Problem Set #3-Key

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Economics 305-Intermediate Microeconomic Theory

Suppose that you consume only two goods pizza (X) and beer (Y). Your budget on pizza and beer is $120 per month. The price of pizza is $3.00 per slice and the price of beer is $1.50 per beer.

(1) What is the largest possible number of pizza slices you could consume in a month given your budget?

120/3 = 40 slices of pizza.

(2) What is the largest possible number of beers you could consume in a month given your budget?

120/1.50 = 80 beers.

(3) If you purchased 30 slices of pizza in a given month, how many beers could you buy?

30(3) = $90. 120-90=30. 30/1.50 = 20 beers.

(4) If you purchased X units of pizza in a given month, what is the formula for the number of beers (Y) you could buy?

Solve the budget constrain for Y.

$I = P_X X + P_Y Y$

$P_Y Y = I - P_X X$

$Y = I/P_Y - P_X/P_Y X$

(5) Show graphically the budget constraint for pizza and beer. Be sure to correctly label all relevant points.

Figure 1

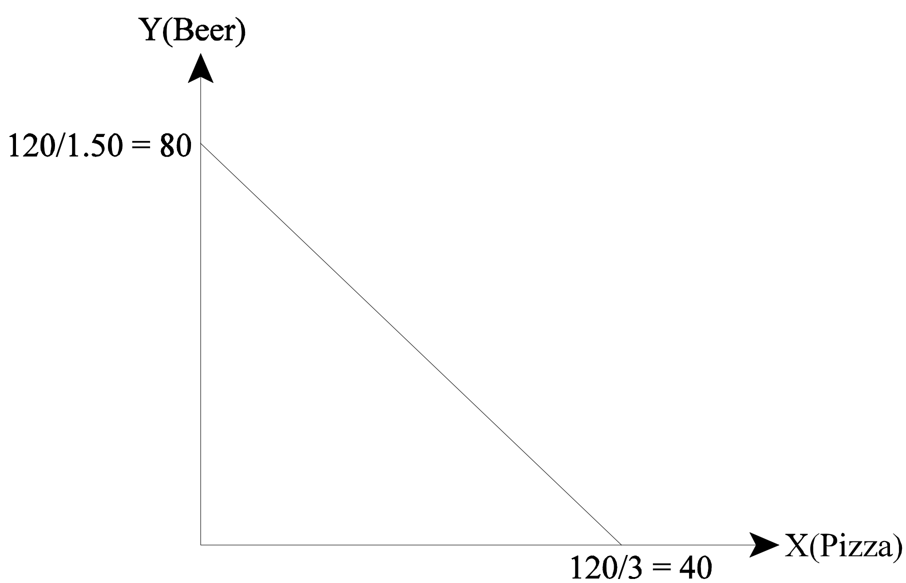


Figure 2

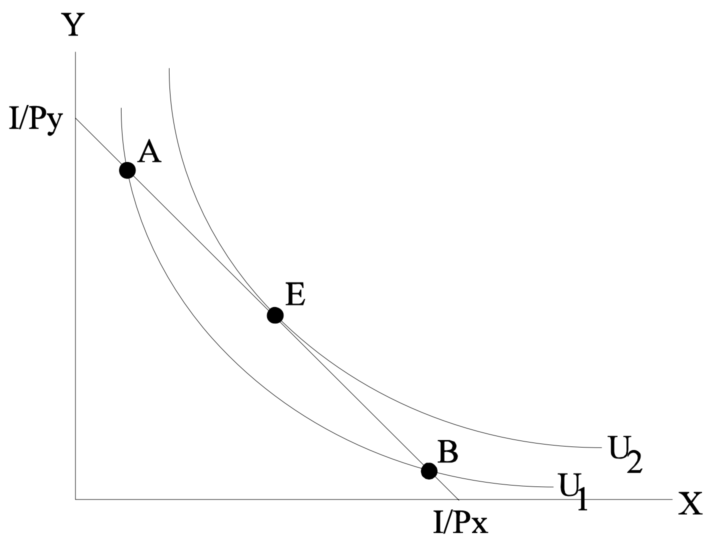


Figure 2 shows the budget constraint and indifference curves for a typical consumer.

(6) Show that the slope of the budget constraint is equal to $-P_x / P_y$.

Use the formula for the slope of a straight line using the X and Y intercepts as the two points i.e., $(0, I/P_y)$ and $(I/P_x, 0)$.

$$\frac{\Delta Y}{\Delta X} = \frac{Y_2 - Y_1}{X_2 - X_1} = \frac{0 - \frac{I}{P_y}}{\frac{I}{P_x} - 0} = \frac{\frac{I}{P_y}}{\frac{I}{P_x}} = \frac{I}{P_y}\frac{P_x}{I} = \frac{P_x}{P_y}$$

(7) Demonstrate that at the equilibrium level of consumption, point E in Figure 2, the equilibrium condition MRS= P_x/P_y is equivalent to the utility maximizing rule $MU_x/P_x = MU_y/P_y$. Explain fully.

This can easily be shown algebraically. Since MRS=MU_X / MU_Y substitute into the equilibrium condition: $MU_X / MU_Y = P_x/P_y$. Multiply each side by MU_Y and divide each side by P_x gives $MU_x/P_x = MU_y/P_y$.

(8) Why is point A in Figure 2 not an equilibrium (i.e., utility maximizing) consumption bundle? How should income be reallocated to maximize utility? Explain fully.

At point A, MRS > P_X / P_Y, or alternatively $MU_x/P_x > Mu_y/P_y$, which means that a dollars spent on X provides greater marginal utility than Y, thus the consumer should increase her consumption of X and decrease her consumption of Y. As consumption of X increases its marginal utility decreases so that the ratio (MU_x/P_x) decreases. Likewise, while consumption of Y decreases its marginal utility increases so that the ratio (MU_y/P_y) increases. The consumer should keep reallocating until $MU_x/P_x = MU_y/P_y$.

(9) Why is point B in Figure 2 not an equilibrium (i.e., utility maximizing) consumption bundle? How should income be reallocated to maximize utility? Explain fully.

At point B, MRS < P_X / P_Y, or alternatively $MU_x/P_x < MU_y/P_y$, which means that a dollars spent on Y provides greater marginal utility than X, thus the consumer should increase her consumption of Y and decrease her consumption of X. As consumption of Y increases, its marginal utility decreases so that the ratio (MU_y/P_y) decreases. Likewise, while consumption of X decreases its marginal utility increases so that the ratio (MU_x/P_x) increases. The consumer should keep reallocating until $MU_x/P_x = MU_y/P_y$

(10) Show that the equilibrium consumption bundle is invariant to a proportional change in prices and income.

This can be demonstrated by showing that a doubling of price and income will not change the consumers choice set.
$2I/2P_x = I/P_x$ and $2I/2P_y = I/P_x$

Figure 3

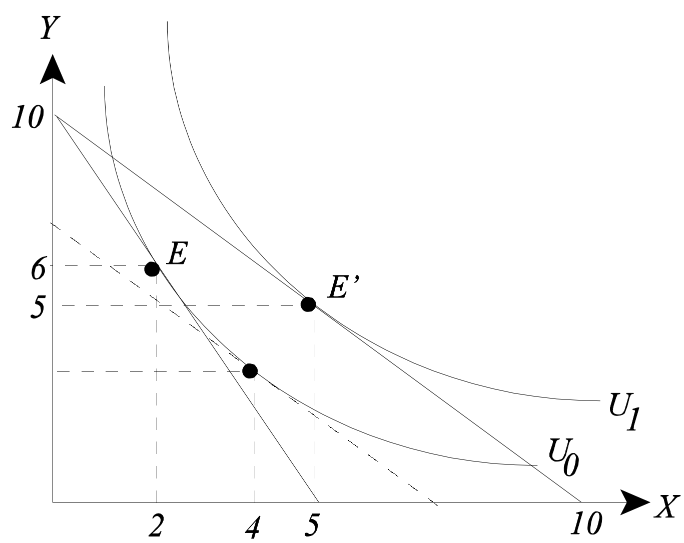


Figure 3 shows an equilibrium consumption bundle at point E when the price of X is P_X=\$6 per unit and the price of Y is P_Y=\$3 per unit. Suppose the price of X falls to \$3 per unit, with equilibrium at E'.

(11) What is the consumers income at the equilibrium consumption bundle E ?

To show income, multiply price by quantity to get I=6(\$3)+2(\$6)= \$30. Recall that the equilibrium condition requires that income is exhausted.

(12) What is the consumers income at the equilibrium consumption bundle E'?

Since only price has changed, income is still \$30. I=5(\$3)+5(\$3)=\$30

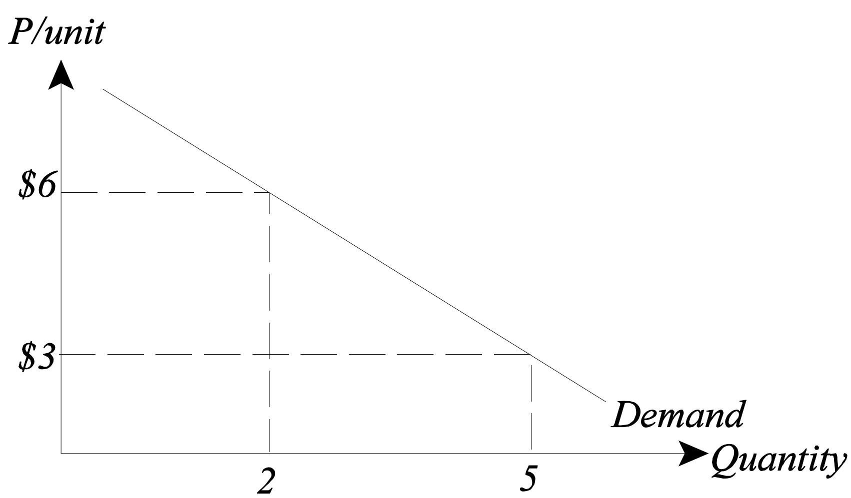
(13) Identify the substitution effect of the price change.

The substitution effect is the movement from 2 to 4 units of good x along the original indifference curve U_1 .

(14) Identify the income effect of the price change. Is good X a normal good or an inferior good?

The income effect is the shift from 4 to 5 units of good X illustrating that good X is a normal good.

(15) Derive the equation for a linear demand curve for good X from the information in Figure 3. Show graphically.



Given the two points, derive the equation for a linear demand $Q^D = a - bP$

Use the formula for the slope of a straight line using the X and Y intercepts as the two points i.e., $P_1Q_1 = (3,5)$ and $P_2Q_2 = (6,2)$.

$$b= \frac{\Delta Q}{\Delta P} = \frac{Q_2 - Q_1}{P_2 - P_1} = \frac{2-5}{6-3} = \frac{-3}{3} = 1$$

$a = 5 + 1(3)=8$

$Q^D = 8 - P$

(16) Suppose a consumer's marginal rate of substitution of Y for X is 5 (that is $MU_x / MU_y = 5$) the price of X is \$9.00 per unit and the price of Y is \$2.00 per unit. Is this consumer spending too much of her income on Y. Explain your answer and show graphically.

Using the utility maximizing condition, you can see that $MU_x / MU_y = 5 > P_X / P_Y = 9/2$, which indicates that this consumer spending too much of her income on Y. To increase her utility she should spend more on X and less on Y.

(17) Suppose that a rational consumer consumes only two goods X and Y. Assume that her marginal rate of substitution of Y for X is given by the following formula:

$$MRS = MU_x / MU_y = Y/X$$

That is the consumers MRS is simply equal to the ratio of the number of units of Y consumed to the number of units of X consumed. Assume that the consumers income is \$100, the price of X is \$5 per unit and the price of Y is \$10 per unit. What is the equilibrium quantity of X and Y consumed?

HINT: Use the equilibrium conditions to solve the problem i.e.,

(1) $MRS = P_x / P_y$
(2) $I = P_x X + P_y Y$

From the first equilibrium condition we know that Y/X=5/10 or that Y=(1/2)X.
Substitute this into the second equilibrium condition and solve for X:
100=5X+10((1/2)X)=> X=10 units.
Substituting this into Y=(1/2)X=>Y=5 units.
The utility maximizing bundle 10 units of X and 5 units of Y.