1) True, false, or uncertain. Please answer and provide a SHORT explanation, correcting if false. (Please correct in a meaningful way, not by adding the word “not.”)

   a) A market that has 10,000 sellers and 10,000 buyers is perfectly competitive.

   Uncertain: a market that is perfectly competitive is one in which no one has market power, and no buyer or seller is big enough to influence the market price. Having a lot of sellers and buyers makes it likely that a perfectly competitive market exists, but it’s not a sure thing. Some of the sections brought up lots of necessary conditions for perfectly competitive markets to exist: perfect information, no transaction costs, no externalities, no public goods, etc. The list is long, and having 10,000 sellers and buyers doesn’t come close to giving us all that we need.

   b) If I go around handing out flowers to people for free, then I am creating an externality and the government should take steps such as imposing a cap or a tax to correct it.

   False. This one’s a little tricky, partly because we were asking you to do more than copy something out of your notes. Is handing out flowers to people for free an externality? The definition given in class was something like, “An activity that affects the welfare of others, and for which no compensation is given.” On page 15 of the reader (from the Zilberman and Marra piece), it says, “Externalities exist in situations where the activities of one economic agent affect, or spill over onto, the technology, consumption set, or preferences of another.” This qualifies, whether you think it’s because receiving a flower might make people happy or whether it might set off their allergies. So the first half of the statement is true, but is the second half? Should the government take steps to correct the externality? Hmmm. What would steps to correct the externality include? The government could force people to pay for flowers they’ve received, which would be a strange regulation. If the government thinks it’s a positive externality, then they could internalize it, making it a part of the economy by subsidizing it. Instead of the Peace Corps, they could create the Flower Corps, where tax dollars are used to pay people to hand out flowers. Hmmm. I’m not sure that I want to see my tax dollars invested that way. Thus, the answer is false. (If you made a convincing argument why the government should step in, we are open to hearing that, but I’ll be really surprised….)

   c) When a tax is imposed to correct an externality, most of the burden falls on consumers who consume goods made by the industry creating the externality.

   Uncertain. Taxes (at least positive ones) bring down the amount bought and sold in the economy, which hurts both producers and consumers. Who loses more surplus depends on the elasticities of supply and demand. Consider taxes that would move these economies to the socially optimal points:

   On the left, CS loses areas A and B, while PS loses C and gains A, which appears to be a smaller loss. On the right, CS loses areas D and E, while PS has lost (F-D). Looks like PS has lost more in this case. Notice how the slopes of the supply and the demand curves made the difference.
d) Improving social welfare by imposing a tax on a negative environmental externality always meets the Kaldor-Hicks criterion.

True! Just because a question says “always” doesn’t mean that it must be false. The first part of the question says that the tax has improved social welfare. If it has improved social welfare, then there’s enough so that if we redistributed, we could make everyone at least as well off as they were before, even if the new situation has made some worse off than they were before. That’s the Kaldor-Hicks criterion, so the answer’s true.

e) A Pareto-efficient allocation says nothing about equity.

True. Pareto efficiency says basically that there’s no waste; economists like to say there’s “no money left on the table” between buyers and sellers. That doesn’t mean that one person doesn’t have most or all of the money. “Equity” means fairness, so no, Pareto-efficiency does NOT mean anything for equity.

2) You run the only bookstore dealing in used textbooks on a college campus. You know that a lot of students took Econ 1, and although the class was very exciting it’s likely that some will want to sell back their textbooks at the end of the semester. The number of students who sell it back to you is likely to vary by the amount of money you’re willing to pay for it. You decide that you don’t want to be too fancy in your estimation so you’ll keep it linear, and you guess that if you offer $15 you will get 20 books, and if you offer $30 you’ll get about 40.

Next you have to figure out how many you think you can sell. Let’s say that the students are cheap, and you know that when you go to sell the books to the next class, the higher you price your textbook the more likely they are to buy it online. Again you decide that you don’t want to be more complicated than making a linear estimation of how many you can sell, and you suppose that if you sell the book for $80 you will sell just 40 copies, but if you sell it for $50 then 100 of them will buy it.

I. Describe mathematically and show graphically the supply and demand “curves” (actually straight lines).

The supply curve information is given first, so let’s deal with that. The line rises 15 over a run of 20, so the slope of the line is 15/20, or ¾. To find the p-intercept, we solve p = ¾ q + b at either point; try (p=15, q = 20) to get b = 0. Thus the supply curve is p = ¾ q . Do the same for demand; the line is -½, so p = -½ q + b. Put in the first point (p = 80, q = 40) to get p = -½ q + 100.
II. Consider the case of a perfectly competitive market for buying the book.
   a) How much would you (the bookstore owner) have to pay to buy the book back from students?

   In the perfectly competitive market, supply equals demand, so \( p = \frac{3}{4} q \) and \( p = \frac{1}{2} q + 100 \). Solving, \( \frac{3}{4} q = \frac{1}{2} q + 100 \) or \( q = 80 \). Since \( p = \frac{3}{4} q \), \( p = 60 \). The owner would have to pay $60 to buy the book back from students.

   b) How much could you charge when you sold it to the next class?

   In a perfectly competitive market, no one has any control over the price, so no one can manipulate it. The owner can’t charge any more than $60 when she sells it, because if she does the students will buy the book from someone else.

   c) About how many copies would you expect to sell, and what would be your total revenue?

   If the owner charges the competitive price of 60, we saw in part a) that she will sell 80 books. Her total revenue will therefore be \( 60 \times 80 = $4800 \).

   d) If buying the books is your only cost, what would your profit be?

   Her profit is zero.

III. Now consider a case in which the local post offices are terrible, and it takes hours of waiting to send a package, so you’re sure that students won’t sell their books over the Internet. If you represent the only opportunity that students have to sell their books, you have a monopsony. Assume there’s no ASUC to coordinate book sales between students, and they aren’t able to do it on their own.

   a) Describe the strategy you should pursue to make the most money off of the students.

   Since you have market power, you will take that into account when finding the profit-maximizing output. You want to buy as many as you can for as cheap a total cost as possible, and when you set your prices, you have to balance these two things. Paying a higher price will cost you more, but it will let you buy more books. To solve this problem, you need to figure out how many you’ll get for offering an additional dollar per book: that’s your “marginal outlay.” The demand curve describes how much you’ll get when you sell the books, so you want your marginal outlay to be always less than or equal to demand. That condition holds true everywhere up until the two lines cross (at which point your marginal outlay exceeds the return you’ll get from selling the book) so to make the most money, you need to set marginal outlay equal to demand.
b) What is the expression describing your (total) cost for buying the books? In other words, express the total cost for buying books as a function of the quantity of books purchased.

Your total cost for buying the books is going to be simply the price you pay multiplied by the quantity you end up buying, or (pq). We know from part I that the supply curve, which tells us how many we will be able to buy when we offer a given price, is \( p = \frac{3}{4} q \), so the cost for buying the books \((pq)\) becomes \( \left(\frac{3}{4} q\right)(q) = \frac{3}{4} q^2 \).

c) What is the marginal cost to you of buying more books? (This is also called the “marginal outlay.”) Describe mathematically and show graphically the marginal outlay “curve.” (You can put it on the same graph you used for part I.)

Since the total cost of buying more books is \( \frac{3}{4} q^2 \), the marginal cost must be the derivative of that, or \( \frac{3}{2} q \). Graphically,

![Graph showing supply, demand, and marginal outlay curves]

d) How many books should you try to buy to maximize your profits?

We can see on the graph that the M.O. crosses the demand curve at about 50, and mathematically we can find that out by setting the marginal outlay, \( \frac{3}{2} q \), equal to demand, \( 100 - \frac{1}{2} q \).

\[ \frac{3}{2} q = 100 - \frac{1}{2} q \quad \text{or} \quad q = 50. \]

e) What price should you offer the students to get that many books?

To find out what price will get students to sell us 50 books, we need to look at the supply curve, which describes how many books will be put on the market at a given price. From I. above, the supply curve is \( p = \frac{3}{4} q \), so substituting in 50 for \( q \) we get \( p = 37.50 \).

f) If you sell the books at the competitive price, how much do you make in total?

Looking back at part II, the competitive price is $60, so we make $60 - $37.50 = $22.50 on each book. Since we bought 50 books, our total profit is \( (22.50)(50) = 1125 \).
IV. Finally, it turns out that you have a friend in the post office who arranges to stop delivery of all textbooks to students. Now you are the only way for students to buy the book, as well as the only place they can go to sell it. Students’ willingness to sell the book and willingness to pay for the book are unchanged.

a) Describe the strategy you should pursue to make the most money off of the students. (Hint: neither the supply nor the demand curve is directly involved.)

This is the “middleman” problem. This is tricky because this person has market power both ways to factor in. In buying, the middleman must consider the marginal outlay, but in selling it’s marginal revenue, not demand, which is relevant. Thus, the middleman will buy where marginal outlay and marginal revenue intersect. To go all the way back to consider her problem from the start, realize that

\[ \text{Total } \Pi = TR - TC. \]
\[ TR = pq = (100 - \frac{1}{2} q) \cdot q \]
\[ TC = pq = (\frac{3}{4} q) \cdot q = \frac{3}{4} q^2 \]

To maximize profit we take the first order condition (yet again), taking the derivative and setting it equal to zero. Taking the derivative of \( TR - TC = 0 \) gives us \( MR - MC = 0 \), but in this case the “marginal cost” she faces is in fact the marginal outlay, which you can check by looking at the math. (The derivative of the TC she faces, \( \frac{3}{4} q^2 \), is \( 3/2 q \), the marginal outlay curve from part IIIc above.)

Here’s the graph:

b) How many books should you buy to maximize your profits?

Set \( MR = MO \), or \( 100 - Q = 3/2 Q \), which gives us \( Q = 40 \).
c) **What price should you offer the students to get that many books?**

The bookseller can buy at prices defined by the supply curve, so we put our profit-maximizing quantity into the supply curve of
\[ p = \frac{3}{4} q \quad \text{so} \quad p = \frac{3}{4} (40) = 30. \]

**d) How much are you going to charge for the books?**

If we want to know how much can be charged in order to sell 40 books, we look at the demand curve, so we take
\[ q = 40 \quad \text{and} \quad p = 100 - \frac{1}{2} q \quad \text{so} \quad p = 80. \]

**e) How many will you sell at that price?**

Yes, this is the same question as in part b. I made a mistake, somehow cutting out a few questions from part IV and replacing them with questions from another part when I posted the final version of the problem set. I just left it rather than posting an updated version- I figured you wouldn’t complain about some easy points! I had meant to ask:

- b. Thinking for a moment about selling the books to the students, what is the expression for your total revenue? Your marginal revenue?
- c. How many books should you buy to maximize your profits?
- d. What price should you offer the students to get that many books?
- e. How much are you going to charge for the books?
- f. What is your profit at that price?

…but oh well!

**f) The post office will never change the length of time required for shipping packages, so your monopsony is secure, but your friend at the post office is asking for a cut of your profits in order to continue the moratorium on textbook deliveries. What is the most that you are willing to pay him?**

First we need to know what our profit is in the “middleman” case. We make $50 from each book (buying at 30 and selling at 80) and we move 40 books at that price, so profit is
\[ 40 \times 50 = 2000. \] If we told our friend that we wouldn’t give him anything, he would take away our monopoly and we would be back down to the monopsony case, where profit was only $1125. Thus, we will be willing to pay our friend up to
\[ 2000 - 1125 = 875 \] to continue the moratorium on textbook deliveries.
3) Suppose the market for mineral water in a small isolated country is perfectly competitive. The marginal cost for mineral water production is $20+Q$, and the demand for mineral water is $P=80-2Q$, where $P$ is the dollar price, and $Q$ is the tons of mineral water produced. Suppose the processing procedure in mineral water production generates pollution, which incurs damage to the environment costing $0.5Q^2$. (The externality does not directly harm producers or consumers.) Please solve the problems below both mathematically and graphically. Please LABEL the graph clearly.

I) Calculate the marginal externality cost and marginal social cost functions, and draw them on a graph with the supply and demand curves. Please label each curve explicitly.

Take the derivative of TEC w.r.t. $Q$: $MEC=(0.5Q^2)'=Q$
$MSC=MEC+MPC=Q+(20+Q)=20+2Q$. The relevant curves are shown in the figure.

II) What are the competitive equilibrium price and quantity for the private sector? Is this competitive equilibrium potentially Pareto efficient? Please provide both mathematical and graphical [labeling the equilibrium “A”] solutions.
Maximization condition for private sector under competitive equilibrium:
P=MP, where P=MB
i.e. 80-2Q=P=MP=20+Q,
solve for Q, we get Q1=20, P1=40, TEC=0.5Q^2=0.5*20*20=200;
It is not potentially Pareto efficient because it doesn’t maximize the social welfare (recall the Kaldor-Hick Criterion)

III) What is the optimal quantity and price for the whole society? Please provide both mathematical and graphical solutions [labeling this point “B”]

Condition for social optimum is: MB=MSC; note here MB=P.
i.e. 80-2Q=P=MSC=20+2Q (from (I))
Solve for Q, we get the social optimal quantity Q2=15, P2=50

IV) Does the competitive equilibrium incur any dead weight loss? If so, how much? Please give the graphical solution and the mathematical solution. On the graph, please label the vertices and describe the region by them (e.g. ∆ABC).

Yes. The optimal social welfare is the area of BCD = \( \int_{Q_1}^{Q_2} MB(q) - MSC(q) dq \).

The social welfare under competitive equilibrium is the area of ACD (welfare of private section=CS+PS) minus the area of AGD. Then we can see the difference between social optimal and current welfare (DWL) is equal to the area of

AGB=\( \int_{Q_1}^{Q_2} MSC(q) - MB(q) dq \)=50 (you can also solve it geometrically. Both answers are acceptable).

V) If the government intends to impose a production tax to reach the socially optimal level of pollution, how much should the tax be? Compared to the competitive equilibrium without government intervention, how much does the government revenue change? How much does the producer surplus change? What is the change in consumer surplus? How much does the pollution cost change? Please give both graphical and mathematical solutions.

The optimal tax t* should be equal to MEC(Q2). Only in this case, will the private sectors take the marginal external cost into full consideration when they determine the quantity. Alternatively, after imposing a unit tax t, the “marginal cost” the private sector consider is t+MPC instead of the previous MPC.
The private maximization condition is MB=t+MP;
To induce the social optimum quantity Q2, we should also have the social maximization condition: MB=MSC
Thus, t*+MPC(Q2)=MB(Q2)=MSC(Q2)=MPC(Q2)+MEC(Q2)
Solve for t*, t*=MEC(Q2).
From III, we know that Q2=15, thus t*=MEC(15)=15;
Via taxing the producers, the government revenue increases by t*Q2=15*15=225.
Previous producer surplus=AP1D=\( \int_{Q_1}^{Q_2} P_1 - MPC(q) dq \)=200
Producer surplus after tax (excluding tax)=HID=\( \int_{Q_1}^{Q_2} P_2 - t * -MPC(q) dq \)=112.5
Loss in producer surplus = 200 - 112.5 = 87.5
Previous consumer surplus = ACP1 = \int_{0}^{Q1} MB(q) - P1 dq = 400
Consumer surplus after tax = BCP2 = \int_{0}^{Q2} MB(q) - P2 dq = 225
Loss in consumer surplus = 400 - 225 = 175
Previous pollution cost = TEC(Q1) = 0.5*20*20 = 200
Pollution cost after tax = TEC(Q2) = 0.5*15*15 = 112.5
Gain in pollution cost reduction = 200 - 112.5 = 87.5
Thus, gain in total social welfare = 225 - 87.5 - 175 + 87.5 = 50—so the DWL is made up via tax.

VI) (bonus question) If a pollution treatment system can be installed so that there will be no pollution costs at the competitive equilibrium, how much will a benevolent government (i.e. the government that is trying to maximize the social welfare) be willing to pay for it?

The standard answer: If the government pays for the treatment system, then consumers and producers gains the competitive equilibrium surplus. As we see before, the government can achieve social optimum via other policies, e.g. tax or standard. Thus the government willingness to pay for the system is just the difference between the social optimum and the total consumer and producer surplus under competitive equilibrium. So the government willingness to pay for the system is equal to the area of ABD = AGD-AGB= TEC(Q1)-DWL=200-50=150.

However, this question causes some confusion due to the term “benevolent”. A benevolent government means a government with intentions to maximize social welfare instead of maximizing government revenue. However, this doesn’t necessarily mean that the government doesn’t consider government’s payment of the treatment system as loss in social welfare. Because this point is not clarified in the question answers assuming the government doesn’t consider its own payment when making decisions to maximize social welfare, and thus getting government’s wiliness to pay equal to TEC(Q1) = 200, are acceptable. However, the first-best answer should be 150.

VII) Please write an essay of no more than one double spaced page in 12 point Times New Roman font (or the equivalent) addressing all of the questions below. Be sure to write your answers to these questions in the form of an essay with graphs as needed, not just in a Q&A format. DO NOT DO ANY ADDITIONAL MATHEMATICAL CALCULATIONS (Graphs can be on another page, but they don’t need to be. You CAN do this all in one page!).

i. Under government intervention with the production tax, who benefits, who loses, and what happens to the environment? Who bears the tax burden? Answer the questions again considering a consumption tax instead of a production tax.

ii. Given the existence of pollution, if there is no government intervention, will some level of market power be socially preferable to none? Please give an example with a relevant graph for your answer. (Hints: you can just consider either the monopoly or the monopsony case. No mathematical solutions are necessary). Comment on the role of market power in social welfare.
iii. Please compare the benefits of relevant agents (consumers, producers, and government) under the two cases (production tax and presence of market power) above.

Main points to include in the essay:

i) Under production tax, government gains revenue; the environment is improved due to less pollution under tax. Both producers and consumers lose. The tax burden is shared by both the producers and the consumers, and the share of the burden depends on the elasticities of the demand and supply curves. These statements shouldn’t change under the case of a consumption tax.

ii) Some level of the market power MAY be preferred to none (It is not ALWAYS the case) because under market power, the production level is lower than the quantity produced under competitive equilibrium. If the equilibrium quantity under market power is closer to the social maximum quantity, or, in an extreme case, happen to be the social maximum quantity, then existence of market power is preferred to none. The point is market power is not always inefficient compared to competitive equilibrium—the efficiency of competitive equilibrium is based on some assumptions, including no externality. And the “no externality” assumption is violated here, so competitive equilibrium is not necessarily preferable to market power here. Any graph showing equilibrium under market power is closer to the social optimal than the competitive equilibrium is acceptable.

iii) In both case, the consumers lose because price increases and quantity of consumption (production) decreases compared to the competitive equilibrium case. Under the market power, the producers gains rents from the market power. Under the tax, however, the government collects the revenue, and the producers lose because they have to pay the tax.