Ted's utility over bunches of grapes x_1 and cans of soda x_2 is $u = x_1 x_2$. The price of a bunch of grapes is p_1 and the price of a can of soda is p_2. Ted has m to spend.

A. Write down Ted's budget equation.

B. What is the slope of the budget equation?

C. What is the slope of Ted's indifference curve at the point where he has 3 bunches of grapes and 2 cans of soda?

D. Write down an equation that implies that the slope of the budget equation is the same as Ted's indifference curve at the point (x_1, x_2). (Hint: This is the "Tangency" condition.)

E. What is Ted's demand function for Grapes in terms of p_1,p_2 and m?

F. If $p_1 = 2$ and $p_2 = 1$, and $m = 10$ how many bunches of grapes does Ted buy?

G. As Ted's income goes up, what happens to his demand for grapes? Are grapes a normal good or inferior good for Ted?

H. As the price of soda goes up, what happens to Ted's demand for grapes? Are grapes and soda substitutes or compliments for Ted?

I. Ted is knocked on the head and suddenly his utility function changes to $u = (x_1 x_2)^2$. Describe how his consumption changes. How do you know?

Sketch some indifference curves of the following utility functions:

A. $u = x_1 + 2x_2$

B. $u = 3x_1 + x_2$

C. $u = min\{x_1, 3x_2\}$

D. $u = max\{3x_1, x_2\}$

E. Which of these utility functions (A,B,C,D above) represent (weakly or strictly) convex preferences?

Chris likes Gold Chains, but now that he has a baby, he is a bit more modest than he used to be. His utility over gold chains (x_1) and baby food (x_2) is $u = 5000\,[ln\,(x_1)] + x_2$. The price of food is $p_2 = 2$ and the price of gold chains is p_1. Chris behaves optimally.

A. What is Chris's MRS for gold chains and baby food?

B. What is the slope of his budget equation?

C. We observe that Chris buys one gold chain and spends the rest of his money on baby food. What must the price of gold chains be?

A quart of milk (x_1) costs \$1. Eggs (x_2) cost \$1 each.

A. Draw the budget constraint for a consumer with $m = \$10$.

B. If this consumer has utility $u = min\{x_1, x_2\}$, how many eggs and quarts of milk does he consume?

C. The grocery store starts a promotion to give away up to 6 free eggs to every consumer for free. They still must pay \$1 for each egg after that. The price of a quart of milk remains \$1 and $m = \$10$. Draw the consumers new budget constraint.

D. What is the consumer's (from part b) new optimal bundle of eggs and milk?

Chris produces hit tracks (h) using talent (t) and days of studio time (s). The number of tracks h he produces is $h = s^{\frac{1}{3}} t^{\frac{1}{3}}$. Studio time costs \$1000 per day. As Chris always says "You can't buy talent." For now, let's assume he's right and that short-run Chris has talent fixed at $t = 1$. Since he was born this way, the talent costs him nothing.

A. How many days of studio time does Chris need to produce h tracks?

B. What are his marginal returns for studio time? Does his production function have increasing, decreasing or constant marginal returns for studio time?

C. If t was not fixed, does his production function have increasing, decreasing or constant returns to scale?

D. What is his short-run cost function for producing tracks when $t = 1$?

E. What is his marginal cost function for producing tracks? Does he have increasing, decreasing or constant marginal costs?

F. When $t = 1$, if every hit he produces earns $\$12,000$, how many tracks will he choose to produce? How many days of studio time does it take him and what is his profit?

G. Suppose Chris is offered the chance raise his talent to 1000 for $\$100,000$. Will Chris take the offer? How do you know?

The market demand for pet sharks is $q_d(p) = 1000 - p$. Suppose that there is a perfectly inelastic supply of pet sharks- $q_s(p) = 200$.

A. Sketch the supply and demand functions. (Be sure to put p on the y-axis!). Demonstrate on this graph that if the supply of sharks increases, then the equilibrium price decreases.

B. What is the equilibrium price for pet sharks?

C. If the government imposes a tax of \$100 per pet shark, what will happen to the equilibrium price? Including this tax, how much will consumers pay per shark?

D. Now suppose the supply function changes to $q_s(p) = p$. What is the equilibrium price and quantity of pet sharks?

E. The government imposes a tax of \$100 per shark, what is the new equilibrium price and quantity?

F. Draw the new supply function along with the demand function. Label the equilibrium price and quantities before and after the tax is imposed. Label the consumer surplus, producer surplus and area of Dead-Weight-Loss due to the tax.

G. What is the amount of dead-weight-loss? (Recall that the area of a triangle is half of the base multiplied by the height).

A consumer will be paid \$4000 this month and \$5000 next month. He may borrow money, or save at the interest rate r. That is, if he borrows money, he must pay back $1 + r$ times that amount he borrowed next month. He can save money and earn interest r. That is, he we will get $1 + r$ times the amount he saved back next month. Suppose he will not have the opportunity to borrow or save next month so we can focus our attention on just these two time periods. He will have to consume whatever he has left over next month. Below, let c_1 and c_2 be his consumption this month and next month respectively.

A. How much can he consume this month if he chooses to only consume this month? How much can he consume next month if he chooses to only consume next month?

B. Sketch his budget equation for consumption this month and next month. Label the intercepts and slope of the budget line.

C. If his utility function for consumption is $U = c_1^{\frac{1}{2}} c_2^{\frac{1}{2}}$ what will he choose to consume today and tomorrow?

D. What must the interest rate be so that the consumer neither borrows nor saves?

E. Suppose that the interest rate is what you found in part D, but then increases. What happens to his consumption c_1 and c_2? What can you say about how the consumer feels about this? Is he better off, worse off or can you not tell?

F. Suppose that the interest rate is what you found in part D so that the consumer is neither borrowing nor saving. What would happen to his consumption c_1 and c_2 if there were price inflation?

Suppose in a local market there are 10 consumer who demand Yoga classes. Their demand functions are $\frac{m_i}{2p}$. In this town, everyone has the same income of $m_i = 20$.

A. What is the price elasticity of demand for individual consumers when $p = 10$? Is the individual demand for yoga classes elastic, inelastic or unit-elastic? How does this change as price changes?

B. What is the market demand for Yoga classes? How many yoga classes are demanded at price $p = 10$?

C. What is the price elasticity of demand for the entire market? What can you say generally about what happens (approximately) to market demand at any price when price increases by 1%?

D. 10 more consumers move to town from Santa Barbara. Their incomes are also each 20, but these folks are real Yoga nuts. They spend all their money on yoga! Their demands are $\frac{m_i}{p} = \frac{20}{p}$. What is the new market demand (all 20 consumers combined) for yoga classes at $p = 10$?

E. What is the individual price elasticity of demand for the new consumers when $p = 10$? What is the new market price elasticity of demand with the addition of the new consumers when $p = 10$? Is market demand elastic, inelastic, or unit-elastic?

F. What are the individual **income** elasticities of demand for the consumers with demand $\frac{m_i}{2p}$ what about for the consumers with demand $\frac{m_i}{p}$? What can you say generally about what happens (approximately) to demand when *everyone's* income increases by 1%?

Well, Chris put his studio next to a shop that makes old lady clothes. Chris produces hits h using effort e. The more effort he uses, the more hits he makes. His production also depends on noise pollution p. The more noise pollution that Chris makes, the easier it is for him to produce hits. But, noise pollution makes it harder for the shop next-door to produce old lady clothes c which they make using wool w. They keep messing up when they hear the loud beats and so it costs them more wool. Their production functions are:

$$h = \sqrt{e} + 10p - p^2$$

$$c = 2\sqrt{w} - 4p$$

Assume hits sell for10 and lady clothes sell for10 as well. Effort e and wool w both cost 1. Assume noise pollution does not cost Chris anything to produce.

A) If the old ladies use $w = 100$ and Chris uses effort $e = 100$ and produces noise pollution $p = 3$, how many hits does Chris produce, how many clothes do the old ladies produce?

B) What are Chris's and the old ladies' profit functions?

C) What are the profit-maximizing levels of e and p for Chris?

D) What is the socially optimal level of noise pollution?

E) How much (in total) would the old ladies have to pay Chris to use the socially optimal amount of noise pollution rather than his optimal amount?

Two consumers have utility functions:

$$U_a = x_1^a x_2^a$$

$$U_b = x_1^b + ln\left(x_2^b\right)$$

Consumer a has 10 units of good 1 and consumer b has 10 units of good 2.

A) Write down the "Market Clearing Conditions" and the consumers budget equations.

B) Write down the consumers marginal rates of substitution and the equation for the contract curve only in terms of x_1^a and x_2^a. (x_1^b and x_2^b should not appear in the final equation).

C) Find both consumers demands for goods 1 and 2 (Assume $p_1 = 1$).

D) Solve for the equilibrium price of good 2. (Assume $p_1 = 1$). What are the equilibrium allocations at these prices?

Briefly describe the following (in words). Do not describe them in terms of math. Give an intuitive description as if you were describing them to someone without experience in economics or mathematics. Be as brief as possible!

A) What does it mean for a consumer's preferences to be **monotonic**.

B) What does it mean for a consumer's preferences to be **transitive**.

C) What does it mean for a consumer's preferences to be **convex**.

D) What is the marginal rate of substitution?

E) Why does finding where marginal cost equals marginal revenue tell us where a firm maximizes it's profit?

A quart of milk (x_1) costs \$2. Eggs (x_2) cost \$1 each.

A. Draw the budget constraint and some indifference curves for a consumer with $m = \$20$ and $u = min\{x_1, x_2\}$.

B. How many eggs and quarts of milk does he consume?

C. What if $u = min\{2x_1, x_2\}$, what is his optimal bundle?

D. The grocery store has a promotion. If you buy 10 eggs at regular price (\$1), all eggs after that are half price. Draw the consumers new budget constraint.

E. What is the consumer's new optimal bundle of eggs and milk?

A company produces ceramic lemons (l). There are two technologies available to produce these lemons. Technology 1 has smaller fixed cost ($100) but costs more to produce per lemon. Technology 2 has a higher fixed($1000) but is cheaper per lemon. The (variable) cost function using technology 1 is $l^2 + 10l$. The (variable) cost function for technology 2 is l^2.

A. Derive the ATV (average total cost) and AVC (average variable cost) for each technology.

B. Derive the marginal cost (MC) for each technology. Do the technologies have increasing, decreasing or constant marginal costs?

C. Given your answer to part B, do you expect that the technologies have increasing, decreasing or constant returns to scale? (You may assume that there is only one input: clay.)

D. Show that $MC = AVC$ at the minimum point of AVC **for technology 1.**

E. Which technology would the firm choose if the price of ceramic lemons was 50?

A local community shares a potato field. There are plenty of potatoes, but the more people that harvest them, the less each will find. In fact, if h is the number of people harvesting potatoes, the total number of potatoes harvested is $p = 10\sqrt{h}$. Potatoes can be sold for \$2 each. It costs \$5 to buy the tools to harvest potatoes.

A) If only one person harvests potatoes, how many can he gather? What is his profit?

B) If each harvester shares equally in the total harvest, and their are 100 harvesters, what is the profit for each harvester?

C) What is the socially optimal number of harvesters?

D) Harvesters will enter as long as they make positive profit. How many harvesters will there be if each decides independently whether to enter?

E) What tax could be imposed on harvesting so that the number of harvesters that enter is the socially optimal amount?

In a few words, describe the following in a way that a person who **hasn't studied economics or mathematics would understand**:

A. When are someone's preferences ***Convex***?

B. What is the ***Marginal Rate of Substitution*** [MRS]?

C. What is the intuitive meaning of the negative of the ***Price Ratio***?

D. Why do we often look for optimal bundles at places where the ***MRS equals the negative of the Price Ratio***?

Fill in the blank:

A. An **inferior good** is one in which the demand for that good _____ as _____ increases.
B. A **Giffen good** is one in which the demand for that good _____ as _____ increases.
C. When someone prefers to have **less** of a particular good, preferences are **not** _____.
D. When someone's preferences are **homothetic,** _____ is the same for two bundles which have the same ratio of x_1 and x_2.

Sketch a few indifference curves for each of the following utility functions.

A. $u = 3x_1 + x_2$
B. $u = min\{x_1, 3x_2\}$
C. $u = x_1 x_2$

A grocery store sells milk (x_1) by the gallon and juice (x_2) by the gallon. (It is possible to buy fractions of a gallon so you don't have to worry about discreteness.)

A. Draw the budget line for a consumer with $m = \$10$ when prices are $p_1 = \$1$ and $p_2 = \$1$ and then demonstrate what happens when m increases to \$20. *Label the slope and intercepts of both lines.*

B. **On a new chart**, draw the budget line for a consumer with $m = \$10$ when prices are $p_1 = \$1$ and $p_2 = \$1$ and then demonstrate what happens when p_1 increases to \$2. *Label the slope and intercepts of both lines.*

C. The grocery store starts a promotion. The milk costs $p_1 = \$0.50$ per gallon for up to 4 gallons. Consumers still pay $p_1 = \$1$ for each gallon of milk after 4. The price of juice remains \$1 per gallon and $m = \$10$. **On a new chart**, draw the consumer's budget constraint. *Label the slope and intercepts.*

D. Greg likes to drink milk-juice cocktails and has $u = min\{x_1, x_2\}$. How much milk and juice does he buy under the budget you drew in part **C?**

Ted's utility over bunches of grapes x_1 and cans of soda x_2 is $u = x_1 x_2$. (You can assume throughout that grapes and soda can be purchased and consumed in fractions so you do not have to deal with discreteness.)

A . The price of a bunch of grapes is p_1 and the price of a can of soda is p_2. Ted has m to spend. Write down Ted's budget equation. What is the slope of his budget line?

B . What is Ted's Marginal Rate of Substitution at the point (x_1, x_2)?

C .What is the slope of Ted's indifference curve when he has $x_1 = 4$ bunches of grapes and $x_2 = 3$ cans of soda?

D . Write down an equation that implies that the slope of the budget equation is the same as the slope of Ted's indifference curve at the point (x_1, x_2). (Hint: *"Tangency Condition"*)

E . What is Ted's **demand function** for **grapes** in terms of p_1,p_2 and m?

F . If $p_1 = 1$ and $p_2 = 2$, and $m = 10$ how many bunches of grapes does Ted buy?

G . As Ted's income goes up, what happens to his demand for grapes? Are grapes a normal good or inferior good for Ted?

H. As the price of soda goes up, what happens to Ted's demand for grapes? Are grapes and soda substitutes or compliments for Ted?

I. Ted is knocked on the head and suddenly his utility function changes to $u = (x_1 x_2)^2$. Describe, briefly, how his consumption changes.

Chris Demands $\frac{1}{2}\frac{m}{p_1}$ gold chains and $\frac{1}{2}\frac{m}{p_2}$ pairs of shoes when his income is m, the price of gold chains is p_1 and the price of shoes is p_2. (You can assume throughout that the goods can be purchased and consumed in fractions so you do not have to deal with discreteness.)

A. How many gold chains and pairs of shoes does Chris demand when $m = 1200$ and $p_1 = 100$ and $p_2 = 100$?

B. Draw Kayne's budget line **and mark his demand** from part A.

C. The price of gold chains increases to $p_1 = 300$. On the graph from part B, **draw the new budget line**.

D. How many gold chains and pairs of shoes does Chris demand after the price change in part C? Label this on your graph from part B.

E. Draw a third budget line on your graph from part B which will allow you to determine substitution and income effects for the change in demand for gold chains after the price change.

F. What bundle of gold chains and pairs of shoes does Chris demand under the budget from part E? *Label this on your graph.*

G. How much of Chris's change in demand for gold chains between part A and part C is due to **substitution effect**?

H. How much of Chris's change in demand for gold chains between part A and part C is due to **income effect**?

In a few words, describe the following in a way that a person who **hasn't studied economics or mathematics would understand**:

A. What does it mean for aggregate demand of a good to be ***Inelastic*** (with respect to price)?

B. Why is it optimal for firms to choose input levels which equate marginal revenue and marginal cost of the inputs?

Fill in the blank:

A. The production function $y = x_1^{\frac{1}{4}} x_2^{\frac{1}{2}}$ has _____ returns to scale.

B. The demand function $\frac{1}{2}\frac{m}{p^2}$ has price elasticity equal to _____.

C. When demand is very elastic and supply inelastic, the burden of a tax will fall primarily on _____.

D. The _____ curve crosses the average variable cost curve at it's minimum.

E. When marginal cost is larger than average total cost, the slope of the average total cost function is _____.

The market demand for pet sharks is $q_d = 300 - p$. The supply of pet sharks is $q_s = \frac{1}{2}p$.

A. What is the equilibrium price for pet sharks? How many sharks are sold at this price?

B. If **demand** for sharks **increased**, what would happen to the equilibrium price and the number of sharks sold in equilibrium?

C. The government imposes a tax of \$60 per pet shark. With the tax in place, how many sharks are sold? What is the new equilibrium price received by suppliers (p_s)? How much will consumers pay per shark including the tax (p_d)?

D. What is the amount of dead-weight loss due to this tax?

Chris produces tennis shoes using robot labor x_1 and human labor x_2. His production function is $y = x_1^{\frac{1}{2}} x_2^{\frac{1}{2}}$. Robot labor costs $w_1 = 5$ and human labor costs $w_2 = 20$.

A. Does this production function have increasing, decreasing or constant **marginal product** for robot labor (x_1)?

B. What is the **Technical Rate of Substitution** for Chris's production function?

C. Using cost minimization, find the **Conditional Factor Demand** for both inputs. (*That is, how much of each input does Chris use to produce y shoes if he is cost minimizing.*)

D. Using your result from part **C,** what is the Chris's cost function for producing y units of output?

E. Does Chris have increasing, decreasing or constant **marginal costs**?

Ted will earn \$200 this month and \$600 next month. Below, let c_1 and c_2 be his consumption this month and next month respectively.

A. Suppose the interest rate is $r = \frac{1}{2}$. How much can Ted consume this month if he chooses to only consume this month? How much can he consume next month if he chooses to only consume next month?

B. Sketch Ted's **Budget Line** for consumption this month and next month. **Label the slope and intercepts.**

C. If Ted's utility function for consumption is $U = c_1 c_2$ what will he choose to consume this month and next month? Is he a borrower or a saver?

D. Suppose the interest rate goes **down**. Is Ted better off, worse off or can you not tell?

E. What does the interest rate need to be so that Ted neither borrows nor saves?

A company produces fake refrigerators (r). There are two technologies available to produce these. Technology 1 has cost function r^2. Technology 2 has cost function $\frac{1}{2}r^2 + 10r$. Neither have any fixed cost.

A. Derive the ATC (average total cost) for each technology.

B. Derive the marginal cost (MC) for each technology. Do the technologies have increasing, decreasing or constant marginal costs?

C. Sketch the **long-run** average total cost curve facing the firm.

D. Over what range of output would the firm prefer to use technology 1 rather than than technology 2?

E. The firm is a price-taker. If the price of fake refrigerators is 20 which technology would they choose in the long run?

1. Briefly describe the following (in words). Give an intuitive answer as if you were writing for someone without experience in economics or mathematics. Be as brief as possible!

A) What is Pareto efficiency?

B) Why must marginal revenue be equal to marginal cost when a firm is maximizing it's profit?

Fill in the Blank

A) For a **Giffen good**, demand _____ as _____ increases.

B) The **first welfare theorem** tell us that, when there are markets for each good, equilibrium outcomes are _____.

C) When two goods are **perfect complements** and the price of one changes, the _____ effect for the change in demand for that good is zero.

D) In an Edgeworth box, the _____ is the set of all **Pareto efficient points**.

E) If a good has constant price elasticity of demand equal to -1, then the demand for that good decreases by _____ when price increases by _____.

Two consumers have utility functions:

$$U_a = x_1^a x_2^a$$

$$U_b = x_1^b + 2x_2^b$$

Consumer a has 20 units of good 1 and consumer b has 10 units of good 2.

A) Write down the "Market Clearing Conditions" and the consumers budget equations.

B) Write down the consumers marginal rates of substitution and the equation for the contract curve only in terms of x_1^a and x_2^a. (x_1^b and x_2^b should not appear in the final equation).

C) Find both consumers demands for goods 1 and 2 only in terms of p_2 (Assume $p_1 = 1$).

D) Solve for the equilibrium price of good 2. (Assume $p_1 = 1$). What are the equilibrium allocations at these prices?

E) Find an equitable equilibrium allocation for this market.

A company produces fake refrigerators (r). There are two technologies available to produce these. Technology 1 has cost function r^2. Technology 2 has cost function $\frac{1}{2}r^2 + 10r$. Neither have any fixed cost.

A. Derive the ATC (average total cost) for each technology.

B. Derive the marginal cost (MC) for each technology. Do the technologies have increasing, decreasing or constant marginal costs?

C. Sketch the **long-run** average total cost curve facing the firm.

D. Over what range of output would the firm prefer to use technology 1 rather than than technology 2?

E. The firm is a price-taker. If the price of fake refrigerators is 20 which technology would they choose in the long run?

A local community shares a persimmon orchard. There are plenty of persimmons, but the more people that harvest them, the less each will find. In fact, if h is the number of people harvesting persimmons, the total number of persimmons harvested is $p = 200h - 10h^2$. Persimmons can be sold for \$1 each. It costs each harvester \$100 to buy the tools to harvest persimmons.

A) If only one person harvests persimmons, how many can he gather? What is his profit?

B) If each harvester shares equally in the total harvest, and there are 5 harvesters, how many persimmons do each gather and what is the profit for each harvester?

C) Harvesters will enter as long as they make positive profit. How many harvesters will there be if each decides independently whether to enter?

D) What is the socially optimal number of harvesters?

E) The government wants to create permits to try to get the number of harvesters to the socially optimal level. What must the government set the cost of permits to so that the number of harvesters is the socially optimal amount?

Chris has a monopoly in the market for stuffed bears (q). Greg's demand for bears is $q = 24 - p$. Taylor's demand is $q = 24 - 3p$. Chris has constant marginal cost of 2 per bear and has no fixed cost (his cost function is $2q$). Assume that Greg and Taylor are the only two consumers of stuffed bears.

A) What is the aggregate demand for bears when the price is such that both Greg and Taylor demand bears.

B) What is the aggregate (market) price elasticity of demand when $p = 4$? Is demand elastic, inelastic or unit elastic?

C) Write down Chris's profit function if he sets one price for both Greg and Taylor. What is the profit maximizing price and number of bears?

D) If Chris can set a different price for Greg and Taylor, what price should he set for each and how many bears does he sell to each? How much more profit does he earn by price discriminating in this way rather than setting one price for both?

E) Chris wants to offer a different two-part tariff for each person. He will charge a flat upfront fee and price per bear for Greg and possibly a different fee and price per bear for Taylor. What entry fee and price per bear should he offer Greg? What about Taylor? What is his total profit from doing this?