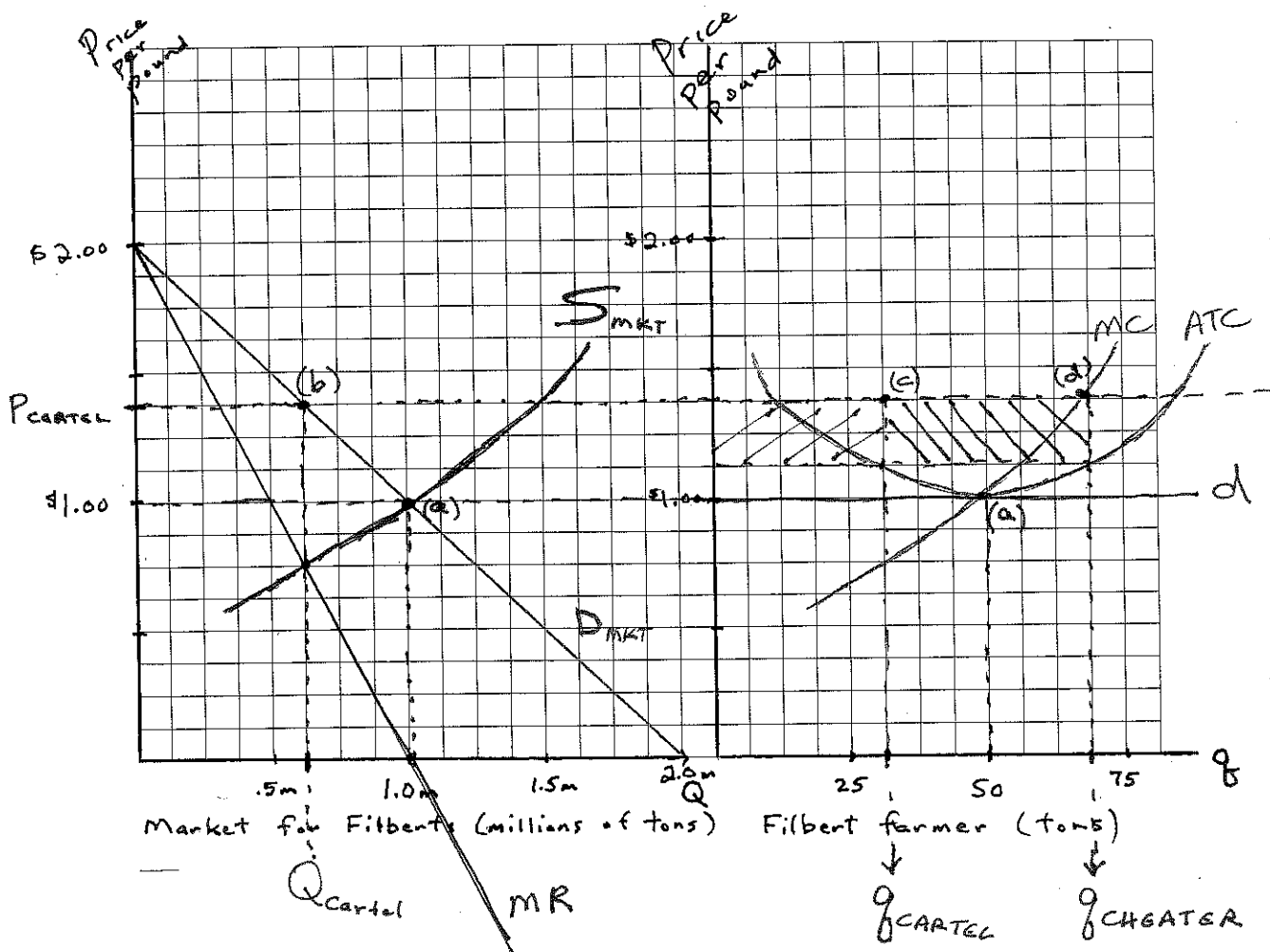


100 points total. Answer each question in the space provided.

1. (25 pts.) Filberts or Hazelnuts are a type of nut that is grown in the Mediterranean region, including Greece, as well as Oregon in the U.S. They are typically grown on small and medium-sized farms, and are consumed all over the world. A typical grower produces 50 tons per year. Last year approximately 1 million tons were produced, and the market price was roughly \$1.00 per pound. Assume that the industry was in long-run equilibrium at that price and output.

- a) Market demand for filberts and the cost curves for a typical farmer are shown in the diagram below. Illustrate the situation described above, and label the outcomes for the market and for the firm with (a). Briefly explain. *Market supply and demand intersect at $P = \$1.00$ and $Q = 1.0m$. Farmers earn zero economic profit at that price.*

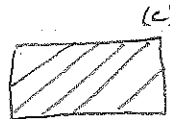


- b) Suppose that the filbert growers ask your consulting firm to put together a proposal for all of them to consider at the annual filbert growers' association meeting. They have seen the success of other international cartels, and know that if they can collectively reduce industry output, the price of filberts will rise above that illustrated in your diagram above. They want you to determine what they should target for market output and price in order to maximize industry profits. Illustrate your analysis in the market diagram above and label (b). Briefly explain your reasoning below.

A profit-maximizing cartel would want to produce the same output and set the same price as a monopoly would. The profit-maximizing output occurs where $MR=MC$, and price is set accordingly on the market demand curve. This price and output combination is labeled (b) in the diagram.

- c) Some of the filbert growers are reluctant to cut their individual outputs in order to achieve the desired reduction in market output. Explain to them why they would benefit from a successful cartel. Use the firm diagram to illustrate your answer, and label it (c).

If each filbert grower cuts his/her output and produces the indicated amount (c), then market output will fall and market price will rise to the monopoly level. Price will exceed ATC for each cartel member, and each one will earn profits equal to the shaded area:



- d) One of the filbert growers sitting in the audience is having the following thought: "This is great. Everyone else seems to be on board with this cartel. But it will be very difficult for anyone to monitor how many filberts I produce and sell." How many filberts will this "cheater" want to produce, and what will her profits be? Illustrate in your diagram and label (d). Briefly explain.

A farmer who cheats on the cartel quota while everyone else adheres to the cartel agreement can increase her own profits by expanding output to the level (d) where the cartel price intersects her marginal cost curve. The cheater's profits are equal to the expanded shaded area:



- e) Knowing what you do about the stability of cartels that lack strong enforcement mechanisms, what do you think will occur in the minds of other filbert growers as time passes? What is the long-run expected market output and price of filberts? How many filberts will each farmer produce and sell? Briefly explain, referring to your diagram.

Every other filbert grower will have the same incentive to cheat. As cheating occurs, market output increases and market price will decline. If these farmers are not able to enforce the cartel agreement, their cartel will be unstable and market price and output will tend to return to the original long-run equilibrium in part (a), where each one earns zero economic profit.

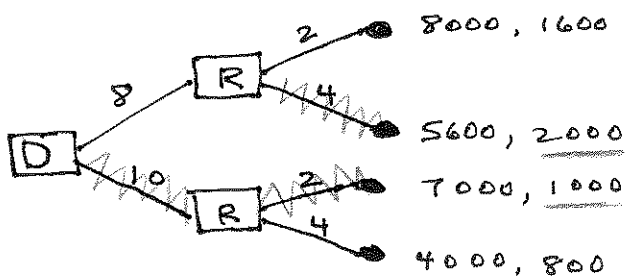
2. (10 pts.) Suppose that the diamond industry consists of only two producers, Russia and DeBeers. Russia has two possible strategies: produce either 2 million or 4 million carats per year, and DeBeers has two possible strategies: produce either 8 million or 10 million carats per year. Depending on the strategies chosen by Russia and DeBeers, total output in the world market will be 10, 12, or 14 million carats, resulting in a world price of diamonds that is \$1200, \$900, or \$600 per carat, respectively, depending on the combined output of Russia and DeBeers. Production costs are \$400 per carat for Russia and \$200 per carat for DeBeers. Determine the profit payoffs of Russia and DeBeers for each combination of possible strategies, and then illustrate these payoffs in a 2x2 matrix. What do you predict will be the outcome of this game?

• if $Q_D = 8$ and $Q_R = 2$
then $Q = 10$ and $P = \$1200$
$\Pi_D = (1200 - 200)8 = 8000$
$\Pi_R = (1200 - 400)2 = 1600$
• if $Q_D = 8$ and $Q_R = 4$
then $Q = 12$ and $P = \$900$
$\Pi_D = (900 - 200)8 = 5600$
$\Pi_R = (900 - 400)4 = 2000$
• if $Q_D = 10$ and $Q_R = 2$
then $Q = 12$ and $P = \$900$
$\Pi_D = (900 - 200)10 = 7000$
$\Pi_R = (900 - 400)2 = 1000$
• if $Q_D = 10$ and $Q_R = 4$
then $Q = 14$ and $P = \$600$
$\Pi_D = (600 - 200)10 = 4000$
$\Pi_R = (600 - 400)4 = 800$

	Russia	
	$Q_R = 2$	$Q_R = 4$
$Q_D = 8$	8000, 1600	5600, 2000
$Q_D = 10$	7000, 1000	4000, 800

DeBeers has a dominant strategy of producing $Q_D = 8$ m. Knowing that, Russia will produce $Q_R = 4$ m as its best response. The strategy pair $Q_D = 8$ and $Q_R = 4$ is a Nash equilibrium.

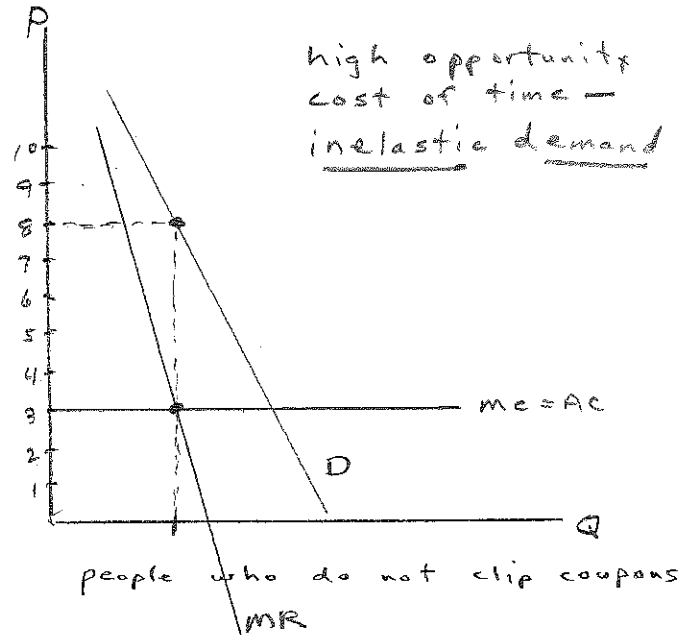
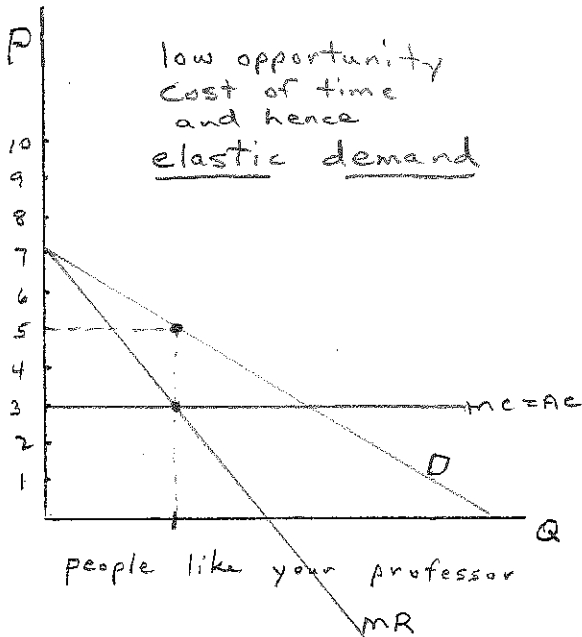
3. (10 pts.) In the above game between Russia and DeBeers, suppose DeBeers is able to commit to an output choice first, leaving Russia to choose its output given the strategy chosen by DeBeers. Should DeBeers choose to play a sequential move game instead of a simultaneous move game if it has that option? Explain your answer with a game tree.



If DeBeers is able to commit to an output of $Q_D = 10$ m first, then Russia will choose to produce $Q_R = 2$ m.

DeBeers will earn profits of $\Pi_D = 7000$, which is better than the 5600 payoff it receives when both choose their outputs simultaneously.

4. (15 pts.) Your professor is able to purchase his favorite skin moisturizer, Curel Hydra Therapy Wet, for \$5. Other customers who do not spend their Sunday afternoons leisurely reading the Lexington Herald-Leader find themselves paying \$8 for the same product.
- a) Can you explain what is going on here, using words and diagrams? Assume that the manufacturer's marginal costs of production and distribution are constant at approximately \$3 per bottle.



Forcing people to undertake a time-intensive activity like clipping coupons sorts them into low willingness-to-pay and high willingness-to-pay market segments.

- b) Who has the more elastic demand for Curel Hydra Therapy Wet, your professor or the other customers who didn't clip the coupon? Assuming that the manufacturer is maximizing profits, calculate the elasticity of demand for each group, using the inverse elasticity pricing rule. Show your work.

$$\frac{P - mc}{P} = \frac{1}{\epsilon}$$

coupon clippers:

$$\frac{5 - 3}{5} = \frac{1}{\epsilon}$$

$$\frac{2}{5} = \frac{1}{\epsilon}, \epsilon = 2.5$$

others:

$$\frac{8 - 3}{8} = \frac{1}{\epsilon}$$

$$\frac{5}{8} = \frac{1}{\epsilon}, \epsilon = 1.6$$

- c) What kind of price discrimination is this?

Third-degree: market segmentation

MANUFACTURER'S COUPON | EXPIRES 12/31/16

SAVE \$3.00 ON ANY ONE (1) Curel® HYDRA THERAPY WET SKIN MOISTURIZER, 8 oz or 12 oz. (Offer excludes trial and travel sizes)

Curel

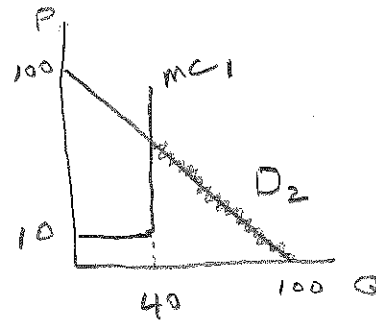
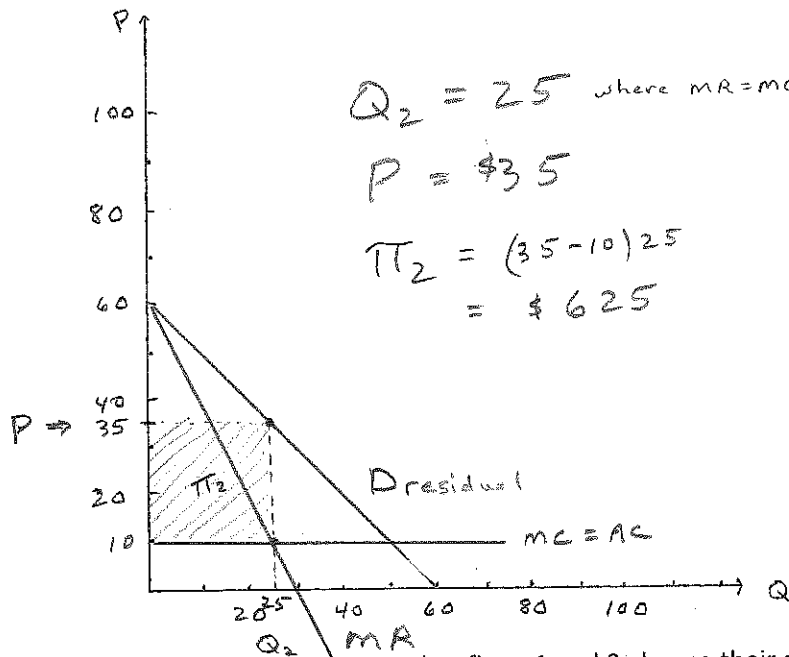
PHARMACEUTICAL TECHNOLOGIES

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5. (15 pts.) Suppose a market with two firms producing a homogeneous product. Market demand is given by $Q=100-P$, where Q is market output (the sum of firm 1 and firm 2's outputs) and P is market price. Suppose also that firm 1 has irreversibly committed to a capacity of $Q_1=40$. Up to capacity, firm 1's marginal costs are constant at $MC=10$. MC becomes infinite once capacity is reached.

a) What does firm 2's residual demand curve look like? What output should it produce in order to maximize its profits, given that $Q_1=40$? Illustrate in the diagram below. What will market price be? What profits will each firm earn?



$$Q_1 = 40$$

$$\pi_1 = (35 - 10)40 = \$1000$$

b) Now suppose that firms 1 and 2 choose their capacities/outputs simultaneously. Explain what the Cournot-Nash equilibrium in this market will be. (Hint: What is firm 2's best response if $Q_1=0$? If $Q_1=40$? If $Q_1=90$?) Graph these best response/reaction functions for firms 1 and 2.

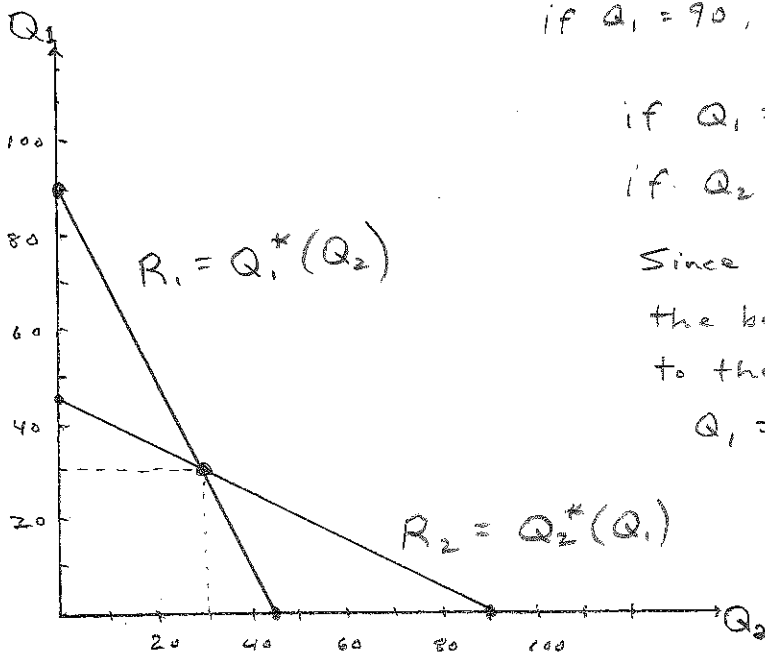
$$\text{if } Q_1 = 0, \text{ then } Q_2^* = 45$$

$$\text{if } Q_1 = 90, \text{ then } Q_2^* = 0$$

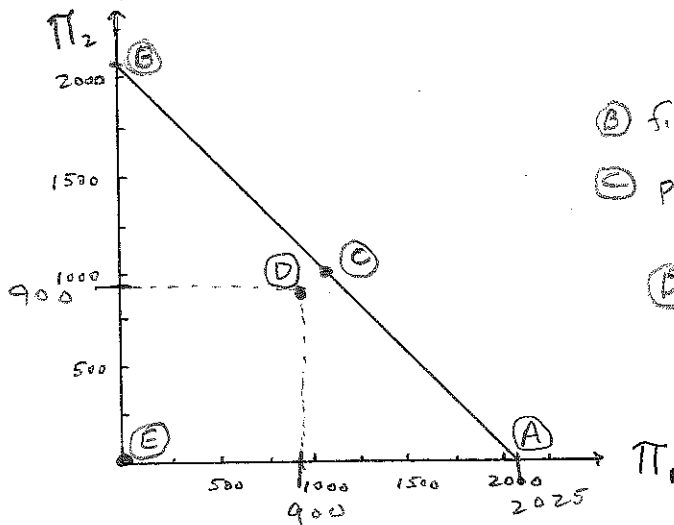
$$\text{if } Q_1 = 30, \text{ then } Q_2^* = 30$$

$$\text{if } Q_2 = 30, \text{ then } Q_1^* = 30$$

Since each firm's output is the best response it can make to the other firm's output when $Q_1 = Q_2 = 30$, this output pair is a Nash equilibrium.



6. (5 pts.) Graph the profit-possibilities frontier for the market described in the previous question in the diagram below. Carefully label the points corresponding to firm 1 monopoly, firm 2 monopoly, perfect colluding duopolists, Cournot-Nash duopolists, and Bertrand duopolists.



- (A) firm 1 monopoly: $\pi_1 = 2025, \pi_2 = 0$
 (B) firm 2 monopoly: $\pi_1 = 0, \pi_2 = 2025$
 (C) perfectly colluding duopolists:
 $\pi_1 = 1012.5, \pi_2 = 1012.5$
 (D) Cournot: $\pi_1 = (40-10)30 = 900$
 $\pi_2 = 900$
 (E) Bertrand: $\pi_1 = 0, \pi_2 = 0$

7. (5 pts.) Briefly describe the market for pizzas in West Liberty, KY and the nature of the "war" that broke out.

The only two pizza restaurants in West Liberty, KY were able to sell medium one-topping pizzas for around \$9, without other competitors undercutting their prices. Then pizza peddlers from Morehead and Jackson 35 miles away started selling pizzas in downtown West Liberty out the back of their trucks for roughly half that price. This hit-and-run entry started a price war that benefitted pizza lovers but severely cut into the profits of the incumbent duopoly restaurants.

8. (5 pts.) Briefly explain the antagonists and the nature of the interaction in the WSJ article "Haven't Shareholders Had Enough Chicken?"

Boeing long dominated the market for jumbo jets, with its 747 model. Airbus started developing a super-jumbo jet in the 1990's that would make the 747 obsolete. All observers agreed that the market for such a jet was not big enough to support two suppliers. Boeing had to decide whether to go ahead with its own super-jumbo project, given the significant head start that Airbus had. Boeing threatened to play this game of "chicken" for several years. When they cancelled their 747-X plans, investors breathed a sigh of relief and Boeing's stock price rose significantly.

9. (10 pts.) Your sister is the mayor of Napflio, Greece. She awards you the monopoly franchise rights to provide cable TV services to citizens of Napflio. As such, you are the only provider and as long as you have no competition, the discounted present value of your economic profit stream is 20,000,000€. Trouble looms on the horizon, however, because a satellite TV company is considering entering your market. Your monopoly franchise rights only apply to hard-wired cable TV, and do not apply to satellite signals and rooftop satellite dishes. If entry occurs and you share the market with a competitor, your discounted present value of economic profits will fall to 9,000,000€. If you contest entry and fight a price "war," the discounted present value of economic profits is -2,000,000€.

You announce publicly that if entry occurs, you will fight. In preparation to fight a price war, you add capacity to your system which enables you to offer additional channels that your competitor could not. The cost of adding such capacity in preparation to fight for customers is 10,000,000€. Only if entry occurs would you find it necessary to utilize this capacity. (a) Is your threat to fight a price war credible? Why or why not? (b) Is the decision to make such a commitment to deter entry a good one? Explain why or why not. You should draw the decision tree for this sequential-move game and refer to it in your explanation.

I = incumbent monopolist

E = potential entrant

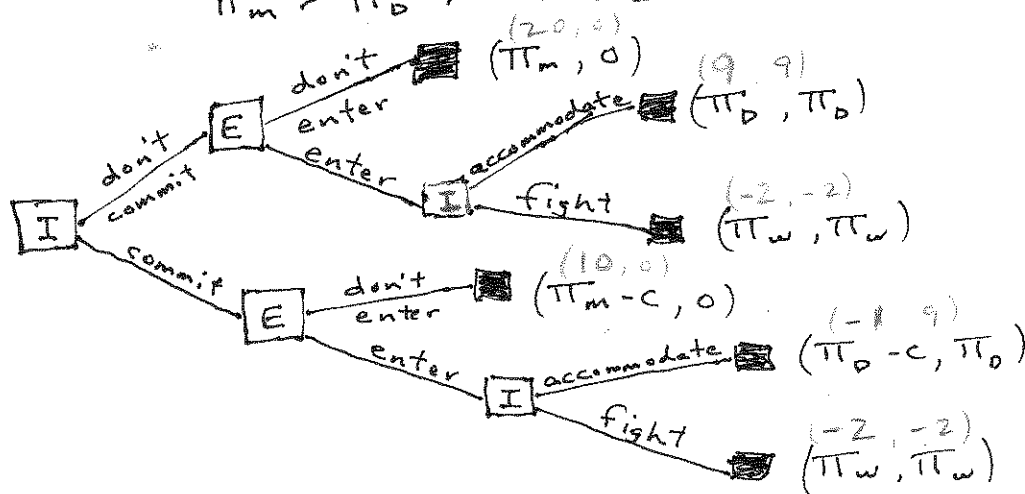
π_m = monopoly profits = 20

π_D = duopoly (shared) profits = 9

π_w = price war losses = -2

C = cost of adding capacity to fight a price war = 10

$$\pi_m > \pi_D > 0 > \pi_w$$



(a) Since $\pi_w < \pi_D - C$, your threat to fight a price war is not credible: $(-2 < -1, \text{so accommodate rather than fight!})$

(b) Monopoly profits if entry is deterred, $\pi_m - C$, exceed duopoly profits if no commitment is made, π_D : $(10 > 9)$. However, since the threat to fight a price war if entry occurs is not credible, you should not commit and add capacity to deter entry.