14.03/14.003 Exam 3 Fall 2009
Please do not open this exam until directed

- **Please read the entire exam before beginning work.**
- There are 120 points on this exam and you have 120 minutes to complete it. (Each point only counts 2/3*rds* as much as the 80 points on the last two exams.)
- Correct answers without explanation do not receive credit.
- **You may use a calculator for Question 3 of Part II.** You will not need a calculator for other questions.
- No other reference material is allowed.
- There are two parts to the exam:

    1. Part I. **Answer 5 of 6 short questions**. 6 points each, 30 points total. *We will only grade 5 short answers per student (no extra credit).* Please make it absolutely clear which questions you are officially answering
    2. Part II. **Answer 3 of 5 medium length questions.** 30 points each, 90 points total. *We will only grade 3 long answers per student (no extra credit).* Please make it absolutely clear which questions you are officially answering

If you haven't already completed the online 14.03/14.003 course evaluation, please do so.
Thank you.

Part I: Short Answer: Answer 5 of 6 Questions (6 points each).

1. The Tyler, Murnane and Willett paper demonstrates that acquiring a GED does *not* raise the test-taker's human capital. [True, false, or uncertain, and *why*]

2. Finkelstein and McGarry find that the adverse selection problem is not that severe in insurance markets, because insurance companies are very good at screening the risk characteristics of all individuals. [True, false, or uncertain, and *why*]

3. In the Keys et al. paper on subprime lending, what economic phenomenon leads to excess default among low documentation borrowers with credit scores just above 619? Is it adverse selection, moral hazard, or something else? Explain.

4. By comparing time saved to lives lost in the 40 states that chose to raise their speed limit from 55 to 65 miles per hour, Ashenfelter and Greenstone calculate an *upper bound*, $\hat{V}$, on the value these states placed on a statistical life (note: *upper bound* means that these states would pay *no more* than $\hat{V}$ to save one more statistical life). Imagine that the federal government had instead allowed these 40 states to raise their speed limits to *any* limit they preferred (e.g., 70, 75, 80 etc), and you had then used the Ashenfelter-Greenstone method to estimate the VSL, $\tilde{V}$, for these states. Would you expect $\tilde{V}$ to be higher, lower, or the same, as $\hat{V}$ (or is this indeterminate)? Explain.

5. Using prior year's rainfall as an instrumental variable for economic growth, Miguel et al. find that growth reduces the probability of civil conflict in sub-Saharan Africa. Imagine that subsequent research has shown that following years with high rainfall, malaria is much more likely to be epidemic among rebel groups, which tend to have their military bases in remote wooded areas. Would you expect this factor to cause the Miguel et al. instrumental variables approach to overstate or understate the beneficial effect of economic growth in reducing civil conflict (or is it indeterminate)? Explain.

6. Card et al., use the discontinuity in Medicare eligibility at age 65 to study the causal effect of health insurance on mortality. It is well known, however, that mortality odds increase with age. Why does this fact *not* cause Card et al. to under-estimate the beneficial effects of healthcare in reducing mortality?

Medium Question #1: Expected Utility and Risk Preference

Anton is a VNM Expected Utility maximizer. Consider the following lotteries:
A: $\$5,000$ for sure
B: $\$3,000$ with probability 40%, $\$6,000$ with probability 60%
C: $\$3,000$ for sure
D: \$600 with probability 50%, $\$5,000$ with probability 50%
Anton is indifferent between A and B and indifferent between C and D. (This does not mean he is indifferent between A and C or between B and D.)

1. [6 points] Is Anton risk-averse, risk-neutral or risk-loving? Explain.

2. [8 points] Anton is presented with the following two lotteries:

   E. $\$3,000$ with probability 40%, $\$6,000$ with probability 60% [Note: lottery E is the same as lottery B]

   F. $\$1,500$ with probability 40%, $\$7,000$ with probability 60%

   Will Anton prefer E to F, prefer F to E, be indifferent between the two, or is the answer indeterminate? Explain.

3. [8 points] Anton is presented with the following two lotteries:

   G: $\$4,000$ for sure

   H: \$600 with probability 25%, \$3000 with probability 20%, \$5000 with probability 25%, $\$6,000$ with probability 30%

   Will Anton prefer G to H, prefer H to G, be indifferent between the two, or is the answer indeterminate? Explain.

4. [8 points] Anton is presented with the following two lotteries:

   I: $\$5,000$ for sure

   J: \$600 with probability 25%, $\$6,000$ with probability 75%

   Will Anton prefer I to J, prefer J to I, or be indifferent between the two. Explain. [Hint: the answer is *not* indeterminate.]

Medium Question #2: Adverse Selection and the Market for "Lemons"

Suppose there are two types of used cars: peaches and lemons. A peach is worth \$3000 to a buyer and \$1900 to a seller. A lemon, on the other hand, is worth \$1000 to a buyer and \$500 to the seller. The fraction of used cars that are peaches is $\lambda_P = \frac{1}{4}$ and the fraction that are lemons is $\lambda_L = \frac{3}{4}$. Assume that all parties are risk neutral, and when buyers and sellers bargain, the agreed sale price is always the maximum that *buyers* are willing to pay.

1. [5 points] What would be the prices for lemons and peaches if there were perfect information about used car quality?

2. [5 points] What would be the price of a used car if neither buyers nor seller knew whether a particular car was a peach or a lemon?

3. [5 points] Assume now that buyers cannot tell if a car is a peach or a lemon. Sellers know which type of car they own. What will be the market price for used cars? Explain.

4. [5 points] Now assume there are as many peaches as lemons ($\lambda_p = 0.5$). Continue to assume that buyers cannot tell if a car is a peach or a lemon. What will be the market price for used cars**?** Explain.

5. [5 points] Continue to assume that $\lambda_p = 0.5$. The Akerlof Institute offers a new service. For price P, it will inspect any used car to determine whether it is a peach or lemon. The inspection is 100% accurate. What is the maximum price P^* that owners of peaches would be willing to pay to have their cars inspected? [Hint: Bear in mind that if one peach owner is willing to pay P^*, all peach owners will be willing to pay P^*.]

6. [5 points] The Akerlof Institute decides to charge P^*. How much will peaches sell for? How much will lemons sell for?

Medium Question #3: What's Risk Worth?
[You may use a calculator for this question.]

Don and John are risk-averse, VNM Expected Utility maximizers, with utility of wealth equal to:

$$U(w) = w^{1/2}.$$

Don's wealth is $\$10,000$ and he faces a 40 percent chance of losing $\$7,500$. John's wealth is $\$1,000,000$ and he faces no risk at all.

1. [6 points] What is Don's certainty equivalent of wealth—that is, what wealth level with certainty would provide Don the same expected utility level as his risky bundle?

2. [6 points] Hypothetically, imagine that John (rather than Don) faced a 40 percent chance of losing $\$7,500$. What would his certainty equivalent of wealth be? [No decimals required; please round your answer to the nearest whole number.]

3. [6 points] Don offers to pay John P to bear his 40% risk of losing $\$7,500$. Don will pay P to John *whether or not* he experiences the loss. If Don loses $\$7,500$, John must pay him $\$7,500$. Under this arrangement:

   - Don's wealth will equal $10,000 - P$ with certainty.
   - John's wealth will equal $1,000,000 + P$, and will have a 40% chance of losing $\$7,500$.

   For what range of values of P will both John and Don agree to this arrangement?

4. [6 points] What insurance mechanism explains why both John and Don are willing to strike this bargain? Explain your answer.

5. [6 points] Would this arrangement be Pareto improving? Explain.

Medium Question #4: Job Market Signaling

Suppose that there are two types of workers in the labor force, low ability (Low) and high ability (High) workers, where the fraction of High workers is λ. A worker knows her type. If High workers are employed by a firm they can produce θ_H units of output in one year, and Low workers produce θ_L units of output per year, where $\theta_H > \theta_L > 0$. If a worker of any ability level does not work for a firm, she produces 0 units of output. Each worker works for just one period and then she retires. Finally, assume that one unit of output produced is worth \$1.

Suppose initially that a firm can observe the ability of each work it hires, and that there are many perfectly competitive firms, all of which use only labor to produce out. The profit that a firm makes for each worker it hires is therefore equal to the value of the output produced by that worker's type minus the wage paid to that worker. Perfect competition implies that the profit made on each worker has to be zero in equilibrium.

1. [6 points] What wage are firms willing to offer to each type of worker?

Suppose from now on that there is asymmetric information; firms have no way to know workers' ability. High ability workers also differ from the low ability workers in their tolerance for writing resumes. High ability workers have a utility function over wage w and the length of resume written s:

$$U_H = w - s,$$

while low ability workers have utility function:

$$U_L = w - 2s.$$

Assume that $s > 0$. The length of workers' resumes does not affect their productivity but it does affect their well-being. Continue to assume that there are infinitely many perfectly competitive firms.

2. [12 points] For what values of s does there exist a pooling equilibrium in which both types of workers write a resume of length s?

3. [12 points] For what values of s does there exist a separating equilibrium in which high productivity workers write a resume of length s and low productivity workers do not write a resume (i.e. they write a resume of length $s = 0$)?

Medium Question #5:

Energy efficient air conditioners receive the *Energy Star* (E^*) certification from the U.S. Environmental Protection Agency (EPA). You are hired by the EPA to test the market signaling value of the Energy Star certificate. [The details of this question are fictional, but the Energy Star program is real.]

Assume that the EPA tests each new model i of air conditioner and assigns a numerical rating, R_i, between 0 and 20, where $R = 0$ is least efficient and $R = 20$ is most efficient. Models rated 10.0 or above ($R_i \geq 10$), are given the E^* certification:

$$E_i^* \begin{cases} 0 \text{ if } R_i < 10 \\ 1 \text{ if } R_i \geq 10 \end{cases}$$

All air conditioners sold to consumers *must* display their energy efficiency rating, R_i. Energy Star models *must* also display the Energy Star logo, which looks like this.

Consumers value energy efficiency because it reduces their electricity bills. Many consumers do not understand energy efficiency ratings (R) , however, but they do know that Energy Star appliances are more efficient than average. You hypothesize that, all else equal, consumers will pay extra for Energy Star appliances because they view the Energy Star logo as a *signal* of efficiency.

Let Y_i equal the retail price of air conditioner model i, and assume you have data on the retail price and energy efficiency $[Y_i, R_i]$ of all air conditioner models sold.

1. [6 points] Your data shows that Energy-Star air conditioners sell for \$100 more on average than non Energy-Star units. Specifically:

$$E[Y|E^* = 0] = \$200,\ E[Y|E^* = 1] = \$300,$$

Explain why a simple comparison of $E[Y|E^* = 1]$ and $E[Y|E^* = 0]$ would *not* provide a valid estimate of the signaling value of the Energy Star certification. Would you expect that \$100 to be an overestimate or underestimate of the signaling value of the Energy Star certificate, and why?

2. [6 points] Draw a graph with Energy Efficiency (R) on the horizontal axis and Price (Y) on the vertical axis. Plot the relationship you would expect to see between R and Y if: (1) the Energy Star logo *does* have market signaling value; and (2) the Energy Star logo *does not* have market signaling value.

3. [6 points] How would you calculate a regression discontinuity estimate, $\hat{T}$, of the signaling value of the Energy Star certificate? Using appropriate causal notation, state the assumptions required for $\hat{T}$ to be a valid estimate of the signaling effect. (You may refer to your diagram.)

4. [6 points] Assume you have calculated that $\hat{T} = \$30$. You learn that due to a technical error, the Energy Star logo was *not* printed on 25% of the air conditioners with $R \geq 10$. In other words, only 75% of Energy Star eligible air conditioners received the Energy Star logo. In this case, do you think that $\hat{T}$ overstates, understates the signaling value of the Energy Star logo for an air conditioner (or is it indeterminate)? Explain.

5. [6 points] Explain how you could calculate an *instrumental variables* regression discontinuity estimate, $\tilde{T}$, of the signaling value of the Energy Star certification. What is your estimate of $\tilde{T}$? [Hint: think of the Energy Star certification as a 'first stage' that raises the probability of receiving an Energy Star sticker from 0% to 75%.]

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