Fighting Alternative Facts:

Teaching Quantitative Reasoning with Social Issues

Dr. Mark Branson

Department of Mathematics & Physics, Stevenson University

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Quantitative Literacy

- As a liberal arts University with a small Mathematics department, a sizable portion of our mission is general education mathematics.
- At Stevenson, students historically took College Algebra or Introductory Statistics to fulfill general education requirements in programs with no further mathematics requirements.
- In Fall 2014, we began offering a new course, “Introduction to Mathematical Reasoning,” designed to provide a range of practical quantitative skills – basic geometry, number sense, financial mathematics, probability, statistics, and mathematics related to voting & choice.

The Case for Quantitative Literacy

- The benefits of Quantitative Literacy are generally described in terms of individual benefits to the student:
  - Financial Literacy helps students make better choices about loans, mortgages, etc.
  - Statistics allows students to better understand the mathematical evidence for various claims
- This reflects a general bias in the mission of universities – our focus is generally on the well-being of our students and our academic communities.
- In focusing on student needs, we risk overlooking the broader social benefits of a quantitative literate population.

Information Literacy

- While illiteracy has traditionally been seen as an inability to comprehend the written word, a growing problem in the modern world is *information illiteracy* – the inability to identify, process, and verify the information provided to us through a variety of sources.
- 84% of adults – and 96% of 18-29 year olds – have access to the internet.[1] These citizens have access to an unprecedented amount of information, and our society has yet to fully adapt to this flood of information
- In the past year, a major topic of discussion has been the ability to discern between information supported by evidence and that which is not – between facts and *alternative facts*.

[1] http://www.pewinternet.org/2015/06/26/americans-internet-access-2000-2015/

The role of Quantitative Literacy

- Quantitative Literacy is key to information literacy.
- The amount of quantitative information available to the general public has exploded over the last 20 years.
- This quantitative data is available in a wide range of sources:
  - Media claims about quantitative data
  - Research papers containing quantitative data
  - Graphs, tables, and other processed quantitative data
  - Raw numerical information
- A quantitatively literate individual has the ability to cross-check and verify the quantitative information provided by these sources.

Quantitative Literacy & Social Justice

- Social Justice is a broad term which encompasses a number of movements for greater equality in society - the Civil Rights, LGBT rights, and Immigrant rights movements, among others.
- Arguments against social justice in the United States frequently take one of two forms:
  - There is no problem – the perceived inequality does not really exist
  - There is a problem, but the inequality is not a result of government policies or social norms
- As mathematicians, we can look at both of these arguments as failures of quantitative literacy

Projects in Social Justice

- Students in Quantitative Literacy courses at Stevenson are required to complete 5-6 group projects on quantitative literacy topics.
- This has proven to be an easy way to introduce social justice topics into the class. In each project, students:
  - Gather information about a topic.
  - Use that information to construct quantitative arguments.
  - Reflect on the social consequences of their conclusions.

Project: Stop & Frisk

MATH 134

Project 2: Stop and Frisk

The "Stop and Frisk" program is a controversial program implemented in New York City to reduce crime rates. We're going to graph some data from the New York City Police Department (NYPD) and evaluate the effectiveness of this program in reducing crime. The program spurred protests during the late 2000s and early 2010s because of allegations that stops were racially motivated.

1. Using the data from the NYCLU, create the following graphs in a program like Microsoft Excel. Note that some of these numbers are not given directly in the paper, but must be calculated from the data which you are given. You can choose the type of graph, but you should pick a graph which is appropriate for representing this data.
    a. The number of people stopped by the police each year
    b. The number of people who were stopped and found to be completely innocent
    c. The number of people who were stopped and not found completely innocent
    d. The percentage of people stopped from each ethnic group (black, Latino, white, and other)
2. You have also been given a spreadsheet containing data from the NYPD on major felony crime rates. Although stop and frisk arrests were frequently for minor crimes, police theorized that reducing these minor crimes would reduce the number of major crimes as well. Plot the number of each crime as well as the total number of crimes taking place in the city each year.
3. Because the population of a city is always changing, crime rates are generally calculated as a ratio of "crimes per 100,000 people." You can find the crime rate per 100,000 people by taking

$$\frac{number\ of\ crimes}{population} * 100{,}000$$

   Find the population of New York City (be sure to cite your source) for each year between 2000 and 2015 and use Excel to calculate the number of crimes per 100,000 people. Explain why this is a better way to measure crime rate than just by number of crimes.
4. Similarly, calculate the number of police stops each year per 100,000 people. Graph both this and the crime rates from the previous problems. Does the crime rate go down when there are more police stops? What about when there are less police stops? Do you think that "Stop and Frisk" reduced major crime rates in NYC? Explain your answer.
5. Find data on the percentage of the population in NYC that identify as black, Latino, white, or other (be sure to cite your sources). How does this data explain why people could be upset about the percentages stopped from each ethnic group?
6. An article in The Atlantic (https://www.theatlantic.com/national/archive/2013/01/stop-and-frisk-may-be-working-but-is-it-racist/267417/ - warning: contains brief profanity during transcripts of police stops) discusses the controversy of racial disparities in "Stop and Frisk" which led to the reduction in the number of stops seen in 2012-2015. If the program were effective at reducing crime, do you think it would be acceptable for the NYC government to continue with "Stop and Frisk"? Are there ways that you could improve the program? Are there other ways that these large number of police stops could affect crime rates or community interactions with the police? You can use your own experiences and research to support these points, but be sure to be respectful of other members of your group. We all have different experiences and opinions, but that does not preclude us from having civil discussions. Write at least 300 words on this topic, and make sure your answer is well-structured and readable. Be sure to cite any sources.

Project: Reading About Polls

MATH 135

Project #5: Reading about Polls

When reading about the results of a poll in the media, very little mathematical information is generally mentioned. To find out about the methodology, sample size, margins of error, etc., you frequently need to refer to the *poll report*.

Read the attached poll report, which asked Americans about their opinions on the Iranian nuclear deal in 2015, and answer the following questions.

1. What was the reason that the poll was given?
2. Read through the questions that were asked at the end of the poll. Do any of them seem biased to you (like they're trying to get a particular answer, or influence people one way or the other)? Explain why or why not.
3. What was the overall sample size for the poll? Notice that many of the graphs and results are "based on those who have heard about the agreement." What was the sample size for people who have heard about the agreement?
4. Calculate the margin of error for the overall sample size, and the smaller sample size for people who have heard about the agreement. On page 7, they say that 58% of people believe that good diplomacy is the best path to peace – which margin of error would apply to that calculation? What about the assertion on page 5 that 42% believe the "relationship between U.S. and Iran will remain about the same?"
5. Although the overall sample sizes are large, the sample sizes for different subgroups are smaller. Find the number of Republicans who responded to the survey AND had heard about the agreement, and use it to compute a margin of error. Then give a confidence interval for the statement "10% of Republicans who are familiar with the deal believe the relationship with Iran will improve" (from the table on page 5).
6. Find the following percentages:
    a. Percentage of 50-64 year olds who have heard about the agreement and have confidence in the US and international agencies' monitoring of Iran's compliance.
    b. Percentage of Democrats who have heard a lot about the agreement.
    c. Percentage of college graduates who believe that diplomacy is the best path to peace.
7. Can you find any values that might be misleading if they were reported without margin of error? Hint: Look for values slightly above or below 50%, or close to the opposing value…adding/subtracting the margin of error could switch the result.
8. Find at least three news articles about this issue that present differing viewpoints, which reference this particular poll (Hint: search for articles published on or right after 7/21/2015, when the article was published). How did these different articles use this information to support their viewpoint? Do you think they were ethical to use the information this way? How could such use of statistics lead people to mistrust statistical information?

Future Plans

- Develop more projects – while many of the projects for the course are social justice-focused, others deal with more traditional concerns (painting a building, zombies)
- Develop a general education course focused on quantitative literacy & social justice, where students can engage in a deeper exploration of a social justice topic using quantitative information
- Encourage students to take action to make a more just society using what they've learned – moving from what Gutstein calls "reading the world with mathematics" to "writing the world with mathematics".[2]

2 Gutstein, E. 2005. Reading and Writing the World with Mathematics: Toward a Pedagogy of Social Justice. Routledge

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Questions?

Mark Branson

Stevenson University

mbranson@stevenson.edu