Intermediate Microeconomic Theory
ECN 100B, Fall 2019
Professor Brendan Price

Homework #7

Due: Saturday, December 7th at 5:00pm

1 Risk attitudes (6 pts. total)

For each of these utility functions, determine whether the agent is risk-averse, risk-neutral, or risk-loving (assume that wealth is positive: $w > 0$). Also indicate whether the agent would always buy, never buy, or be indifferent towards an actuarially fair insurance policy.

a. (2 pts.) $u(w) = 3w^4 + 2w^2$

b. (2 pts.) $u(w) = 3$

c. (2 pts.) $u(w) = 4\sqrt{w} + \ln(w)$

2 Wildfire risks (12 pts. total)

A California resident gets utility from wealth (w) and health (h):

$$u(w, h) = \sqrt{w} + \sqrt{h}$$

She starts out with wealth $w_0 > 0$ and health $h_0 = 100$, but there is a 25% chance that wildfires will create air pollution, lowering her health to $h = 36$. Before wildfire season starts, she can choose to install an HVAC system that would completely eliminate this risk.

a. (3 pts.) If the resident has initial wealth $w_0 = 144$, what is her expected utility without the HVAC system? How much would she be willing to pay for the HVAC system?

b. (3 pts.) If the resident instead has initial wealth $w_0 = 256$, how much would she be willing to pay for HVAC? Comparing your answers to parts a and b, what does this suggest about richer/poorer people's ability to cope with environmental risks?

c. (3 pts.) Suppose that—as the climate continues to change—the probability of wildfire-induced health damages rises to 50%. If the price of an HVAC system is 14, find the "cutoff" value w^* such that residents with $w_0 > w^*$ purchase the HVAC and residents with wealth $w_0 < w^*$ do not.

d. (3 pts.) Now suppose health is non-random (equaling $h_0 = 100$), but wildfires create financial risk: there is a 20% probability that $w = 25$, otherwise $w = 225$. Compute the mean and variance of w. Then compute the resident's certainty equivalent.

3 The value of information (12 pts.)

When making decisions in the presence of uncertainty, agents may have an incentive to invest in information that would reduce this uncertainty and hence help them make better decisions. But information is only useful when there's a chance it will alter your decision.

Pfizer is deciding whether to develop a promising new hair-loss medication called Lycanthea. To develop Lycanthea, Pfizer must pay a fixed cost $FC \geq 0$. Once the drug is developed, manufacturing additional doses is nearly costless, so let's assume that $VC(Q) = 0$.

If Pfizer develops Lycanthea, it will be a uniform-pricing monopolist. However, there is uncertainty about consumer demand. Early-stage clinical trials suggest that there is a 25% chance Lycanthea has no side effects, in which case Pfizer would face high demand given by

$$p_h(Q) = 20 - Q$$

However, based on a troubling incident reported during the early trials, Pfizer's scientists estimate there is a 75% chance that Lycanthea increases the risk of spontaneously turning into a werewolf. That would generate negative press coverage, lowering demand to

$$p_l(Q) = 8 - Q$$

If Pfizer decides to pay the fixed cost, it immediately learns what demand curve it faces (i.e., before having to choose Q). Pfizer is risk-neutral: it wants to maximize its expected profit.

a. (2 pts.) Suppose that (despite the werewolf risk) Pfizer decides to enter the market. Compute Pfizer's optimal quantity Q_l^* in the event that demand is low ($p(Q) = 8 - Q$). Compute Pfizer's optimal quantity Q_h^* in the event demand is high ($p(Q) = 20 - Q$).

b. (2 pts.) If $FC = 0$, Pfizer enters the market. Compute its expected profit.

c. (3 pts.) If $FC = 10$, will Pfizer enter the market? If $FC = 20$? If $FC = 40$?

Now suppose that, before deciding whether to pay the fixed cost FC, Pfizer can run another clinical trial to determine (with perfect accuracy) whether Lycanthea causes werewolves.

d. (4 pts.) For each of the following, determine how much (i.e., the maximum amount that) Pfizer would be willing to pay for another clinical trial.

   i. $FC = 10$
   ii. $FC = 20$
   iii. $FC = 40$
   iv. $FC = 120$

(Hint: in each case, determine what Pfizer will do with/without the information.)

e. (1 pt.) Now suppose Pfizer can't conduct another clinical trial, but it can perfectly price discriminate if it enters the market. If $FC = 40$, will Pfizer enter the market?

