1. The graph below shows conditions in a perfectly competitive market in which there is some sort of externality. In this market a consumer purchases at most one unit of the good. There are many such consumers and they have different maximum willingnesses to pay. Assume the graph is drawn to scale and that due to high transaction costs it is impossible for those affected by the externality to resolve it privately without government intervention.



* 1. What type of externality is present in this market: positive or negative?
	2. What is the maximum level of social surplus that is potentially attainable in this market?
	3. What is the deadweight loss that arises in a competitive equilibrium in this market?
	4. What is the magnitude of a per-unit subsidy that would enable this market to attain the socially efficient outcome?
	5. Indicate whether the following would increase, decrease, or not affect social efficiency relative to the competitive equilibrium:
		1. A per-unit subsidy equal to given to consumers who purchase the good.
		2. The government imposes a price ceiling that sets the maximum price of the good equal to .
		3. The government imposes a tax equal to on consumers who *do not* purchase the good.
1. There are two citizens in Sim City. The first citizen is willing to pay $30 per hour for each hour up to and not willing to pay for any hours above 8. The second citizen has the inverse demand curve .
	1. Suppose the marginal cost of public broadcasting is . What is the economically efficient level of public broadcasting?
	2. Repeat part (a) with
2. Use the table below, which chows the demand for a public good in an economy consisting of two households ( and ), to answer the following questions.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Price |  | $0.00 | $0.50 | $1.00 | $1.50 | $2.00 | $2.50 | $3.00 |
| Quantity Demanded | A | 12 | 10 | 8 | 6 | 4 | 2 | 0 |
| B | 4 | 3 | 2 | 1 | 0 | 0 | 0 |

* 1. Graph the individual demand curves and the market demand curve.
	2. What would make you doubt that the table is an accurate reporting of the individual demand curves?
	3. If the marginal cost of providing one unit of the good is $2.00, what is the socially optimal amount of the public good?
	4. Given the free rider problem, is your answer to (c) most likely an underestimate or an overestimate?
1. Suppose that demand for a product is and supply is . Furthermore, suppose that the marginal external damage of this product is $8 per unit. How many more units of this product will the free market produce than is socially optimal? Calculate the deadweight loss associated with the externality.
2. The marginal damange averted from pollution cleanup is . The marginal cost associated with pollution cleanup is .
	1. What is the optimal level of pollution reduction?
	2. Show that this level of pollution reduction could be accomplished through taxation. What tax per unit would generate the optimal amount of pollution reduction?
3. Firms and each produce 80 units of pollution. The federal government wants to reduce pollution levels. The marginal costs associated with pollution reduction are for firm and for firm , where and are the quantities of pollution reduced by each firm. Society’s marginal benefit from pollution reduction is given by , where is the total reduction in pollution.
	1. What is the socially optimal level of each firm’s pollution reduction?
	2. How much total pollution is there in the social optimum?
	3. Explain why it is inefficient to give each firm an equal number of pollution permits (if they are not allowed to trade them).
	4. Explain how the social optimum can be achieved if firms are given equal numbers of pollution permits but are allowed to trade them.
	5. Can the social optimum be achieved using a tax on pollution?
4. Consider an economy with three types of individuals, differing only with respect to their preferences for monuments. Individuals of the first type get a fixed benefit of 100 from the mere existence of monuments, whatever their number. Individuals of the second and third type get benefits according to:

where denotes the number of monuments in the city. Assume that there are 50 people of each type. Monuments cost $3,600 each to build. How many monuments should be built?

1. The town of Musicville has two residents: Bach and Mozart. The town currently funds its free outdoor concert series solely from the individual contributions of these residents. Each of the two residents has a utility function over private goods () and total concerts (), of the form . The total number of concerts given, , is the sum of the number paid for by each of the two persons: . Bach and Mozart both have income of 70, and the price of both the private good and a concert is 1. Thus, they are limited to providing between 0 and 70 concerts.
	1. How many concerts are given if the government does not intervene?
	2. Suppose the government is not happy with the private equilibrium and decides to provide 10 concerts in addition to what Bach and Mozart may choose to provide on their own. It taxes Bach and Mozart equally to pay for the new concerts. What is the new total number of concerts? How does your answer compare to (a)? Have we achieved the social optimum? Why or why not?
	3. Suppose that instead an anonymous benefactor pays for 10 concerts. What is the new total number of concerts? Is this the same level of provision as in (b)? Why or why not?
2. The Hoo Can Fish Canning Company () is a fish cannery that is located upstream from a brewery, Wahoo Brew (). The cannery has the right to dump wastes from its canning process in the river. The canning wastes float downstream and affect the brewery’s production process. If the cannery produces cans, the cost to the cannery is, while the brewery’s cost of producing b beers is . Each beer sells for $5 in a perfectly competitive market, and each can of fish sells for $4, also in a perfectly competitive market.
	1. Are canning wastes:
		1. An externality for the brewery or the cannery? Explain
		2. A positive or negative externality for the company that is your answer in part (a)? Show this.
	2. Assume that the cannery and the brewery cannot negotiate (the brewers try to drink twice their body weight in beer at work each day, so the canners can’t understand them over the phone because their speech is so slurred, but the brewers won’t meet the canners in person because they smell too much like fish).
		1. Set up the cannery’s profit maximization problem
		2. Derive the first order condition(s)
		3. How many cans does the cannery produce?
		4. Describe how you would calculate the cannery’s profits
		5. Set up the brewery’s profit maximization problem
		6. Derive the first order condition(s)
		7. How many beers does the brewery produce given the number of cans the cannery produces?
		8. Describe how you would calculate the brewery’s profits
		9. What are the total profits of the two firms together?
	3. The brewery and the cannery decide that the profits from merging might be great enough to tolerate working with each other. They propose a merger to the US Department of Justice (DOJ) in which they outline how they will form the Fishy Brew Canning Company (F) and increase profits because of “synergies” between the two production processes.
		1. Set up the new company’s profit maximization problem
		2. Derive the first order condition(s)
		3. Calculate the quantities of and that maximize the joint profits of the two producers
		4. Are these profits greater than the total profits of the two companies in part (b.ix)? Why? (Hint: you don’t actually have to solve for profits. You should be able to answer this without any math at all)
	4. Assume that the DOJ blocks the merger (for fear that the FBBCC will be a monopoly in the fish flavored beer market), but they agree to be an intermediary between the firms so they can negotiate.
		1. The brewery and the cannery negotiate on the level of cans. Who pays who? What is the payment for? (Hint: you can answer this question even without knowing who has property rights)
		2. Would your answer to (a) change if the brewery had the right to clean water? How?
		3. Would the quantity of cans change depending on who has the right to clean water?
	5. Now assume that despite the DOJ’s efforts, the two producers cannot reach an agreement.
		1. Find the tax rate that the DOJ could impose that would lead the firms to the socially optimal outcome. Who does the DOJ impose the tax on? Assume the tax is a per-unit tax.
		2. Describe how you would compute total profits for each firm in this case.
		3. Why might the DOJ have implemented the tax instead of a quota?
3. The Once-ler produces Thneeds (which everyone needs) in a factory that also produces pollution, denoted as . The Once-ler has 0 marginal cost, with the marginal benefit of to the Once-ler equal to . This pollution harms the local population of Brown Bar-Ba-Loots according to the following marginal cost function: .
	1. How much pollution will the Once-ler produce if left to his own devices?
	2. In a landslide, The Lorax is elected president.
		1. What is the optimal quantity regulation that The Lorax would set?
		2. What is the optimal per-unit tax on pollution that The Lorax would set, if The Lorax chooses price instead of quantity regulation?
		3. How much efficiency is lost if The Lorax sets the maximum allowable quantity at ? In other words, calculate the deadweight loss of this policy.
4. True, False, or Uncertain: Bill and Ted have just formed a band, and they practice often, but their music is terrible. The noise from their practicing imposes a negative externality on their neighbors.
5. True, False, or Uncertain: If new neighbors move in next door to the now-famous Bill and Ted, then the noise from their practicing imposes an externality on the new neighbors just as it did on the old neighbors.
6. True, False, or Uncertain: Bill and Ted's neighbors will always prefer zero noise from their practicing.
7. True, False, or Uncertain: Watching a UVA football game on TV is an example of consuming a pure public good.
8. Suppose that the individual demand functions for a particular good are QD = 30 - 4P for 4 people and QD = 20 - P for 3 people. Assume that these 7 people make up the entire market and act as price-takers. The marginal cost of producing the good is constant at MC = $5.
	1. If the good described above is ice cream sundaes, what is the socially optimal quantity in this market? Does the competitive equilibrium result in this quantity? What is the competitive equilibrium price?
	2. If the good is instead fireworks, then what is the socially optimal quantity in this market?
	3. Based on your answer from (a), what is average (per person) spending on ice cream sundaes?
	4. Suppose that in part (b), the socially optimal quantity is provided and the total cost is split evenly among all people. What, then, is average (per person) spending on fireworks? Comparing the two averages you just calculated, which is smaller? Give some intuition for why this is the case.
	5. If, instead, there are 40 people with the first demand function, and 30 with the second, re-compute the answers for (a)-(c). Why does per person spending in (c) change for fireworks but not ice cream?
	6. Briefly discuss how the private market equilibrium for fireworks is likely to differ from the socially optimal level that you calculated in (e).
9. Suppose that Ben and Jerry are again consuming either ice cream sundaes (private) and fireworks (public). Both utility functions are formula, where formula. The price of each good is $1. Income for Jerry is now $125 and Jerry has income of $75.
	1. What is the socially optimal level of fireworks, F?
	2. How does it compare to the socially optimal level in the symmetric problem that we solved in class? Intuition?
	3. If fireworks are privately provided, that is Ben decides for himself and Jerry decides for himself, how many fireworks will Ben provide? What about Jerry?
	4. How does the total amount of fireworks privately provided compare to the amount provided in the symmetric case found in class? Intuition?
10. Paul Ryan and Mitt Romney have preferences over Pats on the back (Pi) and Defense from illegal immigration from Mexico (D). Since only one republican needs to man the border at a time, the total amount of defense is equal to the sum of their individual contributions (Dr + Dm = D). It costs $1 to get a Pat on the Back from Fox news, and $4 to buy a unit of Defense. Paul Ryan has income of $200, and Mitt Romney has income of $140. Suppose both goods are provided privately. Paul Ryan has utility equal to and Mitt Romney has utility equal to .
	1. What is , the best response function for Paul Ryan?
	2. What is , the best response function for Mitt Romney?
	3. Solve for the Nash Equilibrium. In equilibrium how much defense is provided?
	4. What can you say about how this compares to the social optimum, with out doing math? How do you know?
	5. Write down the social planner’s problem and solve for the socially optimal amount of defense provided.
	6. Suppose Obama wants to help these guys achieve the socially optimal quantity, but with the budget issues, he doesn't want it to cause any more debt. He proposes that each man pay a lump-sum tax of . Obama then spends all tax revenue () on defense. Can a tax like this possibly get Ryan and Romney to privately provide the social optimum? Explain briefly.