

Review Problems for the Second Midterm – Answers Follow

1) Over the last 30 years, the labor market for high school and college graduates has exhibited two major trends:

Trend (i): At a national level, the number of college graduates grew at a faster rate than the number of persons whose education stopped at high school (high school graduates).

Trend (ii): At a national level, the ratio of:

[Median College Graduate Wages] has risen substantially.
[Median High School Graduate Wages]

Consider these trends as seen by a firm whose output depends on two inputs - high school graduates and college graduates so we can write the production function:

$$Q = F(\text{High School Graduates}, \text{College Graduates})$$

a) (10 points) Draw a set of isoquant/isocost lines for this firm. Assume the firm's technology does not change over time - i.e. its isoquant lines are fixed. Using words and your diagram, explain how Trend (ii) should change the mix of workers that the firm hires.

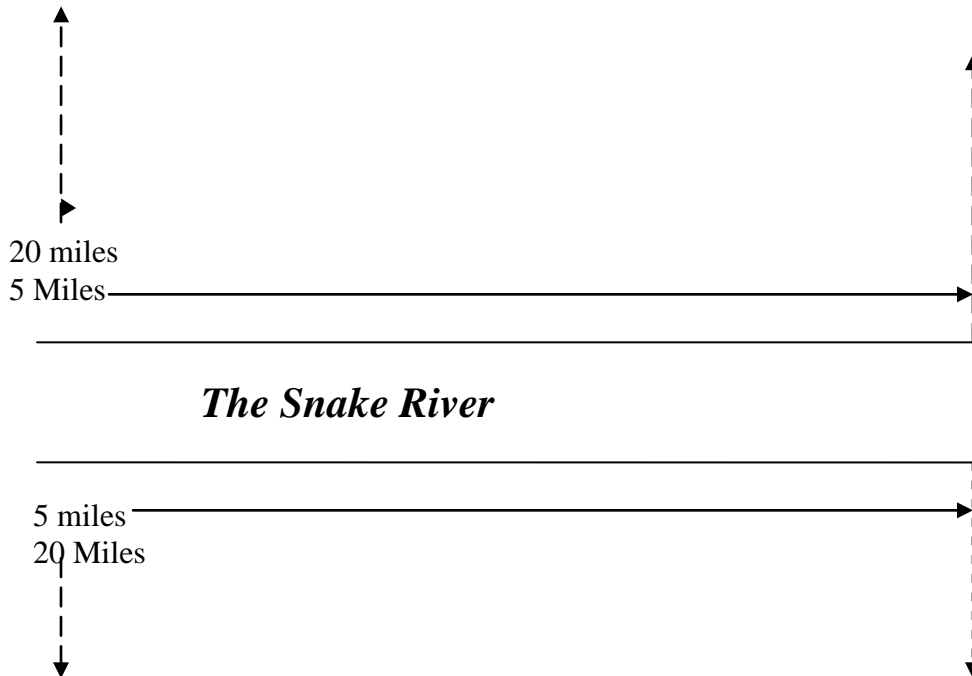
b) If all firms behaved like the firm you described in (a), what should have happened to the relative demands for college and high school graduates in the economy? Explain why this outcome would be *inconsistent* with the combination of Trends (i) and (ii).

c) Suppose that technology **did** change over the twenty-five period, Could changes in technology help to resolve the inconsistency you arrived at in (b)? Use an isoquant map to illustrate your answer.

2) Hula nuts are grown by a set of perfectly competitive very small farms along both banks of the Snake River. On each side of the river, the total land available for farming is a rectangle that runs along the river bank for five miles and extends back from the river bank for 20 miles (see sketch). Land right along the river bank is very fertile but land quality deteriorates further inland and so farms further away from the river have higher average costs.

In particular, all farms reach minimum average cost at 500 pounds of hula nuts but farms very near the river have a minimum average cost of \$2.00 per bushel, farms a half mile

back from the river have a minimum average cost of \$2.50 per bushel, farms a mile back have minimum average cost of \$3.00 per bushel and so on.



In odd numbered years (1999, 2001, 2003, etc.) the Snake River stays within its banks without flooding. In these years hula nuts are grown on all land within 10 miles of the river. In even numbered years (e.g. 2000, 2002, 2004), the Snake River floods its banks. This makes it impossible to grow hula nuts on the farms that lie within two miles of the river.

a) Using two separate diagrams, carefully draw the equilibria for the hula nut industry in odd numbered years and even numbered years (**Just draw the industry - no need draw individual firms**). Point out any differences between the two equilibria.

b) Suppose we wanted to set up three categories of farms:

- Farms that only produced in even numbered years
- Farms that only produced in odd numbered years
- Farms that produced in every year

Using the diagrams you developed in (a), explain which farms would fall into each group. If no farms fall into a particular group, explain why:

3) Acme Tofu is a monopolist selling tofu in the town of Rondelet. Acme's $AC = MC = \$1.00$ per pound at any level of production. The Rondelet demand for tofu can be written:

$$P = \$10.00 - .005Q \quad \text{where } P \text{ is the price per pound and } Q \text{ is measured in pounds:}$$

a) Calculate Acme's profit maximizing quantity and price.

b) Having established its market in Rondelet, Acme begins to think about expanding its market to the town of Lofton. For various reasons that are too complicated to explain, people in Rondelet and Lofton never communicate with each other in any way. Tofu demand in Lofton can be written:

$$P = \$8.00 - .002Q$$

If Acme wants to maximize total profits, should it plan on charging the same price in the two towns? If so, explain why. If not, calculate the price charged and quantity sold in each town.

c) Suppose the Acme plant experiences a fire that limits its capacity to 1200 pounds. It decides to deal with this problem by allocating 600 lbs of tofu to each of the two towns. Will this allocation maximize profits? Explain why or why not. If not, give a rough sense of how the allocation might be improved.

4) At different times, federal, state and local governments have intervened in markets by imposing various price controls. In 1971, President Richard Nixon imposed a partial set of price controls to help reduce the nation's inflation. The controls applied to many goods sold retail to consumers but they did not apply to many goods sold from one business to another. In particular, the law set a maximum price per pound at which chickens could be sold in food stores. But the law did not apply to feed corn that farmers used to raise the chickens. Feed corn prices continued to rise.

a) How would you expect the retail market for chickens to develop over time if the maximum retail price of chickens was fixed by law but the price of feed corn used for chickens continued to rise? Illustrate your answer using appropriate diagrams.

b) In a standard supply-demand equilibrium, anyone who is willing to pay the market price can purchase the good. Was that condition likely to hold in the 1971 retail market for chickens? Explain why or why not. If the condition did not hold, describe what other factors beyond price might determine which consumers purchased chickens.

c) It takes about 60 days to raise a chicken from the time the egg is laid to the time the meat is sold in a supermarket. Under normal conditions, ranchers like to feed a cow for four years before turning it into beef. Assume that 1971 price controls applied to the price of retail beef but not to cattle feed and these retail price controls were expected to continue. How, if at all, would the behavior of the retail market for beef have differed from the consumer market for chickens? Illustrate your answer with appropriate diagrams.

5) Suppose that the city of New Orleans, has sold Louie's Fine Eats a monopoly license to sell food on the grounds of the city zoo.

Over time, the council has received many complaints about Louie's high prices. Council members are reluctant to order Louie to lower his prices but they would like to give the zoo patrons some satisfaction. One council member introduces a bill that would give Louie a 15 percent subsidy on all his costs. Under the bill, Louie would receive a refund equal to 15 percent of his expenditure on wages paid to labor, food he purchases from wholesalers, electricity bills, heating bills, etc. "If we lower Louie's costs", the council member says, "Louie will lower the prices he charges."

A second council member disagrees. "Nonsense," he says. "Louie is a pure monopolist - we all agree on that - and if we lower his costs by 15%, we will just be increasing his profits. Customers won't benefit at all."

If Louie is, indeed, a pure monopolist, which council member (if either) has the correct argument? Illustrate your answer with appropriate diagrams.

6) Your cousin Sally, a self-employed designer, has developed a new back-pack which looks like a great seller. Because of its unique looks and construction, it is totally different from any other backpack. Sally has signed a contract with LL Bean, a retailer, who will make the back pack and sell it. LL Bean will pay Sally \$2.00 for every backpack it sells. LL Bean estimates that it will cost \$10.00 for the labor and raw materials to produce each backpack no matter how many backpacks they produce. They also estimate that demand for the backpack will be:

$$P = \$50 - .0001Q$$

a) If LL Bean didn't have to worry about the \$2.00 payment to Sally, what price would it charge for the backpack and what quantity would it sell? (Note the simple shape of the average and marginal cost curves.)

b) How does LL Bean's price and quantity change once it takes Sally's payment into account?

c) How does Sally feel about the change from (a) to (b)? If Sally could choose, within reason, LL Bean's price and quantity, what price and quantity would she choose? (Define what you mean by "within reason".)

7) Consider the kid's game of matching pennies. In this game two people each have a coin which they privately turn to heads or tails. The two people then simultaneously show their coin to the other person. Assume that person A wins \$1.00 from B if both coins show the same face (either both heads or both tails) and person B wins \$1.00 from A if the two coins show different faces). The payoff matrix for this game has this form with Person A's payoff first in each pair:

		Person B	
		Heads	Tails
	Heads	(1, -1)	(1, -1)
Person A			
	Tails	(-1, 1)	(1, -1)

- a) Does this game have a dominant strategy? Explain why or why not.
- b) If you were going to play this game a number of times, what would your strategy be? Explain your logic.
- c) Does this game have a Nash equilibrium? Explain why or why or why not.

Problems Repeated with Answers

1) Over the last 30 years, the labor market for high school and college graduates has exhibited two major trends:

Trend (i): At a national level, the number of college graduates grew at a faster rate than the number of persons whose education stopped at high school (high school graduates).

Trend (ii): At a national level, the ratio of:

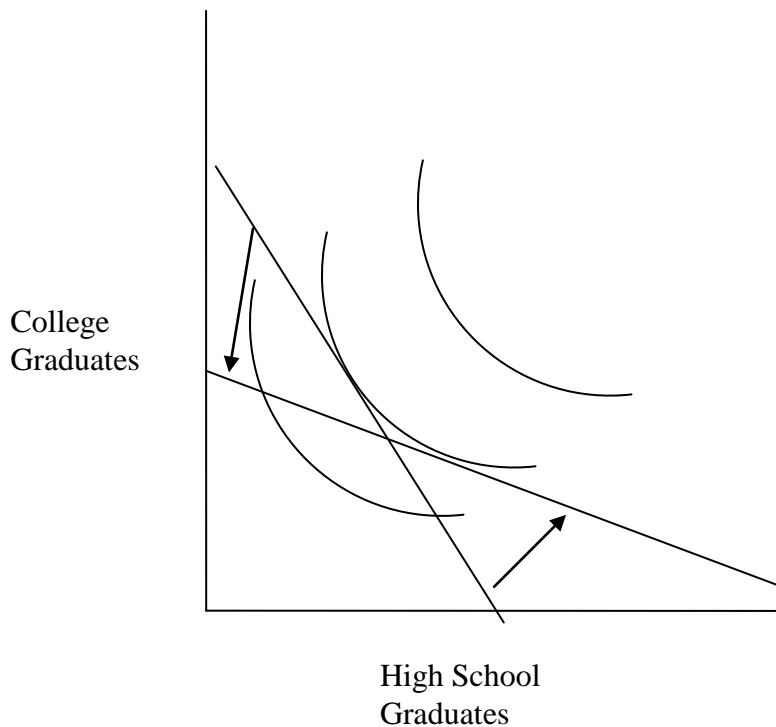
[Median College Graduate Wages] has risen substantially.
[Median High School Graduate Wages]

Consider these trends as seen by a firm whose output depends on two inputs - high school graduates and college graduates so we can write the production function:

$$Q = F(\text{High School Graduates}, \text{College Graduates})$$

- a) Draw a set of isoquant/isocost lines for this firm. Assume the firm's technology does not change over time - i.e. its isoquant lines are fixed. Using words and your diagram, explain how Trend (ii) should change the mix of workers that the firm hires.

Answer:



The clearest way to illustrate this is to focus on a single isoquant. If the graph is drawn with college graduates on the vertical axis, the rising relative wage of college graduates (Trend (ii)) will cause the slope of the isocost line to become less steep. If the old and new isocost lines are applied to the same isoquant, the new cost-minimizing point (tangency) on that isoquant will involve hiring fewer college graduates (because they are more expensive) and more high school graduates.

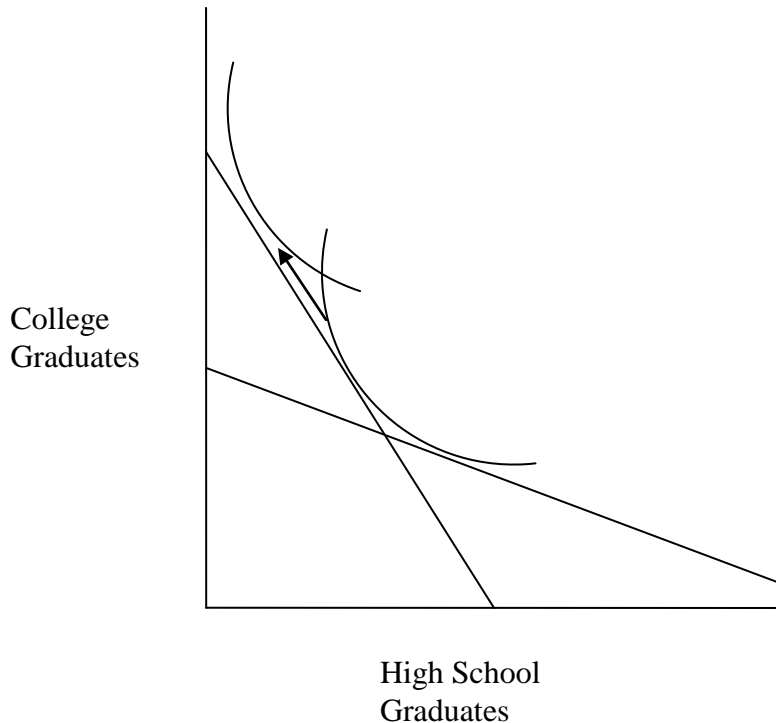
b) If all firms behaved like the firm you described in (a), what should have happened to the relative demands for college and high school graduates in the economy? Explain why this outcome would be *inconsistent* with the combination of Trends (i) and (ii).

Answer: If all firms behave like the firm in (a), the demand for high school graduates should have increased and the demand for college graduates should have declined. We can see this is inconsistent with Trends (i) and (ii) by reasoning as follows:

- We know from Trend (i) that the supply of college graduates has grown faster than the supply of high school graduates. Now we are adding the fact that the demand for college graduates is declining vis-à-vis the demand for high school graduates. Together these facts suggest the wages of college graduates should be **falling** vis-à-vis high school graduates and this is inconsistent with Trend (ii).

c) Suppose that technology **did** change over the twenty-five period, Could changes in technology help to resolve the inconsistency you arrived at in (b)? Use an isoquant map to illustrate your answer.

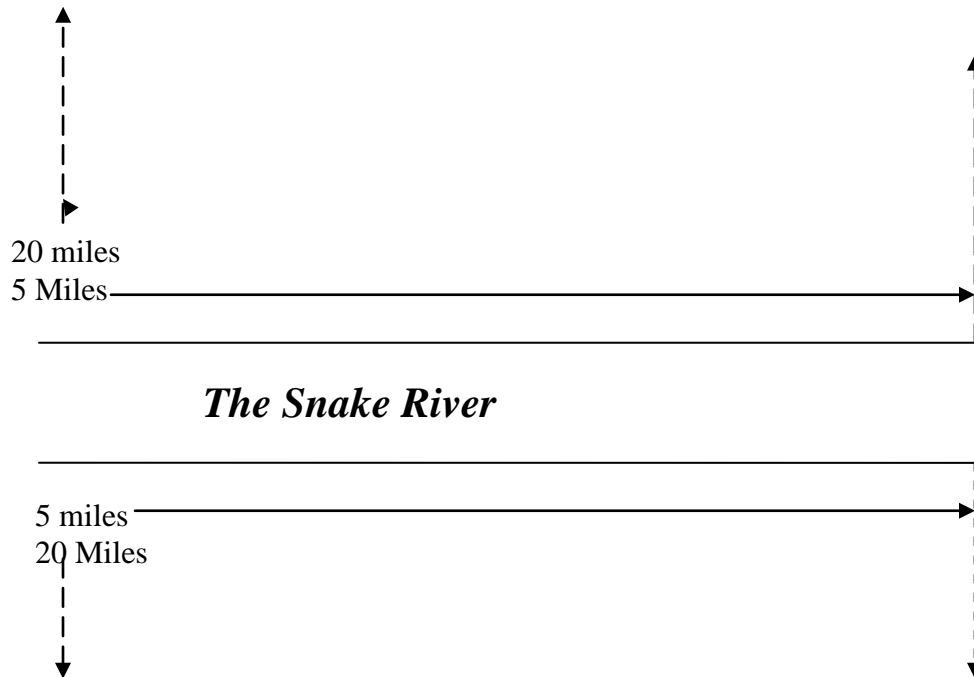
Answer:



Answer: The diagram above is a rough indication that technology could resolve the inconsistency if it shifted to favor college graduates over high school graduates. One way to show this with the original price line would be to focus on the original isocost line and draw a new isoquant that has a tangency involving more college graduates and fewer high school graduates. By itself, this shift in technology would raise the demand for college graduates. If the shift was strong enough, it would be able to offset the growing supply of college graduates and cause their wages to rise (vis-à-vis high school graduates) despite their growing supply.

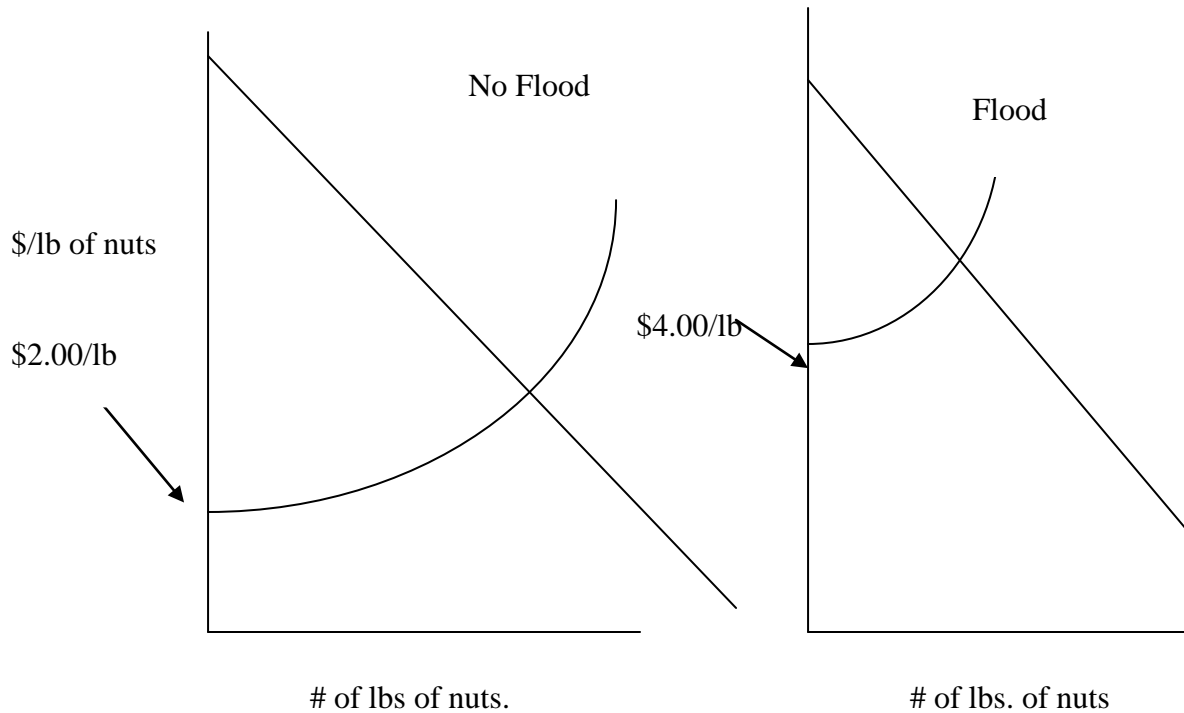
2) Hula nuts are grown by a set of perfectly competitive very small farms along both banks of the Snake River. On each side of the river, the total land available for farming is a rectangle that runs along the river bank for five miles and extends back from the river bank for 20 miles (see sketch). Land right along the river bank is very fertile but land quality deteriorates further inland and so farms further away from the river have higher average costs.

In particular, all farms reach minimum average cost at 500 pounds of hula nuts but farms very near the river have a minimum average cost of \$2.00 per bushel, farms a half mile back from the river have a minimum average cost of \$2.50 per bushel, farms a mile back have minimum average cost of \$3.00 per bushel and so on.



In odd numbered years (1999, 2001, 2003, etc.) the Snake River stays within its banks without flooding. In these years hula nuts are grown on all land within 10 miles of the river. In even numbered years (e.g. 2000, 2002, 2004), the Snake River floods its banks. This makes it impossible to grow hula nuts on the farms that within two miles of the river.

a) Using two separate diagrams, carefully draw the equilibria for the hula nut industry in odd numbered years and even numbered years (**Just draw the industry - no need draw individual firms**). Point out any differences between the two equilibria.



Answer:

See sketch above. In either year, the supply curve will be upward sloping reflecting the declining land quality and higher AC of farms further away from the river. A flood has the effect of taking the lowest cost farms out of production so the minimum price to elicit some supply now rises \$2.00 per bushel (the minimum AC of farms closest to the river) to \$4.00 per bushel (the minimum AC of farms 2 miles back from the river). The equilibrium market price rises as well though we can't say by exactly how much since we don't know anything about the exact shape of the demand curve.

b) Suppose we wanted to set up three categories of farms:

- Farms that only produced in even numbered years
- Farms that only produced in odd numbered years
- Farms that produced in every year

Using the diagrams you developed in (a), explain which farms would fall into each group. If no farms fall into a particular group, explain why.

Answer:

- The simplest case is the second case – farms that only product when there is no flood - these are the farms that lie between the river bank and two miles inland and they don't produce in even years when there is a flood.

- The first case - farms that produce in even years (flood years) are farms whose minimum AC's lie between the equilibrium prices in the two diagrams - i.e. in a non-flood year, the market price is too low to meet their minimum AC, etc.
- The third group involves the farms with min AC between \$4.00 and the equilibrium price in the non-flood years.

3) Acme Tofu is a monopolist selling tofu in the town of Rondelet. Acme's $AC = MC = \$1.00$ per pound at any level of production. The Rondelet demand for tofu can be written:

$$P = \$10.00 - .005Q \quad \text{where } P \text{ is the price per pound and } Q \text{ is measured in pounds:}$$

a) Calculate Acme's profit maximizing quantity and price.

Answer: Begin with two ideas:

- $MR = MC$
- With a straight line demand curve, the MR curve is also a straight line with the same intercept and twice the slope

So $\$10.00 - .01Q = \1.00 ; $.01Q = \$9.00$ and $Q = 900$ pounds of tofu. Given the demand curve, 900 pounds of tofu implies a price of \$5.50 per pound.

b) Having established its market in Rondelet, Acme begins to think about expanding its market to the town of Lofton. For various reasons that are too complicated to explain, people in Rondelet and Lofton never communicate with each other in any way. Tofu demand in Lofton can be written:

$$P = \$8.00 - .002Q$$

If Acme wants to maximize total profits, should it plan on charging the same price in the two towns? If so, explain why. If not, calculate the price charged and quantity sold in each town.

Answer: Given the total separation of the two markets, this is a potential opportunity for price discrimination – i.e. charging a different price in each market. Given the constant marginal cost, we can treat Lofton and Rondelet as two separate problems (If Marginal cost were rising, then production for Lofton would raise the cost of units being sold in Rondelet and so we would have to consider the two towns together).

Again, $MR = MC$ and so $MR = \$8.00 - .004Q = \1.00 , $Q = 1750$ lbs, and putting this back into the demand curve says: $P = \$4.50$ per pound.

c) Suppose the Acme plant experiences a fire that limits its capacity to 1200 pounds. It decides to deal with this problem by allocating 600 lbs of tofu to each of the two towns.

Will this allocation maximize profits? Explain why or why not. If not, give a rough sense of how the allocation might be improved.

Answer: We can see that this is a poor idea because if 600 pounds is allocated to each town, the marginal revenues in the two towns are different

At an allocation of 600 pounds, MR in Rondolet = \$4.00

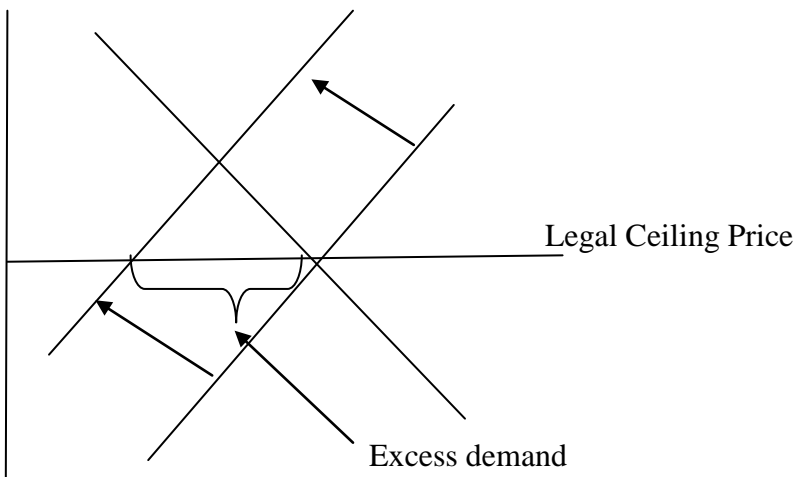
At an allocation of 600 pounds, MR in Lofton = \$5.60

It follows that total revenue can be increased if tofu is shifted from Rondolet to Lofton. Because we are just reallocating the 1,200 pounds – not producing additional tofu – total cost remains the same but the shifts will increase total revenue until the point where MR is equal in the two towns.

4) At different times, federal, state and local governments have intervened in markets by imposing various price controls. In 1971, President Richard Nixon imposed a partial set of price controls to help reduce the nation's inflation. The controls applied to many goods sold retail to consumers but they did not apply to many goods sold from one business to another. In particular, the law set a maximum price per pound at which chickens could be sold in food stores. But the law did not apply to feed corn that farmers used to raise the chickens. Feed corn prices continued to rise.

a) How would you expect the retail market for chickens to develop over time if the maximum retail price of chickens was fixed by law but the price of feed corn used for chickens continued to rise? Illustrate your answer using appropriate diagrams.

Answer: As the cost of feed corn continues to rise while the retail price is fixed, chicken producers recognize they can't make any money. As a result, producers will start dropping out of the market and the supply curve will shift inward.



Normally, the supply curve shifting inward would cause the price to rise. In this case, however, the price is fixed by law and so it can't rise. As a result, a gap opens up between the quantity demanded and the quantity supplied at the controlled retail price. (Such gaps are sometimes called excess demand.)

b) In a standard supply-demand equilibrium, anyone who is willing to pay the market price can purchase the good. Was that condition likely to hold in the 1971 retail market for chickens? Explain why or why not. If the condition did not hold, describe what other factors beyond price might determine which consumers purchased chickens.

Answer: No, it is not likely to hold. In the standard equilibrium, the price is allowed to rise or fall to bring supply and demand back into balance (in this case, it would have risen). But the legal restriction precludes that. In this situation, not everyone who wants a chicken at the fixed price can get one. Some other factors might be first-come, first served - i.e. who gets to the supermarket early in the morning, bribing suppliers, etc. (As a side note, Rachel Wilch, currently on leave from DUSP to work in New Orleans, wrote last week about bottlenecks in food distribution in New Orleans such that supermarkets' shelves were always empty by mid-afternoon).

c) It takes about 60 days to raise a chicken from the time the egg is laid to the time the meat is sold in a supermarket. Under normal conditions, ranchers like to feed a cow for four years before turning it into beef. Assume that 1971 price controls applied to the price of retail beef but not to cattle feed and these retail price controls were expected to continue. How, if at all, would the behavior of the retail market for beef have differed from the consumer market for chickens? Illustrate your answer with appropriate diagrams.

Answer: The difference between the two markets begins with the fact that chicken farmers have a very small amount of supply in the pipeline (60 days) while ranchers have 4 years of supply in the pipeline. If ranchers expect the retail price controls to continue, they, like the chicken farmers will conclude that they can't make money selling cows and this conclusion will apply not to only to new cows, but to cows they are currently raising - i.e. they will lose money by raising a current two-year old cow for the next two years. Therefore, the ranchers may decide to sell off all their stock now and, in the short run, supply may actually increase. In the longer run, the supply curve, like the supply curve for chickens, will shift to the left.

5) Suppose that the city of New Orleans, has sold Louie's Fine Eats a monopoly license to sell food on the grounds of the city zoo.

Over time, the council has received many complaints about Louie's high prices. Council members are reluctant to order Louie to lower his prices but they would like to give the zoo patrons some satisfaction. One council member introduces a bill that

would give Louie a 15 percent subsidy on all his costs. Under the bill, Louie would receive a refund equal to 15 percent of his expenditure on wages paid to labor, food he purchases from wholesalers, electricity bills, heating bills, etc. "If we lower Louie's costs", the council member says, "Louie will lower the prices he charges."

A second council member disagrees. "Nonsense," he says. "Louie is a pure monopolist - we all agree on that - and if we lower his costs by 15%, we will just be increasing his profits. Customers won't benefit at all."

If Louie is, indeed, a pure monopolist, which council member (if either) has the correct argument? Illustrate your answer with appropriate diagrams.

Answer: The first council member is right. The structure of the subsidy should lower Louie's average and marginal cost curves. The lower marginal cost curve will intersect the (unchanged) marginal revenue curve at a higher level of output and sales which means a lower price. See diagram below **where for clarity, average cost curves are omitted.**



If the government had given Louie a fixed amount of money – a grant that did not depend on what he sold – then the second council member would have been right. Louie would have not changed what he was doing. But the 15 percent subsidy expands the range of sales for which marginal cost is below marginal revenue and so Louie will produce these extra units to add to his profit.

6) Your cousin Sally, a self-employed designer, has developed a new back-pack which looks like a great seller. Because of its unique look and construction, it is totally different from any other backpack. Sally has signed a contract with LL Bean, a retailer, who will make the back pack and sell it. LL Bean will pay Sally \$2.00 for every backpack it sells. LL Bean estimates that it will cost \$10.00 for the labor and raw materials to produce each backpack no matter how many backpacks they produce. They also estimate that demand for the backpack will be:

$$P = \$50 - .0001Q$$

a) If LL Bean didn't have to worry about the \$2.00 payment to Sally, what price would it charge for the backpack and what quantity would it sell? (Note the simple shape of the AC and MC curves in this problem).

Answer: This is a straight problem of $MR = MC$, etc. First, we can see that the cost curves are

$AC = MC = \$10.00$ for all output (based on the information in the problem). And because we have a straight line demand curve, Marginal Revenue is also a straight line with the same intercept and twice the slope:

$$\text{So: } MR = MC \text{ becomes } \$50.00 - .0002Q = \$10.00$$

$$.0002Q = 40$$

$$Q = 200,000$$

Plugging Q into the demand curve: Price = $\$50 - .0001Q = \30 per back pack

b) How does LL Bean's price and quantity change once it takes Sally's payment into account?

Answer: Sally's \$2.00 payment means that $AC = MC = \$12.00$ per back pack rather than \$10.00.

$$MR = MC \text{ becomes } \$50 - .0002Q = \$12.00$$

$$.0002Q = 38$$

$$Q = 190,000$$

$$P = \$31.00$$

c) How does Sally feel about the change from (a) to (b)? If Sally could choose, within reason, LL Bean's price and quantity, what price and quantity would she choose? Explain your answer and, as part of your explanation, define what you mean by "within reason".

Answer: Sally's income is based on the number of backpacks LL Bean sells so she isn't very happy about the higher price and smaller quantity sold. If she could choose "within reason", she would probably say that the best solution (for her) would be that LL Bean sell as much as it can without losing money on backpacks – i.e. set the price at \$12.00 per backpack. If we plug this number into the demand curve, quantity would equal 380,000 backpacks sold.

7) Consider the kid's game of matching pennies. In this game two people each have a coin which they privately turn to heads or tails. The two people then simultaneously show their coin to the other person. Assume that person A wins \$1.00 from B if both coins show the same face (either both heads or both tails) and person B wins \$1.00 from A if the two coins show different faces). The payoff matrix for this game has this form with Person A's payoff first in each pair:

		Person B	
		Heads	Tails
Person A	Heads	(1, -1)	(1, -1)
	Tails	(-1, 1)	(1, -1)

a) Does this game have a dominant strategy? Explain why or why not.

Answer: No dominant strategy. For example, From A's perspective, a dominant strategy is one that A would play no matter what strategy B used. That is not the case here. If A knew B was going to show heads, A would also show heads. If A knew B was going to show tails, A would also show tails.

b) If you were going to play this game a number of times, what would your strategy be? Explain your logic.

Answer: The only sensible strategy is to randomly choose each time to show heads or tails. If you don't choose randomly but rather follow any predictable pattern, there is a danger that your opponent will figure out the pattern, will know what you are going to do next and so will know what move to make. This is what is called a "mixed" strategy – i.e. using a coin flip to create a random combination of the two "pure" strategies, heads and tails.

c) Does this game have a Nash equilibrium? Explain why or why or why not.

Answer: In class, we discussed a Nash equilibrium in terms of pure strategies. If we only consider either choosing Heads or choosing Tails, then there is no Nash equilibrium. Whatever box we are in, one player or the other has an incentive to move.

If we are allowed to consider mixed strategies – i.e. using a coin flip to choose whether we show heads or tails – then there is a kind of Nash equilibrium in the sense that if both players are using this mixed strategy, neither has an incentive to change. (This last point is just for your own information – we won't get into mixed strategies on the exam.)

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11.203 Microeconomics
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