ECN 460/560, Spring 2004
Prof. Bruce Blonigen

NAME: ANSWER KEY
SS#: ____________

FINAL – Version A

Friday, June 11, 2004

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1) In the theory of the firm, the "short-run" is defined as that period of time when at least one factor of production is fixed.

2) When a firm expands its plant size and average costs remain constant, this is known as: Constant returns to Scale.

3) Collusion is easier to maintain in a repeated game between firms when the discount factor is higher (higher or lower).

4) Pricing low enough to drive out a current rival is predatory pricing.

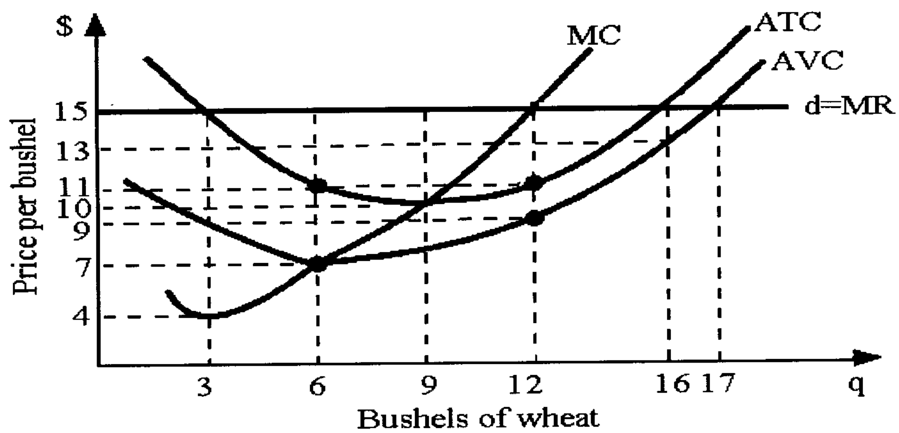


Figure 9.1
This represents the cost and demand conditions facing a wheat farmer

5) Refer to Figure 9.1. For this farmer to maximize profits, he should produce 12 bushels of wheat.

6) Refer to Figure 9.1. At what level of quantity does diminishing marginal returns begin? 3

7) Refer to Figure 9.1. What are average fixed costs (AFC) at a quantity of 6? $4

8) Refer to Figure 9.1. At a quantity of 16, will the wheat farmer make an economic loss, break even, or make an economic profit? Break Even

9) Refer to Figure 9.1. The farmer will shutdown his operations in the short-run if price falls below $7

ECN 460/560 - Prof. Blonigen **NAME:** ____________________

BERTRAND OLIGOPOLY WITH DIFFERENTIATED PRODUCTS. Use the following information to answer questions 10-13 (8 points per question): Pete's Pitas and Filly's Falafel are competing in prices and have differentiated products. Pete's residual demand function is: $Q_P = 10 - P_P + 0.5P_F$, where Q_P is Pete's residual quantity demanded, P_P is the price Pete chooses, and P_F is the price chosen by Filly.

10) For simplicity, assume that Pete does <u>not</u> have any costs (total costs (TC) are zero). Set up Pete's profit maximization problem and show that his best response (i.e., reaction) function is: $\mathbf{P_P = 5 + 0.25P_F}$. Show your work to receive credit.

$$\max_{P_P} \Pi_P = P_P \cdot Q_P - \overset{0}{TC}$$

$$= P_P \cdot (10 - P_P + \tfrac{1}{2} P_F)$$

$$= 10P_P - P_P^2 + \tfrac{1}{2} P_P P_F$$

F.O.C. $$\frac{\partial \Pi_P}{\partial P_P} = 10 - 2P_P + \frac{1}{2} P_F \overset{set}{=} 0 \iff 2P_P = 10 + \frac{1}{2} P_F$$

$$\boxed{P_P = 5 + 0.25 P_F}$$

11) Suppose that Filly's best response function is: $\mathbf{P_F = 8 + 0.5P_P}$. Solve for the Bertrand Nash equilibrium prices - show your work to receive credit.

Sub Pete's reaction function into Filly's

$$P_F = 8 + \frac{1}{2}\left[5 + \frac{1}{4} P_F\right]$$

$$P_F = 8 + 2.5 + \frac{1}{8} P_F$$

$$\frac{7}{8} P_F = 10.5$$

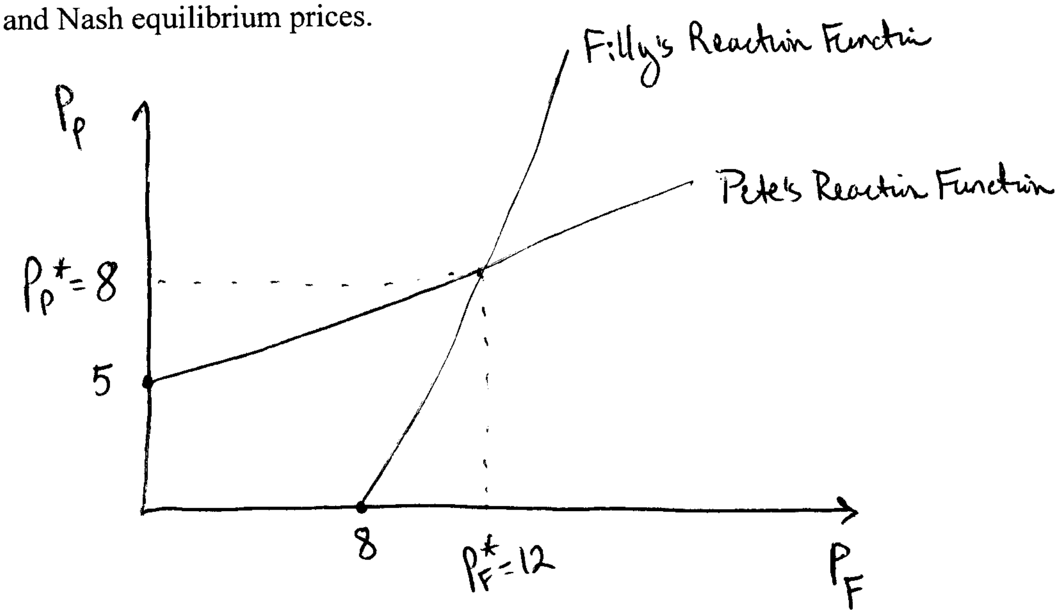
$$P_F^* = \frac{8}{7} \cdot 10.5 = 12$$

Next
Sub $P_F^* = 12$ into Pete's Reaction function

$$P_P = 5 + \tfrac{1}{2}(12)$$

$$P_P^* = 8$$

12) On the axis below, graph the two firms' reaction functions. Label the reaction functions, intercepts, and Nash equilibrium prices.



ECN 460/560 - Prof. Blonigen **NAME:** ______________________________

13) Refer to problem on previous page. Suppose the two firms play a Stackelberg game where Pete picks price first (knowing Filly's best response function) and then Filly chooses his price. Solve for Pete's and Filly's optimal prices in this Stackelberg game.

Petes Problem: $\max_{P_P} \Pi_P = P_P(10 - P_P + \frac{1}{2}P_F)$ given $P_F = 8 + \frac{1}{2}P_P$

sub in P_F $= P_P(10 - P_P + \frac{1}{2}[8 + \frac{1}{2}P_P])$

$= P_P(10 - P_P + 4 + \frac{1}{4}P_P)$

$= 10P_P - P_P^2 + 4P_P + \frac{1}{4}P_P^2$

FOC $\frac{\partial \Pi_P}{\partial P_P} = 14 - 1.5P_P \overset{set}{=} 0 \Rightarrow P_P^* = 9.33$

$P_F = 8 + \frac{1}{2}(9.33)$

$P_F^* = 12.67$

SHORT CALCULATIONS. Show your work. (5 points for each question)

14) Suppose you have a firm in the Competitive Strategy Game that has capacity of 100 units. Your marginal cost for production up to capacity is \$40. The elasticity of the marginal cost for production beyond capacity is 4. What is the marginal cost of the 120th unit?

$\frac{\%\Delta MC}{\%\Delta Q \text{ above cap}} = 4 \iff \frac{\%\Delta MC}{20\%} = 4 \Rightarrow \%\Delta MC = 80\%$

MC for 120 $= 1.8 \times 40$

$= 72$

15) You are an economist for the U.S. Department of Justice and analyzing a market where there are 15 firms: 1 firm has 20% of the market, 4 firms have 10% of the market <u>each</u>, and 8 firms have 5% of the market <u>each</u>. Calculate the Herfindahl-Hirschmann Index of market concentration.

$HHI = (20)^2 + (10)^2 \cdot 4 + (5)^2 \cdot 8$

$= 400 + 400 + 200 = 1000$

16) A firm with some degree of market power charges a profit-maximizing price of 10 when facing a residual demand curve with a price-elasticity of demand of -2. What is the firm's marginal cost at the profit-maximizing level of output?

Lerner Index $\frac{P - MC}{P} = -\frac{1}{\varepsilon_D}$

$\frac{10 - MC}{10} = \frac{1}{2}$

$\iff 10 - MC = \frac{10}{2} \Rightarrow MC = 5$

17) Your entry fee into a market is \$30,000. Capacity costs are \$90 per unit. Your scrap value is \$60 per unit of capacity in the last period. If you build a 100 unit factory, what are the sunk costs if you produce in the factory through the last period?

Sunk costs $= 30{,}000 + (90 - 60) \cdot 100$

$= 30{,}000 + 3{,}000$

$= 33{,}000$

ECN 460/560 - Prof. Blonigen **NAME:** ____________________________

<u>NASH EQUILIBRIUM AND BIDDING FOR FIRMS. Using the following information to answer questions 18-21. (8 points per question)</u> Each period, a group of firms individually decide whether to locate in either Eugene or Springfield. Both towns have the choice of offering tax breaks to entice firms to locate in their community, though it means less to monies to provide public services. The resulting one-period payoffs to this game are in the following table, which lists the welfare payoff for Eugene first in each cell.

		Springfield	
		Tax Break	No Tax Break
	Tax Break	70 , 50	160 , 5
Eugene	No Tax Break	10 , 80	90 , 70

18) Suppose this game is played for just one period. What is the Nash Equilibrium in terms of actions taken by each town in the equilibrium. What is the common term for this type of equilibrium?

The Nash Equilibrium strategies are for both Eugene and Springfield to offer tax breaks. This is a prisoner's dilemma.

19) Suppose that someone proposes a ban on tax breaks by all towns and cities. Would Eugene and Springfield favor or oppose such a ban? Explain.

Yes, because with a ban, tax breaks are not possible, which eliminates this prisoner's dilemma game and each town receives a higher welfare payoff.

20) Suppose that a ban will take place in 10 years and both players know that this will be the last period. Would this alter their play in the early periods? Why or why not?

No, it would not due to The Chain Store Paradox which implies that the prisoner's dilemma game will obtain each period.

21) Now suppose that Eugene and Springfield will play this game for an unknown number of periods in the future. Suppose that they begin by both choosing to NOT offer tax breaks. Calculate whether Eugene would deviate from this equilibrium if it knows that as soon as it offers tax breaks that Springfield will offer tax breaks for every period after that as well. Assume a per-period discount factor of 0.75.

GAIN from tax break in 1st period

$160 - 90 = 70$

Discounted Loss in subsequent periods

$\frac{\delta}{1-\delta}(90-70)$

$\frac{.75}{.25}(20)$

60

GAIN > DISCOUNTED LOSS $\Longrightarrow$ EUGENE will offer tax breaks.

ECN 460/560 - Prof. Blonigen NAME: ______________________

<u>LIMIT PRICING WHERE THE INCUMBMENT HAS A COST ADVANTAGE. Use the following information to answer questions 22 - 24. (8 points per question)</u> Suppose the inverse market demand curve is P = 200 - Q. An incumbent firm currently producing in the market has the following cost function: $C(q_I) = 50q_I$. (That is, the incumbent firm has constant marginal costs of 50). A potential entrant has the following cost function: $C(q_E) = 60q_E$.

22) Suppose the incumbent serves the market by itself. Set up its profit maximization problem and solve for its optimal quantity and profits.

$$\max_{q_I} \pi_I = (200-q_I)q_I - 50q_I$$
$$= 200q_I - q_I^2 - 50q_I$$

F.O.C.: $\frac{\partial \pi_I}{\partial q_I} = 150 - 2q_I \overset{set}{=} 0$

$q_I^* = 75$ $\Rightarrow$ $P_I^* = 200-75 = 125$

$\pi_I = 125 \cdot 75 - 50 \cdot 75$

$\pi_I = \$5625$

23) What is the limit price in this market (to the penny)? If the ~~incumbent charged~~ the limit price, what would its profits be?

Limit price is a penny below the entrant's marginal cost = 59.99

$\pi_{LP} = 59.99 \cdot Q_{LP} - 50 \cdot Q_{LP}$
$= (59.99 - 50) \cdot Q_{LP}$
$= (9.99) \cdot (140.01)$

$\pi_{LP} = \$1398.70$

$$\boxed{\begin{aligned} &\text{If } P_{LP} = 200 - Q \\ &\Leftrightarrow 59.99 = 200 - Q \\ &\Leftrightarrow Q = 140.01 \end{aligned}}$$

24) What additional information ~~would you need~~ to decide whether the incumbent should choose to limit price or accommodate entry?

What would the incumbent firm's profits be if it chose to accommodate entry?

ECN 460/560 - Prof. Blonigen **NAME:** ____________________

MAXIMIZING PROFITS VERSUS SIZE OF THE FIRM. Use the following information to answer questions 25-27. (7 points per question) Many of your Competitive Strategy Game memos suggested that you were trying to maximize the size of your firm (e.g., market share or revenues), not profits. This is wrong, as we next show.

25) Suppose your firm faces a residual inverse demand curve of P=100-2Q and constant marginal costs of 40 per unit (TC = 40Q). Properly set up the firm's profit maximization problem and solve for the P and Q that maximizes profits.

$$\max_Q \pi = P\cdot Q - TC$$
$$= (100-2Q)Q - 40Q$$
$$= 100Q - 2Q^2 - 40Q$$
$$\text{FOC: } \frac{\partial \pi}{\partial Q} = 100 - 4Q - 40 \overset{\text{set}}{=} 0 \rightarrow Q^*_\pi = 15$$

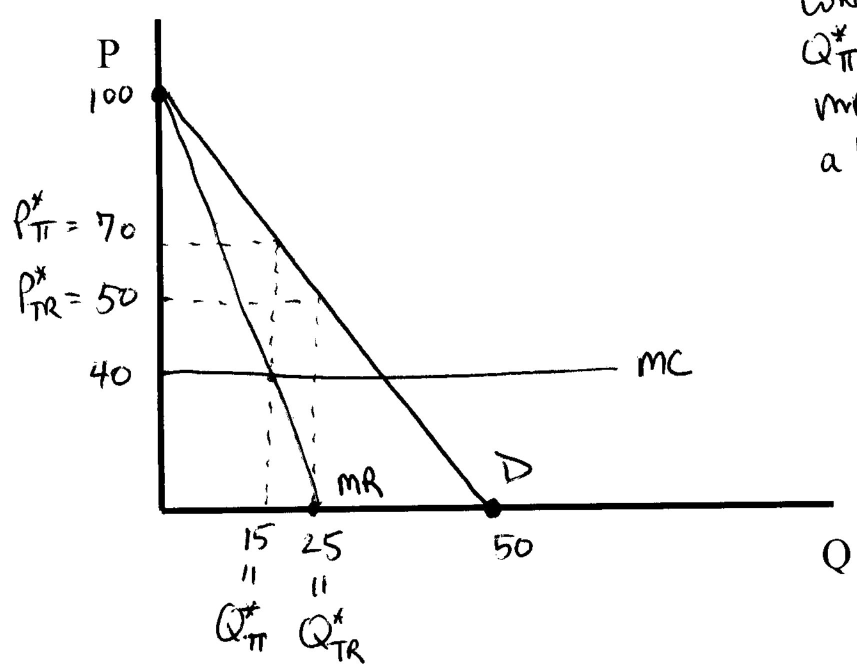
$$P^* = 100-(2\cdot 15)$$
$$P^*_\pi = 70$$

26) Now use the same information on demand and costs as in the question above and set up the firm's total revenue maximization problem and solve of the P and Q that maximize the total revenues of the firm.

$$\max_Q TR = P\cdot Q$$
$$= 100Q - 2Q^2$$
$$\text{FOC } \frac{\partial TR}{\partial Q} = 100 - 4Q \overset{\text{set}}{=} 0$$
$$\rightarrow Q^*_{TR} = 25$$

$$P^* = 100-(2\cdot 25)$$
$$P^*_{TR} = 50$$

27) On the axis below, graph the firms' inverse residual demand curve, the marginal revenue curve, the marginal cost curve, and the P and Q associated with both profit maximization and total revenue maximization. Explain why maximizing total revenues does not maximize profits.



When one expands output above Q^*_π, the MC of each unit is above MR which means you are making a loss on every unit after Q^*_π as one expands to Q^*_{TR}.