

Annotated Examples: M111 Modeling with Data: One-Variable Measurement Data

The examples that follow are intended to illustrate how the learning principles are used to support students' engagement with the content and practices outlined in this badge. These examples do not provide comprehensive coverage of those expectations, but rather elevate some of the learning principles that are less likely to be part of published curricular materials for mathematics instruction. The examples that follow were developed by the Math Badging writing team, unless otherwise specified. These are a small sample of types of learning activities that can be done with students, both in and out of a traditional classroom setting.

Example 1: Community Insights

Students are given a problem like this:

Data can be used to gain insights about communities and help us understand issues.

Framing Questions

What are some questions you have about your community that could be answered by collecting data?

- *Why are these questions/issues important?*
- *Why should we care about this question/issue?*
- *Who else might care about these questions/issues?*
- *Why might it be important to them?*

For this task you will prepare a presentation in any form (slideshow, report, song, artwork) consisting of the following components:

- *State your research topic in the form of a question and share why you chose this question.*
- *Explain why your issue is statistically valid.*
- *How and who will you sample to gather your data?*
- *Collect data from your classmates and from your community.*
- *Create data displays, including summary statistics, for both datasets and compare your findings.*
- *Explain how you could draw inferences from your data about your state. Namely, what aspects would you need to consider that may vary from community to community?*
- *Deliver a message you want to share on a topic of your choice, supported by the evidence you collect.*

(Adapted from Julia Aguirre)

Sample Learning Activity

Invite students to write down questions they have about their community, such as:

- *How often do students eat lunch in a typical week?*
- *How many people participate in regular physical activity?*
- *What is the average screen time of students?*

As students write down ideas, circulate and look for trends. Give students time to connect with a partner and share what they generated. Select students to share ideas about their thinking with the class and revisit frequently the set of framing questions to help students connect data collection to understanding issues in communities. Offer students opportunities to go through iterative cycles of defining their topic and survey questions to use to gather data.

Students will collect data from their classmates or school and create a data display using technology (Desmos, applets, graphing calculator) and use summary statistics to describe what “typical” values are for the data they gathered.

Once students summarize their collected data, they will consider questions about generalizability of their data. These questions can be:

- Will all neighborhoods in your city have the same or similar data distributions? What do you expect to be the same? Different?
- Will all towns in your state have the same or similar data distributions? What do you expect to be the same? Different?
- Synthesis: What is the largest population that you could generalize to using your data? What about your data allows you to generalize to this new, larger population?

Students will then choose a nearby community, gather data from that community, and create a data display for data from the neighborhood and from a nearby community, using technology (Desmos, applets, graphing calculator). Once data sets are created for both communities, have students consider the following:

- How do the data distributions of both communities compare? [emphasis on writing answers in the context of the question of interest]
- Synthesis: Based on the differences you observed between the two datasets, explain a method to gather data for your state that would be representative of the entire state.

Following the discussion, students are given an opportunity to reflect on and revise their work. Finally, one or more reasonable models are revealed explicitly, and students have an opportunity to reflect on the reasonable models and revise their work.

In this example, students are:

- given a cognitively demanding task. It requires that students engage in the modeling cycle as they determine statistical questions and gather and analyze data. Students are also asked to consider how the data they collect would compare to data from other cities and possibly the state, giving space to reflect on sampling methods (LP 1).
- set up to have social interactions, as they work with partners or small groups to model the data (LP 2).
- building conceptual understanding through reasoning about the application of findings from their data set to other populations. Students have opportunities to reason and justify their conclusions (LP 3).
- able to explore areas of interest as they gather data about their communities and reflect on their findings (LP 4).

- engaging with mathematics as a human endeavor used to gain insight about their community and reflecting on the generalizability of their findings to other communities, thereby broadening ideas about what mathematics is, how it is used, and who it is for (LP 5).
- applying mathematics in a relevant, real-world situation. The context for engaging with mathematics is defined by the student, thereby authentically involving the students' real world (LP 6).
- able to use technology as a tool, as they employ Google Sheets, Desmos, or GeoGebra to perform their analysis and design their data displays (LP 7).

Through the implementation of this learning activity, look for opportunities to support students' growth and development on this XQ competency:



- **Problem Solving:** [Empathic Problem Solving](#) (OT.PS.1.b)

Example 2: Strolling or Speeding

Students are given a problem like this:

Part 1

Transportation engineers help determine the speed limit for a road.

Assume you were hired as a transportation engineer.

- *What are some things you would want to consider in setting a speed limit?*

One of the criteria for setting a speed limit is the “[85th Percentile Speed](#).” Learn more about this idea by conducting additional research. One possible site to explore is this website: [Understanding the 85th Percentile Speed](#) by retired civil engineer Charles Marohn. As you research, consider:

- *How would you explain what the 85th Percentile Speed criteria for setting speed limits is?*
- *Why is this issue important?*
- *Why should we care about this issue?*
- *Who else might care about this issue?*
- *Why might it be important to them?*

Part 2

Your job is to inform the local community about the speeds on the road in front of your school.

- *Construct a plan to gather data, then find the mean and standard deviation of speeds on a road in front of your school.*
- *Use what you learned about the 85th Percentile Speed to examine what you notice about your community. What thoughts do you want to offer community stakeholders?*
- *Decide how to best share your message, supported by the evidence you collect.*

Sample Learning Activity

Launch this task by inviting students to write down questions they have about drivers in their community, such as:

- *How fast should cars be allowed to travel?*
- *What are some considerations in designing a reasonable speed limit for a particular road?*
- *How would you know if the speed limit you set is appropriate?*

Give space for students to share questions they generated with their classmates. Amplify questions that connect to the central focus of this prompt and introduce Part 1 of the prompt above.

Provide quiet work time for students to consider their responses and offer opportunities for students to share their initial ideas with classmates before eliciting ideas to be shared with the whole class. Monitor and select students to share their preliminary thoughts with the whole class. Capture ideas that surface on a shared space, like chart paper or a whiteboard, for students to be able to reference as they continue to explore.

Once students land on a shared understanding of the 85th Percentile Speed criteria for determining speed limits, introduce Part 2 of the prompt. Provide time for students to work in small groups to determine how they might go about collecting the data they need. Monitor as student teams puzzle, research, and design a plan. Invite student groups to share their plans. Invite engagement and reflection of each group's approach using questions such as:

- *What's promising about this approach?*
- *What questions does this approach surface for you?*
- *Do you think this approach is reasonable? Why or why not?*
- *What can you take from this approach to apply to your own work?*

(Reasonable plans might include using an app that tracks speed, or creating a group structure to collect the speed and distance of cars on a road.)

Following the discussion, give students an opportunity to reflect and revise their approach.

Once their plan for collecting data is finalized, give students time to gather and analyze the data they collect. Provide access to apps, such as Desmos, GeoGebra, or spreadsheets, to help with the analysis.

Consider having students present their findings in a form that makes sense to them: a public service announcement, poster, song, report, using slideshow and/or audio/video recordings.

Give students an opportunity to reflect and revise their work as needed.

In this example, students are:

- set up to have social interactions, as they have opportunities to exchange ideas and partner with classmates (LP 2).
- encouraged to have agency, as they engage in a task that asks them to recognize and reflect on the driving habits of individuals in their community. They are further asked to consider which audience would be most interested in the findings from their data collection to make choices about which data displays and presentation modes would be most effective in communicating the results to their target audience (LP 4).

- developing an appreciation of mathematics as a human endeavor, one in which they feel a sense of belonging, and that offers opportunities to broaden their ideas about what mathematics is, how it is used, and who it is for (LP 5).
- exploring an issue that likely has great relevance to them (LP 6).
- able to use technology as a tool, as they employ Google Sheets, Desmos, or GeoGebra to perform their analysis and design their data displays (LP 7).

Through the implementation of this learning activity, look for opportunities to support students' growth and development on this XQ competency:



- **Community Advocacy:** [Case-making](#) (GC.SAg.1.)

References

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