Model solutions to the exam on 2019-12-13.

Multiple choice: 1b, 2c, 3a, 4f, 5b, 6c, 7b, 9c, 9b.

I (a) **Mixed bundling** is a pricing strategy where multiple goods that could be consumed separately are sold as a bundle and at least some of the goods can also be bought separately. The bundle must be cheaper than buying all goods separately.

(b) **Empty threat** is a threat that is not in the threatener's interest to carry out once the time comes to carry it out.

(c) **Pigouvian tax** is a tax on an action that causes a negative externality, such as polluting. After taking into account the Pigouvian tax decision-makers have the incentive to choose the action that is best for total welfare. For example, for firms to choose the right amount of investment in pollution-reduction.

(d) If workers fear that high performance would lead to decreases in future bonuses for high performance then the incentive pay system is suffering from a **ratchet effect**. This may cause workers to hold back on "too much" effort in order to protect the generosity of the pay system.

II There are two forces that should be a concern for the consortium. First, the subscription service is less attractive to customers who spend less than the average, and more attractive to those who expect to spend more. Second, those who pay the yearly fee face a zero price for additional services and are thus likely to use more services than they did when they had to pay for each service. This moral hazard together with adversely selected customers means that the actual cost of providing services to subscribers will exceed the previous average cost. The increase in costs could be more than the savings in administrative costs, and the consortium could even make a loss under a subscription system.

III (a) First write down the profit function for firm A:

$$\begin{aligned}\pi_A(p_A, p_B) &= Q^d(p_A, p_B) \cdot p_A - \text{VC} - \text{FC} \\ &= Q^d(p_A, p_B) \cdot (p_A - \text{MC}) - \text{FC} \\ &= (100 - 2p_A + p_B) \cdot (p_A - 10) - 1500 \\ &= 120p_A - 2p_A^2 + p_B p_A - 1000 - 10p_B - 2500\end{aligned}$$

To find the best response price for firm A use the first-order-condition:

$$\begin{aligned}\frac{\partial \pi_A(p_A, p_B)}{\partial p_A} &= 120 - 4p_A + p_B = 0 \Longrightarrow \\ \text{BR}_A(p_B) &= 30 + \frac{p_B}{4}\end{aligned}$$

This is the optimal price for firm A as a function of firm B's price. Firms are symmetric so $\text{BR}_B(p_A) = 30 + p_A/4$. In Nash equilibrium both firms i={A,B} use their best response simultaneously and charge the same price, so $p = \text{BR}_i(p)$.

$$\begin{aligned}p &= 30 + \frac{p}{4} \Longrightarrow \frac{3}{4}p = 30 \Longrightarrow \\ p^* &= 40\end{aligned}$$

At Nash equilibrium prices both firms sell

$$q^* = Q^d(40, 40) = 100 - 2 \cdot 40 - 40 = 60$$

units and earn profits

$$\pi^* = (p^* - \text{MC})q^* - \text{FC} = (40 - 10) \cdot 60 - 1500 = 300$$

(b) For one firm the the value of acquiring the other is the difference in profits that it could make when in control of both varieties over its profits when the firms stay separate. A single company would be able to coordinate the prices of the two varieties. Due to symmetry, it would be optimal to set the same price p for both varieties. The profit function of a unified company is

$$\begin{aligned}\pi(p) &= 2(p - \text{MC})Q^d(p, p) - 2 \cdot \text{FC} \\ &= 2(p - 10)(100 - p) - 3000 \\ &= -2p^2 + 220p - 5000\end{aligned}$$

Profit-maximizing price can be solved from the first-order condition:

$$-4p + 220 = 0 \Longrightarrow p^m = 55$$

At this price both varieties sell $q^m = 45$ units and profits are

$$\pi^m = \pi(55) = 2 \cdot (55 - 10) - 3000 = 1050$$

We know from part IIIa that under competition both firms earn profits of 300, so acquiring the other firm would be worth $1050 - 300 = 750$ to the acquirer.

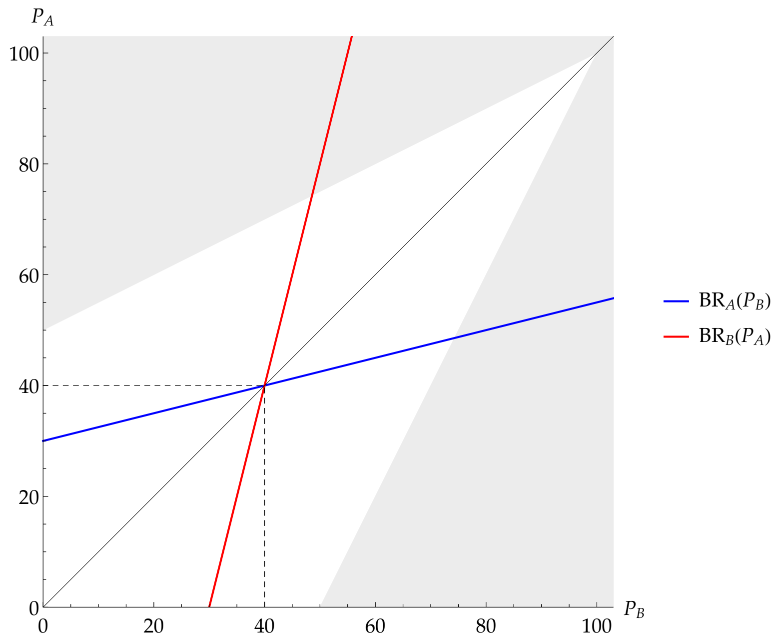

Figure 1: Best response functions in question IIIa. Nash equilibrium is found in their intersection where, due to symmetry, they also intersect with the 45-degree line.

(c) Under price competition the firm that gets to set its price last has an advantage, as it can undercut the other firm. Here the products are imperfect substitutes, so this advantage is not as extreme as under Bertrand competition. Yet if Firm A has to set its price first then B will end up with a lower price and higher profits than A.

When A sets its price first it knows that B will then use its best response. Recalling the best response from IIIa, the profit function of firm A is now:

$$\begin{aligned}
\pi_A(p_A, \mathrm{BR}_B(p_A)) &= (p_A - \mathrm{MC})Q^d(p_A, \mathrm{BR}_B(p_A)) - \mathrm{FC} \\
&= (p_A - 10)\left(100 - 2p_A + \left(30 + \frac{p_A}{4}\right)\right) - 1500 \\
&= (p_A - 10)\left(130 - \frac{7}{4}p_A\right) - 1500 \\
&= -\frac{7}{4}p_A^2 + \frac{295}{2}p_A - 2800
\end{aligned}$$

The price that the first-moving A sets can be solved from its first-order-condition:

$$\pi_A'(p_A) = -3.5p_A + 147.5 = 0 \Longrightarrow p_A \approx 42.14$$

Firm B follows by using its best response $p_B = \mathrm{BR}_B(p_A) = 30 + 42.14/4 \approx 40.54$.

Resulting profits can be obtained by plugging these prices back to the profit function in part IIIa, $\pi_A(42.14, 40.54) \approx 308$ and $\pi_B(40.54, 42.14) \approx 365$. While the last-moving firm benefits more, both firms set higher prices and earn higher profits than under simultaneous price competition.

IV (a) Start by collecting the valuations of the High type (150 €/GB) and the Low type (100 €/GB) into a table:

€	2GB	4GB	Difference
High	300	600	300
Low	200	400	200
Cost	80	160	

Under a versioning strategy the low type will be targeted with the 2GB version and the high type with a 4GB version. The 2GB version is priced at €200, the reservation price of the low type. For the strategy to work the 4GB version should be priced €300 higher than the 2GB version as that is the reservation price of the high types for the quality difference. Thus the 4GB version is priced at €500. Taking into account the costs, the maximized profits from a two-version strategy are

$$200 + 500 - 80 - 160 = 700 - 240 = 460$$

Alternatively, the company can opt to sell only one version. In any a single-version strategy the firm could either set the price at the valuation of the low type and sell to both or at the valuation of the high type and only sell to high types. The resulting profits would be

$$\begin{aligned} \text{4GB priced low: } & 2 \cdot (400 - 160) = 480 \\ \text{4GB priced high: } & 600 - 160 = 440 \\ \text{2GB priced low: } & 2 \cdot (200 - 80) = 240 \\ \text{2GB priced high: } & 300 - 80 = 220 \end{aligned}$$

Highest possible profits, €480 per every two customers, are achieved by selling only the 4GB version and pricing it at €400.

(b) With a fixed cost per unit, the profits from strategies where both customer types buy are reduced more than the profits from strategies where only the high types buy. Customer valuations are not affected so the prices in each possible pricing strategy are unchanged.

The best "both types buy" strategy must still be "4GB priced low", but now profits are reduced to $440 - 2 \cdot 60 = 320$ euros. The best "only high types buy" strategy must still be "4GB priced high", but profits are reduced to $440 - 60 = 380$ euros, which is now the highest achievable profits. So the optimal strategy is now to sell the 4GB version at €600, at which only high-value types buy.