1. Suppose that policymakers have been convinced that the market price of houses in Bozeman is too high.

   a. Suppose the government imposes a binding price ceiling in the Bozeman housing market. Draw a supply-and-demand diagram to show the effect of this policy on the price of houses and the quantity of houses sold. Is there a shortage or surplus of houses?

   ![Supply and Demand Diagram](image)

   The binding price ceiling would occur below the equilibrium price. The lower price would generate a shortage of housing by increasing the quantity demanded to Qd and reducing the quantity supplied to Qs.

   b. Who benefits from this new policy? Who loses?

   Those who are able to buy a house at the new lower price benefit from this policy. Those who are now unable to find a home are hurt by this policy. Sellers are hurt by this policy.
2. A recent study found that the demand and supply schedules for Labradors in Bozeman are:

<table>
<thead>
<tr>
<th>Price ($ per Labrador)</th>
<th>Quantity Demanded (per period)</th>
<th>Quantity Supplied (per period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100</td>
<td>0</td>
<td>150</td>
</tr>
<tr>
<td>1000</td>
<td>20</td>
<td>120</td>
</tr>
<tr>
<td>900</td>
<td>40</td>
<td>90</td>
</tr>
<tr>
<td>800</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>700</td>
<td>80</td>
<td>30</td>
</tr>
<tr>
<td>600</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

a. What are the equilibrium price and quantity of Labradors? What are producer and consumer surplus at equilibrium?

\[ P = 800; \, Q = 60 \]

**Consumer Surplus**

\[ CS = .5 \times 60 \times (1100-800) = \$9000 \text{ per period} \]

**Producer Surplus**

\[ PS = .5 \times 60 \times (800-600) = \$6000 \text{ per period} \]

b. Labrador breeders persuade the local government that because Labradors improve Bozemanites’ mental health, it is important to keep Labrador breeders in business, and prices are currently too low to ensure that. Local policymakers vote to impose a price floor $200 above the equilibrium price. What is the new market price? How many Labradors are sold? What is the deadweight loss from this policy? Who wins and who loses from the policy?
The new price is $1000 and the new quantity is 20 per period.

<table>
<thead>
<tr>
<th>Consumer Surplus</th>
<th>Producer Surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>$CS = .5 \times 20 \times (1100-1000) = $1000 per period$</td>
<td>$PS = [.5 \times 20 \times (666-600)] + (1000-666) \times 20$</td>
</tr>
<tr>
<td></td>
<td>$= 660 + 6680 = $7340$</td>
</tr>
</tbody>
</table>

Consumers are worse off by $8000 per period. Producers are better off by $1340 per period.

The deadweight loss is

$.5 \times 40 \times (1000-666) = 6680$ (subject to rounding)

c. Irate college students march on the City/County building and demand a reduction in the price of Labradors. Local policymakers vote to repeal the price floor and impose a price ceiling $100 below the equilibrium price. What is the new market price? How many Labradors are sold? What is the deadweight loss from this policy? Who wins and who loses from the policy?
The new price is $700 and the new quantity is 30 per period.

<table>
<thead>
<tr>
<th>Consumer Surplus</th>
<th>Producer Surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ CS = .5 \times 30 \times (1100-950) = 30 \times 250 ]</td>
<td></td>
</tr>
</tbody>
</table>
| \[ = 2250 + 7500 = $9750 \text{ per period} \]
| \[ PS = [.5 \times 30 \times (700-600)] = $1500 \text{ per period} \] |

Consumers are better off by $750 per period. Producers are worse off by $4500 per period.

The deadweight loss is

\[ .5 \times 30 \times (950-700) = 3750 \] (subject to rounding)

3. A friend of yours is considering two cell phone service providers. Provider A charges $100 per month for the service regardless of the number of phone calls made. Provider B does not have a fixed service fee but instead charges $0.50 per minute for calls. Your friend’s monthly demand for minutes of calling per month is given by the equation \( Q^d = 100 - 25P \), where \( P \) is the price of a minute.

a. With each provider, what is the cost to your friend of an extra minute on the phone?

*With provider A, the cost of an extra minute is $0. With provider B, the cost of an extra minute is $0.50*

b. In light of your answer to (a), how many minutes would your friend talk on the phone with each provider?

*With provider A, \( Q^d = 100 - (25 \times 0) = 100 \) minutes

*With provider B, \( Q^d = 100 - (25 \times .50) = 87.50 \) minutes

c. How much would he or she end up paying each provider every month?

*With provider A, she pays $100 per month

*With provider B, she pays $0.50 \times 87.50 = 43.75 \text{ per month.}*

d. How much consumer surplus would he obtain with each provider? (Hint: Graph the demand curve and recall the formula for the area of a triangle)

*Provider A: \( CS = (.5 \times 4 \times 100) - $100 = $100 \text{ per month} \)

*Provider B: \( CS = .5 \times 87.50 \times (4-.5) = $153.13 \)
e. Which provider would you recommend that your friend choose? Why?

*He is better off with provider B, since it yields more consumer surplus.*

4. A subsidy is the opposite of a tax. With a $0.50 per gallon tax on gasoline, the government collects $0.50 for each gallon purchased; with a $0.50 subsidy for sellers of gasoline, the government pays sellers $0.50 for each gallon purchased.

   a. Show the effect of a $0.50 per gallon subsidy on the supply curve for gasoline, the effective price paid by consumers, the effective price received by sellers, and the quantity of gasoline sold.

   *See the graph. The effect is to shift the supply curve down by the amount of the tax since producers are now willing to accept 0.50 less from buyers than before (since the government is making up the difference now)*
b. Do consumers gain or lose from this policy? Do producers gain or lose? Does the government gain or lose?

Consumers gain because they get more gasoline and pay a lower price than before. Producers gain because they sell more gasoline and get a higher price than before. The government loses since it has to pay the cost of the subsidy.

5. Suppose that the government subsidizes college education. Each student who attends college gets $5,000 per year from the government. How does the subsidy affect consumer surplus, producer surplus, tax revenue, and total surplus? Does a subsidy lead to a deadweight loss? Explain.

The subsidy will increase demand. Consumer surplus will rise, producer surplus will rise. Tax revenue won’t change, but the government will have to spend more than before to pay for the subsidy. There will be a deadweight loss from the “overproduction” of higher education.

6. Consider how health insurance affects the quantity of healthcare services performed. Suppose that the typical medical procedure has a cost of $100, yet a person with health insurance pays only $20 out of pocket. Her insurance company pays the remaining $80. (The insurance company recovers the $80 through premiums, but the premium a person pays does not depend on how many procedures that person chooses to undertake.)

a. Draw the demand curve in the market for medical care. (In your diagram, the horizontal axis should represent the number of medical procedures.) Show the quantity of procedures demanded if each procedure has the price of $100.
The figure below illustrates the demand for medical care. If each procedure has a price of $100, quantity demanded will be $Q_1$ procedures.

b. On your diagram, show the quantity of procedures demanded if the consumers pay only $20 per procedure. If the cost of each procedure to society is truly $100, and if individuals have health insurance as described, will the number of procedures performed maximize total surplus? Explain.

If consumers pay only $20 per procedure, the quantity demanded will be $Q_2$ procedures. Because the cost to society is $100, the number of procedures performed is too large to maximize total surplus. The quantity that maximizes total surplus is $Q_1$ procedures, which is less than $Q_2$.

c. Economists often blame the health insurance system for excessive use of medical care. Given your analysis, why might the use of care be viewed as “excessive”?

The use of medical care is excessive in the sense that consumers get procedures whose value is less than the cost of producing them. As a result, the economy’s total surplus is reduced.

d. What sort of policies might prevent this excessive use?
To prevent this excessive use, the consumer must bear the marginal cost of the procedure. But this would require eliminating insurance. Another possibility would be that the insurance company, which pays most of the marginal cost of the procedure ($80, in this case) could decide whether the procedure should be performed. But the insurance company does not get the benefits of the procedure, so its decisions may not reflect the value to the consumer.

7. The equations below give the demand and supply of Birkenstocks per week.

\[
\text{Demand:} \quad P = 200 - Q \\
\text{Supply:} \quad P = 50 + 4Q
\]

a. Graph these equations. Indicate their intercepts.

b. What is the equilibrium price and quantity?

\[
200 - Q = 50 + 4Q \\
5Q = 150 \\
Q = 30
\]

\[
P = 200 - 30 = 170
\]

c. Suppose the government imposes a tax of $20 per pair of Birkenstocks on the buyers this market. What is the new equilibrium quantity? How much do demanders now pay for each pair of Birkenstocks? How much do suppliers receive for each pair sold? How much tax revenue does the government earn?
The tax shifts the demand curve down by $20 since the amount buyers are willing to pay is now $20 lower (to make up for the tax).

\[
200 - Q - 20 = 50 + 4Q \\
5Q = 130 \\
Q = 26
\]

\[
P \text{ for buyers} = 200 - 26 = 174 \\
P \text{ for sellers} = 50 + 4(26) = 154
\]

Tax Revenue: 26 * 20 = $520 per period

8. Suppose that a market is described by the following supply and demand equations:

\[
Q^S = 2P \quad Q^D = 300 - P
\]

a. Solve for the equilibrium price and equilibrium quantity.

Setting quantity supplied equal to quantity demanded gives \( 2P = 300 - P \). Adding \( P \) to both sides of the equation gives \( 3P = 300 \). Dividing both sides by 3 gives \( P = 100 \). Plugging \( P = 100 \) back into either equation for quantity demanded or supplied gives \( Q = 200 \).

b. Suppose that a tax of \( T \) is placed on buyers, so the new demand equation is:

\[
Q^D = 300 - (P + T)
\]

Solve for the new equilibrium. What happens to the price received by sellers, the price paid by buyers, and the quantity sold?
Now \( P \) is the price received by sellers and \( P+T \) is the price paid by buyers. Equating quantity demanded to quantity supplied gives \( 2P = 300 - (P+T) \). Adding \( P \) to both sides of the equation gives \( 3P = 300 - T \). Dividing both sides by 3 gives \( P = 100 - \frac{T}{3} \). This is the price received by sellers. The buyers pay a price equal to the price received by sellers plus the tax (\( P + T = 100 + \frac{2T}{3} \)). The quantity sold is now \( Q = 2P = 200 - \frac{2T}{3} \).

c. Tax revenue is \( T \times Q \). Use your answer to part (b) to solve for tax revenue as a function of \( T \). Graph this relationship for \( T \) between 0 and 300.

Because tax revenue is equal to \( T \times Q \) and \( Q = 200 - \frac{2T}{3} \), tax revenue equals \( 200T - \frac{2T^2}{3} \). The figure below shows a graph of this relationship. Tax revenue is zero at \( T = 0 \) and at \( T = 300 \).

d. The deadweight loss of a tax is the area of the triangle between the supply and demand curves. Recalling that the area of a triangle is \( \frac{1}{2} \times \text{base} \times \text{height} \), solve for deadweight loss as a function of \( T \). Graph this relationship for \( T \) between 0 and 300. (Hint: Looking sideways, the base of the deadweight loss triangle is \( T \), and the height is the difference between the quantity sold with the tax and the quantity sold without the tax.)
As the figure above shows, the area of the triangle (laid on its side) that represents the deadweight loss is \( \frac{1}{2} \times \text{base} \times \text{height} \), where the base is the change in the price, which is the size of the tax \( T \) and the height is the amount of the decline in quantity \( \frac{2T}{3} \). So the deadweight loss equals \( \frac{1}{2} \times T \times \frac{2T}{3} = \frac{T^2}{3} \). This rises exponentially from 0 (when \( T = 0 \)) to 30,000 when \( T = 300 \), as shown in the figure below.

e. The government now levies a tax on this good of $200 per unit. Is this a good policy? Why or why not? Can you propose a better policy?

A tax of $200 per unit is a bad idea, because it is in a region in which tax revenue is declining. The government could reduce the tax to $150 per unit, get more tax revenue ($15,000 when the
tax is $150 versus $13,333 when the tax is $200), and reduce the deadweight loss (7,500 when
the tax is $150 compared to 13,333 when the tax is $200).

9. Read, "America's Opioid Epidemic is Driven by Supply," (The Economist, 1/29/2018) and answer the following:

   a. Why might economic conditions be related to the opioid epidemic? Why might low-skilled working-age men be more affected than others?
   b. How and why would a change in unemployment rate affect the demand for opioids?
   c. How can the author's point, "the epidemic is caused by access to drugs rather than economic conditions" be interpreted in terms of demand and supply of opioids?
   d. Use two separate demand and supply diagrams to illustrate the potential impact of Mr. Rhum's two suggestions: (1) focusing on drug monitoring programs, restrictions on who can dispense, stricter prescription guidelines and (2) treatment options like adequate medication-based approaches for addicts, on the price and quantity of opioids.