Econ 149: Health Economics
Problem Set II
Answer Key

1. [This is the last problem from Problem Set 1. If you've already done it, just staple in your old answer.] In the regression model $y_i = \alpha + \beta x_i + \epsilon_i$, the error term ϵ captures influences on y that are not included in the model.

   (a) What has to be true about the relationship between ϵ and x for the estimate of β to be unbiased?

   In order for the estimate of β to be unbiased, the correlation between ϵ and x must be equal to zero.

   (b) Suppose a new pizza shop owner is trying to decide how much to charge, by collecting data on prices of pizzas (x) and quantities sold (y) from local pizza shops. Give an example of something that might be included in ϵ and bias the estimate of β. Give an example of something that might be included in ϵ that would probably not bias the estimate of β.

   First, note that the data on prices and pizza sales are cross-sectional and show variation across local pizza markets (e.g., Irvine pizza versus Costa Mesa pizza). Then, the price of a substitute good in each pizza shop's local market is another example. The price at neighboring cheeseburger joints may be correlated both with the price and quantities sold of pizzas. Alternatively, a measure of each shop's pizza quality might be included in ϵ and bias the estimate of β. This would lead to a bias because pizza quality may be correlated both with demand for an individual shop's pizza (and hence quantities sold) and also would be correlated with the price of pizzas.

   (c) Suggest a multivariate regression that the pizza shop owner should run to get a better answer to the question of how the price she charges is likely to affect quantities sold.

   One example: $y_i = \alpha + \beta_1 x_i + \beta_2 w_i + \beta_3 z_i + \epsilon_i$, where w is the price of a substitute good and z is some measure of pizza quality.

2. Explain why moral hazard increases the price of health insurance. Name two things that can be done to reduce moral hazard?

   Moral hazard increases the amount of medical care consumed. Since the pure premium is the probability of getting sick times the amount of money spent, moral hazard causes the pure premium to rise which causes the price of insurance to rise. Some people will be priced out of the market. Utilization reviews, deductibles, co-pays, and increased time costs all might help reduce moral hazard.

3. Explain why most health insurance is offered through groups rather than through individual policies.

   Groups provide insurance companies with a diversified pool of risk. Some members of the group might be high-risk, some might be low-risk, but on average the insurance company will be exposed to too much risk if they offer only individual policies (because of adverse selection, for example).

4. Suppose for the used car example in the text that there are eight cars that range according to the qualities (.25, .5, .75, 1, 1.25, 1.5, 1.75, 2). Note there is no complete lemon being offered. The average quality of the eight cars is 1.125. Again assume that owners have a reserve value for selling equal to $1,000 times the quality of the car they own. Buyers are willing to pay $1,500 times the expected quality of the cars offered for sale. Determine whether this market will completely disappear or, if the market exists, how many cars will be sold.

   You can imagine an auctioneer listing off prices starting at the lowest possible price a seller would accept, which is 250, which is .25(1000). Now, buyers will buy this lowest quality car until the price surpasses .25(1500)=375. So, between 250 and 375, one will car be sold.

   Now, once the auctioneer reaches 500, the owner of the second worst car will want to participate, since his reservation value is .5(1000). When two cars are on the market, the average quality is $(.25 + .5)/2 = .375$, so buyers will be willing to enter a market with these two cars until the price reaches .375(1500)=562.5. So, between 500 and 562.5, two cars will be sold.

   Once the auctioneer reaches 750, the owner of the third worst car will join the market since his reservation value is .75(1000). When three cars are on the market, the average quality is $(.25 + .5 + .75)/3 = .5$, so buyers will be willing to enter a market with these three cars only at the price .5(1500)=750. So, exactly at a price of 750, three cars will be sold.

   Once the auctioneer surpasses the price of 750, the next seller will only enter the market when the price is 1000, but at that point, the average quality is $(.25+.5+.75+1)/4 = .625$. With this composition of cars, buyers will only pay .625(1500)=937.5. Unfortunately, this is less than the auctioneer's price, so the market won't exist. In fact, it won't exist at any price above 750.

5. Consider the Grossman model of health care demand.

   (a) As an individual ages, does her optimal health stock increase or decrease? Explain why.

   The model predicts a lower optimal health stock because of a higher cost of health investment and a shorter remaining life span over which an individual can enjoy (or recoup) the health investment.

   (b) Explain why the effect of increased wage rates on health investment is ambiguous. In other words, why is it that people who earn more per hour are not necessarily more likely to go to the doctor or exercise?

   Higher wages imply higher income, which makes health investment relatively less expensive and should lead to more health investment. But higher wages also imply higher time costs, which should lead to less health investment. Thus, the net effect of wages is ambiguous.

6. You work for an HMO that wants you to figure out how much it will cost to test for and treat patients with a certain type of cancer. You have 1000 customers and you know that 10 of them have the cancer, so the probability of cancer is $P(C) = .01$ and the probability of no cancer is $P(N) = .99$. A test for this cancer can identify the disease with a 95% probability, so that the probability of getting a "positive" test result if a person has cancer is $P(+|C) = .95$. And the probability of getting a positive given someone does *not* have cancer is $P(+|N) = .05$.

(a) Use Bayes' Rule to calculate the conditional probabilities of true positives $P(C|+)$, false positives $P(N|+)$, and false negatives $P(C|-)$. (Hint, Lecture 3 has notes on Bayes' Theorem and the book has information about cost-benefit analysis.)

$P(C|+) = \frac{P(+|C)P(C)}{P(+|C)P(C)+P(+|N)P(N)} = \frac{.95(.01)}{.95(.01)+.05(.99)} = .16$

$P(N|+) = 1 - P(C|+) = .84$

$P(C|-) = \frac{P(-|C)P(C)}{P(-|C)P(C)+P(-|N)P(N)} = \frac{.05(.01)}{.05(.01)+.95(.99)} = .0005$

Now, we would like to figure out the costs. Each test costs \$20. The cost of treating someone who gets a positive test is \$500. If someone gets this treatment, but did not have cancer, it costs an extra \$500 to treat them. For patients that have cancer, but do not catch it early (i.e., they had false negatives), the cost of eventual treatment is a steep \$5,000.

(b) Calculate the total costs of the test, treatment of true positive, treatment of false positives, and treatment of false negatives. Which cost outweighs all the others?

Direct cost of the tests = \$20 x 1,000 = \$20,000. Number of true positives = 95% x 10 = 9.5. Cost of treating true positives = \$500 x 9.5 = \$4,750. Number of false positives = 5% x 990 = 49.5. Cost of treating false positives = (\$500+\$500) x 49.5 = \$49,500. Number of false negatives = 5% x 10 = .5. Cost of treating false negatives = \$5,000 x .5 = \$2,500. Clearly, the cost of treating false positives outweighs the other costs.

Extra credit: What's the total cost of not conducting cancer tests, and letting all the cancer patients get sick? \$5,000 x 10 = \$50,000. This is much less than the total costs of using the test. (Clearly, this comparison assumes that the delayed treatment will cure all cancers or it ignores the benefit of extending the lives of cancer patients.)

7. We have discussed the role of utility functions in the purchase of insurance.

(a) Suppose an individual's utility function is $U = 20Y$, where Y is income per month, and U is utility. What is the marginal utility if income is \$1,000 per month? \$2,000 per month? Will this person insure against loss of income? Why?

For $U = 20Y$, marginal utility= $\frac{dU}{dY} = 20$ irrespective of income. He is unlikely to insure, at actuarially fair rates, because the loss of utility due to the premium is at least as large as the expected loss of utility due to loss of income.

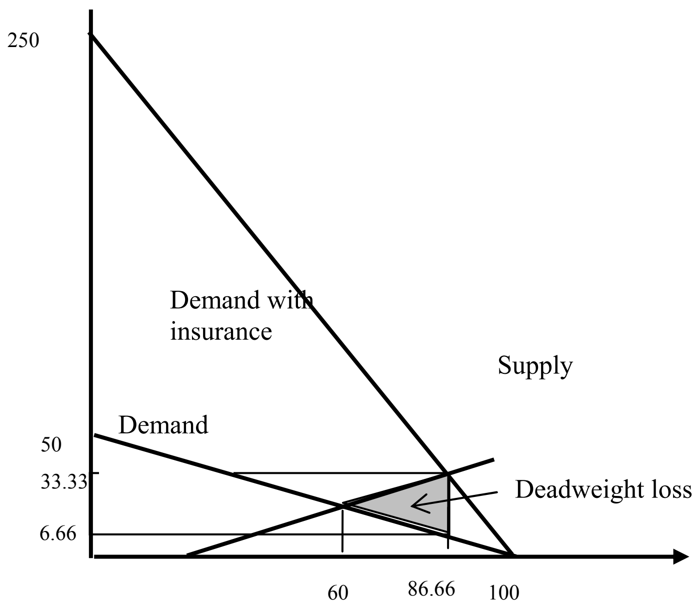
(b) Now, suppose another person's utility function is $U = 200\sqrt{Y}$. What is her marginal utility if income is \$1,000 per month? \$2,000 per month? Will this person insure against loss of income? Why?

Marginal utility= $\frac{dU}{dY} = \frac{100}{\sqrt{Y}}$. Then, if $Y = 1000$, marginal utility is 3.16. Marginal utility at $Y = 2000$ is 2.24. Here, she is likely to insure, because the loss of utility due to the premium, at actuarially fair rates, will be less than the expected loss of utility due to loss of income.

8. Suppose market demand for medical care is $Q_D = 100 - 2P$ and market supply is $Q_S = 20 + 2P$.

(a) Calculate equilibrium Q and P, assuming no health insurance is available.

Equilibrium price = 20; Equilibrium quantity = 60.



(b) Suppose health insurance is available and it provides for a 20% coinsurance rate. What is the new equilibrium? (Hint, how does the demand curve shift?)

Equilibrium price = 33.33; Equilibrium quantity = 86.66.

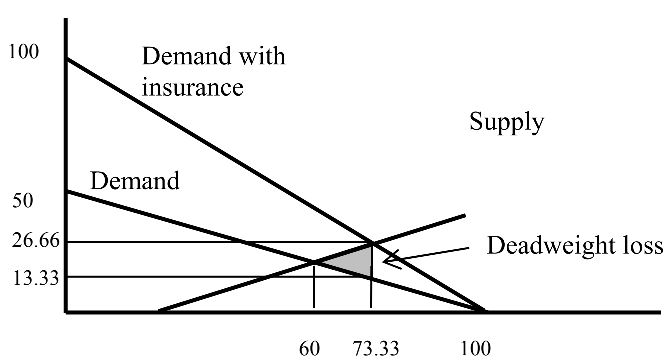
(c) Calculate the deadweight loss of this insurance.

Deadweight loss = 0.5 * 26.66 * 26.66 = 355.56

9. Suppose in the previous question the coinsurance rate was raised to 50%.

(a) What are the new equilibrium P and Q? (Hint, how does the demand curve shift?)

Equilibrium price = 20; Equilibrium quantity = 60.



(b) Calculate deadweight loss in this case.

Equilibrium price = 26.66; Equilibrium quantity = 73.33.

(c) How does this deadweight loss compare to the one in the last problem?

Deadweight loss = 0.5 * 13.33 * 13.33 = 88.89. It is one quarter of the deadweight loss of the previous problem. Higher coinsurance lowers deadweight loss due to moral hazard.