

## ECN 594: Practice Midterm Exam

### Instructions:

- You have **70 minutes**
- You may bring a calculator and notes on a two-sided cheat-sheet (letter-size paper)
- Please be neat. If your work is too messy it will not be graded.
- Be sure to show your working.
- This is a long exam, so there are lots of ways to get points. If you get stuck, move on!
- Good luck!

Name: \_\_\_\_\_

Question:	1	2	3	4	Total
Points:	30	30	20	20	100
Score:					

## 1. Short Answer Questions (30 points)

1. For each question, write either:

- a number or formula
- one of: True, False, or NEI (Not Enough Information)
- a brief definition or explanation (one sentence)

(a) (3 points) A monopolist faces constant elasticity demand with  $\varepsilon = -3$  and has marginal cost  $c = 20$ . What is the optimal price?

(a) \_\_\_\_\_

(b) (3 points) In the logit demand model, write the formula for the own-price elasticity  $\eta_{jj}$  in terms of the price coefficient  $\alpha$ , price  $p_j$ , and market share  $s_j$ .

(b) \_\_\_\_\_

(c) (3 points) True, False, or NEI: In a logit demand model, products with higher prices always have more elastic demand.

(c) \_\_\_\_\_

(d) (3 points) What does “IIA” stand for, and why is it a limitation of the basic logit model?

(d) \_\_\_\_\_

(e) (3 points) True, False, or NEI: OLS estimation of logit demand will underestimate the price coefficient (make it less negative) due to price endogeneity.

(e) \_\_\_\_\_

(f) (3 points) True, False, or NEI: Under perfect price discrimination, there is no deadweight loss.

(f) \_\_\_\_\_

(g) (3 points) Name one type of instrument commonly used to address price endogeneity in demand estimation.

(g) \_\_\_\_\_

(h) (3 points) True, False, or NEI: A two-part tariff with  $F > 0$  and  $p = MC$  always increases total surplus compared to uniform monopoly pricing.

(h) \_\_\_\_\_

(i) (3 points) What is “selection by indicators”? Give a brief example.

(i) \_\_\_\_\_

(j) (3 points) True, False, or NEI: In a self-selection pricing problem, the firm must ensure that high-type consumers don’t want to buy the low-type product.

(j) \_\_\_\_\_

## 2. Demand Estimation (30 points)

2. Consider a market with 3 products and an outside option. The logit demand model is:

$$u_{ij} = \delta_j + \alpha p_j + \varepsilon_{ij}$$

where  $\delta_j$  is the mean utility (excluding price),  $\alpha = -0.5$  is the price coefficient, and  $\varepsilon_{ij}$  is i.i.d. Type 1 Extreme Value.

The following data are observed:

Product	Price ( $p_j$ )	Mean Utility ( $\delta_j$ )	Market Share ( $s_j$ )
1	\$10	2.0	0.25
2	\$8	1.5	0.20
3	\$12	2.5	0.15
Outside	—	0	0.40

- (a) (5 points) Verify that the market share for product 1 is approximately correct using the logit formula:

$$s_j = \frac{\exp(\delta_j + \alpha p_j)}{1 + \sum_k \exp(\delta_k + \alpha p_k)}$$

- (b) (5 points) Compute the own-price elasticity for each product. Which product has the most elastic demand?

- (c) (5 points) Compute the cross-price elasticity  $\eta_{12}$  (how much demand for product 1 changes when the price of product 2 changes). What does the IIA property imply about  $\eta_{12}$  vs  $\eta_{13}$ ?

- (d) (5 points) Suppose you only observe prices and market shares (not  $\delta_j$ ). Write down the Berry inversion formula that would allow you to recover  $\delta_j + \alpha p_j$  from the data.

- (e) (10 points) Using the log-sum formula, compute the expected consumer surplus per consumer in this market. If product 3 were removed, what would be the change in consumer surplus?

$$CS = \frac{1}{|\alpha|} \ln \left( 1 + \sum_j \exp(\delta_j + \alpha p_j) \right)$$

### 3. Price Discrimination by Indicators (20 points)

3. A monopolist sells software licenses. There are two customer segments: businesses (B) and students (S). Marginal cost is \$10 per license.

- Business demand:  $Q_B = 100 - P_B$
- Student demand:  $Q_S = 50 - 2P_S$

(a) (5 points) The firm can identify customer type (e.g., through verification). Solve for the optimal prices under price discrimination by indicators.

(b) (5 points) Compute total profit under price discrimination.

(c) (5 points) Now suppose the firm cannot distinguish customers and must charge a uniform price. What is the total demand curve? Find the optimal uniform price.

(d) (5 points) Compare consumer surplus across the two scenarios (price discrimination vs. uniform pricing). Which group benefits from price discrimination?

#### 4. Two-Part Tariff (20 points)

4. A gym has a monopoly in its local market. There are 100 identical consumers, each with demand  $q = 20 - p$  for gym visits per month. The marginal cost of a gym visit is \$2.
- (a) (5 points) If the gym can only charge a uniform price per visit, what is the profit-maximizing price and profit?
- (b) (5 points) Now suppose the gym uses a two-part tariff: a monthly membership fee  $F$  and a per-visit price  $p$ . What is the optimal two-part tariff?
- (c) (5 points) Compare total surplus under uniform pricing vs. the two-part tariff. Explain the efficiency difference.
- (d) (5 points) Suppose there are now two types of consumers: 50 “heavy users” with demand  $q_H = 30 - p$  and 50 “light users” with demand  $q_L = 10 - p$ . If the gym must offer a single two-part tariff to all consumers, what constraint determines the optimal fee  $F$ ?