

## Insurance

In section today, we will be learning why people buy insurance. Instead of presenting the graph and analysis of insurance, this handout will walk you through how to analyze insurance using tools I will present at the beginning of section. This exercise will serve as both a demonstration of how insurance works (a topic you are responsible for on the exams and problem sets) **and** a demonstration of how to apply a model you have learned in one context to a slightly new situation. Your problem set asks you to go through a similar exercise applying the same ideas to another new situation but doesn't give you as many hints about how to proceed. You may find reviewing this exercise helpful when working on that problem. I anticipate that you will probably not have time to complete the entire exercise in section.

### How Insurance Works

Many of you may already be familiar with how insurance operates, but as a brief summary for those who are not:

Consumers who are facing a possible loss (due to theft, fire, accident, illness, etc.) purchase an insurance policy against the loss. In insurance markets, the price paid for the insurance is called a **premium**. The consumer pays the premium up front. If there a loss occurs, the insurance company will reimburse the consumer for the losses. If a loss does not occur, the insurance company keeps the premium.

Today, we will focus on **full insurance** which completely eliminates risk because the insurance company will completely cover the potential loss. For example, suppose there is a risk that you will be robbed. If you purchase full insurance on your belongings and are robbed, the insurance company will completely compensate you for the loss and you will be no worse off having been robbed. (For simplicity in our analysis today, we will ignore any psychic or sentimental losses that result from being robbed, having your house burn down, etc.).

Before we get started, we need one more definition. **Actuarially fair** insurance is insurance whose premium is equal to the expected loss. For example, suppose there is a 10% chance that you will be robbed and lose \$3000. **Full insurance** would pay you \$3000 if you are robbed and nothing if you are not robbed. Your expected loss is  $.9(\$0) + .1(\$3000) = \$300$  because 90% of the time you will lose nothing and 10% of the time you will lose \$3000. Actuarially fair insurance against this loss will have a premium of \$300.

### Understanding the Purchase of Insurance

We will be using a basic set of facts throughout this example. The total value of David's possessions is \$10,000 (note that  $10,000^{1/2} = 100$ ). There is a 20% chance that David will be robbed. If he is robbed, he will lose \$7500. David's utility function is defined over his total wealth and is given by  $u(w) = w^{1/2}$ . For our purposes, we can treat a utility function defined over wealth just like we treated one defined over income.

Questions 1-4 use the model I will present at the beginning of section while the remaining questions add insurance into the picture.

1. Calculate David's expected wealth and his expected utility using the approach I presented at the beginning of class.

2. Draw a diagram illustrating David's current wealth, his wealth in the event of a loss, his expected wealth and his expected utility.
3. On your diagram, identify David's certainty equivalent and his risk premium.
4. Calculate David's certainty equivalent and risk premium.
5. Suppose David is offered actuarially fair insurance against the full value of his potential loss. What is the premium that would be charged?
6. What is David's expected wealth if he buys the insurance? His expected utility? Add these amounts to your diagram.
7. Will David buy the insurance? How do you know?
8. Suppose the insurance premium was \$2000. Would David buy the insurance?
9. At what premium would David be indifferent between buying the insurance and not buying it? How much does this amount exceed the actuarially fair premium?
10. What is the relationship between your answer to (9) and David's certainty equivalent and risk premium?
11. What is the maximum amount David would be willing to pay for insurance?