PAI 723 Solutions to Problem Set #7

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a) Since the scope of the analysis is the state of New Jersey, some, but not all, of these costs are costs to the state. Only costs paid by the state or state residents should be included. Thus, \$4 billion should be included as costs: \$3 billion covered by state aid plus the \$1 billion paid directly by homeowners.

Note that a cost-benefit analysis done for the state should consider the costs paid by residents. It is not appropriate to only consider the costs to the government. The government receives its funding from state residents. All residents of the state are affected and their costs should be considered as part of the analysis.

- b) Since the scope of the analysis is a single state, this is a legitimate cost to consider. Resources that were going to locations in the state of New Jersey before the hurricane are now going elsewhere.
- c) Since these are local contractors, the increased cost is simply a transfer. While it is a cost to those needing to rebuild, the additional work and additional money earned is a benefit to the local contractors.
- d) Costs should include resources that would have been available but not for the hurricane. Thus, it is likely that most, if not all, of this \$5 million is a cost. Some may not be a cost – for example, if people don't get out to buy groceries in the days after the storm, but buy extra food the next week, all that changes is the timing of the purchases. However, it is unlikely that all the \$5 million has been saved to be spent later. For example, some money saved will likely be spent to rebuild after the hurricane.

2. a) To find the number of buyers purchasing safety equipment, simply replace *P* with \$2,000 and solve for *Q*:

2,000 = 8,000 - 0.5Q 6,000 = 0.5Q Q = 6,000/0.5 Q = 12,000

The graph is shown below, along with the areas necessary to find willingness to pay in part (b).



b) The willingness to pay for 12,000 safety packages equals the total expenditure on safety packages (area B) plus consumer surplus (area A). The value of each is:

area A = consumer surplus = 0.5(8,000-2,000)(12,000) = \$36,000,000 area B = expenditure = (2,000)(12,000) = \$24,000,000 Willingness to Pay = A + B = **\$60,000,000**

c) For every 1,500 safety devices purchased, one life is saved. We simply divide the total number purchased by 1,500 to find the number of lives saved. This gives us 8 lives saved (= 12,000/1,500).

Since the community as a whole is willing to pay \$60,000,000 to purchase these safety devices, they are willing to pay \$60,000,000 to save 8 lives. Dividing \$60,000,000 by 8 lives saved yields a value of **\$7,500,000** per live saved.

A common error here was to divide \$7,500,000 by 12,000, since 12,000 safety devices are purchased. Note that the willingness to pay per person (e.g. \$60,000,000/12,000) is \$5,000. Moreover, what each person is buying is a 1/1,500 reduction in risk. \$7,500,000/1,500 equals \$5,000. Thus, consumers are willing to pay up to \$5,000 to reduce the risk of death by 1 in 1,500. \$7,500,000 represents what an individual would be willing to pay to completely reduce their risk of death.

3. a) On the graph below, D represents the demand curve for consumers, and D + 40,000 is the combined demand including both consumers and the government purchase. The original demand curve intersects supply at a price of \$800 and a quantity of 200,000.

The new demand curve intersects supply at a price of \$900 and a quantity of 210,000. The total demand of 210,000 includes 170,000 computers purchased by consumers and the 40,000 purchased by the government. The amount purchased by consumers at this higher price is where the \$900 price line crosses the consumer's demand curve.



b) Because of the higher price, consumer surplus is lower. They lose areas A and B. This is the area under the consumer demand curve and between the two prices. *We use the original demand curve*, as that represents non-government consumers.

Producer surplus is higher. They gain areas A, B, and C. This is the area between the two prices and above the supply curve. Thus, the net gain is positive – **welfare increases by area C**.



c) Expenditure should be adjusted downward – the true shadow cost is less than \$36 million once we account for the effects of the government purchase on the computer market. A common error here was to adjust upward. Note that we're adjusting costs. If the net effect on markets is positive, the true costs are *lower* that the expenditure.

To calculate the value of this adjustment, note that area C is a triangle with a height of (= 900 - 800) and a base of 40,000 (= 210,000 - 170,000). Thus, its area = 0.5(100)(40,000) =**\$2,000,000**. The true social cost of the government purchase is \$34 million

4. a) In each case, we need to calculate the net present value of each project. For each discount rate, we will select the project with the highest net present value. We use the following formula to calculate the net present value. Note that costs or benefits that occur in year 0 are not discounted. Future benefits and costs are discounted as appropriate. In each case, we are given net benefits for a given year, and discount that value as appropriate. Thus:

$$NPV = FV_0 + \frac{FV_1}{(1+r)} + \frac{FV_2}{(1+r)^2} + \frac{FV_3}{(1+r)^3}$$

where FV_t is the future value of the net benefit in year *t*.

We begin by using the above formulas with a discount rate of 3%:

$$PV_A = -1000 + \frac{500}{(1.03)} + \frac{500}{(1.03)^2} + \frac{500}{(1.03)^3} = -1000 + 485.44 + 471.30 + 457.57$$

= \$414.31

$$PV_B = 100 + \frac{100}{(1.03)} + \frac{100}{(1.03)^2} + \frac{100}{(1.03)^3} = 100 + 97.09 + 94.26 + 91.51 = \$382.86$$

The net present value is higher for option A than for option B. Given this **option A** is preferable.

b) We repeat the calculations with a discount rate of 7%:

$$PV_A = -1000 + \frac{500}{(1.07)} + \frac{500}{(1.07)^2} + \frac{500}{(1.07)^3} = -1000 + 467.29 + 436.72 + 408.15$$

= \$312.16

$$PV_B = 100 + \frac{100}{(1.07)} + \frac{100}{(1.07)^2} + \frac{100}{(1.07)^3} = 100 + 93.46 + 87.34 + 81.63 = \$362.43$$

The net present value is higher for option B than for option A. Given this **option B** is preferable.

c) A higher discount rate means that people place less importance on future outcomes. In option A, the costs are paid up-front, but the benefits come later. With a high discount rate (part b), these benefits are less important. In contrast, the future benefits receive more weight in part a.

Recall that the discount rate relates to interest rates. In part a, with a lower discount rate, the opportunity cost of having money now, rather than in the future, is lower. Thus, paying the up-front cost is not costly. In contrast, if alternative investments could earn an 7% return, paying the costs up-front, rather than investing them elsewhere, is costly.