Handout 12

Topics

- Game Theory
- Monopolistic Competition

Review: Game Theory

- **Setting:** A (normal-form) game consists of players, their strategies and their payoffs. We focus on two-person, two-strategy, single round games.
- **Nash equilibrium (NE)**, the equilibrium of a non-cooperative game, is a configuration of strategies, one for each player, such that each players' strategy is best for them, given that all other players are playing their equilibrium strategy.
- At a NE, each player must be satisfied with their strategy choice, given what other players have chosen i.e. it constitutes a best response.
- A **dominant strategy** is the best response (or the optimal move) for a player, regardless of what the other player does. It gives the player a higher payoff than any other strategy for each and every strategy of the other player . A game may or may not have player(s) with dominant strategies.
- Every player playing a dominant strategy yields a NE outcome.
- If **collusion** is possible in a game, players maximize their joint profits or minimize their joint losses.
- **Max-min strategy:** maximizes one's own minimum gain. Thus, it equals the payoff that a player can guarantee for themselves.
- In a two-player game, you can compute the max-min strategy of a player by finding their minimum payoff under each strategy (assuming your opponent wants to give you the least possible payoff), and then taking the maximum of those payoffs.

Review: Monopolistic Competition

- **Setting:** many firms; entry and exit possible; differentiated products.
- Horizontal differentiation: different products to suit specific consumer groups; Vertical differentiation: make products better than rival products for all consumers; differing prices can ensure that demand for low-quality products remain.
- Firms have downward-sloping demand with linear MR (twice the demand's slope).
- **Profit maximization steps:** set $MC = MR$ to get optimal Q^*; plug Q^* into the demand to get P^*; profits $= (P^* - AC) \times Q^*$.

Exercises

Exercise 1. Game Theory

King Robert is the ruler of the seven kingdoms. His kingdoms trade with the nine free cities of Essos. King Robert suspects that his kingdoms don't have the upper hand in this bilateral trade. The two sides are facing identical options in this trading scenario:

- Cooperate - Keep the trade agreement and allow the free flow of goods; or
- Defect - Break the trade agreement and impose tariffs on the foreign goods.

If both sides cooperate, each side earns a payoff of 15. If they both defect, each side earns a payoff of 10. If one side defects and the other side cooperates, the defector earns 25 while the cooperator earns 5.

(a) Write down the payoff matrix of this game.

(b) Does King Robert or the Free Cities have a dominant strategy?

(c) Find maxmin strategy of King Robert.

(d) Find a Nash Equilibrium for this game.

(e) Is the Nash equilibrium you found earlier Pareto optimal?

Exercise 2. Game in a Duopoly

SpaceX and Blue Origin are the only two firms who sell private trips to space. Market demand is given by the equation $Q_D = 32 - 2P$ (prices, in millions of \$)and consumers who buy do so at the firm with the lowest price. If SpaceX and Blue Origin charge the same price, half the buyers go to each firm. For the companies, providing each trip costs \$4 million and assume there are no fixed costs. Both firms set their price simultaneously.

(a) What is the joint-profit maximizing price (i.e. what price would SpaceX and Blue Origin charge if they were able to collude)? What profit would each company make if it set this price?

(b) Suppose SpaceX and Blue Origin compete by simultaneously choosing prices and can set either the joint maximizing price in part (a) or charge $1 mil less. What are profits if both decide to charge $1 mil less? Show a payoff matrix of the profits of the two firms.

(c) What price will each firm charge in the equilibrium for this game?

Exercise 3. Monopolistic Competition

Use the following information to answer the next **two** questions.

The Sweet Shop sells ice cream in a monopolistically competitive market, and is currently realizing positive profits. It currently faces a demand curve where $P = 10 - \frac{1}{10}Q$, with $MC = \frac{1}{5}Q$.

1. How much will the Sweet Shop decide to produce, and what price will it sell at in the short run?

2. Which of the following will occur in the long run?

   (a) Seeing profits, new firms that make identical products to the Sweet Shop will enter and sell at a slightly lower price, taking away all demand from the Sweet Shop.

   (b) Seeing profits, new firms producing similar products will enter the market, but the demand for the Sweet Shop, and thus the price and output decision, will remain the same.

   (c) Seeing profits, the Sweet Shop will produce more ice cream than in the short run but continue to sell at the same price.

   (d) Seeing profits, new firms will enter the market and cause demand for the Sweet Shop to shift to the left.

3. Suppose Sweet Shop's total cost curve is $\frac{1}{10}Q^2$. In the long-run, if Sweet Shop is producing $Q = 20$, what price must it be charging?

Multiple choice questions

Airline Pricing Competition. Two firms are competing in the airline industry. Consider the following game matrix representing their profits in millions of dollars.

Firm A/ Firm B	Raise Price	Don't Raise Price
Raise Price	50,50	X,100
Don't Raise Price	100,X	60,60

1. Suppose X = 70. What is firm A's maxmin strategy? What is firm B's maxmin strategy?
   a. Firm A: Raise; Firm B: Raise
   b. Firm A: Raise; Firm B: Don't Raise
   c. Firm A: Don't Raise; Firm B: Raise
   d. Firm A: Don't Raise; Firm B: Don't Raise

2. How many Nash equilibrium/a does this game have with X = 70?
   a. 0
   b. 1
   c. 2
   d. 3
   e. 4

3. Now suppose X = 40. What is firm A's maxmin strategy? What is firm B's maxmin strategy?
   a. Firm A: Raise; Firm B: Raise
   b. Firm A: Raise; Firm B: Don't Raise
   c. Firm A: Don't Raise; Firm B: Raise
   d. Firm A: Don't Raise; Firm B: Don't Raise

4. How many Nash equilibrium/a does this game have with X = 40?
   a. 0
   b. 1
   c. 2
   d. 3
   e. 4