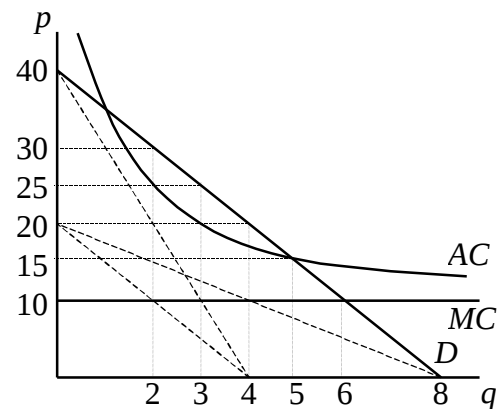


Name:
Student No.:

SPP/Econ 573
Benefit-Cost Analysis
Midterm Exam No. 1
March 15, 2000

Answer all questions, on these sheets in the spaces or blanks provided. In questions where it is appropriate, **show your work**, if you want partial credit for an incorrect answer. Point values of the questions are shown; there are a total of 97 points possible.

1. (10 points) The figure at the right shows the demand curve for a product produced by a monopolist, together with the firm's average and marginal cost curves. There are no externalities or other distortions associated with this product, except for the possibility of monopoly pricing. Marginal cost is constant at \$10, while average cost declines with output because of a presence of a fixed cost. The figure also includes several other lines that may or may not be useful in identifying the prices, quantities, or values requested below. In each case find or calculate the amount requested using the numbers on the axes of the diagram, and write your answer in the blanks provided.



The price at which the firm's profit would be zero.

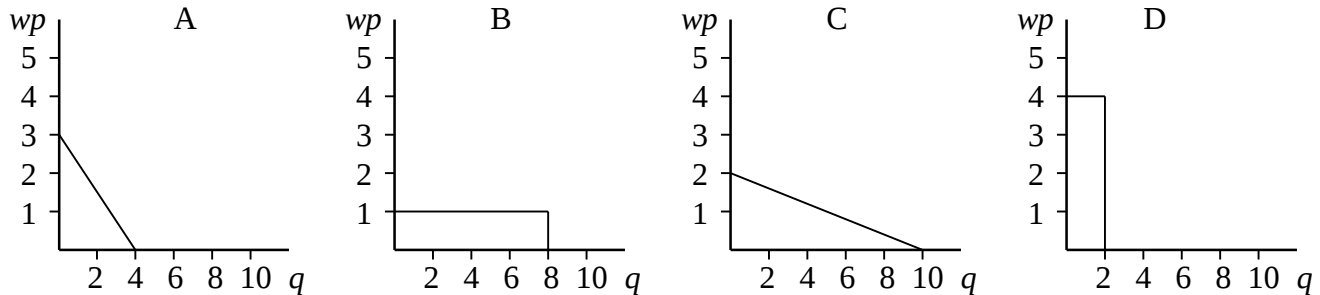
The price the firm would charge as a profit-maximizing monopolist.

The total profit the firm would make as a profit-maximizing monopolist.

The socially optimal level of output

The firm's (approximate) total profit or loss at the socially optimal level of output (specify + or -)

2. (10 points) The graphs below show curves representing the marginal willingness to pay (wp) for a public good for each of the (only) four people in an economy, A, B, C, and D. (These are conceptually the same demand curves for the public good that we looked at in class, although the shapes of some of them are different.)



Which person (or persons, if they are tied), A, B, C, or D, would choose the largest quantity of the public good, if the cost to them would be close to zero?

Which person(s) would be willing to pay the largest **total** amount for the provision of exactly 5 units of the public good (the only alternative being none of it at all)?

What is the highest amount that the **society**, consisting of these four people together, should be willing to pay for a very small amount of the public good?

What is the largest quantity of the public good that this society should provide if it can be provided almost free – that is, if the marginal cost is a positive constant but very close to zero?

How much of the public good should this society provide if the marginal cost is constant and equal to 1?

3. (21 points) The island nation of West Myopia has a population of 3000 persons. Its government pays for the island's national defense by taxing the residents' consumption of bon bons (candies), which are produced competitively at a constant cost of 4 blinks (4 bl) per bon bon (the blink is the national currency). The tax rate is 2 bl per bon bon. The population consists of three groups of 1000 each: Adiposers, Barelybulgers, and Calistas. As individuals, they have the following demand functions for bon bons:

Adiposers: $D_A = 610 - 5 P$

Barelybulgers: $D_B = 1100 - 150 P$

Calistas: $D_C = 240 - 20 P$

Where P is the price of bon bons in blinks and the D 's are quantities demanded in bon bons per month.

One member of this population has just returned from two years at the School of Public Policy, in Ann Arbor Michigan, and has argued that the country would be better off financing its defense with a non-distorting lump-sum tax per person instead of the bon bon tax. In order to evaluate this proposal and its likelihood of being adopted, answer the following questions. Be sure to show your work, so that you can get partial credit if appropriate.

- a. (6 points) With a 2 bl tax and thus a 6 bl price of bon bons (recall that marginal cost is constant at 4 bl), verify that the government collects 1,800,000 bl per year for its defense budget, and determine how much of that is paid by members of each group. That is, how much of what each person spends on bon bons goes to the government in taxes? (Hint: your three answers should add up to 1800 bl, in order to generate the above total revenue from the 1000 members of each group.)

Adiposers: _____

Barelybulgers: _____

Calistas: _____

- b. (6 points) Calculate the increase in consumer surplus that each type of person gets if the tax is removed.

Adiposers: _____

Barelybulgers: _____

Calistas: _____

- c. (9 points) With 3000 people sharing the defense budget of 1,800,000 bl, each will have to pay 600 bl if they are to share it equally through a lump-sum tax per person. Based on each of the three criteria listed on the next page, and assuming that Myopians are rational and respond to their true self-interest, determine whether the proposal to replace the bon bon tax with this lump-sum tax should be accepted. That is, for each criterion listed, answer “yes” or “no” whether the policy change meets the criterion, and **explain why**. Your explanation is necessary, in this case, and it should not just restate the criterion, but should indicate with numbers why the policy change does or does not satisfy it.

Pareto
Optimality: _____ (Yes/No)

Why?

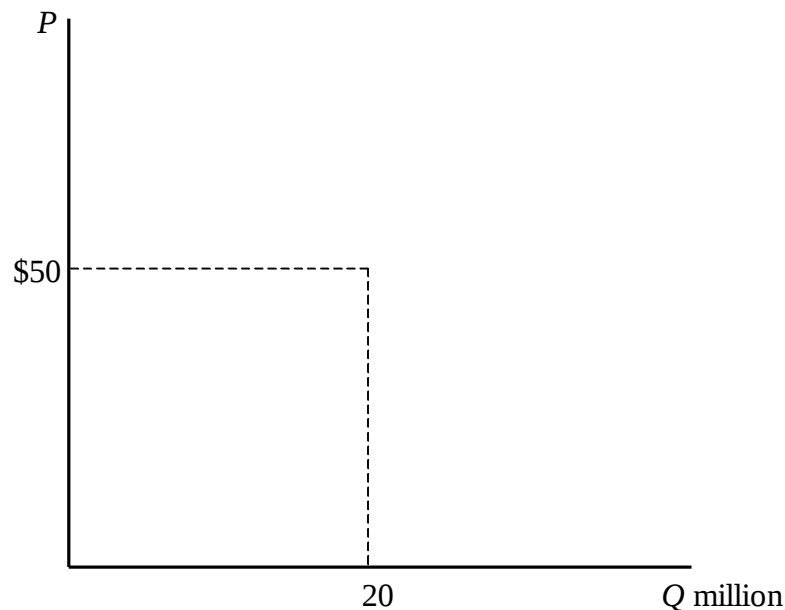
Majority
Voting: _____ (Yes/No)

Why?

Kaldor-Hicks
Criterion _____ (Yes/No)

Why?

4. (22 points) The market for handguns is currently in equilibrium with 20 million being produced and sold each year for a price of \$50 per gun. The government is proposing a requirement that all such guns produced in the future be equipped with trigger locks. All agree that this would increase their cost of production by 7%. Part of the motivation for this proposal is the belief that gun ownership causes a negative externality for society. Suppose that this externality is valued at \$10 per gun. Suppose also that the elasticity of supply of guns is 3, while the elasticity of demand for guns is 0.5. Your job is to calculate the benefits and costs to society (including gun **producers**, gun **buyers**, and those **bystanders** affected by the externality) of requiring trigger locks, assuming that all of these assumptions are correct. To do this, work through the following steps of analysis, following the instructions given.
- a. (4 points) On the axes below, illustrate the effects of the trigger-lock requirement by drawing initial supply and demand curves for the current equilibrium, then new supply and/or demand curves in the presence of the requirement. Label the diagram to indicate both the old equilibrium (P_1, Q_1), the new equilibrium (P_2, Q_2), and the changes in price and quantity (ΔP , ΔQ) caused by the requirement. You need not try to draw any of this to scale – just get the directions right.



For parts (b) through (k) below, fill in the blanks as indicated, using numbers that you derive from the assumptions that are stated above and that are repeated on the next page for your convenience.

Initial quantity	20 million guns
Initial price	\$50 per gun
Elasticity of supply	3
Elasticity of demand	0.5
Increase in cost due to trigger lock	7 percent
Size of negative externality	\$10 per gun

- b. (1 point) Using the inverse **supply** curve, the change in the price of guns, ΔP , is related to the change in quantity, ΔQ , and to the percentage increase in cost due to the new regulation (0.07), as follows (complete the equation by putting the appropriate number in the blank):

$$\frac{\Delta P}{P_1} = \quad \times \frac{\Delta Q}{Q_1} + 0.07$$

- c. (1 point) Using the inverse **demand** curve, the change in price is also related to the change in quantity by using the elasticity of demand (put another number in the blank):

$$\frac{\Delta P}{P_1} = \quad \times \frac{\Delta Q}{Q_1}$$

- d. (2 points) Equating the two price changes in (b) and (c), solve for the change in quantity as (another number, and show your work, from here on):

$$\frac{\Delta Q}{Q_1} =$$

- e. (2 points) The new quantity of guns sold is therefore:

$$Q_2 = \underline{\hspace{2cm}}$$

- f. (2 points) The change in price is:

$$\frac{\Delta P}{P_1} = \underline{\hspace{2cm}}$$

- g. (2 points) And the new price is therefore:

$$P_2 = \underline{\hspace{2cm}}$$

- h. (2 points) The change in consumer surplus (**gun users**) is:

$$? CS = \underline{\hspace{2cm}}$$

- i. (2 points) The change in **producer** surplus is:

$$\Delta PS =$$

- j. (2 points) The gain from the reduced externality to the **bystanders** is:

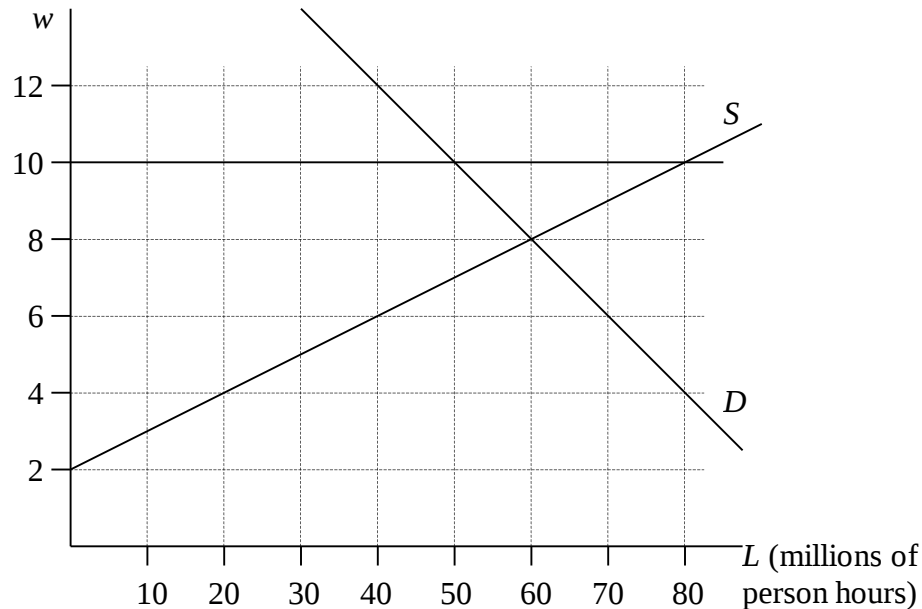
$$\Delta Ext =$$

- k. (2 points) Based (only) on this analysis, should the trigger lock requirement be instituted? Why?

Do it? _____ Why?

- l. (Extra credit) Are there any assumptions that have been made in this analysis that you think should be changed and that might alter the conclusion?

5. (18 points) In the figure below are drawn a supply curve and a demand curve for labor, in a market where the equilibrium wage would be \$8 per hour. However, the government initially enforces a minimum wage that is higher than this, at \$10 per hour. (The quantity axis measures labor in millions of person-hours, but you can ignore the “millions” and state your answers in terms of just hours and dollars, with the “millions” assumed where appropriate.)



Assume that whenever demand for labor is less than supply, the rationing of labor is done randomly.

- a. (2 points) How much labor is employed at the initial minimum wage of \$10, and how much “involuntary unemployment” is there, in the sense of hours that workers want to work in this market at the prevailing wage but cannot?

- b. (2 points) At the initial minimum wage of \$10, what is the average reservation wage (that is, the marginal cost of working in this market) for the workers who are willing to work?

- c. (2 points) How much total “producer surplus” do the workers who are employed get from being employed in this market?

Now suppose that the minimum wage is **increased** from \$10 to \$12. Assume that employment is reduced only by laying off workers who were already employed, and that no new workers are given jobs who didn't have them before. Assume also that the laid off workers are chosen randomly from those initially employed.

- d. (2 points) How much will employment in this market decrease?

- e. (2 points) How much total surplus will the workers who remain employed now enjoy?

- f. (2 points) What is the total loss of welfare of the workers who become unemployed due to this increase in the minimum wage?

- g. (2 points) Quantify the effect on the welfare of demanders of labor in this market due to the change in the minimum wage. That is, how much do they gain or lose?

- h. (2 points) What is the effect of the rise in the minimum wage on the workers who initially wanted to work in this market but were unable to find jobs? What about the workers who initially did *not* want to work in this market but now do?

- i. (2 points) What, then, is the net effect (change in benefits minus costs) on all of society due to this increase in the minimum wage?

6. (16 points) Determine the present discounted values using the interest rates indicated:

- a. (2 points) The present discounted value, at an interest rate of 4% per year, of \$130 two years from now.

- b. (2 points) The present discounted value, at an interest rate of 7% per year, of a payment of \$21 that is repeated every year forever, starting **one** year from now.

- c. (2 points) The present discounted value, at an interest rate of 7% per year, of a payment of \$21 that is repeated every year forever, starting **now**.

- d. (2 points) The present discounted value, at an interest rate of 5% per year, of a payment that is \$72 one year from now and that grows by 3% a year thereafter, forever.

- e. (4 points) What **will be, five years from now**, the value of a stream of costs of \$6 starting in year six and continuing forever, discounted to year five at an interest rate of 3%? What is the discounted value of that same stream of costs from the perspective of today, five years earlier?

- f. (2 points) What is the present discounted value **today**, again with an interest rate of 3%, of benefits of \$6 each year starting one year from now and continuing for only **five** years. (You may derive this directly from the formula, if you know it, or you can notice that this is the same as a \$6 benefit that continues every year forever, together with a \$6 cost that starts in year 6, and use your results from part (e).)

- g. (2 points) The City of Ann Arbor has been offered a tree that will produce a fixed number of apples every year forever, starting one year from now. At next year's prices, those apples are expected to be worth \$480. The price of apples is expected to rise at the same rate as overall inflation, which is 2% a year. The nominal interest rate is 8% a year. What is the present discounted value of this apple tree today to Ann Arbor?