14.03 Fall 2004

Problem Set 4 Solutions

1. **Application: Kane & Staiger Article**

   (a) Imagine we survey a group of teenage girls. We ask them to assess their probability of giving birth to a child during their remaining teenage years. Then we ask them to reassess this probability if a law that required parental consent to abort was passed. Would you expect this average probability to go up or down? Explain carefully in terms of the Kane and Staiger model.

   Answer: This amounts to an increase in A in the K&S model. The effect on births is ambiguous. On the one hand, the cost of pregnancy has increased, so we should see fewer pregnancies; but on the other hand, the cost of abortion conditional on pregnancy has increased, so more pregnancies should go to term.

   (b) An Economist from the Institute for Efficient Transfer Payments suggests that abortion activists should offer to pay women $K > 0$ not to have an abortion. He reasons that this is a potential Pareto improvement because it is a voluntarily exchange: women who accept the offer are better off by revealed preference; abortion activists who make the transfer are also better off by revealed preference (i.e., averting an abortion is worth at least K). How would this payment enter the Kane and Staiger model of abortion choice (formally)? What effect would it have on the abortion rate? On the birth rate?

   Answer: The payment increases the benefit of having a birth (in the K&S model, this increases the utility of having a birth in wedlock to 1+K and the utility of having a birth out of wedlock to K-B). This induces more women to get pregnant, but fewer women get an abortion conditional on pregnancy. Its effect on the abortion rate is therefore ambiguous, while its effect on the birthrate is unambiguously positive.

   (c) Discuss why or why not you believe this policy proposal is a good idea. Use economic arguments [required] and, if you wish, non-economic arguments

   Answer: If abortions go up, then the policy is clearly not Pareto-improving because abortion activists are worse off. Even if abortions go down, it costs more than K for each abortion avoided, and so abortion activists could still be worse off. Moreover, abortion activists could be worse off if they have preferences over teenage births/sexual activity

2. **Application: Ashenfelter & Greenstone (2004)**

   (a) Assume there were no speed limits. Based on the article, how would each driver decide at what speed to drive? Why is it not efficient to let people decide on their own speed limit?

   Answer: Each driver would maximize a utility function over the cost per mile travelled and the probability of dying (which both depend on speed). This is inefficient because the probability of dying is a function of both own speed and others' speed, i.e., driving fast imposes an externality on others.

(b) In what direction would you adjust A&G estimation of *VSL* if:

i. 50 percent of the drivers that use the interstate rural highways earn the minimum wage and the other 50 percent earn the state mean wage (which is above the minimum). Explain.

Answer: Downwards, the number of hours saved should be multiplied by a smaller number than the average state wage.

ii. The average vehicle contains 1.7 people. Explain. (For their calculations A&G assume one person per vehicle)

Answer: We should adjust the estimates upward, because now there are 1.7 times as many hours saved for each fataility.

(c) Draw the Production Possibility Frontier (PPF) of time saved vs. lives saved. Pick a point in the curve to represent the time and number of lives saved by a speed limit of 60 mph. Call this point A. Do the same for a speed limit of 55 mph. Call this point B. Now Imagine that the Emergency Highway Energy Conservation Act enacted in 1974 (which reduced the national speed limit from 65 to 55 mph) was *only implemented* in states where energy consumption per capita was above a certain threshold level. A former 14.03 student proposes that we use the diff-in-diff contrast between the affected and non-affected states to estimate a lower bound for the VSL. Will this research design provide a valid estimate of this parameter? Explain rigorously.

Answer: If energy consumption is uncorrelated with trends in travel time and fatalities, then this strategy allows us to consistently estimate the effects of speed limits on these variables–that is, it estimates the slope of the PPF correctly. But since the decision to reduce speeds was exogenous to state voters' preferences, it tells us nothing about the VSL at all, i.e., it has nothing to do with preferences.

(d) Returning to the A&G paper: A reporter from the *Boston Herald* objects that legislators, in choosing whether or not to adopt the faster speed limit, were heavily influenced by stay-at-home moms, who want to transport their children to daycare at high speed over rural highways each morning. Of course, these women aren't working at paying jobs; hence, the marginal value of their time is zero. This means that we are both over-estimating the value of lives saved (their lives have no monetary value) and under-estimating the median voter's preference for cost savings versus risk. Critique these arguments and offer better reasoned alternatives.

Answer: It is false that these women have a zero marginal value of time– actually, that they don't work implies that the value of their time is higher than the wage rate they face. We cannot know if we are under-estimating or over-estimating the median voter's preferences, the bias can go either way. We don't know how the preferences of stay-at-home-mothers compare with the preferences of the median voter.

3. **Costs and Benefits of requiring Child-Restraint Systems (CRS)**

(a) [This problem is not fictional and the numbers below are from a recent study.] The U.S. Federal Aviation Administration (FAA) is expected to propose that all children younger than two years old be required to travel in child safety restraint systems (CSR) on airplanes. This ruling would require adults to purchase seats specifically for children younger than two years instead of allowing these children to travel on an adult's lap for free (which is the current regulation).

(b) Assume that parents have full information about the risks of traveling with their babies on their laps. Is it socially efficient to allow parents to make a decision to buy a seat for their babies or should the goverment make it mandatory? Explain rigorously.

Answer: Given that there are no (obvious) externatilities regarding parent's behavior, if they act rationally and fully informed they will make the efficient decisions and there is no need for a government intervention.

(c) The FAA calculates that there will be 6.5 million 'enplanements' (plane trips) per year by children younger than 2 years. It also calculates that the expected number of child fatilities averted per year by use of CSR is 0.4. Assuming a price of an airline ticket for a child of \$200 (and ignoring the direct cost of the CSR), what would be the total cost per saved life? Based on the results from A&G do you think that implementing this policy is a good use of societal resources? Why or why not?

Answer: Total Cost per life saved=$\frac{6,500,000*200}{0.4}$=3.25 billion dollars. Clearly, implementing this policy is *not* a cost effective way of saving lives. The cost is more than two thousand times what A&G estimated to be the society's value of a statistical life.

(d) Now, we are going to take into account that some families will switch from air to car travel or vice versa depending on the relative costs of the two. Assume that: the average net increase in car travel per enplanement for families switching from planes to cars is 300 miles; the average vehicle occupancy for extra trips is 2.4 and each person in the car has a risk of car death of 30 percent of the national average of one fatality per 100 million vehicle miles traveled.

i. If the price of an airline ticket for a child is \$200 and under this price 3% of the families switch to car travel, what is the cost for saved life? Compare with your answer for part b.

Answer: Lets first calculate the number of the additional deaths that occur because of people switching to car travel. New car deaths=$\frac{6.5*0.03*2.4*0.3*300}{100} = 0.4212$. This number implies that implementing the policy would actually *increase* the number of deaths rather than reduce them. Under the policy, aprox. 0.0212 more deaths will occur. Society is paying $200 * 0.97 * 6,500,000 = 1.26$ billion dollars and increasing the number of deaths!

ii. What is the cost of a life saved if 20% of the families switch to car travel?
Answer: New car deaths=$\frac{6.5*0.2*2.4*0.3*300}{100} = 2.808$. Under the policy, aprox. 2.408 more deaths will occur. Society is paying $200 * 0.8 * 6,500,000 = 1.04$ billion dollars and increasing even more the number of deaths!

iii. How does this information about substitution between auto and air travel affect your cost-benefit considerations above?
Answer: Substitution rates, even as low as 3%, make the policy not only less cost effective, but actually harmful. The highest the substitution rate the larger the number of death that will occur as a consequence of implementing it.

(e) Faced with your calculations, a high level attorney in a federal regulatory department speaking off the record, makes the following comment:

"It identifies a classic regulator's dilemma of which risks to protect against. While the FAA may well recognize that there could be more auto fatalities if they require car seats, those fatalities will not be blamed on them. Assuming this study is accurate, if the FAA does

the right thing from the point of view of mitigating "total risk," they face the prospect of getting all of the blame for allowing child fatalities on aircraft and none of the credit for preventing child fatalities on the road. Of course, if the airlines wanted to provide seats for kids under 2 at a nominal cost, they might at least break even financially because parents would fly more and kids could fly safely... However, that seems unlikely for a variety of reasons."

i. Given this information, how would you recommend that FAA's regulator respond (you may give a qualitative answer)?
Answer: The statement shows that FAA does not have the proper incentives to implement policies that reduce the *total* number of deaths. The FAA may ask the government to designate a higher agency to be responsible of making this kind of policy decisions. To have the right incentives, this agency should bear both the costs and benefits of the implementation of the policy.

ii. The attorney quoted above recommends that airlines should subsidize infant tickets rather than charge for them. Consider a policy where airlines paid parents $200 to travel with their children on their laps (don't worry about how this is paid for) and assume that the number of families that switch from car to air travel under this policy increases the total number of enplanements by 20% a year. Would this be an efficient policy compared to b.? (Assume the probability of an adult dying in a plane crash is zero and that 0.8 children under 2 a year will die if the use of CRS is not mandatory).
Answer: Cost per life saved=$\frac{200*6500000*1.2}{\frac{6500000*0.2*2.4*300*0.3}{100000}-0.8} = 0.7$ billion dollars, five times less than under b).

4. **E.coli and Food Safety Regulation**

Meat typically becomes contaminated with E. coli O157:H7 during the slaughtering process. The probability of a pound of meat product being contaminated with E coli is 0.00001. E.coli can cause kidney failure with probability of 20%. The cost of the treatment for kidney failure is $\$100,000$.

The meat producing company can test all its products to check for the presence of E. coli, at a cost m per pound. E.coli can be eliminated in the cooking process if the meat is fully cooked to 160°F internal temperature.

Mad Cow Slaughter House sells equal shares of its meat output to three businesses ($1/3^{rd}$ each):

- Franco-Armenian Frozen Bolognese Spagetti, which always cooks its ground beef well done.
- Butcher King, which cooks its hamburgers to 150°F to save 15 cents per pound in electricity
- Chewy Charlie's steak house, where most of its clients eat rare or medium-rare steaks. (Charlie's would go out of business if it sold only well-done steaks).

(a) Under a strict liability law, what would be the maximum m that will guarantee that no meat consumed will be contaminated with E. coli?
Answer:
The expected cost per pound of E.coli is $= 0.00001 * 0.2 * 100000 = 20$ cents
max m is going to be such that the slaughter house is indifferent between testing and not testing*:*

There are two possible assumptions:
1. The slaughter house has to test ALL of its production:
$\frac{2}{3} * Totnumberpounds * 20cents = Totnumberpounds * m \rightarrow m = 13.33$
2. The slaughter house can only test the meat that is going to sell to the hamburguer joint and the steak house:
: $\frac{2}{3} * Totnumberpounds * 20cents = \frac{2}{3} Totnumberpounds * m \rightarrow m = 20$

(b) Under the Caveat Emptor regime, the customers of which business will face a positive probability of consuming meat contaminated with E. coli? Explain.
Answer: Only the customers of Chewy Charlie's steak house will face a positive probability, because for the steakhouse is more cost effective to pay for the expected medical expenses due to E.coli contamination, than to go out of business. The other business are better off preventing E.coli.

(c) If $m = 30$ *cents* and there is a case of kidney failure because of E.coli in each of the three business, who would be held responsible in each case under a Comparative Negligence Regime? Explain.
Answer:
Franco-Armeninan Frozen Bologness Spagetti: this company will be held responsible given that their cost of preventing E.Coli is much smaller than the slaughter house's. (This situation is hypothetical given that their cost of preventing it is zero, so we will never see a case of E.coli here).
Butcher King: The hamburger company will be held responsible given that its cost of preventing E.coli is lower than that for the Slaughter house and for them is cost effective to do so.
Steak House: Neither will be held responsible, given that for both the cost of preventing the illness is higher than the expected medical expenses of not preventing it.

(d) Compare the efficiency of these three legal regimes if $m = 17$ *cents*. Which regime maximizes economic efficiency, or equivalently, minimizes the sum of costs of E.coli prevention and kidney disease? Explain your answer. Feel free to comment on whether the economic efficiency criterion is the right one.
Answer: The costs under the three legal regimes are the following:
1.Strict Liability Law:
Under assumption 1: $\frac{2}{3} * 20cents * Totnumberpounds = 13.33cents * Totnumberpounds$
Under assumption 2: $17cents * Totnumberpounds$
2. Caveat Endevor: $\frac{1}{3} * Totnumberpounds * 0cents + \frac{1}{3} * Totnumberpounds * 15cents + \frac{1}{3} * Totnumberpounds * 20cents$
$= 11.66cents * Totnumberpounds$
3. Comparative Negligence: $\frac{1}{3} * Totnumberpounds * 0cents + \frac{1}{3} * Totnumberpounds * 15cents + \frac{1}{3} * Totnumberpounds * 17cents$
$= 10.66cents * Totnumberpounds$
The most efficient regime is the Comparative Negligence Regime, given that the one liable is the part with the lower cost.

5. **Adverse Selection and The Lemons Market**

(a) Suppose there are two types of used cars: peaches and lemons A peach, if it is known to be a peach, is worth \$3000 to a buyer and \$2500 to a seller. (We will assume that the

supply of cars is fixed and the supply of possible buyers is infinite). A lemon, on the other hand, is worth \$2000 to a buyer and \$1000 to the seller. There are as twice many lemons as peachers.

i. What would be the prices for lemons and peaches if there was perfect information?
Answer: $Plemons = \$2000, Ppeachs = \$3000$

ii. What would be the price of a used car if neither buyer nor seller knew whether a particular car was a peach or a lemon and all agents are risk neutral?
Answer: $P = \frac{1}{3} * \$3000 + \frac{2}{3} * \$2000 = \$2333.33$

iii. Assume buyers can't tell at all if a car is a peach or a lemon. Which would be the market price for used cars and how many peaches would be offered?
Answer: $P = \$2000$ and NO peaches will be offered.

iv. Now assume there are two peaches to every lemon and as before, buyers can't tell at all if a car is a peach or a lemon. Which would be the market price for used cars and how many peaches would be offered?
Answer:$P = \frac{1}{3} * \$2000 + \frac{2}{3} * \$3000 = \$2666.66$ and ALL peaches will be offered.

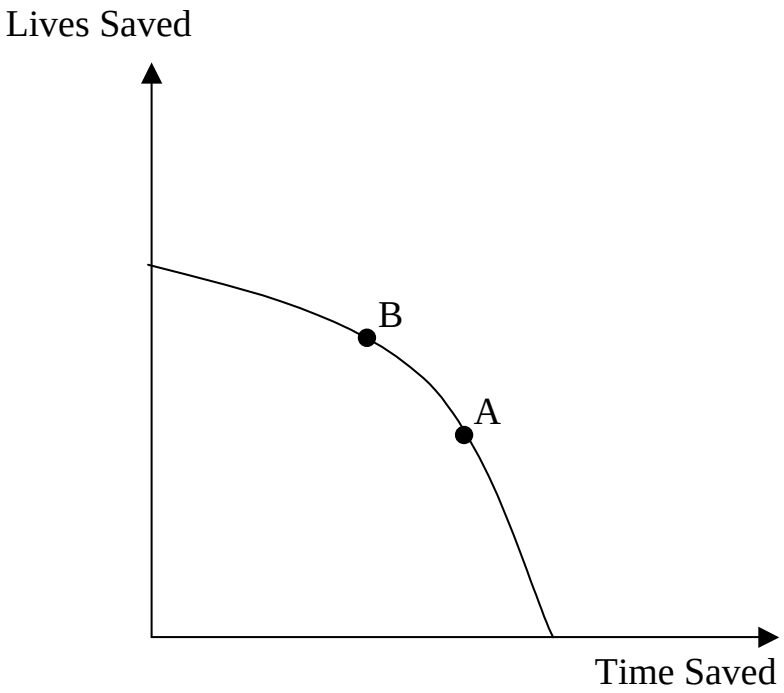
(b) Now imagine that the quality spectrum of used cars runs from real peaches, worth \$2900 to sellers and \$3000 to buyers, down to real lemons, worth \$1900 to sellers and \$2000 to buyers. Between the two extremes are cars of every quality level, always worth \$100 more to buyers than to sellers. Suppose there are 10001 cars and there is just one car per increase of 10 cents in quality. i.e. the first car is worth \$1900 to its owner and \$2000 to buyers, a second worth \$1900.10 to its owner and \$2000.10 to buyers and so on Continue to assume inelastic supply and elastic demand at every level of quality.

i. At price p=\$1900 how many cars would be offer for sale? at p=\$1901? at p=\$1902? Continuing in this way, draw the supply function (smooth over the small discrete bumps).
Answer: At $p = \$1901$, 11 cars would be offered at $p = \$1902, 21$.

ii. At price p, what is the value for buyers of the average car being sold?.What happens to demand if p exceeds \$2100? What happens if p is less than \$2100? Draw the demand curve.
Answer: Value for buyers=$\frac{(1900+p)}{2} + 100$
If $p > \$2100$, value for buyers is less than the price and there is no demand. If $p < \$2100$, value for buyers is higher than the price and there is infinite demand.

iii. What would be the equilibrium price? How many cars change hands?
The equilibrium price is $p = \$2100$ and 2001 cars will change hands.

Q. 2c.



Q. 5b.