

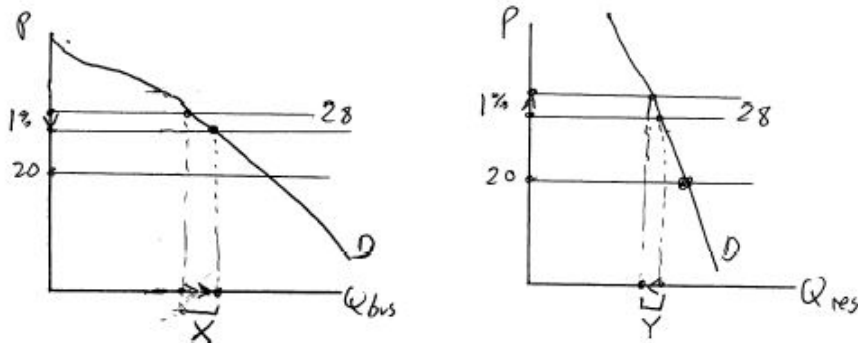
**G406: BUSINESS AND
GOVERNMENT**

**EXTRA PROBLEMS
(CH 9,10)**

CHAPTER 9: NATURAL MONOPOLY

9.1 An electric utility has a marginal cost of 20 for both residential and business customers. Business customers have more elastic demand. The utility could charge 28 to all customers and it would break even, earning enough to cover its fixed cost of 100, though a monopoly would charge even more. Assume that at $P=28$, the quantity demanded by business customers is the same as for residential customers. Explain why the utility should use Ramsey pricing and charge more to residential customers if its goal is to maximize total surplus while not making a loss.

If the utility charges more than 28 to residential customers, it can charge less to business customers, but it must keep its total profit from falling below zero.



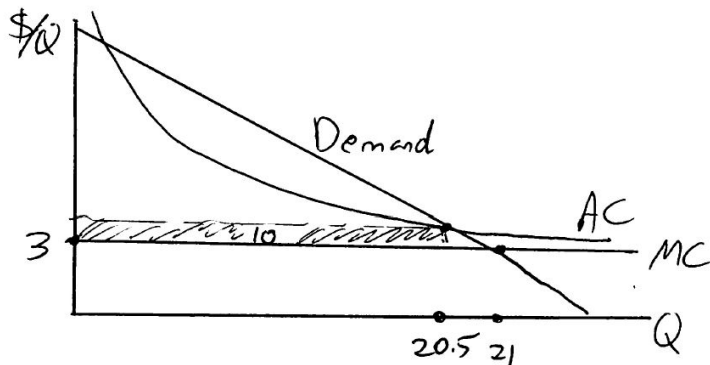
We are told that business customers have more elastic demand. As a result, if we lower the price to them by 1% and raise it by 1% to residential customers, the gain in sales X to businesses will be greater than the loss Y to residences (it might be a gain of $X=2\%$ from business sales and a loss of $Y=.5\%$ from residential sales, for example). Thus, the utility's revenue will actually rise.

The triangle loss from the business market will fall by $.5(1\%)(28)X$. The triangle loss from the residential market will rise by $.5(1\%)(28)Y$. The combination of triangle losses from both markets will fall, since X is bigger than Y . Thus, the utility can actually make more profit by charging more to residences and less to businesses while also reducing total triangle losses.

9.2 A company has a fixed cost of 10 and a marginal cost that is constant at 3. The demand curve is $P = 24 - Q$. Explain why this is a

natural monopoly. Contrast regulation that sets the price at marginal cost with regulation that sets it at average cost. How do the outputs and surpluses differ?

This is a natural monopoly because the average cost curve is downward sloping, so whatever firm is biggest has the lowest average cost and can underprice its competitors. If all firms priced at marginal cost, they'd all price under average cost, which couldn't be an equilibrium, and in fact it would be inefficient to have production by more than one firm since that would raise production costs for the same output.



A regulator could set $P=MC$ so $P=3$, but then the firm would have profits of -10 from its fixed cost and would exit the industry. Thus, marginal-cost pricing requires a subsidy of 10 . Output would be such that $3 = 24 - Q$, so $Q=21$.

A regulator could instead set $P=AC$. We need to compute average cost to find the value. Total cost is $TC=10+3Q$, so average cost is $AC=10/Q + 3$. If the price equals average cost, then from the demand curve, $24 - Q = 10/Q + 3$. We can rewrite that as $21Q - Q^2 = 10$. That yields a price above marginal cost, so there will be a deadweight loss, with area equal to half of the increase in price from $P=AC$ to $P = MC$ times the reduction in quantity.

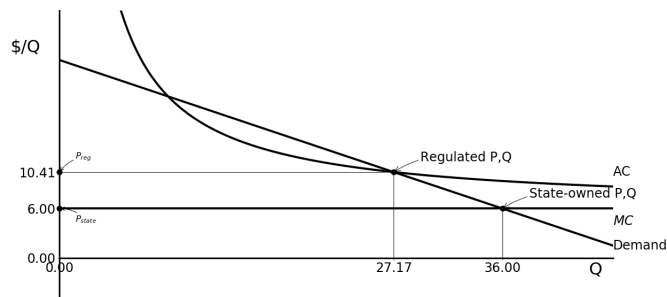
Solving out, we get $Q = 20.5125$, so $P \approx 3.5$ and $AC \approx 10/20.5 + 3$ which is also about 3.5 . The deadweight loss would be about $.5 (3.5-3)(21-20.5) = .125$.

9.3 A water company has a fixed cost of 120 and a constant marginal cost equal to 6 . It faces the demand curve $Q = 48 - 2P$.

(a) Show using a diagram how the price would be determined under rate-of-return regulation or a price cap. You do not need to calculate the exact price.

(b) If the state bought the company and ran it, what price would maximize social surplus, and what subsidy would be needed? Give specific numbers.

(a) The regulatory commission would set the price so that at the quantity demanded, the price would equal the average cost. Since price equals average cost, the water company can break even and continue to operate.



You can tell that the average cost curve is declining because there is a fixed cost but the marginal cost is not rising.

(b) The price would be $P=MC = 6$. There would be no triangle loss then. To cover its fixed costs, the company would need a subsidy of 120, the size of its fixed cost. Note that a fixed cost is fixed, independent of the amount of output. Thus, the fixed cost is 120 no matter what the quantity is— that’s the definition of fixed cost. It is not, for example, equal to $120 \cdot Q$.

9.4 Why do the forces of competition not achieve surplus maximization in an industry that is a natural monopoly?

A natural monopoly has a downward sloping average cost curve. Thus, if the price equals a firm’s marginal cost, it is less than average cost and the firm cannot survive. This means that firms undercutting each other’s prices cannot achieve an equilibrium with $P=MC$. It is not enough to say that a monopoly has lower surplus—you need to explain why the forces of competition permit the monopoly to persist.

- 9.5 A state park is selling firewood at \$10/bundle and juice at \$2/bottle. Firewood costs the park \$7/bundle and juice costs \$1/bottle. The elasticities of demand for firewood and juice are 1.2 and 0.4. In what direction could the park change prices to increase profit while leaving consumer surplus unchanged?

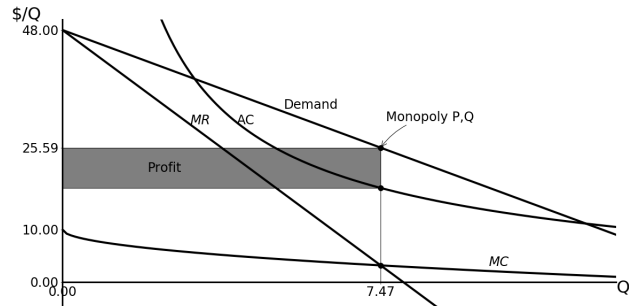
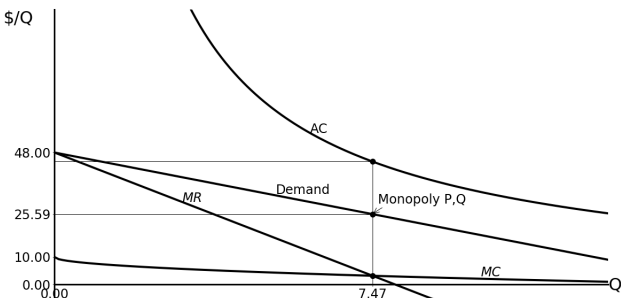
*Ramsey pricing says that $-Elasticity * (P - MC) / P$ should be the same for each good. Right now that expression is equal to $1.2(10-7) / 10 = .36$ for wood and $0.4(2-1) / 2 = .2$ for juice. The price of wood should be lowered and the price of juice should be increased so the two values come closer to each other. A common mistake is to look just at the elasticities, but $(P - MC) / P$ matters too. Also, the aim is not to get $-Elasticity * (P - MC) / P = 1$, as it would be in a monopoly—it is just to get that expression equal for wood and for juice.*

- 9.6 The state is thinking of auctioning off a license for the right to supply water to Middle City. Several companies are going to submit sealed bids for a total payment to the city (not a price per unit to the consumer) and the highest bid will win. The companies have different cost curves, and don't know each others' costs.

(a) Use a diagram to show the *most* the lowest-cost firm would be willing to pay to get the license.

(b) Would the winner of the auction pay exactly the amount you found for him in (a)?

*(a) If demand is so weak that the low-cost firm's average cost curve lies above the demand curve everywhere, then neither firm submits a bid. The left diagram shows that. The right diagram shows a more normal situation. The lowest-cost firm would find the monopoly price by finding Q such that $MR=MC$ and then seeing what price that Q would support. This would allow it to calculate the monopoly profit of $AC * Q_m$, the shaded area, which is the most it would be willing to pay.*



(b) *The winner would pay something less than the value in (a). If the lowest-cost firm bid (a), it would have zero surplus in the end. Therefore it will bid less, hoping that it is still the highest bidder. If it was common knowledge what every firm's cost was, the low-cost firm would bid the monopoly profit that the second-lowest-cost firm would make if it won, and the second-lowest firm would bid that amount too (or, the low-cost firm would bid 1 dollar higher to make sure it won). If nobody knew who had the lowest costs, all firms would bid somewhat less than their maximum, zero-surplus, ceilings.*

- 9.7 If the government auctions off the right to provide toll road service and requires the winner to maintain the road quality but does not regulate price, what are the implications for social surplus and government revenue compared to rate-of-return regulation?

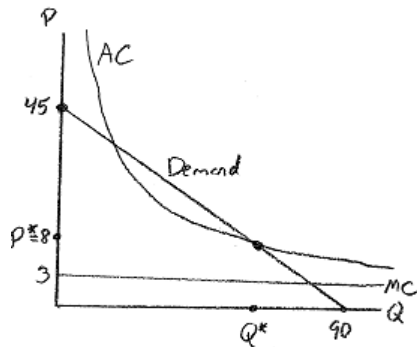
It raises government revenue (as with Indiana tollways) because the firm will charge a monopoly price to drivers and reduce costs, but they will charge a monopoly price and social surplus will fall compared to rate-of-return regulation.

- 9.8 Only one company is distributing electricity in Smallsville. Its fixed cost is 370 and its marginal cost is constant at $MC=3$. The demand for electricity is $Q = 90 - 2P$.

- (a) Show using a diagram how the price would be determined under rate-of-return regulation or a price cap. What would the price be?
- (b) Suppose instead of normal rate-of-return regulation, the state utility commission chose a price and a subsidy for the electric company.

What price would maximize social surplus and what subsidy would be needed? Give specific numbers.

(a) The regulatory commission would set the price so that at the quantity demanded, the price would equal the average cost. Since price equals average cost, the water company can break even and continue to operate. The intersection is where $AC = 370/Q + 3 = 45 - Q/2$, since $P = 45 - Q/2$ with this demand curve. Solving it, $Q = 74$ and $P = 8$.



You can tell that the average cost curve is declining because there is a fixed cost but the marginal cost is not rising.

(b) The price would be $P = MC = 3$. There would be no triangle loss then. To cover its fixed costs, the company would need a subsidy of 370, the size of its fixed cost. Note that a fixed cost is fixed, independent of the amount of output. Thus, the fixed cost is 370 no matter what the quantity is— that's the definition of fixed cost. It is not, for example, equal to $370 * Q$.

9.9 An electric company is charging 12 for daytime and nighttime use of electricity, and marginal cost is the same for both. Demand for daytime electricity is $Q = 60 - 2P$ and for nighttime electricity it is $Q = 24 - P$.

(a) What is the elasticity of demand for daytime electricity?

(b) How can the price be adjusted to keep total profits the same while raising surplus?

(a) The quantity demanded of daytime electricity is $60 - 24 = 36$. The elasticity is $(dQ/dP)P/Q = (-2)(12/36) = -2/3$.

(b) *The Ramsey equation says that $-\text{elasticity} * (P - MC) / P$ should equal the same number for both day and night electricity. The quantity demanded of nighttime electricity is $24 - 12 = 12$. The elasticity for nighttime electricity is $(-1) (12 / 12) = -1$. Since the $(P - MC) / P$ parts of the Ramsey equation are the same at the starting price, we should reduce the price of the more elastic good, nighttime electricity, and increase the price of the more inelastic good, daytime electricity. The reduction in the marginal profit from the nighttime electricity will be less, because if we reduce the price, the quantity will increase more than the quantity of daytime electricity falls when we increase its price.*

- 9.10 Suppose Apex is the only company that has the capability to design and build a new bomber plane for the Department of Defense. How is the government's problem like that of a state utility regulatory commission? What are the advantages and disadvantages of a "cost-plus" contract, one that pays Apex its cost plus a fixed percentage extra?

The Department of Defense wants to pay Apex as little as it can to build the bomber, but enough so that Apex will take the contract. To do so, it must estimate Apex's costs. It also must decide what rate of return on capital will give Apex enough of a return that Apex will accept the contract. Similarly, the state utility commission must try to figure out the utility's costs and what rate of return on capital is required for the utility to be able to continue to raise capital.

A cost-plus contract has the obvious disadvantage that Apex will want costs to be as high as possible. Two advantages are that it protects Apex against the risk of costs being higher than expected (and possible bankruptcy) and does not discourage Apex from maintaining quality in order to keep costs down.

CHAPTER 10: INFORMATION

- 10.1 The supply of cheap beer is perfectly elastic at a price of \$8. Demand is given by $P = 12 - Q/2$. The beer is worth \$2 less than consumers believe, however, because it causes liver disease.
- (a) What is the free market equilibrium price?
- (b) The government is trying to decide between two policies (i) Teach consumers about liver disease, or (ii) Impose a tax of 2 per unit of sales on the producers. What will be sales under each policy?

(a) *The price is initially such that $8 = 12 - Q/2$ so $Q/2 = 4$ and $Q = 8$ and $P = 8$. Or, simply note that if supply is perfectly elastic at 8 then 8 has to be the market price.*

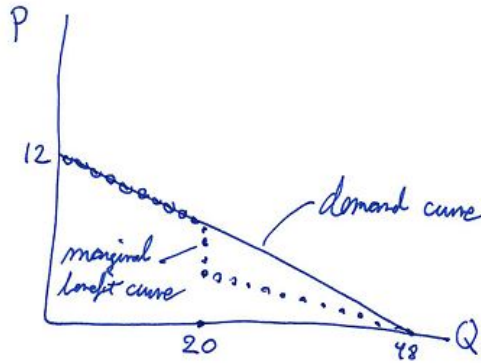
(b) *Informed of the true value, the demand curve changes to $P = 10 - Q/2$, so $8 = 10 - Q/2$, $Q/2 = 2$, and $Q = 4$. Under the tax, the price rises to 10 but the demand curve stays the same as before, so $10 = 12 - Q/2$. This solves to $Q = 4$, the same outcome.*

- 10.2 Of the people interviewed for a banking position, 13% have enough talent for the job, but the interviewer isn't sure which ones. 10% of talented people and 4% of untalented people can answer his tough question. He interviews Smith and Smith answers the tough question correctly. What is the probability that Smith is talented?

The number would be under 50%. Imagine a talent pool of 1000 people. 130 would be talented, and 13 of them could answer the question. 870 would be untalented, and around 30 of them (34.8, to be exact) could answer it. Thus, the proportion of talented to total answerers would be $13 / (13 + 34.8)$ approx .27. This is an example of Bayesian reasoning.

- 10.3 Mr. Jones has an individual demand curve for french fries with equation $Q = 48 - 4P$. He evaluates his benefit from french fries correctly up to a quantity of 20, but beyond that his true value is only half what he thinks, because he has forgotten about the indigestion factor. Draw his demand and marginal benefit curves (not necessarily to scale).

The demand and marginal benefit curves are identical for quantities below 20, but at that point the marginal benefit curve falls to half the height of the demand curve and slopes down to reach 0 at the same quantity of 48.



10.4 Discuss the advantages and disadvantages of three different government policies for dealing with the dangers of muscle-building drugs. The three policies are:

- (a) Ban the drugs.
- (b) Require each drug to be sold with a warning label about its dangers.
- (c) Require each drug to be sold only if the buyer signs off on a special paper saying he is aware of the dangers.

(a) Banning the drug will end the danger but will also prevent people from using it who are aware of the dangers but want the benefits.

(b) This will inform users, but will require some cost for the labels and the warnings may not be understood or even read by many users, especially if they just obtain pills from coaches or friends.

(c) This will also inform users, and will make it more likely that they read the warnings. It will greatly increase the cost, tho, if this paperwork has to be filed away as proof it was done.

10.5 In the 1980's, a man and his wife needed to get check-ups before buying life insurance, including a test for AIDS. The doctor called up the man and said, "I'm very sorry. The test was positive. You have a 999 out of 1,000 chance of dying in the next five years from AIDS." Where did the doctor go wrong? Say what information you would need to compute a better estimate of the man's chances of death? You do not need to perform any calculations.

You already have $\text{Prob}(\text{test positive})$. You need these items of information:

1. *The proportion of married men in the population who have AIDS, Prob (AIDS).*
2. *The probability that the test will have a false positive, saying that someone has AIDS when the person really does not, Prob (test positive|AIDS).*

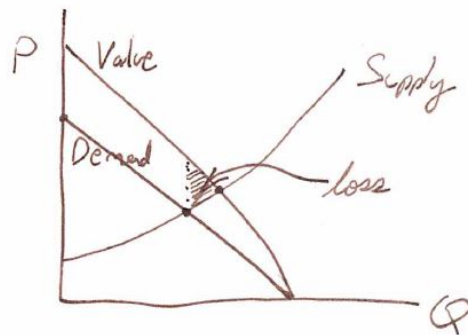
With that, you could use Bayes's Rule to find the answer.

$$\text{Prob}(AIDS|testpositive) = \frac{\text{Prob}(testpositive|AIDS) * \text{Prob}(AIDS)}{\text{Prob}(testpositive)}$$

- 10.6 What are three examples of laws, regulations, or policies that could be justified by people being irrationally blind to the future, using too high a discount rate?

The social security program, which is basically a requirement that people save part of their wages for their old age, would help if we think people really would like to save more if they only knew better. Vice laws such as restrictions on premarital sex, heroin, or smoking would help if we think that young people, in particular, do not look forward enough to the results of their decisions. Restrictions on consumer borrowing— that is, borrowing for current consumption rather than for business investment or buying durable goods such as cars and houses— would help if people want to be stopped from short-term gratification from immediate spending at the expense of later hardship. There are many other examples.

- 10.7 Using a diagram, show the deadweight loss if consumers systematically underestimate the value of a product, valuing it at 80% of its true worth to them. Explain in words why that area is lost surplus.

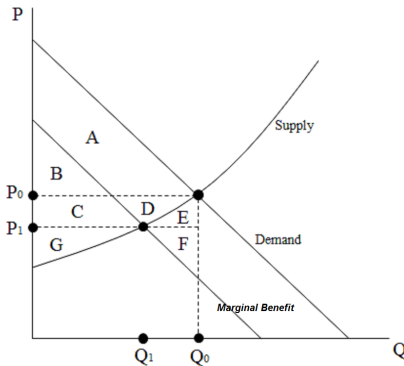


The demand curve always gives a value 80% of the marginal benefit curve. In ignorance of this, consumers buy too little. The shaded area is lost surplus because it represents the excess of the true benefit to consumers of consuming more over the cost to producers.

Note that even at the lower quantity, the consumer surplus is measured using the marginal benefit curve, not the demand curve. The consumers decide how much to buy using their estimated demand curve, but their actual satisfaction is given by the marginal benefit curve.

- 10.8 Suppose people think organic cola prevents cancer, but it does not. Use a diagram to show (a) the amount of consumer surplus and (b) the amount by which total surplus would rise if people found out the truth.

(a) Consumers' demand is greater than their marginal benefit because they overestimate the value of the cola. They think they will get a high surplus when they consume Q_0 , but their actual surplus is lower—it is only $B-E-F$ because they are paying more for the last units than those colas are worth to them. The demand curve is used to find the equilibrium price, but the marginal benefit curve is used to find the consumer surplus at that price and quantity.



(b) Once consumers learn the truth, demand shifts down to the value of the cola. Quantity falls to Q_1 . Consumer surplus rises to $B+C$. Producer surplus falls to G .

- 10.9 Suppose the marginal benefit curve is $P = 24 - Q$ and the supply curve is $Q = P/2$. Consumers, however, all believe that the value of the product is 18.

- (a) If consumers were perfectly informed instead, what would be the equilibrium quantity and consumer surplus?
- (b) If consumers are poorly informed, so they do believe the value is 18, what is the equilibrium quantity and price?
- (c) If consumers are poorly informed, so they do believe the value is 18, what is the equilibrium consumer surplus?
- (a) $24 - P = P/2$ so $1.5P = 24$ so $P=16$. Then $Q=8$. The consumer surplus would be $.5(24-16)(8-0)=32$.
- (b) $P=18$ because the demand curve is flat, so $Q = 18/2 =9$.
- (c) Consumer surplus uses the marginal benefit curve, so it is $.5(24-18)(6) - .5(18-15)(3) = 18-4.5 = 13.5$.

10.10 What are the two types of error the Food and Drug Administration makes, and which kind is more threatening to its employees' careers?

One type is the false negative for safety, where the FDA turns down a drug that is actually safe and effective. The other type is the false positive for safety, where the FDA approves a drug that is actually unsafe or ineffective. Both mistakes reduce surplus, but the careers of FDA officials are more threatened by false positives because drugs that are either unsafe or ineffective will be introduced into the marketplace and this can generate negative publicity for the FDA and could make those who work in the FDA look bad. False negatives are less threatening to FDA officials careers because if the FDA wrongly turns down a drug, it will not be used and their mistake may never be discovered.