

14.01 Principles of Microeconomics, Fall 2007

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Lecture 10

Insurance and Production Function

Outline

1. Chap 5: *Reducing Risk: Insurance*
2. Chap 6: *Outline of Producer Theory*
3. Chap 6: *Production Function: Short Run and Long Run*

1 Reducing Risk: Insurance

Reducing Risk:

- Diversification
- Insurance

Example (House insurance). Assume that one house has the probability p to catch fire, with loss l each time, i.e. the owner's wealth will reduce from y_1 to $y_2 = y_1 - l$. If the owner pay premium k to buy an insurance which covers the loss l when there is a fire, her wealth will be $y_3 = y_1 - k$, for the situations listed (see Table 1).

	No Insurance	Insurance
No Fire	y_1	$y_3 = y_1 - k$
Fire	$y_2 = y_1 - l$	$y_3 = y_1 - k$

Table 1: Wealth of House Owner in Different Situations.

Assuming the owner is a risk-averse, the utility function is concave.

$$u''(y) < 0$$

If the expected wealth at both situations is equal,

$$y_3 = (1 - p) \times y_1 + p \times y_2.$$

We have

$$k = p \times l.$$

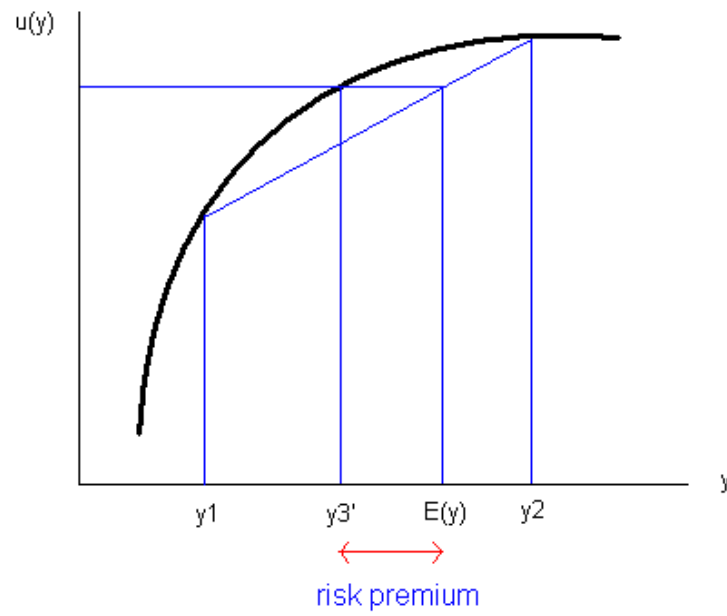


Figure 1: The Utility Function of Risk Averse Person.

The insurance premium is equal to the expected payout by the insurance company, and we say the insurance is actuarially fair.

Since the person is risk-averse,

$$u(y_3) > (1 - p) \times u(y_1) + p \times u(y_2).$$

she will choose to buy insurance.

If the insurance is actuarially unfair,

$$k > p \times l.$$

Then

$$y_3 < (1 - p) \times y_1 + p \times y_2.$$

We do not know if the person wants to buy or not until we get her specific utility function, but it is easy to imagine she may buy insurance if k is close to pl .

Now we consider what is the maximum insurance premium that the companies can charge and the customer is still willing to buy the insurance. In this case, let y'_3 be the house owner's wealth after being charged the maximum premium. Then, (Figure 1)

$$u(y'_3) = pu(y_2) + (1 - p)u(y_1).$$

Thus the maximum insurance premium charged is

$$k' = y_1 - y'_3 = y_1 - E(y) + \text{Risk Premium} = p \times l + \text{Risk Premium}$$

So are insurance companies more willing to take risk? If not, why are they willing to sell insurance? The Law of Large Numbers can explain this. Let L be the total loss from n customers, It is a random variable. The average loss shared by each customer is $\frac{L}{n}$, and $E(\frac{L}{n}) = n \times p$. The expected payout for L by the insurance company will be

$$E(L) = n \times p \times l$$

When

$$n \rightarrow \infty$$

The probability that the loss shared by each customer is equal to a fixed number pl is almost 1. (Figure 2)

$$\text{Probability}\left(\frac{L}{n} = p \times l\right) \rightarrow_{n \rightarrow \infty} 1.$$

Note that this argument only applies to the situation when customers' fire accident events are independent.

Example (Illegal parking). Government has two reasonable methods to punish illegal parking.

- Hire more police, get caught almost for sure but fine is low.
- Hire less police, get caught sometimes but the fine is high.

The latter might be more effective since people are risk averse and are afraid to take risk of being fined to park illegally.

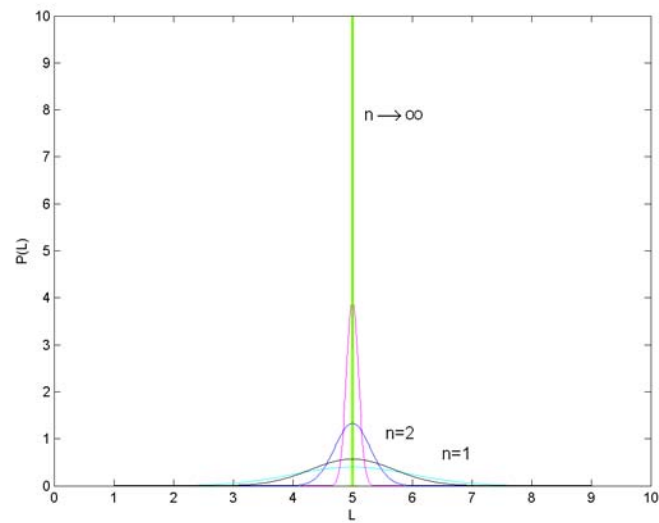


Figure 2: Distribution of $\frac{L}{n}$ with Different Customer Numbers.

2 Outline of Producer Theory

- Production Function: Inputs to Outputs
- Given Quantity Produced, Choose Inputs to Minimize the Cost
- Choose Quantity to Maximize Firm's Profit

The Production Function is

$$q = F(k, L).$$

The two inputs:

k : Capital

L : Labor

It is easier to change labor level but not to change capital in a short time.

Short run. Period of time in which quantity of one or more inputs cannot be changed. For example, capital is fixed and labor is variable in the short run.

Long run. Period of time need to make all production inputs variable. In the long run, both capital and labor are variable.