Enrolment No. _____

AHMEDABAD UNIVERSITY

AMRUT MODY SCHOOL OF MANAGEMENT

UNDERGRADUATE PROGRAMMES

2023-2024 WINTER SEMESTER

MID SEMESTER EXAMINATION

ECO204 INDUSTRIAL ORGANIZATION

Date: 20-02-2024 Total Marks: 50

Time: 02.00 pm – 04.30 pm No. of printed pages: 04

NOTE: The question paper has three sections. Read the entire question paper before attempting any question. You have two and a half hour to attempt the exam.

Section A: This section has 5 questions and carries 15 marks. Question 1 is mandatory. Of the other four, attempt 3.

1. **Mandatory Question**: Derive the price-cost mark-up equation for a monopolist for a general inverse demand curve; i.e. $P = D(Q)$, where D(Q) is downward sloping and total costs are $TC = c.Q$. What happens to price if elasticity is equal to 1? Can you provide intuition for this result? *(6 marks)*

2. Find the elasticity of the following demand curves at the price mentioned *(3 marks)*
   a. $P = 300 - 5.Q$; P = 100
   b. $Q = P^{-3}$; P = 10

3. Platforms are two-sided markets. For each of the below mentioned platforms, which are the two sides of the market: *(3 marks)*
   a. NYKA
   b. LINKEDIN

4. *Urban Company* and *Yes Madam* are two platforms which provide at-home bodycare services. For eg; using this platform, a person can avail services of a barber at her home. *Urban Company* sets up a new rule under which if a user (someone who needs a hair-cut at home) cancels the service, then the service provider (barber in this example) will be penalized. Given this information, will this policy lead *Yes Madam* to decrease the prices charged to its users? Why? Why not? *(3 marks)*

5. For the following utility function, find the demand curve for Q_1 and Q_2. Assuming that $\varphi > 1$, which of the two goods is more sensitive to changes in income? *(3 marks)*
   a. $U = {Q_1}^{\alpha} + \varphi {Q_2}^{\alpha}$ subject to $P_1Q_1 + P_2Q_2 = M$

Section B: Attempt any two questions. Each question carries 12.5 marks.

1. Price Discrimination: A profit maximising hospital in a city is the only one which can provide heart surgeries. The hospital receives two types of patients—rich and poor. The inverse demand function for poor is $P_{poor} = 100 - 2.Q_{poor}$. The inverse demand function for rich patients is $P_{rich} = 100 - Q_{rich}$. The cost function for conducting surgeries is TC = 2. Q^2.

a. The hospital engages in price discrimination; i.e. it can charge different prices to each type of patient. What will be the total number of heart surgeries in the hospital? for rich and poor patients? Assume that the hospital can conduct surgeries separately for the two types of patients; i.e. the total cost function for the hospital for conducting surgeries for poor and rich patients is TC = $2.Q_{poor}^2 + 2.Q_{rich}^2$. *(5 marks)*

b. The government declares that price discrimination is not allowed. If so, what will be the total number of heart surgeries by the hospital? [Hint: With no price discrimination, $P_{rich} = P_{poor} = P$ and $Q = Q_{rich} + Q_{poor}$.] *(5 marks)*

c. Policy-makers have to choose between different policies to ensure overall welfare of people. If policymakers were only interested in total number of heart surgeries, which of the two solutions between a and b will the policymaker choose? If policymakers were interested in the total heart surgeries for the poor patients, then which solution between a and b, will the policymaker choose? *(2.5 marks)*

2. Consider a platform for taxi services. Passengers demand curve can be written as

$$N_B = A - P_B - \frac{t_B}{N_D}$$

where, N_B is the number of passengers, P_B is the price that passengers pay and t_B is the time that passengers spend on waiting for a taxi. N_D is the number of drivers. Thus, N_B decreases with the waiting time for passengers and increases with the number of drivers on the platform. Similarly, Drivers' supply curve is given by

$$N_D = P_D - \frac{t_D}{N_B}$$

where, P_D is the price that drivers receive, t_D is the time drivers spend waiting. Thus, N_D decreases with the waiting time and increases with the number of passengers.

a. Platform earns $P_B N_B$ from passengers and pays $P_D N_D$ to the drivers. Assume that platform has no costs. Write down the payoff function of the platform. *(2.5 marks)*

b. Platform maximizes its payoff subject to $N_D = N_B = N$ and $t_D = t_B = t$. Find the first order condition of the platform's payoff function with respect to N. *(4 marks) [Hint: Find the inverse demand and inverse supply functions. Then, insert the inverse demand and inverse supply function into the payoff function of the platform.]*

c. Verify that from the first order conditions, we can write $N = \frac{A}{4}$, $P_B = \frac{3A}{4} - \frac{4t}{A}$ and $P_S = \frac{A}{4} + \frac{4t}{A}$ *(4 marks)*

d. Now, note that in this question so far, we have not determined *t*, the waiting time on the platform. How will you extend the model to *endogenize* the waiting time? If the waiting time is a choice of the platform, will the platform want more or less waiting time for the users? If the platform can incur costs to change the waiting time, will the costs increase or decrease with waiting time? *(2 marks)*

3. Assume that there are two brands of biscuits—AlmondySweet (A) and ButteryDelight (B). The consumer has the following utility function from these two brands:

$$U(Q_A, Q_B, Q_o) = Q_o(Q_A{}^{\alpha} + Q_B{}^{\beta})^{\frac{1}{\beta+\alpha}}$$

where, Q_o is the numerairre good with price normalized to 1 and $\alpha, \beta < 1$. Price of A and B are P_A and P_B, respectively. Let income be M.

a. Formulate the objective function of this consumer and find the first order conditions with respect to Q_o, Q_A and Q_B. *(2.5 marks)*

b. Use the first order conditions to verify the following equation holds when the consumer is optimizing *(4 marks)*:

$$\frac{\alpha}{\beta}\left(\frac{{Q_A}^{\alpha-1}}{{Q_B}^{\beta-1}}\right) = \frac{P_A}{P_B}$$

c. The profit function for AlmondySweet firm can be written as: $P_A Q_A - c_A Q_A$. Use the answer in b, to verify that the first order condition for the firm can be written as *(4 marks)*:

$$\frac{P_B \alpha^2 {Q_A}^{\alpha-1}}{\beta {Q_B}^{\beta-1}} = c_A$$

[*Hint: Remember to insert the demand function of good A (where is that?!)*]

d. Use your answers in b and c to show that $P_A = \alpha . c_A$. If the price-cost mark-up equation holds here, can you show that elasticity of good A is $\frac{1}{1-\alpha}$? *(2 marks) [Hint: Equations in b and c form a system of equations. Stare at them till you figure out the answer!]*

Section C: Attempt one question. Each question carries 10 marks.

1. Mathematical models are useful to understand real world situations. However, in order to do so fruitfully, one has to utilize the information from the real-world situation and translate it into mathematical terms. Read the case provided in the packet. Answer the following questions:
   a. Para 4 mentions a competitor due to which Facebook has had to *reinvent* itself. Who is the competitor? *(2 mark)*
   b. Para 6 discusses the *shift to video on today's networks.* In particular, *of the 64 minutes per day that the average American spent on social media last year, 40 were spent watching video, up from 28 minutes three years earlier.* Spending time on either watching friends' posts or videos from strangers provides utility to each consumer at some costs. Let t_F and t_V be the time spent on posts from friends and time spent on watching videos, respectively. As a mathematical modeler, you have to choose among various utility representation. This representation can either be $\varphi_F t_F^{\alpha} + \varphi_V t_V^{\alpha} - t_F - t_V$ OR $t_F^{\alpha} + \varphi_F + t_V^{\alpha} + \varphi_V - t_F - t_V$. φ_F and φ_V are non-time utility obtained friends' posts or stranger's videos, respectively. Which of the following would be more appropriate; i.e. should the non-time utility obtained from friends' posts or stranger's videos be additive or multiplicative? Once you choose one of the representations, find the first order condition with respect to t_F and t_V. *(6 marks) [Hint: Note that you are given the information that each user is increasing the time spent on watching videos. Thus, the representation should be such that the optimal time spent on videos should increase (with respect to?).]*
   c. Para 7 discusses further changes in social feeds. In particular, initially, *the networks employed algorithms to prioritise posts that had proved popular among the user's friends.* On the other hand, TikTok used the *interest graph*, inferring people's preferences from the videos they liked. Assume that platforms can increase φ_F and φ_V. Let $g(\varphi_F)$ and $f(\varphi_V)$ be the cost incurred by social media platforms to increase φ_F and φ_V. Thus, the objective function for the platform is $\varphi_F + \varphi_V - g(\varphi_F) - f(\varphi_V)$. Let g' and f' be the first derivative of g and f. Let φ_F^* and φ_V^* are the optimal values of φ_F and φ_V, respectively. Prove that $g'(\varphi_F^*) = f'(\varphi_V^*)$. If it is also true that $t_F < t_V$; i.e. users spend more time watching videos, then ${g'}^{-1}(1) < {f'}^{-1}(1)$, where ${g'}^{-1}$ and ${f'}^{-1}$ are inverses of the first derivatives of g and f, respectively.

2. *Oshwal* restaurant on Ashram Road offers world-famous-in-Ahmedabad *pav bhaji.* On consuming **one** pav bhaji, a consumer i obtains gross utility k_i but has to pay a price P_H. If the consumer cooks *pav bhaji* at home the same consumer can obtain utility U_O , which is the same across all consumers, and has to pay a price P_L.
   a. Denote by $U_H = k_i - P_H$ and $U_L = U_O - P_L$ utility obtained from one *pav bhaji*. A consumer decides to consume at *Oshwal* if and only if the consumer obtains strictly greater utility from *Oshwal* than cooking at home. Above what level of k_i will the consumer prefer eating at *Oshwal* restaurant over cooking at home? *(2 marks)*
   b. k_i varies for different consumers but its the value can be one of the five numbers {1,2,3,4,5}. Let following be the distribution of k_i; i.e. the number of people for each value k_i.

k_i	1	2	3	4	5
N_i	100	100	100	100	100

Assume that $U_O = P_L = 1$. *Oshwal* can set its price as one of the five numbers {1.5, 2.5, 3.5, 4.5, 5.5}. Using your answer in a and the information in b, complete the below demand schedule for *Oshwal* restaurant. *(4 marks) [Demand schedule shows the number of consumers preferring to eat at Oshwal given the price level. As a hint, I have provided the demand against price 3.5]*

P_H	Q_H
1.5	
2.5	
3.5	200
4.5	
5.5	

   c. Now imagine that the distribution of k_i is the following, while everything else remains the same ($U_O = P_L = 1$) *(4 marks)*

k_i	1	2	3	4	5
N_i	25	100	250	100	25

What is the demand schedule given this distribution of k_i?

As Facebook turns 20, politics is out; impersonal video feeds are in

Social media are more popular than ever, but social networks are dying



image: Ricardo Rey

Listen to this story.

Enjoy more audio and podcasts on iOS or Android.

Para 1 "I'm a little intoxicated, not gonna lie. So what if it's not even 10pm and it's a Tuesday night?...Let the hacking begin." So typed a 19-year-old Mark Zuckerberg, liveblogging from his Harvard dormitory as he began work on a website called Facemash. The site displayed randomly selected pairs of students' mugshots, harvested from the university's intranet, and allowed users to vote on who was hotter. It caused a stir and was promptly shut down. But before long, a successor was in the making. On February 4th 2004 Mr Zuckerberg launched a new site: TheFacebook.com.



image: The Economist

Para 2 Facebook, as it later became, quickly overtook established social networks such as Friendster and MySpace to become the world's largest, a position it still holds on its 20th birthday. Today 3bn people—about 60% of all internet users—scroll its infinite feed every month (see chart 1). It has outwitted its rivals, or swallowed them, as it did Instagram and WhatsApp. Six of the ten most-downloaded mobile apps last year belonged to Meta, Facebook's holding company, which is now the world's largest seller of advertising after Google. Meta's market value has surpassed $1trn; in the third quarter of last year it reported revenue of $34bn.

Para 3 Facebook and its imitators have done more than make money. Social media have become the main way that people experience the internet—and a substantial part of how they experience life. Last year nearly half of mobile screen-time worldwide was spent on social apps (and more than a quarter of waking hours were spent on phones), according to Data.ai, a research company. The networks have become what Mr Zuckerberg and others call a digital "town square", in which the arguments of the day are thrashed out and public opinion is shaped. Social media have fomented social movements, from #MeToo and #BlackLivesMatter to the Arab spring and the Capitol riot.

Feedster

Para 4 Now, after two decades of evolution, the town square is being dug up and rebuilt. Following the arrival of competitors such as TikTok, powered by artificial intelligence, Facebook and other incumbents have been forced to reinvent themselves. Platforms that began as places for friends to interact and share their own content are turning into television-like feeds of entertainment, for passive consumption. At the same time, users are moving their conversations and arguments off the

migration, in turn, will have big implications for politics, in a year when countries with more than half the world's population are heading to the polls.

Para 5 Social media are more popular than ever. The average internet user spent nearly two and a half hours a day on social platforms last year, according to GWI, another data company. Usage ticked up during the pandemic and has not returned to pre-covid levels. As more people go online, more are signing up. Total time spent using social apps on Android devices, which account for about 70% of the world's phones and tablets, has risen by 42% since 2020, to 2.3trn hours last year, according to Data.ai.

Para 6 But the sort of social networking that Facebook pioneered is disappearing. The most obvious change is the shift to video on today's networks. The explosive success of TikTok, a Chinese-owned short-video app which launched in 2017 and quickly had young people hooked, has sparked a wave of copycats. Meta has added a video feature called Reels to Facebook and Instagram. Similar products have been bolted onto Pinterest (Watch), Snapchat (Spotlight) and YouTube (Shorts). Elon Musk, who bought Twitter in 2022 and renamed it X, now claims it is a "video-first" platform. Of the 64 minutes per day that the average American spent on social media last year, 40 were spent watching video, up from 28 minutes three years earlier, estimates Bernstein, a broker.

Para 7 The bigger change to social feeds is under the bonnet. At first, social networks showed chronological updates from users' contacts: their friend just got engaged, their uncle was storming the Capitol and so on. As the volume of posts grew, the networks employed algorithms to prioritise posts that had proved popular among the user's friends. Now a new phase has begun. TikTok decided that, rather than guessing what people would like based on their "social graph"—that is, what their family and friends liked—it would use their "interest graph", which it inferred from the videos they and people like them lingered on. And rather than show content created by people they followed, it would serve up anything it thought they might like.

Para 8 Every other big platform has followed suit. In 2022 Mr Zuckerberg announced that Facebook's feed would become a "discovery engine" to seek out engaging content from around the internet. Since last year half of the posts X shows its users come from outside the network of people they follow. Threads, Meta's Twitter-clone, launched last year with a similar approach. The resulting feeds of unrelated content from strangers can be jarring: "Here's a healthy breakfast option! You should kill your mom!" quipped Bo Burnham, a YouTube comedian, in a satirical song. But users seem to like it. Time spent on Instagram has risen by 40% since Meta launched Reels. Even the geriatric Facebook somehow added 5m new users in America and Canada last year.

Google -

Para 9 As users' newsfeeds become unmoored from their network of friends and family, they are posting less about themselves. "The average user is now more of a consumer," says Michael Bossetta of Lund University. In a survey last year by Gartner, a market-research company, only 28% of Americans said they liked documenting their life online, down from 40% in 2020. Some 61% say they have become more selective about what they post, finds Morning Consult, another research firm, which speculates that an influx of "influencer" content may have made users think "their everyday life is too mundane to justify frequent posts". Video, the new format of choice, is harder to create than dashing off a quick status update. And some platforms, such as X, prioritise posts by users who pay, reducing incentives for the rest.

Para 10 Instead, conversations have been moving for some time to private groups. In 2021 Mr Zuckerberg wrote that, as well as debating in the "town square" of Facebook and Instagram, "People increasingly also want to connect privately in the digital equivalent of the living room." Adam Mosseri, head of Instagram, said last year that more photos and videos were being shared in direct messages than on the app's main feed. "All the friends-sharing is moving in that direction," he concluded. Morning Consult asked people how they would be most likely to recommend a movie