

Murderous Nurse



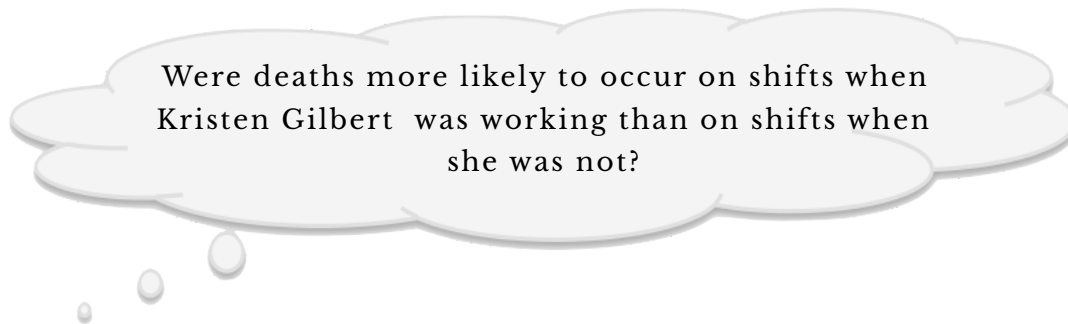
For several years in the 1990s, Kristen Gilbert worked as a nurse in the intensive care unit (ICU) of the Veteran's Administration hospital in Northampton, Massachusetts. Over the course of her time there, other nurses came to suspect that she was killing patients by injecting them with the heart stimulant epinephrine.

Part of the evidence against Gilbert was a statistical analysis of more than one thousand 8-hour shifts during the time Gilbert worked in the ICU¹. Here are the data presented during her trial:

	Gilbert working on shift	Gilbert not working on Shift	Total
Death occurred on Shift	40	34	74
No death occurred on shift	217	1350	1567
Total	257	1384	1641

¹ Cobb, G. W., & Gehlbach, S. (2006). Statistics in the courtroom: United States vs. Kristen Gilbert. In R. Peck, G. Casella, G. Cobb, R. Hoerl, D. Nolan, R. Starbuck and H. Stern (Eds.), *Statistics: A guide to the unknown* (4th Edition), pp. 3–18. Duxbury: Belmont, CA.

You will use these data to answer the following research question:



Discuss the Following Questions

1. Among all 1,641 shifts, what percentage of shifts had a death occur?
2. Among the 257 shifts when Gilbert was working, what percentage of shifts had a death occur?
3. Among the 1,384 shifts when Gilbert was not working, what percentage of shifts had a death occur?
4. Compute the difference between the percentage of shifts in which a death occurred when Gilbert was working and the percentage of shifts in which a death occurred when Gilbert was not working.

5. Based on the research question, specify the treatment variable.
 6. Based on the research question, specify the response variable. Also, identify whether it is a quantitative or categorical variable.
 7. The sample data indicates that shifts that Gilbert worked had a higher percentage of deaths occur than shifts when that she didn't work. Does the difference in percentages convince you that Gilbert was giving lethal injections of epinephrine to patients? Why or why not?
- Read the section *Observational Studies and the Bootstrap Test* from the online book.

Modeling Sampling Variation

You will conduct a bootstrap test using TinkerPlots™ to find out how likely it would be, assuming there is no difference between the percent of shifts in which a death occurred when Gilbert was working and those in which she was not working.

- Set up a sampling device that includes all 1,641 **observed (dummy) responses**. Code the responses so that 1 = death occurred and 0 = no death occurred.
- Link another sampling device to produce the **fixed group/condition labels**.

8. Should the sampling device containing the outcome values be sampled *with* or *without* replacement? What about the sampling device containing the condition labels? Explain why.

Simulate and Evaluate the Results

- Use TinkerPlots™ to bootstrap 500 resamples (trials) of the data.
- Collect and plot the results from these trials.

9. Sketch the plot below.

10. Compute and report the p -value.
11. Based on the p -value you computed, how compatible is the observed difference in means with the results produced by the model specified in the null hypothesis? What does this suggest about the answer to the research question? Explain.

Design and Inference

12. How would you rate the level of internal validity evidence based on the study design? Explain.
13. Based on your response to the previous question, are you willing to draw a causal association between shifts Gilbert worked and increased death rates? If not, offer at least two other possible explanations for the difference in percentage in the data.

14. How would you rate the level of external validity evidence based on the study design? Explain.

15. Based on your response to the previous question, are you willing to draw a generalization about potential “future shifts”. Explain.