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Last Name (Please PRINT): ....

First Name (PRINT): ....

Your UM I.D. Number: ....

INSTRUCTIONS (please read!)

1. Please make sure that you have 8 pages, including this page. Complaints about missing pages will not be accepted.
2. Please answer all the questions. You are not allowed to use any course material. Calculators are permitted.
3. Maximum Time Allowed: 2 hours (16:00–18:00).
4. Your grade depends on the arguments you develop for supporting your answers. Each answer must be justified by using a logical argument consisting of a model/graph. An answer with no justification will not be given any credit.
5. You must provide all the derivations leading you to a numerical solution.
6. When you draw a graph, make sure that you label the axes with the appropriate notation.
7. Maximum Score: 100 Points
8. Budget your time. If you cannot answer a certain question, skip to the next one.
9. Please always bear in mind that "somebody" has to read and understand your handwriting. Please make sure that your ink is "visible" and that your sentences are properly organized and fit into the designated blank space. If you think that your handwriting is poor, please print each word!
10. **Good Luck !**

Instructor's use only

Problem #	1+2	3	4	5	6	7	Total
Maximum	20	20	15	15	15	15	100
Points							

(1) Consider the demand for a telecommunication service subscription in which consumer types are indexed by x on the interval $[0,1]$. Suppose there are $\eta = 120$ consumers of each consumer type x. Assume that the utility function of each consumer x, $x \in [0,1]$ is given by

$$U_x = \begin{cases} (3-3x)q^e - p & \text{if she subscribes} \\ 0 & \text{if she does not subscribe,} \end{cases}$$

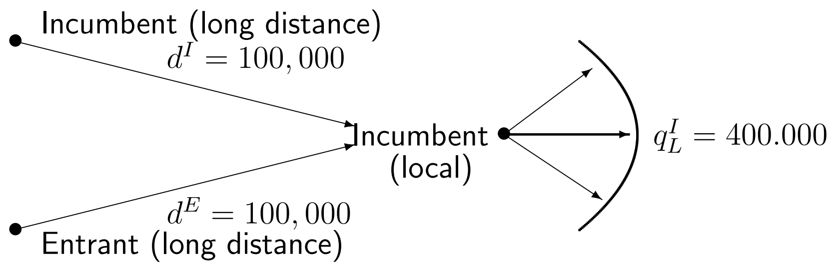
where p is the subscription price, and q^e is the expected number of subscribers.

(1a) [5 points] Formulate and draw the aggregate inverse demand function for this service. Characterize the subscription level under which consumers' willingness to pay reaches the highest level.

(1b) [5 points] Compute the critical mass, q^{cm}, at the subscription price $p_0 = \$80$.

(1c) [5 points] Suppose there is only one provider of this telecommunication service. Assume that this monopoly does not bear any cost. Compute the monopoly's profit-maximizing number of subscriptions, the subscription price, p, and the monopoly's profit.

(2) [5 points] Consider an incumbent monopoly telephone service provider selling long-distance (LD) and local (LC) phone services.



The incumbent provides, both, long-distance and local phone services. Consumers make $d^I = 100,000$ long-distance calls via the incumbent (I), and $d^E = 100,000$ calls via a new entrant (E) who provides only long distance service. Local consumers place $q_L^I = 400,000$ local calls.

The incumbent bears a fixed cost $\phi^I = 1,200,000$ of maintaining the infrastructure for local services. In addition, the incumbent bears a cost $\mu_L^I = 0.5$ for each phone call carried from the *local switch to a local consumer,* that is, the cost of executing a local phone call; and $\mu^I = 3$ which is the cost of a long-distance call carried by the incumbent to the local switchboard. The entrant bears a cost $\mu^E = 2$ of a long-distance call carried by the entrant.

Compute the access charge, a, the entrant must pay the incumbent for each long-distance call originated by the entrant and terminated by the incumbent under two different rules: (1) Fully distributed costs rule, and (2) Efficient component pricing rule (ECPR) assuming that the incumbent charges a price of $p^I = 4$ for a LD phone call. Show the formula of each rule.

(3) Consider an economy with two types of consumers who wish to subscribe to a certain telecommunication service (e.g., obtaining a phone service). There are $\eta_H = 20$ (twenty) type H consumers who place high value for connecting to this service, and $\eta_L = 60$ (sixty) type L consumers who place a low value on this service.

Let p denote the connection fee to this service, and q the actual number of consumers connecting to this service. Then, the utility function of each consumer type

$$U_H \stackrel{\text{def}}{=} \begin{cases} 5q - p & \text{connected} \\ 0 & \text{disconnected} \end{cases} \quad \text{and} \quad U_L \stackrel{\text{def}}{=} \begin{cases} q - p & \text{connected} \\ 0 & \text{disconnected.} \end{cases}$$

(3a) [10 points] Draw the market demand function for connecting to this telecommunication service. Label the axes and prove and explain the graph.

(3b) [10 points] Suppose now that it costs the telephone company $\mu = 75$ to connect each consumer who subscribes to this service. Calculate the connection price which maximizes the profit of this monopoly phone company.

(4) [15 points] In Ben Barbor there are three banks. Each resident (depositor) has one account in one (and only one) of the banks. Bank A has $n_A = 600$ depositors. Bank B has $n_B = 400$ depositors. Bank C has $n_C = 200$ depositors. Assume that the banks bear no cost of serving customers.

It turns out that in an UPE all banks charge each depositor the same annual fee of $\$60$. That is, $f_A = f_B = f_C = \$60$. The utility function of a depositor who has an account with bank i ($i = A, B, C$) is given by

$$U_i = \begin{cases} -f_i & \text{staying with bank } i \\ -f_j - \delta_i & \text{switching from bank } i \text{ to bank } j. \end{cases}$$

Using the above data, compute the switching cost parameters δ_A, δ_B, and δ_C. Show your derivations.

(5) [15 points] Consider a scheduling competition between two broadcasting networks labeled A and B which broadcast only evening news. There are 1000 potential viewers. All viewers work full time and therefore can watch the evening news only after they leave work (and not before). More precisely,
100 viewers prefer to watch the news at 18:00 (and not before 18:00 because they must work).
100 viewers prefer to watch the news at 19:00 (and not before 19:00 because they must work).
500 viewers prefer to watch the news at 20:00 (and not before 20:00 because they must work).
300 viewers prefer to watch the news at 21:00 (and not before 21:00 because they must work).

That is, each viewer cannot watch the news before her most-preferred hour, but can watch it after the preferred hour (after finishing work).

Each network must pick the time for its evening news. The profit of network A is $\pi_A(t_A, t_B) = \rho n_A$ where ρ is the revenue per viewer collected from the advertisers, and n_A is the equilibrium number of viewers who watch A. Similarly, $\pi_B(t_A, t_B) = \rho n_B$.

Let t_A denote the broadcasting time of network A, and t_B of network B. Compute the networks' best response functions (5 points) and conclude which broadcasting times $\langle t_A, t_B \rangle$ constitute a Nash equilibrium (5 points). Also, compute the networks' equilibrium profit levels, $\pi_A(t_A, t_B)$ and $\pi_B(t_A, t_B)$ (5 points).

(6) In a small island in South-East Asia there are 60 native Bengali speakers and 40 Hindi speakers. The language school on this island teaches 3 separate classes: Bengali (language B), Hindi (language H), and English (language E). The tuition is $30 for each class.

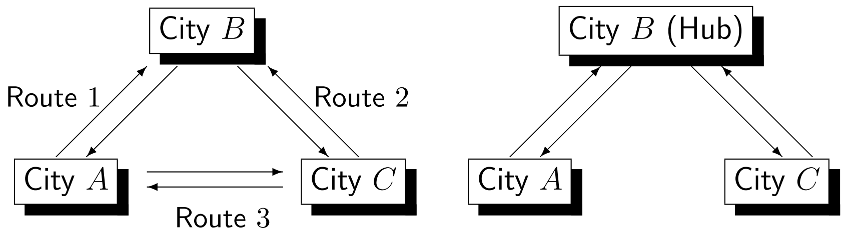
Denote by n_{BH} the number of Bengali speakers who learn Hindi; n_{BE} the number of Bengali speakers who learn English; n_{HB} the number of Hindi speakers who learn Bengali; n_{HE} the number of Hindi speakers who learn English. The utility functions of a Bengali and an Hindi native speakers are

$$U_B = \begin{cases} 60 + n_{HB} & \text{does not study} \\ 100 - 30 & \text{studies Hindi} \\ 60 + n_{HB} + n_{HE} - 30 & \text{studies English} \end{cases} \quad \text{and} \quad U_H = \begin{cases} 40 + n_{BH} & \text{does not study} \\ 100 - 30 & \text{studies Bengali} \\ 60 + n_{BH} + n_{BE} - 30 & \text{studies English} \end{cases}$$

(6a) [5 points] State whether the following statement is True or False (prove): There exists an equilibrium in which all the island's residents learn English.

(6b) [10 points] Compute aggregate consumer welfare levels corresponding to the following three separate situations: I. All residents learn English. II. All Bengali speakers learn Hindi. III. All Hindi speakers learn Bengali. Conclude which situation yields the highest aggregate consumer welfare.

(7) A single airline company serves 3 cities as illustrated in the following figure. The cost of operating a flight on each route i is $\mu = 200$. Assume that aircrafts have an unlimited capacity (can carry any number of passengers).



On each route i, $i = 1, 2, 3$, there are $\eta_i^H = 50$ passengers who have high value of time, and $\eta_i^L = 10$ passengers who have low value of time. The utility functions of type H and L passengers on route i are

$$U_i^H \stackrel{\text{def}}{=} \begin{cases} 12 - p_i & \text{flies directly to destination} \\ 8 - p_i & \text{flies to destination via a hub} \\ 0 & \text{does not fly,} \end{cases} \quad \text{and} \quad U_i^L \stackrel{\text{def}}{=} \begin{cases} 12 - p_i & \text{flies directly or indirectly} \\ 0 & \text{does not fly.} \end{cases}$$

(7a) [10 points] Compute the profit-maximizing airfare on each route $i = 1, 2, 3$, assuming that the airline operates a Hub-and-Spokes (HS) network. Also compute total profit of this operator.

(7b) [5 points] Compute the profit-maximizing airfare on each route $i = 1, 2, 3$ assuming that the airline operates a Fully-connected (FC) network. Also compute total profit of this operator, and determine which network of operation is more profitable for this monopoly airline.