ECOG 6567: MANAGERIAL ECONOMICS

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THEORY OF CONSUMER BEHAVIOR

- First, we need to define the agents' goals and limitations (if any) in their ability to achieve those goals.
- We will deal with a particular set of assumptions, but we can modify them in a number of different ways.
- We will then try to infer something about the agent's behavior. The behavior is going to be a description of choices that people make as a function of the constraints they face.

GOALS

- There are three different ways of approaching the problem of consumer choice.
- The most traditional way is to suppose that there is something called **utility** or satisfaction.
- Consumers get satisfaction from engaging in certain economic activities.
- The utility function measures the amount of satisfaction that the individual gets from a market basket with *n* different commodities indexed by 1, 2,…,n

UTILITY

- **Utility** - the satisfaction or well being of an activity.
- **Utility Function** - A descriptive function that relates satisfaction or well being to the consumption or goods and services.
- *Utility = f (goods, services)*

UTILITY

- In general, we cannot empirically quantify or measure utility but…

Cardinal Utility

- The utility is measurable, and the customer can express his satisfaction in cardinal or quantitative numbers such as 1,2,3, and so on. Theoretically, we assign a measure called "utils" that means units of utility.

Ordinal Utility

- The utility can be ranked qualitatively. In this sense the satisfaction derived from various commodities cannot be measured objectively. Utility is ordered when ranked.

UTILITY

- Example:
  - Consumer surveys would like to be able to measure satisfaction using a measure of cardinal utility. Since it's impossible they attempt to measure ordinal utility for the consumption of goods and services.

TOTAL UTILITY

- Is the total satisfaction received from consuming a given total quantity of a good or service.

MARGINAL UTILITY

- The added utility derived from increasing consumption of a particular product by one unit holding the consumption of all other goods and services constant.

$$MU_x = \frac{\Delta U}{\Delta X}$$

- The amount of a good or service a consumer will consume will depend on the marginal utility of the last unit consumed relative the marginal utility of the last unit of other goods and services with the same price.

MARGINAL UTILITY

- In other words when a consumer buys a product they are buying utility. Therefore if they can get more utility for the same price buying something else they will.

- They will only buy a product until the marginal utility per dollar of that product is less than or equal to the marginal utility per dollar of buying some another product.

NOTE

- This concept of analyzing goals at the margin is something we will use throughout this course.

LAW OF DIMINISHING MARGINAL UTILITY

- As a person increases consumption of a product while keeping consumption of other products constant, there is a decline in the marginal utility that person derives from consuming each additional unit of that product.
- As we consume more, the utility we get for an added unit decreases and therefore we are not willing to pay the same amount that was paid for the last unit.
- This gives us a negative relationship between price and quantity demanded. As price increase consumer demand decrease because we are getting less utility for our money.

LAW OF DIMINISHING MARGINAL UTILITY

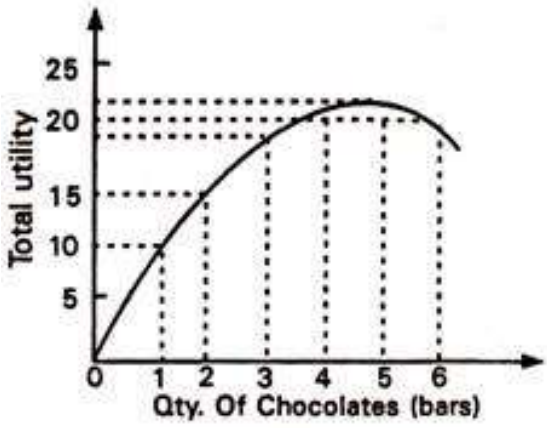


Fig. 4.1. Total Utility

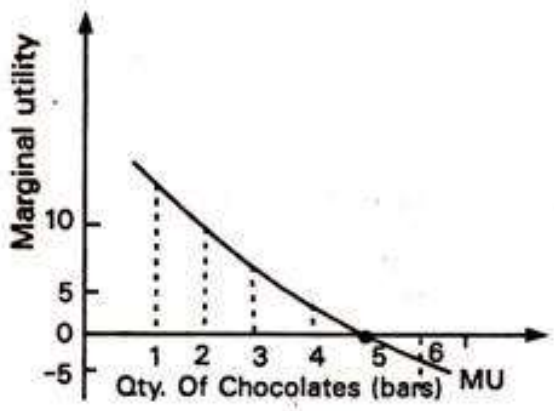


Fig. 4.2. Marginal Utility

LAW OF DIMINISHING MARGINAL UTILITY

The following table will make the law of diminishing marginal utility more clear.

Units	Total Utility	Marginal Utility
1st glass	20	20
2nd glass	32	12
3rd glass	40	8
4th glass	42	2
5th glass	42	0
6th glass	39	–3

MAXIMIZING UTILITY EXAMPLE

Consider the following data describing the change in Johnny's utility when he consume various levels of apples and grapefruit. The price of apples is $0.50, and the price of grapefruit is $1.00.

Q apples	TU Apples	MU	MU/$	Q Grapefruit	TU Grapefruit	MU	MU/$
0	0	-	0	0	0	-	0
1	10	10	20	1	25	25	25
2	18	8	16	2	40	15	15
3	25	7	14	3	53	13	13
4	30	5	10	4	63	10	10
5	34	4	8	5	68	5	5
6	37	3	6	6	71	3	3
7	39	2	4	7	73	2	2
8	40	1	2	8	74	1	1

MAXIMIZING UTILITY EXAMPLE

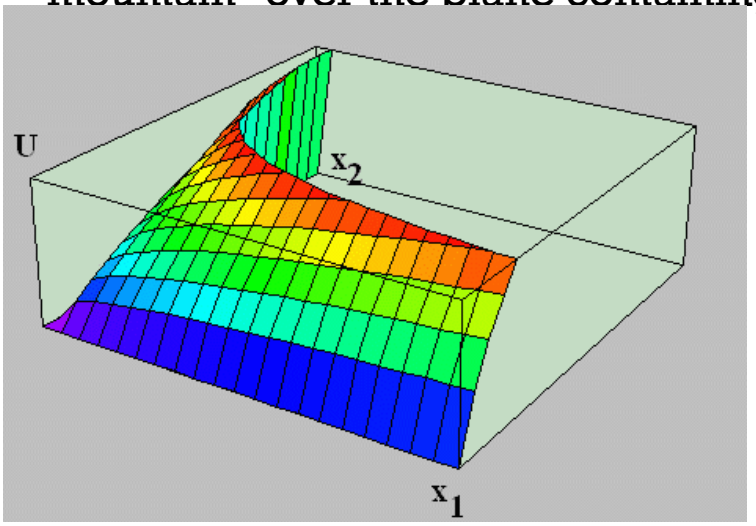
- Johnny's mother sends him to the store with $6.00 to spend on apples and grapefruits, and says "Son, spend all the cash and be sure to maximize your utility". What will Johnny purchase? Explain.
  - Consumers try to spend the limited money they have on what will give them the greatest amount of satisfaction. The optimal consumption rule is where a consumer maximizes utility in the face of a budget constraint is when the marginal utility per dollar spent on each good or service in the consumption bundle is the same.
  - There are two combinations of apples and grapefruits where $\frac{MU_{apples}}{P_{apples}} = \frac{MU_{grapefruits}}{P_{grapefruits}}$.
    - 4 apples and 4 grapefruit (marginal utility per dollar = 10 for each)
    - 8 apples and 7 grapefruit (marginal utility per dollar = 2 for each)
  - However, only the first of these is within Johnny's budget. Four apples and four grapefruit costs Johnny $2 + $4 = $6. So, then he's maximizing its utility with this combination.

CONSUMER CHOICE

- The decision to consume a product depends on the relative utility of other products that are available to consume. In other words, we substitute goods and services for another.
- Although there are many goods and service to choose from, the general theory of consumer choice can be analyzed with two products.
- The goal of the agent would then be to choose that bundle giving the greatest level of satisfaction or utility.
- We can make further assumptions regarding utility. I may assume that it's monotone, i.e. at any point in the space if I move northeast, I am better off (more is better).
- Under certain circumstances we may wish to relax this assumption – there is a limit to how much cherry vanilla ice cream I can enjoy at a single sitting!

CONSUMER CHOICE

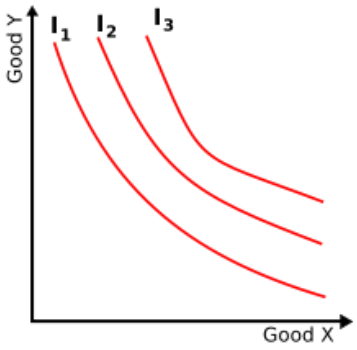
- With two different commodities, if we draw a utility function as a height in a three dimensional space, we get a "mountain" over the plane containing the different bundles.



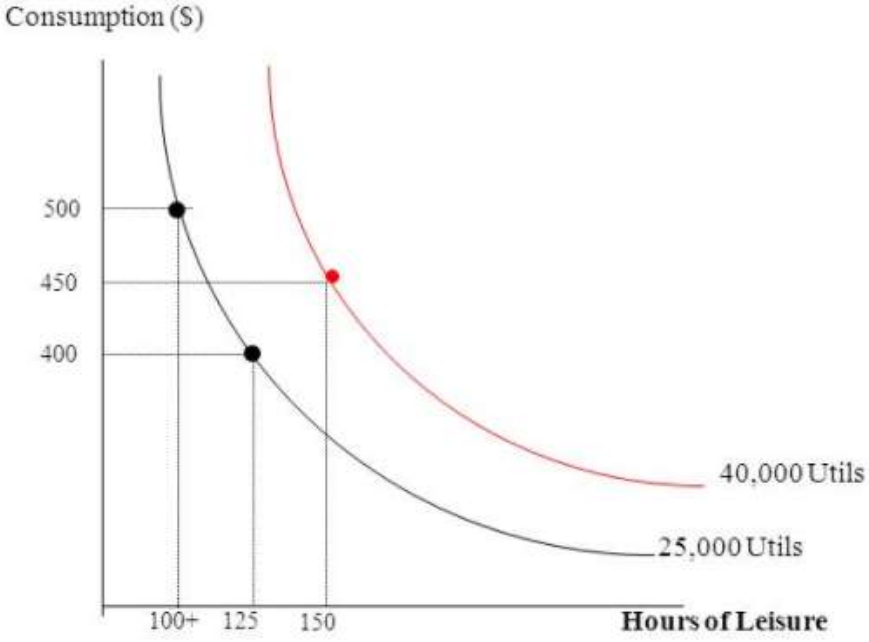
INDIFFERENCE CURVE

- In a two-dimensional drawing, we can "slice" the "mountain" at a certain height and obtain a line connecting all points that give you the same level of utility. That line would be called an indifference curve. There are an infinity number of indifference curves.

- **Indifference curve** – is a curve that identifies all combinations of goods and services that provide the same utility. Since all points provide the same utility the consumer is indifferent between any combination of product X and Y that are on the same indifference curve.



INDIFFERENCE CURVES



MARGINAL RATE OF SUBSTITUTION

- The rate at which a consumer can give up some amount of one good in exchange for another good while maintaining the same level of utility. At equilibrium consumption levels (assuming no externalities), marginal rates of substitution are identical.
- The marginal rates of substitution will be the same regardless of the direction of exchange, and will correspond to the slope of an indifference curve.

MARGINAL RATE OF SUBSTITUTION

- The ratio at which I am willing to trade one good for another is the **marginal rate of substitution (MRS).** If I give up one unit of good 1, how much utility do I lose? I lose a level of utility equal to U_1. How many units of good 2 do I need to make up for that loss of utility? I need $\frac{U_1}{U_2}$.

- The **MRS** is the slope of the indifference curve at a certain point. It says how much of good 2 I can give up if I get one more unit of good 1 and I want to stay on the same indifference curve.

- For example, if $U_1 = 10$ and $U_2 = 5$and I give up a unit of good 1, I loose 10 units of utility and I need 2 units of good 2 to make up for the 10 units of lost utility.

- MRS is usually not constant but diminishes as the amount of substitution increases. Therefore, indifference curves are usually convex.

MARGINAL RATE OF SUBSTITUTION

- The slope of indifference curve: $MRS = \frac{\Delta Y}{\Delta X}$

- A change in utility is equal to the marginal utility times to change in the product consumed.

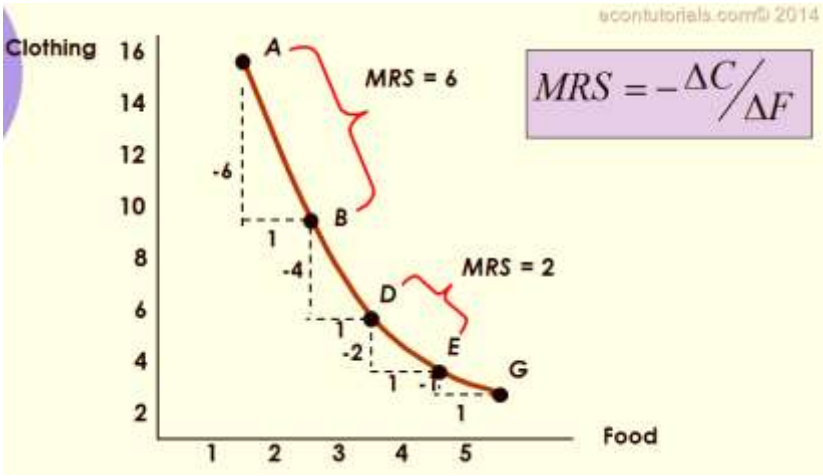
$$\Delta U = MU_x \times \Delta X$$
$$\Delta U = MU_y \times \Delta Y$$

- Therefore, if we keep utility constant the change in utility will equal zero (ΔU=0). This means that the change in utility from a change in one variable must be offset with an opposite change in other variable. We can then set one equation equal to the other times -1.

$$MU_x \times \Delta X = -(MU_y \times \Delta Y)$$

$$\frac{\Delta Y}{\Delta X} = -\frac{MU_x}{MU_y}$$

The slope of the indifference curve is negative



LAW OF DIMINISHING MARGINAL RATE OF SUBSTITUTION

- Usually when we draw an indifference curve, we make an assumption that the goods have a diminishing MRS. As I move along the indifference curve and I get more of good 1 and less of good 2, the relative value of good 1 declines.

LAW OF DIMINISHING MARGINAL RATE OF SUBSTITUTION

- The law of diminishing returns tells us that as we consume more of a product the utility we receive decreases.

- MRS is usually not constant but diminishes as the amount of substitution increases. Therefore indifference curves are usually convex. If the MRS is constant the indifference is a straight line (substitute).

EXAMPLES OF INDIFFERENCE CURVES

- If two goods are **perfect substitutes** then the indifference curves will have a constant slope since the consumer would be willing to switch between at a fixed ratio. The marginal rate of substitution between perfect substitutes is likewise constant. Here the MRS does not depend on how much of goods I am consuming.
  - Example of perfect substitutes:
    - A unit of good 1 always exchange for two units of good 2 along an indifference curve.
    - In most dishes, it doesn't matter if you cook with corn oil or sunflower oil.
    - Apple juice and orange juice.

EXAMPLES OF INDIFFERENCE CURVES

- If two goods are **perfect complements** then the indifference curves will be L-shaped. The marginal rate of substitution is either zero or infinite. Here one good is only useful with the other one.
  - Example of perfect complements:
    - The left shoes compared to right shoes.
    - The consumer is no better off having several right shoes if she has only one left shoe – additional right shoes have zero marginal utility without left shoes.

EXAMPLE OF INDIFFERENCE CURVES

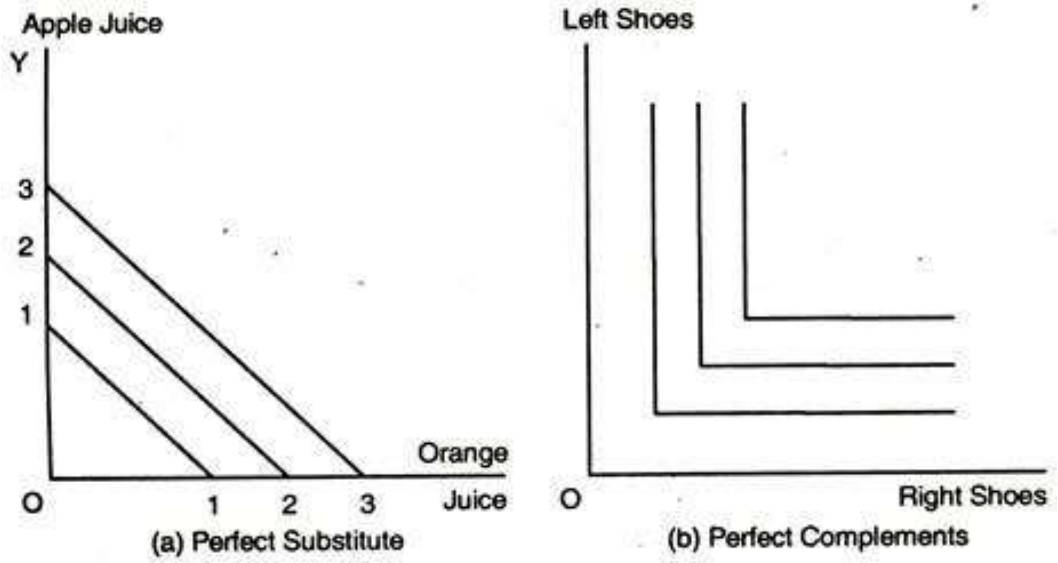
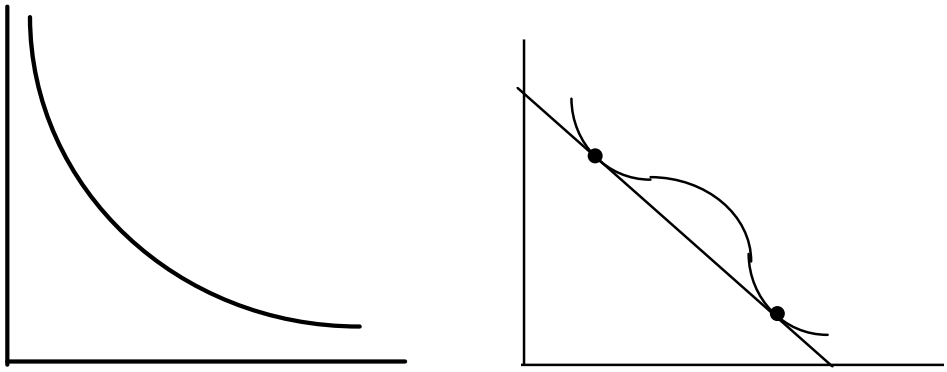


Fig. 4.6

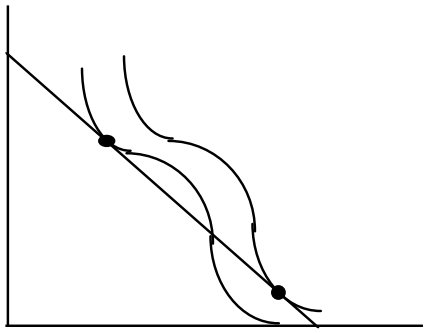
FIRST AND SECOND ORDER CONDITIONS

- Diminishing marginal utility means that the indifference curves bow inward like in the figure on the left.
- However, I can have an indifference curve that bows inward and still have a maxima given my budget constraint. But if I do not have diminishing marginal rate of substitution, I might not have a unique maxima (see picture on the right).



FIRST AND SECOND ORDER CONDITIONS

- If the indifference curve looks like those below, then there are two points on the budget line where the MRS equals the ratio of prices. However, both are not maxima. One is clearly on a higher indifference curve than the other.

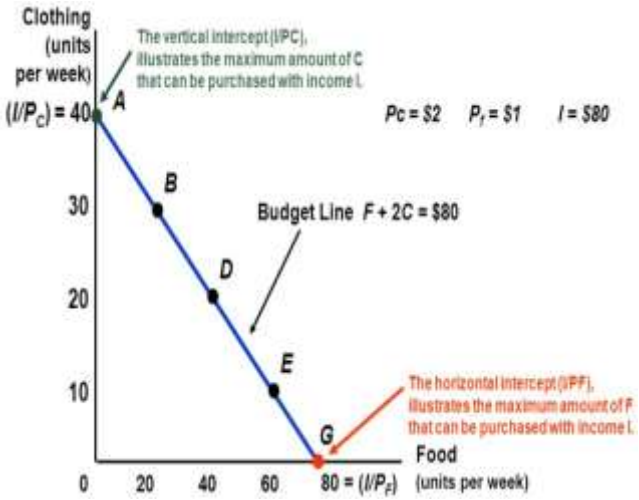


- The FOC, namely that the MRS equals the ratio of prices, is a necessary but not sufficient condition for utility maximization.

BUDGET LINE

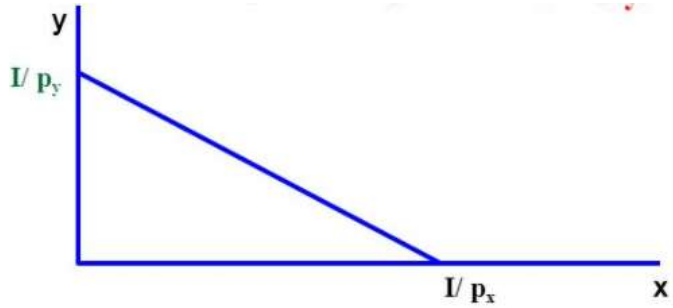
- Depicts the consumption bundles that a consumer can afford.
  - People consume less than they desire because their spending is constrained, or limited, by their income (budget).

- $Budget(Income) = \sum p_i x_i$
- In the two product model it is:
  - $I = p_x\, x + p_y\, y$
  - $y = \frac{I}{p_y} - \frac{p_x * x}{p_y} = \frac{I}{p_y} - \left(\frac{p_x}{p_y}\right) x$
- The slope is $-\frac{p_x}{p_y}$.



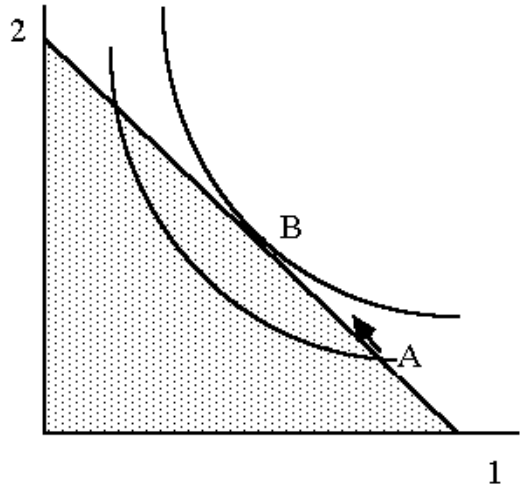
BUDGET LINE

- If I spend all my income, then where $I = p_x\, x + p_y\, y$, I can afford anything on that budget line or below. The slope of this budget line tells me how many more units of good 2 can I buy if I buy 1 unit less of good 1. Another way of saying this is that this is the opportunity cost in terms of good 2 of consuming a unit of good 1. At the corners where $\frac{I}{p_x}$ and $\frac{I}{p_y}$ I spend all my income on only one good.



INDIVIDUAL'S DECISION PROBLEM

- Given preferences and given the constraints, the individual wants to get the highest level of satisfaction or highest indifference curve possible (by assumption).



BUDGET LINE AND INDIFFERENCE CURVES

- Now that we have both the indifference curve and the budget line of the consumer we can figure out the consumption basket that will give the consumer the most utility.
- This will occur where the budget line is tangent to the highest indifference curve. (The point where the two curves are tangent will be where the consumer will receive the highest level of utility given is budget.) Tangency means that the slopes of the two curves must be equal.

$$\frac{\Delta Y}{\Delta X} = -\frac{p_x}{p_y} = -\frac{MU_x}{MU_y}$$

BUDGET LINE & INDIFFERENCE CURVE

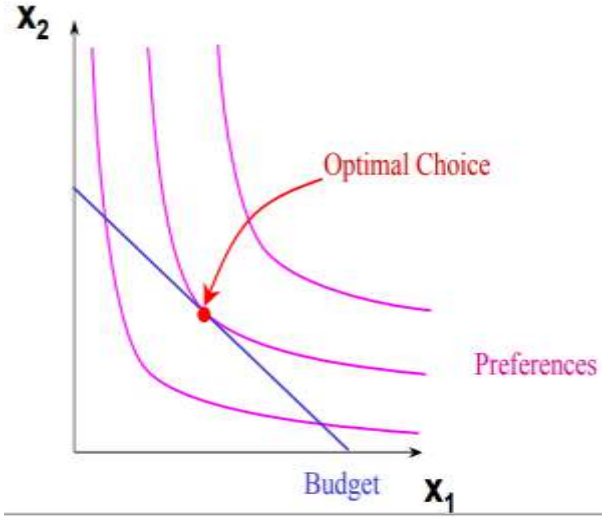
- At point A, I know that $\frac{U_1}{U_2} < \frac{p_1}{p_2}$ (since the indifference curve $\frac{U_1}{U_2}$ is flatter and the budget line $\frac{p_1}{p_2}$ is steeper). In other words, the MRS is less than the opportunity cost.
- $\frac{U_1}{U_2}$ is the amount of good 2 that I need in order to replace a unit of good 1, and $\frac{p_1}{p_2}$ is how much of good 2 I can buy if I give up a unit of good 1.
- This tells me that if I give up a unit of good 1, I can get more of good 2; this will provide more utility than the utility lost from consuming one fewer unit of good 1. This means that I could do better by consuming less of good 1 and more of good 2. I can increase my utility by giving up some of good 1, moving in the direction of the arrow until I reach point B.
- At point B, we have $\frac{U_1}{U_2} = \frac{p_1}{p_2}$, and the budget line and indifference curve are tangent. In that case I could not do better by moving in any direction.

HAM & EGGS EXAMPLE

- In other words, if I face fixed prices, I am going to adjust the amounts of goods I consume until at the margin. I value the goods myself in the same way as their opportunity cost. I am going to adjust my consumption of ham and eggs until I value ham and eggs in the same way market does.
- After everybody adjusts their consumption to spend their money on ham and eggs optimally, everybody will end up valuing ham and eggs the same way margin. (Remember that we are dealing only with two goods).
- People will achieve this in different ways. Some people will achieve this by consuming a lot of ham and very little of eggs, and some will need to spend equal amounts of each: however, at the margin everybody will value ham and egg in the same way. My MRS between ham and eggs is the same as yours since we face the same prices.

CONSUMER EQUILIBRIUM

- Assumptions:
  - There are two goods i.e. commodity X_1 and commodity X_2.
  - The consumer's preference scale for combination of two goods is exhibited by indifference map.
  - The prices of goods are given and remain constant.
  - The consumer has a given income which sets to limits to his maximizing behavior.

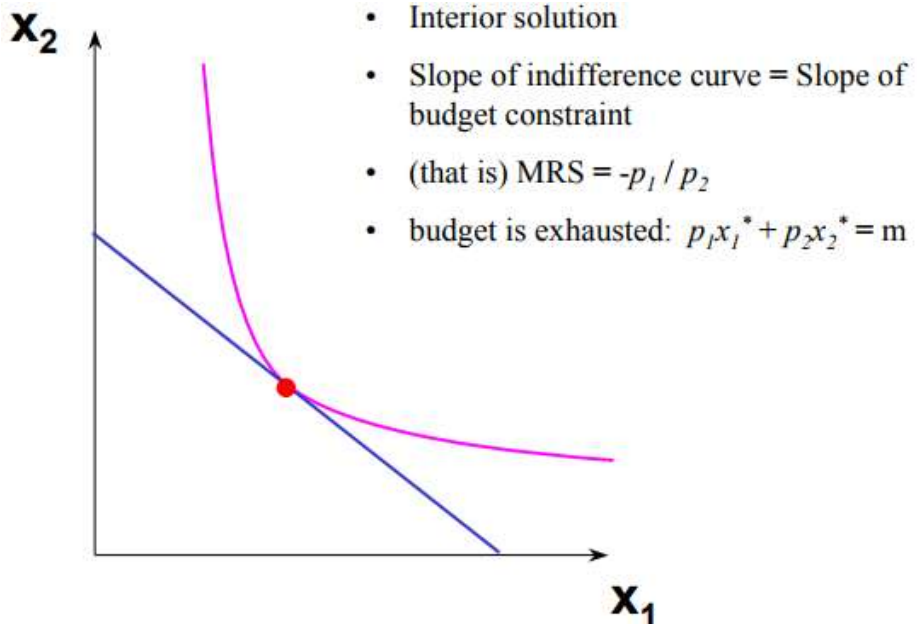


Conditions for consumer's equilibrium

A given budget line must be tangent to an indifference curve, or the marginal rate of substitution between commodity X and commodity Y (slope of indifference curve) must be equal to the price ratio between the two goods (the slope of budget line). This is $MRS_{x,y} = -\frac{p_x}{p_y}$, but because slope of indifference curve are negative, at optimal point $MRS_{x,y} = \frac{p_x}{p_y}$.

At the point of equilibrium, indifference curve must be convex to the origin.

CHARACTERISTICS OF OPTIMAL CHOICE



- Interior solution
- Slope of indifference curve = Slope of budget constraint
- (that is) MRS = $-p_1 / p_2$
- budget is exhausted: $p_1 x_1^* + p_2 x_2^* = m$

CONSUMER EQUILIBRIUM

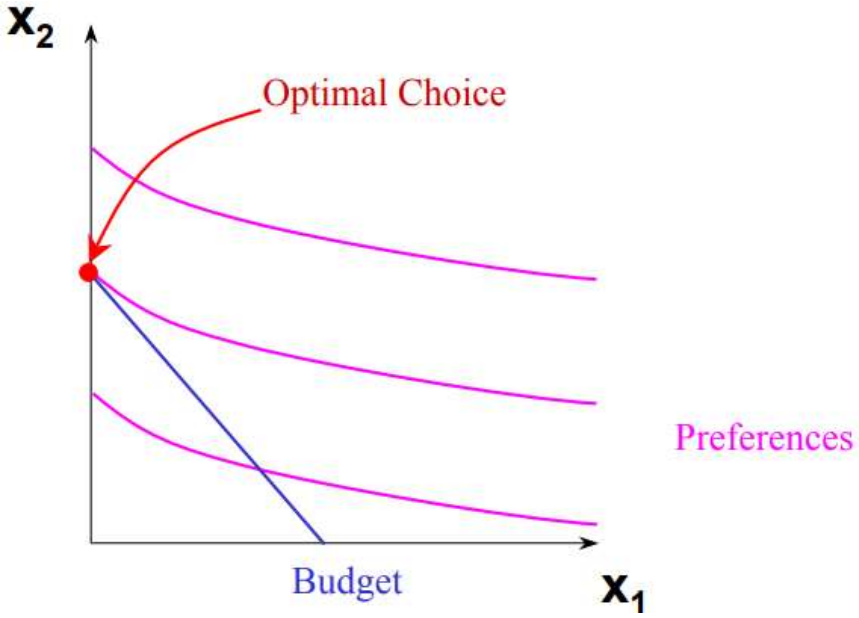
- In the past example of Johnny maximizing the $6 his mother gave him to buy apples and grapefruits at the optimal choice:

$$MRS_{a,g} = \frac{p_a}{p_g} = \frac{0.50}{1} = 0.50 = \frac{1}{2}$$

CORNER SOLUTION

- Is a special solution to an agent's maximization problem in which the quantity of one of the arguments in the maximized function is zero. In non-technical terms, a corner solution is when the chooser is either unwilling or unable to make a tradeoff. Individual's preferences may be such that they can maximize utility by choosing to consume only one of the goods.
  - Example:
    - If the agent's best available choice is at constraint – e.g among affordable bundles of good X and good Y the agent prefers quantity zero of good X – that choice is often not at a tangency of the indifference curve and the budget line, but at a "corner".

CORNER SOLUTION



CORNER SOLUTION

- When we have an interior solution, $\frac{p_x}{p_y} = \frac{U_x}{U_y}$ must be satisfied. However, sometimes a consumer gets highest utility level when $x = 0$ or $y = 0$. If that's the case, we have corner solutions, and

$\frac{p_x}{p_y} \neq \frac{U_x}{U_y}$.

- Conditions for corner solutions:
  - $MRS = \frac{U_x}{U_y} > \frac{p_x}{p_y}$ when $y = 0$
  - $MRS = \frac{U_x}{U_y} < \frac{p_x}{p_y}$ when $x = 0$

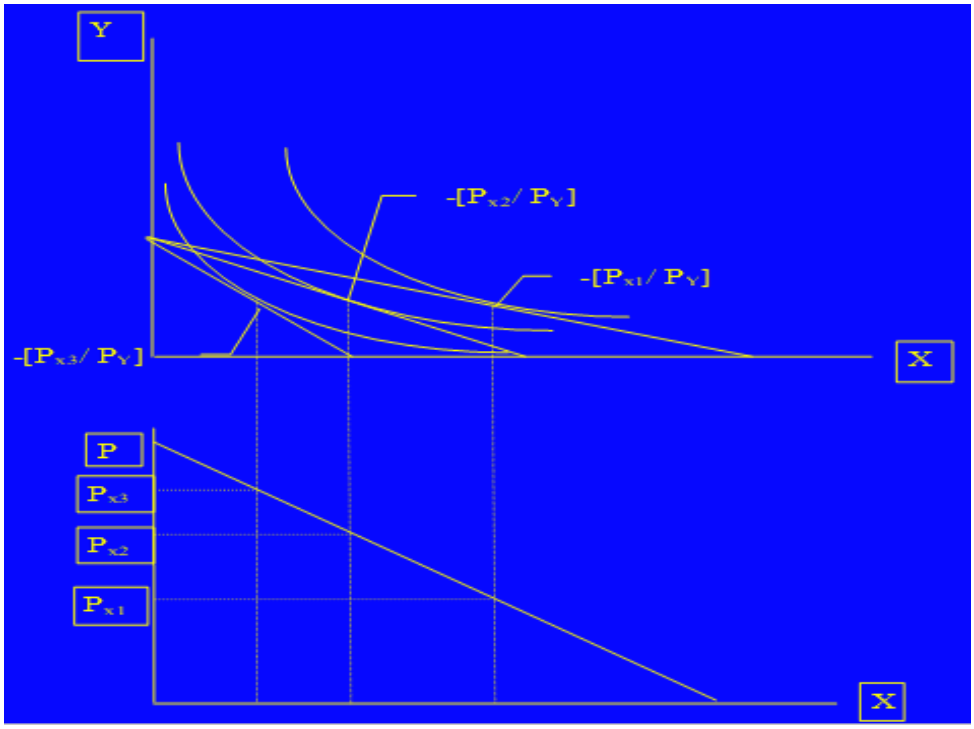
CORNER SOLUTION

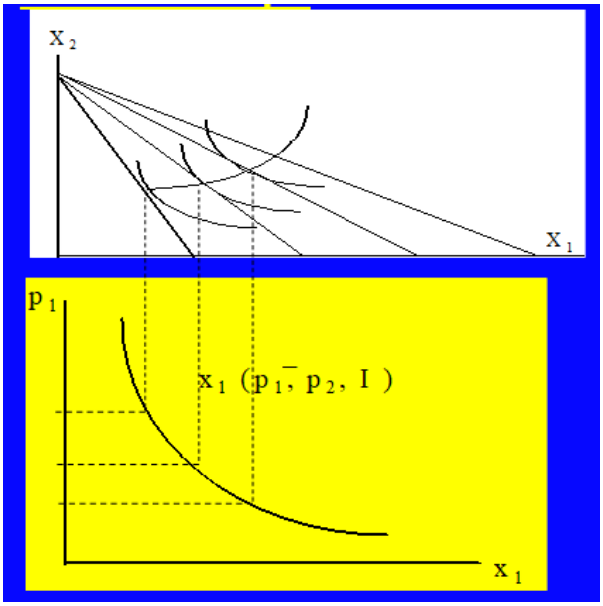
- The best this person can do is to consume at point A. However, at that point the slopes are not equal $\left(\frac{U_x}{U_y} < \frac{p_x}{p_y}\right)$. The market would give me more of good 2 for a unit of good 1 than I need to be just as well off. So I should give some of good 1 and get more of good 2, but I have no good 1 to offer. So for all goods that the individual consumes in **positive** amounts, the individual values them at the same rate ratio as the market prices.

DEMAND CURVE DERIVATION

- Holding the price of one of the products constant we can derive a demand curve for the other product.

- Holding the price of Y constant and letting the price of X vary, we can see that the amount of X demanded decreases as the price increases.


Y
-[Px2/ PY]
-[Px1/ PY]
-[Px3/ PY]
X
P
Px3
Px2
Px1
X


X2
X1
p1
x1 (p1, p2, I)
x1

THE INCOME AND SUBSTITUTION EFFECT

- When the price of a product changes the consumer is effected in two ways:

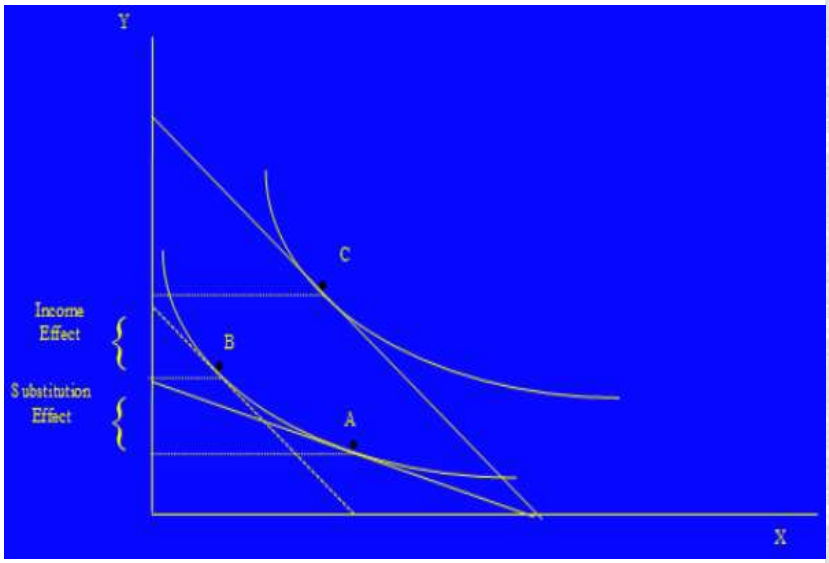
1. The amount the consumer is able to buy changes, this has the same effect as changing the consumers income and is therefore called the **income effect**.
2. The price relative to other goods in the economy has changed. This will cause the consumer to **substitute** one good for another. If the good in question become cheaper than substitute goods the consumer will consumer more of that good. If the good becomes more expensive, the consumer will consume less of the good in question and more of other substitute goods.

THE INCOME AND SUBSTITUTION EFFECT

- **Income effect** - Shift to a new indifference curve following a change in aggregate consumption cause by a price change.

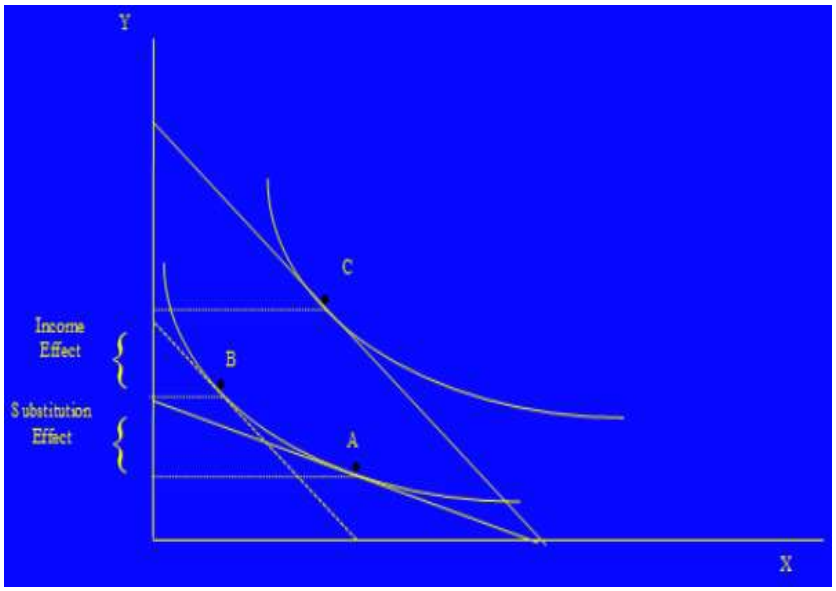
- **Substitution effect** - Movement along an indifference curve reflecting the substitution to cheaper products from more expensive ones.

- Both these effect cause movements along the demand curve.



THE INCOME AND SUBSTITUTION EFFECT

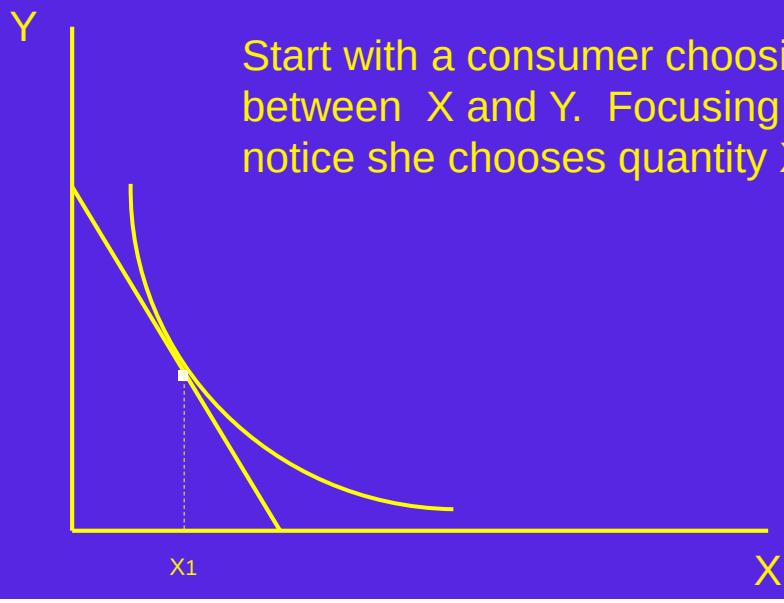
- Consider the graph.
- Starting at point *A*, consider a decrease in the price of *Y* so that we could buy more *Y* if we choose.
- The consumer will now consume more Y. Part of this is attributable to the fact that he can buy more Y, the remainder is attributable that Y is now cheaper compared to X

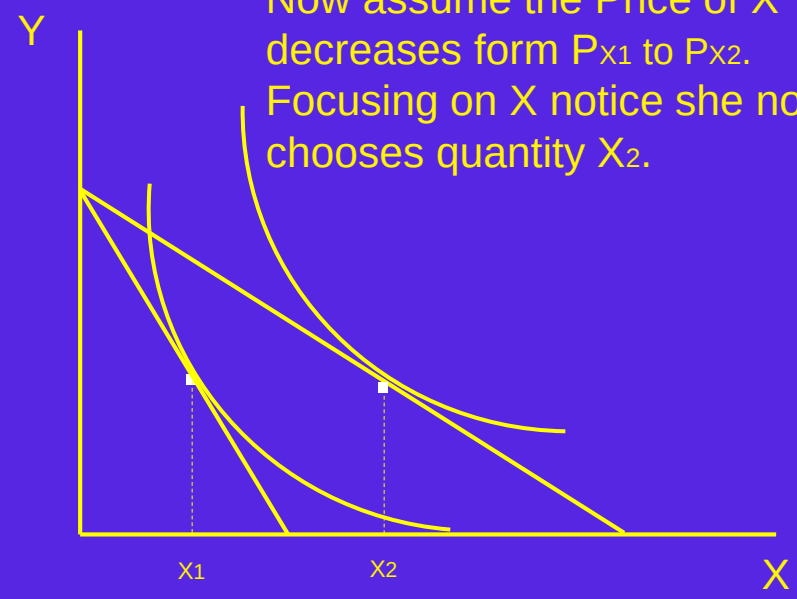


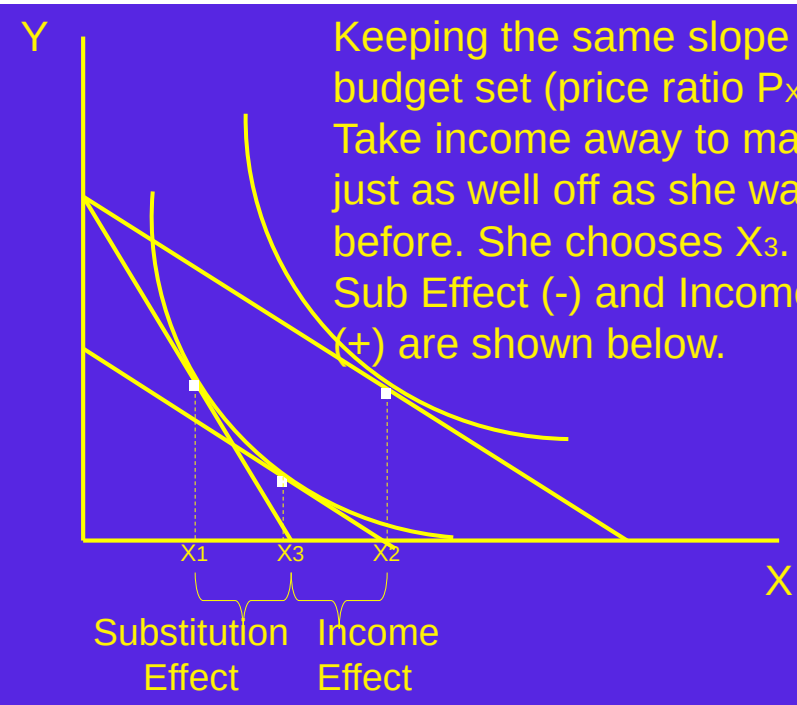
THE INCOME AND SUBSTITUTION EFFECT

- The price of *X* relative to *Y* has changed, the substitution effect is that change in the consumption of both goods using the new price ratio but that will keep the consumers utility unchanged. In other words, a decrease in price acts just like a change in the income of a consumer, the substitution effect captures the relative shift from one good to the other simply because relative prices have changed and the income has not increase. On the graph point *A* to point *B*.
- The income effect is the rest of the total movement.

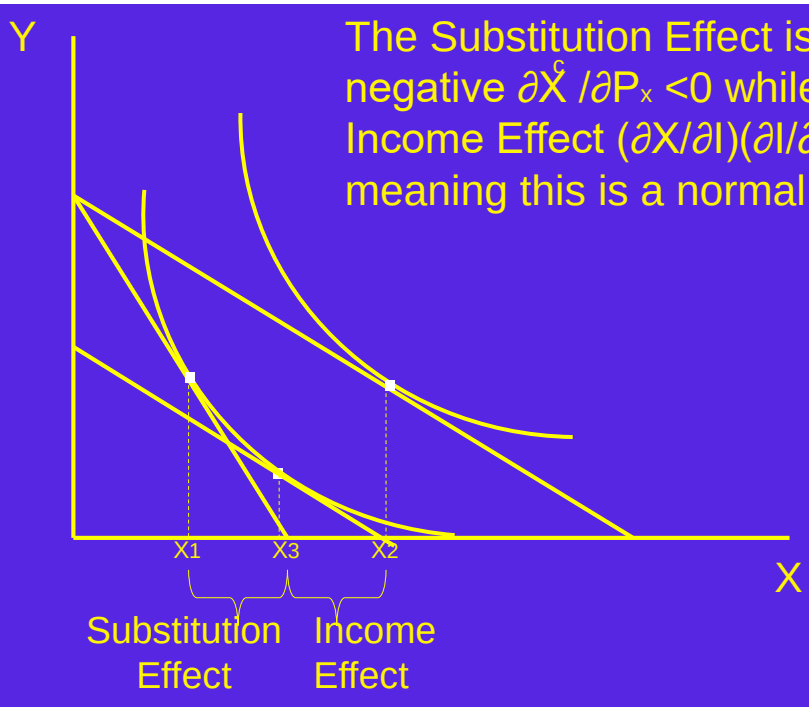
Lets go step by step but this time lets analyze the good on the horizontal axis.







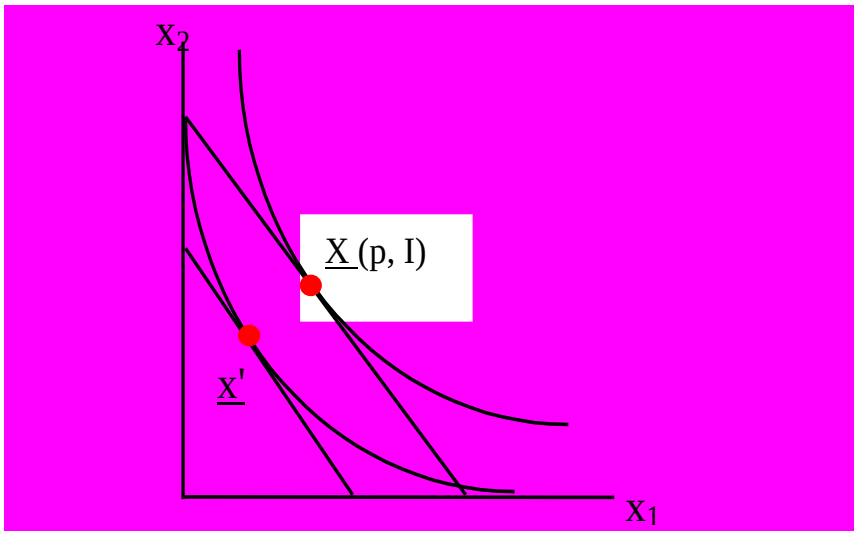
Keeping the same slope for the budget set (price ratio P_{X2}/P_Y) Take income away to make her just as well off as she was before. She chooses X_3. The Sub Effect (-) and Income Effect (+) are shown below.



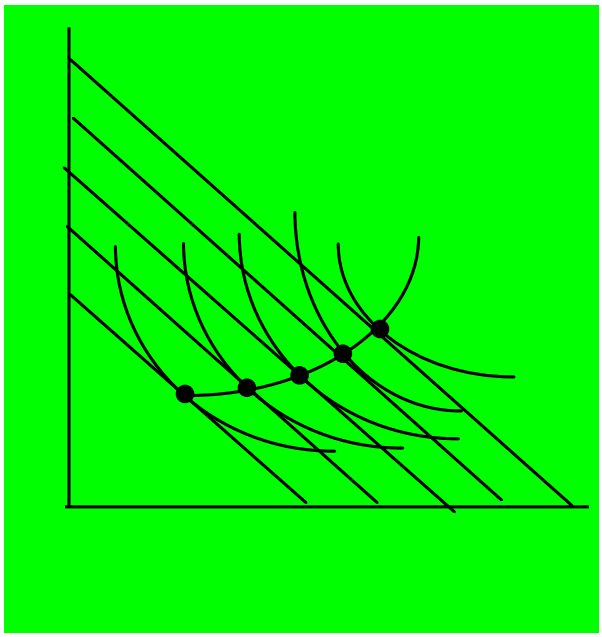
The Substitution Effect is always negative $\partial X^{c}/\partial P_x < 0$ while the Income Effect $(\partial X/\partial I)(\partial I/\partial P_x) > 0$, meaning this is a normal good.

EFFECTS OF CHANGES IN INCOME

- After we maximize an individual's utility subject to a constraint, we end up with a choice that the individual makes. Below the choices under the lower-income and higher-income budget sets are X' and X, respectively.



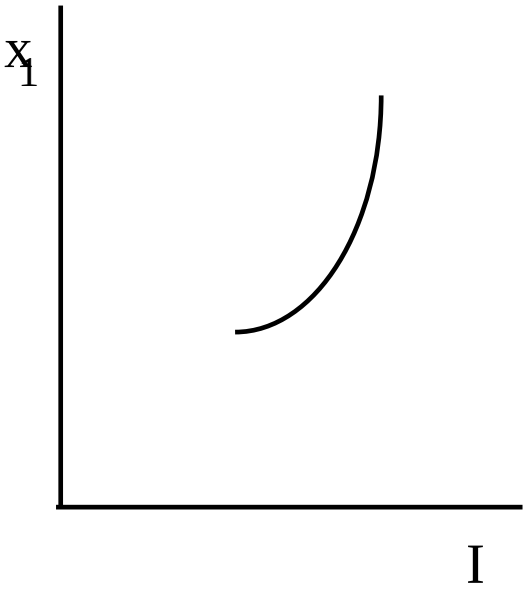
EFFECTS OF CHANGES IN INCOME



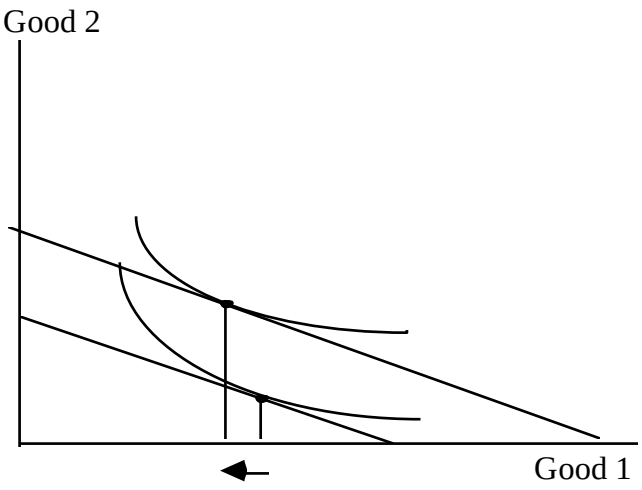
- If we change prices or income, we change the highest point that the individual can reach. For example if we have less income, the new budget line would be parallel but lower, and the new choice would be X' .
- If we want to infer something about how demand behavior changes when we alter the income constraint (and keeping prices constant) we get a graph like this.
- In this figure x_1 is measured on the horizontal axis, and x_2 is measured on the vertical axis. Therefore we can see the demand for a good at each level of income. If we connect all such points, we get an **income consumption (or expansion) path**.

ENGEL CURVE

- Associated with this, I can draw the **Engel curve** where I have income on the horizontal axis and the demand for, say the first good, on the vertical axis. The Engel curve is basically the demand for a good as a function of income, holding all else constant.



- Holding prices constant, if we increase the level of income and the consumption of the good increases, we call it a **normal good** (for example, good 1 in in the graph on the last slide). However, if when income increases the consumption of the good decreases, we call it an **inferior good.** (For example, good 1 in the figure).



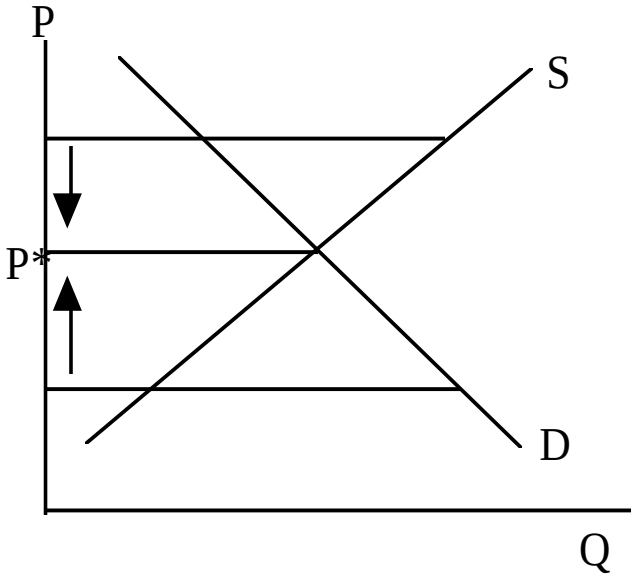
NORMAL AND INFERIOR GOOD

- Some examples of inferior goods, are things that allow us to stay alive without spending much money (such as Spam). If our income increases we switch to a good that we like better but that we could not afford before.

- **A note on assumptions:** Two people, with different assumptions about the way the world is set up, can look at the same data and come up with widely different conclusions. We need to remember that the assumptions that we make affect the conclusions we reach even if the data we work with does not change. The assumptions we make as well as the models we work with will affect the conclusions we reach.

- On the other hand, there is no way of looking at data or facts about the world without having some theoretical model --some way of organizing that data-- in your thoughts. You have to have some idea of the way things go together in order to be able to make sense of the data that you look at.

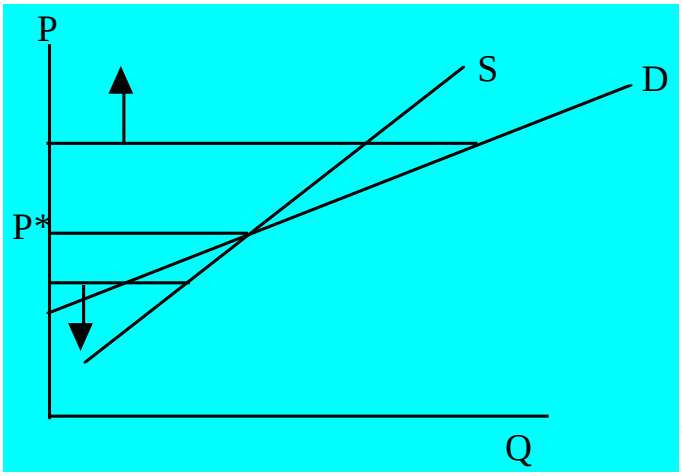
COULD DEMAND CURVES SLOPE UPWARDS?



- Keep in mind that we have to play with the rules of the game. The rules say that utility just depends on the physical amount of the goods consumed and that price does not enter the utility function. Therefore, an example in which I get utility from a good just because it is more expensive violates the assumptions of the model we are working with.

- This is an important question because one thing that economist like to do is **comparative statics**.

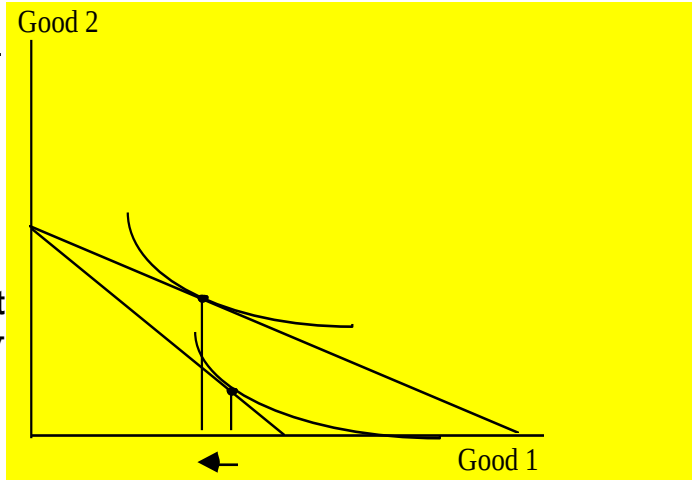
DEMAND AND SUPPLY CURVES



- We want to focus on P* as the outcome from this market. We justify it with the following story: if price is greater than P*, there would be an over supply of the good and that would push the price down. If we are below that price, there would be an excess demand and that would push the price up.
- However, if the demand curve looked differently, an over supply could push prices down and an over demand could push prices up (see figure).

DEMAND AND SUPPLY CURVES

- In this case, P* is still the price in equilibrium, but it is not the price that other prices converge to.
- Downward sloping demand curves and upward sloping supply curves give us a sufficient condition for this type of stability property.
- *Have we made any assumptions that allow us to conclude that individual demand curves could slope upwards?* Suppose we have the following case:



DEMAND AND SUPPLY CURVE

- When the price of good 1 goes down, I am relatively richer so I buy more of good 2. And since good 1 is an inferior good, as the price of good 1 goes down, we become relatively richer so we buy less of it.
- Imagine that there are two goods: rice and meat. I would like to be getting all of my food from meat. However, meat is very expensive and rice is very cheap. I am so poor that if I tried to buy only meat I could not keep myself alive. So I buy mostly rice.
- If the price of rice falls, I could buy as much rice as I did before and have a little left for additional meat. I could even buy less rice that I did before and spend all of the difference on meat and be better off than I was before.

DEMAND AND SUPPLY CURVES

- In conclusion, we can see this behavior if:
  1. We are dealing with an inferior good;
  2. We spend most of our income on it; and
  3. There is no close substitute.

- The things we have talked about so far are local properties of the demand function. They are descriptions about what is happening to this function at a particular point. For example, a good could be a Giffen good for some prices and a normal good for others.

- A good whose quantity demanded increases as its price increases is called a **Giffen good** (sometimes this is referred to as the Giffen's paradox). A Giffen good must be an inferior good, but an inferior good is not necessarily a Giffen good.