\sqrt{y_1}$ and $U_2(x_2, y_2) = x_2 + 2\sqrt{y_2}$ with endowment vector $((4, 12), (8, 8))$. Assume good y is the numeraire.

- (a) Write down the maximisation problem for the agents. **(4 marks)**
(b) Find the Walrasian equilibrium allocation and prices for this pure exchange economy. **(8 marks)**

Extend this pure exchange economy to a production economy. Suppose a firm exists which can produce good y using good x as input and has a production function $y = \alpha x$. Further assume each agent has an equal share of the firm.

- (c) For what values of α will there be a Walrasian equilibrium with 0 production? **(8 marks)**
(d) For which values of α will there be Walrasian Equilibrium with positive production? Find the Walrasian equilibrium. **(8 marks)**
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7. Consider a two-good exchange economy with two large equal-sized groups of consumers. Each consumer in group a has an endowment of 300 units of good 1; each consumer in group b has an endowment of 200 units of good 2. Each type a consumer has a utility function $U_a(x_a) = x_{1a}x_{2a}$ and each type b consumer has a utility function $U_b(x_b) = \frac{x_{1b}x_{2b}}{x_{1a}}$.

- (a) Find the competitive equilibrium allocation and prices. **(10 marks)**
(b) Show that a marginal change in the allocation, which decreases x_{1a} and increases x_{2a} keeping utility of type a consumer constant will increase type b consumer's utility. **(12 marks)**
(c) Can a benevolent policymaker achieve an efficient allocation by changing the price of good 1? If not suggest an alternative method. **(6 marks)**

8. Consider the following game of chicken:

1,2	<i>GS</i>	<i>S</i>
<i>GS</i>	-5, -5	20, 0
<i>S</i>	0, 20	10, 10

where *GS* is "Go straight" and *S* is "Swerve".

- (a) Does either player have a dominant strategy? Explain your answer. **(4 marks)**
- (b) What is the pure-strategy Nash equilibrium (or equilibria) in the game above? **(2 marks)**
- (c) Is there a mixed-strategy Nash equilibrium? If so, solve for the mixed-strategy equilibrium and illustrate all Nash equilibria in a diagram. **(12 marks)**
- (d) Suppose there are two types of player – a Wimp and a Daredevil. The pay-offs to for a Whimp are as above, but the Daredevil playing *GS* when the other player plays *S*. The Daredevil also gets a smaller pay-off from playing *S* when the other plays also plays *S*. The pay-offs of a Daredevil can is represented as:

1,2	<i>GS</i>	<i>S</i>
<i>GS</i>	-5, -5	20, 0
<i>S</i>	0, 20	10, 10

Suppose player 1 is a Whimp, but there is uncertainty about Player 2's type. Player 2 can be a Whimp or a Daredevil with equal probability. Construct the normal form of this game and solve for all pure-strategy Bayes-Nash equilibria. **(10 marks)**
