

M111 Performance Task

Imagining a Better Meal Experience

Modeling with Data: One-Variable Measurement Data
Teacher Version

Design Notes

In this task, students will determine and create an appropriate way to report the findings they analyze and visualize using the one-variable data they collect focused on dining experiences at a cafeteria, food court, or restaurant. This performance task is structured to guide students through the process of simultaneously engaging in each component of the modeling cycle and developing a report. 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. 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:

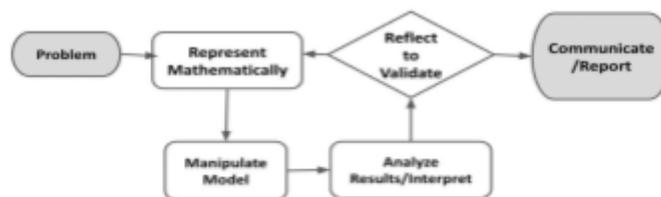


Figure 1. Diagram of Modeling Process. From "Progressions for the Common Core State Standards for Mathematics" [Draft manuscript], by Common Core Standards Writing Team, 2018, p. 6 (http://mathematicalpractices.org/wp-content/uploads/2022/05/modeling_02082019.pdf).

Connections to Learning Principles

Students will:

- collect data outside of the classroom and engage in social interactions (LP1 & LP2);
- build conceptual understanding through thinking deeply about the causes of wait time delays in a given setting and collecting data to inform how to help alleviate this problem (LP3);
- have agency in their learning as they select a question of interest to explore and decide the best way to collect data related to their question (LP4);
- see how data can be used to drive improvements that make our lives better (LP6); and
- have the opportunity to use technology to help organize and understand their collected data (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

Restaurants and other retail operations often collect feedback or other data to improve their operations. For example, when you enter a food court or cafeteria, several things work well to accomplish the goal of getting the food you want to eat. Sometimes, you might notice or wonder what could be done differently to make the experience better. In this task, you will design a proposal for improving services in such a place.

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 collecting data about an idea or problem, creating models of that data, 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 prepare and design a proposal for improving services.

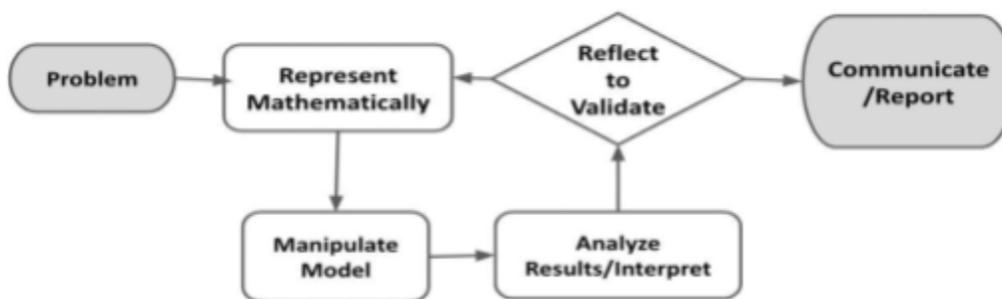


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Imagining a Better Meal Experience

Launch

Imagine you are in class and the bell rings for lunch. As you walk into the cafeteria, there are already a lot of people there getting in line, claiming seats, throwing away trash. You can smell the food, hear the chatter, and see the buzz of activity. There is so much going on around you! As you get in the long line to get a meal, you start thinking about how a cafeteria works.

QUESTION 1



What do you wonder about a school cafeteria? Come up with some questions!

Answers will vary. Possible student responses:

- *Do all grade levels get sent to the cafeteria at the same time?*
- *Why do students want to eat cafeteria food?*
- *How long do you have to wait in line to get cafeteria food?*
- *How long does it take to get from the line to sitting down and eating your food?*
- *What are the most popular food items at the cafeteria?*
- *How do cafeteria managers know how much food to make?*
- *How do cafeteria managers make sure the food line is moving quickly?*

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

What are things that work well in your cafeteria, and what are things that are inconvenient or that could be improved in some way?

Answers will vary. Possible student responses:

Working well:

- *My school staggers lunch break so that there are fewer students waiting in line at any given time.*
- *My school cafeteria has a separate salad and sandwich bar that you don't need to get into the hot lunch line for.*
- *My school cafeteria has pre-prepared grab-and-go salads and sandwiches available if you are in a rush to get to a club or something.*
- *My school cafeteria has a recycling and composting program.*
- *My school cafeteria caters to dietary needs and allergies if they know in advance.*

Inconvenient:

- *While there are two payment lines, the lines are always long as everyone from the hot lunch, salad bar, and quick lunch lines needs to line up in the same payment lines.*
- *You need to have a school payment account to get any cafeteria food or drinks, unless you have free lunches.*
- *The hot lunch and payment lines are very long, so we lose time to eat our lunch and are rushed out of the cafeteria often with little time to eat before the next grade levels' lunch break.*
- *They often run out of the food items that are for specific dietary needs such as gluten free, dairy free, or vegan.*

The rationale for this question is to give students an opportunity to recognize things in the dining experiences they're accustomed to that work well and identify some things that do not.

Ideas that surface here can help set the stage for statistical questions students will generate for this performance task.

Students are likely to mention lunch lines. If your school has multiple lunch periods, perhaps ask the students if they think there is a difference from one lunch period to another.

QUESTION 3

Using the ideas and observations you made in the previous questions, what statistical questions can you create about the cafeteria?

Answers will vary. Possible student responses:

- *How long is the average time spent in the lunch line?*
- *What do most people in our school eat for lunch?*
- *When is it the busiest?*
- *How good is the food?*
- *What is the typical size of a group of kids eating together at lunch?*

This is a good time to invite students to examine the questions generated by the class.

Consider taking a question like *How good is the food?* and working with the class to turn it into a quantitative, one-variable question.

- Pose a question like *How would you measure the quality of the food?*
 - Students may offer suggestions like: *good, great, not good*, or a number on a scale (1-5).

Students might also be interested in gathering more localized data; encourage student agency here and allow students to adjust their focus accordingly, within reason.

- For example, one class implementing this task identified the impending closure of their school cafeteria as worthy of investigating statistically (to identify if there was enough interest/need to argue that the cafeteria should remain open). Those students focused on gathering, interpreting, and publishing data from surveying their peers.

In the **Problem** and **Formulate** sections, you will develop a written plan that contains one of your statistical questions and a detailed data collection plan using the questions from the sections below as a guide. Create a document that will include this written plan and other parts of this task. The **Problem Formulation Checklist** can be used to ensure you have the necessary components before moving on to the remaining parts of the task.

Problem

ACTION 1



Select a one-variable statistical question from the questions you generated above.

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.

Guiding Questions

- Choose one of the statistical questions you created that you are interested in investigating further and that is appropriate for a one-variable statistical model.
- Who would benefit from the data collected from your statistical question? And why?

Formulate

ACTION 2



Describe your data collection plan.

Guiding Questions

- Can you investigate your statistical question? Or do you need to narrow your focus to make your question more specific?
- What data can help you investigate your statistical question?
- How much data should you collect?
- How will you collect your data?
- What type of bias might you encounter?
- How can you minimize bias?
- How frequently do you need to collect data?

Problem Formulation Checklist

Requirement	Teacher Notes
An investigatable, sound statistical question appropriate for a one-variable statistical model has been chosen/identified.	(Teachers, please add your notes here.)
A reasonable, detailed early data collection plan with controls for bias has been created.	(Teachers, please add your notes here.)
(Teachers, please add your notes here.)	

In the **Represent Mathematically** section, you will add on to the document you started above. You will show a summary of the data you collected and the visual you chose for this data. Write a statement explaining why you chose this particular display. The **Represent Mathematically Checklist** can be used to ensure you have the necessary components before moving on to the remaining parts of the task.

Represent Mathematically

ACTION 3



Carry out your data collection plan. Were you able to carry out your plan as designed? What worked well with your plan? Describe any modifications, if any, you needed when carrying out your data collection plan.

ACTION 4



Choose and create an appropriate visual to display your data. Explain why the visual you chose is appropriate for your data.

Represent Mathematically Checklist

Requirement	Teacher Notes
Data collection has been completed and compiled to include in the report.	(Teachers, please add your notes here.)
Chosen data display is appropriate for these data.	(Teachers, please add your notes here.)
(Teachers, please add your notes here.)	

In the **Analyze and Interpret Results** section, you will include an interpretation of your data. Use the measures you calculated above to support your response to the questions posed. The **Analyze and Interpret Results Checklist** can be used to ensure you have the necessary components before moving on to the remaining parts of the task.

Analyze and Interpret Results

ACTION 5



Choose a measure of central tendency and a measure of spread appropriate to your data. Calculate these measures and explain how you chose and calculated them.

ACTION 6



Decide how you will determine and address outliers. Provide a summary of the evidence you considered when addressing outliers.

QUESTION 4



What story did the data tell relative to your question?

How can a cafeteria or restaurant use these data?

Analyze and Interpret Results Checklist

Requirement	Teacher Notes
The measures of central tendency and spread selected are accurate and appropriate for the data.	(Teachers, please add your notes here.)
The possible effects of outliers are explored using the shape, center, spread, and context of data sets.	(Teachers, please add your notes here.)
The story of the data accurately interprets and uses the results of the analysis to explain how this information can be useful.	(Teachers, please add your notes here.)
(Teachers, please add your notes here.)	

In the **Validate and Report** section, you will add on to the document you started above and clarify the voice and audience. In the **Validate** section, you will explain whether the data were sufficient for addressing your statistical question or how you would improve the process in the future. You will also create an appropriate way to report the findings from your work to the intended audience (e.g., through a short video, pamphlet, or other visual). The **Validate and Report Checklist** can be used to ensure you have the necessary components for completing the task.

Validate and Report

QUESTION 5



Validate your model using the Guiding Questions provided and record your responses.

- Did the data sufficiently address the question you were investigating? Why or why not?
- If you were to try to collect data to answer your statistical question again, how would you adjust your process, your question, or how you analyzed the data to provide better information to the audience interacting with your data?

ACTION 7



Communicate your results in a manner and format that are appropriate for your audience and purpose, in a way that most clearly illustrates your findings.

Validate and Report Checklist

Requirement	Teacher Notes
A rationale has been provided showing how the data sufficiently addressed the question at hand or there is a clear understanding articulated about how to improve the data collection and analysis in the future.	(Teachers, please add your notes here.)
The results are clearly communicated in a way that is appropriate for the intended audience.	(Teachers, please add your notes here.)
(Teachers, please add your notes here.)	