(1a) [5 points] See textbook, introduction to Section 8.2 (and/or class discussion).

(1b) [10 points] Patents are awarded for (1) Products, (2) Processes, (3) Designs, and (4) Plants. To be eligible for a patent, an innovation must be (1) Novel, (2) Useful, and (3) Nonobvious. See textbook, Section 9.7 (and/or class discussion).

(2) [5 points] Under the observed prices, the ORANGADA company's profit is

$$\pi_O(60, 60, 60) = (60 - 20)q_O = (60 - 20)(90 - 2 \cdot 60 + 40 + 40) = 2000.$$

Similarly,

$$\pi_G(60, 60, 60) = (40 - 20)q_G = (40 - 20)(100 - 2 \cdot 40 + 60 + 40) = 2400,$$

and

$$\pi_O(60, 60, 60) = (40 - 20)q_T = (40 - 20)(120 - 2 \cdot 40 + 60 + 40) = 2800.$$

We first check whether the market for orange juice alone is the relevant market for the ORANGADA company by raising p_O by 5% from $p_O = 60$ to $p'_O = 63$. Then,

$$\pi_O(63, 60, 60) = (63 - 20)q_O = (63 - 20)(90 - 2 \cdot 63 + 40 + 40) = 1892 < 2000.$$

Thus, the market for orange juice alone should *not* be considered as the relevant market for ORANGADA.

Next, we ask whether the combined market for orange and grape juice should be considered as the relevant market? Setting again $p'_O = 63$ makes the combined profit in both markets is

$$\pi_O(63, 60, 60) + \pi_G(63, 60, 60) = 1892 + (40 - 20)(100 - 2 \cdot 40 + 63 + 40) = 4352 < 2000 + 2400.$$

Thus, the combined market for orange and grape juice should *not* be considered as the relevant market for ORANGADA.

Next, should the markets for the three juices combined be considered as the relevant market?

$$\pi_O(63, 60, 60) + \pi_G(63, 60, 60) + \pi_T(63, 60, 60) = 4352 + (40 - 20)(120 - 2 \cdot 40 + 63 + 40) = 7212$$
$$> 7200 = \pi_O(60, 60, 60) + \pi_G(60, 60, 60) + \pi_T(60, 60, 60).$$

Yes, the relevant market for ORANGADA is the market for the three juices combined.

(3a) [10 points] The firm chooses a uniform price p to solve

$$\max_p \Pi = \pi_O + \pi_G = pq_O + pq_G = p(24 - 2p + p) + p(12 - 2p + p).$$

The first- and second order conditions for maximum profit are

$$0 = \frac{d\Pi}{dp} = 36 - 4p \quad \text{and} \quad \frac{d^2\Pi}{dp^2} = -4 < 0.$$

Hence, $p = 36/4 = 9$. Hence, the quantities sold are $q_O = 15$ and $q_G = 3$. Hence, $\Pi = 9(15+3) = 162$.

(3b) [10 points] The firm chooses the prices p_O and p_G to solve

$$\max_{p_O, p_G} \pi_O + \pi_G = p_O q_O + p_G q_G = p_O(24 - 2p_O + p_G) + p_G(12 - p_G + p_O).$$

The first-order conditions for a maximum are

$$0 = \frac{\partial \Pi}{\partial p_O} = 24 - 4p_O + 2p_G \quad \text{and} \quad 0 = \frac{\partial \Pi}{\partial p_G} = 12 - 4p_G + 2p_O,$$

yielding $p_O = 10$, $p_G = 8$. Hence, the quantities sold are $q_O = 12$ and $q_G = 6$. Hence, $\Pi = 168 > 162$. Clearly JUICIANA earns no less profit when it sets different prices for orange and grape juice compared with uniform pricing. Note that JUICIANA can still set $p_O = p_G$, so the fact that it chooses $p_O \neq p_G$ implies that nonuniform pricing yields a higher profit.

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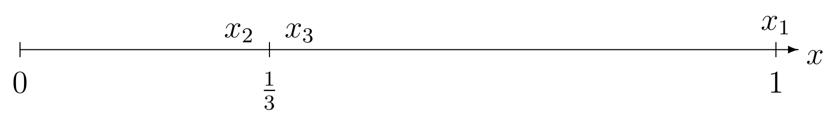
(4) [10 points] To construct firm 3's best response function, we search for a threshold $\tilde{x}_2$ under which firm 3 is indifferent between locating at $\tilde{x}_2 + \epsilon$ and $\tilde{x}_2 - \epsilon$. If firm 3 locates to the "left" of firm 2 it earns $\pi_3^L = \tilde{x}_2 - 0 = \tilde{x}_2$. If firm 3 locates to the "right" of firm 2, it equally splits the profit with firm 1, hence earns $\pi_3^R = (1 - \tilde{x}_2)/2$. Hence, $\tilde{x}_2$ must satisfy

$$\tilde{x}_2 = \frac{1 - \tilde{x}_2}{2} \quad \Longrightarrow \tilde{x}_2 = \frac{1}{3}.$$

Hence, the best-response function of restaurant 3 is

$$x_3 = BR_3(x_2) = \begin{cases} x_2 - \epsilon & \text{if } x_2 > 1/3 \\ x_2 + \epsilon & \text{if } x_2 \leq 1/3 \end{cases}$$

Therefore, $x_2 = 1/3 - \epsilon$, $x_3 = 1/3 + \epsilon$ so $\pi_1 = \pi_2 = \pi_3 = 1/3$.



Therefore, $x_2 = 1/3 - \epsilon$, $x_3 = 1/3 + \epsilon$ so $\pi_1 = \pi_2 = \pi_3 = 1/3$.

Remark: Note that the equilibrium location of firm 3 is not unique in the sense that it is indifferent between locating at any point $x_2 < x_3 < 1$. Therefore,

$$x_3 = BR_3(x_2) = \begin{cases} x_2 - \epsilon & \text{if } x_2 > 1/3 \\ (x_2, 1) & \text{if } x_2 \leq 1/3 \end{cases}$$

Hence, the following locations also constitute an equilibrium: $x_2 = 1/3$, $x_3 = 2/3$ yielding the equilibrium payoffs

$$\pi_1 = \frac{1}{6}, \quad \pi_2 = \frac{1}{3} + \frac{1}{6}, \quad \text{and} \quad \pi_3 = \frac{1}{3}.$$

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(5) [10 points] We show that this innovation should be classified as major/drastic if $c_0 > 140$, and minor if $c_0 < 140$. If the innovator (firm A) can exercise full monopoly power, it solves

$$MR = 240 - 4Q = c_1 = 40 \quad \Longrightarrow Q = 50 \quad \Longrightarrow p^m(c_1 = 40) = 140.$$

However, if $c_0 < 140$, firm A won't be able to charge the monopoly price $p^m = 140$ as it will be undercut by firm B that can still make a profit by setting $c_0 < p_B < 140$, which is the case of minor (nondrastic) innovation.

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(6) [10 points] See Figure 8.11 on p.208 in the textbook. In a contestable market equilibrium, the incumbent firm sets the highest price subject to the constraint that no other firm can undercut its price while making positive profits.

The above definition means that the incumbent's price cannot exceed average cost $p^I \le AC(Q)$, as otherwise, a potential entrant would be able to undercut the incumbent by setting $AC(Q) < p^E < p^I$ while still making a strictly positive profit. Therefore,

$$p = 22 - \frac{Q}{2} = AC(Q) = \frac{40 + 10Q}{Q} \quad \Longrightarrow Q = 20 \quad \Longrightarrow p = 12.$$

(7a) [5 points] In the second stage, the dealer takes d as given and chooses output level Q to solve

$$\max_p \pi^d = (p - d)Q - \phi = [(36 - Q) - d]Q \quad \Longrightarrow 0 = \frac{\mathrm{d}\pi^d}{\mathrm{d}Q} = 36 - 2Q - d \quad \Longrightarrow Q = \frac{36 - d}{2}.$$

Therefore,

$$p = \frac{36 + d}{2} \quad \text{and} \quad \pi^d = \frac{(36 - d)^2}{4} - \phi.$$

Note that $\phi = 0$ for this part of the problem.

(7b) [10 points] In the first stage, the manufacturer selects a dealer price d to solve

$$\max_d \pi^m = (d - 20)Q = (d - 20)\left(\frac{36 - d}{2}\right) \quad \Longrightarrow 0 = \frac{\mathrm{d}\pi^m}{\mathrm{d}d} = \frac{56 - 2d}{2} \quad \Longrightarrow d = 28.$$

Hence,

$$Q = \frac{36 - d}{2} = 4, \quad p = \frac{36 + d}{2} = 32,$$
$$\pi^d = \frac{(36 - d)^2}{4} - \phi = 16 - \phi, \quad \text{and} \quad \pi^m = (d - 20)\left(\frac{36 - d}{2}\right) = 32 + \phi.$$

(7c) [5 points] Consider the following contract between the manufacturer and the dealer: $d = c = 20$ and $\phi = 40$. Then,

$$\pi^d = \frac{(36 - 20)^2}{4} - 40 = 24 > 16 \quad \text{and} \quad \pi^m = 40 > 32.$$

THE END

