Market Power and Monopoly
## Introduction

### Chapter Outline

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In the real world, there are very few examples of perfectly competitive industries.

Firms often have market power, or an ability to influence the market price of a product.

The most extreme example is a monopoly, or a market served by only one firm.

- A monopolist is the sole supplier (and price setter) of a good in a market.

Firms with market power behave in different ways from those in perfect competition.
The key difference between perfect competition and a market structure in which firms have pricing power is the presence of **barriers to entry**, or factors that prevent entry into the market with large producer surplus.

- Normally, positive producer surplus in the long run will induce additional firms to enter the market until it is driven to zero.
- The presence of barriers to entry means that firms in the market may be able to maintain positive producer surplus indefinitely.
Extreme Scale Economies: Natural Monopoly

One common barrier to entry results from a production process that exhibits economies of scale at every quantity level.

- Long-run average total cost curve is downward sloping; diseconomies never emerge.

Results in a **natural monopoly**:

- It’s more efficient for a single firm to produce the entire industry output.
- Splitting output across multiple firms raises the average cost of production.
  - An example is a production process with the following total cost structure:

  \[
  TC = 100 + 10Q 
  \rightarrow
  ATC = \frac{100}{Q} + 10
  \]

✓ What are some industries that might exhibit continuously declining average total costs as output increases?
Sources of Market Power

9.1

Switching Costs

Another barrier to entry results from the presence of consumers’ switching costs, which can result from

• brand-related opportunity costs (e.g., preferred status on an airline).
• technology constraints (e.g., software compatibility issues between Apple and Microsoft Windows–based operating systems).
• search costs (e.g., health insurance plans).

Some goods have characteristics that make them network goods.

• A good whose value to each consumer increases with the number of other consumers of the product

✓ What are some network goods?
  – Telecommunications
  — Computer operating systems
Product Differentiation

For most noncommodity markets, consumers may not treat products from different firms as perfect substitutes

- Example: Burger King and Chipotle compete for fast-food customers, but their products are highly differentiated. How?

Product differentiation refers to imperfect substitutability across varieties of a product.
Sources of Market Power

**Absolute Cost Advantages or Control of Key Inputs**

Many production processes rely on scarce inputs (e.g., natural resource products).

- Example: Saudi Aramco (Saudi Arabia’s state-run oil company) maintains control over a vast oil supply with relatively low extraction costs.

In other circumstances, firms may develop *absolute cost advantages* by engaging in long-term contracts with intermediate suppliers.

- Apple has developed this type of relationship with Foxconn, a Chinese company that assembles many of Apple’s products.
Sources of Market Power

9.1

Government Regulation

A final important barrier is government regulation that limits entry to a market.

- Examples:
  - Patents
  - Licensing requirements (e.g., medical board certification)
  - Prohibition of competition (e.g., U.S. Postal Service)
A true monopolist faces the market demand curve:
• There are no competing firms in this market.
• Price is not fixed; the only way to sell more of a product is to lower the price.

✓ **How does this differ from perfect competition?**
  – Perfectly competitive firms can sell as much as they want at the market price.

Other market structures associated with downward-sloping demand:
• **Oligopoly** is a market structure in which a few competitors operate (e.g., the automobile industry)
• **Monopolistic competition** is a market structure with a large number of firms selling differentiated products (e.g., the fast food industry)
  – In these structures, the demand curve facing a given firm depends on the production decisions of other firms—**strategic behavior**, discussed further in the next chapter.
Marginal Revenue

In perfect competition, the demand curve facing an individual firm is horizontal, and marginal revenue is equal to price.

If a firm has market power, the demand curve for its product(s) will have a downward slope.

✓ What does this imply for the shape of the marginal revenue curve?
   – It must also be downward sloping.

Consider the production decisions of Durkee-Mower, Inc., a Massachusetts firm that makes Marshmallow Fluff.

• Has had a dominant market position since the 1920s
• Table 9.1 shows how price and marginal revenue are related to the quantity of Fluff produced.
# Table 9.1  Marginal Revenue for Marshmallow Fluff

<table>
<thead>
<tr>
<th>Quantity (millions of pounds) ((Q))</th>
<th>Price ($/pound) ((P))</th>
<th>Total Revenue ($ millions) ((TR = P \times Q))</th>
<th>Marginal Revenue ($ millions) (\left( MR = \frac{\Delta TR}{\Delta Q} \right))</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>6</td>
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</table>
Marginal revenue is *not* equivalent to price for a firm facing a downward-sloping demand curve.

**Why is this the case?**
- When a firm produces more of a product, the price for *all* of its products in the marketplace falls.

- This occurs because we are considering a specific market (time and place); decisions are not sequential, so firms cannot price-discriminate.

- **Price discrimination** is a pricing strategy in which firms with market power charge different prices to different customers based on their willingness to pay.
Marginal revenue is *not* equivalent to price for a firm facing a downward-sloping demand curve.

Marginal revenue is the change in total revenue associated with an increase in output, which is composed of two parts.

**Two components for a firm with market power**
1. Increase in total revenue associated with an increase in sales
2. Decrease in total revenue associated with the fall in market price for all previously produced units of output
Market Power and Marginal Revenue

Figure 9.1 Understanding Marginal Revenue

- Price: $P_1$, $P_2$
- Quantity: $Q_1$, $Q_2$
- Demand
- Revenue lost from increasing output
- Revenue gained from increasing output
- Revenue unchanged

Figure illustrates the concept of marginal revenue, showing how revenue changes with output adjustments.
The two opposing effects on marginal revenue of an increase in production by a monopolist can be examined mathematically:

1. The additional revenue from selling one more unit at market price
   \[ \text{Revenue} = P \]

2. The fall in revenue associated with a decline in market price for all units produced
   \[ \text{Revenue} = \frac{P}{Q} \times Q \]

Combining these effects gives the equation for marginal revenue:

\[ MR = P + \frac{P}{Q} \times Q \]
Consider what the equation for marginal revenue means

\[ MR = P + \frac{P}{Q} \times Q \]

Consider a linear demand curve \( \frac{P}{Q} \) is constant

The inverse demand curve is given by \( P = a - bQ \); therefore:

\[ MR = P + \frac{\Delta P}{\Delta Q} Q = (a - bQ) + \frac{\Delta P}{\Delta Q} Q = (a - bQ) + (-b)Q = a - 2bQ \]

\[ MR = a - 2bQ \]
Profit Maximization for a Firm with Market Power

How to Maximize Profit

Firms with market power are still assumed to maximize profits.

- However, unlike in perfect competition, production decisions influence price.

\[ MR \neq P \]

How much will firms choose to produce?

- They will engage in production until \( MR = MC \)

✓ Will a monopolist produce more or less than the aggregate production in an identical perfectly competitive industry?
  - LESS!
Profit Maximization: A Graphical Approach

Consider the market for iPads; assume that the marginal cost of production for Apple is constant at $200 per unit.

There are three steps to determining the profit-maximizing quantity of production:

1. Derive the marginal revenue curve from the demand curve.
2. Find the output quantity at which marginal revenue equals marginal cost.
3. Determine the profit-maximizing price by locating the point on the demand curve at the optimal quantity level.
Profit Maximization for a Firm with Market Power

Figure 9.3 How a Firm with Market Power Maximizes Profit

Profit is maximized when marginal revenue is equal to marginal cost.

Price ($/iPad)

$P^* = 600$

Quantity of iPads (millions)

$Q^* = 80$

Profit is maximized when marginal revenue is equal to marginal cost.
Profit Maximization: A Mathematical Approach

Consider again the market for iPads. The marginal cost of production for Apple is constant at $200 per unit. Now suppose demand is given by

\[ Q = 200 - 0.2P \]

where quantity is measured in millions and price in dollars.

How do we determine the profit-maximizing price–quantity combination that Apple should choose?

1. Derive the marginal revenue curve from the demand curve.
2. Find the output quantity for which marginal revenue is equal to marginal cost.
3. Determine the profit-maximizing price by locating the point on the demand curve at the optimal quantity level.
Profit Maximization: A Mathematical Approach

1. Derive the marginal revenue curve from the demand curve.

\[ Q = 200 - 0.2P \]

\[ 0.2P = 200 - Q \rightarrow P = 1000 - 5Q \]

This is a linear demand curve, so marginal revenue takes the form

\[ MR = a - 2bQ = 1000 - 10Q \]
2. Find the output quantity for which marginal revenue is equal to marginal cost.

For this step, simply set the equation for marginal revenue equal to $200 and solve for quantity.

\[ MR = MC \rightarrow 1,000 - 10Q = 200 \Rightarrow Q^* = 80 \text{ million} \]

3. The profit-maximizing price can be found by substituting the profit-maximizing quantity into the inverse demand curve.

\[ P^* = 1,000 - 5(80) \Rightarrow P^* = $600 \]
A Markup Formula for Companies with Market Power: The Lerner Index

It is useful to have a general approach to determining the rate of markup for firms with market power.

• **Markup** is the percentage of a firm’s price that is greater than its marginal cost.

• The **Lerner Index** is a measure of a firm’s markup, which indicates the degree of market power the firm enjoys.
A Markup Formula for Companies with Market Power: The Lerner Index

Starting with the definition of marginal revenue and setting it equal to marginal cost,

\[ MR = P + \frac{P}{Q} \times Q = MC \]

Multiply the left-hand side by \( P/P \) (doesn’t change anything):

\[ P + \frac{P}{Q} \times \frac{P}{P} \times Q = P + \left( \frac{P}{Q} \times \frac{Q}{P} \right) \times P = MC \]

And finally,

\[ \frac{P}{P} \times \frac{MC}{Q} = \frac{1}{E^d} \]

or, as demand becomes more elastic, the optimal markup falls.
A Markup Formula for Companies with Market Power: The Lerner Index

Markup Rule: \[ \frac{P}{P} \frac{MC}{E^d} = 1 \]

- Left-hand side is firm’s profit-maximizing markup, or the percentage of the firm’s price that is greater than (or marked up from) its marginal cost.
- Indicates that as demand becomes more elastic, the optimal markup falls.

Why does this make sense?
- The more sensitive consumers are to price changes (more elastic) the less the firm can take advantage of them.
Response to a Change in Marginal Cost

Just as in the case of a firm in a perfectly competitive industry, firms with market power will alter output decisions in response to changing marginal costs of production.

Suppose an accident at the factory of an Apple parts supplier leads to an increase in the marginal cost of iPad production from $200 to $250 per unit.

✓ How will this affect Apple’s production decisions?
  – Marginal cost will increase, and because of the downward-sloping marginal revenue curve; the new optimal production should decrease.
  – Price will also decrease as a result.
Figure 9.4 How a Firm with Market Power Reacts to an Increase in Marginal Cost

- Original Price ($/iPad): $1,000
- New Price ($/iPad): $625
- New Quantity of iPads: 75 (millions)
- Original Quantity of iPads: 80 (millions)

Graph shows the firm's demand curve (D), marginal revenue (MR), and marginal cost (MC) curves. The increase in marginal cost causes a shift in the marginal cost curve from $MC_1$ to $MC_2$, resulting in a decrease in quantity sold and an increase in price.
Response to a Change in Demand

Now suppose there is an outward shift in the demand for iPads due to an expansion of their use by the medical industry. The new demand curve is given by

$$Q = 280 - 0.2P$$

The new inverse demand curve is given by

$$P = 1400 - 5Q$$

To find the new profit-maximizing price–quantity combination, follow the same three-step procedure.
Response to a Change in Demand

1. Derive the marginal revenue curve from the inverse demand curve.

\[ P = 1400 - 5Q \]

Marginal revenue takes the form

\[ MR = a - 2bQ \Rightarrow MR = 1400 - 10Q \]

2. Find the output quantity for which marginal revenue is equal to marginal cost.

\[ MR = MC \Rightarrow 1400 - 10Q = 200 \Rightarrow Q^* = 1.2 \text{ million} \]
Response to a Change in Demand

3. The profit-maximizing price can be found by substituting the profit-maximizing quantity into the inverse demand curve.

\[ P = 1,400 - 5(120) = $800 \]

So an outward shift in demand increases both the quantity of iPads produced and the price at which each is sold.
Changing the Price Sensitivity of Consumers

A major way in which firms with market power react differently from those subject to perfect competition is in response to changes in the price sensitivity of demand.

For instance, consider what happened to the demand for iPads when Amazon introduced its Kindle Fire tablet computer.

• Demand for iPads should have become more price-elastic.
• The demand curve for iPads should have had a shallower slope.
How a Firm with Market Power Reacts to Market Changes

Figure 9.5 Responses to a Rotation in the Demand Curve

(a) Perfect competition

In perfect competition the shape of the demand curve does not matter; only the intersection with the supply curve.

(b) Market power
If firms with market power find it profitable to choose a level of output that is different from what would occur in perfect competition, there must be some additional benefit.

- How much better off are firms when they have market power, and what does this imply for consumers’ well-being?
  - Examine Producer and Consumer Surplus to see!
Consumer and Producer Surplus under Market Power

Returning to the example of Apple and the iPad, recall that Apple has a marginal cost of production of $200 per unit and faces inverse demand:

\[ P = 1,000 - 5Q \]

where quantity is measured in millions.

Producer surplus is the difference between the monopoly price of iPads and the constant marginal cost, multiplied by the quantity sold.

\[ PS = (P_m - MC) \cdot Q_m = ($600 - $200) \cdot 80 \text{ million} = $32 \text{ billion} \]
Consumer and Producer Surplus under Market Power

Consumer surplus is calculated as the area under the inverse demand curve and *above* the sales price.

First, calculate the demand choke price, which is the price at which quantity demanded is equal to zero.

\[ P = 1,000 - 5(0) = $1,000 \]

With linear demand, consumer surplus is a right triangle with height equal to the demand choke price net of the sales price and length equal to quantity sold.

\[ CS = \frac{1}{2}(P_{\text{choke}} - P_m) \times Q_m = \frac{1}{2}($1,000 - $600) \times $80 \text{ million} = $16 \text{ billion} \]
Consumer and Producer Surplus under Perfect Competition

How would the outcome of the market for iPads change under perfect competition?

In perfect competition, marginal cost is equal to industry supply, and equilibrium occurs when industry supply is equal to demand.

\[ P = MC \rightarrow 1,000 - 5Q = 200 \rightarrow Q = 160 \text{ million} \]

and price is equal to $200.

✓ What happens to Apple’s producer surplus?
  – It equals zero in perfect competition because \( P = MC \).

Consumer surplus becomes

\[ CS = \frac{1}{2} (P_{\text{choke}} - P_c) \times Q_c = \frac{1}{2} (\$1,000 - \$200) \times 160 \text{ million} = \$64 \text{ billion} \]
Figure 9.6 Surplus from the Apple iPad

Consumer surplus (competition) = $A + B + C$
Producer surplus (competition) = 0
Consumer surplus (market power) = $A$
Producer surplus (market power) = $B$
Deadweight loss from market power = $C$

Market power (

Competition, c

Quantity of iPads (millions)
The Winners and Losers of Market Power

The Deadweight Loss of Market Power

Producer surplus is eliminated under perfect competition, but consumer surplus increases. Also, net surplus improves under perfect competition, from $48 billion to $64 billion. This illustrates the loss in efficiency in markets that are not perfectly competitive.

• When producers have market power, they can improve overall outcomes.
• However, if producers reduce output to a level below the perfectly competitive level, total surplus falls.

This loss of efficiency is a deadweight loss, and in this case it is equal to $16 billion.
The Winners and Losers of Market Power

Figure 9.7 Gains from Market Power under Different Demand Curves

(a) Less elastic demand

(b) More elastic demand

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<thead>
<tr>
<th>Price ($/unit)</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>$P_1$</td>
<td>$Q_m$</td>
</tr>
<tr>
<td>$P_2$</td>
<td>$Q_m$</td>
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Graphs show the comparison of gains from market power under different demand curves, with the price and quantity axes highlighted.
The deadweight loss associated with market power can justify government intervention if regulations help achieve a more competitive or efficient outcome.

**Direct Price Regulation**

In some cases, the government will regulate price rather than attempting to dismantle a monopoly or encourage new participants.

- This is often the case for natural monopolies, or industries in which a firm’s long-run average total cost falls continuously as output increases.

Consider a utility that provides electricity to a town.

- Significant fixed costs (generation and transmission)
- Low marginal costs
What happens if a regulator forces the utility to provide the “efficient” level of electricity (where $LMC = \text{demand}$)?
Antitrust laws are designed to promote competitive markets by restricting behaviors that limit competition

- Mergers and acquisitions
- Price fixing and other forms of collusion
- Predatory pricing

Can be difficult to determine if concentration is bad for consumers

In other cases, the government may actually promote monopolies.

- Patents, licenses, copyrights
  - Designed to spur innovation
  - In setting length of patents, must balance the incentive for innovation with the reduction in consumer welfare that comes with granting a monopoly.

Rent-seeking is a firm’s attempts to gain government-granted monopoly power and therefore additional producer surplus.
In this chapter, we have shown how firms with market power don’t treat output price as fixed but instead recognize that price depends on the quantity produced.

• Firms produce where marginal cost is equal to marginal revenue.
• Equilibrium output is lower than under perfect competition.
• Market power leads to a deadweight loss.

However, we have so far assumed that to sell more of a product, a firm must lower the price on all previously produced units.

In Chapter 10, we examine how firms may be able to charge different prices to different consumers, a practice called price discrimination.
Suppose the demand for a product is given by

\[ Q = 12.5 - 0.25P \]

**Answer the following questions:**

a. Find the marginal revenue curve associated with this demand curve.

b. Calculate marginal revenue when the firm produces six and seven units of output, respectively.
figure it out

a. First, solve for the inverse demand curve.

\[ Q = 12.5 - 0.25P \]

\[ 0.25P = 12.5 - Q \rightarrow P = 50 - 4Q \]

The equation for the marginal revenue for a linear demand curve is

\[ MR = a - 2bQ \]

\[ MR = 50 - 2(4)Q = 50 - 8Q \]

b. Plugging in \( Q = 6 \) to the marginal revenue equation yields

\[ MR = 50 - 8(6) = 2 \]

and \( Q = 7 \) yields

\[ MR = 50 - 8(7) = -6 \]

As output increases, marginal revenue falls, and eventually producing more will result in lower total revenue.
Suppose the demand for a product is given by

$$Q = 16 - 0.5P$$

Answer the following questions:

a. Find the marginal revenue curve associated with this demand curve.

b. Calculate marginal revenue when the firm produces three and five units of output, respectively.
a. First, solve for the inverse demand curve.

\[ Q = 16 - 0.5P \]

\[ 0.5P = 16 - Q \rightarrow P = 32 - 2Q \]

The equation for the marginal revenue for a linear demand curve is

\[ MR = a - 2bQ \]

\[ MR = 32 - 2(2)Q = 32 - 4Q \]

b. Plugging \( Q = 3 \) into the marginal revenue equation yields

\[ MR = 32 - 4(3) = 20 \]

and \( Q = 5 \) yields

\[ MR = 32 - 4(5) = 12 \]

As output increases, marginal revenue falls, and eventually, producing more will result in lower total revenue.
Babe’s Bats (BB) sells baseball bats for children around the world. The firm faces a demand curve of \( Q = 10 - 0.4P \), where \( Q \) is measured in thousands of bats and \( P \) is dollars per bat. BB has a marginal cost curve equal to \( MC = 5Q \).

Answer the following questions:

a. What is BB’s profit-maximizing output? Show the profit-maximizing decision graphically.

b. What price will BB charge to maximize its profits?
figure it out

a. To solve, follow the three-step procedure outlined previously.

First, derive the marginal revenue curve for BB Bats.

\[ Q = 10 - 0.4P \]

\[ 0.4P = 10 - Q \implies P = 25 - 2.5Q \]

This is a linear demand curve, so marginal revenue takes the form

\[ MR = a - 2bQ \implies MR = 25 - 5Q \]

Second, find the output quantity for which marginal revenue is equal to marginal cost.

\[ MR = MC \implies 25 - 5Q = 5Q \implies Q^* = 2.5 \]

The profit-maximizing output for BB’s bats is therefore 2,500 bats.
b. To solve for the optimal price, plug in the profit-maximizing level of output to the inverse demand curve.

\[ P^* = 25 - 2.5(2.5) \Rightarrow P^* = 18.75 \]
The Power Tires Company has market power and faces the demand curve shown in the figure. The firm’s marginal cost curve is

\[ MC = 30 + 3Q \]

Answer the following questions:

a. What are the firm’s profit-maximizing output and price?

b. If the firm’s demand declines to \( P = 240 - 2Q \), what is the firm’s profit-maximizing level of output and price? How does this compare to your answer to question a?

c. Draw a diagram showing these two outcomes. Holding marginal cost equal, how does the shape of the demand curve affect the firm's ability to charge a higher price?
figure it out

a. First, use the graph to find the equation for the inverse demand curve.

\[ P = a - bQ \]

Next, find the marginal revenue curve using the inverse demand curve.

\[ MR = a - 2bQ \Rightarrow MR = 300 - 2(3)Q \]

\[ MR = 300 - 6Q \]
Profit maximization occurs where $MR = MC$, or

$$300 - 6Q = 30 + 3Q \implies 270 = 9Q \implies Q^* = 30$$

And the price

$$P = 300 - 3Q = 300 - 3(30) \implies P^* = $210$$

b. When demand falls to $P = 240 - 2Q$, we have a new MR curve,

$$MR = 240 - 2(2)Q = 240 - 4Q$$

Following a similar process as before,

$$MR = MC \rightarrow 240 - 4Q = 30 + 3Q \implies Q^* = 30$$

$$P^* = 240 - 2(30) \implies P^* = $180$$

The profit-maximizing quantity is the same, but the price is lower.
c. Graphing the outcomes from a and b,

\[ MC = 30 + 3Q \]

Demand and marginal revenue from a.

\[ D \rightarrow P = 300 - 3Q \]
\[ MR \rightarrow P = 300 - 6Q \]

Demand and marginal revenue from b.

\[ D \rightarrow P = 240 - 2Q \]
\[ MR \rightarrow P = 240 - 4Q \]

Because \( D_2 \) is flatter, the firm must charge a lower price, as consumers are more responsive to price changes.
Suppose the local roofing company has market power and faces the following inverse demand curve:

\[ P = 2000 - 10Q \]

where quantity is the number of roof jobs and price is in dollars. The marginal cost for this firm is

\[ MC = 200 + 16Q \]

Answer the following questions:

a. What are the profit-maximizing output and price?

b. If the firm’s demand declines to \( P = 1400 - 12Q \), what are the new profit-maximizing output and price?
a. First, derive the marginal revenue curve from the inverse demand curve.

\[ P = 2,000 - 10Q \]

Marginal revenue takes the form

\[ MR = a - 2bQ \Rightarrow MR = 2,000 - 20Q \]

Setting marginal cost equal to marginal revenue,

\[ MR = MC \Rightarrow 2,000 - 20Q = 200 + 16Q \Rightarrow Q^* = 50 \]

So the profit-maximizing quantity is 50 roofing jobs. To find the price, use the inverse demand curve.

\[ P^* = 2,000 - 10(50) \Rightarrow P^* = 1,500 \]

The profit-maximizing price is $1,500 per roof.
b. Now, perform the same calculations with the new inverse demand curve.  

\[ P = 1,400 - 12Q \]

Marginal revenue is  

\[ MR = a - 2bQ = 1,400 - 24Q \]

Setting marginal cost equal to marginal revenue,  

\[ MR = MC \rightarrow 1,400 - 24Q = 200 + 16Q \Rightarrow Q^* = 30 \]

The profit-maximizing quantity is 30 roofings, and there has been a reduction in demand. Using the inverse demand curve,  

\[ P^* = 1,4000 - 12(30) \Rightarrow P^* = 1,040 \]

And the profit-maximizing price is $1,040 per roof.
Recall that Babe’s Bats faces an inverse demand curve of $P = 25 - 2.5Q$ and marginal cost curve $MC = 5Q$, where quantity is measured in thousands of bats and price in dollars.

Calculate the deadweight loss from market power at the firm’s profit-maximizing level of output.
The easiest way to find deadweight loss is through the use of a diagram.

Price ($/bat)

- Consumer surplus (competition) = $A + B + C$
- Producer surplus (competition) = $D + E + F$
- Consumer surplus (market power) = $A$
- Producer surplus (market power) = $B + D + F$
- Deadweight loss from market power = $C + E$

Market power, $m$
- Quantity of bats, $Q_m = 2.5$

Competition, $c$
- Quantity of bats, $Q_c = 3.33$ (per day)
Mathematically
Recall that the profit-maximizing level of output is 2,500 bats sold at a price of $18.75.
To find the deadweight loss, consider producer and consumer surplus and compare them with the competitive outcome. If BB were in a competitive market, it would set marginal cost equal to price.

\[
P = MC \\
25 - 2.5Q = 5Q \\
Q^* = 3.33
\]

The perfectly competitive output for BBs is 3,330 thousand bats. To find the perfectly competitive price, plug this in to the inverse demand curve.

\[
P = 25 - 2.5(3.33) \Rightarrow P^* = 16.68
\]
The profit-maximizing level of output for BB is 2,500 bats per day at a price of $18.75 per bat. If BB were operating in a competitive market, it would offer 3,330 bats per day at $16.68 per bat.

The deadweight loss associated with market power is equal to the difference in total surplus between the competitive and monopoly conditions.

In this example, you can use the formula to calculate the loss from the graph.

\[
DWL = \text{Areas } C + E = \frac{1}{2} \times \text{Base} \times \text{Height}
\]

\[
DWL = \frac{1}{2} \times (18.75 - 12.50) \times (3.33 - 2.5) = $2.59375
\]

Since quantity is measured in thousands, deadweight loss is equal to $2,593.75.
Joe’s Garage (JG) faces inverse demand curve \( P = 120 - 10Q \) and marginal cost curve \( MC = 20 \), where quantity is measured in rotations per day and price in dollars.

Calculate the deadweight loss from market power at the firm’s profit-maximizing level of output.
The easiest way to find deadweight loss is with a diagram.

Consumer surplus (competition) = $A + B + C$
Producer surplus (competition) = 0
Consumer surplus (market power) = $A$
Producer surplus (market power) = $B$
Deadweight loss from market power = $C$

Price ($/rotation)

- $120
- $70
- $20

Market power, $P_m = 70$
Competition, $P_c = 20$

Quantity of rotations (per day)

- $Q_m = 5$
- $Q_c = 10$
- $MC$
- $MR$
- $D$
Mathematically
The profit-maximizing output and price can be found by setting $MR$ equal to $MC$.

First, find the $MR$ curve from the inverse demand curve $P = 120 - 10Q$.

$$MR = a - 2bQ \implies MR = 120 - 20Q$$

Solving for the profit-maximizing output and price,

$$MR = MC \implies 120 - 20Q = 20 \implies Q^* = 5$$

$$P = 120 - 10(5) \implies P^* = 70$$

In perfect competition, the firm will set $P = MC$.

$$P^c = 20 \implies 20 = 120 - 10Q \implies Q^c = 10$$
The profit-maximizing level of output for JG is 5 rotations per day at a price of $70 per rotation. If JG were operating in a competitive market, it would offer 10 rotations per day at $20 per rotation (price equal to marginal cost).

The deadweight loss associated with market power is equal to the difference in total surplus between the competitive and monopoly conditions.

In this example, it is a right triangle with length of 5 and height of 50.

\[
DWL = \text{Area } C = \frac{1}{2} \times \text{Base} \times \text{Height}
\]

\[
DWL = \frac{1}{2} \times (10 - 5) \times (70 - 20) = \$125
\]