Problem Set #5 Solutions

Note that none of the questions in this problem set requested graphs, and indeed graphs are not needed to solve them. Any graphs that appear in these solutions are to help illustrate the respective markets, their equilibria, and the attendant consumer and producer surpluses. They are not necessary.

In the central part of the state of Euphoria there is a small city, Avicenna, which is the home of Euphoric State University. ["Avicenna" is a corruption of the Arabic Ibn Sina, the byname of the great eleventh-century Iranian Abu Ali al-Husayn ibn Abd Allah ibn Sina: academic administrator, Quran reciter, astronomer, chemist, geologist, psychologist, theologian, mathematician, physicist, physician, poet, and paleontologist.]

For the next several questions, we will look at the daily market for espresso-based drinks in Avicenna.

1. Suppose that the quantity of espresso drinks demanded \(Q_d\) and the quantity of espresso drinks supplied \(Q_s\) are given by the equations:

\[
Q_d = 10,000 - 1000P \quad \Rightarrow \quad P = 10 - 0.001Q_d
\]

\[
Q_s = -5000 + 4000P \quad \Rightarrow \quad P = 1.25 + 0.00025Q_s
\]

where \(P\) is the price of an espresso-based drink in dollars.
a. What is the market equilibrium price?

The equilibrium price, \( P^* \), is the price at which the quantity supplied equals the quantity demanded—where \( Q_S = Q_D \). Thus:

\[
-5000 + 4000P^* = 10,000 - 1000P^* \implies 5000P^* = 15,000 \implies P^* = 3
\]

The equilibrium price of espresso drinks in this market is $3.

b. What is the market equilibrium quantity?

At the equilibrium price, the equilibrium quantity of espresso drinks exchanged is given by either the quantity supplied or the quantity demanded: by definition the market equilibrium occurs where these two are the same. Given the equilibrium price found in part a, we have:

\[
Q_S = -5000 + 4000(3) = 7000
\]
\[
Q_D = 10,000 - 1000(3) = 7000
\]

The equilibrium quantity of espresso drinks exchanged in this market is 7000.

c. What is the producer surplus?

The producer surplus (PS) is equal to the area of above the supply curve and below the equilibrium price. That is, in this case it is equal to the area of a triangle with height \( (3 - 1.25) \) and base 7000. The producer surplus is thus:

\[
\frac{1.75 \cdot 7000}{2} = 6125
\]

The producer surplus is equal to $6,125.

d. What is the consumer surplus?

The consumer surplus (CS) is equal to the area of below the demand curve and above the equilibrium price. That is, in this case it is equal to the area of a triangle with height \( (10 - 3) \) and base 7000. The consumer surplus is thus:

\[
\frac{7 \cdot 7000}{2} = 24,500
\]

The consumer surplus is equal to $24,500.
2. Now suppose that PDC becomes alarmed at the number of strokes that are being treated at the public hospitals of Euphoria, and becomes aware of the link between caffeine consumption and blood pressure on the one hand and between blood pressure and strokes on the other. They decide to impose on consumers a $1/drink tax on espresso drinks and devote the money to hospital stroke-care units.

a. What is the equilibrium price that consumers pay?

The total price paid by the consumers will be \( P_{\text{total}} = P_{\text{transaction}} + \text{Tax} = P_{\text{transaction}} + 1 \), so the quantity demanded can be rewritten as:

\[
Q_d = 10,000 - 1000(P_{\text{transaction}} + 1) = 9000 - 1000P_{\text{transaction}}
\]

The new equilibrium (transaction) price is the price where this new quantity demanded is equal to the quantity supplied.

\[
9000 - 1000P_{\text{transaction}} = -5000 + 4000P_{\text{transaction}} \quad \Rightarrow \quad 14,000 = 5000P_{\text{transaction}} \quad \Rightarrow \quad P_{\text{transaction}} = \$2.80
\]

Due to the tax, consumers pay a total of $2.80 + $1.00 = $3.80 for an espresso drink in equilibrium.

b. What is the equilibrium price that producers receive?

As seen in part a, producers receive the transaction price of $2.80 for each espresso drink in equilibrium.
c. What is the equilibrium quantity?

The equilibrium quantity of espresso drinks exchanged is given by either the quantity supplied at the price received by the producers or the quantity demanded at the price paid by the consumers. Given the relevant prices found in parts a and b, we have:

\[ Q_S = -5000 + 4000(2.8) = 6200 \]
\[ Q_D = 10,000 - 1000(3.8) = 6200 \]

The equilibrium quantity of espresso drinks exchanged in this market is 6200.

d. How much money is raised for hospital stroke care units?

The tax revenue (that is, the amount of money raised for hospital stroke care units) is $1 per espresso drink sold. That is, the tax revenue is $6,200.

e. What is the producer surplus?

The producer surplus (PS) is equal to the area of above the supply curve and below the price received by the producers. That is, in this case it is equal to the area of a triangle with height (2.8 - 1.25) and base 6200. The producer surplus is thus:

\[ \frac{1.55 \times 6200}{2} = 4805 \]

The producer surplus is equal to $4,805.

f. What is the consumer surplus?

The consumer surplus (CS) is equal to the area of below the demand curve and above the equilibrium price. That is, in this case it is equal to the area of a triangle with height (10 - 3.8) and base 6200. The consumer surplus is thus:

\[ \frac{6.2 \times 6200}{2} = 19,220 \]

The consumer surplus is equal to $19,220.

g. What is the change in the producer surplus relative to the market equilibrium?

\[ 4805 - 6125 = -1320 \]

That is, the producer surplus is reduced by $1,320 by this tax.

h. What is the change in the consumer surplus relative to the market equilibrium?

\[ 19220 - 24500 = -5280 \]

That is, the consumer surplus is reduced by $5,280 by this tax.
i. What are the arguments that this tax on espresso drinks is a good idea?

If consumers are uniformed, shortsighted, or simply don’t consider the costs that having a stroke may impose on others, taxing espressos may guide them into purchasing a quantity that is both individually and collectively more optimal.

Insofar as some strokes are deemed to be caused by caffeine consumption, it seems fair that those who consume caffeine should bear special responsibility for paying for costs of strokes imposed on society.

j. What are the arguments that this tax on espresso drinks is a bad idea?

Welfare is destroyed by the tax: some of the surplus goes unrealized after the tax is imposed. This amount is called deadweight loss (DWL), and in this case is equal to $400:

\[
\frac{(3.8 - 2.8)(7000 - 6200)}{2} = 400
\]

Not all strokes are espresso-induced, so it may not be fair to burden espresso drinkers disproportionately to finance this fund.

Espresso drinkers should be allowed to make decisions regarding the tradeoffs between espresso drinking and the possible consequences of future strokes without the intervention of the government.

Does “linked” just mean correlated? A simple correlation between caffeine intake and blood pressure or between blood pressure and strokes (or if both relationships are simple correlations) does not make for a very compelling case that caffeine causes strokes. Even if a causal link were demonstrated between caffeine and strokes, the magnitude of the effect must be taken into account when making policy. (For example, if drinking one thousand espressos per year only increased your chance of having a stroke by 0.01%, the effect would be too small to matter for the consumption patterns of the vast majority of consumers, and a tax on all espresso drinks would be far more harmful than helpful overall.)
3. Now let us return to the market equilibrium. PDC now notes that baristas have low security of employment and often suffer from spells of unemployment. They decide to impose on producers a $1/drink tax to establish a social welfare fund for baristas.

\[
\text{The price kept by the producers after paying the tax will be } \quad P_{\text{kept}} = P_{\text{transaction}} - \text{Tax} = P_{\text{transaction}} - 1, \text{ so the quantity supplied can be rewritten as: }
\]
\[
Q_S = -5000 + 4000(P_{\text{transaction}} - 1) = -9000 + 4000P_{\text{transaction}}
\]

The new equilibrium (transaction) price is the price where this new quantity supplied is equal to the quantity demanded.

\[
10,000 - 1000P_{\text{transaction}} = -9000 + 4000P_{\text{transaction}} \quad \Rightarrow \quad 19,000 = 5000P_{\text{transaction}} \quad \Rightarrow \quad P_{\text{transaction}} = $3.80
\]

Consumers pay the transaction price of $3.80 for an espresso drink in equilibrium.

b. What is the equilibrium price that producers receive?

As seen in part a above, producers only receive (that is, they keep) the equilibrium transaction price minus the per-unit tax. That is, they receive $3.80 - $1.00 = $2.80.
c. What is the equilibrium quantity?

The equilibrium quantity of espresso drinks exchanged is given by either the quantity supplied at the price received by the producers or the quantity demanded at the price paid by the consumers. Given the relevant prices found in parts a and b, we have:

\[ Q_s = -5000 + 4000(2.8) = 6200 \]
\[ Q_d = 10,000 - 1000(3.8) = 6200 \]

The equilibrium quantity of espresso drinks exchanged in this market is 6200.

d. How much money is raised for baristas?

The tax revenue (that is, the amount of money raised for baristas) is $1 per espresso drink sold. That is, the tax revenue is $6,200.

e. What is the producer surplus?

The producer surplus (PS) is equal to the area of above the supply curve and below the price received by the producers. That is, in this case it is equal to the area of a triangle with height (2.8 – 1.25) and base 6200. The producer surplus is thus:

\[ \frac{1.55 \times 6200}{2} = 4805 \]

The producer surplus is equal to $4,805.

f. What is the consumer surplus?

The consumer surplus (CS) is equal to the area of below the demand curve and above the equilibrium price. That is, in this case it is equal to the area of a triangle with height (10 – 3.8) and base 6200. The consumer surplus is thus:

\[ \frac{6.2 \times 6200}{2} = 19,220 \]

The consumer surplus is equal to $19,220.

g. What is the change in the producer surplus relative to the market equilibrium?

\[ 4805 - 6125 = -1320 \]

That is, the producer surplus is reduced by $1,320 by this tax.

h. What is the change in the consumer surplus relative to the market equilibrium?

\[ 19220 - 24500 = -5280 \]

That is, the consumer surplus is reduced by $5,280 by this tax.
i. What are the arguments that this tax on espresso drinks is a good idea?

There may be considerable societal benefit to keeping baristas from starving or being too nervous about their employment status. (Maybe maintaining a ready supply of trained baristas can help improve the productivity of other sectors during good times.)

It still might be a good idea (individually and collectively) for consumers to cut back on their espresso consumption (see 2i), but this tax hasn’t been presented in those terms.

j. What are the arguments that this tax on espresso drinks is a bad idea?

Welfare is destroyed by the tax: some of the surplus goes unrealized after the tax is imposed. This amount is called deadweight loss (DWL), and in this case is equal to $400:

$$\frac{(3.8 - 2.8) \cdot (7000 - 6200)}{2} = 400$$

Is it fair to burden espresso drinkers in particular to help baristas? For one thing, baristas probably serve other beverages besides espressos.

As a result of this tax, fewer espressos will be purchased. Perversely, this tax may actually cause more baristas to become unemployed.

4. What are the differences between your answers to question 2 and question 3?

There essentially no substantive differences between the answers to question 2 and question 3. The prices paid by consumers and received by producers are the same, the quantity exchanged is the same, the tax revenue is the same, the producer and consumer surplus is the same, and the deadweight loss is the same.

The only differences are how to conceptualize the effect of the tax on the market (as a vertical shift in either the demand function or a vertical shift in the supply function) and how to argue for or against the merits of the tax.
5. Return to the market equilibrium. Suppose that all the producers—and we know they are all the producers because they own all the espresso machines in Avicenna—decide that they don't want to work as hard, and that they will make their supply "inelastic": they will share demand equally among themselves and simply go home for the day when the total number of espresso drinks served hits 4000.

\[ Q_D = 10,000 - 1000P \Rightarrow P = 10 - 0.001Q_D \]

However, the quantity supplied follows the same function until \( Q_S = 4000 \), which occurs when \( 4000 = -5000 + 4000P \Rightarrow 9000 = 4000P \Rightarrow P = 2.25 \). The supply function may be written as follows:

\[ Q_S = \begin{cases} 
-5000 + 4000P & \text{if } P \leq 2.25 \\
4000 & \text{if } P \geq 2.25 
\end{cases} \]

The equilibrium price, \( P^* \), is the price at which the quantity supplied equals the quantity demanded—where \( Q_S = Q_D \). Since the supply is being restricted, the equilibrium price can be no lower than the original market equilibrium price, so \( P^* \) will be greater than 2.25. Thus:

\[ 4000 = 10,000 - 1000P^* \Rightarrow 1000P^* = 6000 \Rightarrow P^* = 6 \]

The equilibrium price of espresso drinks in this market with restricted supply is $6.
b. What is the equilibrium quantity?

At the equilibrium price, the equilibrium quantity of espresso drinks exchanged is given by either the quantity supplied or the quantity demanded: by definition the market equilibrium occurs where these two are the same. Given the equilibrium price found in part a, we have:

\[ Q_s = 4000 \]
\[ Q_d = 10,000 - 1000(6) = 4000 \]

Unsurprisingly—given the severity of the supply restriction—the equilibrium quantity of espresso drinks exchanged in this market is 4000.

c. What is the producer surplus?

The producer surplus (PS) is equal to the area of above the supply curve and below the equilibrium price. That is, in this case it is equal to the area of a triangle with height \((2.25 - 1.25)\) and base 4000 plus the area of the rectangle of height \((6 - 2.25)\) and base 4000. The producer surplus is thus:

\[
\frac{1}{2} \cdot 4000 \cdot (2.25 - 1.25) + 3.75 \cdot 4000 = 17,000
\]

The producer surplus is equal to $17,000.

d. What is the consumer surplus?

The consumer surplus (CS) is equal to the area of below the demand curve and above the equilibrium price. That is, in this case it is equal to the area of a triangle with height \((10 - 6)\) and base 4000. The consumer surplus is thus:

\[
\frac{4000 \cdot 4}{2} = 8000
\]

The consumer surplus is equal to $8,000.

e. What is the change in the producer surplus relative to the market equilibrium?

\[ 17,000 - 6125 = 10,875 \]

That is, the producer surplus is increased by $10,875 by this tax.

f. What is the change in the consumer surplus relative to the market equilibrium?

\[ 8000 - 24500 = -16,500 \]

That is, the consumer surplus is reduced by $16,500 by this tax.
For the next several questions, let us remain in Avicenna but return to our yoga-lessons example. To simplify the math, we’ll assume that the supply curve is linear rather than a step function (as in lecture).

6. Suppose that the quantity of yoga lessons demanded \((Q_D)\) and the quantity of yoga lessons supplied \((Q_S)\) are given by the equations:

\[
Q_D = 126 - 5P \Rightarrow P = 25.2 - 0.2Q_D
\]

\[
Q_S = 2P \Rightarrow P = 0.5Q_S
\]

where \(P\) is the price of an espresso-based drink in dollars.

a. What is the market equilibrium price?

The equilibrium price, \(P^*\), is the price at which the quantity supplied equals the quantity demanded—where \(Q_S = Q_D\). Thus:

\[2P^* = 126 - 5P^* \Rightarrow 7P^* = 126 \Rightarrow P^* = 18\]

The equilibrium price of yoga lessons in this market is $18.
b. What is the market equilibrium quantity?

At the equilibrium price, the equilibrium quantity of yoga lessons is given by either the quantity supplied or the quantity demanded: by definition the market equilibrium occurs where these two are the same. Given the equilibrium price found in part a, we have:

\[ Q_s = 2(18) = 36 \]
\[ Q_d = 126 - 5(18) = 36 \]

The equilibrium quantity of yoga lessons in this market is 36.

c. What is the producer surplus?

The producer surplus (PS) is equal to the area of above the supply curve and below the equilibrium price. That is, in this case it is equal to the area of a triangle with height 18 and base 36:

\[ \frac{18 \cdot 36}{2} = 324 \]

The producer surplus is equal to $324.

d. What is the consumer surplus?

The consumer surplus (CS) is equal to the area of below the demand curve and above the equilibrium price. That is, in this case it is equal to the area of a triangle with height \(25.2 - 18\) and base 36:

\[ \frac{7.2 \cdot 36}{2} = 129.6 \]

The consumer surplus is equal to $129.60.
7. Now suppose PDC--Production Distribution Coordination--gets into the act. Somebody gives an eloquent speech about how it is unfair that people are charged as much as $18/lesson for yoga, and PDC enacts a price ceiling: nobody is allowed to charge more than $10/lesson for yoga classes--and the lessons will be taken by those who are the first to sign up.

a. What quantity are suppliers willing to provide at a price of $10/lesson?
   At a price of $10 per yoga lesson, instructors are willing to supply up to $Q_S = 2(10) = 20$ lessons.

b. How many people will want to sign up for yoga lessons?
   At a price of $10 per yoga lesson, $Q_D = 126 - 5(10) = 76$. That is, 76 consumers want to take lessons at a price of $10 per yoga lesson.

c. What is the average valuation the people who want to sign up place on yoga lessons?
   Consider the 76 consumers who want to sign up for yoga lessons at a price of $10. Their valuations range from $10 up to $25.20 (in the limit). The demand curve is linear, so the average valuation of the set of these consumers will be the midpoint between $10$ and $25.20—that is, $17.60$. 

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**Graph Description:**
- **CS** indicates the supply curve.
- **PS** indicates the price-yielding demand schedule.
- The intersection of the supply and demand curves shows the equilibrium price and quantity at $P = 10$ and $Q = 20$.
d. Suppose that the average person who succeeds in signing up has the average valuation among all those who wish to sign up. What, then, is the consumer surplus?

Given that those who succeed in signing up have—on average—the average valuation found in part c. Then the consumer surplus (CS) is equal to the average surplus (17.6 – 10) times the number of these lucky consumers (20). The consumer surplus is 7.6\cdot 20 = 152.

e. What is the producer surplus?

The producer surplus (PS) is equal to the area of above the supply curve and below the price. That is, in this case it is equal to the area of a triangle with height 10 and base 20:

\[
\frac{10\cdot 20}{2} = 100
\]

The producer surplus is equal to $100.

f. Who has gained and who has lost from this decree relative to the market equilibrium, and how much?

In the aggregate consumers have gained $152 – $129.60 = $22.40 in surplus.

Overall, producers have lost $224 in surplus.

g. Can you think of a reason why this decree from the PDC might be popular?

Yoga instructors may have many students per class, so in terms of numbers of citizens (or voters) this decree potentially affects many more consumers than producers. A couple producers who lose as a result of this decree could be outweighed politically by the dozens of consumers who might be made better off.

h. Suppose it is your job to argue that the decree should be repealed. What would you say?

This policy causes huge welfare losses overall.

This policy screws at least 16 consumers who had been willing to pay the equilibrium price and helps only 20 overall.

Yoga instructors are quite keen to see the policy repealed [hint, hint].

<up to $224 in an unmarked envelope pushed across a desk at PDC headquarters>

i. In ancient Athens there was a crime—punishable by death or fine—of having convinced the Assembly of Athens to pass a bad decree: γραφὴ παρανόμων. Do you think those who persuaded PDC to pass this decree should be tried and punished for this crime? Why or why not?

This really looks like a bad policy.

The policy makes yoga lessons potentially available to 40 consumers who would otherwise not be able to afford them. However, only 20 out of 76 total will be able to actually enroll, leaving 56 disappointed. Furthermore, with certainty at least 16 students who had been attending lessons at the market equilibrium price will now not be able to do so. This policy makes no provision for making sure that those who have the highest value for yoga lessons are able to enroll, needlessly destroying even more welfare than the deadweight loss.

Of course, the producers have it even worse, losing $224 of surplus. Perversely, some yoga instructors will likely be unemployed even as there is excess demand for yoga lessons.

Death seems a bit harsh for those who persuaded the PDC to pass this decree, but a fine equal to the deadweight loss plus the surplus lost by allocating the 20 slots inefficiently seems an eminently appropriate punishment.
8. Now suppose that somebody stands up at PDC and gives a persuasive speech that yoga is an alien fitness discipline and that we should be encouraging all-American forms of exercise—like hot-dog eating contests. As a result, PDC passes a decree that no more than 20 people should take yoga lessons a day. However, they do not restrict the price that those lucky enough to be allowed to offer the 20 lessons can charge.

a. To what price will consumers bid up the price of yoga lessons?

If there are only 20 lessons available, the consumers will bid up the price until the quantity demanded is 20. The price will thus be given by:

\[ 20 = 126 - 5P \Rightarrow 5P = 106 \Rightarrow P = 21.2 \]

b. What will the consumer surplus be?

The consumer surplus (CS) is equal to the area of below the demand curve and above the price. That is, in this case it is equal to the area of a triangle with height \((25.2 - 21.2)\) and base 20:

\[ \frac{4 \times 20}{2} = 40 \]

The consumer surplus is equal to $40.
c. What is the average reservation price for which potential yoga teachers will want to teach yoga lessons?

The reservation prices for yoga instructors who would be willing to supply a lesson at a price of $21.20 range from zero to $21.20. Since the supply curve is linear, the average reservation price would be the midpoint of these two values: $10.60.

d. Suppose that the average teacher who succeeds in signing up to give the 20 lesson slots has the average valuation among all those who wish to sign up. What, then, is the producer surplus?

The producer surplus is equal to the average surplus for the average producer \((21.2 - 10.6)\) times the 20 lesson slots: \(10.6 \times 20 = 212\).

e. Who has gained and who has lost from this decree relative to the market equilibrium, and how much?

In the aggregate consumers have lost \(129.60 - 40 = 89.60\) in surplus. Overall, producers have lost \(324 - 212 = 112\) in surplus.

f. Can you think of a reason why this decree from the PDC might be popular?

Not really. Every consumer loses. Producers lose overall. A few (lucky) producers win. This decree will not be popular, but the few lucky producers who are able to teach the 20 lessons will be fond of it.

g. Suppose it is your job to argue that the decree should be repealed. What would you say?

Every consumer loses. Producers lose overall. Only a few lucky producers win, and there's no assurance that these will be chosen efficiently. Many consumers and a few producers will be willing to make a deal to repeal the policy.

h. Do you think those who persuaded PDC to pass this decree should be tried and punished for convincing PDC to pass a bad decree? Why or why not?

Unless there is some other compelling motive for reducing the number of yoga lessons this is clearly a bad policy, and those who convinced the PDC to adopt it should probably be punished for the crime of γραφὴ παρανόμων.

Moreover, they should be punished severely if they happen to have close ties to those lucky few producers who actually benefit from this policy.
9. In the far north of the state of Euphoria there is a small town called Ihavefoundit. There is one theater in Ihavefoundit, and there is no connectivity to the outside world whatsoever. This means that the 1000 or so residents of Ihavefoundit who have a fondness for watching classic Japanese cinema with subtitles have only one way to do so: somebody has to rent a copy of a movie and rent the theater—paying $420 to do both of those things—and then show the movie, charging admission. No matter how many people show up to the theater the cost of showing the movie remains the same: $420.

You are conducting market research to discover the shape of the demand curve. You determine that there is nobody who will pay a price of $60, 1 who will pay $59, 2 who will pay $58, and so on down until you hit $10, at which point there will be 50 willing to pay to see the movie. Then 55 people will be willing to pay $9, 60 in total will be willing to pay $8, 65 will be willing to pay $7, 70 will be willing to pay $6, and 75 will be willing to pay $5. Below $5 a ticket things change: 90 people will be willing to pay $4, 105 will be willing to pay $3, 120 will be willing to pay $2, 180 will be willing to pay $1, and 360 will come if it is free.

Suppose that the profit-making Monopolist Entrepreneurial Company is thinking of entering the business as the only—the monopoly—seller of opportunities to see classic Japanese cinema in the benighted, fog-bound, and redwood-infested town of Ihavefoundit. They hire you to analyze the situation given your extensive market research. They ask:
a. What price maximizes profits for the Monopolist Entrepreneurial Company?

There are a couple different ways to solve this problem. For present purposes, guessing and checking is sufficient and surprisingly quick.

Note that since the marginal cost is always zero, the price that yields the highest revenue will be the price that gives the highest profit. (No matter what the revenue is, the same fixed cost of $420 will be subtracted from it, so the highest revenue will yield the highest profit.)

At a price of $60 the quantity demanded is zero, so revenue is zero.

At a price of $50 the quantity demanded is 10, so revenue is $500.

At a price of $40 the quantity demanded is 20, so revenue is $800.

At a price of $30 the quantity demanded is 30, so revenue is $900.

At a price of $20 the quantity demanded is 40, so revenue is $800.

At a price of $10 the quantity demanded is 50, so revenue is $500.

At a price of $9 the quantity demanded is 55, so revenue is $495.

And so on...

The symmetry of revenue around the price of $30 suggests that $900 is the maximum revenue, but let’s check nearby prices just in case:

At a price of $31 the quantity demanded is 29, so revenue is $899.

At a price of $29 the quantity demanded is 31, so revenue is $899.

Indeed, the monopoly profit-maximizing price is $30.

b. What profits will the MEC make at that price?

MEC makes a revenue of $900 at the monopoly profit-maximizing price of $30.

MEC’s profit is its revenue minus its costs: $900 - $420 = $480.

c. What is the consumer surplus for that price?

The consumer surplus (CS) is the area below the demand curve and above the price. In this case it is equal to the area of a triangle with height (60 – 30) and base 30, since the quantity demanded at a price of $30 is 30.

\[
\frac{30\cdot30}{2} = 450
\]

The consumer surplus is $450.

d. What is the total social surplus for that price?

The total social surplus (or welfare) at MEC’s profit-maximizing price is MEC’s profit plus the consumer surplus:

$480 + $450 = $930

The total social surplus is $930.
10. Let us remain in the far north of Euphoria. MEC refuses to pay your bill. Annoyed, you go to the Redwood Collective for Culture and argue that they should take on the business of showing movies as a non-profit. The RCC is—let us suppose—an efficient organization, able to actually rent a theater, rent a print of the movie, collect money, and not have it stolen. The only constraint on the RCC is that it has to break even.

a. At what price charged per ticket does the RCC break even—that is, collect the $420 it needs to run its operations?

The solution to 9a above gives the revenue collected for many possible prices, but all of those listed yield revenues higher than $420. Continuing that list, we see:

- At a price of $7 the quantity demanded is 65, so revenue is $455.
- At a price of $6 the quantity demanded is 70, so revenue is $420.
- At a price of $5 the quantity demanded is 75, so revenue is $375.

RCC breaks even—that is, it collects $420 in revenue to cover exactly its costs of $420—when it charges a price of $6.

b. What is the consumer surplus when the RCC breaks even?

The consumer surplus (CS) is the area below the demand curve and above the price. In this case it is equal to the area of a triangle with height (60 – 10) and base 50 plus the area of a rectangle with height (10 – 6) and base 50 plus the area of a triangle with height (10 – 6) and base (70 – 50):

\[
\frac{50 \cdot 50}{2} + CS \cdot 0 + \frac{4 \cdot 20}{2} = 1490
\]

The consumer surplus is $1,490 when RCC breaks even, charging a price of $6.
c. How does that compare to the consumer surplus in question 9, when the profit-maximizing entrepreneurial Company showed the movies?

The consumer surplus (CS) is $1,490 - $450 = $1,040 higher with RCC relative to MEC.

d. How does that compare to the sum of the consumer and producer surplus in question 9, when the profit-maximizing Entrepreneurial Company showed the movies?

The sum of consumer and producer surplus with RCC is $1,490 + $0 = $1,490, which is $1,490 - $930 = $560 higher than the sum of consumer and producer surplus under MEC.

e. Which comparison—that of consumer surplus with the RCC to consumer surplus with the profit-making EC in part (c), or that of consumer surplus with the RCC to consumer plus producer surplus with the profit-making EC in part (d)—is the best one to keep in mind in guiding your analysis of whether classic Japanese cinema in Ihavefoundit should be shown by a private company or by a nonprofit organization?

Either comparison is very favorable for RCC: $1490 > $450 and $1,490 > $930.

As seen in questions 6, 7, and 8 decisions about the allocation of surplus depend upon one’s policy goals. By default, economists often advocate for efficiency—that is, maximizing the total social surplus (also called welfare).

11. Suppose that PDC for the state of Euphoria now calls you up and asks whether they should give the RCC a $420 grant from public funds—have movies shown not by a for-profit company and not by a non-profit collective but instead by a public movie-showing program.
a. What price per ticket does the RCC now have to charge to break even?

If RCC is given a $420 subsidy by the government, it doesn’t need to take in any additional revenue from ticket sales to cover its costs.

RCC breaks even by charging $0.

b. What is the consumer surplus now when the RCC breaks even?

The consumer surplus of the first 50 consumers is equal to the area of a triangle with height (60 - 10) and base 50 plus the area of a rectangle with height (10 - 0) and base 50:

\[
\frac{50 \cdot 50}{2} + 10 \cdot 50 = 1750
\]

The consumer surplus of the next 25 consumers is equal to the area of a triangle with height (10 - 5) and base 25 plus the area of a rectangle with height (5 - 0) and base 25:

\[
\frac{25 \cdot 25}{2} + 5 \cdot 25 = 187.5
\]

The consumer surplus of the next 45 consumers is equal to the area of a triangle with height (5 - 2) and base 45 plus the area of a rectangle with height (2 - 0) and base 45:

\[
\frac{45 \cdot 45}{2} + 2 \cdot 45 = 157.5
\]

The consumer surplus of the next 60 consumers is equal to the area of a triangle with height (2 - 1) and base 60 plus the area of a rectangle with height (1 - 0) and base 60:

\[
\frac{60 \cdot 60}{2} + 1 \cdot 60 = 90
\]

The consumer surplus of the next (and last) 180 consumers is equal to the area of a triangle with height (1 - 0) and base 180:

\[
\frac{180 \cdot 180}{2} = 90
\]

The total consumer surplus is thus: $1,750 + $187.50 + $157.50 + $90 + $90 = $2,275.

c. By how much has consumer surplus increased as a result of this $420 grant?

Relative to the case where RCC is in charge but doesn’t receive a $420 grant, consumer surplus increases by $2,275 - $1,490 = $785.

d. What are the arguments that this $420 grant is a good use of the government's money?

Consumer surplus can be increased by $785 at a price of only $420. This seems like a pretty good deal for the society of Ihavefoundit.

e. What are the arguments that this $420 grant is a bad use of the government's money?

To quote Milton Friedman: “To spend is to tax.” The $420 spent by the government to subsidize classic Japanese cinema must come from somewhere. The tax that finances the RCC will distort some other market (either now or in the future if it using bonds to finance the grant), and this tax will impose welfare costs of unknown magnitude. Taking these effects into account, it may well be the case that welfare is destroyed overall.

Why should the other approximately 640 other residents of Ihavefoundit—who prefer not view classic Japanese cinema even when the price is zero—subsidize the entertainment of the minority who do appreciate classic Japanese cinema?
12. Let us now leave Euphoric State and the town of Avicenna. Let us drive across the bridge over the bay to the
city of Holy Frank. And then let us drive 50 miles south along the Royal Road to the town of Tall Stick. In
Tall Stick we find Crony Capitalism University—endowed by one of the early governors of Euphoria with
money he diverted from the railroad connecting the state of Euphoria with the outside world.

Let us say that every year 1000 freshmen arrive at CCU and all immediately think about buying a BMW
convertible. They are, you see, mostly from Angel-Queen City and have not walked anywhere since they
started kindergarten. CCU is half a mile in the Euphoric sun down an avenue of palm trees from even the
closest shops of Tall Stick. Suppose that the selling price of BMW convertibles is $55,000, and suppose that
each of the 1000 freshmen values a BMW convertible $50,000 for purposes of transportation.

But there is a catch. Each student who owns a BMW convertible feels $10 worth of utility happier—call it
vanity—for each and every one of his or her 999 peers who does not own a BMW convertible. Each student
who does not own a BMW convertible feels $10 of utility unhappier—call it envy—for each of his or her 999
peers who does own a BMW convertible. Thus the first student to show up would feel no envy if he or she
did not buy (for nobody else owns one) but would receive 999 · $10 = $9,990 worth of vanity plus $50,000
worth of transportation if he or she were to buy a BMW convertible:

a. Will the first freshman student to show up at CCU buy a BMW convertible?

If the first freshman buys a BMW convertible, she receives $50,000 of transportation value plus
$9,990 of vanity value minus $55,000 in cost = $4,990 of value.

If she decides not to buy a BMW convertible, she receives $0 of value, since no one else has one.

Since $4,990 > $0, the first freshman to show up at CCU decides to buy a BMW convertible.

b. How many of the 1000 freshmen students to show up at CCU will buy BMW convertibles?

Knowing that the first freshman opts to buy a BMW convertible, the second freshman receives
$50,000 of transportation value plus $10·(998) of vanity value minus $55,000 in cost = $4,980 of
value if he buys a BMW convertible. If he doesn't buy one, he receives -$10·1 = -$10 in value
because the first freshman has one. Since $4,980 > -$10, the second freshman also buys a BMW
convertible.

Knowing that the first and second freshmen both buy a BMW convertible, the third freshman
receives $50,000 of transportation value plus $10·(997) of vanity value minus $55,000 in cost = $4,970 of
value if she buys a BMW convertible. If she doesn't buy one, she receives -$10·2 = -$20
in value because the first and second freshmen each have one. Since $4,970 > -$20, the third
freshman also buys a BMW convertible.

If the \( n \)th freshman decides between $50,000 + $10·(1000 – \( n \)) – $55,000 from buying a BMW
convertible and -$10·(\( n \) – 1) from not buying one. That is, the \( n \)th freshman will buy one if:

\[
50,000 + 10 \cdot (1000 - n) - 55,000 > -10 \cdot (n - 1)
\]

\[
50,000 + 10 \cdot 10n > -10n + 10
\]

\[
4,990 > 0
\]

That is, the \( n \)th freshman will always decide to buy a BMW convertible since this inequality
always holds!

This means that all 1000 of the freshmen at CCU decide to buy a BMW convertible.
c. What will be the total consumer surplus received by the 1000 freshman students of CCU from their purchase of BMW convertibles?

Since all of the freshmen at CCU have a BMW convertible, no one receives any disutility from envy, nor does anyone receive any utility from vanity.

The consumer surplus for each of the freshmen is simply the transportation value of the BMW minus its cost: $50,000 - $55,000 = -$5,000.

Since there are 1000 of them, the total consumer surplus is -$5,000,000.

[Note that if none of them bought a BMW convertible, they would each have $0 of surplus, which—in retrospect—sounds a lot better than -$5,000. The problem is that if no one else buys one, each freshman has a strong incentive to be the first one to buy one—or the second to buy one, or the third to buy one, and so on... This kind of situation—where everyone arrives at an outcome that is collectively worse for everyone through pursing a choice that is always better individually (that is, each participant plays a dominant strategy)—is called a Prisoners' Dilemma.]

d. Suppose you are the chair of the Department of Economics at CCU, and the President of CCU asks you how much the university should charge freshmen for parking spaces. Suppose that there is ample parking—this is suburban Euphoria, after all—but all of it is on university land. What do you think is the right price to charge for parking? Why?

If the President of CCU wants to help the freshmen avoid a costly and stupid collective mistake, the university should charge enough for parking to discourage the purchase a BMW convertible. That is, the university should charge strictly more than $4,990 for parking ($4,991, for instance).

If instead the President of CCU wants to maximize the amount of money the university collects in parking fees, it should charge as much as it can without discouraging the purchase of BMW convertibles. That is, the university should charge slightly less than $4,990 for parking ($4,989 perhaps).

Given that the name of the institution is Crony Capitalism University, it’s a safe bet that the President of CCU will go with the latter plan.