

Final Exam

EC 311 - Intermediate Microeconomics

Winter 2024

Give every question your best shot.
“I’m young, scrappy and hungry
And I’m not throwin’ away my shot”

Name: _____ 95#: _____

The maximum amount of points on this exam is 100 points. You have a total of 1h 50min (110 minutes) to complete the exam. The only items allowed on your desk at any time are a pen and/or pencil, scratch paper, a 3x5 note card, and a calculator. Everything else must be stored in your bag underneath your desk. Any form of cheating will result on a zero on the exam.

There are three sections to be completed:

- **Multiple Choice:** 10 Questions
- **Short-Answer Questions:** 4 Questions
- **Multi-Part Analysis Questions:** 2 Questions

Point totals and question specific instructions are listed for each section. Please ask for clarification if a question is not clear to you.

The exam is a total of 9 pages. **Please verify you have all 9 in your exam. If you do not, let me know immediately.**

Multiple Choice - 30 Points

Circle or "X" the answer you think most correctly answers the following questions. If you mark a choice and would like to change it, **clearly indicate which one is your correct answer.**

1. [3 points] Imagine a Perfectly Competitive market with 25 firms. If every firm in the market has a Short-Run Supply Curve of $P = 28 + \frac{1}{2}Q$, what is the **Market Supply** when $P = 28$?
 - A. 28
 - B. 14
 - C. 25
 - D. 0**
2. [3 points] The government decides to impose a one-time registration fee on all firms in the publishing industry; also known as a lump-sum tax. What effect will this have on the firm's production decision?
 - A. They will not change their production**
 - B. They will leave the industry
 - C. They will decrease their production
 - D. They will increase their production
3. [3 points] For a Perfectly Competitive firm that maximizes profits as a function of factors, what should wages equal to?
 - A. The value of the marginal product of capital
 - B. The value of the marginal product of labor**
 - C. The firm cannot set prices
 - D. They should be equal to the rental rate of capital
4. [3 points] If a profit-maximizing firm in a Perfectly Competitive market has a cost function of $C(Q) = \frac{1}{3}Q^2$, how much will it produce when the market price is \$14?
 - A. $\sqrt{42}$
 - B. 42
 - C. $\frac{2}{3}Q$
 - D. 21**
5. [3 points] What are the average fixed costs for a firm with the cost function $C(Q) = 4Q^3 - 5Q^2 + Q + 22$ that produces $Q = 11$?
 - A. 22
 - B. 2**
 - C. $\frac{22}{Q}$
 - D. $\frac{Q}{22}$

6. [3 points] Imagine a market with 5 firms. Each firm's short-run supply function is given by $Q^* = P$. If market demand is $Q_D = 120 - 10P$, what is the market equilibrium price?

A. 8

- B. 12
- C. 5
- D. 10

7. [3 points] The government notices that firms in a certain industry are shutting down. They decide that they want to intervene and help firms so that they can avoid shutting down. What kind of subsidy (a subsidy is just the opposite of a tax) should the government offer?

A. Per-unit subsidy

- B. Lump-sum subsidy
- C. Either lump-sum or per-unit subsidy would help
- D. Neither type of subsidy will help

8. [3 points] For a monopolist that faces the demand curve $P = 65 - Q$, what is the formula for their marginal revenue?

- A. $MR = -1$
- B. $MR = 65 - Q$
- C. $MR = 65Q - Q^2$
- D. $MR = 65 - 2Q$**

9. [3 points] Which of the following statements is true? Assume that all markets have 2 firms

- A. Cournot Price > Cartel Price
- B. Cartel Price > Stackelberg Price**
- C. Perfect Competition Price > Cartel Price
- D. Cournot Price < Perfect Competition Price

10. [3 points] What type of returns to scale does the production function $F(L, K) = L^{1/10}K^{4/5}$ feature?

- A. Decreasing**
- B. Increasing
- C. Constant
- D. Unable to tell from the information given

Short Answer - 30 Points

Answer the following questions to the best of your ability. For full credit, show all of your work and clearly indicate your final solution for each part by circling the answer.

11. [8 points] Imagine a firm with the cost function $C(Q) = 3Q^3 + 300Q + 600$. Currently, the firm can sell its product for a price of \$525. **What is the short-run profit maximizing quantity?** Imagine the government imposes a \$180 per-unit tax on the good that this firm sells. **What is the new short-run profit maximizing quantity, assuming the price goes up to \$624?**

Short-Run π -Max Quantity:

$$P = MC$$

$$525 = 9Q^2 + 300$$

$$225 = 9Q^2$$

$$25 = Q^2$$

$$Q^* = \sqrt{25} = 5$$

With Tax: $C(Q) = 3Q^3 + 300Q + 600 + 180Q$

$$P = MC$$

$$624 = 9Q^2 + 300 + 180$$

$$144 = 9Q^2$$

$$16 = Q^2$$

$$Q^* = \sqrt{16} = 4$$

12. [6 points] For a firm with the cost function $C(Q) = 2.5Q^3 - 10Q^2 + 25Q + 30$. **Below what price will the firm shut down? What are the firm's profits at that price?**

Given by $P = AVC(Q^*)$; $AVC = 2.5Q^2 - 10Q + 25$

$$\text{Find } \frac{\partial AVC}{\partial Q} = 0$$

$$5Q - 10 = 0$$

$$5Q = 10$$

$$Q^* = 2$$

$$P = AVC(Q^*)$$

$$P = 2.5(2)^2 - 10(2) + 25$$

$$P = 2.5(4) - 20 + 25$$

$$P = 10 - 20 + 25$$

$$P = 15$$

$$\pi \text{ should be } -FC = -30$$

$$\pi = P \cdot Q - C(Q)$$

$$\pi = 15 \cdot 2 - 2.5(2)^3 + 10(2)^2 - 25(2) - 30$$

$$\pi = 30 - 2.5(8) + 40 - 50 - 30$$

$$\pi = 30 - 20 + 40 - 50 - 30$$

$$\pi = -30$$

13. [6 points] Imagine two firms are competing in Stackelberg competition. Firm A is the follower and has the best response function $Q_A = 100 - Q_B$, where firm B is the leader. Firm B has the cost function $C(Q_B) = \frac{1}{2}Q_B^3$. The market demand curve is $P = 250 - Q$. Write down firm B's profit function and find their profit maximizing quantity.

$$\begin{aligned}\Pi_B &= P \cdot Q_B - C(Q_B) = (250 - Q_A - Q_B)Q_B - \frac{1}{2}Q_B^3 = (250 - 100 + Q_B - Q_B)Q_B - \frac{1}{2}Q_B^3 \\ &= (150)Q_B - \frac{1}{2}Q_B^3\end{aligned}$$

$$\begin{aligned}\frac{\partial \Pi_B}{\partial Q_B} &= 0 \rightarrow 150 - \frac{3}{2}Q_B^2 = 0 \\ \frac{3}{2}Q_B^2 &= 150 \\ Q_B^2 &= 100 \\ Q_B^* &= \sqrt{100} = 10\end{aligned}$$

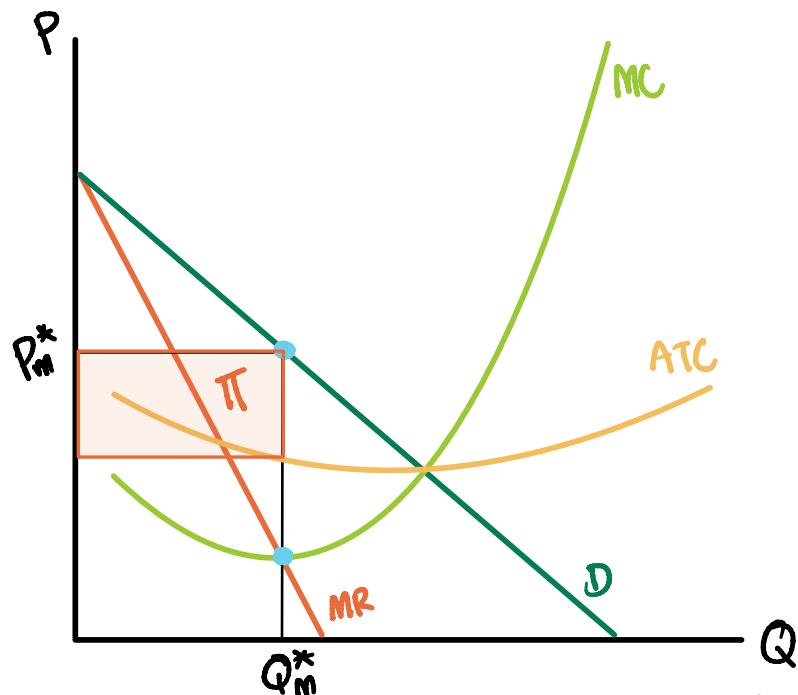
14. [10 points] For a Monopoly, briefly explain the steps to finding the profit-maximizing quantity and price. Draw a monopoly equilibrium graph with the following three (3) features: (1) Profits, (2) Optimal Quantity Q_M^* , and (3) Optimal Price P_M^* .

Steps:

1. Find Q^* by setting $MR = MC$

$$MR = MC$$

2. Plug in Q^* into Demand Curve to get P^*



Multi-Part Analysis - 40 Points

Answer the following questions to the best of your ability. For full credit, show all of your work and clearly indicate your final solution for each part by circling the answer.

15. You found Willy Wonka's Golden Ticket, survived his crazy antics, and are now the proud owner and manager of the Willy Wonka Candy Company. Your cost function is $C(Q) = 2Q^2 + 24Q + 220$. Demand for candy is given by $P = 150 - Q_D$. **Be careful when making the graph part of this question. Be sure to label everything clearly and properly.**

- (a) [3 points] The Willy Wonka Candy Company operates as a **Monopoly**. You want to know exactly how much candy to produce and at what price to sell it in order to maximize profits. **Find the profit-maximizing quantity (Q_M^*) and price (P_M^*)**

$$\Pi = P \cdot Q - C(Q) = (150 - Q_D)Q_S - 2Q^2 - 24Q - 220 = 150Q - Q^2 - 2Q^2 - 24Q - 220$$

$$\frac{\partial \Pi}{\partial Q} = 0 \rightarrow 150 - 2Q - 4Q - 24 = 0$$

$$6Q = 126$$

$$Q_M^* = 21$$

$$P_M^* = 150 - Q^*$$

$$P_M^* = 150 - 21$$

$$P_M^* = 129$$

- (b) [3 points] The government forces you to behave like a **Perfectly Competitive Firm**. **What would the market equilibrium quantity (Q_{PC}^*) and price (P_{PC}^*) be (in the Short-Run)?**

$$\Pi = P \cdot Q - C(Q) = P \cdot Q - 2Q^2 - 24Q - 220$$

$$\frac{\partial \Pi}{\partial Q} = 0 \rightarrow P - 4Q - 24 = 0$$

$$P = 4Q + 24$$

Supply

Supply = Demand

$$4Q + 24 = 150 - Q$$

$$5Q = 126$$

$$Q_{PC}^* = 25.2$$

$$P_{PC}^* = 150 - Q_{PC}^*$$

$$P_{PC}^* = 150 - 25.2$$

$$P_{PC}^* = 124.8$$

- (c) [4 points] Imagine that the barriers to entry that have helped you maintain a **Monopoly** have disappeared. Now, any firm that would like to join your market can do so. Assuming that all these new firms have the same cost function as you, what will the **Long-Run Equilibrium Price and Quantity** be?

$$P = \min(ATC) \text{ or } MC = ATC$$

$$ATC \text{ is } 2Q + 24 + \frac{220}{Q}$$

$$\frac{\partial ATC}{\partial Q} = 0 \rightarrow 2 - \frac{220}{Q^2} = 0$$

$$\frac{220}{Q^2} = 2 \rightarrow 220 = 2Q^2 \rightarrow 110 = Q^2$$

$$Q \approx 10.5$$

$$P = MC$$

$$P = 4Q + 24$$

$$P = 4(10.5) + 24$$

$$P = 42 + 24$$

$$P = 66$$

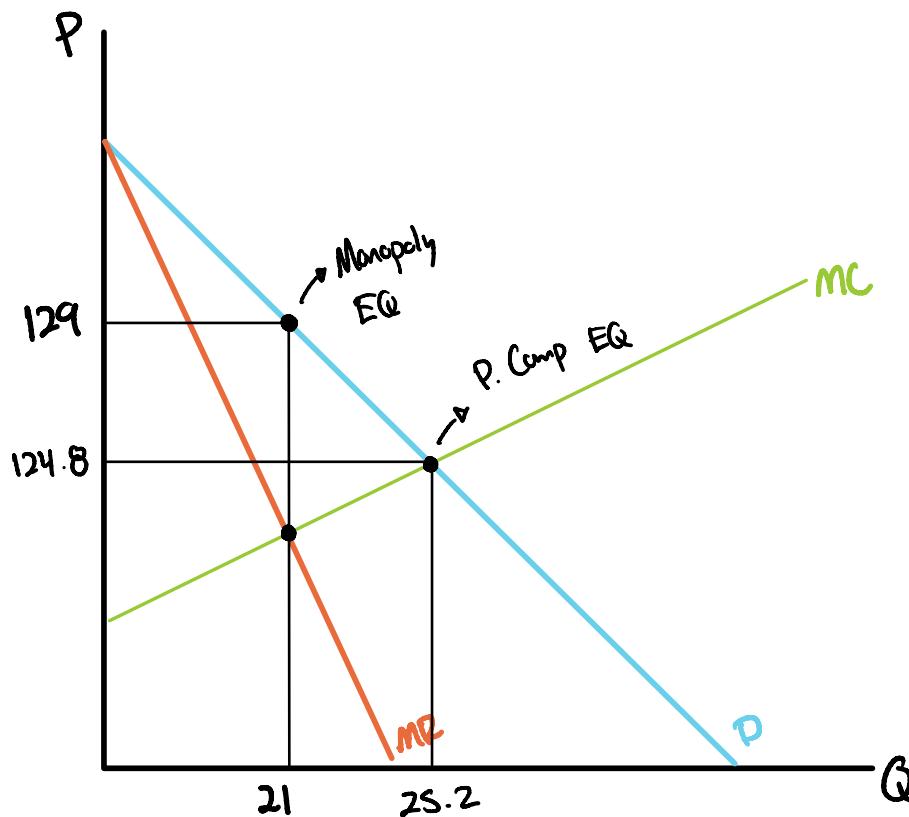
- (d) [2 points] One day, the Hershey CEO approaches you about forming a cartel in order to regain control of the market. You agree to produce less in order to drive prices up. You join them and manage to kick out every other firm in the market. After some time, Hershey undercuts your agreement and produces more than you agreed to. **Should you have seen this coming? Explain your answer.**

Yes. Cartels are unstable & it is only rational to deviate from the cartel agreement

- (e) [8 points] In the (Q, P) plane, graph and label the **Market Demand Curve**, your firm's **Marginal Cost Curve** and your **Marginal Revenue Curve**.

Label the **optimum Price and Quantity values** you found when you are a **Monopoly** (from part a) and when you are a **Perfectly Competitive Firm** (from part b).

How many firms are there in the Long-Run?



From Demand $P = 150 - Q$



$$Q = 150 - P$$

$$Q = 150 - 66$$

$$Q = 84$$

Number of firms is
given by

$$N = \frac{Q_D}{Q^*} = \frac{84}{10.5} = 8$$

16. Two firms are engaged in Cournot competition. Firm A has costs according to $C_A = 0.5a^2$ and firm B has costs according to $C_B = 0.75b^2$. Market demand is given by $P = 114 - 0.5Q$ where $Q = a + b$.

(a) [3 points] What is firm A's best response function?

$$\begin{aligned}\Pi_A &= P \cdot a - C_A \\ \Pi_A &= (114 - \frac{a}{2} - \frac{b}{2})a - 0.5a^2 \\ \Pi_A &= 114a - \frac{a^2}{2} - \frac{ab}{2} - \frac{a^2}{2}\end{aligned}\quad \begin{aligned}\frac{\partial \Pi_A}{\partial a} &= 0 \rightarrow 114 - a - \frac{b}{2} - a = 0 \\ 114 - \frac{b}{2} &= 2a \\ 57 - \frac{b}{4} &= a^*\end{aligned}$$

(b) [3 points] What is firm B's best response function?

$$\begin{aligned}\Pi_B &= P \cdot b - C_B \\ \Pi_B &= (114 - \frac{a}{2} - \frac{b}{2})b - 0.75b^2 \\ \Pi_B &= 114b - \frac{ab}{2} - \frac{b^2}{2} - 0.75b^2\end{aligned}\quad \begin{aligned}\frac{\partial \Pi_B}{\partial b} &= 0 \rightarrow 114 - \frac{a}{2} - b - 1.5b = 0 \\ 114 - \frac{a}{2} &= 2.5b \\ 45.6 - \frac{a}{5} &= b^*\end{aligned}$$

(c) [3 points] What is the Nash Equilibrium of this game?

Firm A:

$$\begin{aligned}a^* &= 57 - \frac{b}{4} \\ a^* &= 57 - \frac{(45.6 - 0.2a)}{4}\end{aligned}$$

$$a^* = 48$$

Firm B:

$$\begin{aligned}b^* &= 45.6 - \frac{a^*}{5} \\ b^* &= 45.6 - \frac{48}{5}\end{aligned}$$

$$b^* = 36$$

- (d) [5 points] Suppose instead of a simultaneous game (Cournot) the two firms engaged in a sequential game (Stackelberg) where firm B is the follower. **What is the Nash Equilibrium of this Stackelberg game?**

$$\Pi_A = 114a - \frac{a^2}{2} - \frac{ab}{2} - \frac{a^2}{2} ; b^* = 45.6 - \frac{a}{5}$$

$$\Pi_a = 114a - 0.5a^2 - 0.5a(45.6 - \frac{a}{5}) - 0.5a^2$$

$$\Pi_a = 114a - 0.5a^2 - 22.8a + 0.1a^2 - 0.5a^2$$

$$\frac{\partial \Pi_a}{\partial a} = 0 \rightarrow 114 - a - 22.8 + 0.2a - a = 0$$

$$114 - 22.8 = 1.8a$$

$$91.2 = 1.8a$$

$$50.6 = a^*$$

Firm B:

$$b^* = 45.6 - 0.2a^*$$

$$b^* = 45.6 - 0.2(50.6)$$

$$b^* = 45.6 - 10.12$$

$$b^* = 35.48$$

- (e) [6 points] Show firm B 's profits in both the Stackelberg **and** the Cournot game.
Do they make different profits depending on which game type they are in?
If so, why? (Show your work)

Cournot

$$P = 114 - 0.5(a+b)$$

$$P = 114 - 0.5(48) - 0.5(36)$$

$$P = 114 - 24 - 18 = 72$$

$$\Pi_B = P \cdot b - C_B$$

$$\Pi_B = 72 \cdot 36 - 0.75(36)^2$$

$$\Pi_B = 1,620$$

Stackelberg

$$P = 114 - 0.5(a+b)$$

$$P = 114 - 0.5(50.6) - 0.5(35.48)$$

$$P = 114 - 25.3 - 17.74$$

$$P = 70.96$$

$$\Pi_B = 70.96 \cdot 35.48 - 0.75(35.48)^2$$

$$\Pi_B = 2,517.7 - 952.6$$

$$\Pi_B = 1,565.1$$

Cournot < Stack