

M102 Performance Task

The Cost of Driving Fast

Modeling with Linear Functions and Equations
Teacher Version

Design Notes

In this task, students will use linear functions to model the relationship between distance and time for several different driving speeds. This performance task is structured to guide students through the process of simultaneously engaging in each component of the modeling cycle and developing one portion of a safe-driving campaign. Students will be recording information as they go through different sections. This can either be captured in an online word processing document or on some standard lined paper if working by hand. Students will also likely want to use either graphing software or graph paper for some portions of the task. Student-teacher consultations have been built in to scaffold the process. Consider using those structured check-in points as places where select student(s) share their approach/findings with the class to support the collective learning of the class. This learning experience centers around the CCSSM modeling cycle as illustrated below:

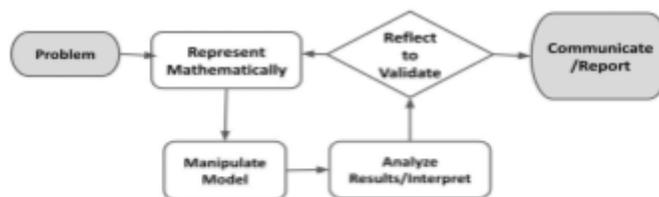


Figure 1. Diagram of Modeling Process. From "Progressions for the Common Core State Standards for Mathematics" [Draft manuscript], by Common Core Standards Writing Team, 2018, p. 6 (http://mathemagicalmaths.org/wp-content/uploads/2022/05/modeling_02182019.pdf).

Connections to Learning Principles

Students will:

- synthesize information from several different sources to build a coherent argument in support of the safe-driving campaign (LP1);
- engage in conversations with other students to help strengthen their collective understanding of the issue (LP2);
- decide which information is relevant to include in the communication they develop (LP4);
- explore an issue that is often central to the teenage experience—safe driving (LP6); and
- have opportunities to create graphs using graphing software and create a final product that may leverage different technologies (LP7).

The following pages provide teacher versions of this task with guidance, suggestions, and comments in **red** and sample student responses in *blue italics*.

Student Task

The Modeling Cycle

If you want to get somewhere faster in an automobile, you simply drive faster. Right? But how much time do people really save by putting the “pedal to the metal”? In this task, you will contribute to a safe driving campaign by analyzing and reporting on the actual amount of time that people save by driving faster.

Mathematical models are used to make sense of ideas and phenomena in our world. As illustrated in the image below, the modeling cycle is a process of identifying a problem, creating models, analyzing the story told by those models, and reporting the results to the appropriate audience. In this task, you will be engaging with the mathematical modeling cycle to understand and communicate whether speeding actually saves as much time as people may believe.

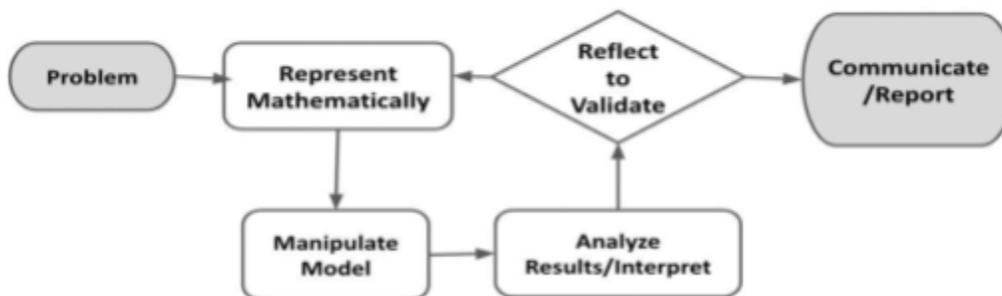


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The Cost of Driving Fast

Launch

Imagine you or somebody you know gets a speeding ticket for driving faster than the posted speed limit. The speeding ticket requires a payment of \$200. Was it worth driving faster than the posted speed limit, knowing that you have to pay \$200?

QUESTION 1



What are some reasons why people might drive faster than the posted speed limit?

Answers will vary. Possible student responses:

- *Late for school or work.*
- *They like how it feels.*
- *To pass other cars.*
- *They don't know what the speed limit is.*

After sharing the **Launch** statement with students, consider giving students a few minutes of individual think time to generate responses.

Consider offering students various ways to share their thoughts with the class: pair-share, chart, or other spaces.

QUESTION 2



Let's think about different distances. What is a place that might be less than one mile from your current location? What is a place that might be about 20 miles from your current location? What is a place that is definitely more than 100 miles from your current location?

Answers will vary. Possible student responses:

- *[No sample answers provided as this question is very localized.]*

As you engage in this **Launch** question, feel free to tweak it to make it more meaningful. For example, if you are in a school building with students, you might ask, *What is a place that is less than one mile from our school?*

The purpose of this question is to help students think about different distances in very practical terms. They will later find out that people drive on average about 20 miles one way to get to work, so calibrating on what "20 miles" is in real terms can be very helpful to support their visualization of that later in the task.

Problem

You have been asked to create one portion of a safe-driving campaign. The primary focus of your portion of the campaign is to help drivers understand whether the potential financial cost of a speeding ticket is worth the amount of time saved by getting to a destination faster.

In the **Formulate and Represent Mathematically** section, you will examine the relationship between how fast a person is driving and how long it will take them to travel different distances. You will create one or more data displays that illuminate the relationships. The **Formulate and Represent Mathematically Checklist** can be used to ensure you have the necessary components before moving on to the remaining parts of the task.

Formulate and Represent Mathematically

QUESTION 3



How long would it take a driver traveling at 40 miles per hour (mph) to travel 10 miles? What about 100 miles?

QUESTION 4



How long would it take a driver traveling at 60 mph to travel 10 miles? What about 100 miles?

ACTION 1



The questions presented above provide some insight into how driving at different speeds affects the amount of time it takes to get to a destination.

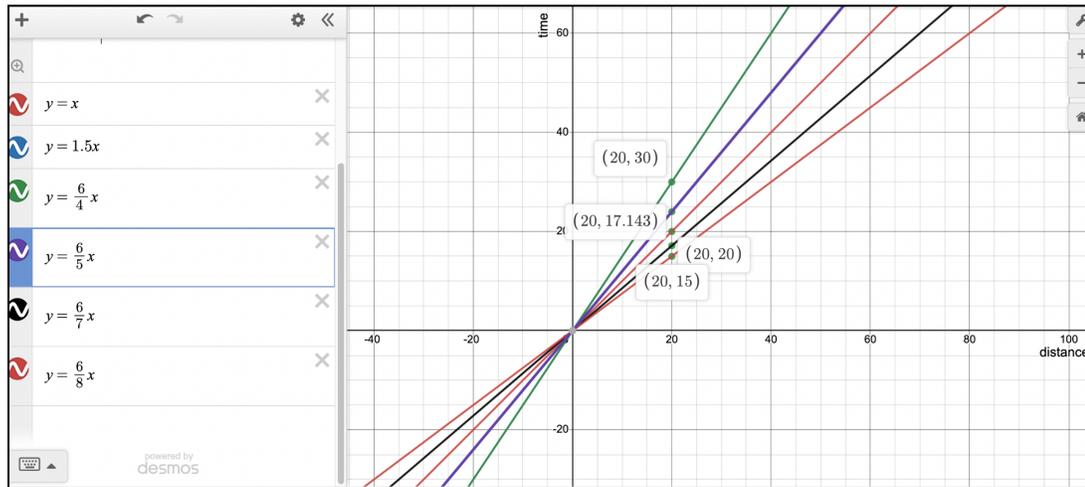
Create a set of graphs to show the relationship between distance traveled and time for at least three different driving speeds.

Note: You are welcome to use additional paper or digital forms to document your work. Be sure to include all of your work in your final submission.



The graphs you create should answer the question:
How long does it take drivers traveling at different speeds to go different distances?

See below for a sample of graphs students might create:



ACTION 2



For each graph, write the equation for that graph. Clearly define any variables used or quantities represented.

See image above.

Formulate and Represent Mathematically Checklist

Requirement	Teacher Notes
At least three graphs have been created to accurately communicate the relationship between driving speed, distance traveled, and time. Graphs are on the same set of coordinate axes.	(Teachers, please add your notes here.)
Any variables used relative to the context of the problem have been clearly defined.	(Teachers, please add your notes here.)
Each graph has been associated with an accurate equation.	(Teachers, please add your notes here.)
(Teachers, please add your notes here.)	

In the **Manipulate Model**, **Interpret**, **Reflect**, and **Report** sections, you will relate driving speed, distance, and time to inform your campaign data; you will research costs associated with speeding tickets; you will consider other information pertinent to your campaign; and you will present your findings and your final campaign. The **Manipulate Model, Interpret, Reflect, and Report Checklist** can be used to ensure you have the necessary components before finalizing your work on this task.

Manipulate Model

ACTION 3



Use the information from the previous section. Complete the tables below to highlight specific quantities of interest that you might use to build your final campaign.

Driving speed (in mph)	Distance (in miles)	Time (in hours)	Time (in minutes)
40	20	$\frac{1}{2}$	30
50	20	$\frac{2}{5}$	24
60	20	$\frac{1}{3}$	20
100	20	$\frac{1}{5}$	12

Driving speed (in mph)	Distance (in miles)	Time (in hours)	Time (in minutes)
40	100	$2\frac{1}{2}$	150
50	100	2	120
60	100	$1\frac{2}{3}$	100
100	100	1	60

Interpret

ACTION 4



Research the cost of speeding tickets locally. Decide how to integrate this information with your findings so far to make a compelling argument that the amount of time people typically save by speeding is not worth the financial burden of possibly getting a speeding ticket.

In anticipation of this local-research part of the task, you may have one or more links readily available for students to use in their research, or allow them to conduct the research on their own.

Reflect

QUESTION 5



As you get ready to synthesize your information, here are a couple of other pieces of information that might help you:

- On average, people drive about 20 miles one way to work.*
- Most people who drive faster than the posted speed limit only exceed that posted speed limit by 1-20 miles per hour.

Why is this information important to know as you develop your communication?

Are there any additional data displays or other speeds that would be valuable to examine and communicate? What other factors contribute to the speed at which a person travels?

What other costs or risks are associated with speeding? Can you find and use any other data to support your argument that speeding does not pay?

*Source: <https://www.zippia.com/advice/average-commute-time-statistics/>

Report

QUESTION 6



Think of different ways you can share this information with others within the context of a **public service announcement**. Specifically, aim to be as *creative* as possible. **Divergent thinking** will help you here: ***What unique idea can you generate that nobody else in your class is likely to produce?*** These types of products will not only grab your audience’s attention more quickly, they will be more memorable in the long run, which, with what you now know about the costs of speeding, could help save lives!



Don't let **format** limit you—you can think of **ANYTHING** from creating/parodying music lyrics, making an informational video or commercial, writing a children’s book or creating a children’s rhyme they can recite when playing hopscotch or jumping rope (we’re talking REALLY divergent, here!), making a speech, creating an interpretive dance, painting an abstract representative picture, assembling a collage of original related photography, or anything unique and memorable you can use to communicate your message.

Note: You are welcome to use additional paper or digital forms to document your work. Be sure to include all of your work in your final submission.

ACTION 5



In addition to your product, you need to create an accompanying **one-pager** with at least **one data display** (table, graph, etc.), **one paragraph explaining the data and making the argument that speeding does not save that much time**, and **one paragraph explaining your product** (this will be especially essential for products that do not use words or that convey their message implicitly/interpretively).

Manipulate Model, Interpret, Reflect, and Report Checklist

Requirement	Teacher Notes
A product has been presented that is unique/creative, well-executed, memorable, and succinct.	(Teachers, please add your notes here.)
The product has been accompanied with a one-pager that includes at least one data display, one argumentative paragraph, and one product-explanatory paragraph.	(Teachers, please add your notes here.)
Information from the task and any additional research has been effectively integrated into the product and/or one-pager to convince the audience that driving over the speed limit is not worth the financial cost (and/or other risks) of a speeding ticket.	(Teachers, please add your notes here.)

(Teachers, please add your notes here.)

References

Flynn, J. (2023, February 13). *15+ average commute time statistics [2023]: How long is the average American commute?* Zippia Research. Retrieved February 16, 2023, from <https://www.zippia.com/advice/average-commute-time-statistics/>