Questions and Problems, Part II: Theory in Practice, Chs. 4 - 6 (150 points maximum, 120 points = 100%; * indicates a required question or problem)

(10)4-1. Consider a $5 tax per unit on the sale of a good sold in an undistorted market whose demand is given by \( Q_D = 50 - 0.5P \); and whose supply is given by \( Q_S = 10 + P \). What is the per period dead weight loss associated with the tax? What is the change in consumer surplus per period? What is the change in producer surplus per period? Last, what is the change in tax revenues? Show the problem and solution graphically.

(10)4-2. Consider a proposal of the City Council to raise bus fares by $0.50. Currently the fare is $1.50 and there are 100,000 riders per day. A search of transportation research literature reveals estimates of the price elasticity for bus transit from 0.05 to 0.07, that is, a 10 percent increase in price is expected to lead to a drop in the number of bus riders from 5 percent to 7 percent. Use these estimates to determine the range of the loss of consumer surplus due to the City Council proposal assuming constant price elasticity, \( e \), and a constant elasticity demand equation: \( Q = AP^{-e} \) where \( A \) is a constant. You may round to the nearest rider per day, and dollar. Show the problem graphically.

*(10)4-3. Determine the compensating variation, CV, and the equivalent variation, EV for the two scenarios below. Associate your CV and EV dollar measures with the correct question:

a. What is the maximum you would be willing to pay for this benefit?
b. What is the maximum you would be willing to pay to avoid this cost?
c. What is the minimum compensation required for you to forego this benefit?
d. What is the minimum compensation required for you to be indifferent to this cost?

Last, illustrate your answers using an indifference map with income on the vertical axis and on the horizontal axis, for scenario one, use shorter commute time, e.g., 2 hours at the origin, 1 hour to the right, etc. For scenario two, use peace and quiet on the horizontal axis.

Scenario 1: A subway extension would benefit Al, since it would shorted his commute time from 1 hour to \( \frac{1}{2} \) hour. He is indifferent between: (1) having the extension built; and (2) receiving $100 without the extension. He is also indifferent between: (1) having to pay $75 and having the extension built; and (2) not having the subway extension. What is Al’s CV and EV measure? Which question above is associated with each measure?

Scenario 2: An airport is planned within hearing distance of Al’s residence. The air port would lower his index of peace and quite from 120 to 70. He is indifferent between: (1) receiving $300 and having the airport built; and (2) not having the airport built. He is also indifferent between: (1) having the airport built; and (2) paying $250 to avoid its construction. What is Al’s CV and EV measure? Which question above is associated with each measure?

*(10)4-4. Suppose the U.S. Army Corps of Engineers is considering dredging harbors on the Mississippi near St. Louis. As a result, the lower cost of shipping is expected to increase the supply of barge services from \( Q_S = -400 + 200P \) to \( Q_{S1} = -100 + 200P \). The demand for shipping is given by \( Q_D = 1100 - 100P \). What are the per period benefits of the project? What is the change in consumer surplus? The change in producer surplus? Show the problem and solution graphically.
4-5. Suppose in the face of the West Nile Virus transmitted by mosquitos, the federal government is considering a program that would subsidize a mosquito eradication program. The mechanism is to pay providers $50 for each city block they spray. Assume that each city block sprayed leads to a $75 external benefits. Also assume the demand for spraying is given by \( Q_D = 1000 - 4P \), and the supply without the subsidy is given by \( Q_S = -100 + 7P \) for \( P > $50 \). With the subsidy residents face a supply schedule that is below the original market supply schedule by $50. The supply equation with the subsidy is thus given by: \( Q_{S,ws} = 250 + 7P \) for \( P > $0 \).

a. In the face of the subsidy program, what is the new quantity of eradication services purchased. What is the effective price paid by the residents? And, what is the price received by the exterminators for their services?

b. What is the gain in consumer surplus enjoyed by consumer who purchase the services?

c. What is the gain in producer surplus enjoyed by the exterminators?

d. What is the gain in surplus enjoyed by those who experience the positive externality?

e. What is the government expenditure assuming the only cost is in the reimbursement of the vouchers?

f. Last, what is the net gain or loss to society? Show the problem graphically.

4-6. Consider the cost of a resource to be used in a government project. The project will require 100 units and the going price of the resource is $5. In each case, show the problem graphically and explain the relationship between government expenditure and opportunity cost.

a. The purchase of the 100 units will not affect the price, because the supply of the units is perfectly elastic at a price of $5. What is government expenditure and what is the opportunity cost of using the resource in the project? Explain

b. Suppose instead that the increased demand for these 100 resources is sufficient to raise the price to $5.357. The supply of the resource is given by: \( Q_{sr} = -400 + 200*P_r \); and the demand for the resource without the government purchase is: \( Q_{dr} = 1,000 - 80*P_r \). What is the government expenditure on the 100 units of the resource? What is the cost (opportunity cost) of using the resource on the project? Explain and show the problem and solution graphically.

c. Consider again the case of perfectly elastic supply at a price of $5, but the resource market is distorted. Specifically, suppose there is a constant marginal external cost of $1.50 associated with the production of each unit of the resource. What is the government expenditure on the 100 units of the resource? What is the cost (opportunity cost) of using the resource on the project? Explain and show the problem and solution graphically.

d. Assume as in c, the resource market is distorted, but there is a positively sloped supply as in b. What is the government expenditure on the 100 units of the resource? What is the cost (opportunity cost) of using the resource on the project? Explain the problem and solution.
(10) 4-7. Consider the purchase of 100 units of a resource from a supplier with market power, that is, price exceeds marginal cost. Assume the seller faces a price equation without the government of \( P_r = 12.5 - Q/80 \) and an associated marginal revenue equation, \( MR = 12.5 - Q/40 \). With the purchase of 100 units, the price equation increases to \( P'_r = 13.75 - Q/80 \) and an associated marginal revenue equation, \( MR' = 13.75 - Q/40 \). The marginal cost of the supplier of the resource is given by the equation, \( MC = 2 + Q/200 \). Profit maximization requires the equality of marginal revenue and marginal cost. What is the government expenditure on the 100 units of the resource? What is the social cost (opportunity cost) of using the resource on the project? Explain and show the problem and solution graphically.

*(10) 4-8. Consider a government project that adds 100 units of publically provided day-care services. Current day-care services are priced at $300 per unit and the added supply is sufficiently small so the price does not change.

a. If the government sells the service at the going price of $300, what are government revenues and what are social benefits? Explain.

b. Suppose instead the government gives the services away by distributing 100 coupons at random to families with children under the age of six. Assume the coupons can be legally and traded at no cost. What are government revenues and social benefits?

c. Assume as before the services are given away at random to families with children, but it is strictly illegal to transfer the coupons.

*(10) 4-9. Consider a government project that adds 100 units of day-care services to an existing supply of 900. Also assume the 100 units are sufficient to cause the price to fall from $300 to $275 and at the lower price, private supply falls from 900 to 850. Show the problem graphically.

a. What are government revenues and social benefits if the 100 units are sold at the market price of $275?

b. Assume the 100 units provided by the project are distributed by a random allocation of coupons to families with children under the age of six. Assume the coupons can be legally and traded at no cost. What are government revenues and social benefits?

c. Assume as before the services are given away at random to families with children, but it is strictly illegal to transfer the coupons. Assume first that all of the families receiving the coupons were not consumers when the price was $300. Second, assume half of the coupons go to families that were previous consumers and half to families that were not consumers.
Consider the job creation “benefits” of a government project. Many government projects are justified, at least in part, by their ability to create jobs, e.g., labor support for drilling in ANWAR. As we will see, these “benefits” are at best, and only in specific circumstances, a deduction from labor expenditures. For each of the following cases, estimate the “benefits” of employing labor for the project. The demand for labor is given by the equation: \( Q_{DL} = 1000 - 50w \) where \( w \) is the wage per hour. The supply of labor is given by the equation: \( Q_{SL} = 500 + 50w \) for \( w \geq $2 \). There is a minimum wage of $6 per hour.

a. Show the problem graphically. What is the number of units of labor employed?
b. A new government program requires the hire of 50 units of labor. They are hired at $6 per hour. What is the budget expenditure?
c. Assume the 50 units come from the unemployed and their reservation wage is $2. What is the budget expenditure? What is the social cost of hiring the 50 units? What are the benefits of the job creation?
d. Assume 40% of the 50 units come from the ranks of the unemployed, who are evenly distributed along the supply curve between the wage of $2 and $6. What is the budget expenditure? What is the social cost of hiring the 50 units? What are the benefits of the job creation?

*(10)4-11. Suppose data are available that allow estimation of a hedonic wage equation with a person’s annual wage a function of wage determining characteristics, such as their educational attainment, their martial status, their gender, etc. In addition data are available for mortality risk by occupation. Let \( X \) represent the vector of wage determining characteristics other than mortality risk, \( r_i \), the number of fatalities per year per 10,000 employee. Suppose the estimation reveals, \( \Delta w/\Delta r = $500 \), that is the marginal change in annual wage due to a marginal change in the mortality risk level is $500, ceteris paribus.

a. What is the implied value of life?
b. Suppose another hedonic wage regression using data on another set of occupations estimates \( \Delta w/\Delta r = $800 \). What is the implied value of life? Which set of occupations are likely riskier those used in the regression for (a), or those used in the regression for (b)? Explain why.
c. How would you use the estimates in (a) and (b) as “ballpark” figures, as a lower bound, or as an upper bound in the following cases.
   i. Estimates are to be used in an analysis of the benefits and costs of mountain climbing rescue squads.
   ii. Estimates are to be used in an analysis of the benefits and costs of research into causes and prevention of infant malnutrition.
   iii. Estimates are to be used in an analysis of the benefits and costs of Alzheimer research.
   iv. Estimates are to be used in an analysis of the benefits and costs of reducing pesticide exposure.
In 1844, a French engineer, Jules Dupuit, published an article that introduced the “bridge-pricing problem”. Consider the estimated demand for daily crossings of a prospective bridge, \( Q_D = 1000 - 250P \). Assume that once the bridge is built the operating costs are zero, i.e., marginal cost, \( MC \), is zero. Construction cost on an annual basis is $364,999. Graphically show the problem, including the average cost curve, and answer the following questions. Draw the AC curve by calculating average cost at four or five crossing levels and extrapolating from these data to make the curve continuous.

a. Would a private enterprise build the bridge? Hint: the private enterprise would operate as a monopoly and set \( MC \) equal to marginal revenue to maximize profits. Given \( Q_D \), the associate marginal revenue equation is \( MR = 4 - Q/250 \).

b. Would a private enterprise build the bridge if the annualized construction cost was $365,001?

c. Dupuit’s analysis makes clear that regardless of whether private enterprise would build the bridge, their scale of operation would be wrong. What is the socially efficient level of operation given \( MC \) equals zero?

d. What are the expected daily social net benefits from constructing the bridge and operating at the socially efficient level. What are the expected daily social net benefits from operating the bridge at the monopoly profit maximizing level (assume daily construction cost is $1,000)? If the bridge is built, what are the social net benefits that are realized under the two levels of operation?