ScienceNews

Activity Guide for Students: Vibration Check

Directions:
Most of us drive across bridges every day and never question their stability – we trust that the bridge will stand. However, bridges can fail. Today, you will learn about one of the biggest failures in bridge construction, read an article about engineers who are looking at ways to use cell phone data to monitor the quality of bridges, and learn some statistics principles while evaluating simulated cell phone data.

Bridge stability

Watch the video about "Galloping Gertie," a famous Washington State bridge that collapsed in 1940, and answer the following questions.

1. What was Galloping Gertie's official name? How did the bridge get its nickname?

2. According to the video, what caused Galloping Gertie's collapse? Be specific.

3. Was Galloping Gertie stable? Why or why not?

4. If you could have made one change to Galloping Gertie to make the bridge more stable, what would you have changed?

5. What types of measurements could you take to determine whether a bridge is stable? How could these measurements demonstrate stability?

6. In the decades since Galloping Gertie collapsed, engineers have continued to study the bridge's collapse, and they have not always agreed on the causes. Name one factor that engineers think influenced the collapse. You will need to go online to do some research?

Bridge vibration check

Read "Crowdsourced cell phone data could keep bridges safe and strong" from Science News online and look over the simulated data provided on the worksheet. When your teacher explains any statistical terms, it also would be a good idea to take a few notes.

Please answer the following questions.

1. Why do different bridges safely vibrate at different frequencies?

2. If all bridges vibrate at different frequencies, why is it important that we pay attention to the vibrational frequencies of a bridge over time?

3. Dataset 1 shows the simulated vibrations recorded by cell phones as they cross an imaginary bridge. What is the average, or mean, of the frequencies recorded by the cell phones as they crossed the bridge? Show your work.

4. Why are we looking at the mean of the frequencies recorded by the cell phones instead of one data point? What other aspects of a dataset might you want to investigate? Explain.

5. Look closely at the datasets. Describe something that strikes you as unusual. What questions come to mind when you think about this unusual feature of the datasets?

6. Datasets 2 and 3 contain simulated data collected by the same cell phones as they passed over the same imaginary bridge on later dates. Calculate the mean for Dataset 2 and the mean for Dataset 3. Show your work.

7. What would finding a statistically significant difference in a dataset tell us about the stability of our bridge? Why would we care to know if the difference between the means was significantly significant?

8. What might an engineer do if they notice that a bridge's vibrational frequency has significantly changed?

Extension

Use popsicle sticks, toothpicks and hot glue to make a model of a local bridge. Make sure that your bridge spans a gap and is stable. Its stability under pressure will be put to the test. After your model bridge's stability has been tested, answer the following questions.

1. What are some things you noticed about the bridge that help it remain stable?

2. What challenges did you encounter when modeling the bridge using popsicle sticks and toothpicks?

3. Where did your bridge break? Be specific.

4. What weights might the real bridge experience? How might a bridge's response to weight show its stability?

5. How is the real bridge different from your model bridge? How might these differences contribute to the real bridge's stability?