

Math Recitation #3– October 6, 2009

**Math-related review topics for midterm:**

1. Income and substitution effects
2. Supply and demand
3. Elasticity
4. Utility maximization
5. Derivatives

**Income + Substitution Effects**

These two effects relate to behavioral responses when there is a **price change** of one of the goods being considered.

- Income effect describes how ‘rich’ or ‘poor’ we feel overall in response to this price change. If the price of either one of our goods goes up, we feel poorer, we effectively have less earning power than before. If the price of either one of our goods goes down, we feel richer. We effectively have more earning power than before.
- Substitution effect describes how we might change our choices *between* the two goods we can buy. If the price of hamburgers goes up, we are going to want to buy fewer hamburgers and more broccoli. We can get much more broccoli now for our money than hamburgers, so our optimizing bundle will change and shift towards more broccoli.

**Price of hamburgers goes up:**

	Hamburgers	Broccoli
Substitution Effect	Negative (-)	Positive (+)
Income Effect	Negative (-)	Negative (-)
Net Effect	Negative (-)	???

## ***General concepts and tips to keep in mind for midterm:***

### **Supply + Demand**

If you're given a demand curve with Q on the left side, Q is your vertical axis variable and P is your horizontal axis variable. The coefficient on P is the slope of this line.

However, convention dictates that we put Q on the horizontal axis. We need to reorder the equation we are given so P is isolated on the left side. When we plot this line, this line's slope will be the inverse (flipped) of what it was in the equation with Q on the left side.

### **Elasticity**

Elasticity = %change in quantity/% change in price =  $(\Delta Q/Q)/(\Delta P/P) = (\Delta Q/\Delta P)*(P/Q)$   
When using this last form of the equation, your P and Q are your initial values. When you are given a point on a demand curve and asked to calculate elasticity, that point is what you would plug in for your P and Q. The  $\Delta Q/\Delta P$  part of the equation can be pulled directly from the slope of the demand equation when Q is on the left side (the vertical axis variable).

When understanding elasticity, look at the magnitude of your number, disregarding the negative sign. The larger the magnitude of the elasticity (a number larger than 1) the more elastic: the change in quantity will be large relative to the change in price. The smaller the number (if you see a fraction, something less than 1) the less elastic it is: the change in quantity in response to a change in price will be small.

Remember to consider both effects of the elasticity of supply *and* the elasticity of demand: how do suppliers react to changes in market price, how do consumers react. These are often in opposition, demand will increase in response to a wage drop while supply (people willing/wanting to work) will be cut back. Both these elasticities affect unemployment.

In the labor market, employers' choices are reflected by the demand curve, workers' choices are reflected by the supply curve.

Revenue that will be lost or gained by drops or increases in price are directly affected by the elasticity of demand.

### **Utility Maximization**

- Step 1. Calculate marginal utilities of your two goods
- Step 2. Calculate MRS by putting good x's marginal utility over good y's
- Step 3. Calculate slope of budget constraint, which is ratio of the two prices
- Step 4. Set MRS and budget constraint slope equal.
- Step 5. Solve for one of the goods in terms of the other

Step 6. Use what you got in step 5 and plug into budget constraint to get the value of one of the goods.

Step 7. Plug the value for one of the good's that you got in step 6 into the expression you got in step 4.

You have now found the point at which an individual is maximizing their utility given their income and price constraints. The budget line is tangent to the indifference curve.

If given a graph and asked to calculate MRS, MRS will be the marginal utility of the x-axis good over the y-axis good.

### Derivatives

Name	Rule	Example
power	$f(x) = ax^n$ then $f'(x) = nax^{n-1}$	$y = -5x^3, y' = -15x^2$
product	$h'(x) = [f(x)g(x)]' = f'(x)g(x) + f(x)g'(x)$	$y = (x^3 + 5x^2 - 6x + 9) \cdot (7x^3 - x^2 - 8x + 1)$ then $y' = (3x^2 + 10x - 6) \cdot (7x^3 - x^2 - 8x + 1) + (x^3 + 5x^2 - 6x + 9) \cdot (21x^2 - 2x - 8)$
quotient	$f(x) = \frac{u}{v}$ , then $f'(x) = \frac{u'v - v'u}{v^2}$	$y = \frac{x^3 + 5}{2x + 1}, y' = \frac{3x^2(2x + 1) - 2(x^3)}{(2x + 1)^2}$
chain	$y = f[g(x)]$ , then $y' = f'[g(x)] * g'(x)$	$y = (2x^5 - 7x^2)^3, y' = 3(2x^5 - 7x^2)^2(10x^4 - 14x)$

**power rule:** applies to any term of the form  $ax^n$  where  $n$  is a **constant** no matter if  $n$  is positive, negative, rational, or not, as long as it includes no variables.

**product rule:** so named since it's used on a **product of 2 or more functions**.

One of the functions is  $u$  and the other is  $v$ .

In the example above:  $u = 6x^2$  and  $v = x^8$

**quotient rule:** so named since it's used on a **quotient of 2 or more functions**.

The numerator function is  $u$  and the denominator function is  $v$ .

**chain rule:** It deals with **layers of functions** -- so pretend to **peel the layers** like peeling an onion.

$f'[g(x)] * g'(x)$  means:

**1st:** take  $f'$ : **the outside function's derivative** -- leave **inside** alone!

**2nd:** multiply by **derivative of inside function  $g'(x)$**

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