

14.41 Problem Set #3

Due: Friday, November 4th 2005

1) The superhero profession is a dangerous business. Every year, in fact, there's a probability p that a given superhero will be caught by a ruthless supervillain, who inflicts damage that requires \$50 in medical costs to heal. Being a superhero doesn't pay well, but fortunately, superheroes receive an annual income of \$100 from their (covert) civilian job. They first spend money on any medical costs, and use the rest for consumption.

In one particular metropolis, there are two types of superheroes: clumsy and skillful. Clumsy superheroes have a 90% probability of being caught by a supervillain and suffering \$50 in medical costs. Skillful superheroes, on the other hand, are only caught with probability 30%. Additionally, these two types have different utility functions. The utility of consumption for clumsy superheroes is $U_{clumsy} = (C_{clumsy})^7$, while the utility of consumption for skillful superheroes is $U_{skillful} = (C_{skillful})^5$. Fortunately for this metropolis, there are eleven times as many skillful superheroes as clumsy superheroes.

ACME Insurance Company has moved in to the city, and is thinking about offering health insurance to superheroes.

a) If ACME can perfectly identify whether each superhero is skillful or clumsy, then it can charge a different premium to each type. Suppose it charges an actuarially fair price for insurance. How much will ACME charge each type for \$1 in medical coverage? How much insurance will each type buy, and how much will each type have for consumption if they get caught, and how much will they have if they don't get caught?

b) Now suppose that the type of the superhero is unobservable by the insurance company (although the superheroes themselves know), so ACME can only offer a single price for insurance.

- i) What is the maximum amount of money each type will pay in order to be fully insured against medical costs? Explain why this amount is the same or is different from the costs of actuarially fair insurance.
- ii) Given this, what is the maximum amount that ACME can charge such that *all* types will fully insure? Will ACME stay in business if it does this? Is there a market failure in the insurance market – why or why not?

c) ACME instead considers offering two types of insurance coverage. The “minimal coverage” plan provides \$20 in insurance coverage for total costs of \$7. The “extensive coverage” plan offers \$50 in insurance for total costs of \$34. Which of these plans, if any, will each type choose? Will ACME stay in business? Now is there a failure in the insurance market? Why or why not?

d) Dr. Brain (a mad scientist) develops a new blood test that flawlessly identifies whether a superhero is clumsy or skillful, so that everyone (including insurance

companies) will then be able to identify their type. However, this test is not free: the test costs \$1.50 to administer to a superhero. Suppose Dr. Brain offers to perform this procedure on any superhero who is willing to pay \$1.50.

- i) Assuming that there is perfect competition in the insurance market, and that once a test is undertaken all insurance companies know the superhero's type, will any type be willing to purchase this test (in the absence of testing, the insurance plans from (c) will be what is offered)? Why or why not? To answer this, think about what will happen in the insurance market in response - i.e. will a single price be offered or will different prices be offered depending on who takes the test – and what will be the equilibrium prices?
- ii) Relative to (c), which type is better off now that it is possible to reveal types - or are both types better off?
- iii) Now is there a failure in the insurance market?

2) Consider the following stylized model of an economy, which exists for two periods (period 1 and period 2). There are two types of people in this economy: type As, who typically have long life spans, and type Bs, who typically have short life spans. There are 20 type As, and 10 type Bs. Each type cares only about consumption while alive, and each person has \$100 in income, which he receives in period one (to make things simple, there are no work decisions to be made in this economy, so we won't worry about labor supply and wages).

Each person has an expected utility function of the following form:

$EU_i = \ln(C_1) + \frac{1}{3} p \ln(C_2)$, where $p=.75$ for type As, and $p=.2$ for the type Bs. (In other words, no one wants to starve if they live into the second period, but no one is certain whether they will reach the second period – and type As are more likely to reach the second period than type Bs are.)

Suppose that no annuity market exists in this economy because potential annuity providers are unable to observe individual types (resulting in adverse selection problems).

a) Although the annuity market doesn't exist, people can still invest money in period 1. In period 2, if the person is still alive, he receives his initial investment, plus a rate of return on the investment of 10% (i.e. the interest rate is 10%). How much will each type choose to save in the first period? What is first period consumption for each type, and how much will each type consume if they reach the second period?

b) Even though people in this economy can consumption smooth by saving and earning a return equal to the interest rate, would people be better off if an annuity market existed that provided actuarially fair annuities? (No need to solve for anything, just explain intuitively why you think a fair annuity market would or would not improve welfare).

c) The federal government, recognizing a market failure in the annuity market, decides to correct the problem by implementing a social security program. The way this social security program will work is that the government sets a lump sum tax T that everyone must pay in the first period. The government takes this money, invests it at an interest rate of 10%, and uses the entire amount to pay B in benefits to everyone who is alive in the second period.

- i) Assume that the government's social security budget must break even (in expectation). Write out the government's social security budget constraint. What multiple of taxes must benefits be for the budget to exactly break even? (i.e. find the X such that $B=XT$ for the gov. to break even).
- ii) Suppose the government is trying to choose the optimal lump sum tax T (and hence, the optimal social security benefit amount B). If the government cares only about the *sum* of utilities for everyone in the economy (i.e. it maximizes a utilitarian social welfare function), and if the budget must exactly break even, what level of T and B will it choose? (Note: you can safely assume that

neither type will want to save privately in addition to social security). Is type A better off with or without social security? How about type B? In what sense is this program redistributive?

- iii) The social security plan in (cii) is never implemented because the administration that proposed the policy is voted out of office by the type Bs. Coincidentally enough, the new administration cares *only* about type Bs. What level of T and B will the new administration choose, if the social security budget must still be balanced? (although the administration cares only about B, each type must get charged the same lump-sum tax, and each type must receive the same amount in benefits if they live to period 2). Assume that everyone can supplement social security benefits with additional savings if they wish (i.e. they can save some of their post-tax income in period 1, as in (a)). Is type A better off with or without social security? What about type B? Is either type better off than with the system from (ii)? Is this new program redistributive, and if so, how does its redistributive nature differ from (ii)?

d) Now, think about how this stylized economy and social security system relate to the American economy and current social security system. In what sense is the Social Security system in the United States redistributive in ways similar to those illustrated above? Who are relevant type As and type Bs?

- 3) Bush's administration hires you to help set its agenda for the following term. You are asked to review the Unemployment Insurance (UI) program, which currently replaces approximately 45% of a worker's wages for 26 weeks after she loses her job. Answer each part of the question in 1-2 paragraphs.

President Bush's labor secretary (Elaine Chao) shows you a table comparing the unemployment durations of individuals who receive UI and do not receive UI. This table reveals that those who receive UI stay unemployed longer than those that do not receive UI. She claims that this proves that UI causes longer unemployment durations.

a) Is she correct? Why or why not? What other evidence could you bring to bear on this question that might be more useful in gleaning the correct relationship between UI generosity and unemployment durations?

b) If UI causes longer unemployment durations, does this prove that the generosity of the program should be reduced? Why or why not?

c) Consider two alternative reforms of the current UI system. The first is to perfectly experience rate firms, so that the taxes that firms pay are set exactly equal to the benefits their workers receive (benefits remain at 45% of wages). The second is a system of individual perfect experience rating - the government would loan individuals 45% of their wages while unemployed, but they would have to pay them back when they get a new job.

- i) Contrast the effects of these alternative policies on unemployment durations and the likelihood of worker layoffs.
- ii) Contrast the extent of insurance for workers provided by each of these alternatives with the current system.

- 4) Having done such a great job analyzing UI, you are now asked to help reform the Disability Insurance (DI) system, which provides benefits for the rest of your life for off-the-job injuries which leave you unable to work. In particular, the administration is considering two alternative reforms:
1. Paying different DI benefits for different types of disabilities (e.g. you get 30% of your previous wage if you have disability type X and 50% if you have disability type Y).
 2. Increasing the length of time people must have gone without working before they are allowed to apply from 5 months to 12 months.
- a) Explain the rationale behind each proposal.
 - b) Explain the downside of each proposal.
 - c) If you recommend reform #1, how would you decide which type of injuries should get higher compensation and which type should get lower compensation?