

Graph reading and scale: Rubric

<http://topdrawer.aamt.edu.au/Statistics/Assessment/Assessment-tasks/Graph-reading-and-scale>

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A class of students recorded the number of years their families had lived in their town. Here are two graphs that students drew to tell the story.



1. What are two things you can say about Graph 1?
2. What are two things you can say about Graph 2?
3. Describe the difference between Graph 1 and Graph 2.
4. Which plot tells the story of how long the students' families have lived in their town better?



The four coded levels of this rubric are similar for the first two questions of the task and hence examples are presented for each part in the single rubric.

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| Code 1 responses | | Idiosyncratic comments on graphs, often missing the meaning |
| 1. | What are two things you can say about Graph 1? | “Not much.” “It has 23.” |
| 2. | What are two things you can say about Graph 2? | “Most people move on.” “It’s easier to look at but it’s not really good enough.” |
| Code 2 responses | | Two data reading comments or one appropriate and one inappropriate comment |
| 1. | What are two things you can say about Graph 1? | “Someone stayed there for 10 years and someone stayed there for 1 year.” “Two people have lived here for 2 years. Eleven have lived here for 1 year.” |
| 2. | What are two things you can say about Graph 2? | “2 years has one less than 3 years.” “People who have lived in their house for 3 years is four people. People who have lived in their house 37 years is one.” |
| Code 3 responses | | One summary statement plus perhaps one data reading comment |
| 1. | What are two things you can say about Graph 1? | “Not many people have lived there long.” “That the longest person’s family to live in the town was 37 years.” |
| 2. | What are two things you can say about Graph 2? | “That most people have stayed in town for different amounts of time. Four people have stayed for 3 years.” “More people have lived in town for 3 years.” |
| Code 4 responses | | Two summary statements either qualitative or quantitative |
| 1. | What are two things you can say about Graph 1? | “That most people had lived in their town for about 5 years. Also between 10 and 15 years.” |
| 2. | What are two things you can say about Graph 2? | “That most people don’t live in the town much after 12 years. The majority live there for 10 years or less.” “The mean = 9.64 years. The median = 8 years. The range = 37 years.” |

| 3. Describe the difference between Graph 1 and Graph 2. | |
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| Code 1 – Lack of appreciation that the graphs hold the same information | <p>“Less people live in their town in Graph 1 than Graph 2.”</p> <p>“Graph 2 shows you more into the future by 2 years.”</p> |
| Code 2 – Focus on aesthetic appearance or personal preference | <p>“Graph 1 is a lot harder to read than Graph 2.”</p> <p>“Graph 1 is in groups. Graph 2 is spread out.”</p> |
| Code 3 – Explicit focus on layout | <p>“Graph 1 went up in 5s. Graph 2 missed out numbers in between.”</p> <p>“Graph 1 was easier to tell how long the majority had lived in the town which was 0–5 because it counted in 5s.”</p> |
| Code 4 – Acknowledgement of the same data but different scales | <p>“There is no difference ... except that Graph 1 shows the spaces whereas Graph 2 doesn’t.”</p> <p>“Graph 2 skips the years out that aren’t being used. Both graphs show the same information (not a difference).”</p> |

| 4. Which plot tells the story of how long the students’ families have lived in their town better? | |
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| Code 1 – Idiosyncratic reasoning | <p>“Graph 2 because the people lived there longer.”</p> <p>“Graph 1 because it has more numbers.”</p> |
| Code 2 – Ease of graph reading | <p>“Graph 2 because it is easier to look at and to count.”</p> <p>“Graph 2 because you didn’t have to count 0-5-10-15, etc.”</p> |
| Code 3 – Misreading of graph | <p>“Graph 1 because the answers are more spread out and easy to see.”</p> <p>“Neither because they tell the same amount of information.”</p> |
| Code 4 – Statistically appropriate reasoning, sometimes with implications for the context | <p>“Graph 1 because it shows in half decades and shows the long stop from 25 years to 37 years.”</p> <p>“The first is better because it shows how spread out the immigration to the town was.”</p> <p>“Graph 1 has separated the families into two groups of 5 years which is easier to interpret.”</p> <p>“Graph 1 has a bigger impact as it shows the peaks better than Graph 2.”</p> <p>“Graph 1 shows that they came in two groups. Maybe when someone said it was a great town to live in.”</p> <p>“Graph 1. Probably a ‘boom’ in population. Population increases in a short period of time, then a drought.”</p> |

When asked what they can tell by looking at the two graphs, there is not very much difference in the comments made by students for the two representations. Some misinterpret the message, either because the frequencies portrayed by the crosses are confused with the numbers on the horizontal scale, or because the label is ignored.

- *Three is the biggest family. (Graph 2)*
- *The families were big but as time went on they went down. (Graph 1)*

At the next level students are likely to be able to read accurately at least one aspect of the data represented in the individual stacks of crosses.

- *One person has not lived in the town for a year. (Graph 2)*
- *Someone stayed there for 10 years. And someone stayed there for 1 year. (Graph 1)*

Summarising the information from more than one stack of crosses may focus on the highest frequency or most extreme values.

- *A lot of people were here 3 years. (Graph 2)*
- *Not many people lived here long. (Graph 1)*

Summarising may also take into account many values and the shape of the distribution.

- *More families lived in their town around the 4 to 5 year mark. But 10 to 15 years is quite popular. (Graph 1)*
- *Most people have resided there for less than 13 years. (Graph 2)*

Although interpretations for the two plots are similar, there is a tendency for more students to comment on clusters when describing the appropriately scaled plot and this should be a feature of classroom discussion. If students want to tell a story about clusters of data then appropriate scaling is necessary.

When students are asked to describe differences between the two plots, many do not realise that the same data are represented in each. Quite a few students focus on the general aesthetic appearance or personal preference with little justification. Some students also focus more explicitly on the layout. A few students acknowledge that the data are the same; only the scales are different.

When further asked which plot tells the story better, students are likely to display one of four levels of appreciation. Many cannot make up their minds or give idiosyncratic reasons. Roughly equal proportions of students are likely to choose each plot as better saying it is 'easier' to read or giving a reason based on misreading the graph. In these cases, choosing Graph 2 is considered less statistically appropriate than choosing Graph 1. In class discussion students may be reluctant to concede that Graph 2 is 'wrong'. Being 'right' or 'wrong' is not the issue here and certainly Graph 2 conveys exactly the same information. The issue about 'how well it tells the story' is what statistics is about, and helping students to appreciate that Graph 1 is statistically appropriate because it tells the story better is the goal of considering tasks like this one. It is likely that general experience with graphs over the middle school years assists students in appreciating the scaled graph if they are presented with it first for consideration.