In class on Monday, 02/08/10, we saw a detailed example of the process of graphically showing the substitution and income effects that result from the change in the price of a good. This handout includes a number of examples of this process.

1. Intuition of Income and Substitution Effects

When the price of a good changes (in this class, only one price will change at a time), we have two effects.

The first effect, the substitution effect, is a movement away from the relatively more expensive good. We represent it as the movement between the initial optimal consumption bundle (OCB) and the point on the initial indifference curve that has a slope equal to the new ratio of prices. We graphically find it by constructing a new line parallel to the new budget constraint and tangent to the old indifference curve.

The remaining effect is the income effect. The income effect is the movement from where the substitution effect left off to the new OCB. We have an income effect because at the new prices, consumers have different purchasing power. We use our assumptions about how consumers respond to income changes here (normal, inferior goods). The income effect must take this into account. Measuring from the end of the substitution effect, to the new OCB, the normal/inferiorness of the good tells us which way to shift our graph.

Remember that we assume all goods follow the law of demand. This means that if the price of a good increases, overall consumption of that good (initial OCB vs. final OCB) will decrease; if the price of a good decreases, overall consumption of that good will increase. You must be careful when drawing the final OCB, its easy to accidentally violate the law of demand.

First I will talk about an example in which there is only a pure income effect (prices remain constant), and then we will look at a few examples in which prices are changing.
2. Example of a Pure Income Effect

In this example we are specifically looking at the information needed to identify where your new OCB will be located after a change in income occurs.

Given

- Two Goods: CD’s (Normal Good)
  Ramen Noodles (Inferior Good)
- Prices: \( P_{\text{ram}} = \$0.50 \) per pack
  \( P_{\text{CD}} = \$1.50 \) per CD
- Income: \( M = \$15 \)
- Standard Preferences

This is our current optimal consumption bundle now we want to see what happens when we increase the income of the consumer while the prices are held constant.

Now suppose the following changes

- Prices: \( P_{\text{ram}} = \$0.50 \) per pack (No Change)
  \( P_{\text{CD}} = \$1.50 \) per CD (No Change)
- Income: \( M = \$30 \)
- Standard Preferences

In this new graph you can see that I have added the new Budget Constraint (RED LINE) which is a parallel shift of the original Budget Constraint (BLACK LINE). I have also included two GREEN DOTTED LINES which break the new Budget Constraint (RED LINE) into three segments which are identified as A, B and C.

If you choose a point on the new Budget Constraint (RED LINE) in segment (A) then your new bundle would have more Ramen Noodles and fewer CD’s then the original OCB. If you choose a
point in segment (B) then you would have more of both goods compared to the optimal consumption bundle. Finally, if you chose a point along segment (C) you would have fewer Ramen Noodles and more CD’s then the original OCB.

Based on the information you were given in the problem which segment should you place you new OCB.

Since your income has increased and Ramen Noodles are an inferior good and CD’s are a normal good you should chose a bundle which as few Ramen Noodles and more CD’s which would be a point along the new Budget Constraint (RED LINE) along segment (C).

**NOTE:** I have removed the Green dotted lines but it should be clear the this graph corresponds to those drawn above.
3. Steps For Finding Income and Substitution Effects

Now we are going to look at what happens when we change one of the prices instead of income. Changing the price is slightly more complicated than only changing the income of a consumer because there is now a substitution effect which is pushing the consumer to substitute towards the cheaper good. First I will describe the steps and then we will look at a few examples.

Steps to Graphically Show Income and Substitution Effects of a Price Change:

(1) Construct Initial Budget Constraint, BC1
(2) Show Initial Optimal Consumption Bundle, OCB1
(3) Now suppose there is a change in price for one good
   (a) Draw New Budget Constraint, BC2
   (b) Show substitution effect.

   We are interested in how the price change has changed the tradeoffs between two goods. Only interested in new slope (stay on original indifference curve)
   (i) Draw a line parallel to BC2 and tangent to IC1.

   (Line parallel to BC2 represents new relationship between prices).

   NOTE: Due to the shape of the indifference curves, at a given point, all points to the left are steeper, all points to the right are flatter.

   (ii) The point tangent to this parallel line is point B.

   Vertical distance between A & B represents the change in consumption of the good on the y-axis due to the substitution effect.

   Horizontal change represents the change in consumption of the good on the x-axis due to the substitution effect.

   (c) Show ”income effect”. Plot the final Optimal Consumption Bundle (Pt. C)

   (i) Determine how consumption of each good will change from B to C.

   Note if goods are normal or inferior.
   Also note if income is ”increasing” or ”decreasing.”

   (ii) Make sure the placement of point C (compared to point A) obeys the Law of Demand.

   The Law of Demand states that the price of a good and consumption of the good are inversely related (if the price of a good increases, the consumption of that good must decrease; if the price of a good decreases, the consumption of that good must increase).

   To compare initial consumption and consumption after the price change, compare initial OCB (Point A) and the final OCB (Point C). Since the price of only one good will change, we can only compare the position of Point A and Point C along one axis (the x-axis if the price of good x changes, the y-axis if the price of good y changes).
The law of demand holds for both normal and inferior goods. This means, for an inferior good, make sure if the price of that good goes down that consumption does not go down. This does not make sense. If price of inferior good goes up, we will not buy more of it.

(iii) New optimal consumption bundle, point "C", must be on BC2 (and satisfy above conditions). Draw IC2 tangent to BC2 at point C.

The movement from point B to point C represents "income effect."

4. Examples of Income and Substitution Effects

Example #1

Lets look at the example that we did before

Given

- Two Goods: CD’s (Normal Good)
  - Ramen Noodles (Inferior Good)

- Prices: \( P_{\text{ram}} = \$0.50 \) per pack
  \( P_{\text{CD}} = \$1.50 \) per CD

- Income: \( M = \$15 \)

- Standard Preferences

Now point A will represent our original optimal consumption bundle now we want to see what happens when we change the price of one of the goods

Now suppose the following changes

- Prices: \( P_{\text{ram}} = \$1.00 \) per pack (Price Increase)
  \( P_{\text{CD}} = \$1.50 \) per CD (No Change)

- Income: \( M = \$15 \) (No Change)

- Standard Preferences

We can see the the New Budget Constraint (BLUE LINE) has rotated downward.
Now we are going to finish Step (3b).

Note the following points:

- The Blue Dotted Line (BC 3) is parallel to the Solid Blue Line (New Budget Constraint, BC 2), thus shifting from BC 3 to BC 2 can be thought of as a decrease in income.

- The movement from Point A to Point B is the substitution effect since we have moved along the same indifference curve.

- Since the price of Ramen Noodles increased and the price of CD’s remained constant then Ramen Noodles have become relatively more expensive than CD’s. Therefore, the consumer is substituting toward CD’s.
Now we are going to finish Step (3c). Which is the same as what we did in the pure income effect example.

Note the following points

- As stated above a shift from the Blue Dotted Line (BC 3) to the Solid Blue Line (BC 2) is a negative income effect or a decrease in income.

- Since Ramen Noodles are an inferior good and CD’s are a normal good our new bundle (point C) should have more Ramen Noodles and fewer CD’s compared to Point B. Thus, the shift from Point B to Point C is the Income Effect.

- Always keep in mind that the Law of Demand always holds. Since the price of Ramen Noodles has increased then the new Optimal Consumption Bundle (Point C) can not have more packages of Ramen Noodles then the original Optimal Consumption Bundle (Point A).
Example #2

Given

- Two Goods: Newspaper (Normal Good)
  Magazines (Normal Good)
- Prices: \( P_{\text{News}} = $1.00 \) per Newspaper
  \( P_{\text{Mags}} = $2.00 \) per Magazine
- Income: \( M = $10 \)
- Standard Preferences

Now point A will represent our original optimal consumption bundle now we want to see what happens when we change the price of one of the goods

Now suppose the following changes

- Prices: \( P_{\text{News}} = $1.00 \) per Newspaper
  \( P_{\text{Mags}} = $2.50 \) per Magazine
- Income: \( M = $10 \)
- Standard Preferences

We can see the the New Budget Constraint (BLUE LINE) has rotated downward.
Now we are going to finish Step (3).

Note the following points

- The Blue Dotted Line (BC 3) is parallel to the Solid Blue Line (New Budget Constraint, BC 2), thus shifting from BC 3 to BC 2 can be thought of as a decrease in income.

- The movement from Point A to Point B is the substitution effect since we have moved along the same indifference curve.

- The consumer is substituting toward the cheaper good which is Newspapers.

- Since both good are Normal goods and we have a negative income effect we should be consuming fewer of each good at Point C relative to Point B.
Example #3
Let everything thing be the same as Example #2 except that Newspapers are now inferior. The only thing that will change is Step (3c) which identifies the income effect.

Note the following points
- The movement from Point A to Point B is the substitution effect since we have moved along the same indifference curve and is exactly the same as in Example #2.

- Since Newspapers are now inferior and Magazines are still normal goods and we still have a negative income effect we should be consuming more Newspapers and fewer Magazines at Point C relative to Point B.
Example #4

Given

- Two Goods: Newspaper (Inferior Good)  
  Magazines (Normal Good)

- Prices: \( P_{\text{News}} = \$1.00 \) per Newspaper  
  \( P_{\text{Mags}} = \$2.50 \) per Magazine

- Income: \( M = \$10 \)

- Standard Preferences

Now point A will represent our original optimal consumption bundle now we want to see what happens when we change the price of one of the goods

Now suppose the following changes

- Prices: \( P_{\text{News}} = \$1.00 \) per Newspaper  
  \( P_{\text{Mags}} = \$2.00 \) per Magazine

- Income: \( M = \$10 \)

- Standard Preferences

We can see the the New Budget Constraint (BLUE LINE) has rotated downward.
Now we are going to finish Step (3).

Note the following points

- The RED Dotted Line (BC 3) is parallel to the Solid Red Line (New Budget Constraint, BC 2), thus shifting from BC 3 to BC 2 can be thought of as an increase in income.

- The movement from Point A to Point B is the substitution effect since we have moved along the same indifference curve.

- The consumer is substituting toward the cheaper good which is Magazines.

- Since Newspapers are inferior goods and Magazines are normal goods and we have a positive income effect we should be consuming fewer newspapers and more magazines at Point C relative to Point B, which is the income effect.