DEPARTMENT OF ECONOMICS
DELHI SCHOOL OF ECONOMICS

Minutes of Meeting

Subject: B.A. (Hons.) , IV Semester

Paper : Intermediate Microeconomics II

Convenor : Dr. Anirban Kar

A meeting of teachers of the above course was held on January 13, 2020 at 3 p.m.

S.N	Name	College
1	Vibhor Verma	SRCC
2	Valbha Shakya	SBSC (M)
3	Roopali Goyanka	IP college
4	Sonia Goel	Ramjas college
5	Arushi Gupta	Miranda House
6	Naveen Thomas	JMC
7	Meenakshi Sharma	SVC
8	Animesh Naskar	Hansraj College
9	Ranjan Swarnakar	ARSD
10	Shikha Singh	SPM
11	Rakesh Kumar	ARSD
12	Leema Paliwal	St. Stephens College
13	Sakshi Bansal	JDMC

1 Syllabus and Readings

Course Description

This course is a sequel to Intermediate Microeconomics I. It covers general equilibrium and welfare, imperfect markets and topics under information economics. To discuss imperfect market and information, we also need to introduce students to strategic interactions and game theory. The emphasis will be on providing conceptual clarity to the student coupled with the use of mathematical tools and analytical reasoning. Abstract proofs can be complemented by numerical examples.

Textbooks

1. Hal R. Varian [V]: Intermediate Microeconomics: A Modern Approach, 8th edition, W.W. Norton and Company/Affiliated East-West Press (India), 2010. The workbook by Varian and Bergstrom could be used for problems.

2. C. Snyder and W. Nicholson [S-N, 2010]: Fundamentals of Microeconomics, Cengage Learning (India), 2010, Indian edition.

3. M. J. Osborne [O]: An introduction to Game Theory, Indian Edition

Course Outline

1. General Equilibrium, Efficiency and Welfare
Equilibrium and efficiency under pure exchange and production; overall efficiency and welfare economics Readings:
(*i*) [V]: Chapters 31 and 33
(*ii*) [S-N]: Chapter 13, p418-p427

2. Strategic form game with perfect information;
(*i*) [O]: Chapter 2 (except 2.10), p13-p50
Mixed strategy and extensive form games with perfect information
(*ii*) [S-N]: Chapter 8 (p231-p253, except concepts already covered above);

3. Market Structure and Game Theory
Monopoly; pricing with market power; price discrimination; peak-load pricing; two-part tariff; monopolistic competition and oligopoly;
(*i*) [S-N]: Chapter 14 (p464-p485); Chapter 15(p492-p507 and p511-p519)

4. Market Failure
Externalities; public goods and markets with asymmetric information
(*i*) [V]: Chapter 34, 36 and 37, except 'Vickrey-Clarke-Groves Mechanism' ([V], p711-p715).

Assessment

Semester Examination:
The question paper will have two sections. Section A will contain 4 questions from topic 1 and 4. Students will be required to answer 2 questions out of 4. Section B will contain 4 questions from topic 2 and 3. Students will be required to answer 2 questions out of 4.

Internal Assessment:
There will be two tests/assignments (at least one has to be a test) worth 10 marks each. Remaining 5 marks is for attendance.

2 Corrections and Clarifications

(Following note is included in the syllabus)

Clarification 1: Smokers and Non-Smokers Diagram
Figure:34.1, Page:646, Chapter:34, Varian, 8th edition

A's money is measured horizontally from the lower left-hand corner of the box, and B's money is measured horizontally from the upper right-hand corner. But the total amount of smoke is measured vertically from the lower left-hand corner.

Clarification 2: Bertrand Price competition
Paragraph:6, Page:494, Chapter:15, Nicholson and Snyder, 2010 Indian Edition

Case (ii) cannot be a Nash equilibrium, either. Let us look at two sub-cases separately $(ii-a)$ $c < p_1 = p_2$ and $(ii-b)$ $c < p_1 < p_2$.

$(ii-a)$ We shall show that Firm 2 has an incentive to deviate. In this subcase Firm 2 gets only half of market demand. Firm 2 could capture all of market demand by undercutting Firm 1's price by a tiny amount ϵ. This ϵ could be chosen small enough that market price and total market profit are hardly affected. To see this formally, note that Firm 2 earns a profit $(p_2 - c)\frac{D(p_2)}{2}$ by charging p_2 and can earn $(p_2 - \epsilon - c)D(p_2 - \epsilon)$ by undercutting. Change in profit due to price cut is,

$$\left[(p_2 - \epsilon - c)D(p_2 - \epsilon)\right] - \left[(p_2 - c)\frac{D(p_2)}{2}\right]$$

Because $D(p_2 - \epsilon) > D(p_2)$ (downward sloping demand curve)

$$\left[(p_2-\epsilon-c)D(p_2-\epsilon)\right] - \left[(p_2 - c)\frac{D(p_2)}{2}\right] > \left[(p_2-\epsilon-c)D(p_2)\right] - \left[(p_2 - c)\frac{D(p_2)}{2}\right]$$

We want to show that Firm 2 can suitably choose the level of price cut, that is ϵ, so that the above difference is positive.

$$\left[(p_2 - \epsilon - c)D(p_2)\right] - \left[(p_2 - c)\frac{D(p_2)}{2}\right] = D(p_2)\left[\frac{(p_2 - c)}{2} - \epsilon\right]$$

Since $p_2 > c$, any choice of strictly positive ϵ smaller than $\frac{p_2 - c}{2}$ would be profitable deviation for Firm 2.

$(ii - b)$ If $p_1 < p_2$ Firm 2 earns zero profit. It can deviate to p_1 and earn positive profit.

Clarification 3: Capacity constraint
Page: 501, **Chapter:**15, **Nicholson and Snyder, 2010 Indian Edition**
[Teachers are also requested to refer to 'The Theory of Industrial Organisation, Jean Tirole, Eastern Economy Edition, 2014, Chapter 5, pages 209 to 216' for a detail discussion. However this reference (Tirole) is NOT part of the syllabus.]

For the Bertrand model to generate the **Bertrand paradox** (the result that two firms essentially behave as perfect competitors), firms must have unlimited capacities. Starting from equal prices, if a firm lowers its price the slightest amount then its demand essentially doubles. The firm can satisfy this increased demand because it has no capacity constraints, giving firms a big incentive to undercut. If the undercutting firm could not serve all the demand at its lower price because of capacity constraints, that would leave some residual demand for the higher-priced firm and would decrease the incentive to undercut. The following discusses a situation where price competition does not lead to marginal cost pricing.

Consider the following simplified model, where two firms take part in a two-stage game. In the first stage, firms build capacity K_1, K_2 simultaneously. In the second stage (first stage choices are observable in this stage) firms simultaneously choose prices p_1 and p_2. Firms cannot sell more in the second stage than the capacity built in the first stage. Let q_i be the output sell of Firm i in stage 2, then $q_i \leq K_i$. Suppose that the marginal cost of production is zero and capacity building cost is c per unit. Let us assume that capacity building cost is sufficiently high, $\frac{3}{4} \leq c \leq 1$.

Market demand curve is $D(p) = 1 - p$. If the firms choose different prices, say $p_i > p_j$, then the firm which has set lower price (Firm j) face the demand $D(p_j)$ and sell the minimum of $D(p_j)$ and K_j (because it can not produce

more than its capacity). That is $q_j = \min\{D(p_j), K_j\}$. Firm i, which has chosen a higher price, faces the residual demand at p_i, which is $(D(p_i) - q_j)$. Therefore, sell of Firm i is the minimum of the residual demand and it's capacity, that is $q_i = \min\{(D(p_i) - q_j), K_i\}$.
If the firms choose the same price $p_i = p_j = p$, then the demand is equally shared (that is each firm faces demand $\frac{D(p)}{2}$). However if a firm has a capacity smaller than $\frac{D(p)}{2}$, it supplies its capacity and the residual demand goes to the other firm.

Before we start our analysis, note that the maximum gross profit a firm can earn is bounded by the monopoly profit, which is

$$\max_p pD(p) = \max_p[p(1-p)] = \frac{1}{4}$$

Thus the maximum profit net of capacity cost is $(\frac{1}{4} - cK_i)$. Since c is greater than $\frac{3}{4}$, to earn non-negative profit, firms will choose a capacity smaller than $\frac{1}{3}$.
We will analyze the game using backward induction. Consider the second-stage pricing game supposing the firms have already built capacities K_1^*, K_2^* in the first stage. We shall show that $p_1 = p_2 = p^* = (1 - K_1^* - K_2^*)$ is a Nash equilibrium. Note that at this price, total demand is $D(p) = K_1^* + K_2^*$. Hence output sells are, $q_1 = K_1^*, q_2 = K_2^*$.

Is a deviation $p_j < p^*$ profitable?
In case of such deviation Firm j charges a smaller price than Firm i, because $p_j < p^* = p_i$. This increases Firm j's demand. However it does not increase Firm j's sell because it is already selling at its capacity K_j^*. This reduces j's profit and such deviation is not profitable.

Is a deviation $p_j > p^*$ profitable?
In case of such deviation Firm j charges a higher price than Firm i, because $p_j > p^* = p_i$. Firm i still sells K_i^* and Firm j faces the residual demand $(D(p_j) - K_i^*) = (1 - p_j - K_i^*)$. Gross profit of j is $[p_j(1 - p_j - K_i^*)]$. If this profit is a decreasing function of p_j, then we can claim that the deviation (price increase) was unprofitable. To check, let us differentiate $[p_j(1 - p_j - K_i^*)]$ with respect to p_j.

$$\begin{aligned}
\frac{d[p_j(1 - p_j - K_i^*)]}{dp_j} &= (1 - 2p_j - K_i^*) \\
&< (1 - 2p^* - K_i^*) \text{ because } p_j > p^* \\
&= [1 - 2(1 - K_i^* - K_j^*) - K_i^*] \text{ because } p^* = (1 - K_1^* - K_2^*)
\end{aligned}$$

$$
\begin{aligned}
&= K_i^* + 2K_j^* - 1 \\
&\leq 0 \quad \text{because } K_i^*, K_j^* \leq \frac{1}{3}
\end{aligned}
$$

Therefore $p_1 = p_2 = p^* = (1 - K_1^* - K_2^*)$ is a Nash equilibrium of the second stage price competition game. At this equilibrium firms use their full capacity, that is $q_1 = K_1^*, q_2 = K_2^*$. Gross profit of Firm 1 is $[(1 - K_1^* - K_2^*)K_1^*]$ and that of Firm 2 is $[(1 - K_1^* - K_2^*)K_2^*]$.

It can be shown that the above is the only Nash equilibrium of the second stage game. A situation in which $p_1 = p_2 < p^*$ is not a Nash equilibrium. At this price, total quantity demanded exceeds total capacity, so Firm 1 could increase its profits by raising price slightly and continuing to sell K_1^*. Similarly, $p_1 = p_2 > p^*$ is not a Nash equilibrium because now total sales fall short of capacity. Here, at least one firm (say, Firm 1) is selling less than its capacity. By cutting price slightly, Firm 1 can increase its profits (formal analysis is similar to the case $p_j > p^* = p_i$).

Now we are ready to analyze the first stage of this game. Firm i's profit net of capacity cost is, $\pi_i = [(1 - K_i^* - K_j^*)K_i^*] - cK_i^*$. Firms are choosing capacities simultaneously. This is exactly like the Cournot game. We can obtain equilibrium choice of capacities by solving the best response functions. Equilibrium choice of capacities are $K_1^* = K_2^* = \frac{1-c}{3}$. Thus the price at the second stage will be $p^* = \frac{1+2c}{3}$, which is greater than zero. Therefore unlike Bertrand competition, 'price-competition' in this game does not lead to marginal cost pricing.