

FLICKS

Which movie rental service should you choose?

name _____

date _____

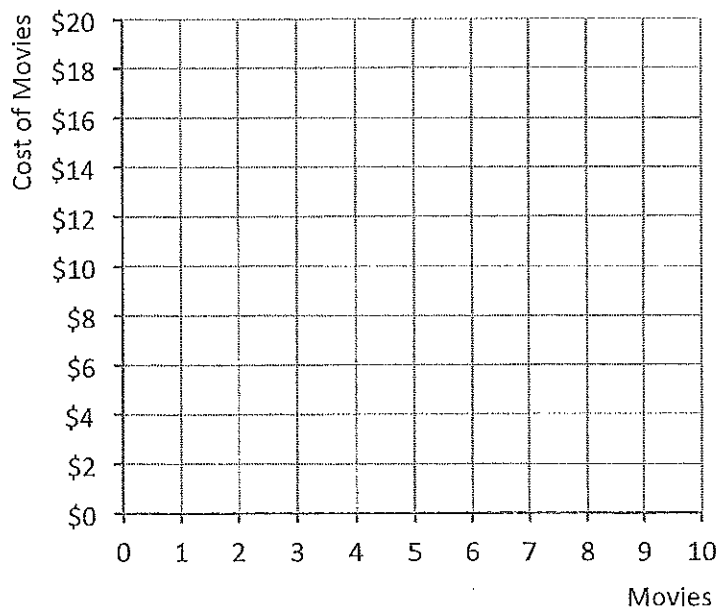
Act One: *The Big Three*

- 1 Redbox, Apple TV, and Netflix are three of the most popular movie rental services in the United States. If you only cared about price, how would you decide which service to use? (Please be as specific as possible.)

Redbox (DVD)	Apple TV (streaming)	Netflix (streaming)
\$1.20/movie	\$5/movie	\$9/month, unlimited movies

- 2 For each plan, write an equation to calculate the **cost of renting m movies** and graph these equations below. How could you use the graphs to determine which service to use, and is this what you expected from before?

Redbox (DVD)	Apple TV (streaming)	Netflix (streaming)





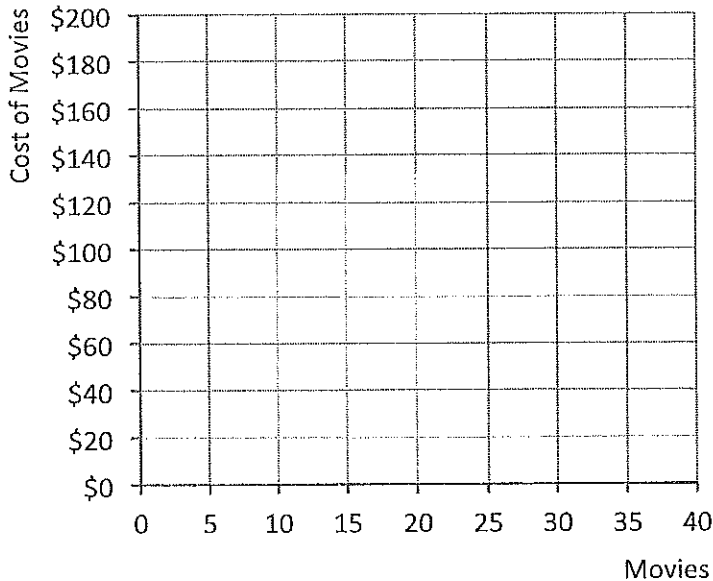
Act Two: Fixed Costs

- 3 In addition to the advertised prices, there are other factors to consider. For instance, each service may require special equipment. Also, Redbox's price is \$1.20 per movie *per day*, and Redbox reports that, on average, customers keep a movie for two days.

For each service, write an equation to calculate the **total cost to watch movies over the course of the first year**. Assume you only rent one movie at a time, and that you already have a TV and internet service.

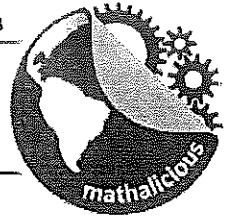
Redbox	Apple TV	Netflix
\$1.20/movie Gas: \$0.50 per movie DVD Player: \$40	\$5/movie AppleTV: \$100	\$9/month, unlimited movies Wi-Fi Adaptor for TV: \$30

- 4 Sketch the total cost for each service on the graph below, and estimate when the different plans cost the same. Then, try to find the exact intersection points algebraically.



Redbox vs. Netflix	
Apple TV vs. Netflix	
Apple TV vs. Redbox	

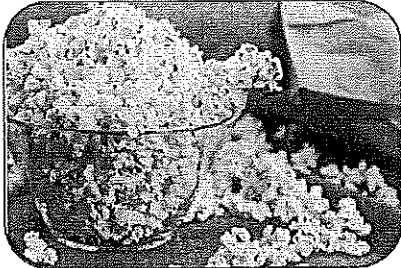
- 5 In reality, people don't just choose movie rental services based on cost. Why might someone choose a more expensive option, and which movie service would *you* choose? Explain.



FLICKS

Which movie rental service should you choose?

lesson guide



Between theaters, DVDs, and internet streaming, accessing your favorite movie has never been easier. With so much choice, though, finding your best option can be tricky. When you want to watch a movie, how can you figure out which service offers the most value?

In this lesson, students write and graph systems of linear equations to determine which of three movie rental services they would use. With all the money they save, they'll be able to rent even more movies!

Primary Objectives

- Write and graph equations for the cost of three rental services in terms of the number of movies rented
- Consider costs related to watching movies (e.g. buying a DVD player), and adjust equations accordingly
- Solve systems of equations graphically and algebraically
- Discuss other features to consider besides cost and how those features might affect the choice of service

Content Standards (CCSS)

Grade 8
EE.7b, EE.8b, EE.8c,
F.3, F.4

Mathematical Practices (CCMP)

MP.2, MP.3, MP.4

Materials

- Student handout
- LCD projector
- Computer speakers

Before Beginning...

Students should be able to graph and evaluate linear functions. Prior familiarity with writing linear equations will also be useful, so that this lesson can be used to introduce systems of linear equations and how to solve them.

Preview & Guiding Questions

Students watch a video from the satirical *Onion News Network* about a Blockbuster Video historical tour. The premise is that brick-and-mortar video stores are so antiquated that stepping into one is like stepping back in time to the age of our forefathers.

As a class, discuss the joke and whether or not students think it makes sense. It's possible some of your students will still rent movies from physical stores, but in many homes people stream movies over the internet or use kiosks like Redbox when they go grocery shopping. Have students talk about how they rent movies in their family, and what they do or do not like about the different movie-rental services they've used. After you've discussed a few different rental options with your students, including pros and cons for each service, they'll be ready to jump into Act One.

- *What's the joke that the video is trying to make? Why is it funny to imagine a Blockbuster museum?*
- *Does your family ever rent movies from physical stores? If so, which ones?*
- *For those of you who have been to a movie rental store, does it usually seem busy or not?*
- *Do you agree with the sentiment from the video?*
- *For those of you who don't rent movies from stores, how does your family rent movies?*
- *What do you like about the movie-rental service you use? What don't you like as much?*

Act One

After learning about the renting habits of their classmates, students begin Act One by considering three rental services: Redbox, Apple TV, and Netflix. Given the pricing information for each service, they discuss which one seems like the best deal and how the best deal varies with the number of movies rented. They then write down cost equations and graph them and check that their graphs agree with their earlier conclusions.

Act Two

In Act One students determined which service is the best deal for renting movies. But some costs, like the price of the Apple TV device, were ignored. In Act Two students try to account for these additional costs, rewriting their equations and solving them in order to come up with a better idea of when each service is the best.

Finally, although students have focused on cost when choosing a rental service, there are other factors (like convenience, movie selection, etc.) to think about as well. The lesson ends with a discussion about what else we should consider and how those other factors might influence our decision about which service to use.

Act One: The Big Three

- 1 Redbox, Apple TV, and Netflix are three of the most popular movie rental services in the United States. If you only cared about price, how would you decide which service to use? (Please be as specific as possible.)

Redbox (DVD)	Apple TV (streaming)	Netflix (streaming)
\$1.20/movie	\$5/movie	\$9/month, unlimited movies

Apple TV always costs more than Redbox – \$3.80 more per movie – so people who only care about cost should never use Apple TV. Between Redbox and Netflix, Redbox is a better deal if someone watches 7 movies or fewer in a month. If someone watches 8 or more movies in a month, Netflix is a better deal.

Explanation & Guiding Questions

The first thing that your students should notice is that Apple TV is always more expensive than Redbox: \$5 per movie versus \$1.20. So, if you only cared about price, you'd never choose Apple TV over Redbox.

What about the choice between Redbox and Netflix? Here the answer isn't as clear, because the pricing is different. Students should realize that the choice here depends on how many movies a person watches. If you watch a ton of movies, Netflix is the best option, since it has a flat rate; but if you only watch a few movies in a month, Redbox is a more cost effective option.

When it comes to finding the point at which you should switch from one option to the other, students may simply count, since the numbers aren't too bad: 7 movies at Redbox cost less than \$9, but 8 will cost more. If you want to emphasize solving, you can also have them set up an inequality. For example, if m is the number of movies you would rent in a month, Redbox only makes sense if $1.20m < 9$, or $m < 9 \div 1.20 = 7.5$. Since we can't rent a fractional number of movies, this means Redbox is the better option when $m \leq 7$.

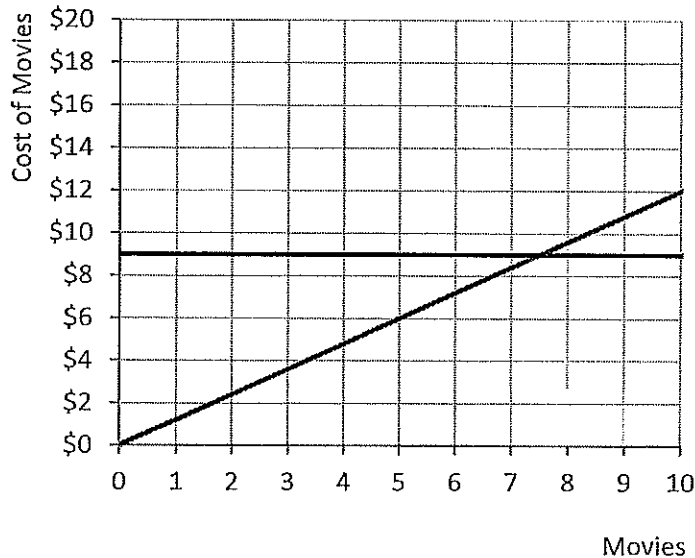
- *Is there a service that's never the cheapest?*
- *How would you decide whether to choose Redbox or Netflix?*
- *How many movies would you have to watch for Redbox to be more expensive?*

Deeper Understanding

- *How does Apple TV make any money when Redbox and Netflix are so much cheaper? (Apple TV is more convenient than Redbox since you don't have to leave your home. Also, the selection of films is probably better than Netflix, and maybe the quality is higher.)*
- *If Redbox didn't exist, how would you decide between Apple TV and Netflix? (If you watch more than one movie a month, use Netflix; otherwise use Apple TV. This is because $\$5 < \9 but $\$10 > \9 .)*
- *If m represents the number of movies you rent in a month, what values can it take? (Non-negative integers.)*

- 2 For each plan, write an equation to calculate the **cost of renting m movies** and graph these equations below. How could you use the graphs to determine which service to use, and is this what you expected from before?

Redbox (DVD)	Apple TV (streaming)	Netflix (streaming)
$C = 1.2m$	$C = 5m$	$C = 9$



The y -coordinate of a line at m represents how much it costs to rent m movies; the smaller the y -coordinate, the cheaper the plan. If all someone cares about is the cost of m movies, he or she should pick the line with the smallest y -coordinate.

On the graph, the red line (Redbox) is the lowest/cheapest from 0 movies until a little more than 7 movies, at which point the blue line (Netflix) becomes the cheapest plan.

Of course, nobody can rent fractions of a movie. Therefore, Redbox is best for someone renting at most 7 movies, and Netflix is best for someone renting 8 movies or more.

Explanation & Guiding Questions

For students who have trouble coming up with the equations, you can start by first asking them about the price for specific values of m until they see the pattern. When it comes to Netflix, some students may be confused because the price doesn't depend on m . But this is just another way of saying that the cost function is constant!

After graphing these linear equations (either directly from the equation or by plotting points), you may want to pause and discuss some properties of the lines. For example, the slope of each line tells us how much each additional movie costs with each service, and the y -intercept tells us how much it costs to rent zero movies.

In deciding on a plan, students should realize that the cheapest option corresponds to the *line with the smallest y -coordinate*. Between 0 and 7.5 movies, the lowest line comes from Redbox's pricing, but beyond that, Netflix becomes less expensive. At the point where the graphs intersect, the cost is the same – as before, we see that if price were all that mattered and you could rent 7.5 movies, you shouldn't care whether you use Redbox or Netflix!

- How much does it cost to rent 2 movies from Redbox? 5 movies? 9 movies?
- How much does it cost to rent m movies from Redbox? From Apple TV?
- How much does it cost to rent a movie from Netflix? 5 movies? 9 movies?
- What does the slope of each line represent? What do the y -intercepts represent?
- Which graph represents the cheapest rental option? How do you know?
- What does it mean when two of the graphs intersect?

Deeper Understanding

- What would it mean if all three lines intersected at the same point? (All three services would cost the same.)
- Once two lines intersect, can they ever intersect again? (No; straight lines can't intersect more than once.)

Act Two: Fixed Costs

- 3 In addition to the advertised prices, there are other factors to consider. For instance, each service may require special equipment. Also, Redbox's price is \$1.20 per movie *per day*, and Redbox reports that, on average, customers keep a movie for two days.

For each service, write an equation to calculate the **total cost to watch movies over the course of the first year**. Assume you only rent one movie at a time and that you already have a TV and internet service.

Redbox	Apple TV	Netflix
\$1.20/movie Gas: \$0.50 per movie DVD Player: \$40	\$5/movie Apple TV: \$100	\$9/month, unlimited movies Wi-Fi Adaptor for TV: \$30
$\$1.20 + \$1.20 + \$0.50 = \2.90 $C = 2.9m + 40$	$C = 5m + 100$	$\$9(12) = \108 $C = 138$

Explanation & Guiding Questions

Compared to Act One, two things may have changed in our cost equation. The first is the cost per additional movie (i.e. the **slope**). For Apple TV and Netflix, these costs are the same as before (\$5 per movie and \$0 per movie, respectively), but for Redbox the per-movie cost has now increased from \$1.20 to \$2.90.

The second thing that has changed is the initial set up cost for each service. Before watching a single movie on Apple TV, for example, you first need the Apple TV device itself. Including these set up costs gives us a clearer picture of which option is the least expensive.

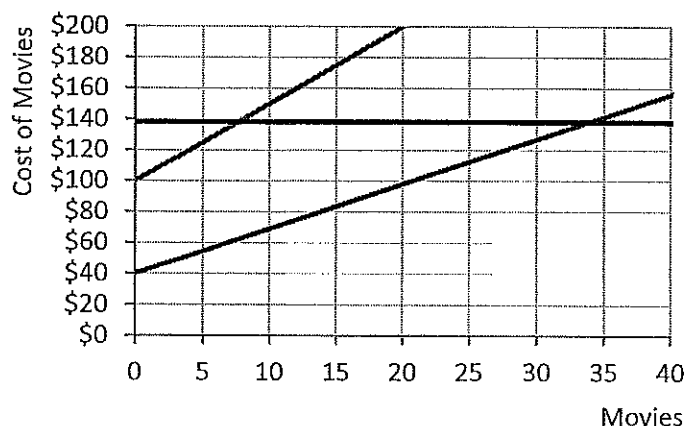
Be sure to emphasize the fact that we're calculating costs over a year. Some students are likely to forget that the \$9 rate for Netflix is per-month, and therefore may think that the Netflix costs should be just $\$30 + \$9 = \$39$. While that's true for a single month, remind them that Netflix pricing depends on the duration of the subscription, not the number of movies rented.

- Typically, how much are you paying for each additional movie with Redbox? With Apple TV? With Netflix?
- What are the setup costs for a year of Redbox? A year of Apple TV?
- What's the total cost of watching movies for a month with Netflix? For a year?
- For each service, what's the total cost of watching one movie? Two movies? m movies?

Deeper Understanding

- What happens to the slope of the Redbox equation as you increase the number of days you hold on to a movie? (It increases by \$1.20 each day.)
- How do these plans compare to watching movies in the theater? (Unless you only go to one or two movies a year, Redbox is cheaper than going to a theater.)

- 4 Sketch the total cost for each service on the graph below, and estimate when the different plans cost the same. Then, try to find the exact intersection points algebraically.



Redbox vs. Netflix	$2.9m + 40 = 138$ $2.9m = 98$ $m \approx 33.8$
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Apple TV vs. Netflix	$5m + 100 = 138$ $5m = 38$ $m \approx 7.6$
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Apple TV vs. Redbox	$5m + 100 = 2.9m + 40$ $2.1m = -60$ $m \approx -28.6$
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Explanation & Guiding Questions

Students can interpret their graphs as they did in Act One: the lower the line, the less expensive the service, and where the lines cross the services cost the same. This means that Netflix and Apple TV cost the same after around 8 movies, while Netflix and Redbox should cost the same after around 34 movies. Since Apple TV and Netflix don't appear to intersect, this suggests that Redbox is, once again, always the cheaper option.

When it comes to finding the intersection points more precisely, one approach you may want to consider is the "Downside" method. This will be especially helpful for students who are new to solving systems of equations. It works like this: have students choose a pair of rental plans and articulate the downside of each one. In order for the plans to be equivalent (from a cost standpoint), the downsides of each plan have to balance out. For example:

Downside of Redbox	\$2.90 more per movie	# of movies for plans to be equal
Downside of Netflix	\$98 more fixed cost	$2.90m = 98$ $m = 98 \div 2.90$ $m \approx 33.8$

This also works when comparing Apple TV to Netflix. But Apple TV has no downside compared to Redbox! This is because the costs for Redbox and Apple TV are equal when m is negative ($m \approx -28.6$), which doesn't make sense. If students find this intersection, it'll be a good opportunity to talk more about the domain of their equations.

- Based on your graph, after how many movies will Netflix cost about the same as Apple TV? As Redbox?
- On your graph, do Redbox and Apple TV ever cost the same for the same number of movies? Why not?
- Comparing Redbox to Netflix, what's the downside of each service?
- For Redbox and Netflix to cost the same, what must be true about their downsides?
- What are the downsides comparing Apple TV and Netflix? Apple TV and Redbox?
- Can you rent a negative number of movies? What would this even mean?

Deeper Understanding

- How would things change if someone gave you an Apple TV as a gift? (In this case, the price of watching m movies would be the same as in Act One: $5m$. Now Apple TV is cheapest if you watch no more than 8 movies in a year. Redbox is cheapest if you watch between 9 and 33 movies; for more than 33 movies, use Netflix.)

- 5 In reality, people don't just choose movie rental services based on cost. Why might someone choose a more expensive option, and which movie service would *you* choose? Explain.

Answers will vary.

Explanation & Guiding Questions

There are a variety of factors besides price that will influence what type of rental service people use. Here are a few that may come up in class:

1. Convenience – you don't have to leave your house to watch a movie on Apple TV or Netflix.
2. Movie Selection – Netflix lets you watch as many movies as you want, but has a much more limited selection than Redbox or Apple TV.
3. Cost per day – Redbox is the only service that charges a daily rate. With Apple TV, you have the movie for 30 days after you pay, but once you start the movie you only have 24 hours to finish it.

Can your students come up with some other things to consider?

- *Besides the price, how else are these rental services different?*
- *Which ones do you think are the most/least convenient to use? Why?*
- *Why do you think some people choose Apple TV, even though it's the most expensive?*
- *If you're bad about returning movies, do you think Redbox would be a good service for you to use?*

Deeper Understanding

- *With so many rental options, do you ever buy movies? Why or why not? (Answers will vary.)*

