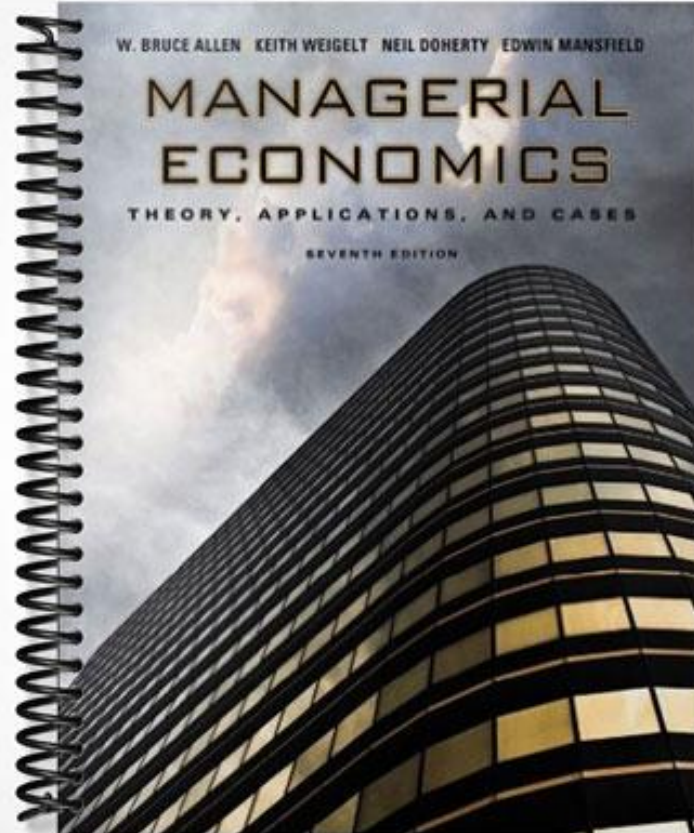


SOLUTIONS MANUAL





INSTRUCTOR'S MANUAL

Managerial Economics

SEVENTH EDITION

INSTRUCTOR'S MANUAL

Managerial Economics

SEVENTH EDITION

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Lecture Notes**1. Introduction**

- Objectives
 - Provide a guide to making good managerial decisions.
 - Use formal models to analyze the effects of managerial decisions on measures of a firm's success.
- Managerial Economics
 - Differs from microeconomics in that the former focuses on description and prediction while managerial economics is prescriptive
 - Is an integrative course that brings the various functional areas of business together in a single analytical framework
 - Exhibits economies of scope by integrating material from other disciplines and thereby reinforcing and enhancing understanding of those subjects

2. The Theory of the Firm

- Managerial Objective
 - Make choices that will increase the value of the firm.
 - The value of the firm is defined as the present value of future profits:
 - Present value of expected future profits $= \frac{\pi_1}{1+i} + \frac{\pi_2}{(1+i)^2} + \dots + \frac{\pi_n}{(1+i)^n}$
 - Present value of expected future profits $= \sum_{t=1}^n \frac{\pi_t}{(1+i)^t}$
 - Present value of expected future profits $= \sum_{t=1}^n \frac{TR_t - TC_t}{(1+i)^t}$

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- Notation
 - π_t Profit in time $t = \text{total revenue in time } t - \text{total cost in time } t$
 - i Interest rate
 - n Number of time periods
 - TR_t Total revenue in time t
 - TC_t Total cost in time t
- Managerial Choices
 - Influence total revenue by managing demand
 - Influence total cost by managing production
 - Influence the relevant interest rate by managing finances and risk
- Managerial Constraints
 - Available technologies
 - Resource scarcity
 - Legal or contractual limitations

STRATEGY SESSION:

Bono Sees Red and Corporate Participants See Black

DISCUSSION QUESTIONS

1. How can a firm assess the benefits and costs of cause marketing?
2. What other examples of cause marketing can you identify?

3. What Is Profit?

- Two Measures of Profit
 - Accounting profit
 - * Historical costs
 - * Legal compliance
 - * Reporting requirements
 - Economic profit
 - * Market value
 - * Opportunity, or implicit cost
 - * More useful measure for managerial decision making

4. Reasons for the Existence of Profit

- Profit
 - Measures the quality of managers' decision making skills
 - Encourages good management decisions by linkage with incentives
- Sources of Profit
 - Innovation: Producing products that are better than existing products in terms of functionality, technology, and style.

- Risk taking: Knowing that future outcomes and their likelihoods are unknown, as are the reactions of rivals.
- Exploiting market inefficiencies: Building barriers to entry, employing sophisticated pricing strategies, diversifying, and making good strategic production decisions

5. Managerial Interests and the Principal–Agent Problem

- Principal–Agent Problem
 - The interests of a firm’s owners and those of its managers may differ, unless the manager is the owner.
 - Separation of ownership and control
 - * The principals are the owners. They want managers to maximize the value of the firm.
 - * The agents are the managers. They want more compensation and less accountability.
 - * The divergence in goals is the principal–agent problem.
 - Example of moral hazard (Moral hazard is explained in Chapter 14.)
 - * Moral hazard exists when people behave differently when they are not subject to the risks associated with their behavior.
 - * Managers who do not maximize the value of the firm may do so because they do not suffer as a result of their behavior.
 - Solutions
 - * Devise methods that lead to convergence of the interests of the firm’s owners and its managers.
 - * Examples: Stock option plans and bonuses linked to profits.

6. Demand and Supply: A First Look

- Market
 - A group of firms and individuals that interact with each other to buy or sell a good
 - Part of an economy’s infrastructure
 - A social institution that exists to facilitate economic exchange
 - Relies on binding, enforceable contracts

STRATEGY SESSION:

Baseball Discovers the Law of Supply and Demand

DISCUSSION QUESTIONS

1. Do you see a relationship between variable pricing of baseball game tickets and odds making on horse races?

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2. How do you think real-time variable pricing would influence the practice of ticket scalping?

7. The Demand Side of a Market

- Demand Function
 - Quantity demanded relative to price, holding other possible influences constant
 - Negative slope
 - Period of time
 - Shifts in demand
 - Other influences (held constant)
 - * Income
 - * Prices of substitutes and complements
 - * Advertising expenditures
 - * Product quality
 - * Government fiat
- Total Revenue Function
 - A firm's total revenue (TR) for a given time period is equal to the price charged (P) times the quantity sold (Q) during that time period.
 - $TR = P \times Q$
 - The demand function reflects the effect of changes in P on quantity demanded (Q) per time period and, hence, the effect of changes in P on TR .

8. The Supply Side of a Market

- Supply Function
 - Quantity supplied relative to price, holding other possible influences constant
 - Positive slope
 - Period of time
 - Shifts in supply
 - Other influences (held constant)
 - * Technology
 - * Cost of production inputs (land, labor, capital)

STRATEGY SESSION:

Demand and Supply—How High Oil Prices Coax High-Cost Suppliers into the Market

DISCUSSION QUESTIONS

1. During 2008, the price of a barrel of crude oil rose to above \$130. In the last quarter of 2008, financial crisis lead to a global economic slowdown.

The price of oil promptly dropped by half. Were these price fluctuations the result of changes in supply or demand?

2. Given the volatility of crude oil prices, do you think that private investors will be likely to develop projects to extract oil from oil shale? How do you think investment in alternative technologies like solar, geothermal, wind, and biomass are likely to respond to oil price volatility?
3. Government can encourage the development of alternative sources of energy such as extraction of oil from oil shale by offering incentives such as tax credits or subsidies or by direct investment. Should it? What are the pros and cons of government intervention in the development of energy technologies?

9. Equilibrium Price

- Disequilibrium Price
 - Price is too high.
 - * Excess supply
 - * Surplus
 - * Causes price to fall
 - Price is too low.
 - * Excess demand
 - * Shortage
 - * Causes price to rise
- Equilibrium Price
 - Quantity demanded is equal to quantity supplied.
 - Price is stable.
 - The market is in balance because everyone who wants to purchase the good can, and every seller who wants to sell the good can.
- Actual Price
 - Invisible hand is the situation when no governmental agency is needed to induce producers to drop or increase their prices.
 - If the actual price is above the equilibrium price, there will be a surplus that will put downward pressure on the actual price.
 - If the actual price is below the equilibrium price, there will be a shortage that will put downward pressure on the actual price.
 - If the actual price is equal to the equilibrium price, there will be neither a shortage nor a surplus and price will be stable.

10. What If the Demand Curve Shifts?

- Increase in Demand
 - Represented by a rightward or upward shift in the demand curve

- Result of a change that makes buyers willing to purchase a larger quantity of a good at the current price and/or pay a higher price for the current quantity
- Will create a shortage and cause the equilibrium price to increase
- Decrease in Demand
 - Represented by a leftward or downward shift in the demand curve
 - Result of a change that makes buyers purchase a smaller quantity of a good at the current price and/or continue to buy the current quantity only if the price is reduced
 - Will create a surplus and cause the equilibrium price to decrease

11. What If the Supply Curve Shifts?

- Increase in Supply
 - Represented by a rightward or downward shift in the supply curve
 - Result of a change that makes sellers willing to offer a larger quantity of a good at the current price and/or offer the current quantity at a lower price
 - Will create a surplus and cause the equilibrium price to decrease
- Decrease in Supply
 - Represented by a leftward or upward shift in the supply curve
 - Result of a change that makes sellers willing to offer a smaller quantity of a good at the current price and/or offer the current quantity at a higher price
 - Will create a shortage and cause the equilibrium price to increase

STRATEGY SESSION: Life During a Market Movement

DISCUSSION QUESTIONS

1. Several factors are mentioned as contributing to disequilibrium in global food markets. Among them are emotions (panic), government restrictions on trade, the Malthusian specter of population growth outpacing food production, slowing productivity growth in the agricultural sector, rising incomes, and the production of ethanol. Which of these are supply factors, and which are demand factors? How does each influence market price?
2. The market price for crude oil fluctuated widely during 2008. What supply and demand factors contributed to these fluctuations? Is the petroleum market subject to any of the same factors cited as influencing agricultural markets?

Chapter 1: Problem Solutions

1. A book is to be written by Britney Spears. Batman Books agrees to pay Britney \$6 million for the rights to this not-yet-written memoir. According to one leading publisher, Batman Books could earn a profit of roughly \$1.2 million if it sold 625,000 copies in hardcover. On the other hand, if it sold 375,000 copies, managers would lose about \$1.3 million. Publishing executives stated that it was hard to sell more than 500,000 copies of a nonfiction hardcover book, and very exceptional to sell 1 million copies. Were Batman managers taking a substantial risk in publishing this book?

SOLUTION:

There was a substantial risk of loss. On the other hand, there was substantial opportunity for gain. Risk is unavoidable. The appropriate balance between risk and return is what should determine managers' decisions. Successful decisions in circumstances of risk are a source of profit.

2. Some say that any self-respecting top manager joining a company does so with a front-end signing bonus. In many cases this bonus is in the seven figures. At the same time the entering manager may be given a bonus guarantee. No matter what happens to firm profit, he or she gets at least a percentage of that bonus. Do long-term bonus guarantees help to solve the principal-agent problem, or do they exacerbate it? Why?

SOLUTION:

An executive who spends a lifetime working for a single company or in a single industry has a poorly diversified human capital portfolio. Such an executive also often has a significant, undiversified financial investment in the form of stock options and pension plans that are used in partial substitution for current salary to align the long-term wealth of the executive with that of the shareholders. As an executive climbs the corporate ladder, the value of his or her human capital becomes more closely tied to the fortunes of the firm and industry. This lack of diversification requires a compensating risk premium. A large signing bonus may allow a risk-averse executive to make an investment that increases the value of the firm but that the executive would otherwise avoid because of concern for his or her own personal wealth; thus the bonus may reduce the principal-agent conflict. Of course, the benefits of reduced risk to the executive come at the potential cost of indifference to the wealth of the shareholders. Although a large signing bonus may help solve the incentive alignment problem, compensation that is too great and too insensitive to the fortunes of the shareholders makes the principal-agent problem worse.

3. If the interest rate is 10 percent, what is the present value of the Monroe Corporation's profit in the next 10 years?

Number of Years in the Future	Profit (millions of dollars)
1	8
2	10
3	12
4	14
5	15
6	16
7	17
8	15
9	13
10	10

SOLUTION:

Number of Years in the Future	Profit (millions of dollars)	$(1 + i)^{-t}$	Present Value (millions of dollars)
1	8	0.90909	7.27272
2	10	0.82645	8.26450
3	12	0.75131	9.01572
4	14	0.68301	9.56214
5	15	0.62092	9.31380
6	16	0.56447	9.03152
7	17	0.51316	8.72372
8	15	0.46651	6.99765
9	13	0.42410	5.51330
10	10	0.38554	<u>3.85540</u>
Total			77.55047

The answer is \$77.55047 million.

4. Managers at Du Pont de Nemours and Company expect a profit of \$2.9 billion in 2008. Does this mean that Du Pont's expected economic profit will equal \$2.9 billion? Why or why not?

SOLUTION:

Economic profits differ from accounting profits because of differences in the way depreciation is measured, differences in the way revenues and costs are recognized in terms of timing, and the inclusion of the opportunity cost of owner-supplied inputs in the calculation of economic profits. Du Pont's economic profits might well be negative if accounting profits do not exceed the risk-adjusted rate of return multiplied by the firm's equity value.

5. William Howe must decide whether to start a business renting beach umbrellas at an ocean resort during June, July, and August of next summer. He believes he can rent each umbrella to vacationers at \$5 a day, and he intends to lease 50 umbrellas for the three-month period for \$3,000. To operate this business, he does not have to hire anyone (but himself), and he has no expenses other than the leasing costs and a fee of \$3,000 per month to rent the business location. Howe is a college student, and if he did not operate this business, he could earn \$4,000 for the three-month period doing construction work.
- If there are 80 days during the summer when beach umbrellas are demanded, and Howe rents all 50 of his umbrellas on each of these days, what will be his accounting profit for the summer?
 - What will be his economic profit for the summer?

SOLUTION:

- $TR = (80 \text{ days}) \times (50 \text{ umbrellas}) \times (\$5 \text{ per day}) = \$20,000$
 $TC = (3 \text{ months}) \times (\$3,000 \text{ per month rent}) + (\$3,000 \text{ umbrella lease})$
 $= \$12,000$
 $\text{Accounting Profit} = TR - TC = \$8,000$
- $\text{Economic profit} = \text{accounting profit} - \text{opportunity cost}$
 $\text{Economic profit} = \$8,000 - \$4,000 = \$4,000$

6. On March 3, 2008, a revival of *Gypsy*, the Stephen Sondheim musical, opened at the St. James Theater in New York. Ticket prices ranged from \$117 to \$42 per seat. The show's weekly gross revenues, operating costs, and profit were estimated as follows, depending on whether the average ticket price was \$75 or \$65:

	Average Price of \$75	Average Price of \$65
Gross revenues	\$765,000	\$680,000
Operating costs	600,000	600,000
Profit	165,000	80,000

- With a cast of 71 people, a 30-piece orchestra, and more than 500 costumes, *Gypsy* cost more than \$10 million to stage. This investment was in addition to the operating costs (such as salaries and theater rent). How many weeks would it take before the investors got their money back, according to these estimates, if the average price was \$65? If it was \$75?
- George Wachtel, director of research for the League of American Theaters and Producers, has said that about one in three shows opening on Broadway in recent years has at least broken even. Were the investors in *Gypsy* taking a substantial risk?
- According to one Broadway producer, "Broadway isn't where you make the money any more. It's where you establish the project so you can make

the money. When you mount a show now, you really have to think about where it's going to play later." If so, should the profit figures here be interpreted with caution?

- d. If the investors in this revival of *Gypsy* make a profit, will this profit be, at least in part, a reward for bearing risk?

SOLUTION:

- a. Given a price of \$75, the weekly operating profit of \$165,000 would pay off the \$10 million investment in $10,000/165 = 60.6$ or 61 weeks. If the price is \$65, it would take $10,000/80 = 125$ weeks to pay off the investment. This does not provide for any return on investment, however.
- b. The investors in *Gypsy* were indeed taking a substantial risk. If only one in three shows breaks even, two out of three make losses.
- c. The profit figures should be interpreted with caution because they do not take into account the likelihood of profits when, and if, the show goes on the road.
- d. Yes.
7. If the demand curve for wheat in the United States is

$$P = 12.4 - 4Q_D$$

where P is the farm price of wheat (in dollars per bushel) and Q_D is the quantity of wheat demanded (in billions of bushels), and the supply curve for wheat in the United States is

$$P = -2.6 + 2Q_S$$

where Q_S is the quantity of wheat supplied (in billions of bushels), what is the equilibrium price of wheat? What is the equilibrium quantity of wheat sold? Must the actual price equal the equilibrium price? Why or why not?

SOLUTION:

Setting demand equal to supply yields

$$\begin{aligned} 12.4 - 4Q &= -2.6 + 2Q \\ Q &= 15/6 = 2.5 \\ P &= 12.4 - (4)(2.5) = -2.6 + (2)(2.5) = \$2.40 \end{aligned}$$

The actual price need not be equal to equilibrium price, although it will generally tend to move toward it because of the equilibrating effects of shortage and surplus. Factors that might prevent the actual price from equaling the equilibrium price include the cost and availability of information, transportation costs, and a lack of opportunities for price equalizing arbitrage.

8. The lumber industry was hit hard by the subprime mortgage turmoil in 2008. Prices plunged from \$290 per thousand board feet to less than \$200

per thousand board feet. Many observers believed this price decrease was caused by the slowing of new home construction because of the glut of unsold homes on the market. Was this price decrease caused by a shift in the supply or demand curve?

SOLUTION:

Because the demand for lumber is derived in large part from the demand for new housing construction, a decline in construction would be likely to cause the demand for lumber to fall, leading to lower lumber prices. Supply would not be affected by changes in housing construction.

9. From November 2007 to March 2008, the price of gold increased from \$865 per pound to over \$1,000 per pound. Newspaper articles during this period said there was little increased demand from the jewelry industry but significantly more demand from investors who were purchasing gold because of the falling dollar.
 - a. Was this price increase due to a shift in the demand curve for gold, a shift in the supply curve for gold, or both?
 - b. Did this price increase affect the supply curve for gold jewelry? If so, how?

SOLUTION:

- a. A change in the value of the dollar causes the dollar price of globally traded commodities to change. If the value of the dollar falls, the dollar price of commodities will rise. In this case, a decline in the value of the dollar can be expected to cause the market for gold (with price measured in dollars) to experience an increase in demand and a decrease in supply, and thus an increase in price. There may also have been an additional increase in demand due to expectations by investors that the dollar price of gold would continue to rise. Finally, there may have been a further supply decrease if producers, speculating that prices would rise further, withheld gold from the market.
- b. Gold is an input to the production of jewelry. An increase in the price of gold would therefore be expected to reduce the supply of jewelry, resulting in higher jewelry prices.

CHAPTER 2

Demand Theory

Lecture Notes

1. Introduction

- Objectives
 - Explain the importance of market demand in the determination of profit.
 - Understand the many factors that influence demand.
 - * Elasticity: Measures the percentage change in one factor given a small (marginal) percentage change in another factor.
 - * Demand elasticity: Measures the percentage change in quantity demanded given a small (marginal) percentage change in another factor that is related to demand.
 - Explain the role of managers in controlling and predicting market demand.
 - * Managers can influence demand by controlling, among other things, price, advertising, product quality, and distribution strategies.
 - * Managers cannot control, but need to understand, elements of the competitive environment that influence demand, including the availability of substitute goods, their pricing, and the advertising strategies employed by their sellers.
 - * Managers cannot control, but need to understand how the macro-economic environment influences demand, including interest rates, taxes, and both local and global levels of economic activity.

2. The Market Demand Curve

- Market Demand Schedule
 - Table showing the total quantity of the good purchased at each price

- Market Demand Curve
 - Plot of the market demand schedule on a graph.
 - Price (the x variable) is on the vertical, and quantity demanded (the y variable) is on the horizontal axis.
 - Example (Figure 2.1): Demand curve for laptops.
- Characteristics of the Market Demand Curve
 - Quantity demanded is for output of the entire market, not of a single firm.
 - For most products and services, the market demand curve slopes downward and to the right.
 - Quantity demanded is defined with regard to a particular time period.
 - * Determinants of the position and shape of the market demand curve.
 - Consumer tastes
 - * Example (Figure 2.2): Increase in preference for laptop computers causes an increase in demand for laptop computers.
 - Consumer income
 - * Normal and inferior goods.
 - * Example (Figure 2.3): Increase in income causes an increase in demand for laptop computers.
 - Population size in the market

STRATEGY SESSION:
The Customer Is Always Right—Wrong!

DISCUSSION QUESTIONS

1. Like retail technology stores, clothing stores have their angels and devils. How do you think the devils prey on clothing stores, and how could their behavior be discouraged? How do you think angels could be encouraged to shop at a particular clothing store?

Answer: Devils buy clothes, wear them, and then return them for a refund. Stores can refuse to provide refunds on returns and, instead, provide a credit for future purchases or only allow exchanges. Angels buy lots of clothes on impulse. Stores could offer quantity discounts or a “shoppers club” with special notification of sales.

2. Some electronics stores refuse to allow customers to return or exchange products, instead requiring them to deal directly with the manufacturer. What are the pros and cons of this approach with regard to the stores’ objective of encouraging angels and discouraging devils?

3. Industry and Firm Demand Functions

- Market demand function: The relationship between the quantity demanded and the various factors that influence this quantity
 - Quantity of $X(Q) = f(\text{factors})$
 - Factors include
 - * Price of X
 - * Incomes of consumers
 - * Tastes of consumers
 - * Prices of other goods
 - * Population
 - * Advertising expenditures
 - Example (equation 2.1): $Q = b_1P + b_2I + b_3S + b_4A$
 - * Assumes that population is constant and that the demand function is linear
 - * P = price of laptops
 - * I = per capita disposable income
 - * S = average price of software
 - * A = amount spent on advertising
 - * $b_1, b_2, b_3,$ and b_4 are parameters that are estimated using statistical methods
 - Parameters: Constant or variable terms used in the function that helps managers determine the specific form of the function but not its general nature.
 - * Example (equation 2.2): $Q = -700P + 200I - 500S + 0.01A$
 - Relationship between the market demand function and the market demand curve
 - * Market demand curve shows the relationship between Q and P when all other variables are held constant at specific values.
 - * Market demand function does not explicitly hold any values constant.
 - Example (equation 2.3): $Q = -700P + 200(13,000) - 500(400) + 0.01(50,000,000)$
 - * Example (equation 2.4): $Q = 2,900,000 - 700P$
 - * Example: $P = 4,143 - 0.001429Q$ (graphed in Figure 2.4)
 - Example: $Q = -700P + 200(13,000) - 500(200) + 0.01(50,000,000)$
 - * Shift in demand due to a change in the average price of software from 400 to 200
 - * Example (equation 2.5): $Q = 3,000,000 - 700P$
 - * Example (equation 2.6): $P = 4,286 - 0.001429P$ (graphed in Figure 2.4)
- The Firm's Demand Curve
 - Negative slope with regard to price
 - * Slope may not be the same as that of the market demand curve.

- Represents a portion of market demand
 - * Market share
 - * Responds to same market and macroeconomic factors as the market demand curve
- Directly related to the prices of substitute goods provided by competitors
 - * Increase in competitor's price will cause a decrease in a firm's demand.
 - * Decrease in competitor's price will cause an increase in a firm's demand.
- Inversely related to the prices of substitute goods provided by competitors
 - * Increase in competitor's price will cause a decrease in a firm's demand.
 - * Decrease in competitor's price will cause an increase in a firm's demand.

4. The Own-Price Elasticity of Demand

- Own-price elasticity of demand: More simply referred to as the price elasticity of demand, this is the concept that managers use to measure their own percentage change in quantity demanded resulting from a 1 percent change in their own price.
 - The elasticity of a function is the percentage change in the dependent (y) variable in response to a 1 percent increase in the independent (x) variable.
 - The price elasticity of a demand function is the percentage change in quantity demanded in response to a 1 percent increase in price.
 - $\eta = \left(\frac{P}{Q} \right) \frac{\Delta Q}{\Delta P}$
 - Price elasticity generally is different at different prices and on different markets.
- Terminology
 - Price elasticity demand is symbolized by the Greek letter eta (η).
 - $0 \geq \eta \geq -\infty$
 - When $|\eta| > 1$, demand is elastic.
 - When $|\eta| < 1$, demand is inelastic.
 - When $|\eta| = 1$, demand is unitary.
 - When $\eta = 0$, demand is perfectly inelastic, and the demand curve is vertical.
 - * Quantity demanded is the same at all prices.
 - When $\eta = -\infty$, demand is perfectly elastic, and the demand curve is horizontal.

- * Price is the same for all quantities demanded.
- * If price rises, quantity demanded falls to zero.
- * If price falls, quantity demanded increases without limit.
- Linear Demand Curves
 - The slope of a linear demand curve is constant.
 - If the demand curve is neither vertical nor horizontal, the price elasticity will differ depending on price.
 - * At the midpoint of a linear demand curve, $\eta = -1$, with η approaching zero as price approaches the vertical intercept.
 - * At prices above the midpoint, demand is elastic, with η approaching negative infinity as price approaches zero.
 - * At prices below the midpoint, demand is inelastic.
 - Given a demand curve defined as $P = a - bQ$, the price elasticity of demand is $\eta = \left(\frac{-1}{b}\right) \frac{a - bQ}{Q}$

5. Point and Arc Elasticities

- The point price elasticity formula should be used working with an estimated demand curve or when the change in price is very small.
 - $\eta = \left(\frac{\Delta Q}{\Delta P}\right) \left(\frac{P}{Q}\right)$
 - Calculated value for small changes will differ depending on whether P and Q are the starting values or the ending values after the price change. The change will be small if the change is small.
 - * Example: $P_1 = 99.95$, $P_2 = 100.00$, $Q_1 = 20,002$, and $Q_2 = 20,000$
 - * $\eta = [(20002 - 20000)/(99.95 - 100)][99.95/20002] = -0.1999$
 - * $\eta = [(20000 - 20002)/(100 - 99.95)][100/200000] = -0.22$
 - If the price change is large, then the direction of change will influence the calculated elasticity.
 - * Example: $P_1 = 5$, $P_2 = 4$, $Q_1 = 3$, and $Q_2 = 40$
 - * $\eta = [(40 - 3)/(4 - 5)][5/3] = -61.67$
 - * $\eta = [(3 - 40)/(5 - 4)][4/40] = -3.70$
 - This problem is corrected by using the arc midpoints formula.
- The midpoints arc elasticity formula should be used to estimate the price elasticity of demand from a demand schedule where price differences are not very small.
 - $\eta = \left(\frac{\Delta Q}{\Delta P}\right) \left(\frac{P_1 + P_2}{Q_1 + Q_2}\right)$
 - Example: $P_1 = 5$, $P_2 = 4$, $Q_1 = 3$, and $Q_2 = 40$
 - $\eta = [(40 - 3)/(4 - 5)][(5 + 4)/(3 + 40)] = -7.74$

6. Using the Demand Function to Calculate the Price Elasticity of Demand

- Given
 - $Q = -700P + 200I - 500S + 0.01A$
 - Q = quantity demanded of computers
 - Price = $P = 3,000$
 - Income = $I = 13,000$
 - Software = $S = 400$
 - Advertising = $A = 50,000,000$
- Derive the demand curve
 - $Q = -700P + (200)(13000) - (500)(400) + (0.01)(50000000)$
 - $Q = 2900000 - 700P$
- Determine Q
 - $Q = 2900000 - (700)(3000) = 800000$
- $\eta = (-700)(3000/800000) = -2.62$
- For $P = 2000$, $Q = 2900000 - (700)(2000) = 1500000$,
so $\eta = (-700)(2000/1500000) = -0.93$

7. The Effect of Price Elasticity on the Firm's Revenue

- Derivation of relationship between marginal revenue ($\Delta TR/\Delta Q$ or dTR/dQ) and the price elasticity of demand:
 - $TR = PQ$
 - $dTR/dQ = Q(dP/dP) + P(dQ/dP)$
 - $(1/Q)(dTR/dQ) = (dP/dP) + (P/Q)(dQ/dP) = 1 + \eta$
- $1/Q$ is positive. Implications:
 - If $\eta = -1$, $dTR/dQ = 0$, so total revenue is at a maximum and a change in P will have no effect on total revenue.
 - If $\eta > -1$ (inelastic), $dTR/dQ < 0$, so an increase in P (and consequent decrease in Q) will increase total revenue.
 - If $\eta < -1$ (elastic), $dTR/dQ > 0$, so an increase in P (and consequent decrease in Q) will decrease total revenue.
- If the price elasticity is unitary, any price change will cause an equal and opposite percentage change in quantity. Total revenue will remain constant.
- If the price elasticity is in the inelastic range, then a 1 percent change in P will cause less than a 1 percent change in quantity in the opposite direction. Therefore, total revenue will change in the same direction as price.
- If the price elasticity is in the elastic range, then a 1 percent change in P will cause more than a 1 percent change in quantity in the opposite direction. Therefore, total revenue will change in the opposite direction from price.

PROBLEM SOLVED:

Price Elasticity of Demand: Philip Morris

DISCUSSION QUESTIONS

1. The decline in total revenue from cigarette sales in 1993 is attributed to Philip Morris's cut in the price of cigarettes. Are there other factors that might have contributed to this decline in revenue?

Answer: The price elasticity of demand assumes that "all other things" are held constant. Changes in taxes, consumer income, or attitudes toward tobacco during this period might have reduced demand, while the price cut increased quantity demanded. If this were the case, then the true price elasticity would likely be closer to -1 .

8. Funding Public Transit

- Given
 - Price (fare) elasticity of demand for public transit in the United States is about -0.3 .
 - All public transit systems in the United States lose money.
 - Public transit systems are funded by federal, state, and local governments, all of which have budget issues.
- Which transit systems have the most difficult time getting public funding?
 - Revenue from sales will increase if fares are increased, because demand is inelastic.
 - Costs will likely decrease if fares are increased, because quantity demanded (ridership) will fall.
 - Managers of public transit will therefore increase fares if they do not receive enough public funds to balance their budgets.

9. Determinants of the Own-Price Elasticity of Demand

- Number and similarity of available substitutes
- Product price relative to a consumer's total budget
- Time period available for adjustment to a price change

10. The Strategic Use of the Price Elasticity of Demand

- Example: Strategic pricing of first-class ($\eta = -0.45$), regular economy ($\eta = -1.30$), and excursion ($\eta = -1.83$) airline tickets between the United States and Europe
 - First-class prices should be relatively high because demand is inelastic.

- Regular economy and excursion prices should be relatively low because demand is elastic.
- Example: Using differentiation strategies to change the price elasticity of demand for a product
 - Differentiation strategies convince consumers that a product is unique and therefore has fewer substitutes.
 - If consumers perceive that a product has fewer substitutes, then their price elasticity of demand for the product will decrease (become less elastic) in absolute value.
 - Differentiation strategies do not require actual differences in products, only a perceived difference.

STRATEGY SESSION:

Elasticity in Use

DISCUSSION QUESTIONS

1. Suppose that a manufacturer sells a product through an upscale boutique and, with a different brand name, through a discount retailer. The elasticity of demand at the boutique is -1.2 and at the discount retailer is -2.6 . If the optimal price at the boutique is \$85, what price (P_D) should be charged at the discount retailer?

Answer: $85(1 - 1/1.2) = P_D(1 - 1/2.6)$, so $P_D = \$23.02$.

2. A consulting firm charges \$250 per hour to Fortune 500 companies. The estimated elasticity of demand for consulting services is -3.1 . The firm is planning to spin off a subsidiary firm that will work with smaller businesses. The estimated elasticity of demand for these firms is -7.3 . What price per hour (P_S), to the nearest dollar, should be charged by the subsidiary?

Answer: $250(1 - 1/3.1) = P_S(1 - 1/7.3)$, so $P_S = \$200$.

11. Total Revenue, Marginal Revenue, and Price Elasticity

- A firm's total revenue (TR) is equal to the total amount of money consumers spend on the product in a given time period.
 - Linear demand curve: $P = a - bQ$
 - Corresponding total revenue curve: $TR = PQ = aQ - bQ^2$
- Marginal revenue (MR) is the incremental revenue earned from selling the n th unit of output.
 - $MR = \Delta TR / \Delta Q = \Delta(aQ - bQ^2) / \Delta Q = a - 2bQ$
 - * $\eta = (-1/b)[(a - bQ)/Q]$
 - * If $Q = a/2b$, then $\eta = -1$.

- * If $Q > a/2b$, then η is inelastic.
- * If $Q < a/2b$, then η is elastic.
- $MR = \Delta TR/\Delta Q = \Delta(PQ)/\Delta Q = P(\Delta Q/\Delta Q) + Q(\Delta P/\Delta Q) = P[1 + (Q/P)(\Delta P/\Delta Q)]$, so $MR = P(1 + 1/\eta)$.
- * $|\eta| > 1$ (elastic) implies $MR > 0$.
- * $|\eta| < 1$ (inelastic) implies $MR < 0$.
- * $|\eta| = 1$ (unitary) implies $MR = 0$.

STRATEGY SESSION:

Verizon and the Elasticity of Demand

DISCUSSION QUESTIONS

1. What assumption was Verizon making about the elasticity of demand for Internet services?

Answer: That it was inelastic

2. What assumption was Verizon making about its marginal revenue from Internet services?

Answer: That it was negative

12. The Income Elasticity of Demand

- Income elasticity of demand (η_I): The percentage change in quantity demanded (Q) resulting from a 1 percent increase in consumers' income (I)
 - Income can be defined as aggregate consumer income or as per capita income, depending on circumstances.
 - $\eta_I = \left(\frac{\Delta Q}{\Delta I}\right)\left(\frac{I}{Q}\right)$
 - $\eta_I > 0$ for normal goods
 - * On average, goods are normal, since increases in aggregate income are associated with increases in aggregate consumer spending.
 - $\eta_I < 0$ for inferior goods
 - * Examples: Hamburgers and public transportation
- Strategic management and the income elasticity of demand
 - The demand for a product that has an income elasticity of demand that is large in absolute value will vary widely with changes in income caused by economic growth and recessions.
 - Managers can lessen the impact of economic changes on such products by limiting fixed costs so that changes in production capacity can be made quickly.
 - Managers can forecast demand for products using the income elasticity of demand combined with forecasts of aggregate income.

PROBLEM SOLVED:**Income Elasticity of Demand****DISCUSSION QUESTIONS**

1. Suppose that a market demand function is defined as $Q = 20,000 - 8P + 0.1I$, where $P = 2,000$ and $I = 20,000$. What is the income elasticity of demand?

Answer: $Q = 6,000$, so $\eta_I = 0.1(20000/6000) = -1/3$

2. If the income elasticity of demand for a product is unitary, then a 1 percent change in income will change demand in the same direction by 1 percent. If price remains constant, then spending on the product will change by 1 percent, and consequently, spending on the product will be the same percentage of income after the income change as it was before. If the income elasticity of demand is greater than 1, then spending will increase as a percentage of income as income increases. If it is less than 1, spending will decrease as a percentage of income as income increases. How do you think the percentage of income spent on jewelry, food, clothing, housing, and automobiles responds to a 1 percent increase in income?

13. Cross-Price Elasticities of Demand

- Cross-price elasticity of demand (η_{XY}): The percentage change in quantity demanded of one good (Q_X) resulting from a 1 percent increase in the price of a related good (P_Y)
 - Income can be defined as aggregate consumer income or as per capita income, depending on circumstances.
 - $\eta_{XY} = \left(\frac{\Delta Q_X}{\Delta P_Y} \right) \left(\frac{P_Y}{Q_X} \right)$
 - $\eta_{XY} > 0$ if the two products are substitutes.
 - * Example: Wheat and corn
 - $\eta_{XY} < 0$ if the two products are complements.
 - * Example: Computers and computer software
 - $\eta_{XY} = 0$ if the two products are independent
 - * Example: Butter and airline tickets
 - Example Calculation
 - * Given: $Q_X = 1,000 - 0.2P_X + 0.5P_Y + 0.04I$, $Q_X = 2,000$, and $P_Y = 500$
 - * $\eta_{XY} = 0.5(500/2000) = 0.125$, so the two products are substitutes.
- Strategic management and the cross-price elasticity of demand
 - Managers can use information about the cross-price elasticity of demand to predict the effect of competitors' pricing strategies on the demand for their product.

- Antitrust authorities use the cross-price elasticity of demand to determine the likely effect of mergers on the degree of competition in an industry.
 - * A high cross-price elasticity, indicating that two goods are strong substitutes, suggests that a merger would significantly reduce competition in the industry.
 - * A low cross-price elasticity, indicating that two goods are strong complements, suggests that a merger might give the merged firm excessive control over the supply chain.

14. The Advertising Elasticity of Demand

- Advertising elasticity of demand (η_A): The percentage change in quantity demanded (Q) resulting from a 1 percent increase in advertising expenditure (A).
 - $\eta_A = \left(\frac{\Delta Q}{\Delta A} \right) \left(\frac{A}{Q} \right)$
 - Example Calculation
 - * Given: $Q = 500 - 0.5P + 0.01I + 0.82A$ and $A/Q = 2$
 - * $\eta_A = 0.82(2) = 1.64$

15. The Constant-Elasticity and Unitary Demand Function

- Constant-elasticity demand function: Mathematical form that always yields that same elasticity, regardless of the product's price and consumers' income
 - Example: $Q = 200P^{-0.3}I^2$
 - Price elasticity of demand = -0.3
 - Income elasticity of demand = 2.0
- Unitary elastic demand function and total revenue (TR)
 - $TR = PQ$, so if TR is constant, $Q = (TR)(P^{-1})$
 - Price elasticity of demand = -1
 - Rectangular hyperbola

Chapter 2: Problem Solutions

1. The Dolan Corporation, a maker of small engines, determines that in 2008 the demand curve for its product is

$$P = 2,000 - 50Q$$

where P is the price (in dollars) of an engine and Q is the number of engines sold per month.

- a. To sell 20 engines per month, what price would Dolan have to charge?
- b. If managers set a price of \$500, how many engines will Dolan sell per month?
- c. What is the price elasticity of demand if price equals \$500?
- d. At what price, if any, will the demand for Dolan's engines be of unitary elasticity?

SOLUTION:

- a. For $Q = 20$, $P = 2,000 - 50(20) = \$1,000$
 - b. For $P = 500$, $Q = 40 - 500/50 = 30$
 - c. $\eta = (\Delta Q/\Delta P)(P/Q) = (-1/50)(500/30) = -1/3$
 - d. For $P = \$1,000$, $\eta = (\Delta Q/\Delta P)(P/Q) = (-1/50)(1,000/20) = -1$
2. The Johnson Robot Company's marketing managers estimate that the demand curve for the company's robots in 2008 is

$$P = 3,000 - 40Q$$

where P is the price of a robot and Q is the number sold per month.

- a. Derive the marginal revenue curve for the firm.
- b. At what prices is the demand for the firm's product price elastic?
- c. If the firm wants to maximize its dollar sales volume, what price should it charge?

SOLUTION:

- a. $MR = \Delta TR/\Delta Q = 3,000 - 80Q$
 - b. $P \geq \$1,500$
 - c. $P = \$1,500$
3. After a careful statistical analysis, the Chidester Company concludes the demand function for its product is

$$Q = 500 - 3P + 2P_r + 0.1I$$

where Q is the quantity demanded of its product, P is the price of its product, P_r is the price of its rival's product, and I is per capita disposable income (in dollars). At present, $P = \$10$, $P_r = \$20$, and $I = \$6,000$.

- a. What is the price elasticity of demand for the firm's product?
- b. What is the income elasticity of demand for the firm's product?
- c. What is the cross-price elasticity of demand between its product and its rival's product?
- d. What is the implicit assumption regarding the population in the market?

SOLUTION:

- a. $\eta = (\Delta Q/\Delta P)(P/Q) = (-3)(10/1,110) = -3/111$
- b. $\eta_I = (\Delta Q/\Delta I)(I/Q) = (0.1)(6,000/1,110) = 60/111$

- c. $\eta_{\text{cross}} = (\Delta Q/\Delta P_r)(P_r/Q) = (2)(20/1,110) = 4/111$
- d. The calculations assume that the population is constant.
4. The Haas Corporation's executive vice president circulates a memo to the firm's top management in which he argues for a reduction in the price of the firm's product. He says such a price cut will increase the firm's sales and profits.
- The firm's marketing manager responds with a memo pointing out that the price elasticity of demand for the firm's product is about 20.5. Why is this fact relevant?
 - The firm's president concurs with the opinion of the executive vice president. Is she correct?

SOLUTION:

- Whether total revenue will go up or down when the product price is lowered and more units are sold depends on whether the quantity of units sold increases by a greater percentage than the price is reduced by. That is, it depends on whether the demand is elastic or inelastic.
 - Assuming that the marketing manager is correct that the demand elasticity is -0.5 , then a price reduction will cause the number of units sold to increase by a smaller percentage than the price has fallen, and both the president and executive vice president will have egg on their faces when total revenues decline after the price is reduced.
5. Managers of the Hanover Manufacturing Company believe the demand curve for its product is

$$P = 5 - Q$$

where P is the price of its product (in dollars), and Q is the number of millions of units of its product sold per day. It is currently charging \$1 per unit for its product.

- Evaluate the wisdom of the firm's pricing policy.
- A marketing specialist says that the price elasticity of demand for the firm's product is -1.0 . Is this correct?

SOLUTION:

- At $P = 1$, $MR = -3$. The price is too low; increasing the price and selling fewer units would increase revenues.
 - No. While $\Delta Q/\Delta P = -1$, $(\Delta Q/\Delta P)(P/Q) = -1/4$ at $P = 1$.
6. On the basis of historical data, Richard Tennant has concluded, "The consumption of cigarettes is . . . [relatively] insensitive to changes in price. . . . In contrast, the demand for individual brands is highly elastic in its response to price. . . . In 1918, for example, Lucky Strike was sold for a short time at

a higher retail price than Camel or Chesterfield and rapidly lost half its business.”

- a. Explain why the demand for a particular brand is more elastic than the demand for all cigarettes. If Lucky Strike raised its price by 1 percent in 1918, was the price elasticity of demand for its product greater than -2 ?
- b. Do you think that the demand curve for cigarettes is the same now as it was in 1918? If not, describe in detail the factors that have shifted the demand curve and whether each has shifted it to the left or right.

SOLUTION:

- a. As we define a product more narrowly, consumers have better substitutes (whose prices are held constant) as the price of the good under consideration varies. This makes the demand for a good more elastic the more narrowly the good is defined. We are not told how much Lucky Strike was priced above Camel and Chesterfield, but assuming that the margin was less than 25 percent, we can conclude that the cross-price elasticity was greater than 2. This isn't exactly right; we must also assume that Lucky Strike's fall in sales resulted from a reduction in the price of Camels and Chesterfields for the cross-price elasticities as explained to students.
 - b. Population, per capita income, and subsidized health care have all increased; this probably caused the demand curve for cigarettes to shift out, or to the right. Public health education and general education have increased; this probably shifted the demand curve in, or to the left.
7. According to S. Sackrin of the U.S. Department of Agriculture, the price elasticity of demand for cigarettes is between -0.3 and -0.4 , and the income elasticity of demand is about 0.5.
- a. Suppose the federal government, influenced by findings that link cigarettes and cancer, were to impose a tax on cigarettes that increased their price by 15 percent. What effect would this have on cigarette consumption?
 - b. Suppose a brokerage house advised you to buy cigarette stocks because if incomes were to rise by 50 percent in the next decade, cigarette sales would be bound to spurt enormously. What would be your reaction to this advice?

SOLUTION:

- a. Cigarette consumption would fall by between 4.5 and 6.0 percent.
- b. Assuming that the prices of cigarettes were to remain constant, a 50 percent increase in income would cause sales of cigarettes to increase 25 percent. The weighted average of all income elasticities equals 1, so consumption of noncigarette items would increase by more than 50 percent and certainly more than the 25 percent performance of cigarettes. I would not follow the broker's advice.

8. Using the PIMS (Profit Impact of Market Strategies) survey of major U.S. firms, Michael Hagerty, James Carman, and Gary Russell estimated that, on average, the advertising elasticity of demand was only about 0.003. Doesn't this indicate that firms spend too much on advertising?

SOLUTION:

No. The fact that the elasticity of demand with respect to advertising is relatively small (-0.003) does not necessarily mean that an additional dollar spent on advertising would not be profitable or that the last dollar spent was not profitable.

9. The McCauley Company hires a marketing consultant to estimate the demand function for its product. The consultant concludes that this demand function is

$$Q = 100P^{-3.1}I^{2.3}A^{0.1}$$

where Q is the quantity demanded per capita per month, P is the product's price (in dollars), I is per capita disposable income (in dollars), and A is the firm's advertising expenditures (in thousands of dollars).

- What is the price elasticity of demand?
- Will price increases result in increases or decreases in the amount spent on McCauley's product?
- What is the income elasticity of demand?
- What is the advertising elasticity of demand?
- If the population in the market increases by 10 percent, what is the effect on the quantity demanded if P , I , and A are held constant?

SOLUTION:

- The price elasticity of demand is -3.1 .
 - An increase in price will cause revenues to fall because the demand is elastic.
 - The income elasticity of demand is 2.3.
 - The advertising elasticity of demand is 0.1.
 - If P , I , and A are held constant, per capita consumption is constant. Therefore, a 10 percent increase in population gives rise to a 10 percent increase in the quantity demanded.
10. The Schmidt Corporation estimates that its demand function is

$$Q = 400 - 3P + 4I + 0.6A$$

where Q is the quantity demanded per month, P is the product's price (in dollars), I is per capita disposable income (in thousands of dollars), and A is the firm's advertising expenditures (in thousands of dollars per month). Population is assumed to be constant.

- a. During the next decade, per capita disposable income is expected to increase by \$5,000. What effect will this have on the firm's sales?
- b. If Schmidt wants to raise its price enough to offset the effect of the increase in per capita disposable income, by how much must it raise its price?
- c. If Schmidt raises its price by this amount, will it increase or decrease the price elasticity of demand? Explain. Make sure your answers reflect the fact that elasticity is a negative number.

SOLUTION:

- a. Sales will increase by 20 units per month.
- b. Price must be increased by \$6.67 per unit.
- c. Two possible interpretations, both lead to more elastic demand. You could assume that the question is asking if demand is more elastic after both the income and price have increased. Since $\Delta Q/\Delta P$ is unchanged and P/Q has increased, the demand will be more elastic. Alternatively, you might assume that the question is asking, as we increase the price to choke off the anticipated increase in the quantity demanded after income has gone up, does the demand become more or less elastic? This is, of course, just moving up a linear demand curve, which implies an increasingly elastic demand.