STAT 135
2. Critical thinking

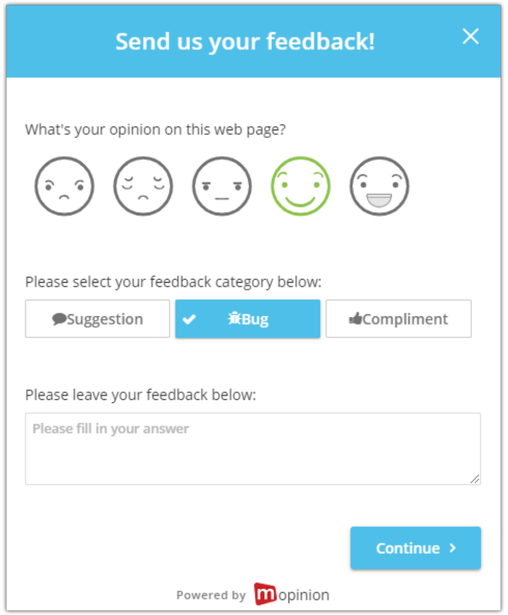
Spring 2022

Lecturer: Dr Rebecca Barter (*she/her*)
Office hours: Tu 9:30-10:30, Th 1:00-2:00
Office: Evans 339

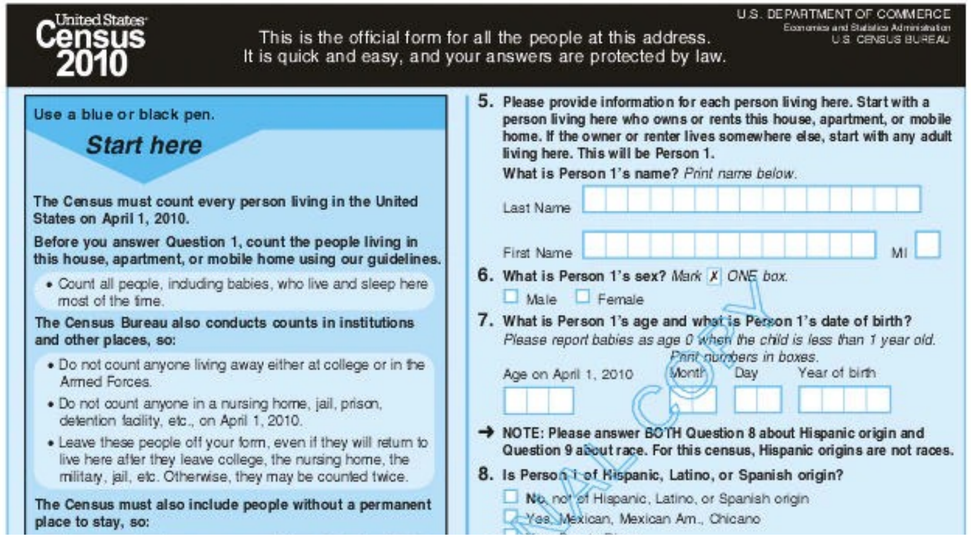
Email: rebeccabarter@berkeley.edu
Twitter: @rlbarter
GitHub: rlbarter

Learning about the real world from real data is hard

Data is everywhere… and is of varying quality



TheCornellLab of Ornithology



Data is an imperfect reflection of reality

Photo by Dasha Yukhymyuk on Unsplash

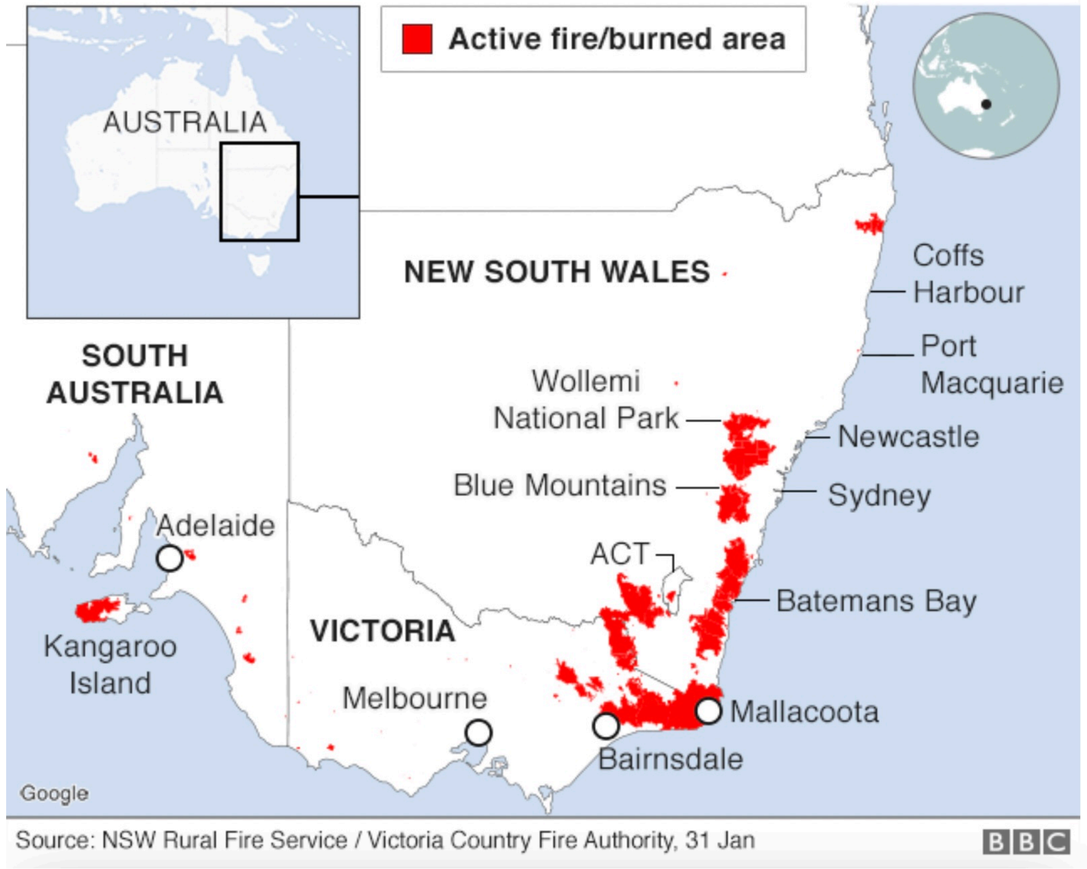
Can we learn from data that is an imperfect reflection of reality?

Sure we can!

We just have to be transparent about the **limitations** of the data and our analyses

An example

Remember the massive bushfires in Australia in early 2020?



Context is important

Remember the “dark day” (Sep 9 2020)?

…Those fires paled in comparison:

California burnt area: 4.6 million acres

Australia burnt area: 46 million acres

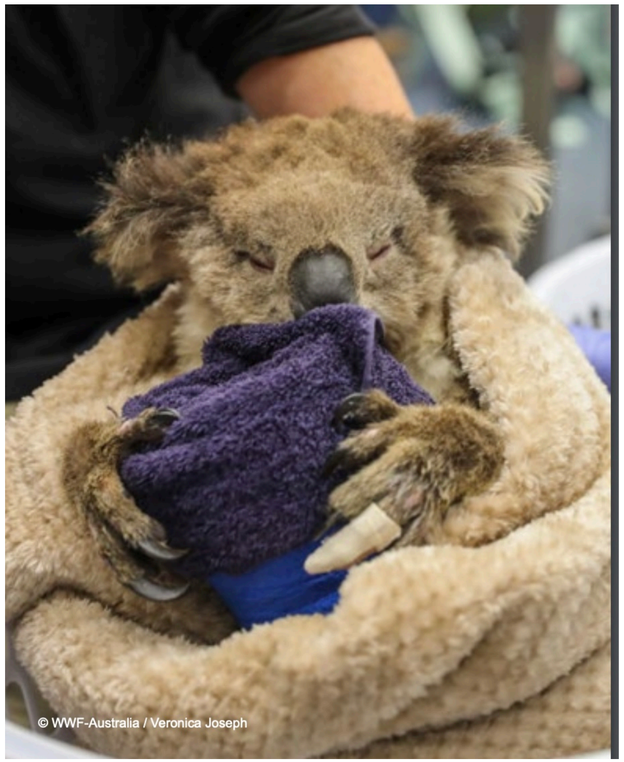
Reports started to emerge about the Australia fires….

Over 1 billion animals killed

Discussion:

How do you think scientists came up with this number that “1 billion” animals were killed?

What are the real-world challenges involved in trying to identify the number of animals that were killed by the fires?



The World Wildlife Fund report:
(wwf_report.pdf on BCourses)

The estimation technique used:

Historical data of the densities of a few animal species in various Australian regions were extrapolated to a wide range of species across the burnt areas.

Discussion:

What are some limitations with this approach?

Would it be possible to collect “better” data?

The World Wildlife Fund report:
(wwf_report.pdf on BCourses)

Some of the limitations highlighted in the WWF Report:

- Not all animals who were in the area would have necessarily died
- The **geographic regions** on which the animal density data were based may not have been the same as the geographic region of the fires
- Much of the animal density data used in the study was based collected decades ago, and the densities may have changed dramatically since then.
- These historical studies are typically based on regions where these animals were *known* to have higher densities (extrapolating estimates based on this data might be **biased**)
- **Seasonality** was not taken into account
- The study did not take into account **fire intensity**: regions were treated as binary, where every geographic location was either not affected by fire or it was.
- There was no density data for some species (e.g., platypus and flying foxes), so they were not included in the total

The World Wildlife Fund report:

In total, we estimate that almost **3 billion** native vertebrates are likely to have been present within the 2019-20 bushfire areas. Our estimate comprises approximately:

- 143 million mammals
- 2.46 billion reptiles
- 181 million birds
- 51 million frogs

These are estimates of the numbers of individuals within selected taxon groups that were likely to have been present within the impact area of the 2019-20 bushfires. We will never know the true number of individuals killed by the fire, although future efforts to quantify this could be informed by our study in combination with research on other factors such as the ability of different taxa to survive fire.

6.1. THE DATA DEFICIT

There are many limitations in the data that prevent us from developing a more accurate estimate of the impacts of bushfires, especially during atypical intense and extensive fire seasons such as what occurred over 2019-20. These include data on densities of different taxa, an understanding of different species' abilities to survive and their responses to different fire regimes and

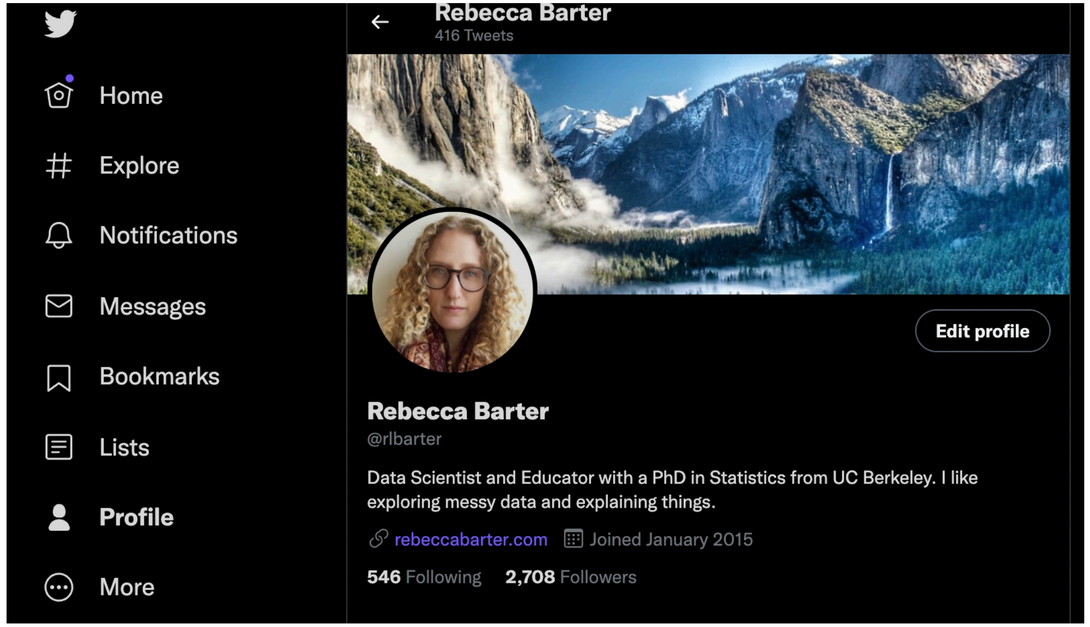
The best data there is is often the data that you have

Transparency is key

Always be transparent about the limitations of your data and your analyses

Defining “probability”

What is a probability?



Is my twitter account a bot?

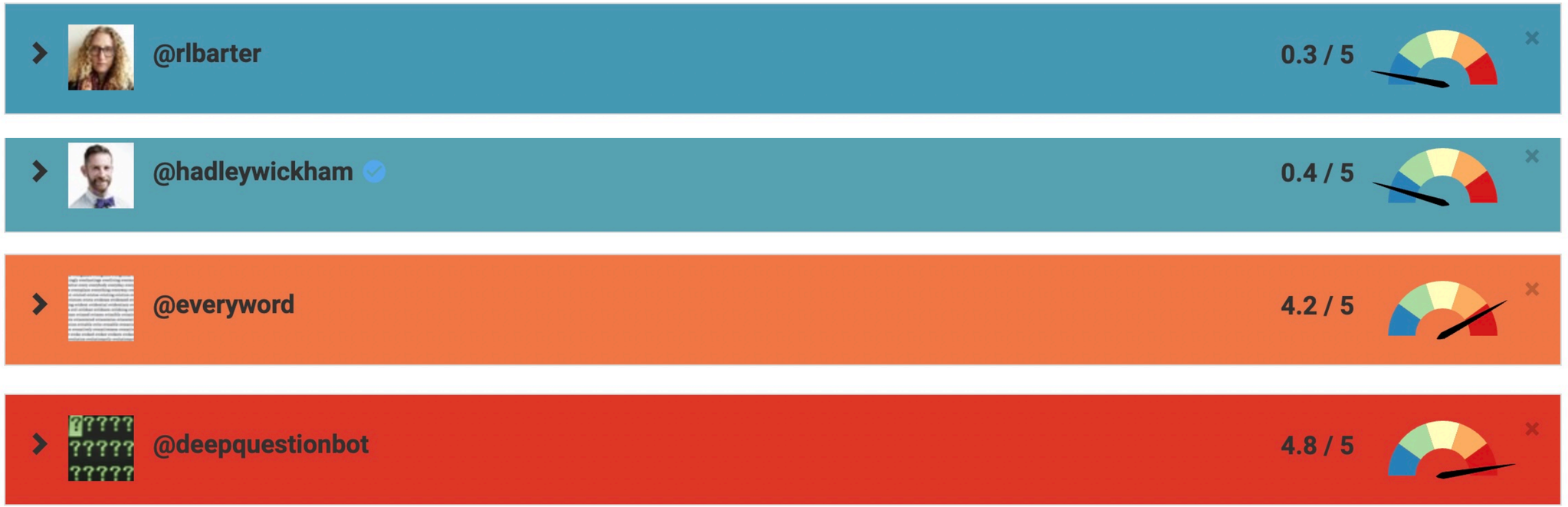
Botometer®

An OSoMe project (bot•o•meter)

What is a probability?

Botometer®

An OSoMe project (bot•o•meter)



But what does it mean that the chance that I am a bot is 0.3/5?

What if I told you that the bot was trained based on the opinions of 10 graduate students?

What is a probability?

How would you interpret the following statements?

1. There is a 50% chance that when I flip a coin the outcome will be “heads”

2. There is an 80% chance that an earthquake of magnitude 6.0 or larger will occur in the Bay Area over the next 30 years

3. There is a 1% chance that Matthew McConaughey will be elected the governor of Texas

4. There is a 50% chance that it will rain tomorrow

In many situations, probabilities are not well-defined

Frequentist: the probability of an event is based on the relative frequency with which the event tends to occur across a repeatable process

Bayesian: the probability of an event is based on your *belief* (which is based on prior knowledge and data-based evidence) that it will occur

Neither perspective is necessarily the “correct” one

Sometimes one perspective will make more sense for a particular problem than the other

What is a probability?

Which of the following statements might make more sense in a Frequentist context vs a Bayesian one?

1. There is a 50% chance that when I flip a coin the outcome will be “heads”	**Frequentist**
2. There is an 80% chance that an earthquake of magnitude 6.0 or larger will occur in the Bay Area over the next 30 years	**Bayesian**
3. There is a 1% chance that Matthew McConaughey will be elected the governor of Texas	**Bayesian**
4. There is a 50% chance that it will rain tomorrow	**?**

In this class, we will *mostly* be Frequentists