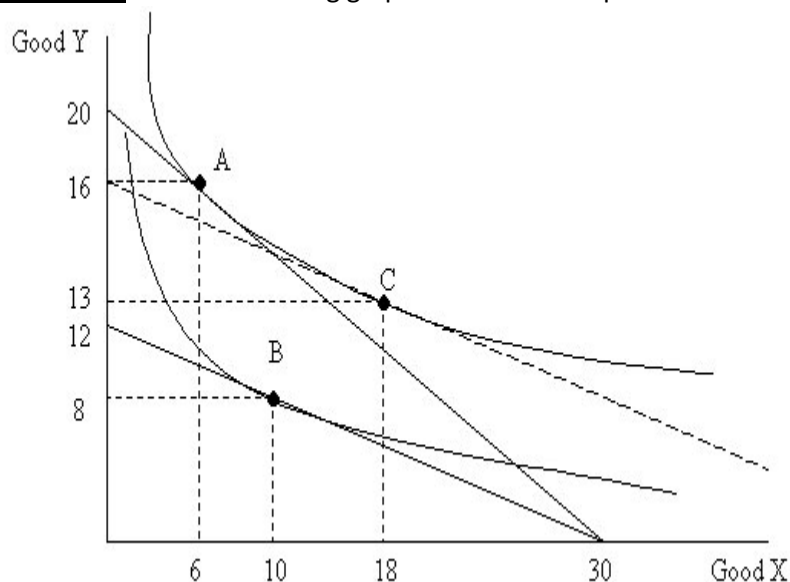


Problem 1: Use the following graph to answer the questions.

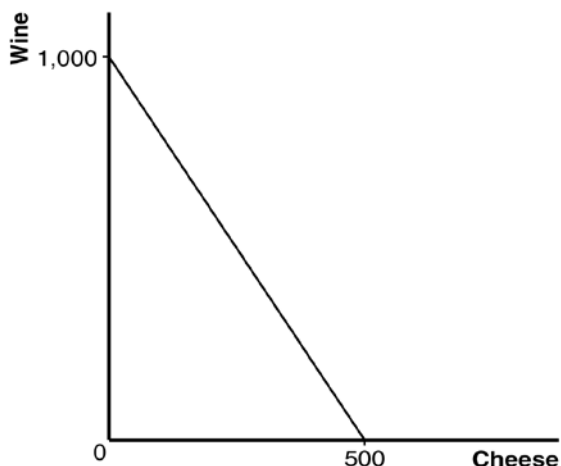


- From the graph, which good has the price change? Did the price go down or up? What is the fraction of the new price relative to the original price?
 The price of good Y has risen because the budget line moves in. Since the intercept indicates I/P_y , $P_y^2/P_y^1 = (I/P_y^1) / (I/P_y^2) = 20 / 12 = 5/3$.
- Using the points A – C, explain what movement shows the substitution effect, the income effect, and the price effect (total effect).
 The substitution effect is shown by the movement from A to C. The income effect is C to B. The price effect is A to B.
- Is good X a normal good or an inferior good? Is good Y a normal good or an inferior good?
 Both of good X and Y are normal since both income effects are negative in response to income decline.
- Derive the condition that good X becomes an inferior good. (i.e. X is an inferior good if x-value of point B is {less, more, equal to} than ____.) Derive the same condition for Y.
 X is an inferior good if x-value of point B is more than 18. Y is an inferior good if y-value of point B is more than 13.
- From the graph, are X and Y complements or substitutes? Explain.
 They are substitutes since the quantity demanded for good X went up in response to the price increase of good Y.

Problem 2: Income and Substitution Effects

A consumer has income of \$3,000. Wine costs \$3 a glass, and cheese costs \$6 a pound.

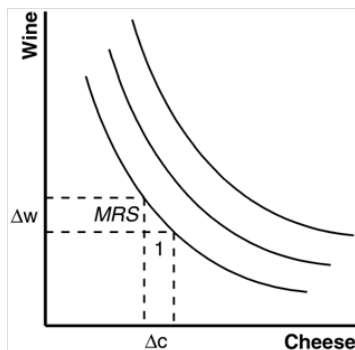
- (a) Draw his budget constraint (put cheese on the horizontal axis). What is the slope of her budget constraint?



The intercept on the horizontal axis shows how much cheese the consumer could buy if she bought only cheese; with income of \$3,000 and the price of cheese \$6 a pound, she could buy 500 pounds of cheese. The intercept on the vertical axis shows how much wine the consumer could buy if she bought only wine; with income of \$3,000 and the price of wine \$3 a glass, she could buy 1,000 glasses of wine. With cheese on the horizontal axis and wine on the vertical axis, the budget constraint has a slope of $-1,000/500 = -2$.

- (b) Consumer's indifference curves for wine and cheese are shown on the graph below. Use this graph to describe and explain the four properties of the indifference curves.

Figure 2 shows a consumer's indifference curves for wine and cheese. Four properties of these indifference curves are:



- (1) Higher indifference curves are preferred to lower ones because more is preferred to less
- (2) Indifference curves are downward sloping because if the quantity of wine is reduced, the quantity of cheese must increase for the consumer to be equally happy
- (3) Indifference curves do not cross because a consumer prefers more to less
- (4) Indifference curves are bowed inward because a consumer is more willing to trade away wine if she has a lot of it and less willing to trade away cheese if she has little of it.

(c) Given the prices of wine and cheese, what would be the marginal rate of substitution at the point that corresponds to the optimal consumption choice? What does the marginal rate of substitution tell us?

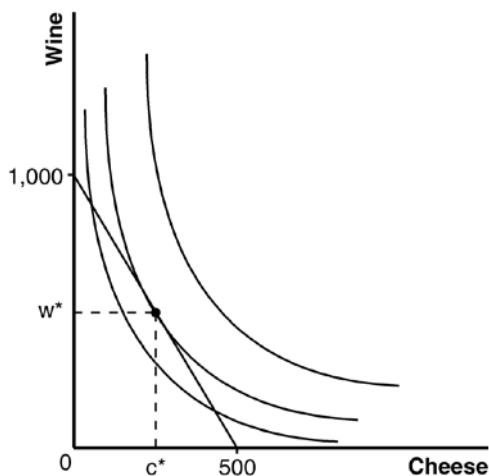
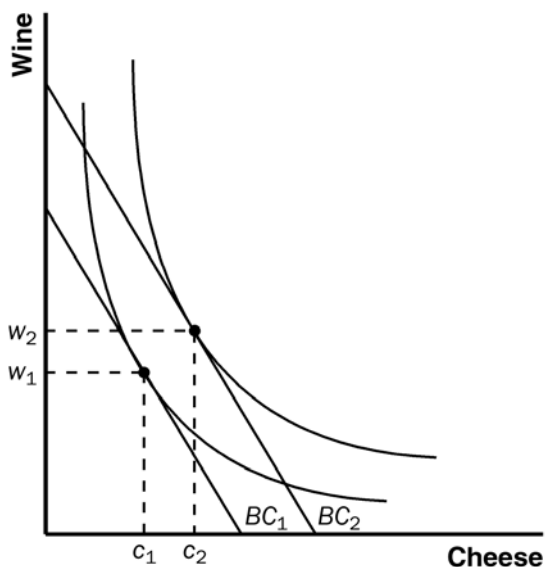


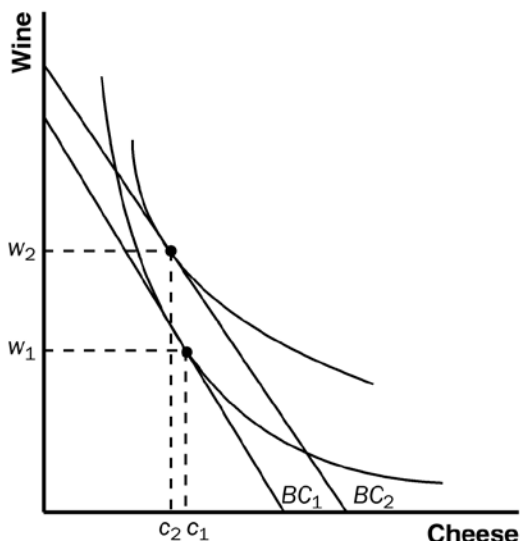
Figure 3 shows the consumer's budget constraint and indifference curves for wine and cheese. The consumer's optimum consumption choice is shown as w^* and c^* . Because the marginal rate of substitution equals the relative price of the two goods at the optimum, the marginal rate of substitution is $\$6/\$3 = 2$. In Figure 2, the marginal rate of substitution (MRS) of one point on an indifference curve is shown. The marginal rate of substitution shows the amount of wine the consumer would be willing to give up to get one more pound of cheese.

(d) A person who consumes wine and cheese gets a raise, so his income increases from \$3,000 to \$4,000. Show what happens if both wine and cheese are normal goods.

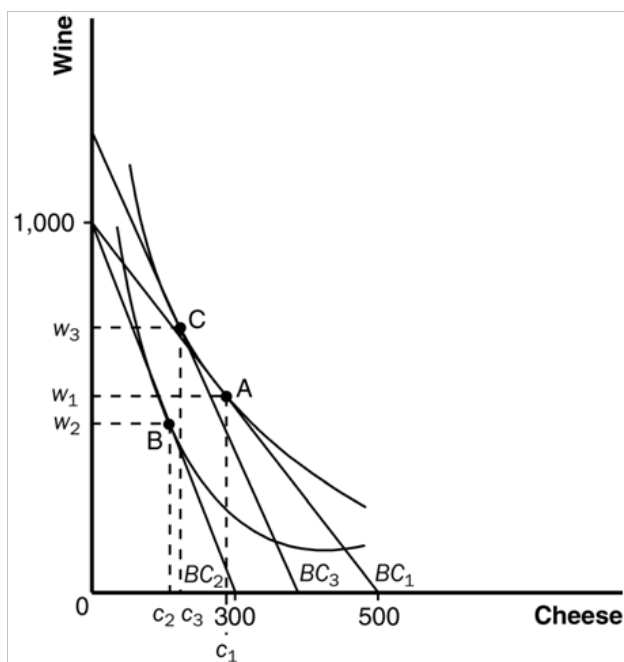


The effect of an increase in income. The rise in income shifts the budget constraint out from BC_1 to BC_2 . If both wine and cheese are normal goods, consumption of both increases. If cheese is an inferior good, the increase in income causes the consumption of cheese to decline, as shown in Figure 5.

(e) Now show what happens if cheese is inferior good.



(f) The price of cheese rises from \$6 to \$10 a pound, while the price of wine remains \$3 a glass. For a consumer with a constant income of \$3,000, show what happens to consumption of wine and cheese. Decompose the change into income and substitution effects.



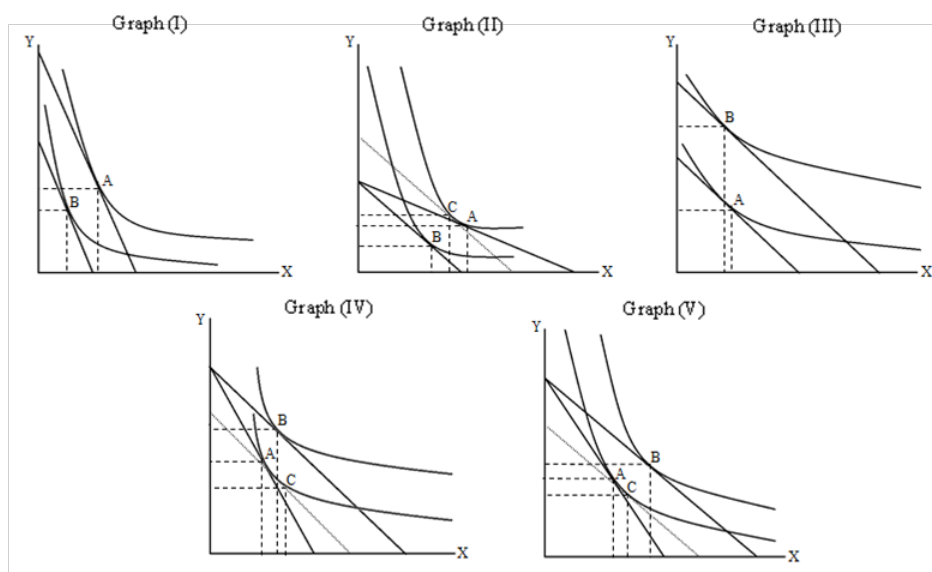
A rise in the price of cheese from \$6 to \$10 a pound makes the horizontal intercept of the budget line decline from 500 to 300, as shown in Figure 6. The consumer's budget constraint shifts from BC_1 to BC_2 and her optimal choice changes from point A (c_1 cheese, w_1 wine) to point B (c_2 cheese, w_2 wine). To decompose this change into income and substitution effects, we draw in budget constraint BC_3 , which is parallel to BC_2 but tangent to the consumer's initial indifference curve at point C. The movement from point A to C represents the substitution effect. Because cheese became more expensive, the consumer substitutes wine for cheese as she moves from point A to C. The movement from point C to B represents an income effect. The rise in the price of cheese results in an effective decline in income.

(g) Can an increase in the price of cheese possibly induce a consumer to buy more cheese? Explain.

An increase in the price of cheese could induce a consumer to buy more cheese if cheese is a Giffen good. In that case, the income effect of the rise in the price of cheese induces the consumer to buy more cheese because cheese is an inferior good. If the income effect is bigger than the substitution effect (which induces the consumer to buy less cheese), the consumer would buy more cheese.

Problem 3: Identifying Income and Substitution Effects

The notation below works as follows: A is the original bundle, B is the new bundle after the change, and C is the “in-between” bundle.



- (a) Of the above graphs, _____ show(s) an increase in the price of good X and _____ show(s) an increase in income. : (II); (III)
- (b) In which of the graphs is X a normal good? (I), (II) and (V)
- (c) In which of the graphs is X an inferior good? (III) and (IV)

Problem 4: Perfect Substitutes and Budget Constraints

Connie has a monthly income of \$200 that she allocates among two goods: meat and potatoes.

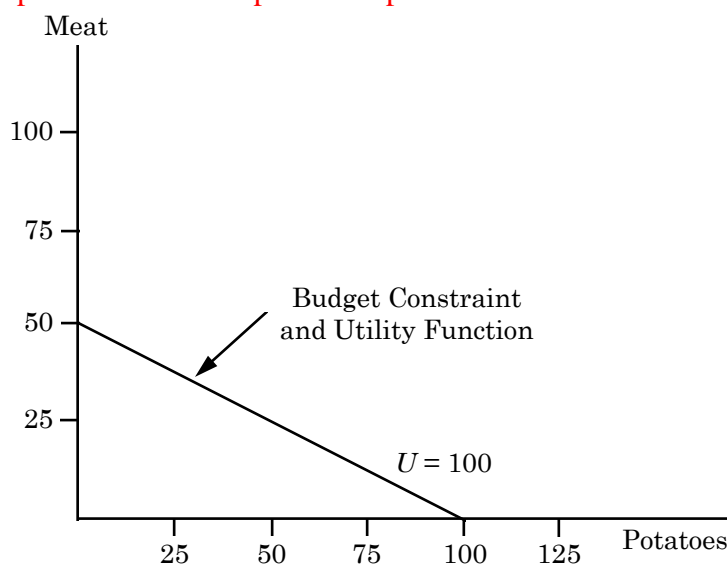
- a. Suppose meat costs \$4 per pound and potatoes \$2 per pound. Draw her budget constraint.

Let M = meat and P = potatoes. Connie's budget constraint is

$$4M + 2P = 200, \text{ or}$$

$$M = 50 - 0.5P.$$

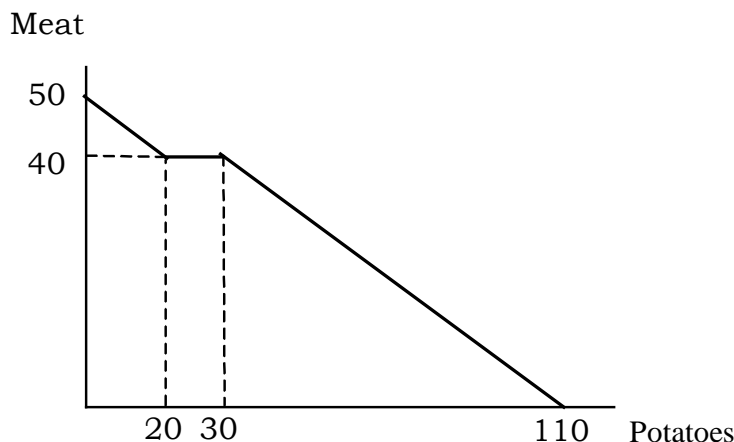
As shown in the figure below, with M on the vertical axis, the vertical intercept is 50 pounds of meat. The horizontal intercept may be found by setting $M = 0$ and solving for P . The horizontal intercept is therefore 100 pounds of potatoes.



- a. Suppose also that her utility function is given by the equation $U(M, P) = 2M + P$. What combination of meat and potatoes should she buy to maximize her utility? (*Hint*: Meat and potatoes are perfect substitutes.)

When the two goods are perfect substitutes, the indifference curves are linear. To find the slope of the indifference curve, choose a level of utility and find the equation for a representative indifference curve. Suppose $U = 50$, then $2M + P = 50$, or $M = 25 - 0.5P$. Therefore, Connie's budget line and her indifference curves have the same slope. This indifference curve lies below the one shown in the diagram above. Connie's utility is equal to 100 when she buys 50 pounds of meat and no potatoes or no meat and 100 pounds of potatoes. The indifference curve for $U = 100$ coincides with her budget constraint. Any combination of meat and potatoes along this line will provide her with maximum utility.

- b. Connie’s supermarket has a special promotion. If she buys 20 pounds of potatoes (at \$2 per pound), she gets the next 10 pounds for free. This offer applies only to the first 20 pounds she buys. All potatoes in excess of the first 20 pounds (excluding bonus potatoes) are still \$2 per pound. Draw her budget constraint.



With potatoes on the horizontal axis, Connie’s budget constraint has a slope of $-1/2$ until she has purchased twenty pounds of potatoes. Then her budget line is flat from 20 to 30 pounds of potatoes, because the next ten pounds of potatoes are free, and she does not have to give up any meat to get these extra potatoes. After 30 pounds of potatoes, the slope of her budget line becomes $-1/2$ again until it intercepts the potato axis at 110.

- c. An outbreak of potato rot raises the price of potatoes to \$4 per pound. The supermarket ends its promotion. What does her budget constraint look like now? What combination of meat and potatoes maximizes her utility?

With the price of potatoes at \$4, Connie may buy either 50 pounds of meat or 50 pounds of potatoes, or any combination in between. See the diagram below. She maximizes utility at $U = 100$ at point A when she consumes 50 pounds of meat and no potatoes. This is a corner solution.

