Problem 1 (60%)

Explain in your own words.

a) Explain the double marginalization problem and explain at least two possible ways vertically related monopolies can design their contracts in order to avoid this problem.
b) Explain why markets with incompatible network goods have a tendency to be dominated by a single good.
c) Explain the concept of two-sided markets and provide a theoretical argument for why social networks charge advertisers to place ads on their site, but let the users use their service for free.
d) In sealed-bid second-price auctions the optimal strategy is to bid your true valuation. Explain why this isn't the case in first-price auctions.
e) Does the optimal strategy in a first-price auction involve bidding closer to, or farther from, your true valuation as the number of competing bidders in the auction increases? Explain!
f) Consider a pair of competing firms where one firm has a high-quality product and the other has a low-quality product. Explain why it isn't always profitable for the low-quality producer to raise his quality, even if it didn't cost anything to do so.
g) Consider a game where two firms selling perfect substitutes compete in quantities with sequential moves. Explain why there is a first-mover advantage and why the advantage hinges on the first-mover's ability to commit to his action.
h) Consider again a game where two firms selling perfect substitutes, but now the firms compete in prices with sequential moves. Explain why there is now a second-mover advantage.
i) Explain why two firms who compete in quantities end up producing more, and earning lower profits, than a monopolist firm would.

Answers:

a) The DM problem arises when vertically related firms have to raise the per unit/linear price in order to obtain revenue. They do that without taking into account the effect it has on the rest of the vertical chain. The key to solve the problem is to design contracts where firms can earn revenue without distorting the per unit price. Vertical integration, two-part tariffs, profit sharing and resale price maintenance are constructs we talked about in class.
b) Network effects mean that the utility of consuming a good increases the more consumers are consuming the same good. When networks are incompatible, the effects are exclusively contained within the one network. A dominating network can therefore provide a lot of utility and can be very hard to overthrow. (The award for the best sales person in history should go to the one who sold the first telephone.)
c) In a two-sided market, a platform owner caters to two sides, where the utility to either side depends on the number of actors on the other side. Newspapers who cater to advertisers and readers is one example. Amazon with sellers and buyers, is another. The theory tells us that a monopolist platform owner will deviate from the traditional Lerner price index by subtracting the cross network benefit each additional user on one side provides to the other side, from the marginal cost:

$\frac{p-(c-cnbf)}{p} = 1/\varepsilon$. As users provide benefit to the advertisers, they should get a price below the marginal cost of serving them, while advertisers, who (presumably) provide a net disutility to the users, should get priced above their marginal cost.

d) In a first-price auction your bid determines your price. Therefore, each bidder faces a trade-off between winning more often (higher bid) and obtaining a bigger surplus on each win (lower bid). It can easily be shown that for $b_i = v_i$, there is a strict gain to shading your bid (else you get a zero surplus either you win or lose).

e) As there are more bidders, the winning probability conditional on a bid goes down (more likely that someone outbids you), but the surplus you get conditional on winning with a particular bid is unchanged. Therefore the trade-off shifts and you should increase the probability of winning by shading your bid less.

f) As the low-q firm raises his quality, the two goods become closer substitutes and the price competition intensifies. Our simple model in class predicted maximal differentiation, i.e. that the low-q firm chose the lowest possible quality in order to soften the price competition. As the price competition softened, the high-q firm raised its price so much that the low-q firm could too, thereby obtaining higher profits when it lowered its quality.

g) There is a first-mover advantage because there is a fixed demand curve and the two firms' goods will sell for the same price. The first-mover can choose to produce a lot, thereby lowering the marginal revenue for the second-mover. The second-mover will respond by choosing to produce less. As the two goods sell for the same price, the first-mover obtains higher profits. This is only possible if the first move involves a credible commitment. After the second firm has made its choice, the first-mover has an incentive to go back on his choice and produce less. If that was possible, however, his initial high-production choice wouldn't be credible and the second-mover wouldn't choose to produce little.

h) There is now a second-mover advantage because with perfect substitutes and unlimited capacities, all consumers flock to the cheapest good. The second-mover can now undercut his opponent and steal the entire market.

i) The reason, as we discussed it in class, is that each firm acts as a monopolist on the residual demand curve, taking the other firm's output choice as given. Expanding production in general implies a trade-off between selling many units and obtaining a high price on each unit you sell. With two firms, many of the inframarginal units – the ones for which the price goes down when you choose to expand your output – belong to the other firm and does not factor into the decision of this firm. Starting at the monopoly output level, the gain from selling more units becomes more important when there is more than one firm, and total output increases.

Problem 2 (40%)

In this problem there are N firms. Each firm produces a quantity q_i of a homogeneous good, to a common marginal cost of zero. The inverse demand in the market is given by $p = 1 - Q$, where Q is total quantity supplied, $Q = \sum_i q_i$.

a) Let Q_{-i} be the output of the other firms, from firm i's perspective: $Q_{-i} = \sum_{j \neq i} q_j$. Explain the problem that we assume each firm solves and derive the best response function for firm i.

We assume each firm sets its output to maximize profits, and that it takes the other firms' quantity choices as given. When firm $\boldsymbol{i}$ produces $\boldsymbol{q_i}$ units and the other firms jointly produce $\boldsymbol{Q_{-i}}$ units, the price will be $\boldsymbol{p = 1 - Q_i - q_i}$. The problem it solves is then

$$\max_{q_i}(1 - Q_{-i} - q_i)q_i$$

FOC: $\boldsymbol{1 - Q_{-i} - 2q_i = 0}$. Then solve for $\boldsymbol{q_i}$ to get

$$q_i = BR(Q_{-i}) = \frac{1}{2} - \frac{Q_{-i}}{2}$$

b) Assume a symmetric Nash Equilibrium and show that the aggregate output will be given by

$$Q^{NE} = \frac{n}{(n+1)}$$

Answer: Insert for the defined equilibrium outputs in the best response functions. Then we get $\boldsymbol{q^{NE} = \frac{1}{2} - \frac{q^{NE}(n-1)}{2}}$, which solves to $\boldsymbol{q^{NE} = \frac{1}{(n+1)}}$. Multiply this with $\boldsymbol{n}$ to get $\boldsymbol{Q^{NE}}$.

c) Derive the equilibrium price and the equilibrium per-firm profits.

Answer:

$$\boldsymbol{p^{NE}(Q;n) = 1 - Q^{NE}(n) = 1 - \frac{n}{n+1} = \frac{1}{n+1}}$$

Profits are given by

$$\boldsymbol{\Pi^{NE}(n) = p^{NE}(n)q^{NE}(n) = \frac{1}{n+1}\frac{1}{n+1} = \frac{1}{(n+1)^2}}$$

d) Assume that there are three firms ($n = 3$), and that two of them merge so that only two firms are left. *As the model is formulated, would there be any synergies in such a merger?*

Answer:
In the model, there are no synergies from such a merger. This would only replace two firms with a single firm, that would be identical to each of the two pre-merger firms. Since the firms themselves decide on capacities, the only thing that happens is that there are fewer decision makers.

e) Explain what would happen to aggregate profits, the joint profits of the two merging firms and the consumer surplus following such a merger.

Answer:

Aggregate profits are $n\Pi^{NE}(n) = \frac{n}{(n+1)^2}$. For 2 firms, this is 2/9, while for three firms this is 3/16, which is smaller.

For the two merging firms, they replace two claims on profits in a three-firm industry with a single claim on profits in a two-firm industry. They therefore replace $2\Pi^{NE}(3) = \frac{2}{16} = 1/8$ with $1\Pi^{NE}(2) = 1/9<1/8$. This merger is not profitable for them.

The difference is due to the fact that also the non-merging firms benefit from the merger, as every firm will be able to enjoy the higher price. This is a "positive" external effect that the merging firms are not able to capture.

As $p^{NE}(2) = 1/3 > p^{NE}(3) = 1/4$, consumer surplus will decrease following the merger. This is a "negative" external effect of the merger.

f) If the two remaining firms merge, so that only a single monopolist firm is left, will the two firms find such a merger profitable? Explain.

Answer:
Yes, as $\Pi^{NE}(1) = \frac{1}{4} > 2\Pi^{NE}(2) = \frac{2}{9}$. When two firms merge to one, there are no external firms who benefit. The two merging firms capture the entire profit increase due to the merger.

g) Assume now that there are some fixed costs of operating, such that per-firm profits are $\Pi(n) = pq_i - e$, and that $e = 1/20$. Assume that there is free entry. How many firms will find it profitable to enter in a free-entry equilibrium?
Answer: As $pq_i = 1/(n+1)^2$, $\Pi(3) = \frac{1}{16} - \frac{1}{20} = \frac{1}{80} > 0$, while $\Pi(4) = \frac{1}{25} - \frac{1}{20} < 0$, so 3 firms will want to enter.

h) Assume that from the free-entry equilibrium, two of the firms consider merging, and that no further entry is possible after the merger. Would that merger be profitable? Explain!
Answer: $\Pi(2) = \frac{1}{9} - \frac{1}{20} = \frac{11}{180} > 2 * \Pi(3) = \frac{1}{40}$. Now a merger also entails some synergies, because they can get rid of the fixed costs for one of the two firms. So in addition to the slightly lower profits from production (1/9<1/8), they can also save 1/20 in fixed costs. As the savings in fixed costs exceeds the lost production profits, the merger is profitable.

i) If we instead assume that new firms are allowed to enter the market following the merger, under the same assumptions as in the free-entry equilibrium, would any potential entrant find such entry profitable? Explain why considering entry barriers is important when consider the competitive effects of the merger.
Answer: We already know that the free-entry equilibrium has 3 firms, so one additional firm would find it profitable to enter. The anti-competitive effects of the merger would therefore be undone by entry. The same thing applies in the real world: If a merger weakens the competition, additional entry could become

profitable. It is therefore more important to have strict merger control in markets with higher entry barriers.
Here the students might start to discuss how soon entry can take place. If so, that's great!