Glossary

Accounting Cost (*page 194*) Actual expenses plus depreciation charges for capital equipment. (These charges are determined by the Internal Revenue Service.)

Adverse Selection (*page 596*) A form of market failure resulting from asymmetric information: If insurance companies must charge a single premium because they cannot distinguish between high-risk and low-risk individuals, more high-risk individuals will insure, making it unprofitable to sell insurance.

Agent (*page 608*) An individual employed by a principal to implement the objective of the principal.

Antitrust Laws (*page 353*) Regulations intended to promote a competitive economy by prohibiting actions that restrain competition.

Arc Elasticity of Demand (*page 110*) Used when dealing with a relatively large price change, the arc elasticity is equal to $(\Delta Q/\Delta P)\,(\overline{P}/\overline{Q})$ where $\overline{P}$ and $\overline{Q}$ are the averages of the prices and quantities before and after the price change.

Asymmetric Information (*page 593*) A situation in which a buyer and a seller have different information about a transaction.

Average Cost (*page 198*) Production cost per unit of output.

Average Expenditure (*page 345*) The price per unit paid by a buyer.

Average Product (*page 171*) Total output per unit of a particular input.

Average Revenue (*page 321*) Revenue divided by the number of units sold, i.e., price per unit.

Backward-Bending Labor Supply Curve (*page 502*) The portion of the labor supply curve at which the wage rate increases and the hours of work supplied decrease, giving the curve a negative slope.

Bandwagon Effect (*page 118*) A positive network externality in which an individual demands a good in part because many other people have the good.

Barrier to Entry (*page 419*) Anything that makes it prohibitive for new firms to enter a market; it is necessary if incumbent firms are to maintain monopoly power.

Bilateral Monopoly (*page 352*) A market with one buyer and one seller.

Budget Line (*page 69*) All combinations of goods that can be purchased with an individual's income.

Bundling (*page 384*) A pricing strategy that involves selling two or more products as a package.

CAPM (Capital Asset Pricing Model) (*page 538*) A model in which the risk premium for a capital investment depends on the correlation of the investment's return with the return on the entire stock market.

Cardinal Ranking (*page 63*) A quantitative measure of the value of a good in terms of a basic unit of utility.

Cartel (*page 414*) A group of firms that explicitly agree to set prices and/or to limit output.

Ceiling Price (*page 49*) A maximum price that firms are allowed by the government to charge for a good.

Clayton Act (*page 354*) As amended by the Robinson-Patman Act, a law that makes it illegal to discriminate by charging buyers of essentially the same product different prices.

Coase Theorem (*page 643*) When parties can bargain without cost and to their mutual advantage,

the resulting outcome will be efficient, regardless of how the property rights are specified.

Common Property Resource (*page 645*) A resource, such as air and water, to which anyone has free access.

Comparative Advantage (*page 582*) A country A has a comparative advantage over another country B in producing a good if the cost of producing the good in A, relative to the cost of producing other goods in A, is lower than the cost of producing the good in B, relative to the cost of producing other goods in B.

Competitive Markets (*page 11*) Markets in which buyers and sellers individually have little or no ability to affect prices.

Complements (*page 101*) Goods that tend to be used together, so that an increase in the price of one good tends to decrease the demand for its complement.

Constant Cost Industry (*page 264*) An industry whose long-run supply curve is horizontal.

Constant Returns to Scale (*page 187*) When a doubling of inputs causes output to double.

Consumer Price Index (*page 13*) A measure of the aggregate price level based on a large market basket of goods; calculated by the U.S. Bureau of Labor Statistics.

Consumer Surplus (*page 113*) The difference between the amount consumers are willing to pay for a good and the amount they actually pay.

Contestable Market (*page 272*) A market that firms can freely enter or exit without incurring sunk costs.

Contract Curve (*page 566*) A curve that. includes all efficient allocations of two goods between two consumers, or two inputs between two production functions, in an Edgeworth box.

Cooperative Game (*page 454*) A game in which players can negotiate binding contracts that allow them to plan joint strategies.

Cost Function (*page 224*) A relationship between the cost of production and the level of output of a firm or firms.

Coumot Equilibrium (*page 424*) The Nash equilibrium that occurs when firms simultaneously choose the quantities they will produce.

Coumot Model (*page 421*) An oligopoly model in which firms assume that their competitors' outputs are fixed, and simultaneously decide how much to produce.

Cross-Price Elasticity of Demand (*page 31*) The percentage change in the quantity demanded of a good that results from a 1 percent increase in the price of another good.

Deadweight Loss (*page 280*) A measure of efficiency loss, given by the sum of lost consumer and producer surplus, less revenues to the government.

Decreasing Cost Industry (*page 267*) An industry whose long-run supply curve is downward sloping.

Decreasing Returns to Scale (*page 187*) When a doubling of inputs causes output to increase by less than a factor of two.

Demand Curve (*page 95*) The amount of a good consumers are willing to purchase as a function of its price.

Depreciation (*page 195*) The decline in value of a capital asset as it is used over time.

Discount Rate (*page 535*) A rate used to compare the value of a dollar received in the future to a dollar received today.

Diseconomies of Scale (*page 212*), When a firm's costs more than double in response to a doubling of output.

Diseconomies of Scope (*page 218*) When one firm produces less of two outputs than two separate specialized firms could produce.

Diversifiable Risk (also Nonsystematic Risk) (*page 537*) Risk that can be eliminated by diversifying, e.g., by investing in many projects or by holding the stocks of many companies.

Dominant Firm Model (*page 442*) A model of oligopoly in which one firm sets price, knowing that other firms will produce as much as they want at that price.

Dominant Strategy (page 456) A strategy that is optimal regardless of how one's competitors behave.

Duality in Consumer Theory (*page 134*) The optimum allocation of income between two goods may be determined by choosing the highest indifference curve that is tangent to the budget line, or by choosing the lowest budget line that touches a given indifference curve.

Durable Good (*page 33*) A consumption or capital good bought to provide services for a long time.

Economic Profit (*page 258*) The difference between a firm's revenues and costs, including any opportunity costs.

Economic Rent (*page 261*) The difference between the payments made to a factor of production and the minimum amount that must be spent to obtain the use of that factor.

Economies of Scale (*page 212*) When a firm's costs less than double in response to a doubling of output.

Economies of Scope (*page 218*) When one firm produces more of two outputs than two specialized firms could produce.

Edgeworth Box Diagram (*page 564*) A diagram that shows all possible allocations of two goods between two people, or of two inputs between two production processes.

Effective Yield (*page 529*) The interest rate that equates the price of a bond with the present discounted value of its expected future payments. Also called the *rate of return* on the bond.

Efficiency Wage (*page 617*) The wage a firm will pay to an employee as an incentive not to shirk.

Elastic Demand (*page 29*) When the percentage change in quantity demanded of a good in response to a 1 percent change in price is greater than one in magnitude.

Elasticity (*page 28*) A measure of 'the percentage change in one variable resulting from a 1 percent increase in the other variable.

Emissions Fee (*page 630*) A charge per unit of emissions imposed oil a polluter.

Emissions Standard (*page 630*) A legal limit on how much pollutant a firm may emit.

Engel Curve (*page 99*) The quantity of a good consumed as a function of income.

Equal Marginal Principle (*page 88*) A rule for optimization when two or more options are available, i.e., to maximize utility, a consumer should equalize the marginal utility of each dollar spent on each good consumed.

Equilibrium Price (also Market-Clearing Price) (*page 19*) The price at which the quantity supplied and quantity demanded are equal.

Excess Demand (*page 49*) Demand that results when the quantity demanded exceeds the quantity supplied because a price ceiling keeps the price of a good below its equilibrium price.

Expansion Path (*page 209*) A curve that describes the combinations of labor and capital a firm will choose to minimize costs for every level of output.

Expected Value (*page 140*) The average value of a set of uncertain outcomes.

Explicit Cost (*page 194*) The actual outlays by a firm, including wages, salaries, costs of materials, and property rentals.

Externality (*page 623*) An action by either a producer or a consumer that affects other producers or consumers, yet is not accounted for in the market price.

Feedback Effect (*page 558*) A price or quantity adjustment in one market that is caused by price and quantity adjustments in related markets.

First-Degree Price Discrimination (*page 364*) Charging each person her reservation price for a good.

Fixed Cost (*page 198*) A cost that does not vary with the level of production, such as plant main" tenance and insurance.

Fixed Inputs (*page 170*) Factors that cannot be changed in the short run.

Fixed-Proportions Production Function (*page 183*) When the production isoquants are L-shaped, so that only one combination of labor and capital can be used to produce each level of output.

Free Entry (Exit) *(page 415)* When firms may enter (exit) an industry without incurring a sunk cost,

Free Rider *(page 652)* A consumer or producer that does not pay for a nonexclusive good in the expectation that others will.

General Equilibrium Analysis *(page 558)* A method of analysis that simultaneously determines the prices and quantities in several markets.

Giffen Good *(page 104)* A good whose demand curve slopes upward as a result of a large income effect

Income-Consumption Curve *(page 97)* A curve that includes the utility-maximizing combinations of goods associated with every income level.

Income Effect *(page 104)* The increase in consumption brought about by an increase in income, when the prices of goods are held constant.

Income Elasticity of Demand *(page 31)* The percentage change in the quantity demanded of a good resulting from a 1 percent increase in income.

Increasing Cost Industry *(page 265)* An industry whose long-run supply curve is upward sloping.

Increasing Returns to Scale *(page 187)* When a doubling of inputs causes output to more than double.

Indifference Curve *(page 59)* A graphical representation of all combinations of market baskets that provide the same level of satisfaction.

Indifference Map *(page 62)* A set of indifference curves that describes the consumer's preferences among various combinations of market baskets.

Inelastic Demand *(page 29)* When the percentage change in the quantity demanded of a good in response to a 1 percent change in price is less than one in magnitude.

Inferior Good *(page 98)* A good for which consumption falls as an individual's income rises.

Intel-temporal Price Discrimination *(page 375)* Separating consumers into groups with varying demand functions and charging them different prices at different points in time.

Isocost Line *(page 204)* A line that includes all possible combinations of inputs that can be purchased for a given amount of money.

Isoquant *(page 168)* A curve that shows all the possible combinations of inputs that yield the same output.

Isoquant Map *(page 169)* A set of isoquants, each of which shows the maximum output that can be achieved for any set of inputs.

Kinked Demand Curve *(page 438)* The demand curve oligopolistic firms face due to the rigidity of prices, where the price elasticity of demand is higher for price increases than for decreases.

Labor Productivity *(page 177)* The average product of labor as applied to an industry or to the economy as a whole.

Law of Diminishing Returns *(page 174)* As the use of an input increases (while other inputs remain constant), the additional output produced will eventually decrease.

Learning Curve *(page 220)* The relationship between a firm's cumulative output and the (declining) amount of inputs needed to produce a unit of output.

Lerner Index *(page 334)* A measure of monopoly power calculated as the excess of price over marginal cost as a fraction of marginal .cost.

Marginal Cost (or Incremental Cost) *(page 198)* The increase in cost from producing one additional unit of output.

Marginal Expenditure *(page 345)* The incremental cost of purchasing one additional unit of a good.

Marginal External Cost *(page 624)* The increase in cost imposed externally as a firm (or firms) increases its output by one unit.

Marginal Product of Inputs *(page 171)* The additional output produced as the input is increased by one unit.

Marginal Rate of Substitution *(page 64)* The amount of one good an individual will give up to gain one more unit of another good.

Marginal Rate of Technical Substitution *(page 181)* The amount by which one input can be reduced when one extra unit of another input is used, so that output remains constant.

Marginal Rate of Transformation *(page 578)* A measure of how much of one good must be given up to produce an additional unit of another good.

Marginal Revenue *(page 240)* The change in revenue resulting from a one-unit increase in output.

Marginal Revenue Product *(page 492)* The additional revenue resulting from the sale of output created by the use of one additional unit of an input.

Marginal Social Cost *(page 624)* The sum of marginal cost and marginal external cost (for each level of output).

Marginal Utility *(page 87)* A measure of the additional satisfaction obtained from consuming one additional unit of a good.

Market *(page 10)* A collection of buyers and sellers who interact, resulting in the possibility of exchange.

Market Demand Curve *(page 107)* The horizontal summation of all individual consumers' demand curves.

Market Power *(page 322)* The ability to profitably affect price. Refers to either monopoly or monopsony power.

Market Signaling *(page 600)* The process by which sellers send buyers information about a product's quality.

Markup Pricing *(page 334)* Increasing the production cost of a good by a fixed percentage to determine a sales price.

Maximin **Strategy** *(page 460)* A gaming strategy that maximizes the minimum gain that can result.

Median Voter *(page 655)* The individual with the median preferred outcome among all voters.

Mixed Bundling *(page 389)* When two or more goods are sold both as a package and individually

Mixed Strategy *(page 461)* A gaming strategy in which a player makes a random choice among two or more possible actions, based on a set of chosen probabilities.

Monopolistic Competition *(page 413)* A market in which firms compete by selling differentiated products that are highly substitutable for one another, and there is free entry and exit

Monopoly *(page 319)* A market with only one seller.

Monopoly Power *(page 319)* The ability of a firm to profitably charge a price higher than marginal cost.

Monopsony *(page 319)* A market with only one buyer.

Monopsony Power *(page 320)* The ability of a buyer to purchase a good at a price below its marginal value.

Moral Hazard *(page 604)* When an insured party can affect the probability or magnitude of an event against the occurrence of which it is insured.

Nash Equilibrium *(page 421)* A set of strategies or actions in which each player is doing the best it can, given the actions of its opponents.

Natural Monopoly *(page 343)* An industry in which economies of scale are so great that the efficient level of production.for one firm satisfies the entire market demand.

Net Present Value *(page 532)* The present discounted value of expected future cash flows from an investment, less the cost of the investment.

Network Externality *(page 118)* The dependence of an mdividual's demand on the consumption levels of other people.

Nominal Discount Rate *(page 535)* A discount rate that includes the effects of inflation.

Nominal Price *(page 13)* The price actually quoted for a good at a given point in time; also called the "current dollar" price.

Noncooperative Game *(page 454)* A game in which negotiation and enforcement of a binding contract are not possible.

Nonexclusive Good *(page 648)* A good that people cannot be excluded from consuming, and for the use of which it is difficult to charge them.

Nonrival Good *(page 648)* A good for which the marginal cost of provision to an additional consumer is zero.

Normal Good *(page 98)* A good for which consumption increases when income rises.

Normative Analysis *(page 6)* An analysis leading to a recommendation or a prescription.

Oligopoly *(page 419)* A market with few sellers.

Oligopsony *(page 345)* A market with few buyers.

Opportunity Cost *(page 194)* The cost associated with opportunities that are foregone by not putting the firm's resources to their highest value use.

Opportunity Cost of Capital *(page 533)* The rate of return that one could earn by investing in a different project with similar risk.

Ordinal Ranking of Utility *(page 63)* Values that denote relative levels of satisfaction, assigned when the particular unit of utility is unimportant.

Pareto Efficiency *(page 567)* An allocation of goods in which one person must be made worse off in order to make another person better off.

Partial Equilibrium Analysis *(page 558)* A determination of the equilibrium prices and quantities in a particular market that ignores effects from other markets.

Peak-Load Pricing *(page 376)* A form of intertemporal price discrimination in which peak users pay more than off-peak users because marginal cost is higher during peak periods.

Perfect Competition *(page 271)* A market in which all goods are perfect substitutes, there are no barriers to entry, and no firm can affect the market price.

Positive Analysis *(page 5)* An explanation or prediction of an economic activity.

Predatory Pricing *(page 354)* A pricing policy designed to drive one or more competitors out of business and/or discourage new entrants to a market.

Present Discounted Value *(page 524)* The current value of an expected future cash flow.

Price-Consumption Curve *(page 95)* A curve derived by tracing the utility-maximizing combinations of two goods as the price of one changes.

Price Discrimination *(page 363)* Charging different prices to different customers for similar goods

Price Elasticity of Demand *(page 110)* The percentage change in the quantity demanded of a good resulting from a 1 percent increase in the price of that good.

Price Elasticity of Supply *(page 32)* The percentage change in the quantity supplied of a good resulting from a 1 percent increase in the price of that good.

Price Leadership *(page 439)* A form of implicit collusion, where one firm in the market sets the price and other firms follow suit.

Price Support *(page 292)* A policy by which the government sets the market price of a good,usually an agricultural product, above the free-market level and buys up whatever output is needed to maintain that price.

Price Taker *(page 242)* A firm with no influence over the market price.

Principal *(page 608)* An individual who employs one "or more agents to achieve his or her objective.

Principal-Agent Problem *(page 608)* The probblem that arises when managers (agents) pursue their own goals, even if that entails lower profits for the owners of the firm (the principals).

Prisoners' Dilemma *(page 435)* A game in which two prisoners must decide separately whether to confess to a crime; it is a parable for competition in which all firms would do better if they cooperated, but each has a strong incentive to undercut its competitors.

Producer Surplus *(page 255)* The sum over all units of production of the difference between the market price of the good and the marginal cost of production.

Production Possibilities Frontier *(page 577)* .A curve that describes the various combinations of two goods that can be produced given fixed quantities of inputs.

Profit Maximization *(page 239)* The goal of a firm; it is achieved when the marginal revenue of the firm is equal to the marginal cost of production.

Public Good *(page 648)* A nonexclusive and nonrival good.

Pure Bundling *(page 385)* When a firm sells two or more goods only as a package.

Rate of Return *(page 529)* The discount rate that makes the net present value of an investment equal to zero.

Rate-of-Retum Regulation *(page 344)* Setting a price that gives a monopoly a competitive return on its assets.

Reaction Curve *(page 423)* The profit-maximizing production choices of one firm in a duopoly as a function of the other firm's output.

Real Discount Rate *(page 535)* The discount rate that applies when cash flows are in real terms, i.e., after netting out inflation.

Real Price *(page 13)* The price of a good relative to the aggregate price level; also called the "constant dollar" price.

Regulatory Lag *(page 344)* Delays that are usually required to change a regulated price.

Reservation Price *(page 364)* The maximum amount that a customer is willing to pay for a good.

Return *(page 157)* The total monetary flow an asset yields as a fraction of its price.

Revealed Preference *(page 81)* An approach to consumer theory in which preferences are determined by observing the choices consumers make.

Risk *(page 139)* The possibility of several different outcomes occurring when the probability of each outcome is known.

Risk-Averse Individual *(page146)* A person who prefers a certain income to a risky alternative with the same expected income.

Risk-Free Return *(page 159)* *A* return which is free of risk, whether of default or interest rate fluctuations. An example is the return on U.S. Treasury bills.

Risk-Loving Individual *(page 146)* A person who prefers a risky alternative to a certain one even though both offer the same expected income.

Risk-Neutral Individual *(page 146)* A person who is indifferent between earning a certain income and earning a risky one with the same expected income.

Risk Premium *(page 147)* The amount of money that a risk-averse individual will pay to avoid taking a risk.

Secondary Supply *(page 39)* The supply from recycled scrap material.

Second-Degree Price Discrimination *(page 367)* Charging different prices for different quantities of the same good.

Sequential Game *(page 469)* A game in which players move in order, rather than simultaneously.

Sherman Act *(page 354)* A law that prohibits contracts, combinations, or conspiracies that restrain trade, and makes monopolizing or attempting to monopolize illegal.

Slutsky Equation *(page 136)* An equation that separates the effect of a price change on quantity demanded into an income and a substitution effect.

Snob Effect *(page 120)* A negative network externality in which an individual's demand for a good is higher the fewer are the other people who have it.

Stackelberg Model *(page 427)* A model of oligopoly in which one firm sets output before the other firms do.

Strategic Move *(page 420)* An action that constrains one's own behavior in a way that yields a strategic advantage.

Substitutes *(page 101)* Goods that compete in the market, so that if the price of one good increases, the quantity demanded of the substitute will also increase.

Substitution Effect *(page 103)* The change in consumption of a good that is associated with a change in its price, while the level of satisfaction is held constant.

Sunk Cost *(page 195)* An expenditure that when made cannot be recovered.

Supply Curve *(page 18)* The amount producers are willing to sell as a function of the market price.

Technical Efficiency *(page 167)* When firms combine their inputs to produce a given output as inexpensively as possible.

Third-Degree Price Discrimination *(page 368)* Dividing consumers into two or more groups with different demands for a product in order to charge different prices to each group.

Tit-for-Tat Strategy *(page 464)* In a repeated game, a strategy that responds in kind to an opponent's previous play. The strategy cooperates with cooperative opponents and retaliates against uncooperative ones.

Total Cost *(page 198)* The total cost of production, composed of fixed and variable costs.

Transfer Prices *(page 402)* The internal prices at which the parts and components from a firm's upstream divisions are "sold" to downstream divisions.

Transferable Emissions Permits *(page 633)* Marketable permits, allocated among firms, that specify the maximum level of emissions that can be generated,

Transitivity of Preferences *(page 59)* If a consumer prefers basket A to basket B, and also prefers basket B to basket C, then he will prefer basket A to basket C.

Two-Part Tariff *(page 379)* A form of pricing in which consumers are charged both an entry fee and a usage fee.

Tying *(page 392)* Requiring the purchaser of a product to also purchase a second product from the same firm.

Uncertainty *(page 139)* The possibility of several different outcomes occurring when the probability of each is unknown.

User Cost *(page 545)* The opportunity cost of depletion when producing a unit of an exhaustible resource.

Utility *(page 85)* The level of satisfaction that a person gets from consuming a good or undertaking an activity.

Utility Possibilities Frontier *(page 571)* A curve that includes all efficient allocations of resources measured in terms of the utility levels of two individuals.

Variable Cost *(page 198)* A cost that varies with the level of output, such as expenditures on wages and raw materials.

Welfare Effects *(page 276)* Gains and losses brought about by government policy.

Answers to Selected Exercises

CHAPTER 2

2. If the Soviet Union had purchased an additional 200 million bushels, the new demand, Q_D' would have been equal to 200 + Q_D: 200 + Q_D = 200 + 2580 - 194P = 2780 -194P. Equating quantity supplied with quantity demanded: 1800 + 240P = 2780 - 194P. P = $2.26, an increase of 46 cents per bushel.

4. a. Total demand, Q_D = 3550 - 266P, equals domestic demand, Q_{DD}, plus export demand, Q_{DE}, where Q_{DD}= 1000 – 46P and Q_{DE} = 2550 – 220P. If export demand decreases by 40%, Q_D = 1000 - 45P +0.6 (2550 - 220P) = 2530 - 178P Domestic supply is Q_S = 1800 + 240P. Equating supply and demand, 1800+ 240P = 2530 - 178P, implying P = $1.75. The market-clearing quantity is 2220 million bushels.

b. With'a price of $3, the market is not in equilibrium. Demand = 2530 - 178.3 = 1996, Supply = 1800 + 240.3 = 2520, and excess supply = 2520 - 1996 = 524 million bushels. The government must purchase this amount to support a price of $3. It spends $3-524 million = $1.6 billion.

6. a. First, considering non-OPEC supply: Sc = Q^* = 6. With E_S = 0.1, and P^* = 4, E_S = $d(P^*/Q^*)$ implies d = 0.15. Substituting for d, Sc, and P in the supply equation, c = 5.4, and Sc = 5.4 + 0.15P. Similarly, since Q_D = 18, E_D) = $b(P^*/Q^*)$, and b = 0.225. Substituting for b, Q_D = 18, and P = 4 in the supply equation means that 18 = a - 0.225(4). We find a = 18.9. So, Q_D = 18.9 - 0.225P.

b. As above, E5 -= 0.4 and E_D = -0.4: Es = $d(P^*/Q^*)$ and E_D=b(P^*/Q^*) implying 0.4=d(4/6) and -0.4 = b(4/18). So, d = 0.6 and b = 1.8. Next solve for c and a: Sc = c + dP and Q_D = a - bP, implying 6 = c + (0.6)(4) and 18 = a - (1.8)(4). So, c = 3.6 and b = 25.2.

c. With OPEC's supply reduced from 12 bb/yr to 6 bb/yr, add this supply of 6 bb/yr to the short-run and long-run supply equations: Sc' = 6 + Sc = 6 + 5.4 = 0.15P = 11.4 + 0.15P and Sc" = 6 + Sc = 6 + 3.6 + 0.6P = 9.6 + 0.6P. These are equated with short-run and long-run demand, so that: 11.4 + 0.15P = 18.9 - 0.225P, implying that P = $20 in the short run, and 9.6 + 0.6P = 25.2 - 1.8P, implying that P = $6.50 in the long run.

CHAPTER 3

4. a. See Figure 3a, where B represents the number of packages of butter and M. the number of packages of margarine.

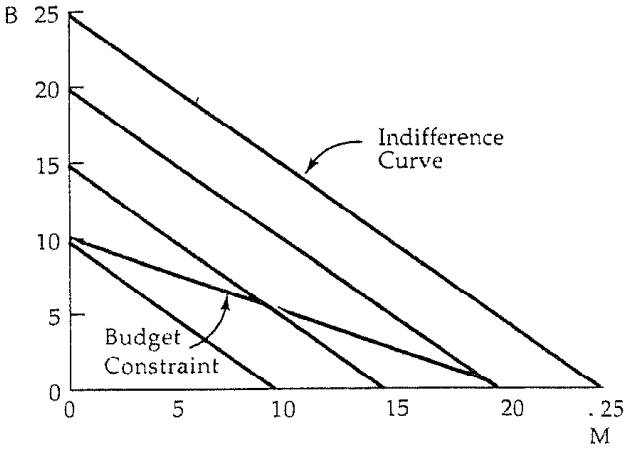

FIGURE 3a

b. Convexity means that the curve is "bowed inward," Here, the indifference curves are not "strictly convex," since they are straight lines.

c. The budget constraint is Y = $P_B B$ + $P_M M$, 20 = 2B + M, B = 10 - 0.5M. Given that Bill is indifferent between butter and margarine, and that

the price of butter is greater than the price of margarine. Bill will only buy margarine.

5. a. See Figure 3b, where "A" is the quantity of alcoholic drinks and "N" is the quantity of non-alcoholic drinks.

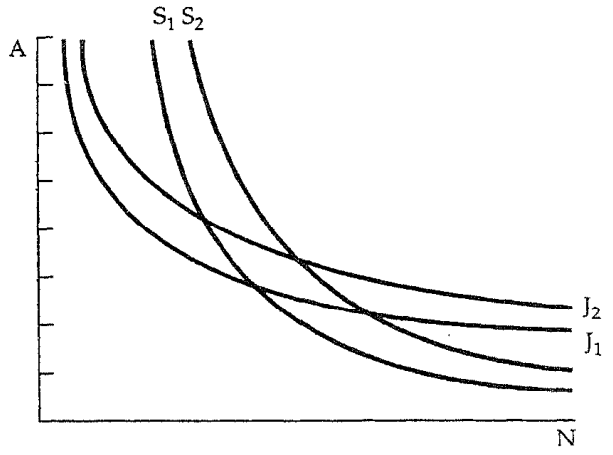

FIGURE 3b

b. At any combination of A and N, Jones is willing to give up less of A to get some N than Smith is. Thus, Jones has a *lower* MRS of A for N than Smith has. Jones" indifference curves are less steep than Smith's at any point on the graph.
c. To maximize satisfaction, each consumer must consume quantities such that the MRS between any two commodities equals the ratio of the prices. There MRS's must be equal because they face the same prices. But because they have different preferences, they will consume different amounts of the two goods, A and N.

6. In Figure 3c, we plot miles flown, M, against all other goods, G, in dollars. The slope of the budget line is $-P_M/P_G$. The price of miles flown changes as miles flown changes, so the budget curve is kinked at 25,000 and 50,000 miles. Suppose P_M is \$1 per mile for less than 25,000 miles, P_M = \$0.75 for 25000 ≤ M ≤ 50,000, and P_M = \$.50 for M > 50,000. Also, let P_G = \$1. Then the slope of the first segment is -1, the slope of the second segment is -0.75, and the slope of the last segment is -0.5.

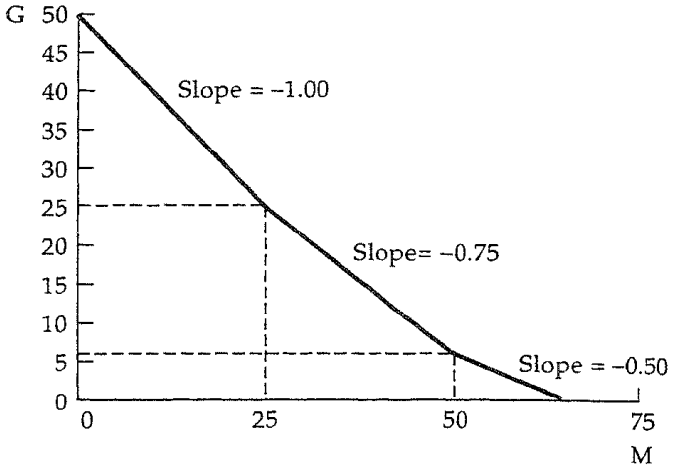

FIGURE 3c

CHAPTER 4

1. a. With a small change in price, the following point elasticity formula is appropriate: £EE_P= %ΔQ/%ΔP. For computer chips, E_P = -2, and for disk drives, E_P = -1. Let $TR_1 = P_1Q_1$ be revenue before the price exchange and $TR_2 = P_2Q_2$ be revenue after the price change. Then ΔTR would be $TR_2 - TR_1$. For computer chips, $\Delta TR = -12\%TR_1$ For disk drives, $\Delta TR = -1\%TR_1$.
b. Although we know the responsiveness of demand to changes in price, we need to know the quantities and the prices of the products to determine total sales revenues.

4.a. The demand curve is a straight line with a vertical intercept of P = 12 and a horizontal intercept of Q = 6 (since Q = 6 - P/2).
b. If there were no toll, the price P would be 0, so that Q = 6 .
c. If the toll is \$6, Q = 3. The consumer surplus lost is the difference between consumer surplus when P = 0 (36) and consumer surplus when P = 3 (20.25), or 15.75.

9. a. With small changes in price, the point elasticity formula would be appropriate. But here, the price of food doubles from \$2 to \$4, so arc elasticity should be used: $E_P = (\Delta Q/\Delta P)(\bar{P}/\bar{Q})$. We know that E_P = -1, P = 2, ΔP = 2, and Q = 5000. So, if there is no change in income, we can solve for ΔQ: $-1 = (\Delta Q/2)\ [(2 + 1)/(5{,}000 + \Delta Q/2)] =$

$(\Delta Q \cdot 3)/(10{,}000 + \Delta Q)$. We find that $\Delta Q = -2{,}500$: she decreases her consumption of food from 5,000 to 2,500 units.

b. A tax rebate of $5,000 implies an income increase of $5,000. To calculate the response of demand to the tax rebate, we use the definition of the arc income elasticity: $E_I = (\Delta Q/\Delta I)\ (\bar{I}/\bar{Q})$ We know that $E_I = 0.5$, $I = 25{,}000$, $\Delta I = 5000$, $0 = 2500$. We solve for ΔQ: $0.5 = (\Delta Q/5000)[(25{,}000 + 2500)/(2500 + \Delta Q/2)]$. Since $\Delta Q = 238$, she increases her consumption of food from 2,500 to 2,738 units.

c. On her final indifference curve, she chooses to consume 2,738 units of food (for $10,952) and $19,048 worth of all other goods. At the original food price of $2, this combination would have cost her 2738.$2 + $19,048 = $24,524, So, she would have had an extra $476 to spend on either food or other consumption, and would have been better off.

CHAPTER 4-APPENDIX

1. The first utility function can be represented as a series of straight lines; the second as a series of hyperbolas in the positive quadrant; and the third as a series of *"L"s*. Only the second utility function meets the definition of a strictly convex shape.

3. The Slutsky equation is $dX/dP_X = \partial X/\partial P|_{U=U^*} - X(\Delta X/\Delta I)$, where the first term represents the substitution effect and the second term represents the income effect. Because there is no substitution as price change with this type of utility function, the substitution effect is zero.

CHAPTER 5

2. The four mutually exclusive states are given in Table 5 below.

7. Consumers with income X^* will simultaneously purchase unfair insurance and take unfair gambles. They are risk averse against large losses, but risk loving for large income gains.

CHAPTER 6

1. a. The average product of labor, *AP*, is equal to *Q/L*. The marginal product of labor, *MP*, is equmal to $\Delta Q/\Delta L$. The relevant calculations are given in the following table.

L	*Q*	*AP*	*MP*
0	0	–	–
1	10	10	10
2	17	8½	7
3	22	7⅓	5
4	25	6¼	3
5	26	5⅕	1
6	25	4⅙	−1
7	23	3²⁄₇	−2

b. This production process exhibits diminishing returns to labor, which is characteristic of all production functions with one fixed input. Each additional unit of labor yields a smaller increase in output than the last unit of labor.

c. Labor's negative marginal product can arise from congestion in the chair manufacturer's factory. As more laborers are using a fixed amount of capital, they get in each other's way, decreasing output.

5. If the marginal product (MP) of labor is greater than the average product (AP) of labor, then each additional unit of labor is more productive than the average of all previous units. By adding the last unit, the average of all units increases. The AP is at a maximum when the productivity of the last unit is equal to the average of all previous units.

Table 5

	Congress Passes Tariff	Congress Does Not Pass Tariff
Slow growth rate	State 1: Slow growth with tariff	State 2: Slow growth without tariff
Fast growth rate	State3: Fast growth with tariff	State 4: Fast growth without tariff

8. a. Let Q_1 be the output of DISK, Inc., Q_2 be the output of FLOPPY, Inc., and X *be* equal amounts of capital and labor for the two firms. Then, $Q_1 = 10X^{0.5}X^{0.5} = 10X^{(0.5+0.5)} = 10X$ and $Q_2 = 10X^{0.6}X^{0.4} = 10X^{(0.6+0.4)} = 10X$. Because $Q_1 = Q_2$, they both generate the same output with the same inputs.
b. With capital fixed at 9 machine units, the production functions become $Q_1 = 30L^{.5}$ and $Q_2 = 37.37L^{.4}$. Consider the following table:

L	Q Firm 1	MP Firm 1	Q Firm 2	MP Firm 2
0	0	—	0	–
1	30.00	30.00	37.37	37.37
2	42.43	12.43	49.31	11.94
3	51.96	9.53	57.99	8.68
4	60.00	8.04	65.06	7.07

For each unit of labor above 1 unit, the marginal product of labor is greater for DISK, Inc.

CHAPTER7

3. a. Total cost, TC, is equal to fixed cost, FC, plus variable cost, VC. Since the franchise fee, FF, is a fixed sum,'the firm's fixed costs increase by the fee. Then average cost, equal to (FC + VC)/Q, and average fixed cost, equal to (FC/Q), increase by the average franchise fee (FF/Q). Average variable cost is unaffected by the fee, as is marginal cost.
b. When a tax t is imposed, variable costs increase by tQ. Average variable cost increases by t (fixed cost is constant), as does average (total) cost. Because total cost increases by t with each additional unit, marginal cost increases by t.

4. If the firm can produce one chair with either four hours of labor or four hours of machinery or any combination, then the isoquant is a straight line with a slope of -1 and intercepts at $K = 4$ and L = 4. The isocost line, $TC = 22L + 110K$, has a slope of–⅕ and intercepts at K = TC/110 and L = TC/22. The cost minimizing point is a corner solution, where $L = 4$ and $K = 0$, and TC = 88.

7. The production of gasoline involves distilling crude oil and refining the distillate into gasoline. Given that the marginal cost of production is constant up to the capacity constraint for both processes, the marginal cost curves are "mirror" L-shapes. Total marginal cost MC = MC_1 + MC_2, where MC_1 is the marginal cost of distilling crude oil up to the capacity constraint, Q_1 and MC_2 is the marginal cost of refining distillate up to the capacity constraint, Q_2. If the capacity constraint of the distilling unit is lower than that of the hydrocracking unit, total MC is vertical at Q_1. (See Figure 7.) If the capacity constraint of the hydrocracking unit is lower than that of the distilling unit, total MC is vertical at Q_2.

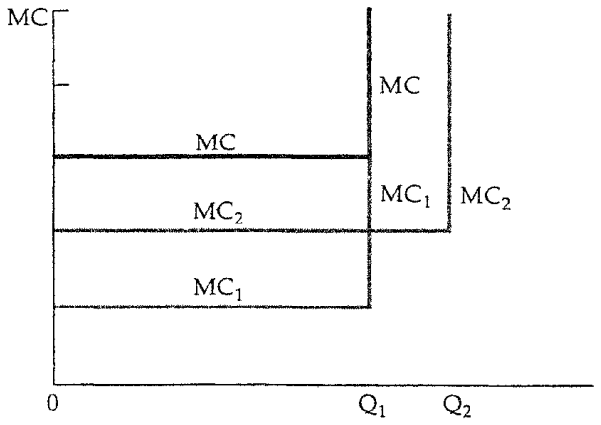

FIGURE 7

CHAPTER 7-APPENDIX

1. a. Returns to scale refers to the relationship between output and proportional increases in all inputs. If $F(\lambda L,\lambda K) > \lambda F(L,K)$, there are increasing; returns to scale; if $F(\lambda L,\lambda K) = \lambda F(L,K)$, there are constant returns to scale; if $F(\lambda L,\lambda K) < \lambda F(L,K)$, there are decreasing returns to scale. Applying this to $F(L,K) = K^2L$, $F(\lambda L,\lambda K) = (\lambda K)^2(\lambda L) = \lambda^3K^2L = \lambda^3F(L,K) > \lambda F(L,K)$. So, this production function exhibits increasing returns to scale.
b. $F(\lambda L,\lambda K) = 10\lambda K + 5\lambda L = \lambda F(L,K)$. The production function exhibits constant returns to scale.
c. $F(\lambda L,\lambda K) = (\lambda K\lambda L)^{0.5} = (\lambda^2)^{0.5}\ (KL)^{0.5} = \lambda(KL)^{0.5} = \lambda F(L,K)$. The production function exhibits constant returns to scale.

2. The marginal product of labor is $100K$. The marginal product of capital is $100L$ The marginal rate of technical substitution is K/L Set this equal to the ratio of the wage rate to the rental rate of capital:

$K/L = 30/120$ or $L = 4K$. Then substitute for L in the production function and solve for a K that yields an output of 1000 units: $1000 = 100K \cdot 4K$. So, $K = 2.5^{0.5}$ $L = 4\text{-}2.5^{0.5}$, and total cost is equal to \$397.47.

CHAPTER 8

1. The table below shows the firm's revenue and cost information when the price falls to \$35. At a price of \$35 the firm should produce 7 units to maximize profit.

3. a. Profit is maximized where marginal cost (MC) is equal to marginal revenue (MR). Here, MR is equal to \$60. Setting MC equal to 60 yields a profit-maximizing quantity of 30.

b. Profit is equal to total revenue (PQ) minus total cost. So PQ - 100 - Q^2. At $P = 60$ and $Q = 30$, profit = 800.

c. The firm produces in the short run if its revenues are greater than its variable costs. The firm's short-run supply curve is its MC curve about minimum AVC. Here, AVC is equal to variable cost, Q^2, divided by quantity, Q. So, AVC = Q. Also, MC is equal to $2Q$. So, MC is greater than AVC for any quantity greater than 0. This means that the firm produces in the short run as long as price is positive.

5. a. With the imposition of a 1-dollar tax on a single firm, all its cost curves shift up by \$1.

b. Because the firm is a price taker, the imposition of the tax only on one firm does not change the market price. Given that the firm's short-run supply curve is its marginal cost curve (above average variable cost), and that the marginal cost curve has shifted up (or inward), the firm supplies less to the market at every price.

c. If the tax is placed on a single firm, that firm will go out of business unless it was earning a positive economic profit before the tax.

CHAPTER 9

1. a. In free-market equilibrium, $L^S = L^D$. So, w = \$3 and $L^S = L^D = 30$. If the minimum wage is \$4, then L^S =40 and L^D =.20. $L^S > L^D$ and employers hire 20 employees.

b. With the subsidy, only w - 1 is paid by the firm. The labor demand becomes $L^{D*} = 60 - 10(w - 1)$. So, w = \$3.50 and L = 35.

4. a. Equating demand and supply, $28 - 2P = 4 + 4P$. $P^* = 4$ and $Q^* = 20$.

b. The 25% reduction required by the new Payment-In-Kind Program would imply that farmers produce 15 bushels. To encourage farmers to withdraw their land from cultivation, the government must give them 5 billion bushels that they sell on the market Since the total supply to the market is still 20 billion bushels, the market price remains at \$4 per bushel. The farmers gain \$20 billion (\$4-5 billion bushels) from the PIK Program, while consumers are not affected.

c. Taxpayers gain because the government does not have to pay to store the wheat for a year and

Output (units)	Price (\$/unit) P =40	Revenue (\$) P =40	Total Cost	Profit (\$) P=40	Marginal Cost P =40	Marginal Revenue P =40	Revenue (\$/unit) P =35	Marginal Reyenue P =35	Profit (\$) P =35
0	40	0	50	-50	—	—	0	—	-50
1	40	40	100	-60	50	40	35	35	-65
2	40	80	128	-48	28	40	70	35	-58
3	40	120	148	-28	20	40	105	35	-43
4	40	160	162	-2	14	40	140	35	-22
5	40	200	180	20	18	40	175	35	-5
6	40	240	200	40	20	40	210	35	10
7	40	280	222	58	22	40	245	35	23
8	40	320	260	60	38	40	280	25	20
9	40	360	305	55	45	40	315	35	10
10	40	400	360	40	55	40	350	35	-10
11	40	440	425	15	65	40	385	35	-40

then ship it to an underdeveloped country. The PIK Program can last only as long as wheat reserves last. But PIK assumes that the land removed form production can be restored to production at such times as the stockpiles are exhausted. If this cannot be done, consumers may eventually pay more for wheat-based products. Finally, farmers enjoy a windfall profit because they have no production costs.

9. The supply and demand curves for natural gas can be approximated as follows: $Q^S = 14 + 2P_G + 0.25P_O$, $Q^D = -5P_G + 3.75P_O$. With the price of oil at \$12 per barrel, these curves become $Q^S = 17 + 2P_G$, and $Q^D = 45 - 5P_G$. Setting $Q^D = Q^S$, $17 + 2P_G = 45 - 5P_G$, P = \$4. At this price, equilibrium quantity is 25 Tcf. If a ceiling of \$1 is imposed, producers would supply 19 Tcf and consumers would demand 40 Tcf. Consumers gain area A - B = 57 - 3.6 = \$53.4 billion in the figure. Producers lose are A - C = -57 -9 = \$66.0 billion. Deadweight loss is equal to 53.4 - 66 = \$12.6 billion.

CHAPTER 10

2. There are three important factors: (1) How similar are the products offered by Caterpillar's competitors? If they are close substitutes, a small increase in price could induce customers to switch to the competition. (2) What is the age of the existing stock of tractors? A 5% price increase induces a smaller drop in demand with an older population of tractors. (3) As a capital input in agricultural production, what is the expected profitability of the agricultural sector? If expected farm incomes are falling, an increase in tractor prices induces a greater decline in demand than one would estimate with information on past sales and prices.

3. a. Optimal production if found by setting marginal revenue equal to marginal cost. If the demand function is linear, $P = a - bQ$ (here, $a = 100$ and $b = 0.01$), then $MR = a - 2bQ = 100 - 2(0.01)Q$.

Total cost = $30{,}000 + 50Q$, so MC = 50. Setting MR=MC implies $100 - 0.02Q = 50$, so $Q = 2{,}500$. Substituting into the demand function, P = 100 - 0.01,2.500 = 75 cents. Total profit is $-30{,}000 + 50 \cdot 2{,}500 - 0.01(2{,}500)^2 = -30{,}000 + 125{,}000 - 62{,}500$, or \$325 per week.

b. Suppose initially that the consumers must pay the tax. Since the price (including the tax) that consumers would be willing to pay remains unchanged, the demand function can be written $P + t = 100 - 0.01Q - t$. Because the tax increases the price of each unit, total revenue for the monopolist decreases by tQ, and marginal revenue decreases by t: $MR = 100 - 0.02Q - t$, where t = 10 cents. To determine the profit-maximizing output with tax, equate marginal revenue and marginal cost: $100 - 0.02Q - 10 = 50$, or Q = 2,000 units.

From the demand function, $P = 100 - 0.01 \cdot 2{,}000 - 10 = 70$ cents. Total profit is $-30{,}000 + 50 \cdot 2{,}000 - 0.01(2{,}000)^2 = 30{,}000$ cents or \$300 per week.

7. a. Pro: Although Alcoa controlled about 90% of primary aluminum production in the United States, secondary aluminum production by recyclers accounted for 30% of the total aluminum supply. It should be possible for a much larger proportion of aluminum supply to come from secondary sources. Therefore, the price elasticity of demand for Alcoa's primary aluminum is much higher than we would expect. In many applications, other metals,Such as copper and steel, are feasible substitutes for aluminum. Here, the demand elasticity Alcoa faces may be lower than we would otherwise expect.

b. Con: The stock of potential supply is limited. Therefore, by keeping a stable high price, Alcoa could reap monopoly profits. Furthermore, since Alcoa had originally produced the metal reappearing as recycled scrap, it would have taken into account in its output decisions the effect of scrap reclamation on future prices. Hence, it exerted effective monopolistic control over the secondary metal supply.

c. Alcoa was not ordered to sell any of its US. production facilities. Rather, (1) it was barred from bidding for two primary aluminum plants constructed by the government during World War II; and (2) it was ordered to divest itself of its Canadian subsidiary, which became Alcan.

CHAPTER 11

1. a. The Saturday-night requirement separates business travelers, who prefer to return home for

the weekend, from tourists, who travel on the weekend.

b. By basing prices on the buyer's location, sorting is done by geography. Then prices can reflect transportation charges, which the customer pays for whether delivery is received at the buyer's location or at the cement plant.

c. Rebate coupons with food processors separate consumers into two groups: (1) customers who are less price sensitive (those who have a lower elasticity of demand) do not request the rebate; and (2) customers who are more price sensitive (those who have a higher demand elasticity) request the rebate;

d. A temporary price cut on bathroom tissue is a form of intertemporal price discrimination. Price-sensitive customers buy more tissue than they would otherwise during the price cut, while non-price-sensitive consumers buy the same amount.

e. The plastic surgeon can distinguish a high-income patient from a low-income patient by negotiation. Arbitrage is no problem because plastic surgery cannot be transferred from low-income patients to high-income patients.

8. a. A monopolist with two markets should pick quantities in each market so that the marginal revenues in both markets are equal to one another and equal to marginal cost. Marginal cost is the slope of the total cost curve, 30. To determine marginal revenues in each market, we solve for price as a function of quantity. Then we substitute this expression for price into the equation for total revenue. $P_{NY} = 150 - 3Q_{NY}$, and $P_{LA}=120 - (3/2)Q_{LA}$ Then total revenues are $TR_{NY} = QmP_{NY} = Q_{NY}(150 - 3Q_{NY})$, and $TR_{LA}= O_{LA}Q_{LA}=Q_{LA}120 - (3/2)Q_{LA}$. The marginal revenues are the slopes of the total revenue curves: $MR_{NY} = 150 - 6Q_{NY}$, and $MR_{LA}= 120 - 3Q_{LA}$. Next, we set each marginal revenue to marginal cost (=30), implying $Q_{NY} = 20$, and $Q_{LA}= 30$. With these quantities, we solve for price in each market: $P_{NY} = 150 - 3{\cdot}20 = 90$, and $P_{LA}=120 - (3/2){\cdot}30=75$.

b. With the new satellite, Sal can no longer separate the two markets. The total demand function is the horizontal summation of the two markets. Above a price of 120, the total demand is just the New York demand function. Below a price of 120, we add the two demands: $Q_T = 50 - (1/3)P + 80 - (2/3)P = 130 - P$. Sal maximizes profit by choosing a quantity so that MR = MC. Total revenue is QP, where $P = 130 - Q$. $TR = Q(130 - Q)$, so, marginal revenue is $130 - 2Q$. Setting this equal to marginal cost implies a profit-maximizing quantity of 50 with a price of 80. In the New York market, quantity is equal to $50 - (1/3)80 = 23\frac{1}{3}$, and in the Los Angeles market, quantity is equal to $80 - (2/3)80 = 26\frac{2}{3}$. Together, 50 units are purchased at a price of 80.

c. Under the market conditions in (a) profit is equal to the sum of revenues from each market minus the cost of producing quantity for both markets: $Q_{NY}P_{NY} + Q_{LA}P_{LA} - 1{,}000 - 30(Q_{NY} + Q_{LA}) = 20{\cdot}90 + 30{\cdot}75 \quad -1{,}000 + 30(20 + 30) = 1/550$. Under the market conditions in (b) profit is equal to the total revenue minus the cost of producing quantity for both markets: $QP - (1{,}000 + 30Q) = 50{\cdot}80 - (1{,}000 + 30{\cdot}50) = 1{,}500$. So Sal makes more money when the two markets are separated.

Under the market conditions in (a), in the New York market, consumer surplus is $(150 - 90){\cdot}20(1/2) = 600$, and in the Los Angeles market consumer surplus is $(120 - 75){\cdot}30(1/2) = 675$. Under the market conditions in (b), in the New York market, consumer surplus is $(150 - 80){\cdot}23\frac{1}{3}(1/2) = 816$, and in the Los Angeles market, consumer surplus is $(120 - 80){\cdot}26\frac{2}{3}(1/2) = 533$. The New Yorkers prefer (b) because the equilibrium price is 80 instead of 90, so their consumer surplus is higher. But the customers in Los Angeles prefer (a), because the equilibrium price is 75 instead of 80.

10. a. With individual demands of $Q_t= 6 - P$, individual consumer surplus is equal to \$18 per week, or \$936 per year. An entry fee of \$936 captures all consumer surplus, even though no court fee would be charged, since marginal cost is equal to zero. Weekly profits would be equal to the number of serious players, 1,000, times the weekly entry fee, \$18, minus \$5,000, the fixed costs, or \$13,000 per week.

b. When there are two classes of customers the club owner maximizes profits by charging court fees above marginal cost and by setting the entry fee equal to the remaining consumer surplus of the consumer with the smaller demand—the occasional player. The entry fee, T, is equal to the consumer surplus remaining after the court fee is assessed: $T= (Q_2 - 0)\ (6 - P)(1/2)$, where $Q_2 = 3 - (1/2)P$, or $T = (3 - (1/2)P)(6 - P)(1/2) = 9 -$

$3P + P^2/4$ Entry fees for all players would be 2/000(9 - $3P + P^2/4$. Revenues from court fees are equal to $P(Q_1 + Q_2)$ = P[(6 - P)l,000 4- (3 - P/2)l,000] = 1,000(9P - $3P^2/2$. Then TR = [(9 - 3P + $P^2/4$)2 + (9P - $SP^2/2$1,000) = (18 + 3P - $P^2$1,000. Marginal cost is zero, and marginal revenue is given by the slope of the total revenue curve: $\Delta TR/\Delta P = 3{,}000 - 2{,}000P$. Equating marginal revenue and marginal cost implies a price of $1.50 per hour. Total revenue is equal to $20,250. Total cost is equal to fixed costs of $5,000. So, profit is $15,250 per week, which is greater than the $13,000 per week when only professional players become members.

c. An entry fee of $18 per week would attract only serious players. With 3,000 serious players, total revenues would be $54,000, and profits would be $49,000 per week With both serious and occasional players. Entry fees would be equal to 4,000 times the consumer surplus of the occasional player: $T = 4{,}000(9 - 3P + P^2/4)$. Court fees are $P[(6 - P)3{,}000 + (3 - P/2)1{,}000] = (21P - 3.5P^2)1{,}000$.Then TR = $[4(9 - 3P + P^2/4) + (21P - 3.5P^2)]1{,}000 = (36 + 9P - 2.5P^2)1{,}000$. Equating marginal revenue and marginal cost implies a price of (9/5), or $1.80 per hour. Then total revenue is equal to $44,100. Total cost is equal to fixed costs of $5,000. Profit with a two-part tariff is $39,100 per week, which is less than the $49,000 per week with only professional players. The club owner should set annual dues at $936 and earn profits of $2.548 million per year.

11. Mixed bundling is often the ideal strategy when demands are only somewhat negatively correlated and/or when marginal production costs are significant. The following tables present the reservation prices of the three consumers and the profits from the three strategies:

	Reseirvation Prioe ($)		
	Forl	For 2	*Total*
Consumer A	6.00	3.25	9.25
Consumer B	3.25	8.25	11.50
Consumer C	10.00	10.00	20.00

	Pricel	*Pricel*	*Bundled*	*Profit*
Sell Separately	5.95	8.20		28.30
Pure Bundling			9.20	27.60
Mixed Bundling	5.95	8.20	14.10	28.25

The profit-maximizing strategy is to sell each item separately.

15. a. For each strategy, the optimal prices and profits are

	Price 1	*Price 2*	*Bundled*	*Profit*
Sell Separately	59.95	59.95		239.90
Pure Bundling			99.95	399.80
Mixed Bundling	59.95	59.95	119.85	359.60

Pure bundling dominates mixed bundling because with marginal costs of zero, there is no reason to exclude purchases of both goods by all customers.

b. With marginal cost of $35, the optimal prices and profits are

	Price 1	*Price 2*	*Bundled*	*Profit*
Sell Separately	89.95	89.95		109.90
Pure Bundling			99.95	119.80
Mixed Bundling	59.95	59.95	119.85	149.60

Mixed bundling dominates all other strategies because with significant marginal costs, the firm wants to exclude purchases of both goods by some consumers.

CHAPTER 11-APPENDIX

1. We examine each case, then compare profits.

a. Optimal quantities and prices with no external market for engines are $Q_E = Q_A = 2{,}000$, P_E = $8,000, and P_A = $18,000. For the engine-building division, TR = 2,000-$8,000 = $16M, TC = $2(2{,}000)^2$ = $8M, and π = $8M. For the automobile-assembly division, TR = 2,000·$18,000 = $36M, TC = $8,000-2,000 + 16M = $32M, and π = $4M. Total profits are $12M.

b. Optimal quantities and prices with an external market for engines are Q_E = 1,500, Q_A = 3,000, PE = $6,000, and PA = $17,000. For the engine-building division, TR = 1,500-$6,000 = $9M, TC = $2(1{,}500)^2$ = $4.5M, and$\pi$ = $4.5M. For the automobile-assembly division, TR = 3,000'$17,000 = $51M, TC = (8,000 + 6,000)3,000 = $42M, and π = $9m. Total profits are $13.5M.

c. Optimal quantities and prices with a monopoly market for engines are Q_E = 2,200, Q_A = 1,600,

PE = \$8,800, and PA = \$18,400, with 600 engines sold in the monopolized market for \$9,400. For the engine-building division, TR = 1,600-\$8,800 + 600-9,400 = \$19.72M, **TC** = $2(2,200)^2$ = \$9.68M, and π = \$10.04M. For the automobile-assembly division, TR = 1,600-\$18,400 = \$29.44M, TC = (8.000 + 8,800),600 = \$26.88M, and π = \$2.56M. Total profits are \$12.6M.

The upstream division, building engines, earns the most profit when it has a monopoly on engines. The downstream division, building automobiles, earns the most when there is a competitive market for engines. Given the high cost of engines, the firm does best when engines are produced at the lowest cost with an external, competitive market for engines.

CHAPTER 12

1. Each firm earns economic profit by distinguishing its brand from all other brands. If these competitors merge into a single firm, the resulting monopolist would not produce as many brands as would have been produced before the merger. But, producing several brands with different prices and characteristics is one method of splitting the market into sets of customers with different price elasticities.

3. a. To maximize profit $\pi = 53Q - Q^2 - 5Q$, we find $\Delta\pi/\Delta Q = -2Q + 48 = 0$. $Q = 24$, so $P = 29$. Profit is equal to 576.

b. $P=53-Q_1-Q_2$, $\pi_1 = PQ_1 - C(Q_1) = 53Q_1 - Q_1^2 - Q_1Q_2 - 5Q_1$ and $\pi_2 = PQ_2 - C(Q_2) = 53Q_2 - Q_1Q_2 - Q_2^2 - 5Q_2$.

c. The problem facing Firm 1 is to maximize profit, given that the output of Firm 2 will not change in reaction to the output decision of Firm 1. Therefore, Firm 1 chooses Q_1 to maximize π_1, as above. The change in π_1 with respect to a change in Q_1 is $53 - 2Q_1 - Q_2 - 5 = 0$, implying $Q_1 = 24 - Q^2/2$. Since the problem is symmetric, the reaction function for Firm 2 is $Q_2 = 24 - Q_1/2$.

d. Solve for the values of Q_1 and Q_2 that satisfy both reaction functions: $Q_1 = 24 - (1/2)(24 - Q_1/2)$. So, $Q_1 = 16$ and $Q_2 = 16$. The price is $P = 53 - Q_1 - Q_2 = 21$. Profit is $\pi_1 = \pi_2 = P \cdot Q_i - C(Q_i) = 256$. Total profit in the industry is $\pi_1 + \pi_2 = 512$.

8. a. To determine the Cournot equilibrium we calculate the reaction function for each-firm, then simultaneously solve for price. *Assuming marginal cost is zero,* profit for Firm 1 is $P_1Q_1 = P_1(20 - P_1 + P_2) = 20P_1 - P_1^2 + P_2P_1$. $MR_1 = 20 - 2P_1 + P_2$. At the profit-maximizing price, $MR_1 = 0$. So, $P_1 = (20 + P_2)/2$. Because Firm 2 is symmetric to Firm 1, its profit-maximizing price is $P_2 = (20 + P_1)/2$. We substitute Firm 2's reaction function into that of Firm 1: $P_1 = [20 + (20 + P_1)/2]/2 = 15 + P_1/4$. $P_1 = 20$. By symmetry $P_2 = 20$. Then $Q_1 = 20$, and by symmetry $Q_2 = 20$. Profit for Firm 1 is $P_1Q_1 = 400$, and profit for Firm 2 is also 400.

b. If m 1 sets its price first, it takes Firm 2's reaction function into account. Firm 1 profit is $\pi_1 = P_1[20 - P_1 + (20 + P_1/2]$. Then, $d\pi_1/dP_1 = 20 - 2P_1 + 10 + P_1$. Setting this expression equal to zero. $P_1 = 30$. We substitute for P_1 in Firm 2's reaction function. $P_2 = 25$. At these prices, $Q_1 = 20 - 30 + 25 = 15$ and $Q_2 = 20 + 30 - 25 = 25$. Profit is $\pi_1 = 30 \cdot 15 = 450$ and $\pi_2 = 25 \cdot 25 = 625$.

c. Your first choice should be (iii), and your second choice should be (ii). Setting prices above the Cournot equilibrium values is optional for both firms when Stackelberg strategies are followed. From the reaction functions, we know that the price leader provokes a price increase in the follower. But the follower increases price less than the price leader, and hence undercuts the leader. Both firms enjoy increased profits, but the follower does best, and both do better than they would in the Cournot equilibrium.

CHAPTER 13

1. If games are repeated indefinitely and all players know all payoffs, rational behavior will lead to apparently collusive outcomes. But, sometimes the payoffs of other firms can only be known by engaging in extensive information exchanges.

Perhaps the greatest problem to maintaining a collusive outcome is exogenous changes in demand and in the prices of inputs. When new information is not available to all players simultaneously, a rational reaction by one firm could be interpreted as a threat by another firm.

2. Excess capacity can arise in industries with easy entry and differentiated products. Because down-

ward sloping demand curves for each firm lead to outputs with average cost above minimum average cost, increases in output result in decreases in average cost. The difference between the resulting output and the output at minimum long-run average cost is excess capacity, which can be used-to deter new entry.

4. a. There are two Nash equilibria, (100,800) and (900/600).

b. Both managers will follow a high-end strategy, and the resulting equilibrium will be (50,50), yielding less profit to both parties.

c. The cooperative outcome (900,600) maximizes the joint profit of the two firms.

d. In comparison to the maximin outcome, the first firm benefits the most (850). The second firm benefits 550, so that any positive offer will encourage collusion. Suppose, however, that without cooperation the firms would reach the (100,800) equilibrium. Then firm 1 would have to offer firm 2 a minimum of 201 to encourage collusion.

CHAPTER 14

1. The budget line for workers under this program is a straight line at $5,000. There is no incentive to work under the new program. Only wages yielding incomes greater than $10,000 will yield a positive labor supply.

5. The demand for labor is given by the marginal revenue product of labor; $MRP_L = MR \cdot MP_L$. In a competitive market, price is equal to marginal revenue, so MR =10. The marginal product of labor is equal to the slope of the production function $Q = 12L - L^2$. This slope is equal to 12 - 2L. The firm's profit-maximizing quantity of labor occurs where $MRP_L = w$, the wage rate. If $w = 30$, solving for L yields 4.5 hours per day. Similarly, if $w = 60$, solving for L yields 3 hours per day.

8. Economic rent is the difference between total wages for all employed workers minus the amount that would have induced these workers to work. Total wages are equal to $wL_D = 1{,}200w - 10w^2$. The total income that workers would have accepted is the area under the labor supply curve up the labor demanded at w. From the supply function, we know that $L = 20w$, or $w = (1{,}200 - 10w)/20$. Then this area is a triangle equal to $L_D'W_s'1/2 = (1{,}200 - 10w)[(1{,}200 - 10w)/20]\text{-}1/2 = 36{,}000 - 600w + 2.5w^2$. If the union's goal is to maximize rent, then it would choose a w to maximize $(1{,}200w - 10w^2) - (36{,}000 - 600w + 2.5w^2) = -36{,}000 = 1{,}800w - 12.5w2'The$ slope with respect to w is 1,800 - 25w. The maximum occurs where this slope is equal to zero, or $w = 72$. At a wage rate of $72, 480 union members are employed. They would have been willing to, work for a total income of $5,760 (0.5·480·480/20). They receive $34,560 and enjoy economic rents of $28,800 (34,560 - 5,760).

CHAPTER 15

1. The present discounted value of the first $80 payment one year from now is $PDV = 80/(1 + 0.10)^1 = \$72.73$. The value of all these coupon payments can be found the same way: $PDV = 80[1/(1.10)^1 + 1/(1.10)^2 + 1/(1.10)^3 + 1/(1.10)^4 + 1/(1.10)^5] = \$303.26$. The present value of the final payment of $1,000 in the sixth year is $1{,}000/1.1^6 = \$564.47$. So the present value of this bond is $303.26 + $564.47 = $867.73. With an interest rate of 15 percent, PDV = $700.49.

3. Redefining terms, the net present value equation becomes $NPV = -5 - 5(1 + R)^{-1} - 1(1 + R)^{-2} - 0.5(1 + R)^{-3} + 0.96[(1 + R)^{-4} + (1 + R)^{-5} + (1 + R)^{-6} + (1 + R)^{-7}] + 0.96[(1 + R)^{-8} + (1 + R)^{-9} + (1 + R)^{-10} + (1 + R)^{-11}] + 0.96[(1 + R)^{-12} + (1 + R)^{-13} + (1 + R)^{-14} + (1 + R)^{-15}] + 0.96[(1 + R)^{-16} + (1 + R)^{-17} + (1 + R)^{-18} + (1 + R)^{-19}] + 0.96(1 + R)^{-20} + 1(1 + R)^{-20}$. With an interest of 4 percent, the NPV becomes -5 - 4.8075 - 0.9246 - 0.4445 + 3.0978 + 2.6482 + 2.2637 + 1.9349 + 0.4381 + 0.4564 = -$338,000. The investment is not worthwhile.

7. a. If we buy a bottle and sell it after t years, we pay $100 now and receive $100t^{0.5}$ when it is sold. The NPV of this investment is $NPV = -100 + e^{-rt} 100t^{0.5} = -100 + e^{0.1t} 100t^{0.5}$.

If we do buy a bottle, we will choose t to maximize the NPV The necessary condition is $dNPV/dt = e^{-0.1t}(50 - t^{0.5}) - 0.1e^{-0.1t} 100t^{0.5} = 0$. Solving, $t = 5$. If we hold the bottle 5 years, the NPV is $-100 + e^{-0.1t \cdot 5} 100.5^{0.5} = 35.67$. Since each bottle is a good investment, we should buy all 100 bottles.

b. You get \$130 now, but lose the $\$100 \cdot 5^{0.5}$ you would get for selling in five years. The NPV of the offer is NPV = $130 - e^{-0.1 \cdot 5} \cdot 5^{0.5} = -5.6 < 0$. Therefore, you should not sell.

c. If the interest rate changes from 10 percent to 5 percent the NPV calculation changes to NPV = $-100 + e^{-0.05t} \cdot 100t^{0.5}$. If we hold the bottle 10 years, the maximum NPV is $-100 + e^{-0.05 \cdot 10} \cdot 100 \cdot 10^{0.5} =$ \$91.80.

CHAPTER 16

1. Even with identical preferences, the contract curve may or may not be a straight- line. This can easily be shown graphically. For example, when both individuals have utility functions $U = x^2y$, the marginal rate of substitution is given by $2y/x$. It is not difficult to show that the MRS's of both individuals are equal for all points on the contract curve $y = (Y/X)/x$, where X and Y are the total quantities of both goods. One example in which the contract curve is not a straight line is when the two individuals have different incomes and one good is inferior.

2. The marginal rate of transformation is equal to the ratio of the marginal costs of producing the two goods. Most production possibilities frontiers are "bowed outward." However, if the two goods are produced with identical production functions, the production possibilities frontier is a straight line.

6. A change from a constant-returns-to-scale production process to a sharply-increasmg-returns-to-scale process does not imply a change in the shape of the isoquants. One can simply redefine the quantities associated with each isoquant such that proportional increases in inputs yield greater than proportional increases in outputs. Under this assumption, the marginal rate of technical substitution would not change, and there would be no change in the production contract curve.

CHAPTER 17

5. a. In the recent past, American automobiles appeared to customers to be of lower quality. To reverse this trend, American companies invested in quality control, improving the potential repair records of their products. They signaled the improved quality of their products through improved warranties.

b. Moral hazard occurs when the party to be insured (the owner of an American automobile with an extensive warranty) can influence the probability or the magnitude of the event that triggers payment (the repair of the automobile). Covering all parts and labor associated with mechanical problems reduces the incentive to maintain the automobile. Hence, a moral hazard problem is created with extensive warranties.

6. Truth in advertising promotes competition by providing the information necessary for consumers to make optimal decisions. Honest advertising facilitates this process. In the absence of truthful advertising, buyers are unable to do these comparisons. Goods priced identically can be of unequal quality. Hence, there will be a tendency for buyers to "stick" with proven products, reducing competition between existing firms and discouraging entry.

CHAPTER 18

3. One needs to know the value to homeowners of swimming in the river, and the marginal cost of abatement. The choice of a policy tool will depend on the marginal benefits and costs of abatement. If firms are charged an equal rate effluent fee, the firms will reduce effluent to the point where the marginal cost of abatement is equal to the fee. If this reduction is not high enough to permit swimming, the fee could be increased.

The setting of a standard will be efficient only-if the policy maker has complete information regarding the marginal costs and benefits of abatement Further, the standard will not encourage firms to reduce effluent further if new filtering technologies become available. A transferable effluent permit system still requires the policy maker to determine the efficient effluent standard. Once the permits are distributed, a market will develop and firms with a higher cost of abatement will purchase permits from firms with lower abatement costs. However, unless permits are sold initially, no revenue will be generated.

5. a. Profit is maximized when marginal revenue is equal to marginal cost. With a constant marginal

revenue of \$20 and a marginal cost of $10 + 2Q$, Q-5.

b. If bees are not forthcoming, the farmer must pay \$10 per acre for artificial pollination. Since the farmer would be willing to pay up to \$10 to the beekeeper to maintain each additional hive, the marginal social benefit of each is \$30, which is greater than the marginal private benefit of \$20. Equating the marginal social benefit to the marginal cost, $Q = 10$.

c. The most radical change that would lead to more efficient operations would be the merger of the farmer's business with the beekeeper's business. This merger would internalize the positive externality of bee pollination. Short of a merger, the farmer and beekeeper should enter into a contract for pollination services.