Lesson of the Day: Dangerous Denominators

In this lesson, students will examine the math behind Covid-19 risk in schools and uncover misleading percentages and data reliability in coronavirus case reporting.

By Dashiell Young-Saver,   Oct. 15, 2020

Lesson Overview

This fall, students and parents across the country have taken on a new, high-stakes task: health data analysis. To gauge the safety of returning to school, many families have pored over coronavirus case data, as reported by local school dashboards. The economist Emily Oster, in her Sept. 28 Opinion piece for The New York Times, "What Parents Need to Know About School Coronavirus Case Data," provides helpful insights for making sense of these reports.

In this lesson, you will use Covid-19 data from schools to analyze the importance of sample size — the denominator in percentages. Then you will investigate misleading percentages and data reliability in coronavirus case reporting.

Warm Up

Watch a segment of this video, posted in August, at these timestamps: 12:36-13:08. The video features an interview with President Trump in which he discusses Covid-19 statistics. Answer the following question:

- In your own words, describe the argument President Trump makes about why coronavirus case counts in the United States are higher than counts in other countries.

Continue the video through these timestamps: 13:08-14:22. In the charts presented by President Trump, the president uses a death rate statistic in the United States that is relatively low in comparison with other countries. By contrast, the reporter uses a statistic that puts the death rate in the United States at a relatively high level. Here are the two statistics they discuss in the video:

$$\text{Death Rate (Trump)} = \frac{Deaths}{Positive\ Case\ Count} \quad | \quad \text{Death Rate (Reporter)} = \frac{Deaths}{Country\ Population\ Size}$$

Respond to the following questions in writing, or in class discussion:

- In what way do the two formulas differ?
- Given President Trump's argument about testing frequency in the United States, why might *his* U.S. death rate statistic be lower than the same statistic in other countries that run fewer tests?
- By contrast, why might the *reporter's* U.S. death rate statistic be higher than the same statistic in other countries?
- If you had to provide the most *useful* death rate statistic to the American public, which one would you report: President Trump's or the reporter's? Explain your choice.

Activity: Dangerous Denominators

Read the featured article from the beginning through the following paragraph:

One way to think about it: If there are five cases in a school of 15, then if your child interacts with other children randomly, there is a 35 percent chance that they interact with someone who has Covid-19. If there are 5 cases in a school of 1,500, there is a 0.33 percent chance. That's the denominator.

Note: The denominator is the bottom number of a fraction.

Calculate these percentages using the above example. Here is the formula:

$$\text{Percent chance of a student being exposed} = \frac{Number\ of\ positive\ cases\ in\ school}{Total\ number\ of\ students\ in\ school - 1}$$

Note: We subtract by 1 in the denominator because a student cannot infect him or herself.

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Answer this question:

- Why is the denominator — number of children in the school — important in determining how dangerous it is to attend a certain school?

Navigate to the article's linked data exploration tool. The tool provides summaries and visuals of coronavirus and demographic information at schools in the United States. First, click on "Student-Infection-Rate" from the left-hand pane. Next, click "Describe" at the top-left corner to see a summary appear. Answer the following:

- Interpret the y-axis using the description of the data.
- Why do you think the tool displays infection rates, rather than counts of the number of students infected?

Now, let's divide the data into two categories: public and private schools. Click on "School-Type-Binary" in the left-hand pane, and click "Relate" at the top-left corner to see the relationship between school type (public versus private) and infection rates. Answer the following:

- Do private schools tend to have higher, lower or similar infection rates, compared with public schools? Why do you think this is?
- Statistics are only as good as the reliability of the data. What factors may affect the reliability of this data in comparing public and private schools? What factors may influence any difference?

Going Further

Read the remainder of the article. Toward the end of the Op-Ed, the author makes this statement: "Private schools in our data have lower infection rates, which seems to reflect, at least in part, their demographics and the fact that they do more mitigation."

Sometimes we see relationships in our data — like private schools having lower infection rates — that may have multiple explanations. The author of this article offers two possible explanations: Private schools are better at creating a safe environment and students who attend private schools are exposed to the virus less often in their daily lives.

Answer the following questions, with class discussion:

- Given what you just read, why do you think private schools may have had lower infection rates?
- What other possible explanations could there be for the difference between private and public school infection rates?

Sometimes it is difficult to determine the true explanation behind data trends. Other times, it may be difficult to determine whether we've collected enough data or even the appropriate data in the first place. For example, families and teachers in New York City have raised concerns about the potential for undetected cases to cause large outbreaks at schools. For more information, read this article up to, and including, the following graphics:

How more testing catches outbreaks earlier

Keeping New York's schools open will require detecting outbreaks before they grow too big. Researchers modeled how large an outbreak at an average New York school would grow before it is very likely to be detected.

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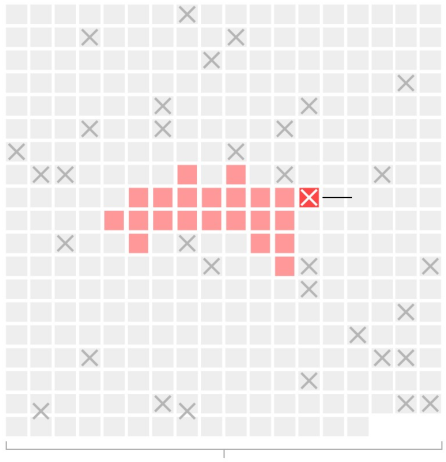
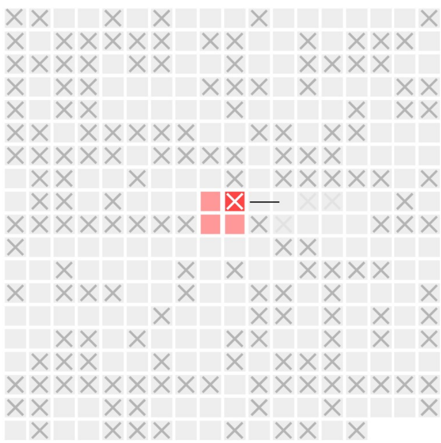


If a school tests 10% of students and staff every two weeks......

an outbreak could grow to 22 people before the first infection is identified — making it very difficult to control.

339 in-person students and staff



If a school tests 50% of students and staff every two weeks…

…an outbreak could grow to 4 people before the first is identified — much more manageable.

Note: Figures represent the sizes of outbreaks that can be detected at least 90 percent of the time if each percentage of students were tested every two weeks.

Source: Anna Bershteyn and R. Scott Braithwaite, New York University

By The New York Times

Answer the following questions:

- Based on these graphics, what are the benefits of providing more tests? What barriers might there be to testing many people — students, teachers, staff — at each school?
- Given the concern of unmeasured cases, do you believe there may be unmeasured cases in the schools discussed in the earlier article? Explain your answer. What is the effect of the unmeasured cases?

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Source: https://www.nytimes.com/2020/10/15/learning/lesson-of-the-day-dangerous-denominators.html

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Comment: Milo, Minneapolis, MN   Feb. 15, 2021
Invite students to think of a better choice. Some might realize that neither cases nor population is a good basis for predicting deaths. A much better denominator would be "infections". Yes, infections are typically unknown. But with that starting point, students should be more able to evaluate the strengths and weaknesses of death per case vs. deaths per capita.