

Firms and Markets (B01.1303)

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Course Description

The goal of this course is to give you some insight into how markets work. The first part of the course starts with the study of decision making by consumers and firms and concludes with a fundamental result in economics: a set of conditions under which markets function efficiently. In the second part of the course, we focus on situations when, for one reason or another, markets don't work efficiently. We will emphasize the importance of strategic behavior, as modeled by game theory.

Microeconomics (as the topic of this course is frequently referred to) is an important component of an MBA program. First, microeconomics focuses on specific dimensions of optimal firm decision making, such as pricing and entry and exit. Second, the economics formal perspective on business plays an important role in other areas of MBA study, such as finance or marketing. Finally, by studying public policy towards market failures, microeconomics highlights important factors conditioning firm strategy.

Some of the key concepts we will introduce include economic incentives, marginal analysis, opportunity cost (which costs matter), market efficiency (what does it mean for a market to work), strategic behavior (how to predict and respond to your rivals' decisions), and asymmetric information (what happens when others know something you do not). Our experience with students in prior years is that much of this is intuitive. But much is not, and our hope is that the combination of theoretical structure and practical examples will be useful in the years to come. It will not make you a success on its own, but it might give you an edge a few times when it matters.

A complete list of topics can be found in the detailed course outline.

Prerequisites

You are expected to be comfortable with basic algebra and calculus, including systems of equations, logarithms and NPV calculations, derivatives.

Course Materials

- Lecture notes. They review the theory relevant to most classes. In 3-6 pages, they outline and explain the conceptual issues for the day, define terms, give examples, and (where it makes sense) work through numerical problems.
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- Textbook. There is no required textbook for this course. However, if you want to have a reference text, I very strongly recommend Michael Baye's *Managerial Economics and Business Strategy* (McGraw-Hill, 6th edition), which is available in the bookstore. There is also a study guide to accompany the text. About 30% of students indicate that they find this book helpful. It really doesn't matter whether you get the 4th, 5th or 6th edition of this book so if you do get it get the cheapest. I also want to draw your attention to *Managerial Economics* by Samuelson and Marks (Wiley, 4th edition). This is a good auxiliary text for the course – it is a little more advanced in some parts, but is a little more comprehensive and is sensible on how to take concepts to data.
 - Slides. The slides are a forecast of where the class will head, but if the discussion moves in another interesting direction we will generally let it run its own course. Also, I will amend the slides from time-to-time to keep the course up-to-date with current research and events. I will use blackboard to post the most up-to-date slides. I will also endeavour to post copies of all the board-work I do in class.

With the exception of the text, all of this material will be handed out the first day of class and posted on the course management system (<http://classes.nyu.edu>).

Deliverables and Grades

The various “deliverables” in the course are designed to develop different skills:

- Class participation. It's important to integrate what you learn and be able to express it effectively. Your grade will be based on such measures as the quality (not the quantity) of your contributions, attendance, punctuality, and so on.
- Individual problem sets. Problem sets emphasize quantitative applications of the principles and tools developed in class. They are due at the start of class. They will not be graded, but will be marked with a check (and possibly a plus or minus). Most of the problems are quantitative; some require a qualitative answer (the latter typically refer to mini-cases that my colleagues and I have written over the years). The problems marked “challenge problems” are harder than most and need not be perfect to get a check. Your overall performance on problem sets will serve as an informal tie-breaker if you're on the border between two grades. You should also note that the problem sets are the best preparation for the mid-term exams.
- Mid-term exam. Generally three or four problems, similar to the practice mid-term exams that I will distribute in due course. In past summer intensives students have opted to make this redemptive, in the sense of counting only if it increases your final grade. I'll assume that your class will choose this too, but we will discuss it in class on the first day.
- Group projects. Generally more complex and realistic quantitative assignments that use and extend the principles and tools developed in class.
- Final-term exam. Generally three or four problems, similar to the practice finals that I will distribute in due course. A slight weighting toward the latter part of the course

Your grade for the course will be based on your contributions to all of these deliverables, weighted as follows:

Class participation	15%
Individual problem sets (3) “check+/-”	

Group projects (2)	25%
Mid-term exam	25% (redemptive)
Final exam	35% or 60%

The mid-term is redemptive, in the sense that it only counts if it increases your grade. This means that if you do better in the final than the mid-term, then the mid-term will not count. The reason for doing this is that this course will move fast and I am sensitive to cater to students who need a little time to get their head around what economics is about. Ultimately I care about what you know at the end of the course: this grading scheme is consistent with that concern.

Final grades will follow the School's guideline for core courses: no more than 35% of the class will receive A or A-. This guideline was instituted in response to student concerns that different sections of a course might be graded by different standards. Dates and deadlines for all assignments can be found in the detailed course outline.

Exams and re-grading

You are responsible for checking the midterm exam dates and avoid any conflict with other commitments. During the exams, you are not allowed to consult class notes, books, or any other material. However, you may consult one page of notes (a standard-size sheet of paper written on one side). Questions about grading must be made in writing and no more than a week after the exams are returned.

Honor Code

The Stern community believes that honesty and integrity are necessary for rewarding academic and professional experiences. These qualities form the basis for the strong trust among members of the academic community (students, faculty, and administrators) that is essential for excellence in education. The Honor Code requires that each student act with integrity in all academic activities and endeavor to hold his or her peers to the same standard.

In this course, you may discuss assignments with anyone, but any written work submitted for a grade should be your own. On exams, you may bring in and consult one piece of paper with anything on it you like, but your answers should be entirely your own work. Additional information is available at http://w4.stern.nyu.edu/scorp/committee.cfm?doc_id=4797

Students with disabilities

If you have a qualified disability and will require academic accommodation during this course, please contact the Moses Center for Students with Disabilities (CSD, 998-4980) and provide me with a letter from them verifying your registration and outlining the accommodations they recommend. If you will need to take an exam at the CSD, you must submit a completed Exam Accommodations Form to them at least one week prior to the scheduled exam time to be guaranteed accommodation.

Help

There are times when a little help can get you past an obstacle. If you're stuck, send me an email (jasker@stern.nyu.edu) or stop by my office (KMC 7th floor, room 79). I try to respond quickly to email.

Firms and Markets: Outline and Calendar (Summer 2, 2008)

Notes:

* denotes that an assignment or group project is due at the beginning of that class, and
** denotes a midterm in that class.

1. July 1: First Half

Introduction and Competition. Brief intro then get cracking.

1. July 1: Second Half

Overview of Competition and Consumer demand, I. Market Equilibrium Demand Curve. Consumer surplus.

2. July 3: First Half *

DUE AT START OF CLASS: INDIVIDUAL PROBLEM SET 1 (MATH REVIEW).
Consumer demand, II. Demand elasticity and issues in estimation

2. July 3: Second Half

Economic costs. Opportunity cost, sunk cost, marginal costs; economic costs and cash flows.

3. July 8*: First Half

DUE AT START OF CLASS: INDIVIDUAL PROBLEM SET 2 (DEMAND AND COSTS).

Finish Economic costs, review competition and do some practice. Opportunity cost, sunk cost, marginal costs; economic costs and cash flows.

3. July 8: Second Half

Competitive markets The perfect competition model. Price taking behavior. Supply function. Market supply and market demand. The law of supply and demand. Equilibrium and comparative statics.

4. July 10: First Half

Basic pricing. Profit maximization and the elasticity rule.

4. July 10: Second Half

Basic pricing. Profit maximization and the elasticity rule.

5. July 15*: First Half

DUE AT START OF CLASS: INDIVIDUAL PROBLEM SET 3 (COMPETITIVE MARKETS).

DUE AT START OF CLASS: GROUP PROJECT 1 (CINEMEX).

Advanced pricing, I. Market segmentation.

5. July 15: Second Half

Advanced pricing, II. Versioning. Bundling.

Practice / Review.

6. July 17: First and Second Half

Strategy and games, I. Strategies and payoffs, normal and extensive-form games (tables and trees), best responses, Nash equilibrium.

Strategy and games, II. The prisoner's dilemma and other important games.

7. July 22**: First Half

Midterm examination (in class). Same format as the practice midterm (3 or 4 problems, largely quantitative). You may consult one page of notes (a standard-size piece of paper, single sided, with anything on it you like) and a calculator.

7. July 22: Second Half

Advanced Market Power and Strategic Thinking: Bidding in auctions.

Strategy and games, I. Strategies and payoffs, normal and extensive-form games (tables and trees), best responses, Nash equilibrium.

8. July 24: First Half

Pricing games. The Bertrand model and applications.

8. July 24: Second Half

Collusion How to stay out of jail and spot market manipulations, Legal matters.

9. July 29*: First Half

DUE AT START OF CLASS: INDIVIDUAL PROBLEM SET 4 (GAMES).

Finish Collusion and Start Assymmetric Information: The agency problem. The lemons problem.

9. July 29: Second Half

Asymmetric information, II. The agency problem. The lemons problem.

10. July 31: First Half*

DUE AT START OF CLASS: GROUP PROJECT 2 (NEWSPAPERS).

Strategic Entry & Commitment. Credibility. The value of commitment. First-mover advantages.

10. July 31: Second Half

Finish off outstanding business. Advanced topics...

11. August 5*: First Half

TAKE BEFORE CLASS: PRACTICE FINAL.

Advanced Topics according to interest. Either:

1. Networks, Externalities and public goods.
2. Economics of Taxation
3. Product Positioning and Differentiation

11. August 5: Second Half

Review session. Come with questions (this is why I want you to do a practice final before class).

12. August 7**

TAKE BEFORE CLASS: PRACTICE MIDTERM.

Review session. Come with questions.

Final examination (in class). Same format as the practice midterm (3 or 4 problems, largely quantitative). You may consult two pages of notes (a standard-size piece of paper with anything on it you like, you can use both sides) and a calculator.

Where in Baye are the Topics that We Cover in Class? [Baye 6th Edition]

This is a guide to the textbook. It is designed to help you find the bits in Baye that are relevant for the topics covered in class. When you read Baye, use the lectures as a guide to what is important: in some bits Baye goes into more detail than I think is useful.

- Demand
Pages: 36-45, 73-89, 117-147 (this last section is a good example of where Baye goes into a little too much detail, at times)
- Costs
Pages: 46-52, 177-87
- Competitive Markets
Pages: 52-64, 267-278
- Monopoly
Pages: 236-256 (very good background), 278-296, 397-401, 509-515
- Advanced Pricing
Pages: 404-417

As you can see the organization of Baye is somewhat different from how we run through things in class. After topic 5 things diverge a little more.

- Auctions
Pages 456-466
- Strategy and Games
Pages 352-365, 378-387
- Hazards of Price Competition
Pages 315-338 (but particularly 336-338)
- Asymmetric Information
Pages 450-455
- Competition and Cooperation
Pages 330-332, 339-340, 365-377
- Product Differentiation and Positioning
Baye is not helpful
- Entry and Exit
Pages 474-486
- Networks and Standards
Pages 497-500, 520-522

Where in Baye are the Topics that We Cover in Class? [Baye 5th Edition]

This is a guide to the textbook. It is designed to help you find the bits in Baye that are relevant for the topics covered in class. When you read Baye, use the lectures as a guide to what is important: in some bits Baye goes into more detail than I think is useful.

- Demand
Pages: 36-45, 73-89, 117-145 (this last section is a good example of where Baye goes into a little too much detail, at times)
- Costs
Pages: 45-52, 177-89
- Competitive Markets
Pages: 52-64, 267-280
- Monopoly
Pages: 236-256 (very good background), 280-296, 397-399, 509-518
- Advanced Pricing
Pages: 404-414

As you can see the organization of Baye is somewhat different from how we run through things in class. After topic 5 things diverge a little more.

- Auctions
Pages 455-466
- Strategy and Games
Pages 352-365, 378-386
- Hazards of Price Competition
Pages 315-338 (but particularly 336-338)
- Asymmetric Information
Pages 449-455
- Competition and Cooperation
Pages 330-332, 339-340, 365-377
- Product Differentiation and Positioning
Baye is not helpful
- Entry and Exit
Pages 474-486
- Networks and Standards
Pages 494-500, 518-522

Where in Baye are the Topics that We Cover in Class? [Baye 4th Edition]

This is a guide to the textbook. It is designed to help you find the bits in Baye that are relevant for the topics covered in class. When you read Baye, use the lectures as a guide to what is important: in some bits Baye goes into more detail than I think is useful.

- Demand
Pages: 34-41, 71-89, 112-139 (this last section is a good example of where Baye goes into a little too much detail, at times)
- Costs
Pages: 43-50, 173-84
- Competitive Markets
Pages: 50-63, 260-273
- Monopoly
Pages: 231-252, 273-290, 392-396
- Advanced Pricing
Pages: 398-419

As you can see the organization of Baye is somewhat different from how we run through things in class. After topic 5 things diverge a little more.

- Auctions
Pages 449-459
- Strategy and Games
Pages 347-359
- Hazards of Price Competition
Pages 308-340 (but particularly 331-332)
- Asymmetric Information
Pages 442-449
- Competition and Cooperation
Pages 335-337, 361-374
- Product Differentiation and Positioning
Baye is not helpful
- Entry and Exit
Pages 466-482
- Networks and Standards
Pages 486-492

Where in Samuelson & Marks are the Topics that We Cover in Class? [4th Edition]

This guide is designed to help you find the bits in S&M that are relevant for the topics covered in class. When you read S&M, use the lectures as a guide to what is important: Be aware that S&M is a little more advanced than Baye. Its great advantage is that it has sensible coverage about how to take the concepts we cover in class to data.

- Math Preliminaries
Pages: 66-71
- Demand
Pages: 80-96 (127-133 is advanced, but relevant to aspects of asset pricing theory in finance) (139-173 is a good introduction to estimating demand)
- Costs
Pages: 261-301
- Competitive Markets
Pages: 321-350
- Monopoly
Pages: 96- 117, 360-371, 492-499
- Advanced Pricing
Pages: 419-423

The organization of S&M is somewhat different from how we run through things in class. After topic 5 things diverge a little more.

- Auctions
Pages: 718-747
- Strategy and Games
Pages: 434-461 (484-489 is advanced, a technical aspect of formal game theory)
- Hazards of Price Competition
Pages: 408-415
- Asymmetric Information
Pages: 512-515, 632-645, 653-658, (675-679 is advanced) (591-610 is helpful background)
- Competition and Cooperation
Pages: 371-375, 461-465
- Product Differentiation and Positioning
Pages: -
- Entry and Exit
Pages: -
- Externalities, Networks and Standards
Pages: 499-512

Group Project I: The California Electricity Market

In recent years, the California electricity market has been in the news frequently. For a time, California generators were selling power at prices several times higher than those in other states. The question is why. This project uses recent data that have been gathered on the California electricity market to investigate important issues of supply, demand, and strategic behavior.

For the purposes of this project, we will use the data on generating capacity and marginal costs for power generation units in California, in the spreadsheet project_electricity.xls. The spreadsheet contains capacity and cost information for the main power generation plants in California.

There are two types of electricity generating plants in California: thermal and hydro. Thermal Generation plants (all but two of the generation plants) have a variable cost that is based upon its fuel cost, thermal efficiency, and variable operation and maintenance (O&M) costs. These marginal costs (in \$/MWh) are constant up to the full capacity of each plant. For example, consider a 1,000 MW generation unit alpha, which has a fixed O&M cost of \$2500, a variable fuel cost of \$20/MWh and a start-up cost of \$1,000. If the unit's owner decides not to operate generation unit alpha in any of the day's 24 hours, its costs are \$2,500. If the owner operates alpha at 100 MW for 1 hour of the day, its costs are $\$2,500 + \$20 \cdot 100 + \$1,000 = \$5,500$. If the owner operates alpha at 500 MW for hours 1 and 3 of the day, and at zero in all other hours, its costs are $\$2,500 + \$20 \cdot 500 \cdot 2 + \$1,000 \cdot 2 = \$24,500$.

Two of the generation plants, Big Creek and Helms, are run-of-river hydro plants. These units have no fuel costs. Being run-of-river, the plants can generate a given amount of power each hour at zero fuel cost, though there is still a small variable O&M cost. They cannot generate more than their run-of-river quantities.

Suppose, for the purpose of this exercise that market demand is inelastic with constant demand of 19,000MW. Suppose also that all firms have committed to pay their fixed costs (that is, they are sunk).

- (a) Assuming that firms behave as price takers, what is the equilibrium price?
- (b) Suppose it's summer and market demand increases to 20,000 MW. What is the new market price?
- (c) What happens to the price if a drought takes the run-of-river plants out of operation? Consider the impact both during periods of high demand (20,000 MW) and low demand (19,000 MW). Comment.

Let us continue with the assumption that run-of-river plants are out of operation. Further suppose that the Reddy Kilowatt Organization (RKO) owns the following generation facilities:

Diablo Canyon 1
Mohave 1
Mohave 2
Hunters Point 1& 2

- (d) RKO has been running its facilities at full capacity and selling everything that it produces at the current market price. What would happen to RKO's profit if it stopped producing at Hunters Point 1&2? Consider separately the cases of high and low demand.
- (e) Hunters Point 1&2 is scheduled to shut down for a month of maintenance work. Should RKO do so during the summer (high demand) or during the rest of the year (low demand)? (Note in answering this question, abandon the assumption that RKO is a price taker. Instead, assume that the firm correctly anticipates the impact of its decision on market price.)
- (f) Discuss your answers to the previous two questions in no more than two or three paragraphs.

Notes

The values in the file "project_electricity.xls" are based upon data for the seven largest generation firms in the California market. The numbers were constructed from public sources and generously provided by Severin Borenstein and James Bushnell of the University of California at Berkeley.

Written by Stern Economics Department for the purpose of class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Group Project 2: Newspaper Wars

Since Rupert Murdoch took over the archrival *New York Post*, a series of price cuts and retaliatory moves have taken place. These events have severely affected industry profits. Leonard N. Stern, formerly owner of *The Village Voice*, summarized the situation as follows:

The *Daily News* is the dominant tabloid of the city, and it is now under challenge for its life. This is it. I believe the battle has been joined. When it's over, things are not going to look the way they do today.

And referring to Rupert Murdoch's willingness to take losses, he added:

I've been in many businesses, including publishing. I can tell you categorically: I don't want to be in any business where I have to compete with Rupert Murdoch.

You have been hired by the *Daily News* as a strategy consultant. During your first meeting with the management of the *Daily News*, the situation was summarized as follows:

Everything was fine until Murdoch took over the *Post*. Currently, we are both pricing at 25¢, down from our normal 50¢. True, circulation and advertising revenues have gone up, but the problem is that our net profit is down by a lot. You can look at it from two points of view. One is: with low prices we are leaving a lot of money on the table. The other one is: we are playing the game against a fellow named Murdoch.

At the meeting, you were provided with circulation and revenue data for both papers, which is available in the project_dailynews.xls spreadsheet. You'll see there that newspapers have two important sources of revenue: sales and advertising. Advertising is tied to circulation, so a lower price that generates higher circulation may raise advertising revenue. At the meeting with the *Daily News*, you were also told that overhead costs are in the order of \$525k a week for both firms. Marginal costs are estimated to be 12¢ for the *Post* and 13¢ for the *News*. Also, for both papers, depreciation of equipment (printing presses, trucks, computers, etc.) averages at about 8¢ a copy (although it is higher when circulation is lower and vice versa). All of this information is common knowledge throughout the industry.

The senior management of the *Daily News* wants a short report that addresses the following questions with respect to the pricing of newspapers:

- (a) Suppose that each firm's newspaper price is set only once and must be either 25¢ or 50¢. What price should the *Daily News* charge? Explain.

- (b) Suppose that prices are set only once but each newspaper has complete flexibility as to what price to charge (rounded off to the nearest penny). What price should the *Daily News* charge? Explain.

Since round numbers—especially 25¢ and 50¢—are clearly “focal points” for tabloid pricing, let’s return to the choice of just those two price points. And for purposes of simplification, let’s assume that *both* newspapers have symmetric payoffs, and assign the hypothetical values as given by the matrix below:

		Post	
		50¢	25¢
News	50¢	270, 70	300, 190
	25¢	300, 70	190, 190

- (c) Provide a week-by-week “dynamic” strategy for pricing that the Daily News's management can continue to implement after your consulting engagement has ended. In essence, you must give them instructions—an explicit algorithm—for what price (50¢ or 25¢) to set at the beginning of every week (starting with week 1), based on whatever information you believe is relevant from the history (experience) of prices and pricing in previous periods at each weekly decision point. You should use a 52-week time horizon. You should also justify your strategy.

Notes

Some of the data in this assignment is adapted from the article “Daily News Opens a New Front in the Tabloid War; Free Paper Raises Stakes in Battle With Post,” by Felicity Barringer with Jayson Blair, *The New York Times*, September 11, 2000.

Written by Stern Economics Department for the purpose of class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. While this case was inspired by real-world events, some of the characters and figures are fictional.

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Problem Set I: Math Revision

The Main purpose of this is self-diagnosis: if any of this looks wildly unfamiliar then you should come to the math review session.

(1) **Linear equations**

Solve the following system of linear equations: (i.e. find the values of x and y)

$$x = 10 - 2y$$

$$y = x + 4$$

(2) **Quadratic equations**

a) Knowing that $p > 0$, determine the solution to the equation $p^2 = 20$

b) Solve the equation $5 = \frac{1}{y^2}$

(3) **Logarithms**

Solve the following equations:

a) $\log_{10} x = 4$.

b) $\ln x = 4$

(4) **Derivatives**

Compute the derivatives of the following functions

a) $2y^3 + 4y$

b) $(x + 3)(2 - x)$

c) $(\frac{1}{2})q^2 + q$

d) $6q + 7q + 3(2q + 1)$

e) $(q^3 + q)^2$

(5) **Derivatives of derivatives**

Compute the second derivatives of the functions in the previous exercise.

(6) **Maximization**

Find the value of q that maximizes the value of the following function, $\pi(q)$:

$$\pi(q) = (100 - q)q - ((\frac{1}{2})q^2 + q)$$

Problem Set 2: Demand and Costs

1. *Wireless demand.* AT&T Wireless estimates that demand for its service has an elasticity of -1.5 . In 2001, 18mm customers generated revenues of approximately \$ 12.5 billion at an effective price of about 10 cents a minute. If elasticity is constant, what would revenues be at a price of 8 cents? 9 cents? 11 cents?

Data For Question 2

Year	Avg Commission (%)	Turnover (% of Market)	Year	Avg Commission (%)	Turnover (% of Market)
1960	0.74	12			
1961	0.78	15	1980	0.52	36
1962	0.72	13	1981	0.48	33
1963	0.8	15	1982	0.40	42
1964	0.87	14	1983	0.32	51
1965	0.88	16	1984	0.26	49
1966	0.82	18	1985	0.22	54
1967	0.83	22	1986	0.21	64
1968	0.85	24	1987	0.22	73
1969	0.78	20	1988	0.23	55
1970	0.77	19	1989	0.24	52
1971	0.80	23	1990	0.25	46
1972	0.74	23	1991	0.24	48
1973	0.66	20	1992	0.23	48
1974	0.90	16	1993	0.21	54
1975	0.83	21	1994	0.19	54
1976	0.68	23	1995	0.18	59
1977	0.65	21	1996	0.16	63
1978	0.66	27	1997	0.10	69
1979	0.55	28	1998	0.08	76

Data adapted from Charles Jones, “A century of stock market liquidity and trading costs.”

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2. *NYSE demand.* In 1975, the SEC ordered the New York Stock Exchange to “deregulate” a commission structure that dated back to the 1790s. As expected, the resulting competition drove commissions on round-lot trades down substantially. Perhaps less expected, the drop in commissions triggered a sharp increase in trading volume. The table on the next page gives annual data on commissions (expressed as a percentage of the value of the trade) and the number of transactions (turnover, expressed as a percentage of the value of the market). Your mission is to use this data to estimate the elasticity of demand for NYSE brokerage services.

- (a) Graph the commission against turnover.
- (b) Draw a line approximating the set of points. Use the line to estimate the elasticity of demand. Does it appear to be constant?

-
- (c) One of the difficulties in estimating an elasticity is that the demand curve can shift over time as the economy evolves. What factors might have affected the demand for brokerage services over the last forty years? How might they affect your estimate of the demand curve and the resulting elasticity? Does it make sense to you to measure quantity as a percentage of market value?

3. Costs. After working for years as a chef, your cousin Jared is thinking about opening his own restaurant and has asked you to help with his financial analysis.

Basic expenses. To open a restaurant, he will have to quit his current job (which pays \$46k a year) and invest his savings of \$200k (currently earning 6% annually) in equipment. He estimates he will have to spend \$4k during the first year to maintain the equipment and preserve its market value of \$200k. He would not pay rent: his father gave him title to a small building, whose current tenant is a shopkeeper. The tenant estimates that she nets \$3000 a month from sales, over and above the \$2500 a month she pays in rent.

Other expenses. He anticipates spending \$50k a year for food, \$40k for extra help, and \$14k for utilities and other supplies during the first year of operations.

Jared's question to you: How much revenue would he have to generate to make his first year more profitable than staying in his current job?

4 Costs and supply. Analysts estimate that a firm's costs are

$$C(q) = 100 + 4q + q^2.$$

- (a) What is the firm's fixed cost?
(b) Graph the average cost curve. At what output level is average cost lowest?
(c) Graph the marginal cost curve. At what quantity are average and marginal cost equal?
(d) What is the firm's supply curve? In other words: At each price p , how much would it choose to produce?

PROBLEM SET 3: COMPETITIVE MARKETS AND MONOPOLY

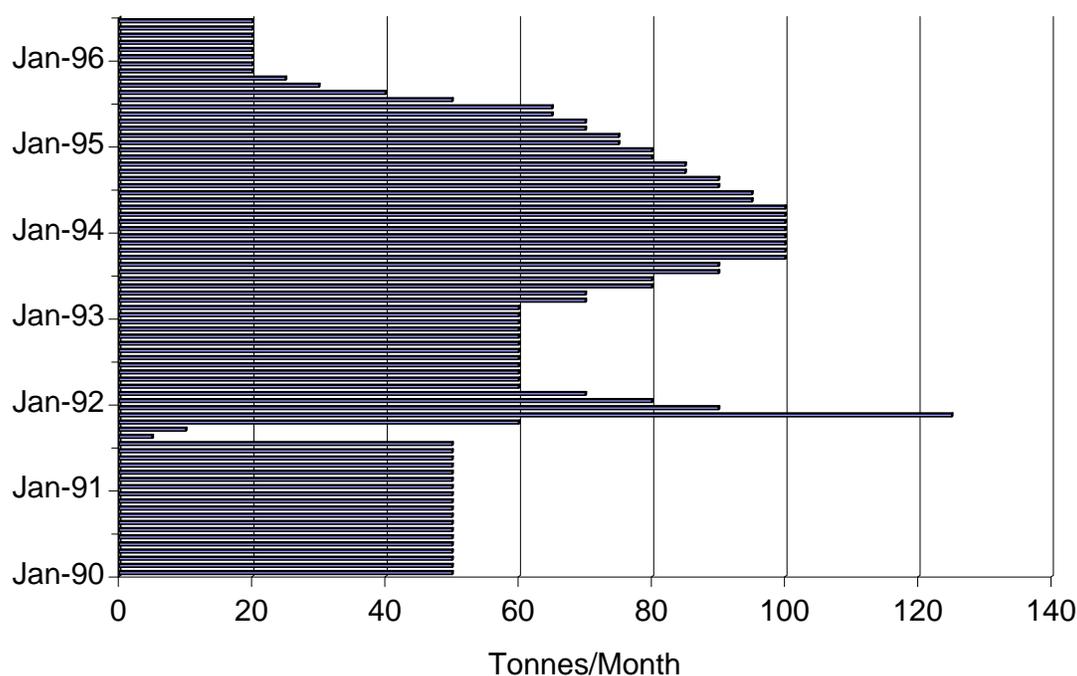
1. **Supply and demand.** Consider a market with a demand function $Q = 20 - p$. There are ten firms currently operating. Each has a variable cost of $VC(q_i) = (q_i)^2$ and a fixed cost of 4.

- Find TC, MC, and AC for a representative firm.
- What is the supply curve for a single firm? For the entire market?
- What are the equilibrium price and quantity?
- At the equilibrium price, what is output and profit for each firm? Do you expect the price to be stable, increase, or decrease?
- What is the “long-run” price in this market? How much will each firm produce at this price?

2. **Coconut production in Fiji** has been a tough business for many years. Fiji exports most of its commercial coconut production. The global market for coconuts is perfectly competitive and Fiji production has little impact on the world price. Fiji takes the world price as given. The data below shows monthly Fiji commercial coconut exports for the 1990's. Exports are defined as tonnes shipped per month. To be counted as shipped the product must leave Fiji and enter a destination country. It tends to take about 8 weeks for coconuts to be shipped to final consumers, regardless of their country of origin.

Coconut palms are plentiful in Fiji and the main problem in production is finding labor for harvesting and obtaining transportation and storage facilities.

Fiji Coconut Exports Jan 1990 - June 1996



After consulting industry experts you discover the following:

- In August of 1991 the Maldive Islands, a major coconut producer, was hit with a sizable Tsunami which wiped out 50% of its crop and 20% of its coconut palms.
- In February of 1993, L'Oreo (a well known cosmetics brand) decided to base its entire global range on coconut oils.
- In April 1994 Trinidad Coconuts Inc., of Trinidad, started using their patented Harvest-O-Matic coconut harvester which reduced their production costs by 90% and allowed them to increase their productive capacity by 400%.
- In July 1995, the global price of pearls increased by 250%. Fiji being surrounded by many natural reefs which produce pearls naturally increased pearl production by a similar order of magnitude.

Account for the patterns in Fiji coconuts exports during the following periods [10 points each]:

- January 1991 to December 1992
- January 1993 to December 1993
- January 1994 to June 1995
- July 1995 onwards

Monopoly Related Questions:

I. Market shares. The following tables summarize 2001 market shares for investment banking and credit cards (data courtesy Mike Mayo's March 2002 analyst report on Citigroup for Prudential Financial):

Investment Banking (Fees)		Credit Cards (Receivables)	
Goldman Sachs	13.7%	Citigroup	18.0%
Morgan Stanley	11.2%	MBNA America	13.5%
Merrill Lynch	11.0%	First USA/Bank One	12.3%
Citigroup (SSB)	10.4%	American Express	9.3%
CSFB	9.5%	Discover	8.7%
JP Morgan	6.9%	Chase	7.4%
UBS Warburg	4.5%	Providian	5.9%
Lehman Brothers	4.4%	Capital One	5.8%
Deutsche Bank	3.4%	Bank of America	5.1%
Dresdner Kleinwort	3.4%	Household Bank	2.9%

- Compute the HHI for each of these markets. (You should read ahead in the notes – this should not be overly hard)
- What would the DOJ merger guidelines suggest about a merger between Goldman Sachs and Merrill Lynch?
- What would the DOJ merger guidelines suggest about a merger between Banc One and American Express?

2. Pricing pharmaceuticals. The global pharmaceuticals giant, MelCo, has had great success with Xamoff, and over-the-counter medicine that reduces exam-related anxiety. A patent currently protects Xamoff from competition, although rumors persist that similar products are in development. Two years ago, MelCo sold 25 million units for a price of \$10 for a package of ten. Last year it raised the price to \$11, and sales fell to 22 million units.

-
- (a) Estimate the elasticity of demand for this product.
 - (b) MelCo is considering a further price increase to \$12. Estimate the impact on the quantity sold. Do you expect revenue to increase or decrease?
 - (c) A financial analyst estimates the cost of production at \$2 a package. What price maximizes MelCo's profit?
 - (d) When the patent expires in 2010, what do you expect to happen to demand? What about the elasticity?

3. Software versions. Your startup software company has just completed the first version of SpokenWord, a voice-activated word processor. You currently have no direct competitors. As marketing manager, you must decide how to price it. You commission a study that suggests that there are two markets, professionals and students, with one million customers each. Professionals are willing to pay up to \$400 and students up to \$100 for the full-feature version. A scaled-down version is worth \$50 to students and nothing to professionals. Both versions are essentially free to produce.

- (a) What prices of the two versions generate the most revenue?
- (b) Suppose that, instead of the scaled-down version, the firm offers an intermediate version worth \$200 to professionals and \$75 to students. What prices generate the most revenue now? Is the firm better off selling the intermediate or scaled-down version?
- (c) (Optional) How might your answer change if customers who buy your product tend to stick with it in the future, even if competing products appear on the market?

PROBLEM SET 4 (Games)

1. Matrix game. Use the following game to answer the questions below:

		PI				
		L	C			
		125	250			
PI	T	100	300	200		
		0	500			
	M	250	500	750		
		-100	300	350		
	B	0	400	-100		

- (a) Find each player's dominant strategy, if it exists
(b) Find the Nash equilibrium

2. Another matrix game. Consider the following two-player, three-strategy game:

		Plav		
		L	C	R
Plav	T	1	1	1
		2	0	1
	M	2	2	2
	B	10	0	3

- (a) Find each player's dominant strategy, if it exists
(b) Find the Nash equilibrium

Question 3 on next page....

3. Intel and AMD. The following normal form game depicts the pricing rivalry between Intel and AMD for their newest top-of-the-line chip. Each company considers five possible price levels: \$449, \$399, \$349, \$299 and \$249. Monthly profits in million dollars are:

		AMD				
		449	399	349	299	249
Intel	449	200	180	150	120	95
	399	230	210	160	130	110
	349	210	190	180	140	120
	299	180	170	150	120	100
	249	120	110	105	95	90

- Find each firm's best response to each possible strategy of the other.
- What is (are) the Nash equilibrium (equilibria) of the game?
- What combination of strategies generates the highest total profit? Why might the two firms not be able to come to an agreement on this outcome?
- What aspects do you think are left out in this game? (This is an open question; please limit your answer to a paragraph or two.)

- 4 (From a previous exam): This question pulls together a lot of the issues covered in the course so far...

The graph on the next page shows the industry for Artificial Intelligence Security Systems (AISS). AISS is a cutting edge security solution for banks, governments and other targets of coordinated denial of service attacks. The recent attacks on Estonia which shut down the entire countries internet backbone is a good example of the sort of system integrity problem that AISS is intended to deal with.

The data are price and quantity data for the past year. There is only one AISS algorithm which is embodied in software produced by DeepDish and GinaVI. The software they produce is basically identical.

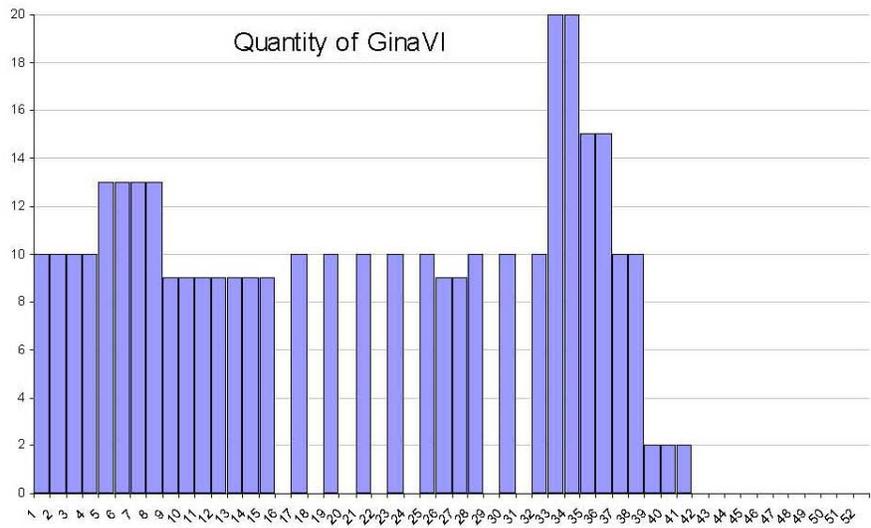
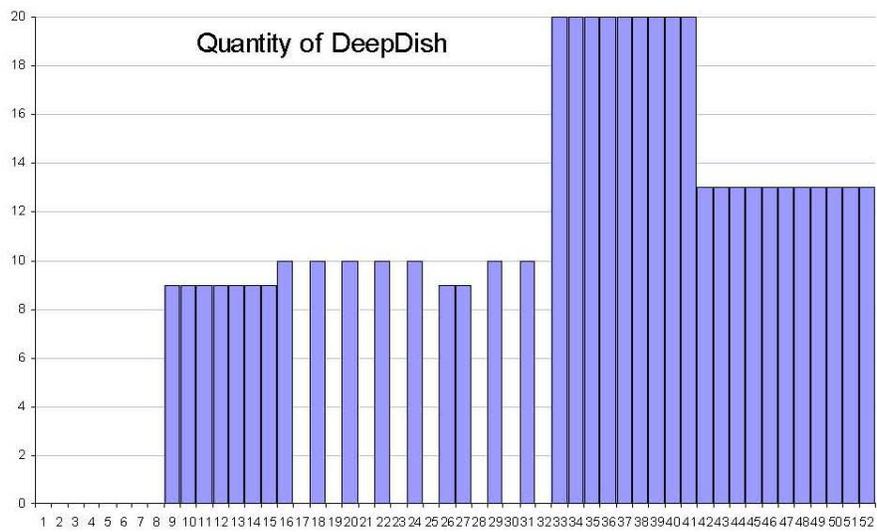
At the start of the year GinaVI was the only producer in the market. At the end of week four Prof. Hilbert Space at MIT published a paper which improved the AISS algorithm which halved the time needed to integrate the algorithm into its host software, which in turn halved the effort needed to produce the software.

At the end of week 8 DeepDish entered the AISS market, with backing from RRK, the worlds second largest private equity firm. From that point on demand and cost conditions for both firms did not change.

Your research analysis reveals a press release announcing that GinaVI had ceased supplying the software at the end of week 42.

- a) How would you describe the market structure prior to week 9? (1 Point)
- b) Using a diagram, explain what happened between weeks 4 and 5? (5 Points)
- c) Using data from weeks 1-8, provide an estimate of the demand elasticity in the AISS market. [2 Points]
- d) Justify the validity of the estimate. [2 Points]
- e) Describe market activity between weeks 9 and 15 [3 points]
- f) Carefully explain market activity between weeks 16 and 32 [7 points]. (In your answer be sure to account for the dramatic volatility in the quantity supplied by each firm)
- g) What do you think is happening after week 33? Justify your claim. [5 Points]
- h) In week 48 GinaVI makes a formal complaint to the Federal Trade Commission. What do you think they might be complaining about? [2 Points] (challenge)
- i) Do you think that they have a complaint with a solid economic foundation? Justify your opinion. [4 Points] (challenge)
- j) Would your answer change if DeepDish did not have private equity backing? [4 Points] (challenge)

SEE GRAPHS ON NEXT PAGE



**Practice for that part of the course preceding the Midterm Examination
- Questions and Answers**

Some of these questions are better practice than others – the ones that are particularly useful I have indicated with a “\$”

1. (30 points) It’s been several years since the hugely successful launch of Xamoff, an over-the-counter medicine that reduces exam-related anxiety. Industry reports estimate sales last year at 20 million doses at a price of \$12 each. The product was developed by Professor Simon Bartov of NYU, who licensed pharmaceuticals giant Melco to produce it. You have learned, however, that because the product was developed at NYU, the University has the right to license one additional vendor. They have offered the license to you for \$2 per dose. Further research suggests that you would be able to produce for \$5/dose. The question is whether your costs are low enough to withstand the competition that may arise with Melco. You are worried, in particular, that the royalty to NYU may give you higher costs than Melco, whose cost structure is kept closely guarded.
 - (a) (\$) Market research suggests that the elasticity of demand for Xamoff is between -2 and -3 . Use each of these numbers to estimate Melco’s marginal cost.
 - (b) (\$) Suppose competition between you and Melco drives the price down to the marginal cost of the high-cost producer. Would you make money at this price?
 - (c) (\$) What do you tell NYU?

2. (40 points) A distant family relation is thinking of starting a pizza restaurant in the Village and would like your advice. He says that people in this business are making thousands of dollars a week and wonders whether he could do the same. You consult a friend in the restaurant business, who tells you that pizza is thought by consumers to be a homogeneous product. She also tells you that the demand for pizza is

$$Q = 84 - 2p,$$

and the cost function for a restaurant (they’re all the same) is

$$C(q) = 25 + 2q + q^2.$$

Price is measured in dollars per pizza. Quantities are measured in thousands of pizzas per week. The capital “Q” in demand is a reminder that this is the demand curve for the whole industry.

- (a) (\$) Does pizza-making have a fixed cost?
- (b) (\$) Draw the average and marginal cost AC curves, showing their most important qualitative features. Show that the minimum of the average cost curve is at $q = 5$. (If you can’t show this, please assume it for the rest of the problem.) What are average and marginal cost at this level of output? What is the supply curve for a single restaurant?

- (c) Given the cost structure and demand, how many restaurants will operate in this market in the long run? (this is a question I hate, but the answer is below if you are interested)

Suppose that, in the short run, there are 10 restaurants operating.

- (d) (\$) What is the market supply curve?
 (e) (\$) What is the equilibrium price of pizza? At this price, do the existing restaurants make money?
 (f) (\$) What would you tell your relative?
3. Supply and demand [33 points]. For each of the following, use a supply and demand diagram to deduce the impact of the event on the stated market. Would you expect the impact to be primarily on price or quantity? Feel free to mention issues that you don't think are captured by a traditional supply and demand analysis.
- [8 points] (\$) Event: The FDA announces that aspartame may cause cancer. Market: Saccharin. [Comment: aspartame and saccharin are low-calorie sweeteners.]
 - [9 points] (\$) Event: Oil price increases. Market: California electricity.
 - [8 points] (\$) Event: Innovation reduces price of avionics (airplane electronics). Market: airplane engines.
 - [8 points] (\$) Event: An import tariff is imposed on steel. Market: aluminum.

Suggested Answers

- Xamoff knockoff.
 - One version of the elasticity formula is $p(1+1/\epsilon) = MC$. With $\epsilon = -2$, $MC = 6$. With $\epsilon = -3$, $MC = 8$. The uncertainty about the elasticity thus translates into uncertainty about Melco's costs.
 - Your MC is 7: 5 for production, 2 for NYU. If the elasticity is -2 , you're in trouble: Melco could price below your cost and still make money.
 - You need to get NYU to budge. One approach might be to get them to accept \$1, which would allow you to match Melco's cost in the worst-case scenario. A more complex deal would be to tie the royalty to the market price: if the price falls to \$6, the royalty falls to \$1.
- Pizza: an analysis of a competitive industry.
 - Yes: $C(0) = 25$.
 - $MC(q) = dC/dq = 2 + 2q$. (This is a derivative.) MC is increasing (it's a straight line). AC is U-shaped (the U is a little flatter on the right side than the left, but that's a fine point). The min is where $AC=MC$ (this is a general result): $q = 5$. The marginal and average costs at $q = 5$ are both 12.
 - The supply curve for a single restaurant is given by the MC curve: $p = MC = 2 + 2q$. Or we'd typically say: $q = p/2 - 1$.
 - In the long run, firms will produce at the minimum of AC and therefore produce $q = 5$ and sell at price $p = 12$. At $p = 12$, demand is $Q = 84 - 2p = 60$, which leaves room for $60/5 = 12$ restaurants.
 - With 10 restaurants, we get 10q at each price: $Q = 10q = 10(p/2 - 1) = 5p - 10$.
 - Set supply equal to demand: $p = 94/7 = 13.43$. At this price, each restaurant supplies $q = p/2 - 1 = 5.71$. (Remember, units are thousands per week.) At this quantity, $AC = 12.09$ and profits are $5.71(13.43 - 12.09) = 7.65$ thousand dollars per week.

- (g) Advice: this is currently a profitable business and there's room for 2 more. After your relative enters, profits will drop. (You could compute the profit by redoing (e) with 11 restaurants.) And if another restaurant appears, profits will disappear altogether.

Q 3 Answer.

- (a) Saccharin and aspartame are substitutes. We would expect demand for saccharin to increase (demand curve shifts up/right). This would lead to an increase in the price of saccharin and the quantity produced. The supply is likely to be fairly elastic (flat) as there are several producers. Thus we would expect the main impact to be on quantity. [8 points: 5 for shift in demand, 3 for analysis of slope of supply curve.]
- (b) Oil is an input to some of the generating plants. This implies an upward shift in marginal cost of some plants (those that use oil). If the plants are the marginal ones (those determining the price) the price will rise. Since demand is inelastic, the primary impact will be on price. Otherwise, there's no impact: these plants simply make less money. Some of you may have also noticed that oil and electricity are substitutes (in the long run). This implies that you can also have a shift of the demand to the right. This increases the price even further, and makes the overall effect on quantity ambiguous [9 points: 5 for shift in supply, 2 for analysis of slope of demand curve, 1 for distinguishing between marginal plants and others, 1 for the additional impact on demand.]
- (c) Avionics and engines are complements. A fall in the price of avionics increases demand for engines, raising both price and quantity. We'd guess supply is relatively flat, so the main impact is on quantity. [8 points: 3 for noting the products are complements, 2 for shift in demand, 3 for analysis of slope of supply curve.]
- (d) Supply of steel shifts left/up because foreign steel is now supplied at a higher price. The domestic price of steel will thus go up. Since steel and aluminum are substitute products in various applications, this is likely to increase the demand for aluminum, as well as its price and the quantity produced. The number of aluminum suppliers is limited, so we would expect the main impact to be on price. [8 points: 5 for shift in demand, 3 for analysis of slope of supply curve.]

MORE QUESTIONS AND ANSWERS

1. What price art [33 points]? The Village Globe Theatre (off-off-off-Broadway) sold 175 tickets at \$10 per seat at its last show. As an experiment, they raised the price to \$11, and subsequently sold 150 tickets. The theater has a capacity of 250 and prefers prices in even dollar amounts. What price should it set?
- (a) [11 points] (\$) Estimate the price elasticity of demand in the vicinity of \$10/seat.
- (b) [11 points] (\$) If the demand curve is linear (every dollar reduction in price sells an additional 25 tickets) and the theater wants to increase its revenue, should it increase or decrease its price (from \$10) or leave it unchanged?
- (c) [11 points] (\$) What price generates the most revenue?

Answer.

- (a) The log estimate is $\log(150/175)/\log(11/10) = -1.617$. You could also do this with the percent change formula. An estimate based on changes starting from the \$10 price is

$$\varepsilon = (-25/175)/(1/10) = -10/7 = -1.43.$$

Or you could start from the high price, giving you an elasticity of

$$\varepsilon = (-25/150)/(1/11) = -11/6 = -1.83.$$

It's somewhat annoying that it makes a difference where you start, which is one of the reasons we prefer the log version. The relevant point here, though, is that the elasticity is

- less than minus one no matter how you compute it. [11 points for an accurate calculation of the elasticity.]
- (b) Decrease. There are several ways to see this. One is that revenue falls (from 1750 to 1650) when you raise price, so you might guess that reducing price raises revenue. Another is the elasticity: since it's less than minus one, revenue increases when you decrease price. [11 points for noting that revenue is lower and elasticity is less than -1 (4 off for missing either of these points).]
- (c) Finally, you can extrapolate demand to other prices since you're told that demand is linear: each one-dollar price reduction is associated with an additional 25 tickets. You can work out the revenue directly (multiply price times quantity). With even dollar amounts, the table looks like this:

Price	Quantity	Revenue
11	150	1650
10	175	1750
9	200	1800
8	225	1800
7	250	1750

- Thus a price of 8 or 9 generates a maximum revenue of 1800. [11 points for getting the right answer, either by this method, by using calculus based on a linear demand curve, or some other method. 7 points for getting an approximately right answer – for example, by using an approximate calculation of elasticity or not noticing that the elasticity isn't constant for this demand curve.]
2. Industry dynamics [34 points]. Industries are constantly evolving, with new products and production methods replacing old, less efficient ones. A concrete (if somewhat stylized) version follows. Two “old” firms produce using the same technology, whose cost function is

$$\text{Old: } C(q) = 16 + 2q + q^2.$$

A “new” firm has entered with a potentially more efficient technology that has higher fixed cost but lower average and marginal cost (Amazon?):

$$\text{New: } C(q) = 18 + 2q + q^2/2.$$

The question is how the two kinds of firms interact.

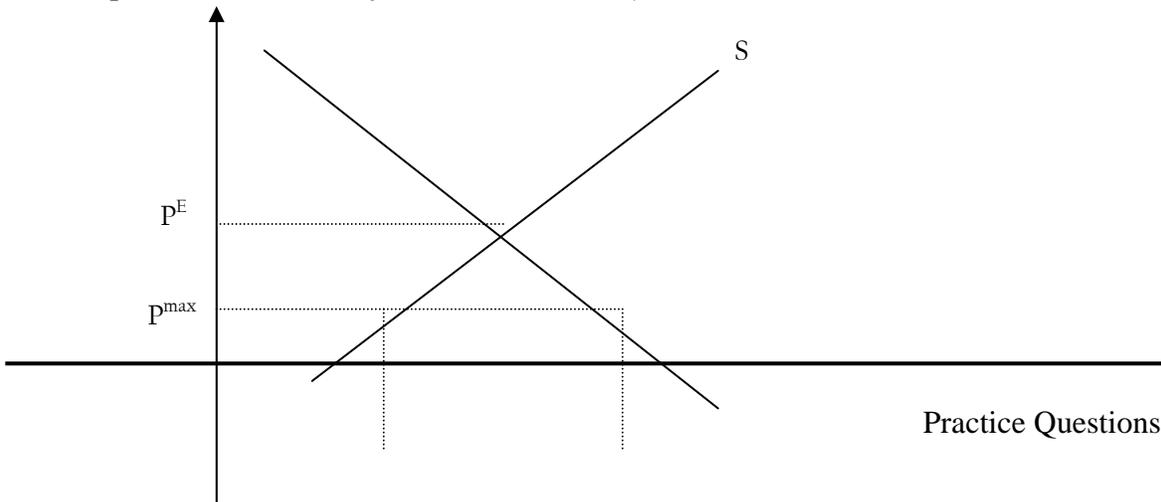
- (a) [7 points] (\$) Use a graph to describe qualitatively the AC and MC curves for old firms.
- (b) [12 points] (\$) Derive the supply curves for all three firms. What is the industry supply curve?
- (c) [8 points] (\$) If industry demand is $Q=32-p$, what is the equilibrium price? How much do the three firms produce, individually and in total?
- (d) [7 points] (challenge question) (\$) If the new firm's technology is widely available, how would you expect the industry to develop?

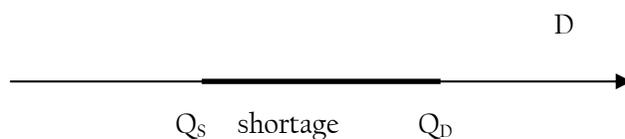
Answer.

- (a) If you included the fixed cost in the curves, it's the usual U-shaped AC and linear increasing MC (crossing AC at its minimum). If you did not, the two curves are two lines intersecting at $(q=0, p=2)$

- (b) Supply for old firms: $MC(q)=2+2q$. If $p=MC$, $q=p/2-1$. Supply for the new firm: $MC(q)=2+q$, so $q=p-2$. Industry supply: sum two old firms and the new one: $Q=2(p/2-1)+(p-2)=2p-4$. These are short-run supply curves (the fixed costs are sunk). In the long run, we would need to find the minimum average cost and use it to eliminate supply by unprofitable firms. [12 points: 4 for each supply curve, 4 for market supply.]
- (c) We equate supply and demand: $2p-4=32-p$, so $p=36/3=12$. At this price, the old firms produce 5 each (look at their supply curves) and the new firm produces 10. [8 points: 4 for equilibrium price, 2 for market supply, 2 for firm supplies.]
- (d) The old technology has a minimum AC of 10 at $q=4$, the new one has a minimum AC of 8 at $q=6$. You'd expect entrants using the new technology to take over. In this case, since the fixed costs are sunk, the old firms will hang in there at a low output level. For example, if the price is driven down to 8 (breakeven for the new technology), old firms will produce 3. You could also say that the old firm may have to pay the fixed costs again in the long run. In this case, with a price of 8 it won't do it and will be kicked out of the market [7 points: 4 for noting the difference in min AC, 3 for a discussion of entry.]
4. [25 points] What would be the effect of the following events on the *housing rental market in Manhattan*? Be sure to distinguish between shifts of the supply and demand curves and movements along the curves. Use a graph if necessary.
- [5 points] A new tax subsidy for home owners in New York State.
 - [5 points] (\$) A decrease in wages in New York City.
 - [5 points] (\$) A new wave of immigration from Eastern Europe.
 - [5 points] A new regulation that imposes a tax on home owners who keep their properties empty.
 - [5 points] A cap on the maximum rent the owners can charge.

Answer: (a) A tax subsidy for home owners shifts the demand curve to the left as renters choose instead to buy homes (buying is a substitute for renting). The equilibrium price and quantity both go down. (b) A decrease in the wages in New York City can have two opposite effects: first, it decreases both the number of people who want to live in Manhattan rather than in the other boroughs. This tends to shift the demand curve to the left. On the other hand, less of the Manhattan residents could want to buy an apartment rather than rent (because they cannot afford a mortgage they could afford before). This will tend to shift the demand curve to the right. The overall impact is ambiguous and depends on the magnitude of the two effects. (c) This will tend to shift the demand curve to the right. Hence, both the equilibrium price and quantity will go up. (d) This will tend to shift supply to the right as home owners will be more likely to rent their apartments. (e) If the cap is below the equilibrium price the cap will generate a shortage on the rental market (see picture below). (If the cap is above the equilibrium price, it won't have any effect on the market.)





5. [40 points] A friend of yours is thinking of opening a photo print lab in Nolita and would like your advice. Although the photo print market in Manhattan is very competitive, she claims there is room for more entrants. She also tells you that the demand for photo prints is given by

$$Q = 20 - 2P$$

and that the cost function of a photo print lab (they're all the same) is

$$C(q) = 1/2 + q + q^2/2$$

Price is measured in dollars per print. Quantities are measured in thousands of prints per week. The capital "Q" in demand is a reminder that this is the demand curve for the whole industry.

- (g) [8 points] (\$) Draw the average and marginal cost curves, showing their most important qualitative features. Show that the minimum of the average cost curve is at $q = 1$. (If you can't show this, please assume it for the rest of the problem.) What are average and marginal cost at this level of output?
- (h) [5 points] (\$) What is the short-run supply curve for a single lab (i.e. if the fixed cost is sunk)?
- (i) [7 points] Given the cost structure, what is the long-run equilibrium price? How many labs will operate in this market in the long run?

Suppose that, in the short run, there are 8 labs operating.

- (j) [8 points] (\$) What is the short-run market supply curve?
- (k) [6 points] (\$) What is the short-run equilibrium? At this price, do the existing labs make money?
- (l) [6 points] (\$) What would you tell your friend? Explain.

Answers

(a) $C(q) = 1/2 + q + q^2/2$

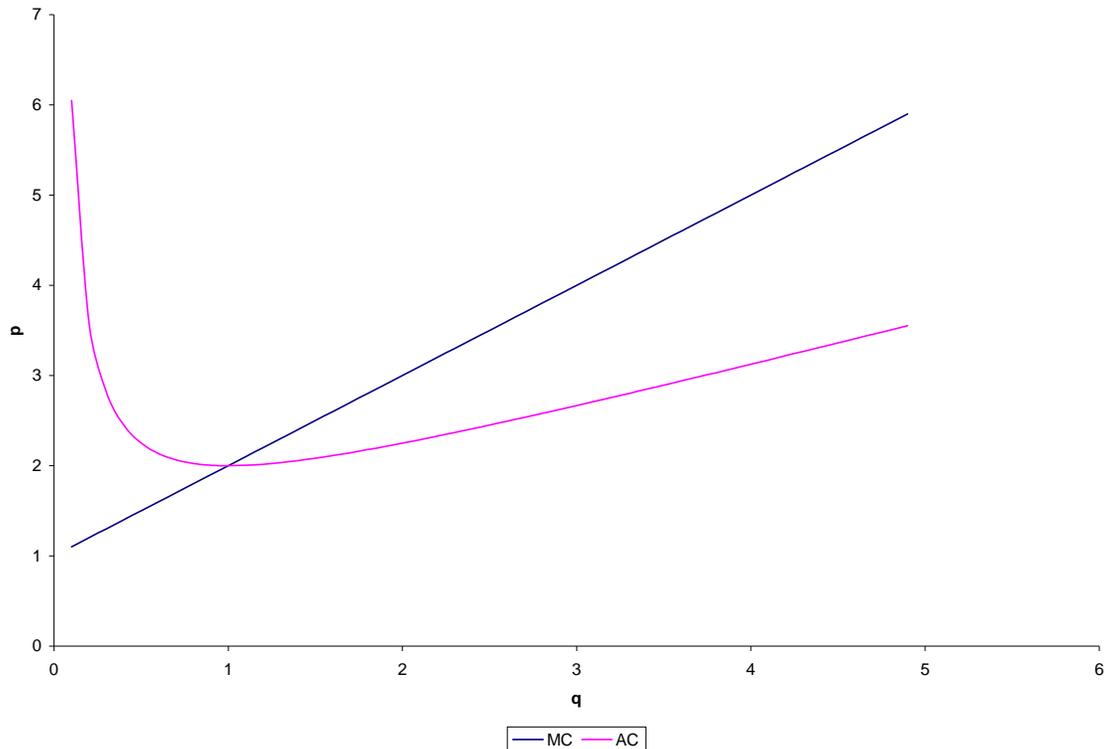
Average cost $AC(q) = C(q)/q = 1/2q + 1 + q/2$

Marginal cost $MC(q) = dC(q)/dq = 1 + q$

Note that the minimum average cost is where the MC and AC curves meet, that is where $1/2q + 1 + q/2 = 1 + q$ which is where $q^2 = 1$ or $q = 1$.

At this point $AC = MC = 2$. For lower quantities, $MC < AC$ and for higher quantities $MC > AC$

Graphically:



- (b) Short run supply for a single lab (assuming that it is producing a positive quantity) is given by $P=MC$
 $P = 1 + q_i$ or $q_i = P - 1$
- (c) Given the cost structure, in the long run, exit and entry of firms (assuming that the $\frac{1}{2}$ is a fixed cost rather than a sunk cost) implies that the price in the market will fall to the minimum average cost of an entrant.
 So here the long run equilibrium price (from part (a)) will be 2
 At this price total industry output would have to be 16 (from the demand curve) for demand to be satisfied.
 At a price of 2 (from part b) each firm will produce 1 unit of output.
 Since 16 units are produced in total then there would be 16 labs operating.
- (d) The supply of each individual firm (from part b) is given by $q_i = P - 1$.
 There are 8 firms, so total industry supply is given by $Q_s = 8P - 8$
- (e) The short run equilibrium is where total industry supply meets demand i.e, where $8P - 8 = 20 - 2P$, so $10P = 28$ or $P = 2.8$. At this price the existing labs make money (there are a number of ways to show this, the simplest is that since this price is strictly greater than the min AC then firms are making money, alternatively one could explicitly calculate that each firm supplies 1.8 units at a price of 2.8 from Part b and at this price and quantity, profits are 1.12).
- (f) You should advise your friend that at present there are opportunities to come in and make money in this market, but that others might also be attracted to come in and enter.

3 [35 points] A local tailor has two types of customers, individuals and department stores. There are 100 individuals and 10 department stores. Each individual has a demand given by $Q_I = 40 - P$, and each department store has a demand given by $Q_S = 200 - 10P$. The marginal cost of one more alteration is constant and equal to zero.

- [15 points] Suppose that the tailor can charge different prices to each type of customer. What are the optimal prices? What is the total profit?
- [10 points] What is the value of each demand's elasticity at the optimal price level? Comment.
- [10 challenging points] Suppose that a regulation prohibits price discrimination. What is the optimal (uniform) price? How much does the regulation cost the tailor in terms of forgone profits?

Answers

(a) For the individual customers, since there are 100 of them total demand is given by $Q = 4000 - 100P$. The inverse demand function is therefore $P = 40 - Q/100$
 $MR = 40 - Q/50$
 Marginal cost here is given by $MC = 0$
 Setting $MR = MC$ for this segment yields $Q = 2,000$ and at this quantity $P = 40 - Q/100$ implies that the price would have to be 20.
 For the department store segment, since there are 10 such stores, demand is given by $Q = 2000 - 100P$. The inverse demand function for this segment is $P = 20 - Q/100$
 $MR = 20 - Q/50$. Setting $MR = MC$ for this segment yields $Q = 1000$ and $P = 10$.
 Revenues from the individual customers are $2000 * 20$ and from the department stores $1000 * 10$. Since $MC = 0$, the operating profits (or the total profits if there are no sunk or fixed costs) are simply equal to the total revenue of 50,000.

(b) Since at the optimal point $MR = MC = 0$, the demand elasticity has to be equal to -1 in both markets.

(c) To find the optimal price we have to find the total demand first. The total demand is $Q = 100(40 - P) + 10(200 - 10P) = 6000 - 200P$. The inverse demand is $P = 30 - (Q/200)$. From this you get $TR = Q(30 - (Q/200)) = 30Q - (Q^2/200)$, and $MR = 30 - (Q/100)$. To find the optimal price set $MR = MC$ and get $Q = 3000$ and $P = 15$. The profit in this case is 45,000, and the cost to the tailor of the regulation is $50,000 - 45,000 = 5,000$.

- Supply and demand [33 points]. Industry analysts tell us that in the market for "whatsits" supply and demand are:

$$\text{Supply: } Q = 2p$$

$$\text{Demand: } Q = 100 - 2p$$

Prices are measured in dollars and quantities in thousands.

- [15 points] (\$) What price would you expect to clear the market? How many are sold at this price?
- [8 points] (\$) What is the elasticity of demand at this price and quantity?
- [10 points] (challenge question) (\$) At the market-clearing ("equilibrium") price, what is producer surplus? Consumer surplus? (Please illustrate both concepts in a supply/demand diagram and compute their dollar values.) What do the surpluses mean?

Answer.

- (a) Equate supply and demand: $Q=2p=100-2p$. Therefore $p=25$ (dollars) and $Q=50$ (thousand).
- (b) The elasticity (this is a definition) is $\epsilon=(dQ/dp)(p/Q)$. We find the first part from the demand curve: $dQ/dp=-2$ (this is a derivative). The elasticity is therefore $\epsilon=(-2)(25/50)=-1$. (Pure luck that it turned out this way.)
- (c) Consumer surplus is the triangle below the (inverse) demand curve ($p=50-Q/2$) and above the price. Its height is 25 (the difference between its intercept of 50 and the price of 25) and its width is 50 (the equilibrium quantity). The area of the triangle is $25 \times 25 = 625$. Similarly, producer surplus is the triangle above the (inverse) supply curve ($p=Q/2$) and below the price, which has the same area. What it means? These market transactions have created additional value to buyers and sellers of $625+625=1250$.

6. Pricing cubed [34 points]. You're the monopoly producer of a new kind of high-capacity reusable storage device. You'd like to make sure you're pricing your product effectively, so you hire a consultant to estimate your demand and cost of production. She tells you inverse demand is

$$p = 25 - q$$

and your cost function is

$$C(q) = 15 + 10q + q^3/3.$$

(Quantities q are measured in thousands and must be positive.) You're initially skeptical (is she using q^3 just to show off?), but she convinces you the function is a good approximation to observed costs over the relevant range of production quantities (q between 0 and 10).

- [11 points] (\$) How much should you produce?
- [11 points] (\$) What price should you charge?
- [11 points] (\$) What is your profit at this price and quantity?

Answer.

- (a) This is a calculus problem, although you could also solve it (with more effort) by setting up a grid of values for q and computing profit at each one. Profit (as a function of q only) is

$$\text{Profit}(q) = (25-q)q - [15 + 10q + q^3/3].$$

To find the quantity that generates the highest profit, we compute the derivative and set it equal to zero: $25-2q - [10+q^2] = 0$. This has two solutions, $q=3$ (the one we want) and $q=-5$ (the one we don't want, because it's impossible to produce a negative quantity).

- At $q=3$, $p=22$.
- Profit is 12, computed as the difference between revenue (66) and cost (54).

7. Green power [33 points]. Using a new, clean, energy-efficient technology, startup CleanEn has proposed a new electricity generating plant downtown to serve the New York City electricity market. The new plant would be in direct competition with three existing plants, all of which have higher operating costs. CleanEn's management estimates that the costs of the various plants are:

Plant	Hudson	Red Hook	Astoria	Downtown
Manager	Con Ed	BHO	Banana	CleanEn
Year Built	1988	1975	1962	2003?
Capacity	200	100	150	100
Operating Cost (per unit)	18	21	25	12
Deprec + Interest (per unit)	12	8	3	12
Average Cost (per unit)	30	29	28	24

Operating cost is the marginal cost of producing a unit of electricity: labor, fuel, maintenance. Average cost adds to this depreciation on the plant and interest paid on the debt issued to finance it. Demand for electricity is currently 450. Analysts expect future demand to be stable with little sensitivity to price.

- (a) [11 points] (\$) What price would you expect if only the existing plants were operating?
 (b) [11 points] (\$) What price would you expect if CleanEn built its downtown plant?
 (c) [11 points] (\$) Should CleanEn build the plant?

Answer.

- (a) Each plant should be operated at any price at or above its marginal cost. The other costs are sunk: there's nothing they can do about them so they're irrelevant to the decision of how much to produce. At any price below 18, no plant will produce. At 18 the Hudson plant will produce up to 200. At 21 Red Hook will produce up to 100, so the supply at 21 is 300 units. At 25 Astoria kicks in, so we have a total supply of 450 at 25, which clears the market.
 (b) The price should remain at 25. Note that all old three plants lose money at this price, but they lose no more (and in two cases less) operating than shutting down.
 (c) With all four plants in operation, Astoria would produce 50 at a price of 25 or above. At this price, the Downtown plant makes money (price is greater than average cost).

Comments. There are a couple things missing from this traditional static analysis. One is demand: How stable is it? What are the prospects for growth? The other is potential competition: Do others have access to the same technology? Could they enter, too? Could existing plants upgrade their technology? You get the idea. For it to make sense to enter this market, you have to believe there's a reliable market and that others won't come in and undercut you.

1. Supply and demand [33 points]. For each of the following, use a supply and demand diagram to deduce the impact of the event on the stated market. Would you expect the impact to be primarily on price or quantity? Feel free to mention issues that you don't think are captured by a traditional supply and demand analysis.
 (a) [9 points] (\$) Event: War in Middle East. Market: World oil.
 (b) [8 points] (\$) Event: Increased fuel-efficiency of cars. Market: World oil.
 (c) [8 points] (\$) Event: Deregulation. Market: German retail fixed-line telecommunications.
 (d) [8 points] (\$) Event: Development of strong competitor to Roundup. Market: Roundup.

Answer.

- (a) Price rises, either through reduction in supply or the expectation of it.
 (b) Demand shifts left, price and quantity both fall. Primary impact on price because supply curve is steep.
 (c) Presumably the possibility of entry increases supply, which drives price down, quantity up. Our guess is that demand is elastic, so the major impact is on quantity.
 (d) We could look at this in several ways. If we consider the narrow market for Roundup alone, demand falls (some customers shift to the substitute). As a result, price and quantity both fall.
2. Derivative pricing [34 points]. Finance guru Marti Subrahmanyam has written a book on advanced financial derivatives based on his legendary course at Stern. His publisher estimates that the demand for the book comes from two groups, students (who are sensitive to the price) and bond traders (who are not). Their respective demand curves are

$$\text{Students: } q = 550 - 3p$$

$$\text{Traders: } q = 150 - p$$

His publisher tells him that it is impossible to charge the two groups different prices.

- (a) (\$) What is total demand for the book?
 (b) (\$) If it costs \$25 to produce each copy of the book, what price generates the highest profit? How many are sold at this price? What is the profit?
 (c) (challenge question) Suppose Professor Subrahmanyam offers his publisher a choice: he can take a fixed rate of \$25/book or 28% of total profits. How much would the publisher produce in each case? How much does he make in each case? Which does he prefer? Which does Professor Subrahmanyam prefer?

Answer.

- (a) [8 points] Add the two demands: $Q = (550 - 3p) + (150 - p) = 700 - 4p$.
 (b) [18 points] Profit (as a function of Q only) is

$$\text{Profit}(Q) = [(700 - Q)/4]Q - 25Q.$$

- To maximize profit, we differentiate with respect to Q and set the result equal to zero: $700/4 - Q/2 = 25$, so $Q = 300$. Price solves $300 = 700 - 4p$, so $p = 100$. Profit is $75 \cdot 300 = 22,500$.
- (c) [8 points] Profit-sharing is easy: maximizing two-thirds of profit is the same as maximizing profit, so the resulting price and quantity are the same. The publisher gets 72% of profit (16,200) and Professor Subrahmanyam gets 28% (6,300, which is \$21/book). But what about the other case (the \$25 royalty)? This raises marginal cost (from the publisher's perspective) from \$25 to \$50. The best quantity now solves (using the same method) $700/4 - Q/2 = 50$, so $Q = 250$. Price solves $250 = 700 - 4p$, so $p = 450/4 = 112.5$. Profit is $62.5 \cdot 250 = 15,625$, so the publisher prefers profit-sharing. Professor Subrahmanyam gets 6,250, so he also prefers profit-sharing.

What's going on? Incentives matter: the form of the contract makes a substantial difference to the publisher's decision. This is a general issue, one that will come up again later in the course.

3. Agility [33 points]. You are the manager of a firm that sells a "commodity" in a competitive market. Your cost function is $C(q) = q + 2q^2$. Your long lead-time on production means that you must decide how much to produce before you know the market price.

- (a) [15 points] Suppose you know that the price will be \$100. What output quantity maximizes expected profit? What profit do you make at this output?
- (b) [8 points] (challenge question) Suppose there is a 60% chance the price will be \$100 and a 40% chance the price will be \$200. What output quantity maximizes expected profit? What is your expected profit?
- (c) [8 points] (challenge question) Suppose you were able to make your firm more “agile:” to be able to react quickly enough to decide output after seeing the price. What output quantities would you choose at each price? What is your expected profit at these quantities? What is the expected value to you of agility?

Answer.

- (a) Profit is $100q - (q + 2q^2)$. We find the profit-maximizing price by taking the derivative with respect to q and setting the result equal to zero: $100 - (1 + 4q) = 0$. Therefore $q = 24.75$. At this output level, profit is $100 \times 24.75 - (24.75 + 2 \times 24.75^2) = 1225.125$.
- (b) Expected profit is $(0.6 \times 100 + 0.4 \times 200)q - (q + 2q^2)$. We find the profit-maximizing quantity by the usual method: take the derivative with respect to q and set the result equal to zero. So: $140 - (1 + 4q) = 0$ and $q = 139/4 = 34.75$. Expected profit at $q = 34.75$ is 2415.125.
- (c) Here you set production levels differently for the two possible prices. At $p = 100$, you set $q = 24.75$ and earn a profit of 1225.125 [see (a)]. At $p = 200$, you set $q = 199/4 = 49.75$ and earn a profit of 4950.125. Expected profit is $2715.125 = 0.6 \times 1225.125 + 0.4 \times 4950.125$, which is 300 higher than if you had chosen a single output quantity for both market conditions. In this sense, agility is worth 300 to you. The primary source of value here is the ability to produce more when the price is high.

QUESTION 10:

Two airlines, Flibinite Airways (FA) and Dayrdevl Inc. (DI), offer competing services on the Cleveland/Newark route. No other airlines fly this route. The companies are now considering possible advertising/promotion campaigns for next year, for which they will make commitments in December. Each is considering both a “modest” and a “heavy” campaign. Since they compete with each other, the campaign of each would have consequences for the other’s sales and profits. Also, since FA has a somewhat better safety record and a stronger brand name, its profits are higher. The estimated annual profits (in \$ millions) that each company could expect are known to each other (they have been reported in the trade press) and are as follows:

		FA	
		M	H
DI	M	80	20
	H	50	40

- (a) (\$) If each airline chooses its campaign without knowledge of the other’s choice, what campaigns are they likely to choose? Explain.
- (b) A consultant to FA has suggested that FA could commit to a choice of campaign in November and publicly announce its choice. Do you think that this is a good idea? Explain.

Suggested Answer:

- (a) FA chooses heavy; DI chooses heavy. Why? Heavy is a dominant strategy for FA: it produces higher payoffs whether DI choose modest or heavy. DI knows this, and therefore chooses heavy as well. Put another way, this is the Nash equilibrium.
- (b) Yes. If FA commits to moderate, then DI will also choose moderate, and FA's profits will be higher.

Question II: Game Theory and Commitment

(25 points – unless otherwise indicated, answer in the space beneath each question)

- a. (\$) What is meant by Nash Equilibrium? (1 point)
- b. (\$) What is meant by a strategy? (1 point)
- c. (\$) For each game represented below, describe any Nash Equilibria that exist. (3 points per game)

		Column Player	
		L	R
Row Player	U	2	3
	D	3	4

		Column Player		
		L	M	R
Row Player	U	3	3	3
	M	4	-1	3
	D	3	2	9

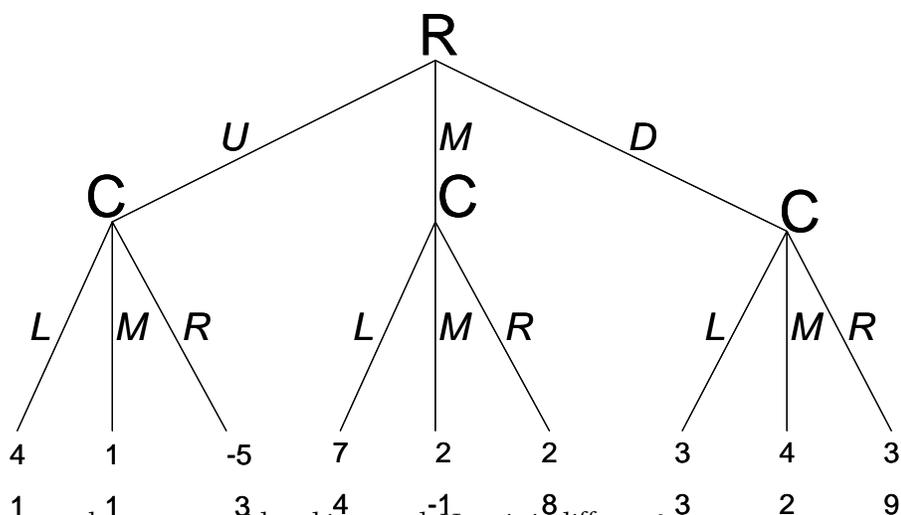
- d. Consider the following game:

		Column Player		
		L	M	R
Row Player	U	4	1	3
	M	7	2	2
	D	3	4	3

- i. (\$) Does the Column Player have any dominated strategies? If so, what are they? (2 points)
- ii. (\$) Does the Column Player have a dominant strategy? If so, what is it? (2 Points)
- iii. (\$) Does the Row Player have any dominated strategies? If so, what are they? (2 Points)
- iv. (\$) Does the Row Player have a dominant strategy? If so, what is it? (2 points)

v. (\$) What is the Nash Equilibrium in this game? (1 Point)

e. Consider the following game:



i. (\$) Compare this game to the game considered in part d. How is it different? (3 points)

ii. (\$) Imagine R (for Row Player) can either commit to moving first or wait and make their move simultaneously with C (for Column Player). If R commits then she plays a game like that above, if she does not the game is as in part d. Is there anything to be gained by such a commitment? Carefully justify your answer. (5 points)

Answers to Q2: Game theory and Commitment

a. see your notes

b. see your notes

c. Game 1: (D,L) only, Game 2: (M,L), (R,U), (D,R)

d. i. L & M, ii. R, iii. U, iv. no dominant strategy, v. (D,R)

e. i. in this game row moves first whereas before row and column moved simultaneously

ii. no gain from commitment – there is no difference in the outcome of equilibrium play in either game.

Practice for that part of the course after the first Midterm Examination - Questions and Answers

1. Vitamin C is a generic vitamin produced by many companies: entry is easy, brand names are not important. A good friend – a world-renowned orthopedic surgeon from New Jersey – tells you that he is about to publish in *The New England Journal of Medicine* (a highly respected and widely quoted medical journal) a study indicating that daily doses of 500 mg of vitamin C tend to improve muscle tone and increase physical stamina in adults, with no adverse side effects. Though a very good doctor, he is woefully ignorant about the basic workings of markets. He would like to know what is likely to happen, *and why*, to the price of vitamin C, to the quantity sold, to the profits of the producers, and to the number of firms that produce it. Consider these issues both in the short run and long run. Summarize what you would tell him.

Suggested Answer:

One would expect demand to increase as a result of the article. In the short run, supply is fixed. We would therefore observe a move along the supply curve, with both price and output going up. Current producers would see profits go up. The extent of the price hike would depend on the steepness of the supply curve: the steeper the short-run supply curve is, the greater the price increase.

In the long run, one would expect the supply function to shift right, as new producers enter the market and existing producers expand their capacity. If demand stays high, this would correspond to a movement along the demand curve, with output going up and price going down. Since there is easy entry, you wouldn't expect a high return on investments in new capacity.

To summarize: We would expect price to go up in the short-run, then back down in the long run, possibly to almost the same level as the initial level. As to output, we would expect it to go up, with a greater increase in the long run than in the short run. Except for a short-term impact on current producers, we would not expect much if any increase in profit.

2. (\$) (this may be covered before the first midterm) You are running a car dealership and notice that car buyers come in three "types," whose taste for optional air conditioning and power brakes varies. The three types are equally numerous. They value the two options as follows:

Consumer Type	Air Conditioning	Power Brakes
1	\$1,000	\$500
2	\$800	\$300
3	\$100	\$800

These values tell you, for example, that a consumer of type 1 values equally \$1000 in cash and air conditioning. Your cost is zero for both options.

-
- (a) (\$) If you can identify the type of a consumer, what prices for air conditioning and power brakes together maximizes your profit?
- (b) (\$) Suppose you cannot identify a buyer's type. If you have decided (take this as given) to sell brakes and air conditioners for \$800 each, what price of the two together maximizes your profit? Explain why such "bundling" might increase your profit over selling the options separately.

Suggested Answer:

- (a) If you know buyers' identities, you set prices to maximize revenue. The best you can do is to charge exactly the buyers' valuations (or just below). Thus you would get (for the two options together) 1500 from type 1's, 1100 from type 2s, and 900 from type 3s.
- (b) If only the \$800 prices were set, consumers 1 and 2 would buy an air conditioner and consumer 3 power brakes. Total revenue would be $3 \times 800 = 2400$. There are several possibilities regarding the price of the bundle. At 1500, consumer 1 would buy the bundle, generating an additional \$700 in revenue. At 1100, both 1 and 2 would go for the bundle, an additional $2 \times (1100 - 800) = 600$ in revenue. At 900, all three consumers would buy the bundle, for an added revenue of $3 \times (900 - 800) = 300$. We conclude that the optimal bundle price is \$1500. It's a classic example of how "bundling" can increase revenue.
1. Short answer [20 points, 5 each]. Briefly define and give an example of each of the following:
- (a) (\$) Winner's curse.
- (b) (\$) Adverse selection.
- (c) Holdup.
- (d) (\$) Herfindahl-Hirschman Index.

Answer:

- (a) In an auction with common values and estimation error, the winner will be the bidder with the most optimistic (and likely overoptimistic) estimate of the item's value. Example: bidding for the mineral rights of an oil track.
- (b) The tendency for offers to attract ("select") the least desirable customers. Example: health insurance may attract the highest health risks.
- (c) If a supplier must make a relationship-specific investment to produce inputs for a particular producer, she loses leverage over the sale once the investment has been made. We say she has been "held up." Example: GM and Fisher Body.
- (d) A summary measure of the degree of concentration in an industry: HHI = the sum of the squared market shares (expressed as percentages) of the firms in an industry. Example: In the US car market, the HHI is about 2500, indicating relatively few producers.
2. Raising venture capital [30 points]. An inventor is looking for a venture capitalist investor to fund the development of a radical new business idea. He estimates that it will cost \$5m to develop the idea. He is considering a partnership in which a venture capitalist supplies the \$5m and gets 90% of the profits in return, leaving 10% for the inventor. The inventor and venture capitalist have different information about the idea. The inventor knows whether the idea is good ("G") or bad ("B"), but the investor knows only that the idea is good or bad with probability 50% each.
-

After receiving the \$5m investment, the inventor can either work to develop the idea or simply spend it – for example, by spending the year in Hawaii “doing research.” The venture capitalist does not understand the development process well enough to tell whether going to Hawaii is productive or not. If the idea is good, and the inventor invests the \$5m, the project will generate a profit of \$100m. If the idea is good, but the inventor goes to Hawaii, there will be no profit. If the idea is bad, it will generate no profit regardless of what the inventor does. If the venture capitalist decides not to fund the project, both parties get zero.

- (e) [10 points] (\$) Draw a game tree describing the interaction between the inventor and investor, listing carefully all of the moves involved.
- (f) [10 points] (\$) What is the outcome of this game? Explain in words why the venture capitalist does or does not fund the project.

Answer.

- a. The order of moves: venture capitalist decides whether to fund or not, nature decides whether the idea is good or bad, and inventor decides whether to work or go to Hawaii.
- b. The inventor will go to Hawaii if the idea is bad (since $5m > 0$), work if the idea is good (since $100m * (0.1) > 5m$). The venture capitalist will fund the idea (since $100m * (0.5) * (0.9) - 5m > 0$).
3. YES network [30 points]. On April 1, 2002, as the New York Yankees opened its season in pursuit of another baseball championship, thousands of Yankee fans found themselves unable to watch the team on television. They were victims of a dispute between two industry powerhouses: Cablevision and the YES Network. Cablevision (which controlled cable television services in some New York City areas) refused to pay the YES Network (the Yankees’ new television channel) what it demanded for permission to air the broadcasts – namely, \$2 per-subscriber per-month. Cablevision’s initial offer was, in fact, only 50 cents.

The dispute between YES and Cablevision had deep roots. Major League Baseball teams owned the local broadcast rights to most of their games, and sold these rights to various television stations. In large markets like New York, these rights were extremely valuable, and the Yankees commanded the highest price of any team in baseball. In return, networks or stations that purchased rights earned advertising sales revenue (by selling commercial time during broadcasts) and in some cases subscription revenue (through customers who otherwise would be blocked from accessing the network).

The Madison Square Garden Network (MSG Network), a subsidiary of Cablevision, had held such rights to Yankees games since 1989, and was generally praised for above-average productions. The network had broadcast approximately 100 games per year and sold another 50 to an over-the-air (non-cable) network. But the Yankees wanted to start their own network. The result: the Yankees Entertainment and Sports Network (the YES Network), which debuted during spring training of 2002.

The conflict between Cablevision and YES, which prevented most Yankee games from appearing in Cablevision-wired homes, centered around two basic issues: first, whether the games would have been shown on “basic” cable (so that every subscriber could watch every game) or “premium” cable (so that Yankee fans would have to pay an additional fee to have access to YES); and second, how much money Cablevision would pay the Yankees for the privilege of transmitting their games.

An additional factor in the dispute was the increasing competition to cable of Direct Broadcast Satellite (DBS). The primary disadvantage of DBS had been its inability to provide customized, local programming (the signal was the same in Maine as in Seattle). However, legislation eventually allowed providers to broadcast many local stations at once, allowing customers to select the package best fitting their needs. One of the main players in the DBS industry in 2002 was DirecTV (owned by Hughes Electronics, in turn owned by General Motors).

- (a) [10 points] What are the advantage(s) and disadvantage(s) to the Yankees of creating their own channel, thereby integrating downstream into broadcasting?
- (b) [15 points] (\$) Price competition between cable and DBS was central to the Yankees' strategy. To see how this might work, suppose that the price that allows Cablevision to break even with revenue from subscribers and advertisement is \$2. Instead, due to less advertising revenue, suppose that DirecTV can afford to pay only \$1.50. Suppose, in addition, that broadcast rights can be sold to Cablevision or DirecTV, but not to both, that the two buyers have the same number of subscribers, and that they submit bids simultaneously to YES. If the Yankees set up a bidding war between Cablevision and DirecTV, what are their reaction curves? Who wins the bid? At what price?
- (c) [5 points] (\$) What other factors do you think might play a role in practice in the Yankees insisting on a price of \$2?

Answer.

- (a) Disadvantage: It's often cheaper to allow specialists to handle distribution (scale economies, core competence). Advantage: You gain greater leverage against cable companies, which are typically local monopolies. There's no obvious relationship-specific investment, supply chain coordination, or information issue.
 - (b) Cablevision would bid slightly above any bid by DirecTV, up to its limit of \$2. Similarly, DirecTV would bid just above Cablevision, up to its limit of \$1.50. The outcome is for Cablevision to get the bid at just over \$1.50.
 - (c) The Yankees might hold out for more than \$1.50 for a couple reasons: they demonstrate a tough bargaining stance with cable operators in other areas (Cablevision has only part of the NYC area) and they have an interest in fostering competition between cable and satellite. In fact, they might (and perhaps did) offer different prices to the two distributors.
1. (30 points) "A new breed of investment firm is capitalising on the boom in litigiousness and taking a piece of the profits. [These firms] underwrite lawsuits in exchange for a share of proceeds." (*Financial Times*, Dec 3, 2001.)

One example is Suits R Us. Potential plaintiffs come to them with cases. For each one, SRU decides whether or not to take it; if so, it offers a standard percentage rate contract. Given SRU's experience with many previous cases, the firm has a better idea than most plaintiffs of the odds that the case will win in court.

- (a) (\$) Suppose you have a potential case in hand (in which you would be the plaintiff). What considerations should you take into account when deciding whether to apply to Suits R Us?
- (b) (\$) Name two other situations that lead to similar problems.

Suggested Answer:

It's an asymmetric information (most likely a hidden type) problem. Like many in the business world, it's based on expertise rather than some innate information advantage. Nevertheless, SRU knows more about this business than the average plaintiff, which should make the plaintiff wary of giving away too much of a potential settlement.

- (a) The problem is that SRU will only take the case only if it thinks it's a good one, in which case you're probably better off taking it yourself. The key is that SRU probably has a better assessment of the odds of success than you do.
- (b) Examples of the "hidden type" problem: used cars, tickets from scalpers etc.

6. (35 points) The word is out: a revolutionary discovery by a faculty member at NYU's Courant Institute for Mathematical Sciences will finally allow the practical implementation of parallel processing in personal computers. As holder of the patent, NYU has licensed the technology to two firms, to assure PC manufacturers of two sources of supply. One firm, located in the US, has already moved ahead with engineering plans for building a production facility. The question is whether to go for a plant of size 1, 2, or 3. The second firm is located in Brazil. It will also have to decide whether to build a plant of size 1, 2, or 3. However, it is a bit late with respect to the US firm, and won't be able to move ahead before next year.

You have been hired as a consultant to the US firm. Your analysis shows that the profits from various combinations of plant sizes is:

	1	2	3
1	3.9	2.9	1.9
2	2.9	3.8	1.8
3	1.9	1.8	-0.3

Note that the matrix is symmetric, so that it doesn't matter which firm is which.

- (a) (\$) Comment on the pattern of payoffs. At which combination(s) of plant sizes is total profit (the two firms together) highest? Lowest?
- (b) (\$) As a consultant for the US firm, what size factory do you recommend? Describe the game played between the two firms and the optimal strategy by the US.
- (c) (\$) When you meet with the Executive Committee of the US firm, one executive remarks: "There's no need for haste. Why don't we wait until the Brazilian firm builds its plant and make a more informed decision?" How would you reply?

Suggested Answer:

The idea is that moving first ("commitment") is valuable in this context.

- (a) Total profit declines as total output falls from 6 (both produce 3) to 2 (both produce 1). You can imagine this comes from the two firms restricting output and driving the price

- up. For a given level of output (4, for example), different combinations of outputs for the two firms simply change the distribution of profit between the firms, with the higher output firm having the higher profit (profit is proportional to market share).
- (b) Suppose US chooses 1; then Brazil chooses 2 (which has the highest payoff) and the US payoff is 2.9. Similarly, if US chooses 2, Brazil chooses 2 and the US payoff is 3.8. And if US chooses 3, Brazil chooses 1 and the US payoff is 5.7. The last (3) generates the highest payoff, so the US should build a plant of size 3.
- (c) The situation just described gives the US a large advantage: by choosing/moving first, it can force Brazil to choose a low output level and keep most of the profit for itself. If the two firms choose capacities at the same time, the Nash equilibrium is (2,2) and the US firm has a payoff of 3.8, substantially less than 5.7. If it lets the Brazilian firm choose capacity first, Brazil chooses 3 (they do the same calculation US did in (b)) and the US does even worse: 1.9. Thus waiting to collect more information reduces their profit from 5.7 to 1.9. The appropriate advice: Don't do it!
8. (35 points) Competition for 4th generation (4G) wireless telecommunications is under way. Two standards are in competition with each other. One standard is sponsored by firm Q, the other by firm N. Crucial to the competition is the decision of a third firm, E, whether to join N or Q. If E joins Q, then E's profit would be 4, Q's 6, and N's 5. If E joins N, then it will make a profit of 3, N will get 8, and Q will get only 4. If E joins neither Q nor N, it gets 2.
- (a) (\$) Firms N and Q are thus in competition over E. Suppose that they simultaneously decide how much to offer E to join their standard. Let p_i be the value offered by firm i , where i can be N or Q. How much would N and Q be willing to pay E? For a given value of p_Q , what is the optimal value of p_N (and vice-versa)?
- (b) (\$) Describe the outcome of a "price war" between N and Q to gain E's support.
- (c) (\$) Suppose now that N and Q form the following agreement: While each firm will continue to use its own technology, they agree that neither will offer any payment to E. Is this agreement sustainable?

Suggested Answer:

This is a bidding war between the Q and N for E's cooperation. The way this is set up, E has most of the leverage. We might summarize the payoffs like this

	Q's Payoff	N's Payoff	E's Payoff
E joins Q	6	5	4
E joins N	4	9	3
E joins neither	4	5	2

- (d) E's cooperation has a value of 2 ($=6-4$) to Q, 4 ($=9-5$) to N. Thus Q is willing to bid up to 2 and N up to 3 for having E join in. Bidding between Q and N is analogous to the Bertrand price game when the firms have different marginal costs. In this case E would go to Q for any value of p_Q that differs from

- p_N by less than 1. For example $p_N = 1.5$ and $p_Q = .8$, then E will go to Q, for $4 + .8$ is greater than $3 + 1.5$. It follows that, for an p_N less than 3, p_Q 's optimal price is p_N minus 1 plus a small amount (the least price necessary to bring E on board). If p_N is greater than 3, then $p_Q = 2$. Regarding N, for any p_Q less than 3 the optimal price is p_N equal to p_Q plus 1 plus a small amount (again, the least price necessary to bring E on board). If p_Q is greater than 1, then $p_N = 4$: N won't bid more than the value of having Q on its side.
- (e) Notice that the calculations in the previous question are analogous to the reaction curves under Bertrand competition. Continuing with this analogy, we can see that the intersection of the reaction curves is at $p_Q = 2$ and $p_N = 3$ plus a small amount. At these price levels, firm E chooses to join N and gets a payoff of 6 ($= 3 + 3$). Firm N gets a payoff of 6 ($= 9 - 3$) and firm Q gets a payoff of 4.
- (f) In this situation, E would choose Q and get a payoff of 4. Q gets a payoff of 6 and N gets a payoff of 5. This is not an equilibrium. By offering $p_N = 1$ (plus a small amount), N could convince E to join its standard and increase N's payoff from 5 to 8. There's no reason why N would prefer to pay nothing and have a lower payoff.
3. Short answer [25 points]. Define and give an example of each of the following:
- (a) (\$) Adverse selection.
 - (b) Relationship-specific investments. (we may not get to this)
 - (c) Economy of scope.
 - (d) (\$) Network effect. (we may not get to this)

Answer.

- (a) The tendency for offers to attract ("select") the least desirable customers. Example: health insurance may attract the highest health risks.
 - (b) Investments that are specific to a relationship between two firms and have little or no value otherwise. Example: Fisher's investment in a chassis plant contiguous to GM's assembly plant.
 - (c) We say there is an "economy of scope" if the average cost of producing two products together is less than producing them separately. Example: chickens and alligators.
 - (d) When the value of a product depends on the number of others using the same product. Example: telephones.
4. Buffett and GE [25 points]. Paraphrased from the *Wall Street Journal* (November 13, 2002):

GE is apparently trying to sell Employers Re, its huge reinsurance operation. Reinsurers provide insurance to insurers, allowing insurers to spread their risks or cap their potential losses. The top 3 players in this business are Munich Re, Swiss Re, and General Cologne, which is controlled by Warren Buffett's Berkshire Hathaway. GE CEO Jeffrey Immelt stated that Employers Re was a business he wanted to "reposition for value" – translation: consolidate, sell, shrink or fix. Why? Employers Re was a big money maker after its 1984 acquisition by GE, but has become a trouble spot of late. In October, GE said that Employers Re expects a 2002 loss of \$350 million to \$450 million, and break-even results in 2003.

Selling the business has proved difficult. A public offering was derailed by a sour IPO market and steep losses in the unit. Observers also cite concerns about the adequacy of the unit's claims reserves and Employers Re's own use of reinsurance. A large reason for concern about reserves is mounting asbestos litigation, which is adding billions of dollars to the insurance industry's already huge exposure. Concerns about reinsurance revolve around Employers' purchase of "financial reinsurance," which is known for smoothing earnings as well as

spreading risk. Under its typically complex terms, the purchaser often pledges future investment income to the reinsurer selling the coverage. Berkshire's National Indemnity unit is one of the biggest providers of financial reinsurance.

With Munich Re, Swiss Re, and some other potential bidders in financial distress, Berkshire may emerge as the only bidder. Berkshire would likely wind down much of Employers Re's operations, using its own claims-handling expertise to try to save money along the way, and squeeze bigger profits out of the parts it keeps. Analysts suggest that Mr. Buffett isn't likely to do the deal unless it looks like a no-lose situation. Any deal, therefore, is likely to include limitations on how soon Berkshire would pay losses on the policies it acquires or some other sort of cap on payments.

- (a) Why might GE want to sell Employers Re, even though in the current market it's likely to be forced to accept poor terms?
- (b) Why might Employers RE be worth more to Buffett than to GE?
- (c) What problems do you see to completing a deal? What solutions would you recommend to resolve them?

Answer.

- (a) A business in trouble is a major drain on managers' time. This is a real cost: they might be doing things that have higher value to the firm.
- (b) Economies of scale and expertise might allow Buffet to run the same operation more efficiently. This is suggested by the comment that Berkshire would use "its own claims-handling expertise to save money."
- (c) Problems: One is risk: Firms simply don't like large, unbounded risks, such as the risk in asbestos liabilities. Another is asymmetric information: Are there things about Employers Re that GE knows but Buffett doesn't? One example might be financial reinsurance, in the sense that non-experts may have difficulty telling what they're buying. For Berkshire, however, its own presence in the same business may make this less of an issue. Solutions: GE needs some way to assure a buyer that it isn't unwittingly buying a "dog." The suggestions in the article are for GE to assume some of the liability itself for claims on existing policies. This could take the form of assuming some fraction of the claims or an overall cap on them. Alternatively, the sale price could be contingent on some measure of performance of existing policies.

5. (\$) Retail banking [25 points]. You are the marketing manager of a retail bank. Your market research team tells you that there are two types of customers. 10,000 low-use customers are willing to pay up to 12¢ per check up to 4 checks a month; additional checks have no value to them. 4,000 high-use consumers are willing to pay up to 17¢ per check for the first 4 checks a month; up to 14¢ per check for the next 6 checks; and zero thereafter. Customers' types cannot be distinguished *a priori*. The marginal cost of processing a check is 2¢.

You decide to offer two plans, targeted to the two types of customers. Plan A allows a maximum of 4 checks a month and charges p_A per check. Plan B has no limits on the number of checks and a price p_B per check. What prices, p_A and p_B , produce the highest profit?

Answer.

This is a price discrimination problem based on self-selection. You want to choose prices that generate maximal profit, given that the two types of customers will choose the plan that generates the most surplus for them: willingness to pay minus what they actually pay.

The idea is to offer one plan that will be chosen by low-use customers (Plan A) and one that will be used by high-use customers (Plan B). Obviously, the most we can charge low-use customers is $p_A=12$ (this and what follows are in cents). How much can you then charge high-use customers? The value p_B must be low enough that they would not prefer to go for Plan A. By choosing Plan B, high-users would get a surplus of $4*(17-12)=20$. By choosing Plan B, they get $4*(17-p_B)+6*(14-p_B)$. For high-end consumers to choose Plan B, we must have

$$4*(17-p_B) + 6*(14-p_B) \geq 4*(17-12) = 20,$$

or $p_B \leq 13.2$. The profit from this plan is

$$(12-2)*4*10,000 + (13.2-2)*10*4,000 \text{ (cents)} = \$4,000 + \$4,480 = \$8,480.$$

A detail: We need to make sure we don't make more by charging a higher price for Plan B and ignoring the low-use customers altogether. We get the most out of the high-use customers by charging $p_B=14$. The profit generated is then

$$(14-2)*10*4,000 = \$6,000.$$

This is lower than the other, so it's not the best plan.

6. 3D Karaoke [25 points]. 3D Karaoke (3DK) is getting hot in Manhattan. For those who are new to the experience, 3D Karaoke comes with special 3D glasses that give you the image of an enthusiastic audience that screams and shouts as you sing along. You can choose your preferred audience.

There is currently one 3DK bar in the Village, but two new companies have announced plans for creating their own bars: K-R-Us and the company you work for, BASTar. The company that owns the technology has given one-bar licenses to these two entrants with the assurance that they will be the only two licenses issued in Manhattan for years to come.

The two entrants are currently trying to determine their best locations, which they're each narrowed to the Village and Midtown. If both bars are located in the Village, then each will receive a net profit of \$10m. If both bars located in midtown then BASTar gets \$19m and K-R-Us \$21m. If BASTar locates in the Village and K-R-Us in Midtown, then BASTar gets \$22m and K-R-Us \$9m. Finally, if BASTar locates in Midtown and K-R-Us in the Village then BASTar gets \$9m and K-R-Us \$18m.

- (a) (\$) What do the payoffs tell you about the nature of competition between the two entrants?
- (b) (\$) Suppose BASTar and K-R-Us must decide simultaneously where to locate. Describe the game played between the two firms. Are there any dominant strategies in this game? What is the Nash equilibrium?
- (c) (\$) Suppose now that your firm, BASTar, has the possibility of an early credible commitment to a location. In other words, you can choose a location before K-R-Us does so, and when the latter makes its location choice it will do so knowing what location BASTar has chosen. Represent and solve this game.

- (d) Based on the answers to the previous questions, calculate the value of commitment. How might you achieve such credible commitment?

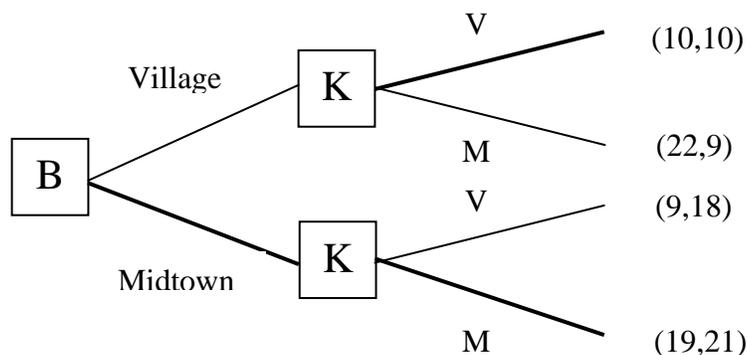
Answer.

- (a) Since there already exists one bar in the Village, two more would lead to very aggressive competition among them. It would be better for both to locate in Midtown. However, if only one locates in Midtown then there won't be enough critical mass to attract customers (there's apparently an advantage to agglomeration).
- (b) The payoff matrix for the game is

		K-R-Us	
		Village	Midtown
BAStar	Village	10	9
	Midtown	18	21

Village is a dominant strategy for BAStar and (Village,Village) is the (only) Nash equilibrium. It's an unfortunate game for both players. Note that K-R-Us would benefit if it paid BAStar (say) \$2m to choose Midtown.

- (c) If BAStar moves first, we have a different game. We could represent this with a tree:



In this case, the equilibrium is (Midtown, Midtown). Note that both entrants prefer this game to the previous one.

- (d) Commitment (moving first) increases BAStar's profit from 10 to 19, so its value is 9. Just as interesting, it increases K-R-Us's profit, too, from 10 to 21. But how do you accomplish it? Good question! Sign a contract with a developer? The key points: the action must be observable and irreversible. In this case there's an additional factor: both entrants are better off with BAStar going first, so it's not hard to imagine that they could agree on this order of play.