Suggested Answers
Problem Set 4
Health Economics

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1. As smoking rates fell from 37 to 22 percent, that means 15 percent of the population is at risk of gaining weight. Assume that all of the difference in obesity rates between former and current smokers is due to their quitting smoking, then smoking cessation increases the chance of being obese by 6 percentage points or 0.06. Therefore, we would expect obesity rates to increase by (0.15)(0.06) = 0.009 or 9 tenths of one percentage point. Since obesity increased by 16 percentage points, the fall in smoking can explain AT MOST 0.009/0.16 or 5.6 percent of the rise in obesity.

2. Let Y be income and since utility is linear in income, U=Y and utility without playing the lottery is Y. A lottery player pays $1 for a ticket. They have a 1 in 1000 chance of winning $500. If they purchase a ticket, E(U) = (0.999)(Y-1) + (0.001)(Y-1+500) = Y -1 +.001($500) = Y - 1 + 0.5 = Y - 0.5. In this case, U= Y > E(U) = Y – 0.5, so, this person would not play the lottery.

   People play the lottery because there is a utility value from playing the lottery, which is not based in this simple model.

3. Let the probabilities of drawing a red, black or yellow ball be labeled as R, B and Y, respectively. The choice of gamble A over B implies that

   RU(100) +(1-R)U(0) > BU(100) + (1-B)U(0).

   Assuming that U(0)=0, the choice of Gamble A implies that R>B or that people exopect there are more red balls than black balls in the urn.

   The choice of Gamble D over C implies that

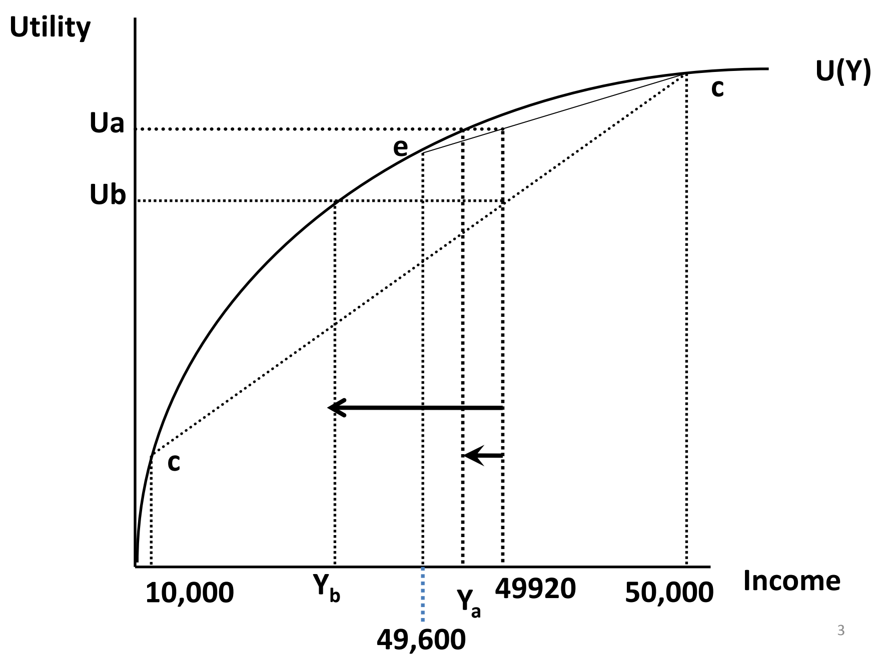
   (B+Y)U(100) + (1-B-Y)U(100) > (R+Y)U(100) + (1-R-Y)U(100)

   And again, assuming U(0)=0, then this implies that (B+Y)U(100) > (R+Y)U(100) or (B+Y) > (R+Y) or B>R. The choice of Gamble D over C means that the participant believes there are more Blacks balls than red balls in the urn, which is inconsistent with the choice of option A over B above.

4. Utility when income is certain: U(25) = $25^{0.5}$ = 5
   Utility when income is uncertain: E(U) = .5U(36) + .5U(16) = .5(6) + .5(4) = 5.
   Betsy is indifferent between the two jobs. Notice that the job with the risky income has higher expected income than the original situation [0.5(36) + 0.5(16)] = 26.

   If utility is now U=$Y^{0.9}$, utility of the original job is now $25^{0.9}$ = 18.11 and expected utility is EU = 0.5($36^{0.9}$) + 0.5($16^{0.9}$) = 18.64 so she now take job #2.

5. A graph is below. Both people are expected to lose \$80 [(0.2)(400) = (0.002)(40,000) = \$80], but the downside risk associated for person B is much greater. In the graph below, income in the good state is \$50,000 for both type A and B. Income in the bad state for person A and B is \$49,600 and \$10,000 respectively. Therefore, line (cd) is expected utility line for person B and line (ce) is the line for person A. Expected income in both cases is \$49,920 and therefore EUa and EUb represent expected utilities for both types of people. The risk premium person A is willing to pay to shed risk is 49,920-Ya. In contrast, the risk premium person B is willing to pay to shed risk is 49,920-Yb. Although the expected loss is the same, person B is willing to pay a lot more to shed risk because the downside risk of a loss is much higher for this person.



6. $EU_{wo} = (1-P)U[Y] + PU[0]$

7. $EU_w = (1-P)U[Y(1-\theta P)] + PU[Y\theta(1-P)]$

$d\,EU_w/d\theta = -(1-P)YPU'[Y(1-\theta P)] + PY(1-P)U'[Y\theta(1-P)] = 0$

Rewrite as $(1-P)YPU'[Y(1-\theta P)] = PY(1-P)U'[Y\theta(1-P)]$

The terms (1-P)YP can be cancelled from each side, leaving $U'[Y(1-\theta P)] = U'[Y\theta(1-P)]$ which means marginal utilities in the good and bad states of the world are equal, which implies that income in the good and bad states of the work are equal, or

$Y(1-\theta P)= Y\theta(1-P)$

Solving for θ, one gets that θ=1, which means that workers should fully insure.

8. $EU_w = (1-P)U[Y(1-k\theta P)] + PU[Yk\theta(1-P)] = (1-P)\ln[Y(1-k\theta P)] + P\ln[Yk\theta(1-P)]$

$d\,EU_w/d\theta = -(1\text{-}P)kYP/[Y(1\text{-}k\theta P)] + PYk(1\text{-}P)/[Yk\theta(1\text{-}P)] = 0$

In the first term, the Y's cancel in the numerator and denominator. In the second term, the Yk(1-P) cancel in the numerator and denominator.

$d\,EU_w/d\theta = -(1\text{-}P)kP/[(1\text{-}k\theta P)] + P/\theta = 0$

Rewrite as $P/\theta = (1\text{-}P)KP/[(1\text{-}k\theta P)]$

Solving for θ, we get $\theta=1/k$ and since $k>1$, workers should have less than full insurance.

9. $EU_w = (1\text{-}P)\ln[Y(1\text{-}k\theta P)] + P\delta\ln[Yk\theta(1\text{-}P)]$

$d\,EU_w/d\theta = -(1\text{-}P)kYP/[Y(1\text{-}k\theta P)] + PYk(1\text{-}P)\delta/[Yk\theta(1\text{-}P)] = 0$

$(1\text{-}P)kP/[(1\text{-}k\theta P)] + P(1\text{-}P)\delta/[\theta(1\text{-}P)] = 0$

$k/[(1\text{-}k\theta P)] = \delta/[\theta(1\text{-}P)]$

$\theta = \delta/(k\text{-}kP\text{+}k\delta p)$

Notice that of $k=1$ and $\delta=1$, $\theta=1$ which is our original situation. Given the stated values of $k=1.15$, $p=0.07$ and $\delta=0.90$, then $\theta=0.78$. A quick search of the WWW shows that $\theta=0.66$ in Indiana. Not bad.

10. $E(U)_{w/out\ insurance} = 0.99U(\$50{,}000) + 0.01U(\$50{,}000\text{-}\$20{,}000) = 0.99(50000^{0.5}) + 0.01(30000^{0.5}) = 223.103$

With insurance, the person will pay a premium PREM for insurance and therefore, income in the "good" state is Y-PREM. If a health shock occurs, the person will experience a loss L but receive a payment of L from the insurance company to cover these expenses. As a result, income in the "bad" state is also Y-Prem-L+L = Y-PREM. Therefore, utility with insurance is $U(Y\text{-}PREM) =(Y\text{-}PREM)^{0.5.}$ A person will continue to pay for insurance so long as $E(U)_{w/insurance} >= E(U)_{w/out\ insurance}$. Therefore, the most a person would pay is the point is the PREM that reduces utility with insurance to the point where where $E(U)_{w/insurance} = E(U)_{w/out\ Insurance}$

$E(U)_{w/insurance} =(Y\text{-}PREM)^{0.5} = E(U)_{w/out\ insurance} = 223.103$. Squaring both sides produces

$Y\text{-}PREM = 223.103^2$ so $PREM = Y\text{-}223.103^2 = \$50{,}000 – 223.102^2 = \$225.15$

When $U=Y^{0.1}$, then $E(U)_{w/out\ insurance} = 0.99(50000^{0.1}) + 0.01(30000^{0.1}) = 2.949$

$E(U)_{w/insurance} =(Y\text{-}PREM)^{0.1} = E(U)_{w/out\ insurance} = 2.949$. Raising both sides by a factor of 10 generates $Y\text{-}PREM = 2.949^{10}$ and $PREM = Y – 2.949^{10} = 50{,}000 – 49{,}751 = \$249$

The premium is greater in the second case because the marginal utility of income is so small. The downside risk presents a tremendous loss in utility so Carol is willing to pay more in that situation to shed herself of risk.