Problems on foundations of microeconomics (chapters 1-4)

1. Following are the supply and demand function for basketball shoes. Assume that the constant values for income and the price of basketballs are $Y = 2004$ and $P_{Basketballs} = 30$ respectively.

$$Q_D^{Shoes} = 500 - 10P_{Shoes} + \frac{1}{2}Y - 20P_{Basketballs}$$

$$Q_S^{Shoes} = 20 + 4P_{Shoes}$$

   a (Find the equilibrium price and quantity for this market.

   b Which measure of elasticity would you use to determine if basketballs and Nike shoes are complements or substitutes based on this demand function? Calculate the elasticity you suggest at the equilibrium price and quantity. Are Nike shoes and basketballs complements or substitutes?

   c Which measure of elasticity would you use to determine if Nike shoes are a normal good or an inferior good? Calculate the elasticity you suggest at the equilibrium price and quantity. Are Nike shoes a normal good or an inferior good?

   d Suppose that a price floor is imposed at $P_{Nike} = 75$. How will this alter the price and quantity of Nike shoes in this market?

2. How is the popular notion of business profit different from the economic profit concept? What role does the idea of normal profits play in this difference?

3. Climate Control Devices, Inc., estimates that sales of defective thermostats cost the firm $50 each for replacement or repair. Boone Carlyle, an independent engineering consultant, has recommended hiring quality control inspectors so that defective thermostats can be identified and corrected before shipping. The following schedule shows the expected relation between the number of quality control inspectors and the thermostat failure rate, defined in terms of the percentage of total shipments that prove to be defective.

Number of quality control inspectors	Thermostat failure rate (percent)
0	5.0
1	4.0
2	3.2
3	2.6
4	2.2
5	2.0

   The firm expects to ship 250,000 thermostats during the coming year, and quality control inspectors each command a salary of $60,000 per year.

   a Construct a table showing the marginal failure reduction (in units) and the dollar value of these reductions for each inspector hired.

   b How many inspectors should the firm hire?

   c How many inspectors should be hired if additional indirect costs (lost customer goodwill and so on) were to average 30 percent of direct replacement or repair costs?

4. Consider a coffee shop opening in the Charlotte area. On average, beverage customers spend $4 on beverages with an 80% gross margin, and food customers spend $5 on food with a 50% gross margin. Gross margin simply reflects price minus input cost and does not reflect variable labor and related expenses. The table below shows customer traffic throughout the day:

Time of Day	Beverage Customers	Food Customers
06:00	150	50
07:00	250	100
08:00	200	75
09:00	175	50
10:00	100	25
11:00	200	75
12:00	200	175
13:00	125	150
14:00	75	75
15:00	50	50
16:00	100	25
17:00	75	50
18:00	50	75
19:00	50	25
20:00	25	25
21:00	25	10
22:00	25	10

a Assume labor, electricity, and other variable costs are $175 per hour of operation. Which hours should the store remain open?

b Assume the store is open 365 days per year and that the rental cost of the building is $2 million per year. Should this site remain open?

c Suppose that instead of having 50 beverage customers and 50 food customers at 15:00 the store had 10 beverage customers and 20 food customers at that time. When analyzing profit for that hour, should the store remain open or close at 15:00 and reopen at 16:00? Now consider this decision from a more practical standpoint: Would impact might closing down for an hour in the middle of the day have on sales throughout the day?

5. An insurance company has the following total cost function:

$$TC = \$41,000,000 + \$500Q + \$0.005Q^2$$

The annual premium of $1,500 will remain stable for upcoming periods, so $MR = P = \$1,500$.

a Calculate the profit-maximizing quantity for this company.

b Calculate the company's optimal profit, and optimal profit as a percentage of sales revenue (profit margin).

6. Consider a firm with the following total cost and total revenue functions:

$$TR = \$1,800Q - \$0.006Q^2$$
$$TC = \$12,100,000 + \$800Q + \$0.004Q^2$$

a Calculate quantity, marginal cost, average cost, price and profit at the average cost minimizing quantity.

b Calculate quantity, marginal cost, average cost, price and profit at the profit maximizing quantity.

c Compare the results from parts **a** and **b**.

7. The owners of a van conversion company have fixed capital and labor expenses of $1.2 million per year, and variable expenses that average $2,000 per van conversion. The annual demand function for van conversions is given by:

$$Q = 1,000 - 0.1P$$

where Q is the quantity of van conversions and P is the price.

   a Calculate the profit-maximizing quantity, price, and profit levels.

   b Using the Lagrangian method, calculate profit-maximizing quantity, price, and profit levels if quantity is limited to 300 van conversions (due to a parts shortage) in the upcoming year.

   c Calculate and interpret λ, the Lagrangian multiplier.

   d Calculate the value to the owners of having the parts shortage removed.

8. Demand and Supply Curves. The following relations describe monthly demand and supply relations for dry cleaning services in the metropolitan area:

$$
\begin{aligned}
Q_D &= 500,000 - 50,000P \text{ (Demand)} \\
Q_S &= -100,000 + 100,000P \text{ (Supply)}
\end{aligned}
$$

where Q is quantity measured by the number of items dry cleaned per month and P is average price in dollars.

   a At what average price level would demand equal zero?

   b At what average price level would supply equal zero?

   c Calculate the equilibrium price/output combination.

9. Consider the following supply and demand functions for Ramen noodles. The variables are defined in the table below. Constant values are given for the last 2 variables.

Variable	Meaning	Constant value
Q_D	Quantity demanded of Ramen	
Q_S	Quantity supplied of Ramen	
P_{Ramen}	Price of Ramen	
P_{Kraft}	Price of Kraft Mac and Cheese	$0.99
Y	Consumer income	$11,500

$$Q_D = 1,141,000 - (2,683,700)\,P_{Ramen} + (100,000)\,P_{Kraft} - (20)\,Y$$
$$Q_S = -100,021 + (680,000)\,P_{Ramen}$$

   a Write down the inverse demand function for Ramen noodles.

   b Find the equilibrium price and quantity in this market.

   c Suppose that P_{Kraft} increases to $1.33. Recalculate the equilibrium price and quantity given this change.

   d Calculate the own-price elasticity of demand. Use the equilibrium price and quantity as your initial price and quantity. Is demand elastic or inelastic at the equilibrium price and quantity?

   e Calculate the cross-price elasticity for a 1% increase in the price of Kraft Macaroni and Cheese. Are Ramen noodles and Kraft Macaroni and Cheese substitutes or complements? Explain how you know whether they are substitutes or complements.

   f Calculate the income elasticity for Ramen noodles. Use the equilibrium price and the constant value for income. Are Ramen noodles a normal good or an inferior good? How do you know? If it is a normal good, is it a necessity or a luxury?

10. Rob's utility function over goods a, b, and c is given by:

$$U(a, b, c) = 12a^2 b^4 \sqrt{c}$$

Rob has an income of $Y = 5200$ and the prices of goods a, b, and c are $p_a = 2$, $p_b = 8$, and $p_c = 4$ respectively. Find Rob's optimal bundle of goods a, b, and c.

11. Holding all else equal, indicate how each of the following changes would affect a budget constraint that limits consumption of goods (Y) and services (X). Explain your answer.

    a Deflation that uniformly drops the price of all goods and services.

    b Inflation that consistently increases the price of all goods and services.

    c Technical change that reduces the price of goods, but leaves the price of services unchanged.

    d Economic growth that boosts the level of disposable income.

    e Government-mandated health care coverage for workers that boosts the price of goods by 3% and increases the price of services by 5%