Engineering 110 Notes

Extra Credit Points Total:
0.1 in-class answer 3-30-16
0.2 Piazza discussion points 4-3-16
0.2 Piazza discussion points 4-10-16
0.2 Piazza discussion points 4-18-16

W 1 M Lec 3-28-16

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Text
Engineering Economic Analysis by Newnan, Lavelle, Eschenbach

- Available online as ebook for simultaneous users through KNOVEL platform

Anything Posted on CourseWeb
https://ccle.ucla.edu/course/view/16S-ENGR110-1

Calculator (A simple calculator that cannot hold text in memory)

- No TI-89

We will include how companies behave in different kinds of market structures

- Microeconomics
- Customize it to engineers
- Production structures
- Market structures
- How tech companies fit into different microstructures
- How to maximize profits in different market structures
- See what companies do on top of that specific to their product and target audience.
- Quite a bit of current articles that have been posted recently.

Current Event Articles

- Read news daily
- Show an interest in this class and you get extra credit!
- Keep your attention right here on the topic and make you think
- Do NOT memorize anything, it will be on the formula sheet!
- If you ask intelligent questions, you get extra points!
- At the end of the class, when you add up everything, extra points will go up to the average.
- It helps a lot!

- Good method of engaging those who have been involved in the quarter and the way our brain works, chances are you can carry it better forward upon graduation.
- News
- WSJ, NYT, etc.
- There will be an enduser using a product without paying anything, and there will be a payer.
- These two segments depend on each other!
- Advertisers would pay for us and they would show up on an online site
- These two different customer segments would provide revenue for the news generator and the customer would benefit from free news.
- Being able to read the news freely
- Price discrimination
- WSJ is NOT allowing us to read their news, so they probably figured out that there is a high willingness to pay people
- At a high price, you have a lower quantity
- At a low price, you have a higher quantity
- You will have some guys who don't want to open up new browsers and they want to be on WSJ and be able to read it conveniently.
- Probably collecting all the data and making all the revenue comparisons
- If my commodity becomes very sought after, how can I make these people encouraged to jump on the other side?
- Our product is sought after and it is NOT available anywhere else.
- Whenever a company does something, there is a reason behind it.
- Look at their first page, look at their interesting articles, and get directed to another site.
- Find a way to read those articles for free
- Not unethical!
- Still pay for it with our time

Grading

- Homework + Group Project - 30%
- Total of 8 Homeworks
- Lowest dropped
- Each about 3%, makes 20% total
- Group Project 10%
- You can work and submit as a group… up to 4 people
- You cannot collude with more than one group
- If you are working with a group, work with that group and view it as an individual
- DUE every Sunday 11 PM (with the exception of two weeks)
- Group Project
- Will be posted in the second week
- 4 to 6 people in each group!
- Start to look for group member now!
- Midterm - 30%

- Offers regrades if necessary
- April 25th, Monday, review in class
- Week 5 - Wednesday April 27th
- Closed books and notes
- Formula sheet will be provided
- You need to bring a calculator.
- Final - 40%
- June 7th, Tuesday, 8-11 AM
- Closed books and notes
- Formula Sheet will be provided.
- You need to bring a calculator.
- If you have a conflict, wait for the email regarding an alternative date!!

Q. No curve, every person for themselves!
85%-100% is an A (target goal!)
80-85% is an A-
75-80% is a B+
70-75% is a B

- A lot of students think this is an Intro class, it will show new concepts and keep them as simple as possible.
- If you are NOT familiar with these concepts, try thinking through them early on without waiting for the midterm or the final.
- If you come to class and get extra points, it is much easier!
- She takes your weighted average and then adds on your extra points afterwards!
- One extra point is worth 4 points on your final!
- If you have extra points, give a chance to other people.

Other Ways to Accumulate Points
- Participate in the Current Event Discussions
- Post your comments on the Forum
- Don't miss lectures, chance to get extra points!
- Everything is posted online though!
- Attendance is NOT taken!
- Points are given to people who are participating and engaging.

Important: Your Responsibility
- Check grades coming in before the final!

Course Content:
- Microeconomics: Individual, firm, industry (first half of the class)
- One company and one industry (the production process in one company)
- What is the production structure of one particular company?
- What are your options?
- Big machine and 2 people

- Small machine and > 2 people?
- There are industries populated with companies that produce commodities
- What kind of industry are they playing in?
- There are multiple markets with identical products (perfectly competitive)
- Different market structures
- Market share (identifies if a company is strong in a market where it has achieved more than 70% of the market)
- Monopoly!
- Company that is producing matches (commodity that is NOT open to much differentiation)
- Identical commodities, no room to differentiate your product much
- There are either perceived or real differences between Crest and Colgate (toothpaste)
- These markets are in need of advertising!
- This is where you see ads the most when you are online and on FB
- You see the kinds of ads corresponding to product differentiation and to where they are important.
- Have you ever seen an ad for a match or potato?
- Probably not since you cannot really differentiate them.
- You have a market where a company is very strong in terms of their market share and you want to work in an environment where there are a lot of firms producing matches.
- Industries in between where you only have a few firms i.e. restaurant businesses where you have monopolistically competitive market.
- Product differentiation
- One restaurant is a substitute for another restaurant, but NOT a perfect substitute since they have slight stylistic nuances.
- Oligopoly
- Car industry
- Product may NOT be differentiated i.e. aluminum but there are only a few firms that are competing.
- If you are going to be selling a product with a very high market share vs a product with a more even distribution, the way the companies behave will differ!
- Macroeconomics: National Income, Tech Companies within the Global Economy, International Trade (second half of the class)
- Market structures after we introduce product-cost structures
- Typical production cost structure and we will take it and apply it to these markets.
- Q. If we have this cost structure, how are we going to price things?
- Use this to find current event discussions to base it off of.
- Decision trees and project evaluation from ENG 111
- Don’t need ENG 111 as a prereq to evaluate.
- Look into cases if the companies are basing it off different time periods.
- National income and all the money you are receiving from other countries that does NOT contribute to national debt.

- Produce this many units per year within this country and see how many we are producing.
- Our metric is talking about prices within a macro setting!
- U.S. prices i.e. GDP, cost of living
- GDP is the amount a country produces within its border's per year.
- **Inflation rate (very important!)**
- Money is the most important thing in Macroeconomics!
- Look at adverse aspects of the Bitcoin model and come up with a monetary system.
- The real things that we are producing and through what channels are these effects seen.
- Any ideas that they can bring to the market today?
- One-time use portable charger
- Cheap portable charger and you pick it up to a vending machine and dump it after.
- When you travel, you want your Wi-Fi to be very fast.
- Pros:
- Good revenue model
- Company will get $3 instead of selling a one-time permanent use.
- At the end of the year, it starts to add up!
- Everyone relies heavily on their phones nowadays.
- Product differentiation: being able to charge 25% will be $1, premium version will be $3, etc.
- Partnership and make it more important to get your names out.
- After getting enough experience, they get their own phone.
- Apple sued Samsung and partnership is continuing.
- Partners will acquire your IP and we can put this on our shelf.
- The premium brandnames will be partners as well as competitors.
- Advantageous for outdoor venues where it is harder to have difficulty finding an outlet.
- Cons:
- Environmental challenges - disposing phone batteries
- Redbox model - gets a movie and returns it back.
- Target those who aren't sensitive to price, but then you might as well get a better price.
- Moral hazard: If I can charge my phone easily, the opportunity cost of forgetting it at home is NOT as high now.
- Duracell and Energizer: they could come in, create the same product and kill your company!
- Entry into the market is tough!
- The big companies hire people to think about stuff that can be produced!
- What is code that is possible to write to complete this task?
- Brainstorm on stuff and the patents office is much different.
- Lynda was working with Apple to develop Siri and they had a patent for it.
- Budget is higher than the real research and development budget.
- You have to be thinking about easy to copy issues!

- To get you out of the market, they will buy you out and shut you down.
- Partner up with Staples Center and offer it up for free.
- Tech companies will give out free swag at a career fair and provide these chargers
- Homework will be posted Wednesday

W 1 W Lec 3-30-16
Production Cost Structure:

0. Factors of production
0. Different types of costs
0. Short & Long run & scale
0. Profit Maximization

Factors of Production

0. Land: space to operate your things
0. Labor: workers to stay in the factory
0. Capital: money/machines. In finance, it means the big equipment you buy In economics, it is anything intangible that you use to produce and sell the product.
0. Entrepreneurship: risk. They have the vision and idea to put it together. Entrepreneurship is arguably the most important ingredient.

Costs:

- Sunk cost - cost that cannot be recovered going forward.
- Whether we produce it or not, we cannot recover it.
- If you do not start production, that is gone already.
- Opportunity cost - you may not be paying something out front does not mean you are paying for it.
- You pay for it at the end due to factors like time.
- Sleeping vs listening: each has an opportunity cost
- There are other opportunities that can be achieved or obtained if you don't use that resource in this operation.
- Fixed costs - costs that do NOT depend on the level of production
- Rent, housing prices
- There is a time attribute to fixed cost as well.
- If you have not produced, you cannot recoup that. You can present a case where we want the attributes of each cost so we can identify it as a sunk item or a fixed cost item.
- If we haven't started the production process, it will belong to the fixed cost too.
- Variable cost
- **All costs are variable in the long run**
- Can be a software company and it can be an intangible commodity
- Fixed cost and variable costs
- If you are an app producer, you need a computer
- As you change the quantity, you need more of this thing.
- It is easier to understand within the manufacturing process.

- Cost that depends on the quantity
- Q represents quantity

- We have decided we are going to be a small business: this is the size of the machine we are using and this is the space we will need.
- We are going to determine the scale of our operation and we have to determine with scale of how much we should produce.
- GM and Toyota were filing for bankruptcy and Tesla got a huge factory from the two companies for $2 million. They were able to collect the remains in the aftermath of the financial crisis.
- The Gigafactory is something huge and they are building a certain portion of it for the production process.
- They got some bids from different states and it will bring a lot of employment.

Scale

- We know what the fixed costs are and the time interval we are going to be getting out of this operation.
- Short Term: the time interval during which some but not all costs are fixed.
- Once we know more about price, demand, and competitors, this area becomes **long-term**.
- All of this information is out of our contract and we are ready to determine a new scale.
- Long Term: Everything becomes variable cost
- **All costs are variable**
- For a software company, the short-term is very short compared to a company like Boeing
- It would take a lot of time for Boeing to change their scale compared to a software company.
- Things are determined by the short-run or long-run.
- For a typical production process, the productivity of an ingredient is going to change in a definite way.
- If you have a fixed ingredient that is purchased, and you see the market demand is strong, you can produce a little more.
- Without a specialization of labor, one person will be doing everything.
- In this case, the productivity of that person is NOT at an efficient level.
- As you start to add more people, the time at which you are producing can be reduced and the productivity will be higher since you have more people.
- When you have a fixed cost, the productivity is going to increase, giving you an idea of the per-unit costs incurred as you are going forward.
- Per unit, you can produce more, meaning the per-unit costs will be lower.

Graph (check notebook)

- Total variable cost of 1st unit is 10
- The total variable cost of 2nd unit is NOT 20, it is NOT linear.
- Per-unit we have less cost.

- At some point, you will have to increase your scale and produce more.
- Bring in more factors of production and we need to produce more and more chocolate bars for example.
- If you have a fixed factor of production, when you increase the factor of production, first we are going to reap the benefits of specialization.
- Eventually, you will hit the capacity constraints
- The 2nd derivative is negative in and refers to specialization and eventually, we reach capacity constraints.
- We are looking for the inflection point of this curve where it changes sign (in this case, negative to positive)
- If you are a high-fixed cost firm, you need to produce **A LOT**
- Total Variable Cost (TVC)
- As we increase production, the extra cost incurred gets lower and lower (due to specialization)
- Per-unit cost here is going down because the extra unit is bringing in less cost.
- It is increasing passed a certain point because we have reached the point of **diminishing returns**
- TC (Total Cost) = TFC (Total Fixed Cost) + TVC (Total Variable Cost)

AFC (Average Fixed Cost)
- Equivalent to per-unit fixed cost
- AFC == per-unit fixed cost

Look at the graph on notebook

ATC
- ATC = (TFC + TVC)/Q = AFC + AVC
- AFC is never 0
- Tesla is trying to change scale but it is taking time.
- They cannot get enough batteries from Panasonic, so they know they have to produce more.

- Objective is to maximize profits
- Where should we produce?
- The demand side also has to be brought up to this picture.
- The kind of market you are in determines the kind of price you can charge to stay in business.
- The price is going to be driven down to the cost level and only we can produce it.
- You will be in a situation where you can determine the price.
- This thing that you are producing means you are taking the price as given.
- We cannot change the price.
- Minimum per unit cost is not necessarily the profit maximization point.

Marginal cost: Change in total cost when you add an additional item

- If it is positive, you are adding to your profit
- If it is negative, you are losing profit

The total cost increases by where P and MC difference is positive
- The additional revenue you are getting is changing with revenue.
- Added complexity which will go back later.

In economics, we have opportunity cost and optimization happens at the margin.
- Determine things based on what is happening on the margin.

0.1 extra credit points today.

W 1 Dis 4-1-16
TA: Kevin Landry
OH: Th 1:30-2:30 Boelter 6532A & by Appt.

Projects and HW's are graded easier than the exams are.
- Problems in discussions here are related to the exams.

1.) Opportunity cost, for example needs to be included in calculating the total costs. Which one of the following cost types should not be included?

A. Variable cost
B. Unskilled labor costs
C. Skilled labor costs
D. Patent cost
E. Sunk Cost (should not be included)

- In some/many/almost cases, patent cost is part of sunk cost
- There may be recurring renewal costs associated with it.

2.) As the production level increases, AVC & ATC curves get closer and closer, why? Would they eventually intersect.
A. The difference between them is the fixed cost, and as you have more variable costs, the fixed cost gets smaller.
They would only intersect if AFC = 0

3.) If increasing production by more units results in per unit total cost to increase, then we can ensure that:
A. Marginal Cost is minimized
B. Average total cost is flat
C. Average variable cost is falling
D. Marginal cost is higher than average total cost: If we know it increased the average, than the marginal cost is higher than the average total cost
E. ATC > MC

MC = dC/dQ

Look at table in handwritten notes
i) Determine the optimal production (profit maximizing) level if price is 8.
@ P = 8 -> P = MC when Q = 9
ii) Can firm cover its variable costs at this production level? Total costs?
TR = 8 * 9 = 72
P * Q

Since $72 is > both TVC ($40) and TC ($50), the answer is yes.

iii) If the production level remains the same, can the firm cover its VC @ p = 6? Total costs?
TR = 6 * 9 = $54. Yes because $54 > both TVC ($40) and TC ($50)

iv) What if we were to change price to 5, can we now cover the variable costs? TC?
My answer: Yes for VC and no to TC.
TR = 5 * 9 = $45. $45 > TVC ($40) and $45 < TC ($50)

- This would only be correct if you see this **If the production level remains the same**

Solution: @ Q = 1, TR = 1 * 5 = 5, VC = 5, TC = 15, Net loss = 10
@ Q = 7, TR = 7 * 5 = 35, VC = 26, TC = 36, Net loss = 1

5.) You rented a space and equipment for $1,000/month to produce commodity X. Before continuing, you predict:
Total Cost = (Q^3)/6 + 1,000

If price = $50/unit, how many units would you produce?

<Bookmark>
W 2 W Lec 4-6-16

- Understand different parameters useful for the profit maximization point.
- Law of Diminishing Returns
- At some point, you will produce less and less
- Productivity decreases past a certain point.
- As you increase one factor of production while keeping the others fixed, eventually per unit output will go down!

0. Profit Maximization
0. Example
0. Short-term & Long-term shutdown rules
0. Supply Derivation
0. LRATC (Long-run average total cost)
0. Market Structures

See diagram

- Change quantity in continuous terms - you can produce in decimal units!
- Does NOT need to be integer!
- Stop when MC = MR (P), this what start to diminish your total profit
- Q* is your optimum production level

What if P = 500, rather than P = 2,000?

- Profit maximized
- You also minimized loss
- Give you the point where you make the least loss
- When you equate your MC to MR (sometimes P), if it makes the maximum profit, it will pick that
- If it is NOT possible to cover all of your costs, then it will look at all available quantity points and see where you have the least loss (profit minimization)
- This rule gives us either where profit is maximized and where loss is minimized.
- For discrete cases, you want to round down (floor function)
- If at point 5, your price is still higher than your marginal cost, but at point 6, you see MC > P, then you would produce at point 5.

Q. I have not started producing yet, but I have purchased my equipment, I have a fixed cost. If I knew that that I wouldn't have a profit, what would I have done?
A. Prices going down. If you committed, should you produce or not.

Sunk costs -> forget about it and move on!

Shutdown conditions:
https://en.wikipedia.org/wiki/Shutdown_(economics)

- If you can cover your variable costs, you can keep running **in the short-term!**
- In the long-term, get out of this business and go somewhere else.
- Accept your losses, get out of this business, go somewhere else.
- Hire two guys and pump up some oil and your total variable cost should be covered.

Shutdown Rule

0. Short Run -> P > AVC -> Produce
   P < AVC -> Shutdown
0. Long Run -> P < ATC -> Shutdown

- I am out of this contract and going into the 2nd round.
- If I cannot cover my ATC, then stop producing and get out of that business

- Can we can see how price is related to quantity as the intuition suggests?

A. Quantity increases as price increases because companies will be willing to produce more if they earn more for each.

- There will be more people in it than less.
- You see that at different price levels, companies will be optimizing at higher quantity levels
- Whatever company size is will supply a certain quantity.
- Increasing the price means each company will be willing to supply more.

Economies of scale:

- The additional cost incurred decreases as you increase your production
- In the long run, all costs are variable

Increase scale

- As you get into a bigger scale, you get into better deals and take advantage of your size and reduce ATC
- At a bigger scale, there are even more advantages

Example: Starbucks vs Peet's

- Starbucks is multinational, which lets you get into a lower ATC than Peet's
- Who would not want to switch to a lower ATC level?
- If a firm is moving from one scale to the next, the size is doubling but the costs are NOT doubling.
- Dish out more money to be able to produce more.
- If that is the case, you are experiencing economies of scale.
- In some industries, as you get bigger and bigger, you will become so big that you will run into **managerial inefficiencies**
- Companies that become too big means that inefficiencies will be rising as you get bigger and bigger.
- This can lead to a situation where the ATC starts to go back up past a certain point
- Similar to Law of Diminishing Returns but for scale!
- Forms an envelope-U
- Imagine there are infinitely many of these and this huge curve is known as LRATC (Long Run Average Total Cost)

Releasing the condition is fixed

- Perfect competition
- Intermediate product and all these companies are waiting in-line and they are not selling as much.
- No flavored gasoline
- Working with a startup for vanilla from poop (WTF?)
- There is a case where a price fixed case is NOT plausible.
- Under what condition can you have a case where having a fixed price would be plausible?
- 1. Product is homogeneous.
- Change the quantity, and price is the same.

- 2. The company is so small compared to the industry that it has no say in the price.
- Compared to the industry size, company size is very small.
- Market price is determined and if you are a small oil producer, can you affect prices?
- NO! You are too small to have an impact on the market.
- This is known as **perfect competition**

Examples of Product Differentiation

- Bag markets
- There are distinguishing characteristics that differentiate products, so you can charge different prices.
- Sell things at a lower price or you would supply a niche market with handmade artisans
- You cannot affect the average bag price in the market, but you can affect your own price.
- Lots of people can customize their product in one way or another
- If there are lots of companies in an industry, how can this item be shaken in real life? Is there a trend to having lots of small firms or going into companies getting bigger and bigger?
- One company will start swallowing the other smaller companies.
- More and more companies are consolidating or merging.
- Industries are concentrated more and more.
- Imagine starting from a perfectly competitive market and if one of these suddenly becomes cost-efficient, are they going to make more profit?
- They are going to increase the size and buy out their competitors.
- Perfect competition is rare in real life.
- In a perfectly competitive setting, it is usually what we see in several of those cost effective in some ways.
- Figuring out a way to produce something in more efficient ways.
- Production argument is valid but to a point, if you are entering an arena where the price is NOT constant, then we are entering a flipped world.

W 2 Dis 4-8-16

- Midterm is in about two weeks

1.) When price = $50, a perfectly competitive firm can only cover its VC @ the optimal production level, Q* = 1,000, making a loss of $200,000.
If price = $100, profit = $0 @ new Q* = 3,000, how much is the TVC in that case?

Solution: FC = $200,000 because P = $50 covers VC

PI = TR - TC
0 -> TR = TC
$300,000 = TC = TR

TC = TVC + TFC
$300,000 = TVC + $200,000
-> TVC = $100,000

2.) A perfectly competitive firm rented 2 production facilities, A & B, at a total cost of $400. The facilities differ in their productivity levels represented by their respective Total Variable Cost function: TVC_A = 10Q_A^2 + 6Q_A
TVC_B = 12Q_B^2 + 4Q_B

A) If price = $100/unit, what is Q*? How much should be produced in facility A vs B?
B) What is the avg. variable cost for A & B?
C) ? <Check Kevin Landry notes later>

- Price-taker: Just accept whatever price and non-differentiated product.
- Smartphone business example: There is nothing different about their smartphone compared to the rest of the market.

Solution:
MC is the derivative and the cost equation

A) MR = MC
MC_A = 20Q_A + 6
MC_B = 24Q_B + 4

MR = P in perfectly competitive market
MR_A = $100
MR_B = $100

100 = 20Q_A + 6
Q_A = 4.7

100 = 24Q_B + 4
Q_B = 4

B) TVC_A = 10Q_A^2 + 6Q_A
<See notebook>

C) Look at Kevin Landry's solution later

3.) A car company is considering using carbon fiber composite material in the body of the car it is planning to produce. Carbon fiber costs $10/pound (lb). R&D dept. says 1st lb of carbon fiber adds $12,240 of value to the final product and each additional lb adds half as much value as the previous.

W 3 M Lec 4-11-16

- With a bigger scale, your average total cost would have a better outlook for per-unit costs.
- You can better use the features of your boat and this is what we observe with your stories behind it.
- Per-unit costs will go down at least for a while.
- At the small scale, you will not achieve the advantages of lower-per unit costs that you see at larger scales.
- Imagine your long-run average total cost can be changed in scale continuously.

How to obtain ATC

- U-shaped ATC
- Producing more units will be harder in terms of cost
- Does NOT apply to every industry
- What kinds of industry do not have an ATC cost curve?

Economies scale refer to if you increase in scale and if per-unit costs go down.

- Per-unit cost advantage will get better and better.

Fixed Price

- After a fixed price, how would we maximize the profit?
- How would we get our optimal quantity?
- In this class, compared to other econ classes, we are trying to relate things to the real world and make this information useful when we go out there.
- You have to think in these terms and we want to relate this to current events.
- If the product was homogeneous i.e. what you are producing is the exact same thing as someone else in the industry, it doesn't make a difference!
- You should be able to set the price to your liking to maximize your profit.
- If I would like to charge more, you cannot do that because the things that I am selling are exactly the same, and I am very small compared to the industry, so others can supply what I am not supplying.
- Customers would react to higher prices by purchasing from other competitors, so you cannot change the price!
- Is decreasing your price a good strategy?
- Uber and Lyft are going into price wars for this.
- If you are decreasing your scale, you cannot increase production or reap off benefits for that.
- You might as well charge this price because you are selling at this quantity, and you cannot increase your market share.
- These industries are where economies of scale do NOT apply.

In a firm with a fixed price, small size, and homogeneous price, it leads to a result that is one of the most important features of price-takers.

- This is perfectly competitive, so its requirements are that it is homogeneous, very small compared to industry size, and economies of scale do NOT matter!
- In this case, lowering the price causes it to get stuck in there.
- These are the two important features of perfect competition.

Easy entry

- It incentivizes other firms to come into the market.
- They will be able to do so because entry is easy, and we can think of multiple, real-world examples where entry isn't easy.
- Breaking into the car industry used to be very difficult, and people are praising Tesla for entering in to the car industry fairly successfully.
- Some companies are harder to get into compared to others.
- Because of all these 4 features that we put together, **this is an idealized market structure NOT seen much in the real world.**

If a firm is in a perfectly competitive industry, and its ATC is like the other firms as well, and if the price is here

0. This firm is NOT determining that price in this market
- Consumers - supply and demand determine the price.
- Each firm as an upward sloping supply curve and a downward demand curve.

Demand

- High prices means low demand
- Low prices means high demand

For the completeness of our argument, there will be some arguments where we increase price and quantity increases.

- If you see commodity as a status item, then increasing the price makes you want it more.
- For most cases (99.9% of the time), this is true!

If you are covering all your fixed costs, it is more advantageous in the short-term to stay in the market.

- What were the costs?
- Real costs that you could make elsewhere
- Opportunity costs
- Economic profit is NOT accounting profit
- This is economic profit, meaning you can cover all your costs including your opportunity costs
- You are covering all of these things if you make 0 profit.

Q. How do you quantify your opportunity costs?
A. If you are considering your business, whether it is a viable option or not, you should include opportunity costs to see if you are covering immediate out of pocket costs.

- You are indifferent about staying in this industry.

Q. Isn't it a reality that entry is easy and wouldn't people enter? This points to better opportunities to other industries.
A. If firms are making positive economic profit, this is a great invitation for others to enter.

- You are doing as well as you are doing elsewhere, and for an outside potential entrant, you can do this much in another industry.
- This is better than what I could do elsewhere.
- Jump in!
- This changes the supply and demand curve.
- Supply increases!
- In the long run, positive economic profit invites new entry -> industry supply inc.
- Price goes down, driving out any positive economic profit
- Perfect competition -> long run -> zero economic profit
- What is the y-axis for supply and demand?
- Does this mean in the long-run, do you have to quit.
- No! You are indifferent if you stay or go, but you probably want to stay if you want to pay your bills.

Q. In the long-run, wouldn't every company go into perfect competition?
A. Adam Smith's *Wealth of Nations* says that if everyone looks at their own profit, then everyone will benefit because cost will be driven down and everyone is going to be happy.

- Economists started to see different market structures (what is Rockefeller doing with Standard Oil)
- Fortunately or unfortunately, after we complete the market structures info, we will have to figure it out ourselves.

Four different market structures

0. Perfect competition
- Price takers

0. Monopolies
- Price setters

Monopolies

- Perfectly horizontal demand for an individual company in a perfectly competitive market structure
- Downward sloping demand for a monopolist
- If you are decreasing the price, you are possibly able to sell more.

Q. What does it mean the MR != P?
A. If you would like to sell one more unit, you wouldn't be able to sell the extra unit at the same price.

- The market determines a relationship between quantity demanded and price.

- You would need to possibly reduce the price, and you cannot sell as many as you wish at the price of your liking.

- Monopolists ask what your per-unit costs are, and it can go up to ATC and per-unit costs * quantity would be your total cost
- The box difference is your economic profit
- This will NOT be driven down to 0 in the long-run
- Patent corporations like Apple and someone can defend it down the line.
- Messed up situation because of patents
- They have the right to produce that product and until someone else figures it out, the company is going to be the monopolist of the market.
- Patents are supposed to create incentives to create new stuff, and if you are trying to invest, why not reap the benefits at the end?
- The article is referring that a patent is used as a weapon and big companies are going to have these sessions where they are brainstorming into the market.
- You just need a general software algorithm. I have the general patent for that for Siri.
- Voice recognition
- Apple, Google, all of these guys are talking to this small company and the big company says either you need to sell the company or I will sue you and this is a patent.

Amount of money spent on litigation
- Twice as much as the research and development money.
- Very inefficient
- Natural monopolies are a recipe for disaster.
- Because of the market's structure, there will be a lack of innovation.
- Market size is NOT big enough to support two different companies.

W 3 W Lec 4-13-16
- Demand seen by the monopolist was the same as the industry demand.
- For most commodities and services, you would see a downward sloping demand.
- Same logic with perfect competition and take the 1st order derivative and set this to get the optimal quantity.

What is good about monopoly?
- We were asking a question whether being a monopoly was illegal or not.
- It was NOT illegal!
- High market share, but would the government come after you?
- Probably not.
- It depends what you are doing with the monopoly and what you do with the power.
- If you try to set the price higher and set it insanely high.

- If you use your power for anti-competitive behavior, the government will try to break you up.
- U.S. Government is going after Google because it is trying to eliminate competition.
- These are seeing the positives and negatives and try to just warn them.
- We should warn them by suing them.
- The problem that the government is having is that Google claims that when it gives you search results, they put the services they provide on top.
- If you try to push others down, this is considered anti-competitive.
- The guy who went after Microsoft in the 1990s was doing the same thing as Eric Schmidt.
- Microsoft was bundling its OS with other programs
- If you do not include Internet Explorer, we will cut the deal with you.
- Microsoft had to open some code to the public.
- Being a monopoly is good, and if the company uses this, it becomes a strategically important aspect of any tech company.

Why do markets work?

- They work because there were other attempts at establishing other economic models that didn't work.
- What is the #1 foundation of markets?
- Supply and demand.
- If you do NOT have well-established property rights, then there will be no economics.
- Who says that it is yours?
- It is the foundation for the market, and if you have property rights, you have transactions.
- This creates prices and they emerge after we transact and exchange stuff amongst ourselves.
- Some things are sought after and others are not so much.
- If the price is high, then there is opportunity, so let's innovate and find a way to get the piece of the pie.
- Prices create the signal mechanism to the innovators

How does Google make money?

- Advertisements!
- Based on what you search before, they keep track of your interests via cookies
- Google and Facebook do not work with well-defined rules.
- Some resources that these companies are using are NOT framed with property rights.
- We are going to see this evolve in the future and once in a while, it comes up in the news.
- Property rights will NOT be well-established here.

Natural monopoly

- If there is one football team, there won't be enough demand to have two football teams
- Why don't we produce energy locally rather than having this big plant with old inefficiencies?
- This can be where energy is needed.
- This kind of behavior is very rare and let's keep it that way.
- We have a case where you are a monopoly and there is NO good service since you are a monopoly.
- Any money I have funds for should be used towards lobbying my case for state officials

With the Google search, is it safe?

- Do they have the luxury of acting like taxi cabs
- Because they have their hands in so many things, they have a little more space than you can think of if they were just search engines.
- Doing seemingly unrelated things.
- They are anticipating things and strategizing for situations and seeing how to revise the algorithm and make it better each time.
- Now that we have this infrastructure, how can we use these servers to create more products?
- Where does the world go towards drivers-less cars?

- Google's monopoly isn't very safe because they don't have control over raw materials and it isn't a conventional monopoly and it makes a purely Internet company and try so hard to diverse the stuff they do.

If you are producing a perfectly competitive product, you don't have any funds for R&D

- You are BARELY surviving!
- No buffer to innovate
- Depending on the structure of the monopoly, funds cannot be used for innovation or keeping the status quo as it is.
- Use funds they are getting by using their monopoly power and setting the price high and getting positive economic profit

The oil industry

- Oil was not produced by just one producer, but a handful of producers.
- Sometimes, they act as a cartel and they act as one firm in terms of deciding the price.
- The countries producing high levels of petroleum use easy-to-obtain petroleum.
- It is dispersed and the technology we had before was NOT commercially viable to make it attractive to the producer.
- It became commercially viable and since 1990, you can go to oil production in the U.S. and Canada and see that it is increasing.
- If new suppliers are coming into the market, it is now viable for them to make profit.

- Hopefully, they have a plan B if Tesla starts selling electric cars to everyone.
- They are trying to stay afloat as much as possible!
- Oil prices are shrinking and going down very low, but it is a double-edged sword.
- You are trying to keep people out by keeping prices low, and if it goes below $50, it would NOT be commercially viable at that point.
- Technology continues to improve and the break even point drops.

Keep competition out and drive them out

- Monopolists can drive out competition by driving down the price.
- Because so many people depend on oil, fi you don't produce more, they ill offer you little higher.
- Price wars can be done by creating artificial shortages.
- Tacit collusion: if companies set prices together, it is explicitly illegal.
- Steve Jobs did this with price-fixing
- Steve Jobs was half-Darth Vader
- Companies sometimes do ridiculous things to show off and do unreasonable things to demonstrate that they have cash.

Monopolistic competition

- Closer to perfect competition than monopoly
- Product is differentiated
- Entry is relatively easy
- Restaurants
- Lots of competitors but the product is differentiated
- Banh mi at Sawtelle is NOT the same as the banh mi in Silverlake or the banh mi in San Gabriel.
- If you offer it at a low price, there will be more people coming in and there are lots of close substitutes for your product.

Profit Maximization under Monopolistic Competition

- Demand goes down as entry goes into the market.
- At each price level, your demand is becoming flatter because the # of substitutes in the market is going up.
- Monopolistic competition -> people enter and for each firm, the demand shifts to the left and becomes flatter

Q. How do we get out of the trap of losing profits in the long run?
A. Convince customers that it is worth it! Either create a better product or advertise a better product!

- Google and Facebook survive because of ad money.
- For heterogeneous products, you want to further product differentiation or create perceived product differentiation.
- Perceived differentiation and advertisement is an attempt to reverse this process.

- Produce more loyalty for a product and make it less price sensitive.

Product multiplication: Strategy they are using

- If you are producing a differentiated enough product, what you do is play some ads and estimate advertisement funds.

Oligopoly

- Only handful of firms are operating in a certain industry.
- Car industry
- Only a handful of firms producing a certain type of product
- Can be differentiated
- Toyota != Honda, Tesla, Mazda, etc.
- Product can be homogeneous
- Aluminum
- The major determining feature of an oligopoly is that there are only a handful of firms
- When a firm is determining its price or quantity, does the firm think about what the other is doing?
- Hell yes they do!
- Strategic interaction -> with oligopoly, you have strategic interaction!
- Try to survive and at any one point, another firm can become successful and drive you out.
- If oligopolists cooperate against consumers, this is very bad!
- **Collusion** is illegal!
- If you set a price, that is illegal
- Steve Jobs did this shit!
- Steve Jobs has a very inspiring interview called “The Lost Interview”
- For an engineer, he is talking about the position of an engineer versus a businessman.
- The business mind along with the engineering mind did NOT work!
- The companies that are really successful are not run by businesspeople; they are run by engineer!
- Engineer master race!
- Strategic interaction

Prisoner’s Dilemma

- Is there anything else I could do to improve my situation?
- If we can find a cell where no one unilaterally can deviate from this game, that is the best solution we have.
- Not a Nash equilibrium, there is at least one situation where we are not-optimal in choosing a cell.
- In an oligopolistic market, you might end up in a not so good situation because you are trying to guard yourself against the other and giving away a lot of resources.
- Oligopolies are NOT good for society because resources are used for guarding rather than producing.

Mel trying to be Steve Jobs

- "We are entering a period where we are trying to improve a product further. Why don't we have a case of companies producing more than one product? Price discrimination!"

Price Discrimination

- If there is a surplus, we can do price discrimination.
- We do NOT know who is who.
- There are signaling mechanisms you can use to get at that.
- Airline industry -> get different signals and price consumers accordingly.
- If you are buying at the last minute, your willingness to pay is high.
- Look for rates a month earlier and offering you a lower price.
- A way of getting a chunk of consumer surplus.
- We try to use signals to see whose willingness to pay is higher.

W 3 Dis 4-15-16
Midterm is on April 27th

1.) You have the following info for firm A who operates in a perfectly competitive market.
Fixed cost = 18, Marginal Cost = 2Q + 10 (for Q >= 1)
You have the following info about the industry:
Total Quantity Demanded: P = -Q/500 + 30
Total Quantity Supplied: P = Q/500 + 10

See Notebook for solutions

2.) A monopolist has the following cost & demand for its product:
MC = 10Q (monopolist's)
TFC = 400 (monopolist's)
P = -5Q + 400 (industry)

A.) Find monopolist's Q* & P*
B.) If market is perfect competitive instead, what is Q* & P*

3.) John Forbes Nash -> Game Theory -> A Beautiful Mind

Collusion - knowing what the other guy was doing

- Get together and fix prices or know each other's decisions

- Problems here aren't that bad but it is an interesting theory

W 4 M Lec 4-18-16

- Quantity supplied increases with price

- The consumers are optimizing their own problems in terms of the budgets that they have and the options available to consume.
- There will be some downward sloping demand line
- Monopolistically competitive firms can get away with producing less to charge higher price
- This produces a consumer surplus!
- Companies will be aware of the fact that there is some money on the table.
- It would be possible to capture more of the revenue supplied by the consumers.
- We do NOT know which consumer has this capability
- As a company, what do you do to get to consumer so they are willing to pay.
- What can be we do to get more of the chunk
- Price discrimination
- Airfare as it gets closer to the price
- Uber surge pricing
- People are really pissed off when they are charged a higher price when it is done behind their backs.
- Companies try to differentiate the same product slightly to justify their price difference.
- Evangelists who want to get the product as early as possible have a high willingness to pay
- Hardcover books vs softcover books
- Product is the same, but hardcover books cost more and come out first.
- Car industry
- Multiple options as prices go up.
- Amazon Prime
- It comes free for students!

Q. How does this account to specific student discounts?
A. Who has a high willingness to pay? Students are cheap, professors are cheap, senior citizens are cheap!

- Youtube Red

Freemium Model

- Emerging as a business model for tech companies, especially those that do online business.

Bundling

- Offering several products for sale as one combined product.
- We can get discounts and trying to make people pay for a bundle rather than individual services.
- Makes it more reasonable for you to pay more.
- Amazon's videos might attract Netflix users if you already have shipping.

Assume that a company produces two different products: Product I and Product II

- Some portion of the population has a higher demand for one of your products, and a higher demand for another product of yours
- How would you price them?
- It depends on the market structure and the costs of switching into the market.
- Depending on the region, there are different prices at different gas stations in Los Angeles
- If you know who is looking at your products online, you can charge different prices and the prices that you see
- Some people have to drive to get to work, so we can charge a higher price because people won't have access to get to their jobs
- Disneyland
- You like this ride

The kinds of things you can auction and the kinds of things you shouldn't option?

- Revised it so you can buy now option and then two different sites with posted prices.
- Ship and sail
-

Time Value of Money

- Previously, we observed when time doesn't make any difference.
- From the time we get our money back, there is some time in between where things are happening and we are treating the problem as if there is no difference with covering the cost a year or two years from now.
- We need to release the implicit assumption there is no cost now.
- Who would want to get $1,000 today compared to tomorrow
- Difference between being paid right now vs being paid later

Online Lecture online later

Time Value of Money

- Introduce the basic idea behind it and apply the concept to a production structure.
- The kind of utility you get will have more opportunities and there would be no additional value tomorrow.
- Time is a commodity
- If you get to that resource today, money is just a measure of the things you can get.
- All of these resources have more value for today than tomorrow.

If you have $1,000 today vs $1,000 in a year, you can invest that money today!

- Looking at the same thing from the other perspective, the present value of $1,100 could be found by rearranging the equation

Q. What is the value of $1,100 if it is offered by you today if your opportunity is 20% per year?
A. You make $1,100/1.2 = $950. This is lower than $1,000.

What do Wall Street people do?

- They adjust the expected rate and with this probability, you can estimate how much you will have and discount.
- You are offered either $1,000 now or $1,100 later.
- If your opportunity is the same after a period of time, you are indifferent and can choose one option over the other.

Equivalence

Year	Plan 1	Plan 2	Plan 3
1	1,600	1,400	x
2	1,000	1,240	x

- The one you pick will be determined by the opportunity cost
- How could I find the present value of the first plan?

i is used to denote interest, but *r* is also often used universally.

- *i* and *r* will e used interchangeably

Taking a reference point will not make a difference, mathematically, they are equivalent

- Find x dollars?

Payment Plan I - Pay everything at the end of the loan term

- $5,000 - to get into any production activity, we need money
- Pay it back and optimize our profits and sell our commodities
- Over one year, we can pay it after the end of the 5th year
- Interest that accumulates and it is added on top of that.
- At the beginning of the last year, we keep adding 8% on top of the current value.

Payment Plan II - Pay the accumulated interest as well as 1/5th of the principal each year

- Another year goes and interest accumulates
- Total payment keeps going on.

Payment Plan III - Pay only the accumulated interest each year

- The total payment is $400 for interest each week

Which one would you choose?

- Assuming you get the same rate that the bank is offering you, it doesn't matter.
- These plans will be equivalent!

Q. You can never compare cash without an attached time.

- For Payment Plan II, this cash belongs to the each individual period
- Payments cannot be added up like that without treating them properly.
- If you carry them to the same period, you would see that the total cash payment would be exactly equal.
- Terminology explanation
- With the first plan, you are accumulating interest as if you are making a bigger payment.
- The money is in your pocket and you can do whatever you want with it if your opportunity cost is 0.8%
- You can recoup that money you have to pay at the end of the bank.

You can NEVER add cash values that belong to different periods

- If you can make 8% in the market, you can increase your money and you are going to be able to make that payment at the end.
- If you choose to pay some of it at the bank, less money will be added to your debt, but you cannot make the money in the market.
- If money you can make in the market and the amount in the bank is different, then you have a different situation
- We are getting all these loans

Application of Time Value to Production Structures
FC = $21,000
TVC = Q^2
Market Price = P

- What is the least amount of price to operate properly here?

Looking at the ATC, for the price to be profitable

- The price that you calculated as such, you should increase it by the amount you raised it.
- How much money do you need to cover that $5?
- Whatever money you can make in the market in one year.
- Recoup that in one year's time, you should be getting whatever money you get with $5 in that market.

W 4 W Lec 4-20-16

- Including opportunity costs in our calculation
- Include the present values
- The money we are going to be getting after selling Price P is going into our pockets in one year.
- This difference is taken into account via the following terms:
- If I incur these costs, how much money do I need to be able to cover these costs?
- If I have $2,000,000 now, I will need more in the future.
- In one year's time, you will owe more than $2,000,000.

- If you didn't borrow that money, I need $2,000,000 and I am trying to find the price that I need to get in one year's time when I sell the quantity that I produced.
- You need to take into account the interest rate.
- In the case where you have the money, how much should you get from this business to cover your costs.
- Opportunity cost that is lost from taking this route.
- It doesn't matter whether you borrow the money or it is your own money, it has to be taken into account by investing your money in your own business.
- You should be able to cover the financing cost and it doesn't matter what the source is.
- Hey, when we are talking initially about fixed costs, we should include all the opportunity costs, but it wasn't clear what the opportunity cost was.
- This problem illustrates that to you.
- In one year's time, you need to calculate the amount in future time!
- There may be some business where the suppliers ask you to pay a price in one year's time.
- You will be able to sell the units that you produced in one year's time and you don't need to make any adjustments.
- When there are time lags between the cash disbursement, it is possible that you collect something first and then make the collections later.
- You need to bring all the cash payments into one period.

Distant Cash Flow Matters Less - especially at higher interest!
<Look at diagram on CCLE>

- You can pick any time when you are comparing this project to another project.
- Compare stuff mathematically, but out in the industry, we usually bring the cash flow out into the present.

- If I pick 10% as market rate, the last one will have the highest net present value, regardless of whatever interest rate.
- Even with 0% interest rate, this one is going to be highest.
- Does the value difference between them depend on the rate?
- Looking at the last term, the last term as a rate in the denominator and the value of the project depends on the year *i*
- At any rate, the last project has the highest value.

Rate of Return Analysis
- Most frequently used exact analysis technique in the industry.
- The more tail-heavy a project is, the more its value will be affected by rate changes.
- The value of a project that is tail-heavy will jump compared to a front heavy project.
- Tail-heavy means that most of the cash flow is at the end.

Internal Rate of Return

- Give me $10 and at the end of the class, I will give you $12
- Without defining the concept, tell me intuitively what the rate of return is?
- Leave *r* as an unknown variable here
- You can calculate the rate of return in this way
- For every dollar you put down on this project, what does per-period return that you are obtaining?
- Calculate what those cash payments are once you know that return.

Example: Rate of Return Calculation

- Maria borrowed a loan of $9000 each year for 4 years/ No interest is charged until year 4, then the interest rate is 5%. If Maria makes 5 equal annual payments, what is each payment? What is the internal rate of return for Maria's loan?

Which rate is better?

- No rate for 5 years, then 5%, or calculation now an then you pay interest at the end

When borrowing money, you want a lower rate than the market

- Look out in the market and we want to be able to do better than in the market
- When you are borrowing, then you will look at this case and say this is a good opportunity if the market rate is lower than you.
- If the rate of return is higher than what you can get in the market, it is NOT a good deal because you won't be making money
- If the bank is giving you this, how are you making money?
- The difference is the money they are making, and they are mowed down in all sorts of shenanigans.
- More sophisticated instruments at loaning out money.
- "The Big Short"
- How do you know that this is the cash flow?
- 2.67% is averaged out over that period of time.
- Over time per year.
- You receive money over time and the net present value changes with every year.
- That rate ensures the NPV you receive is the one you actually have to pay back so you don't pay back more than the loan was worth.
- What is the source of 2.67% being lower than 5%?
- What would happen in this case?
- This is the proper way of distributing payment to the bank over 9 years.

Example - continued

- If you calculate the net present value, what would be the value here if r = 0?
- If r was a little higher, it would still be negative until about 2.5% interest rate

- Different rates you can plug into this equation
- That must be the internal rate of return
- If you write down the equations or net present value, you will get a line like that.
- Is this is a borrowing or lending type?
- You are borrowing first, and then paying money later.
- This is good if the internal rate of return is lower than the market.

Example: Rate of Return Calculation Continued

- If the bank charged 5% at the beginning, what is the rate of return?
- 5%!
- (9000)(1.05 + 1.05^2 + 1.05^3 + 1.05^4) = $40,731
- Check if it is a lending-type or borrowing-type
- If the cash flow you have in your hands is a borrowing type,
- Criteria to look at the borrowing case and see if the internal rate of return is lower.
- With the lending type, you want your cash flow to be higher

Behavioral Economics

- Advantages
- Intuitive
- Easy
- Disadvantages
- Limited in cash flow types it works on (does not work fi there is more than one sign change)
- Scaling problem

- There is some psychology interacting with the data to lead us to behave in one way or the other.
- Guy was covering a series of experiments like this
- With all sorts of different audiences, he was getting different answers when the answer was very obvious.
- To calculate a rate, you don't need a reference point.

Scaling Problem
$10 -> $12
$1 -> $2

- You cannot compare stuff directly without knowing more specifics
- We cannot compare stuff because of this scale situation.
- How much money are we putting in, and how much money are we getting out?
- How are you going to rescue the internal rate of return?
- With the 1st option, you are putting down $10 and the 2nd option puts down $1
- Trying to normalize things with an extra $9, you can do something with it!

- If you have different projects at different scales with different initial investments, you do the following.
- If you use a small amount of money on this project and put the rest into the market, compare these to the big project and see which s doing better.

Example: Why Individual IRRs cannot be used for comparison purposes

- B is offering a higher IRR
- When we calculate the higher NPV, we find A has a higher NPV
- You cannot compare directly in these cases!

A-B

- This is the cash flow that I would have gotten if I picked A over B
- Whatever A is offering on top of B is better than the market.
- If you invest on the small project and invest the rest of the money on the market, you will be worse off.
- Borrowing type implies a negative NPV
- Both A-B and B-A direct you towards A
- It doesn't matter if you look at A-B or B-A but you want to look at the bigger project and take away the smaller project
- You need to take the difference and evaluate things as such.

Let's say you are sitting in a room and someone says you have 12% and I have 8%, how do I defend my 8%?

- The base you apply 8% will possibly give you less percentage but more overall

W 4 Dis 4-22-16
Monday -> Midterm Review
TA will have office hours on Tuesday from 2-5 (most likely, will email)

0. Suppose we can make an investment that pays $5,000 in 2 years and costs $4,000. Market rate = 10%.
0. Given that we're in a perfectly competitive market and all costs are due now & all revenue arrives at the end of the year. TVC = 5Q + Q^2/200; FC = $21,000; MR (Market Rate) = 10%

What is the minimum price that would make your year profitable?

0. Suppose we have 2 choices:

1 - Lend $1 and get back $2 the next period
2 - Lend $10 and get $12 back the next period
MR = 10%
Based on IRR, which should I pick?
Based on incremental IRR which choice should I pick?

Extra Exercise

Firm A wants to invest on a new machine in order to increase their revenue by $5000 in the first year and $7000 in the second year. The machine has an economical life time of 2 years. Disposal of machine is expected to be sold at $1000 after two years. Cost of the machine is $10842 at the beginning of the first year. What would be the IRR of this machine?

Solution:
Let's write the NPV, we know when it is zero r will be IRR:

W 5 M Lec 4-25-16
Midterm Revision ENG 110
Profit maximizing

- Profit = Total Revenue(Q) - Total Cost(Q)
- Producing one more unit will NOT make us more profit
- Equate the 2nd line equation to 0 and the demand curve

Exercise 1

- If I push the demand, we would be gaining $1045.
- Part C
- Giving you the new demand and the maximum you want to spend in the long term
- In the long-term, we want to maintain that but push the demand to the right
- In the long-term, we want to improve it.

Oligopoly

- Very few competitors (~4)
- We would continue moving from one box to the other until the intersection of one column or row means we cannot go elsewhere.
- We need the best option we have and they are playing around with that.

Future and present values

- FV = PV * (1+i)^n

Consumer Surplus

- Figure out who is running the service for the price higher than you are setting it

Exercise 5

- Bundle the commodities and offer 1 unit of A and 1 unit of B together at 120-epsilon.
- Without knowing which customer has a high valuation and which has low, you can extract all you can from consumer surplus
- Use a huge bunch of customers in the 50% range

Exercise 7

- Write down your assumptions!
- We can follow up and find new quantities, but we cannot figure out if we can change our quantity or not.

W 5 Kevin O.H. 4-26-16

- APR = percentage range for loans

Go over some current event examples

- If you have promotions, the demand curve stays like that and you become a perfectly competitive market in the long run.

W 5 Dis 4-29-16

- Form groups and get the draft done that is due in a couple of weeks.

Annuity: A series of fixed payments required from you or paid to you @ a specified frequency over the course of a fixed time period

0. Suppose we can make an investment that pays $5,000/year each year for 10 tears. The first payment starts next year. Given that the market rate is 11%, what is the maximum amount we are willing to invest?

0. You have take-out a set of student loans for college. Each year you borrowed $10,000. Because this is a set of student loans, you are charged no interest until year 5, one year after graduation. You plan on paying back the full loan in 10 years. How much do you need to pay each year if the interest rate is 10%?

- When considering time value of money, time is officially 5 years, but we treat it as 0 because no interest has been charged yet.

0. We have a choice of building a full-sized facility for $400 mm now, or building a reduced-size facility now for $300 mm and expanding in 25 years for an additional $350 mm, @ 6% interest? (Both will be used for 50 years)

NPV_full = $400 mm
NPV_red = $300 mm + $350 mm/(1.06)^25 = $381.6 mm

W 6 M Lec 5-2-16

- The cash flow for one and the cash flow for the other
- Compare the NPV

W 6 W Lec 5-4-16

- Rate of Return Calculation
- Two options to acquire a property at $300,000
- Finance through the seller with 20% down and balance due in 5 annual payments at 12%
- Pay cash with 10% discount
- What is the IRR for the loan offered by the seller?
- Bad thing is you have to pay everything up front.
- Whenever you have a payment, the later the better.

- Whenever you have cash flow, the sooner the better.
- With the other option, you will be paying the full price and as your payments are due, there will be an interest that is going to be charged on the total balance at the end of the year.
- Payments are delayed.
- Not obvious which option is better.
- You can use the methods we have learned so far to attack this problem.
- Which one would be better in this case and all of these will be gone over not from scratch but from the context of different scenarios
- Figure out the cash flow and then determine the internal rate of return.
- Once you have figured that out, the compare that to the market and determine it.
- When you apply those steps to this problem, the seemingly difficult thing of comparing these two options will be a lot easier.

- The first one is the option where you pay it up front and you don't pay anything for the next 5 years.
- The cost of the billing was $300,000
- Pay the full price over time with 20% of the payment right now
- The rest you are going to be paying over time with 12% interest rate applied.
- We know how to figure that out now!

- When I take the difference, take the lending type cash flow and right the net present value.
- Replace rate with an unknown and equate NPV to 0.
- High order polynomial so you try different rates to try to satisfy this equation
- The increment of this over that and I am looking at this and if this is more attractive than the market because it is lending type, I am looking for a high rate.
- If this rate, which is the rate of cash flow and is higher than the market, you pick paying the cash because it is higher than the market rate
- Since we are taking advantage of this discount, they amount to something better than the company's loan offer.
- We are picking the first option as our project.

Example: Incremental Analysis using Graphical Comparison

- The useful lives are 5 years for both, so what can we do to evaluate these options
- Calculate Net Present Value and they will be done or take the difference and find the Internal Rate of Return
- If r is the rate I calculated here and if that is greater than the market, I will pick High (the green)
- Here is a graph that shows you the following, take the cash flow of the green line which represents the net present value of the cash flow at different rates.

- x-axis is rates that could be applied to the NPV of the project and purple represents the NPV of the cash flow.
- NPV is a function of r and we can just graph it
- What could we see here that we couldn't see before?
- You have a more complete view of the situation and can see where the two rates intersect.
- If the rate is NOT that certain or we are not sure, this gives us a more complete view and if it happens to be 12%, don't worry about it since all over this range, this project will be better than that one.
- The choice of rate becomes NOT too big of a deal.
- If the market rate is out of this area, then you have to pay closer attention to the rate you are picking.
- If you have some funds allocated for refinement, let's allocate some money for some discount rate since it is material that is important in picking one project over the other.
- For a long time, we don't have a problem because we don't have to pay that much attention to the rate and we can decide which project over what rates.

IRR = NPV = 0

- Green has IRR = 15%, Purple has IRR = 20%
- Let's take the incremental difference and calculate the IRR of that difference
- At the cross point, the NPV is equal to each other.
- The NPV difference == 0
- This point is giving us where the IRR is for the increment and difference.
- If this rate is higher than the market (if the market is not he left side), you pick the green one!
- You pick it because it gives you higher NPV
- Both methods agree with each other and you can see the methods applied on this graph.
- If you take the IRR and find out it was higher than the market, then the increment you took over is more desirable
- Q. Why do two methods give us the same thing? Why do we need the NPV's to be equal?

I am looking at this and at some rates, green is better and at other rates, purple is better. You have to find what the market tells you and it really depends.

Example: Incremental Analysis using Graphical Comparison (3 things)

- Purple is the NPV of A
- Put down $2000 and put 410 for 20 years (1st one)
- Put $4000 and get 639 for 20 years (2nd one)
- Put $5000 and get 700 for 20 years (30 years)
- **Looks at the highest one for each point in the y-axis (highest NPW wins!)**
- Represents the difference of purple and green

- If MARR >= 9.6%, choose Alternative A.
- If 9.6% >= MARR >= 2%, choose Alternative B
- If 2% >= MARR >= 0%, choose Alternative C

Example: Incremental Analysis (with Do-Nothing option)

- If you have different lives, compare annual worth lives
- Normalizing can be done further and we can do this thing per year, how do we find per year cost by taking the time value of money into account?
- Per year benefit (whenever I have this machine) is $65
- Per year cost (whenever I have this machine) is -200(A/p, r, 6)
- The total (whenever I have this machine) is +65 - 200(A/p, r, 6)

Elements in Comparing Mutually Exclusive Alternatives (Choice Table)

- If the initial cost is different, here is the rule of thumb
- Consider many crossovers and you have many options (5 choose 2)

0. Rearrange the alternatives in order of increasing cost
0. Calculate IRR of the least expensive alternative to see if it is better than "Do Nothing" at MARR at 10%

- NPV_D = 0 = -$1000 + $117 (P/A, IRR_D, 20)
- IRR_D = 9.94% < 10%
- "Do Nothing"

0. Calculate IRR of the next alternative, B, to see if it is better than "Do Nothing" at MARR of 10%
0. Compare Defender B with the next alternative, A. This comparison must be made incrementally.

Choosing an Analysis Method

- All analysis methods provide consistent solutions.
- Comparing mutually exclusive options
- You have to pick this or the other
- You need to take the increments and find the internal rate of return of the market.
- If I have an option where I could invest 2,000 and another where I invest 4,000, this allows me to normalize my initial investments and decide from there.

Selection of an interest rate (Minimum Attractive Rate of Return)

- You are starting a company and running it for only 3 years.
- Get married and he wants to get something stable and get a job.
- Use this three year period investing on this idea.
- Projecting the cash flow and you know what you are going to get and you know your cash flow in front of you.
- You know how to calculate the value of that project.
- You need some money to get your idea off the ground
- You go to the bank for some money and they say you look very experienced and very knowledgeable, so they will give you a very good rate.
- Do you have anything valuable in collateral?

Criteria

- Internal and External Sources of Capital
- We are open to the public and selling our shares
- This money goes into the bin and we offer alternative ways of financing the companies
- This goes into the big bin and all sorts of money goes into this money pile
- Each source may have a different cost and what do we do?
- We can take some money and use a portion from a source and we can make a reasonable calculation about what this pile is.
- Money can come from the bank (external fund)
- Made some money and profit and we need to invest on the company (so that is an internal source)
- I have invested money before and we need to put some amount into my company
- Determine if a project is riskier than another, and if it is along the lines of my previous products, my cash flow will be more definite.
- Apple Car has a higher risk, so we need to apply a higher discount rate.

Sources of Capital

- We can look at the cost of each and determine a weighted average and find the average cost for my funds

Cost of Funds

- Cost of borrowed money depends not he firm's financial strength, ability to repay debts, the debt's duration, and whether the debt has collateral or unsecured
- Cost of capital, aka the weighted average cost of capital (WACC), assumes all the money and the people who are buying these stocks are relying on gaining traction
- To the company, we need to figure out the cost and markets have a way of calculating it and this is more of a finance topic

In choosing a discount rate, all the money we collect so far should find an average cost per year and we need an amount right now.

- Immediately, I need money if we go to the bank what are the costs for that?
- For all the projects that I considered so far, what was the best one I had to reject because I didn't have enough capital?
- Take the maximum rate and that is the discount rate we should use to apply to any project we are thinking of investing in the future.

W 6 Dis 5-6-16

0. San Fran spends $1 mm/year repainting the GG Bridge. You have developed a paint that lasts twice as long. If the city switches to your paint, how much would they be willing to pay. MARR = 4%

0. Suppose we need to buy equipment for a project. We have 2 options of equipment w/ no salvage value. Option A lasts for 2 years and costs $18,000. Option B lasts 5 years, and costs $40,000. MARR = 5%. Which should we choose? EUAC_A vs EUAC_B

0. An investor paid $8,000 to a consulting firm to analyze possible uses for a small parcel of land on the edge of town. In their report, consultants suggested 3 alternatives. Assuming 10% market rate, what should the investor do?

Alternatives	Total Investment	Net Annual Benefit	Salvage	Lifetime
A. Veggie Market	$50,000	$5,100	$30,000	15 years
B. Gas Station	$95,000	$20,500	$30,000	20 years
C. Small motel	$300,000	$46,000	$150,000	25 years

0. Suppose we are going to make an investment and we are offered two options:
1: invest 300,000 & receive a return of $105,519/yr for 5 years
2: invest 250,000 & receive a return of $12,329/yr for 5 years
MARR = 7%
Which option should we choose based on individual IRR's? Is this correct? How would a graphical representation f the options represent our solution? Write out choice tables.

W 7 M Lec 5-9-16

- We need to carry out decision-making over time.

If lines are unequal, then calculate the per year annual worth.

- If you have cost and benefits that are not dispersed over years, you will distribute those bulk values and take into account the time value of money.
- If you borrow money, you eventually have to pay it back.
- You have to deem this as your present value and there will be a uniform series

Q. Will it be the same as the equivalent annual worth where they meet at IRR?
A. Yes.

Q. When it comes to benefit, you don't want to touch it. Why not?
A. The benefit that you are going to be obtaining is different from later periods.

Q. How do you find equivalent worth if annual benefit changes halfway through?
A. You can get Net Present Value and redistribute it to Year 0.

- There are little things we have to worry about

- For a company, it is a little different because companies make profit and put things back into the business.
- Whatever funds the company has needs to be invested.
- Funds will be coming from various different sources
- Bonds are statements where you need money and those who lend money will get paid back a certain amount each year.
- If you have debt, you can purchase it if you feel like the company is doing well.
- Apple issues a lot of bonds
- IPO: when a company decides to sell its share to the public for trading purposes.
- More details of this purpose will be discussed in ENG 111
- Either you get into debt or you issue stocks
- With debt, you know how much you have to pay and how much it costs.
- With the shares of your company, it doesn't tell you how much money you get paid each year.
- There is an implicit cost because no one will be able to buy your shares if you collect and run with it.

For everybody: individuals, startups, established companies:

- A big cost item is insurance or healthcare.
- **Taxes** are a big thing and paying employees is a big factor too.
- When you calculate your tax options at the end of the year, a certain percentage will go into your taxes.

Governments impose taxes for two of the following reasons

0. To get revenue
0. Incentivizing behavior by putting taxes on certain things like cigarettes
- Creates disincentives for smoking

Rent is non-deductible and you cannot save in taxes.

- If you purchase a home instead of paying rent, this is exactly the same thing and you can deduct the amount you are paying.
- Government is incentivizing home ownership rather than renting.
- If companies improve people's lives, why are we taxing them?
- Debt obligations are taxed, but stock are not written off.

If you issue bonds and need to get paid back 7%, you will get loaned back money.

- That 9% and 7% is the immediate cost, but actual cost is less than that because money gets easier to pay back over time.
- Estimating the average cost of that to be 11%.
- This cost item cannot be deducted, and you need to pay back 1.8 million per year.
- For bonds, you need to pay back 1.4 million per year.
- The first two are debt financing, and the last one is equity financing.

Tax Savings (40%)

- Pay less taxes by this amount and you are going to recover a certain amount of it from taxes.
- The overall cost of my bank loan is NOT 1.8, but rather 1.08
- This is due to tax savings
- $8.52 million is the average weighted cost of capital
- Look at the ultimate cost i.e. tax savings when determining things

WACC_before-taxes = (0.2)(9%) + (0.2)(7%) + (0.6)(11%) = 9.8%

- Calculated by taking amount/total amount * rate of return and adding them all up

Shark tank

- One guy who is selling a plastic phone that does nothing.
- Serves as a phone so you don't get distracted.
- It doesn't do anything and it is just a piece of plastic

WACC_after-taxes = 8.52 million / 100 million = 8.52%

Whatever is in your radar is your 2nd best option and you integrate that into your calculations.

Investment Opportunities

- Look at rates of returns: for every dollar you put down, what is the rate of return you will get from this?
- You are going to have a situation like this where we have different opportunities in which you save in some costs and get new equipment later on.
- Internal rate of return is the same thing (IRR) == rate of return (RoR)

Decision making

- Given that we have different risk levels for different options, can we use the same discount rate for different options that have different risk levels.

Learning Objectives

- Use a range of estimates to evaluate a project
- Describe possible outcomes with probability distributions
- Combine probability distributions for individual variables

Example: Impact of Estimates in Economic Analysis

- The 3rd year demand is following the demand of the past ten years, but what happens if there is a recession int he next few years.
- Reduce this to a more simple situation and here is your outcome.
- Have a more detailed version of this estimate and include optimistic (O) estimate, most likely (M) estimate, and a pessimistic (P) estimate.
- With Beta distribution, you can put 4x more weight on the most likely scenario and come up with the average.

Mean value = (O + 4M + P) / 6

W 8 W Lec 5-18-16
Example: Economic Decision Trees

- Big chunk of the market that serves to those that are trying to reduce the level of uncertainty
- People are ready to pay a premium on information that fine tunes the probability distribution for these events
- See if outcome affects cash flow in one way or another
- See if it is possible to provide a service to see that there is value in having the cash flow in front of you in a more certain way.
- Make things more likely - oil example
- Using a general probability distribution, he can obtain this information from non-tailored detail and test this oil well and get data from it.
- Have a probability distribution that is specifically targeting this oil well and see that there is value with that and assume the cost of it is $1 million
- If you pay $1 million, the insurance company can know this and offer to negotiate this.
- Depending on your competition, then price will depend on that as well and see how the price of anything is affected by the intrinsic value of the commodity.
- See the relative negotiation power of each group.
- Take a weighted average and add them up to give you the expected value.
- This is NOT only done in economics but also in various disciplines.
- Should we stop there and take the expected value, or is there more to this we should be worried about?

- Ignore time value of money here

- Let's assume that the car costs $13,000.
- This is very basic and our argument is on this example
- Just looking at expected values would make sense in this case.

Seatbelt - Ralph Nader: Equivalent of Bernie Sanders 20 years ago

- He said we should have mandatory car seats and he had to fight for this and for consumer rights.
- Economists looked at the number of accidents
- After the law was passed, we had more accidents.
- People will behave in a different way because they feel more secure.
- For some reason, if the seatbelt isn't working, you can feel it with experience.
- There were more accidents but less deaths
- An economist suggested that if you want to reduce the number of accidents, put a sharp object in front of the driver's heart.
- Instill fear into the heart (literally) of the driver

- Only looking at expected values is NOT a good idea!
- Not only look at expected values, but also consider how risky the uncertain situation is.
- We can put our fingers in an actual metric and the risk metric

Startups are supposed to be the ones who take the rest: huge downsides, but huge upsides

- A lot of risks
- This is why we have venture capitalists and angel investors investing on these huge risks.
- There is too much risk involved and we don't want to screw them over.
- AirBnb: Stumble upon something on your daily life and this problem has NOT been solved before
- Framework of every successful startup.
- They stumble upon a problem and say they can start this.
- This huge chunk can subsidize these other ideas that did NOT take off.
- Invest on them and do NOT make them liable.
- This big guy whose idea worked out subsidizes the other ones that did NOT
- Very good system and people are able to go ahead and see if someone is going to invest on this.
- This is the time to take risks because you are young!
- If you have an idea, push for it and build shit!

Risk

- Risk can be thought of as the chance of getting an outcome other than the expected value.
- With 3% probability, you will be paying $13,000.
- Figure out how far it is from the expected outcome.
- Measures of risk:
- Probability of a loss
- Standard deviation

Example: Risk vs Returns

- Assume all projects are lending type, initial costs, and lives are the same!
- Standard deviation comes pretty close to a universal definition of risk
- Concentrate on loss and find a threshold for loss
- If a project comes with a possibility of having a loss higher than this, do NOT take that project.

Macroeconomics

- Looks at economics from a wide perspective i.e. country or region
- Consider production that takes place in an entire region.
- Can be thousands of services or products being used.
- Take a wide perspective and try to make this economy better.
- What is the criteria to make this economy better?

- Based on quantity of goods and services, which ideally should increase.
- Consumers will be buying more of them, which should be the objective here.
- Firms in a market economy and households are the primary focus
- Constitute the major economic activity

Business Cycle

- Sometimes, the economy is doing well
- Firms invest and hire people, as well as increase production levels
- Sometimes, though, things are going down, so let's fire some people.
- We are NOT expecting people to purchase as much as before, and this is called **downturn**
- Every company goes through these business cycles
- There are several different theories about this!
- Japan is in shambles!
- Prime minister said on one hand, this may happen, but on the other hand, another may happen.

Chicago School of Economics

- Affected the U.S. economy for the last 50 years
- Deregulation
- Small government
- Depend on free enterprise and no regulation of firms
- Reduce taxes and do NOT have the government produce stuff
- Leave them only (laissez faire capitalism)

Keynesian School of Economics

- Strong government
- Interfere with firms functioning

- Everyone has a different explanation of the business cycle
- Why it happens and how to get rid of ups and downs.
- Year after year, produce more goods and services

GDB

- Gross Domestic Product (GDP) is the total of all the goods and products that is produced within the borders of a country in a given period.
- A good assumption simplifies the case so you can understand it in a better, clear way.
- This is usually defined by a period of 1 year
- From one year to the next, how does this number change?
- That is the growth level of the economy.
- This grew by .02% or it contracted by -.02%, for example
- It grew by 3% (refers to the total goods and services produced from one year to the next)
- It better be hitting the expectations

- iPhones are NOT part of the U.S. GDP because they aren't made in the U.S.
- Toyota Camry's are considered part of the U.S. GDP because they are produced in Kentucky (even though Toyota is Japanese)

W 9 M Lec 5-23-16

- Midterm grades were redistributed and we paid close attention to what points were given to what topics
- She tried to make it as fair as possible (we shall see)
- Points for each question on the exam are different from what we will see in the solutions

The average was 73% on the test.

- It wasn't that difficult after all.

- Monetary policy is going to be covered in class
- No office hours this week but next week will have many Office Hours

Macroeconomics looks at economic behavior of large regions

- European Union (EU)
- Set economic rules together
- In a big setting, the most important players are households and firms
- This is correct for market economies
- In command economies, it is communist/socialist and the government plays a big role
- Resource markets - households are selling labor/capital/land/ entrepreneurship
- Assessing the performance of an economy is able to produce more and achieve this
- If this is successful, why don't we look over time and see how the things are increasing or not.
- Around 1990s, all countries converged to using GDP (Gross Domestic Product)

Gross Domestic Product (GDP): The total of all the goods and products that is produced within the borders of a country in a given period.

- Take all of these, add them up, and that is the GDP of the United States.
- Right at the beginning with that calculation, you can see what kinds of problems may arise from that objective and arrive at the things we are trying to arrive.
- Is this calculation method revealing things?
- See how I was doing compared to other countries.
- There have always been concerns articulated by politicians and industry about the relative shortcomings of GDP

- iPhones - not counted under GDP even though it is NOT produced in the U.S.

- Toyota Camry - those produced in Kentucky are counted under GDP. A Camry produced here doesn't look like the ones elsewhere

Q. What is so bad about producing iPhones in another country?
A. Discuss this under current event discussions.

- **Things produced in the U.S. are counted under our GDP**
- Many do not count iPhones and there is some misrepresentation of the situation
- It is good to know that this is a way of calculating GDP and if we say, "Hey, GDP dropped", then we have to keep in mind that there are components of GDP and we have to see why.
- What is going on?
- Is Toyota having difficulties and not able to produce as many as before.
- When things change, you have to figure out what the components are so you can investigate further.

- Bottled water - ?
- Sales of used cars - NOT counted under GDP because they are interior commodities.
- The production of that firm is NOT counted under U.S. GDP

Product market vs resource market
- People in resource market use entrepreneurship, land to get rent
- Favors an income approach (under 1 year) and use this info to find the GDP
- Find out how much salaries and wages are obtained
- The approach we will be using is the expenditure approach
- This does NOT look at the resource market and what are the total expenditures made by different groups
- Four major spenders
- Constitutes one big portion of the economy
- This is the expenditure that comes from consumers
- Firms go out and purchase stuff as well
- Whenever they purchase stuff, it is generally for investment
- Depends on the type of industry they are in.
- Government is relatively small compared to the other components of GDP
- Sizable government expenditure every year and we would have people buying our stuff.
- All sorts of other people buying our military products and people buying our movies, etc.
- Lots of purchasing happening from outside
- Called **exports**
- In return, we are **importing** stuff
- Some other things are NOT made in the U.S.

- If we consider the total consumption in 2015, we are NOT only considering stuff produced in U.S., but we also have to consider stuff produced outside of the U.S.
- If our government purchases it or our firm purchases it, take all those imports away and the net result we arrive at is the GDP.

Q. What about the loans that the U.S. gets from other companies?
A. Financial services are counted but NOT the loans themselves

- Talking about the real side, not the money we are using to measure and facilitate these transactions
- The loans should be counted and it has an effect on the economy

"National income" - what we have produced in one year

Shortcomings of GDP as a measure:

- Population increase
- Use it to understand if we are growing or not by 2%?
- Can we take this as the well-being of the country increasing or not?
- The total population is probably increasing as well.
- Not paying attention to the population increase will be concealing if it is going up or not.
- Take the entire GDP and divide it by the population by that year.
- Take per capita GDP rather than total GDP

- Manufacturing to service

- Overestimation of GDP because we are moving from a manufacturing economy to service economy
- We used to manufacture stuff and now we are producing services
- Engineers produce stuff, and if we take out the computer engineers, the other engineers will be doing something else
- Companies are no longer producing tangible stuff; they are now producing services and intangible stuff
- Childcare, food, etc. - all of this production was not counted under GDP
- All these services are now in the market place transacted now
- Counted as part of GDP, yet they were not counted before
- Hence, we had overestimates of GDP before.
- When you look at GDP in 1950s and compare it to now, we came a long way, but it is generally inflated because we are now counting those things.

- Does NOT account for product improvements

- The kind of laptop you would use 26 years ago would cost for around the same price as a modern laptop, but the quality is obviously much better now

- Measures disutility as utility

- Hurricane Sandy or other natural disaster
- Things that are leveled are NOT counted
- Things that were produced before are not accounted for

- Externalities

- We are using resources we pay for and don't pay for
- Borrow from the future and use these for future generations

- We create externalities with this attitude and GDP does NOT count for this
- Underground economy (8% to 14% of GDP)
- Does NOT count under GDP
- Developing country, look at the per capita GDP and there is NO way that it is 500.
- Underground is huge, especially in developing countries
- Look at money that represents total production of goods and services in an economy
- Income inequality
- 18 trillion dollars and it all goes to one person
- We don't care about this measurement in GDP
- We only care about total production
- Should be adjusted for price changes over time
- Multiply each commodity and service with the respective price and then add them up
- We need to be producing the exact same stuff, and if they are going up, it will look as if the GDP is going up
- Since the way we measure GDP is done by $, i.e. that is the unit we used, the unit changes from one year to the next
- This means it is not the same dollar value as before! We have to take inflation into account
- Correct for that using the following slides
- Equality and efficiency question
- If we have a GDP of 18 trillion dollars, what percentage of the GDP goes to what percentage of the population

Q. Disutility vs utility?
A. These kinds of things give utility to the population so we want more of them

- Xanax (the drug) is produced and counted under utility in GDP
- If you sell more and more Xanax, let's assume everything else is produced at the same amount, is that good or not?
- This implies people are really depressed
- Hurricane Katrina: we don't care about this because a lot of things were destroyed

Why do prices change?

- Do they tend to go up or down?
- We want to discuss what price changes are and where did they come from?
- Prices usually go up and we don't like this.
- However, if prices go down, it is usually really bad!
- We would like to stay as a producer in the diamonds business, and all of these would be affecting prices.
- Take a general view overall and this could tell us things about the system
- Why is there inflation?
- Inflation refers to the general price level increasing over time.

- Many theories for why there is inflation
0. Demand pull inflation
- We can do something about it to control it
- Source tells you if you have the tools to control it or not
0. Cost push inflation
- Cost of a major ingredient becomes very expensive suddenly
- Causes all the other prices to go up.
- The cost of ingredients can go up and this can cause problems if you have the same kind of demand
- Firms cannot produced the way they used to produce
- Either I am going to transfer this price increase to my consumer or I need to cut back from my resources

Aggregate Demand
- Let's try to understand the demand in relation to the general price level
- Just like in one product case, the demand is negatively sloped
0. Wealth effect
- Relation between price level and the total goods and services that are produced
- If the price changes, how does the demand level change?
- If in an economy the price level goes up, we have income and we have a stack of wealth, if we have a price level increase, then we will generally see a decrease in the demand of the product
0. Interest effect
- Capital is really mobile today; interest rates is matching that corresponding price increase
- Interest rate is a major determinant of the total investment in the economy
- If you wanted to start a company, you will try to borrow some money for various purposes
0. International trade effect
- Negative relationship between entry into a market for a country and price level
- What is the 1st source of someone determining if you are going to be lending money and this is the interest that I demand from you.
- If there is a person that demands money like that, all the interest rates will be related.
- We will start to understand this when we talk about money

It becomes more and more difficult to find labor and capital as we look for engineering talent
- As these resource become more and more scarce, what are we going to do if we would like to produce more?
- Move from Michigan to Los Angeles, California?
- Poaching - moving people around now and pay more for them and you are supposed to push the prices higher and higher rather than producing more and more.

- The only thing the economy is doing is pushing on the prices rather than producing more
- If an economy wants to produce more, then they will hire engineers from India.
- Not going to happen in bulk over one year.

Consumers want exactly the amount the production side is producing
- This is the price level we would like to pay as consumers
- This is known as our **equilibrium**
- This does NOT always occur somewhere close to the full employment
- It is possible for it to happen somewhere where we are operating under capacity
- People would NOT be employed and things are NOT being utilized efficiently
- The consumption side of the economy and the production side tend to agree with an equilibrium where there is unemployment in the economy

It is possible there are some firms and industries doing well even if the general kind is NOT doing well.
- What should we do to have this economy used to the fullest?
- All the sectors need to do this.

Adjusting for Prices: CPI, GDP Deflator
- Usually when you hear inflation is going up or down, the number they refer to is called Consumer Price Index (CPI)
- CPI - Consumer Price Index: A measure comparing the prices of consumer goods and services that a household typically purchases to the prices of those goods and services purchased in a base year.
- Clothes, housing appliances, etc.
- Base year 2000, in 2000, whatever the cost of this basket will create an index.
- We look at this same basket and ask how much it would be.
- We have created an index and we have followed this same basket of commodities and we need to check the importance of commodities and figure that out.
- If it has a high weight in that basket, the overall weight will be affected by that.
- From one year to the next, we are following the price increase and this is known as inflation.

Inflation Rates Graph (2006 - 2016)
- Before 2008, we were doing fine and producing a lot of stuff and this pushed the aggregate supply up a lot.
- If demand is increasing in the economy, then there is going to be NOT much production increase but only price increase.
- As we gave an example earlier, if the ingredient becomes expensive like oil prices, then we will see this As shifting to the left

- Cost push inflation
- Most inflation we observe is demand-pull

Just by changing the expectation, you can change the numbers

- Japan suffers from this a lot; cannot change expectations for the longest time and now they are suffering from unemployment
- They don't hire more people because they think it means less money in people's pockets.
- Expectations are negative and in an economy, we don't want very high inflation, and we don't want prices going down.
- We want a healthy level of inflation and this is about 2% inflation (golden percentage!)
- 2% inflation says that in general, it gives a signal to the firms
- Are you making plans to produce for the next year?
- What are you looking at?
- Prices (are they going down or up?)
- If there is some increase, give us a signal that the demand is strong going forward.
- 2% is what we are looking for, and central bank can affect this inflation rate and see how several parties can affect this.
- All of them try to target 2%
- Can be pushed back and forth to achieve 2% (Keynesian and Chicago economists)

- A healthy level of inflation is 2%
- Otherwise, it is seen as a signal of going forward and if the price level is going down, it is called deflation i.e. Japan
- Seen as a bad thing because it is a self-fulfilling prophecy
- Maybe we shouldn't invest going forward and rather we should fire people.
- Things were big in Japan in the 80s; what we see in China nowadays is like Japan in the 80s.
- Japan couldn't wake up from that nightmare later.
- We want to achieve a 2% inflation with a GDP close to full employment
- Keynesian say we can
- Chicago says we canNOT

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0. CPI (Consumer Price Index): measure of how average price of the basket of the consumer is changing over time - measure versus a base year of 100

Year	CPI
1985	100
2016	250

Macroeconomics: deals with measuring and maintaining the well-being of the economy of a large region

GDP (gross domestic product): All goods & services produced in a region in a given period of time.

- Toyota makes in U.S. borders
- Adds to U.S. GDP
- Adds to Japan's GNP

Calculation via Expenditure:
GDP = C + I + G + NX

- C == consumption by households i.e. buying a new laptop
- I == investment from firms in private sector
- G == government spending
- NX == (Exports - Imports)
- Usually countries heavy in services don't have enough raw materials

1.) Suppose we have a 1-commodity economy….
For 1996, milk costed $2.99 and 27.5 million gallons were made
For 1997, milk costed $4.00 and 30 million gallons were made
For 1998, milk costed $6.00 and 40 million gallons were made

- GDP deflator: a weighted index of price of goods and services produced during a specific period

What is the real GDP and the nominal GDP and the GDP deflator to relate these terms if the base year is 1996?

d_GDP = GDP_nominal / GDP_real * 100

2.) GDP was 5,800 in 2007
GDP for 2012 was 6,380 in 2007 prices & 7,800 in 2012 prices
What was the average inflation b/w 2007 & 2012?

3.) The nominal GDP increased from 6,379 to 6,420 from 2004 to 2005
The real GDP decreased from 6,018 to 5,681.
What was the inflation rate over the course of one year?

4.) In notebook
5.) In notebook

- GDP doesn't account for population differences or currency differences

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- Everything up to macro will be on the test
- 20% is from before the midterm, 80% is after!

Factors of Production

- Land: factories, and offices
- Labour, workers
- Capital: machines, money, assets
- Consists of your money and assets, not just machines
- Intellectual property falls under capital
- Entrepreneurship: the concept of the product

Market Structures

- Look at the chart!
- 8.5 x 11 - you get a full page and stuff it with whatever you want
- Everything moves form perfect competition down to monopoly
- PC - lots of sellers, homogeneous, no barriers to entry
- No price control
- As you move down to monopoly, you have a single company owning that part of the market and it is very hard to enter
- Monopolies such as the diamond industry are the only people that supply the products.
- Include utilities companies or things that are government subsidized
- Q. Does a natural monopoly require innovation?
- A. NO! They have been carved out on the map and the Westwood region has been carved out to a given company.
- Is there a real innovation in that? No not really. They can make it more efficient, however.
- Oligopoly - minimizing the other competitors advantage. Know the game theory stuff.

Profit Maximisation

- Generally, MR = MC
- Take the derivative of your cost and you have your marginal cost and marginal revenue.

Exercise 1

- Get the marginal revenue
- R: Q * D(Q)

Exercise 2

- Start off with one cell and see if there is an advantages
- Can have multiple equilibriums

Exercise 3

- Find Q*

Exercise 4
Part A

- Price is not given!

Part B

- Find IRR of both

Part C

- Find IRR of both

Annuity

- Payments are uniform
- Sum up each term as a Net Present Value
- If you plug it into an annuity formula, you get the exact same answer
- The only catch is it is one of that starts before the cash flow

Exercise 6

- APR is the annual % rate, which is a yearly rate
- Use annuity in this case
- 347 pays more than we should because it counts in the interest rate

Internal Rate of Return

- When borrowing, we want the lowest rate possible so we can maximize the amount we make
- If the NPV starts below 0 and moves up, that is a lending rate flow
- IRR is the intrinsic rate of return of your projects
- If I borrow $10 from you today, and I give you $11 tomorrow

Exercise 7

- Sort these from largest to smallest

Exercise 8

- The initial cash flow is positive

B

Exercise 9

- If you look at IRR and the chosen choice, do we have any say on whether this is a borrowing cash flow or a lending cash flow?
- Does it have to be explicitly given?
- E

Equivalent Uniform Annual Costs (EUAC)

- Correctly figure out how much they are per year

Exercise 10

- If you don’t use IRR, use NPV

Exercise 11

- Three options here, and we want to solve them by EUAC to compare them for which one is better

Exercise 12

- Draw out a block diagram (not necessary)
- Decision tree problem

Exercise 14

- Get NPV and bring it back to the year and move the probability back
- In this case, the EUAC because they are all different years

Weighted Average Cost of Capital (WACC)

- In ENG 111, we learn how to fund projects
- Either borrowing (issuing debt i.e. bonds) or we issue stocks (IPO's of companies)

- Debt is taxed, equity is not taxed

Q. If we give out bonds and coupon rates, are we liable for taxes?
A. Hell yeah we are. We are technically borrowing, so we are gaining money.

Exercise 20

- Weighted average problem

Exercise 21

- Higher numbers are better
- You are expecting to make more than 11.2%, which is better than the rejected proposal of 11%