

# Intermediate Microeconomics Exercise Class 5

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# Content

1 Concepts Review

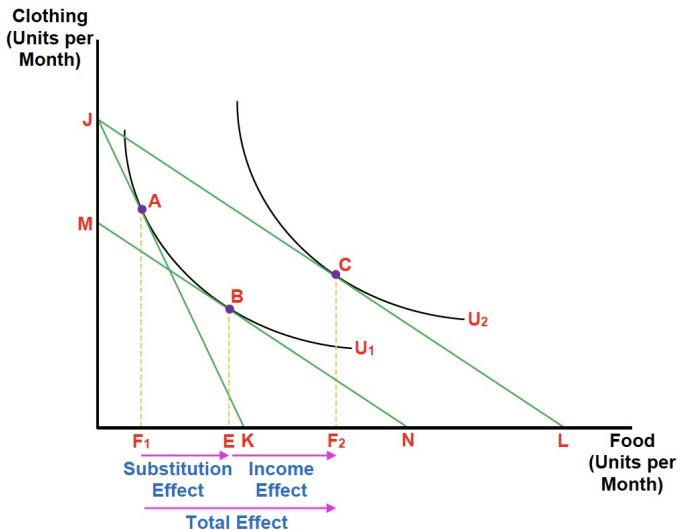
2 Additional Questions

# Income and Substitution Effects

- Relative Price:  $\frac{P_x}{P_y}$
- Substitution Effect (替代效应)
  - ▶ Hicks Substitution Effect
  - ▶ Slutsky Substitution Effect
- Income Effect
- Total Effect = Substitution Effect + Income Effect (收入效应)

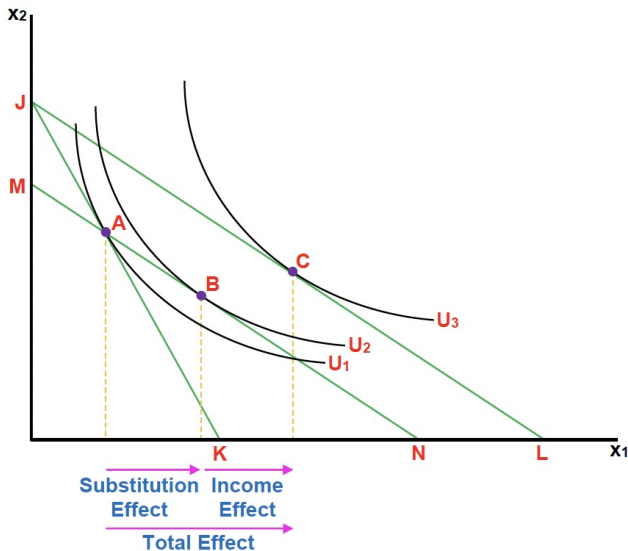
# Income and Substitution Effects Cont'd

## Hicks Substitution Effect



# Income and Substitution Effects Cont'd

## Slutsky Substitution Effect



# Income and Substitution Effects Cont'd

## Slutsky Substitution Effect

- Pivoted Budget
- Original Choice
- Final Choice

# Income and Substitution Effects Cont'd

## Hicks Substitution Effect

- Normal Goods
  - ▶ Substitution Effect: Positive
  - ▶ Income Effect: Positive
  - ▶ Total Effect: Positive
- Inferior Goods
  - ▶ Substitution Effect: Positive
  - ▶ Income Effect: Negative
  - ▶ Total Effect: ?
- Giffen Goods 吉芬商品
  - ▶ Substitution Effect: Positive
  - ▶ Income Effect: Negative
  - ▶ Total Effect: Negative

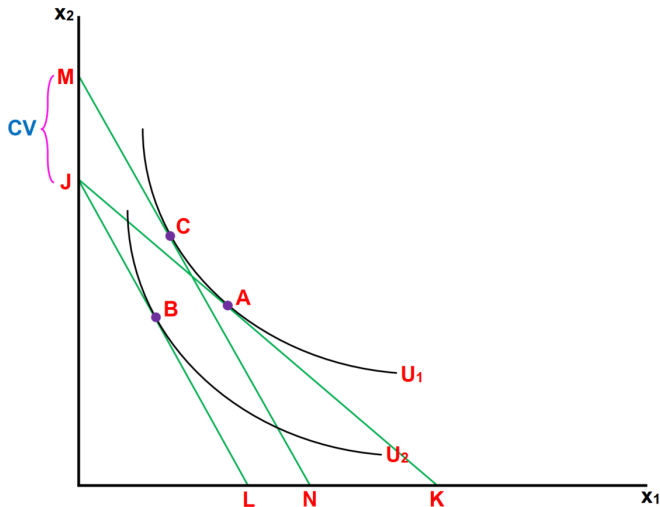
### 定理

*Giffen goods must be inferior goods.*

# Compensating and Equivalent Variation

## Compensating Variation

### Compensating Variation

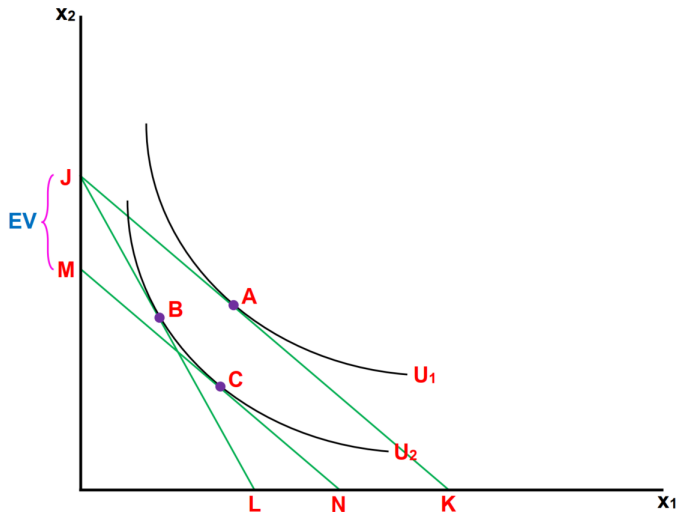




# Compensating and Equivalent Cont'd

## Equivalent Variation

### Equivalent Variation



# Production

- Inputs
  - ▶ Labor
  - ▶ Capital (Physical and Financial)
  - ▶ Land
  - ▶ Raw Materials
- Output
- Technology

# Production Cont'd

- Production Function:  $Q = F(K, L)$
- Short-Run Production: At least one variable is fixed
- Long-Run Production: Alter all inputs
  - ▶ Linear:  $Q = F(K, L) = aK + bL$
  - ▶ Leontief:  $Q = F(K, L) = \min\{aK, bL\}$
  - ▶ Cobb-Douglas:  $Q = F(K, L) = aK^bL^c$
- Total Product, Average Product and Marginal Product
- Marginal Rate of Technical Substitution:  $\frac{dK}{dL} = -\frac{MP_L}{MP_K} = MRT_{LK}$

# Production Cont'd

- Isoquant 等产量线
  - ▶ Capital-Intensive
  - ▶ Labor-Intensive
- The Slope of IQ – The MRTS
- The Shape of IQ – Convex: Law of diminishing marginal returns
- Isoquant Map

# Production Cont'd

- Returns to Scale 规模收益

- ▶ Increasing Returns to Scale:  $f(tx_1, tx_2) > tf(x_1, x_2)$ , for all  $t > 1$
- ▶ Constant Returns to Scale:  $f(tx_1, tx_2) = tf(x_1, x_2)$ , for all  $t > 0$
- ▶ Decreasing Returns to Scale:  $f(tx_1, tx_2) < tf(x_1, x_2)$ , for all  $t > 1$

- For industries that are relatively stable, expect firms to show constant returns to scale
- Firms have strong incentives to increase returns to scale
- Markets will punish firms with decreasing returns to scale

# Production Cont'd

- Why does increasing returns to scale exist?
  - ▶ Higher output allows higher labor specialization
  - ▶ Sometimes the technology simply requires large output runs to use the technology efficiently
- Why does decreasing returns to scale exist?
  - ▶ Higher costs of information flow coordinating
  - ▶ Higher costs of decision-making and managing

# Question 1

Our old friend, John Snow, has a utility function given by  $U(x_1, x_2) = \min\{2x_1, x_2\}$ , where  $x_1$  and  $x_2$  are the quantities of the two commodities he consumed. His income is 40, and the prices are  $(p_1, p_2) = (2, 1)$ .

- a) Calculate the utility-maximizing bundle for John.
- b) Suppose now the price of good 2 rises to  $p'_2 = 3$ . What are the Hicks and Slutsky substitution effects of this change on the demand for good 1 and good 2?
- c) Recall that the price of good 2 has risen from  $p_2 = 1$  to  $p'_2 = 3$ . Calculate the compensating variation (CV) and equivalent variation (EV) of this change.

## Question 2

John has a utility function  $U(X, Y) = XY$ , and an income of 4. If the prices of  $X$  and  $Y$  change from  $(p_x = 1, p_y = 1)$  to  $(p'_x = 2, p'_y = 1)$ , what are the Compensating Variation and the Equivalent Variation?



## Question 3

There are two types of food in the canteen, rice noodles ( $x$ ) and stewed beef ( $y$ ). Suppose John's utility function is given by  $U(x, y) = x^{0.7}y^{0.3}$  and his optimal consumption bundle is  $(0.7, 0.3)$ . The relative price  $p_x/p_y$  is equal to what?

## Question 4

A firm uses two inputs: labor ( $L$ ) and capital ( $K$ ). The wage rate  $w > 0$  and rental rate  $r > 0$ . For each of the production function, go through the following four steps:

Step 1 : With  $L$  on the horizontal axis and  $K$  on the vertical axis, sketch a typical isoquant and indicate at least two points.

Step 2 : Discuss returns to scale.

Step 3 : In the short run, capital is fixed at  $K = \bar{K}$ . Solve the firm's short-run cost minimization problem to get conditional labor demand  $L_s^*(w, r, y | \bar{K})$  and cost function  $c_s(w, r, y | \bar{K})$ .

Step 4 : In the long run, both labor and capital are variable. Solve the firm's long-run cost minimization problem to get conditional input demands  $(L^*(w, r, y), K^*(w, r, y))$  and cost function  $c(w, r, y)$ .

a)  $f(L, K) = L^2 + K^2$

b)  $f(L, K) = \begin{cases} 2L & \text{if } L \leq K \\ L + K & \text{if } L > K \end{cases}$

## Question 5

It is known that a consumer's demand function for milk is

$$x = 10 + \frac{y}{10p}.$$

Here  $x$  is the amount of milk consumed in a week,  $y = 120$  dollars is income, and  $p = 3$  dollars (per barrel). Now let's say the price of milk goes from 3 dollars to  $p = 2$  dollars.

- a) What is the total effect of the price change on the consumer's demand? (How much will his milk consumption change?)
- b) Please calculate the Slutsky substitution effect of price change. (Hint: How much money will the consumer save if he maintains his consumption level? How much money does he now use for the original utility?)
- c) Please calculate the Slutsky income effect of price change.

## Question 6

The utility function of a consumer is  $u(x_1, x_2) = x_1^2 x_2$ . Let  $p_1$ ,  $p_2$ , and  $m$  denote the price of good 1, the price of good 2 and the income, respectively.

- a) If  $m$  is 24,  $p_1$  is 1,  $p_2$  is 1, and now  $p_1$  rises to 2, find the Slutsky substitution effect and income effect of this consumer with respect to good 1.
- b) Find the corresponding Hicks substitution effect and income effect.

## Question 7

Suppose a consumer consumes only two kinds of goods. He buys  $x_1 = 5$ ,  $x_2 = 10$  when  $p_1 = 10$  and  $p_2 = 5$ . Now,  $p_1$  is down to 8 and  $p_2$  is up to 6.

- Does the consumer's standard of living increase or decrease after the price change?
- Why is that?

**Thanks!**