Problem Set 4
Health Economics

Bill Evans
Spring 2013

1. People who quit smoking tend to gain weight, and obesity rates of former smokers are much higher than current smokers. In 2001 for example, obesity rates for former smokers are 6 percentage points higher than current smokers. Over the past 30 years, adult smoking rates have fallen from 37 to 22 percent while obesity rates have increased from 15 to 31 percent. Some have suggested that falling smoking rates may be responsible for higher obesity rates. Given the information above, at most what fraction of the rise in obesity can be explained by falling smoking rates?

2. Many state lotteries have a daily drawing where people can purchase a ticket for $1 with a 3-digit number from 000-999. If the number on the ticket matches the number drawn, the person wins $500. Suppose a person is risk neutral, i.e., their utility is linear in income. In this case U=Y. Show that a risk neutral person will never purchase a lottery ticket. Why then do so many people purchase these types of lottery games?

3. Suppose there is an urn containing 30 red balls and 60 other balls than can be either black or yellow, but you do not know the proportions of black and yellow balls. Consider the following gambles:

   Gamble A: You receive $100 if you draw a red ball
   Gamble B: You receive $100 if you draw a black ball

   Consider two other gambles:

   Gamble C: You receive $100 if you draw a red or yellow ball
   Gamble D: You receive $100 if you draw a black or yellow ball.

   When offered Gambles A or B, the vast majority of people choose A. When offered Gambles C and D, the vast majority of people choose D. Show that the choice of A and D is inconsistent with expected utility theory.

4. Suppose that Betsy's utility function is given by the equation $U=Y^{0.5}$ where Y is measured in thousands of dollars. Betsy's current job pays her $25,000 (Y=25) per year and she can earn this amount next year with certainty. Betsy is offered a different position but in this new job, Betsy has a 50% chance of earning $36,000 (Y=36) and a 50% chance of earning only $16,000 (Y=16). Should Betsy take the new job? Does your answer change if Betsy's utility function is $U=Y^{0.9}$?

5. Suppose that everyone has the same utility function and an annual income of $50000 but people face different risks to health. Person A has a 0.20 chance of experiencing a health shock that requires $400 in expenses while Person B has a 0.002 percent chance of experiencing a health shock that requires $40,000. Graphically illustrate that Person B would be willing to pay a greater risk premium for insurance that Person A although the expected loss is the same for both types of people. Explain your answer.

6. Bob has a job where he earns Y per year but there is a probability P Bob will be injured on his job. If injured, Bob will not be able to work and his income will fall to zero. Write an equation for Bob's expected utility in the absence of any type of insurance.

7. Continue with the previous problem. Under workers' compensation, if a worker is injured on the job and unable to work, the workers' comp program will pay the worker a fraction θ of their income (Y) in the injured state. If insurance is priced at actuarially fair rates it is easy to show that the premium for insurance is PYθ and assume the premium is paid in both the good and the bad state of the world. Therefore, income in the good state is Y-YPθ=Y(1-Pθ) and income in the bad state is therefore

$Y\theta$- $PY\theta = Y\theta(1\text{-}P)$. Write an equation for Bob's expected utility under workers compensation. In this general case, what is the optimal replacement rate of income in the bad state, that is, what is the utility maximizing value for θ?

8. Continue with the previous problem. Suppose Bob's utility function is $U=\ln(y)$ where y is income. We also know that premiums are not available at actuarially fair rates but instead, there is typically a 'loading factor' that prices policies above the fair price. Suppose that the premium price with loading is now $kPY\theta$ where $k>1$. In this situation, income in the good state is now $Y\text{-}kYP\theta=Y(1\text{-}kP\theta)$ and income in the bad state is therefore $Y\theta$- $kPY\theta$ =- $Y\theta(1\text{-}kP)$. With a loading factor k and log utility, what is now the utility maximizing value for the replacement rate θ? (Solve for θ as a function of k and P).

9. Continue with the previous problem. Suppose now that utility is state dependent where utility in the "good" state is $U(Y)=\ln(y)$ and utility in the bad state is $V(Y)=\delta\ln(y)$. Expected utility can be written as

   $$EU = (1\text{-}P)\ln[Y(1\text{-}kP\theta)] + P\delta\ln[Y\theta(1\text{-}kP)]$$

   Find the optimal value of the replacement rate θ as a function of k, P and δ. The probability of experiencing a lost workday injury in the manufacturing sector is about $p=0.07$. One survey estimates that $\delta=0.90$ and in workers compensation, the load factor is roughly $k=1.15$. With these values, what is the optimal value of θ. Using Google, what is the current value of θ for the state of Indiana? Are you not entertained?

10. Carol has annual income of \$50,000 and there is a 1% chance she will experience an accident that will cost her \$20,000 in medical expenses. If Carol's utility function is $U=Y^{0.5}$, what is the most she would she be willing to pay for an insurance policy that would cover all her medical costs when they occur. How would this answer change if Carol's utility function is instead $U=Y^{0.1}$. Provide an intuitive explanation for why this value changed the way it did when the utility function changed.