Exam Data Collection & Games and Incentives

Started: Oct 24 at 10am

Quiz Instructions

The exam consists of 5 questions. You have to complete all questions. The maximum number of points is 120 within 120 minutes (+reading time).

Aids: non-programmable pocket calculator approved by Frankfurt School.

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Good luck!

Question 1 — 16 pts

There are two symmetric firms offering soft drinks (e.g., Pepsi, Coke). Production costs are (for simplicity) zero. Firms can, however, invest in costly advertising to affect their demand. Assume that firms simultaneously choose between three levels of investment: zero, €1 million, and €3 million. While the total demand for soft drinks is fixed at €20 million, advertising allows firms to potentially steal business from their competitor. Advertisement has the following implicants for the revenues of firms:

- If both firms make the same investment decision, firms evenly split total demand such that each firm's revenue will be €10 million. (Note: This happens if both firms invest zero, if both firms make the costly investment worth €1 million, and if both firms make the costly investment worth €3 million.)
- If one firm invests €1 million, and the other does not, the revenue of the investing firm will be €17 million and the revenue of the non-investing firm will be €3 million.
- If one firm invests €3 million, and the other does not, the revenue of the investing firm will be €18 million and the revenue of the non-investing firm will be €2 million.
- If one firm invests €3 million, and the other firm invests €1 million, the revenue of the firm which invests €3 million will be €11 million and the revenue of the firm which invests €1 million will be €9 million.

A. Please state the Nash equilibrium for this game, state the profit of each firm in equilibrium, and discuss whether the Nash equilibrium is Pareto efficient. (Hint: Translate the situation into the normal form game representation.) (10 points)

B. Assume now that the economic situation changes slightly. If one firm invests €3 million, and the other firm invests €1 million, the revenue of the firm which invests €3 million will be €(11+X) million and the revenue of the firm which invests €1 million will be €(9-X) million, with $0<X<9$. For what values of X would (€3 million,€3 million) be the only Nash equilibrium of the new game? (6 points)

Question 2

24 pts

Consider a single market for a homogenous product. There are two firms which compete over quantities. Each firm produces a homogeneous product at no costs, that is, $C1 = 0$, $C2 = 0$. The demand is $D(P)=12-P$, with P being the markt price.

A. Please state the profit function for each firm. (2 points)

B. Assume now that both firms move simultaneously. Please compute the Nash equilibrium for this game and compute the equilibrium profits of each firm. (8 points)

C. Assume now that firm 1 could invest in a technology that would allow it to move first in the market while firm 2 moves second. If firm 1 would acquire this technology, the timing would be as follows: Firm 1 decides first how much it wants to produce. Firm 2 then observes how much firm 1 has produced. Thereafter firm 2 decides how much it wants to produce. What would be the largest amount that firm 1 would be willing to pay for this technology? (Hint: If firm 1 aquires the technology, firm 1 and firm 2 would face Stackelberg competition in quantities. Determine first the equilibrium strategies for firms 1 and 2 in Stackelberg competition. Then determine the equilibrium profit of firm 1 and compute the willingness to pay based on that and the equilibrium profit you have determined in your response to Question 2.B.) (14 points)

Question 3

16 pts

Consider a market with two firms. The firms face the following demand functions:

$q1 = 1 - p1 + (1/2)^*p2$

$q2 = 1 - p2 + (1/2)^*p1$

The firms set their prices simultaneously. Assume that costs of each firm are 0.

A. In what way are the two demand functions interdependent of the two firms? (4 points)

B. Assume the firms compete in one period only. Calculate the prices that constitute the Nash equilibrium for this game. (6 points)

C. Determine the equilibrium profits for the game and discuss how and why they differ from the equilibrium profits in standard price competition. (6 points)

Question 4

24 pts

Consider a market with two firms which produce a homogeneous product. Firms are in Cournot-competition. The inverse demand function is given by $P=1-Q$, with $Q=q1+q2$ and $q1$ being quantity produced by firm 1 and $q2$ being the quantity produced by firm 2. Firm 1 produces as costs $C1 = q1*q1 = (q1)^2$ and firm 2 produces as costs $C2 = q2*q2 = (q2)^2$.

Assume firms play the game repeatedly over an infinite number of periods and set their quantities simultaneously in each period. The common discount factor of both firms is $0<d<1$. Determine the critical discount factor above which firms can sustain the monopoly quantity as a subgame perfect equilibrium with the following grim trigger strategies: Produce half of the monopoly quantity in the first period. Keep producing half of the monopoly quantity as long as both firms have done so in all previous periods. If one firm has deviated from producing half of the monopoly quantity, the punishment phase starts in the very next period and includes that firms produce the Nash equilibrium quantities that they would produce if the game lasts only for one period.

- Start by determining the monopoly quantity and respective monopoly profit and what firms' profits would be if they share the monopoly profit. (6 points)
- Determine the optimal deviation of a firm and the corresponding deviation profit, given that the other firm produces half the monopoly quantity. (6 points)
- Determine the profits both firms realize in the punishment phase. (Hint: Firms produce the Nash equilibrium quantities that they would produce if the game lasts only for one period) (6 points)
- Finally, determine the critical discount factor. (6 points)

Question 5

40 pts

A. Please describe what we mean by the unobserved counterfactual. Please use an example to explain your answer. (8 points)

B. Please describe the issue of selecting bias and discuss whether it leads to overestimation or underestimation. Please use an example to explain your answer. (8 points)

C. When designing an experiment, what are the advantages and disadvantages of quantitative measures, of qualitative measures, of hypothetical measures, and of incentivized measures? (8 points)

D. In class we discussed that experiments may not allow to identify causal effects if there is no (or only partial) compliance. What does compliance refer to in the context of experiments? (Hint: The experiment in which class sizes were studied in schools in the US). (8 points)

E. Please describe the zero conditional mean assumption. What does it imply for OLS regressions if the assumption, what if it does not? (8 points)