

REAL-WORLD TAKEAWAYS

- Cities use tickets and fines to deter bad behavior and also to raise revenue for local services.
- The time it takes someone to pay off a ticket depends on their income and essential living expenses.
- Many cities generate additional revenue by charging monthly fees when someone can't pay a fine immediately. This affects both the time it takes to pay off the ticket and the final cost. Some people who struggle to pay go into debt, lose their jobs, and even go to jail.
- Different countries calculate fines differently. In Finland, for example, speeding tickets are based on a person's income.

MATHEMATICAL OBJECTIVES

- Write and solve a system of linear equations and interpret the intersection in a real-world context
- Explore how changing the slopes and y-intercepts affects where (and if) two lines intersect
- Use a unit rate to create a table, graph, and equation

LESSON AT A GLANCE

110 MIN.

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LAUNCH		Watch a clip of John Oliver asserting that “if you don’t have the money to pay them, tickets can ruin your life” and discuss the veracity of that claim.	5 min.
PART ONE	1	For two people with different incomes, tax rates, and expenses, calculate how much money each will have available for savings each month.	15 min.
	2	Using proportional reasoning, algebraic reasoning, or graphing, determine how many months’ worth of savings it would take each person to pay off the same \$150 ticket: just a single month for one of them; three months for the other.	20 min.
PART TWO	3	Watch a John Oliver clip about late fees added on to fines. Using both a table and a graph, model the accumulation of savings and the total ticket cost <i>with a monthly late</i> fee added over time. Determine that it may take someone 10 months and \$600 to pay a \$150 ticket.	30 min.
	4	Consider how changes to the base fee and the monthly fine would affect the city and someone paying a ticket.	20 min.
	5	Evaluate the fairness of two different systems for fines: the one explored throughout the lesson and a Finnish approach in which fines are proportional to income.	20 min.

- L Students watch a clip from the HBO program, *Last Week Tonight with John Oliver*, about the effects of municipal fines like parking and speeding tickets. Oliver discusses different types of tickets and concludes the clip by saying, “For most people, tickets are just annoying. But if you don’t have enough money to pay a fine immediately, tickets can wreck your life.”

Ask students whether they think Oliver was exaggerating or whether getting a ticket really can wreck someone’s life.

DISCUSSION QUESTIONS

1. In addition to parking and speeding tickets, what are some other examples of municipal violations?
2. Have you or anyone you know received a ticket? What was it for and how much did it cost?
3. When John Oliver says, “Tickets can wreck your life,” do you think he’s exaggerating or being literal?

KEY TAKEAWAYS

- For someone who’s relatively well-off, a ticket – even one that’s a few hundred dollars – will be a nuisance but is unlikely to “ruin” their life. However, for someone who doesn’t have much money, a ticket can be a real problem, especially if it comes with monthly fees or other penalties.
- The same fine won’t necessarily affect everyone the same.

- 1 In a certain town, Ali earns \$1,000 per month and Bo earns \$7,000. After paying taxes and monthly expenses, how much can each person save each month?

	INCOME 	TAXES 	EXPENSES				SAVINGS 
			HOUSING 	TRANSP. 	FOOD 	OTHER 	
ALI	\$1,000	10%	\$500	\$100	\$200	\$50	\$50
BO	\$7,000	20%	\$3,200	\$800	\$900	\$500	\$200

METHOD 1 (EX. ALI):
CALCULATE EVERYTHING SEPARATELY

Tax Paid:
 $10\% \text{ of } \$1,000 = 0.01 \cdot \$1,000 = \$100$

Take-Home Pay = Income – Tax Paid:
 $\$1,000 - \$100 = \$900$

Savings = Take-Home Pay – Expenses:
 $\$900 - \$500 - \$100 - \$200 - \$50 = \50

METHOD 2 (EX. BO):
CALCULATE INCOME KEPT, DEDUCT EXPENSES

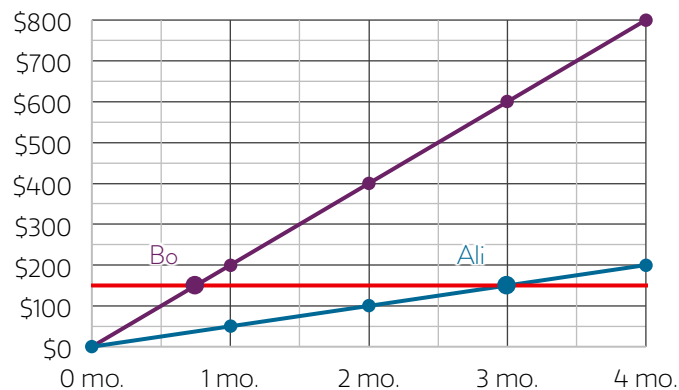
If person pays 20% of income in taxes,
 person must keep 80% of income

Take-Home Pay = Percent of Income Kept:
 $80\% \text{ of } \$7,000 = 0.8 \cdot \$7,000 = \$5,600$

Savings = Take-Home Pay – Expenses:
 $\$5,600 - \$3,200 - \$800 - \$900 - \$500 = \200

- 2 Assuming they spend no additional money, show how much Ali and Bo will be able to save over time. Then, imagine they both get caught for speeding and receive a **\$150 ticket**. For each person, how many months' worth of savings will it take to pay off the ticket, and does this seem like a reasonable amount of time? Explain.

MONTHS	FINE	SAVINGS, ALI	SAVINGS, BO
0	\$150	\$0	\$0
1	\$150	\$50	\$200
2	\$150	\$100	\$400
3	\$150	\$150	\$600
4	\$150	\$200	\$800



METHOD 1:
SKETCH GRAPH

See graph above

METHOD 2:
USE/EXTEND TABLE

Months	Fine	Savings, Ali	Savings, Bo
0	\$150	\$0	\$0
0.25	\$150	--	\$50
0.50	\$150	--	\$100
0.75	\$150	--	\$150
1	\$150	\$50	\$200
2	\$150	\$100	--
3	\$150	\$150	--

METHOD 3:
SOLVE EQUATIONS

$$\begin{aligned} \text{Ali (Savings} &= 50m) \\ 50m &= 150 \\ m &= 3 \end{aligned}$$

$$\begin{aligned} \text{Bo (savings} &= 200m) \\ 200m &= 150 \\ m &= 0.75 \end{aligned}$$

Students' answers will vary as to whether the 0.75 months vs. 3 months discrepancy is reasonable or not. Sample response:

To pay the \$150 ticket, Ali will pay 3 months' worth of savings, while Bo will pay 0.75 months' worth of savings (or 3 weeks' worth). On one hand, this discrepancy doesn't seem reasonable; even though they both committed the same infraction, the fine hurts Ali more. On the other hand, speeding puts people in danger. As long as the fine was known to drivers beforehand, it's reasonable to charge each person the same penalty for the same violation.

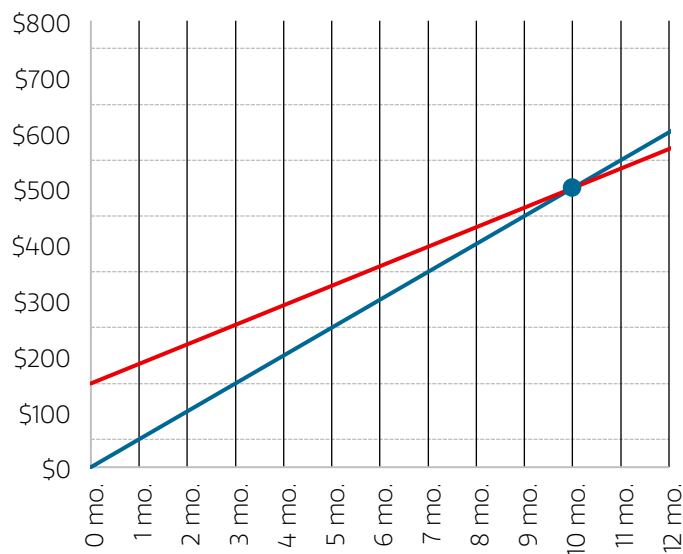
TEACHING TIP

Students may argue that if Bo gets paid at the end of the month, it will take him/her 1 month to pay off the ticket, not 0.75 months. To avoid confusion stemming from pay schedules, you should avoid asking "How long will it take Bo and Ali to pay off the ticket?" Instead, you can frame the question as, "How many months' worth of savings will the ticket cost?"

- 3 In many cities, when someone doesn't pay off an entire fine, the city will add a monthly fee until they do. Watch the video from *Last Week Tonight with John Oliver*. Then, imagine Ali gets a \$150 ticket for speeding. This time, though, the city adds a \$35 fee every month until the ticket is fully paid.

Use the table and graph to show what the fine will be, and how much Ali will have saved, after each month. How long will it take to pay off the ticket, and how much will it end up costing in total?

MONTHS	FINE	SAVINGS, ALI
0	\$150	\$0
1	$\$150 + \$35 = \$185$	\$50
2	$\$185 + \$35 = \$220$	\$100
3	$\$220 + \$35 = \$255$	\$150
6	$\$150 + \$35(6) = \$360$	$\$50(6) = \300
12	$\$150 + \$35(12) = \$570$	$\$50(12) = \600



**METHOD 1:
ESTIMATE FROM GRAPH**

See graph above.

**METHOD 2:
EXTEND TABLE**

Months	Fine	Savings, Ali
...	...	...
6	\$360	\$300
7	\$395	\$350
8	\$430	\$400
9	\$465	\$450
10	\$500	\$500
11	\$535	\$550
12	\$570	\$600

**METHOD 3:
SOLVE EQUATION**

Ali

$$\text{Savings} = 50m$$

$$\text{Fine} = 150 + 35m$$

$$50m = 150 + 35m$$

$$15m = 150$$

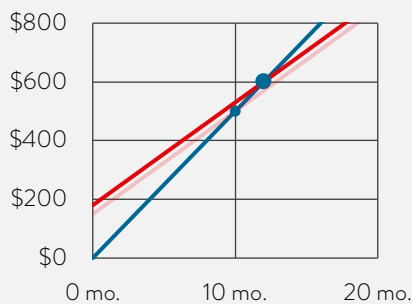
$$m = 10$$

Ali will spend 10 months' worth of savings to pay off the ticket, which will end up costing \$500 in total.

- 4 Imagine a city needs more money and is considering raising *either* the ticket amount *or* the monthly fee. Which do you think would be better and why?

METHOD 1: EXPLORE SPECIFIC SCENARIOS

Example 1:

Initial Fee: \$150 \$180Monthly Penalty: \$35

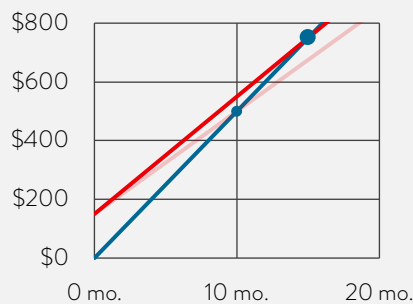
$$50m = 180 + 35m$$

$$15m = 180$$

$$m = 12$$

New ticket costs 12 months' of savings,
costs \$600 in total

Example 2:

Initial Fee: \$150Monthly Penalty: \$35 \$40

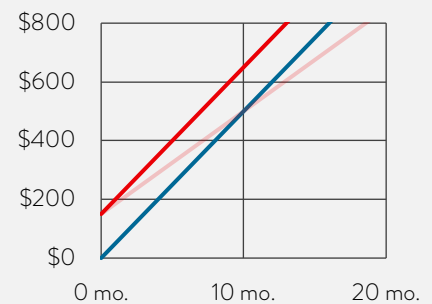
$$50m = 150 + 40m$$

$$10m = 150$$

$$m = 15$$

New ticket costs 15 months' of savings,
costs \$750 in total

Example 3:

Initial Fee: \$150Monthly Penalty: \$35 \$50

$$50m = 150 + 50m$$

$$0 = 150$$

no solution!!

Ali will spend all of her savings on the
monthly fee and never pay off the ticket.

METHOD 2: REASON LOGICALLY

If the city increases the initial fine, the ticket will take longer to pay off than it did originally and will cost more in total. Because Ali's savings (\$50/month) is greater than the additional monthly penalty (\$35/month), though, Ali will eventually be able to pay the ticket off, regardless of what the initial fee is.

However, this won't necessarily be the case if the city increases the monthly penalty. If the city keeps the initial fine at \$150 and raises the monthly penalty to (say) \$40, Ali will eventually be able to pay off the ticket. Once the monthly penalty hits \$50, though, Ali will never be able to pay off the ticket; all of Ali's savings will go towards the monthly fee and none will go towards the initial ticket.

In terms of which option is better, that depends: *better for whom?* If the city increases the initial fine and leaves the monthly penalty alone, this will affect everyone who gets a speeding ticket, including people like Bo. On the other hand, if the city increases the monthly penalty and leaves the initial fine alone, the new policy will only affect people like Ali who can't afford to pay off the ticket in the first month. In each scenario, the city would generate more revenue, but the two policies would impact residents differently.

TEACHING TIP

The phrasing of the question is intentionally vague: *better for whom?* Challenge students to consider the options from a variety of perspectives: Ali's, Bo's, and the city's.

- 5 Cities around the world make money from tickets, but not all of them calculate fines the same. Watch the videos about Harriet Cleveland (USA) and Reima Kuisla (Finland), and describe the pros and cons of each system. Then, how do you think governments should determine how much fines cost?

Students' responses will vary. Possible pros and cons include:

	Everyone Pays Same Fine (ex. USA)	Fine Based on Person's Income (ex. Finland)
Pro	Everyone who commits the same violation receives the same consequence. "If you can't pay the fine, don't do the crime."	Since the fine amount depends on the person's wealth, people are more likely to "feel" it the same regardless of their income.
Con	People will "feel" the consequence differently. A \$250 ticket will "hurt" a poor person more than it will a rich person.	The millionaire Reima Kuisla got a \$60,000 ticket for driving 14 mph over the speed limit. This seems excessive.