

MAT152: Statistical Methods I: Activity 4

This course provides a project-based approach to introductory statistics with an emphasis on using real-world data and statistical literacy. Topics include descriptive statistics, correlation and regression, basic probability, discrete and continuous probability distributions, confidence intervals and hypothesis testing. Upon completion, students should be able to use appropriate technology to describe important characteristics of a data set, draw inferences about a population from sample data, and interpret and communicate results.

Global Learning Outcomes:

- 1) Investigate and understand global issues through statistical analysis.
- 2) Use statistical techniques to draw inferences about global populations.
- 3) Interpret and communicate results in a cultural context.

Confidence Intervals for Case Fatality Rates for Ebola by Debbie Anderson
Students will gain an understanding of Ebola and the recent outbreak in West Africa. They will use statistical analysis to explain observed phenomenon related to the epidemic.
Objective:
The purpose of this lab is to have students learn about Ebola and the recent outbreak in West Africa. They will use selected websites to answer basic questions about Ebola and the progression of events in West Africa relative to this epidemic. After gaining an understanding of the disease, they will use data from the World Health Organization to estimate fatality rates for Ebola, constructing both point estimates and confidence intervals. Students will compare results across countries. In groups, they will then use their knowledge of Ebola to explain differences or similarities found.
Time:
50 minutes
Materials:
<ol style="list-style-type: none">1. https://www.youtube.com/watch?v=[NiH18]NmQA2. http://www.webmd.com/a-to-z-guides/ebola-fever-virus-infection3. http://www.cbsnews.com/news/ebola-hotspots-remain-but-un-sees-progress/4. http://time.com/3559256/ebola-guinea-iv-fluids/5. http://www.doctorswithoutborders.org/article/end-ebola-outbreak-west-africa-world-must-learn-lesson-future-outbreaks-says-msf5. http://www.who.int/features/ebola/storymap/en/

6. <http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/case-counts.html>
7. Computer and internet access.
8. Pencil and notebook paper for recording answers to Questions 11-13
9. Copy of the attached activity.

Procedure:

This activity should be done after teaching Confidence Intervals.

This activity has two pieces which are as follows:

- (1) Preparation piece: This piece is to be completed before class. Students will research basic facts about Ebola and complete a set of short answer questions. (#1 – 14). The answers will be written directly on the lab activity paper in the space provided. This piece is intended to familiarize students with Ebola, in general, and issues relevant to its appearance in West Africa in 2014.
- (2) In class: At the beginning of class, a Doctors Without Borders' video will be shown. Students will then divide into groups of 2-3 students and proceed with the activity. (NOTE: Students who have not completed the prep work (above) will go to a separate area of the room and do the prep work before proceeding. They will become a group. Warning: It will be hard to complete the lab if the prep work has not been completed prior to class.).
 - (a) Students will link to a CDC website to get data needed to do the statistical analysis. Each student will do the statistical analysis on notebook paper, which will be attached to the lab activity paper. (#15-17)
 - (b) After completing the statistical analysis, students, as a group, will discuss the question posed (#18). After discussion, one student from each group will be chosen to write a summary of what conclusions the group has reached. The summary conclusion should be written directly on the lab activity paper.

Assessment:

Each student's paper will be graded separately for questions #1-17. A group grade for question #18 will be given. The Activity is worth a total of 100 points.

The Ebola Epidemic in West Africa

In December 2013, the tragic death of an 18-month old boy in Guinea began what became the largest and deadliest outbreak of Ebola since the virus was discovered in 1976. Within months, three West African countries (Guinea, Liberia, and Sierra Leone) were dealing with this deadly virus. In September 2014, the World Health Organization (WHO) described the epidemic as “out of control.” Ebola had never been seen in West Africa and the three countries were unprepared at every level - clinicians had never managed cases, no laboratory had ever diagnosed a patient specimen, no government had ever witnessed the social and economic upheaval that can accompany an outbreak of this disease. People could not understand what hit them or why. Unfamiliar with every aspect of the disease, they were wary of the health care workers trying to help them. The death toll was staggering. The international response was slow but eventually the much needed help came. The epidemic was officially declared “over” in all 3 countries in January 2016.



Preparation work: You will begin this activity by researching Ebola and answering questions. Reference websites have been provided. This work is to be done prior to class and should take about 20 minutes.

In-class portion. Using data from the World Health Organization, you will construct point estimates and confidence intervals on the fatality rates (CFR) for each of the 3 countries. You will then compare the rates. Finally, as a group, you will discuss a question posed and formulate a response. One student from each group will be chosen to write the written response on his/her paper.

Preparation work - Becoming familiar with Ebola

Read the following articles and answer the questions below each article. Read through the articles to get an overview, then answer the questions.

Basic facts about Ebola: <http://www.webmd.com/a-to-z-guides/ebola-fever-virus-infection> . After entering the website, be sure to click on the “Visual Guide to Ebola” and “Slideshow.”

1. What is Ebola?
2. What animals are suspected to be the natural hosts of Ebola?
3. How is Ebola spread from human to human?
4. Once infected, how long before symptoms occur?
5. Once infected, are people contagious without symptoms?
6. What are the symptoms of Ebola?
7. Can Ebola be diagnosed based solely on symptoms?
8. Is there any cure for Ebola?
9. How is someone with Ebola treated?

Cultural Practices and Community Involvement. This article is from an interview with David Nabarro, the U.N. Ebola chief.

<http://www.cbsnews.com/news/ebola-hotspots-remain-but-un-sees-progress/>

10. What were the traditional practices that had to be changed in order to stop the spread of Ebola? (NOTE: There is a link to the CBS video “Ebola Protocols Clash with African burial customs.” This is an extremely interesting video (3:16)).

11. Community leaders getting “on board” was critical. Of the 3, which country was first to embrace the need to change behaviors?

Surviving Ebola: This article is long. Begin at the paragraph that starts “The key to helping...” and read through the paragraph that ends “...he says.”

<http://time.com/3559256/ebola-guinea-iv-fluids/>

12. What is the key to survival for Ebola patients?

13. Why is early aggressive supportive care important?

14. What type of facilities are needed to improve survival rate?

In-class work – Ebola in West Africa

The following video (3:43) is from Doctors Without Borders (MSF). This video presents an overview of the Ebola epidemic that started in December 2013. The class will watch this together.

<http://www.doctorswithoutborders.org/article/end-ebola-outbreak-west-africa-world-must-learn-lesson-future-outbreaks-says-msf>

Timeline of the spread of Ebola Epidemic

Click on the link below. Start with March 2014 and “click along the dots” (in the timeline below the map) to answer the question(s) in the space provided.

<http://www.who.int/features/ebola/storymap/en/>

- What country saw the first case? When was it confirmed? * _____
- What country was the 2nd to become infected? When? _____
- What country was the 3rd to become infected? When? _____

*(NOTE: Although not identified until March 2014 in Guinea, according to the World Health Organization (WHO):

Retrospective studies conducted by WHO staff and Guinean health officials identified the index case in West Africa’s Ebola epidemic as an 18-month-old boy who lived in Meliandou, Guinea. The boy developed an illness characterized by fever, black stools, and vomiting on 26 December 2013 and died two days later. The exact source of his infection has not been identified but likely involved contact with wild animals.” Thus, Dec 2013 is generally considered the date the Ebola epidemic started.)

Estimating the fatality rate

Case Fatality Rate (or CFR). The CFR – which is calculated by dividing the number of deaths that have occurred due to a certain condition by the total number of cases – is actually a measure of risk. For infectious disease, CFR is a very important epidemiological measure to estimate because it tells us **the probability of dying after infection**. (*Disease Daily, Sept. 10, 2014*).

The following link will provide the numbers you need to estimate the CFR for each country. Use the columns marked “Total Cases” and “Total Deaths”

<http://www.cdc.gov/yhf/ebola/outbreaks/2014-west-africa/case-counts.html>

Do the following work on notebook paper. Organize your work neatly. Be sure to show all work for your calculations.

15. For each country (Guinea, Liberia, and Sierra Leone):
- a) Find a point estimate for the CFR. Give answer with 3 decimal places. Show work. Label clearly.
 - b) Construct and interpret a 90% confidence interval for the CFR. Give answer with 3 decimal places. Find the width of the interval. Show work. When writing your interpretation, don't just use the term “CFR,” say what it means as explained above.
 - c) Construct and interpret a 95% confidence interval for the CFR. Give answer with 3 decimal places. Find the width of the interval. Show work. When writing your interpretation, don't just use the term “CFR,” say what it means as explained above.
16. Which of the intervals (90% or 95%) was wider? Why? Answer in a complete sentence.
17. Copy your answers from 15(c) to the table below, then answer questions (a) – (c). Answer questions on your notebook paper.

	95% confidence interval
Guinea	
Liberia	
Sierra Leone	

Based on these confidence intervals:

- a. Is it reasonably possible that the CFR in Guinea and Liberia are equal? Explain.
- b. Is it reasonably possible that the CFR in Guinea and Sierra Leone are equal? Explain.
- c. Is it reasonably possible that the CFR in Liberia and Sierra Leone are equal? Explain.

Why the difference in CFR?

No one is exactly sure why the fatality rate differs among the 3 countries. Many explanations have been given.

18. As a group, discuss the following question. After the discussion, choose one student in the group to write a summary of what the group has concluded on his/her paper. Answer in complete, well-reasoned sentences.

Based on what you've learned about the Ebola epidemic in West Africa, what do you think are some possible reasons for the observed differences in CFR among the 3 countries?

Please note that this question is "wide open" for your opinions. As part of your answer, you may also consider what you've learned this semester about sampling as well as any other information you may have relative to this issue.