

## 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  $F$ ?