

Prior elicitation

Stat 340, Fall 2021

Your turn 1: Tuning your prior belief

Note: You can find an `.Rmd` file for this activity on the course webpage under today's date.

Background

In Alison Bechdel's 1985 comic strip *The Rule*, a character states that they only see a movie if it satisfies the following three rules:

- the movie has to have at least two women in it;
- these two women talk to each other; and
- they talk about something besides a man.

A movie that satisfies these criteria is said to have passed the “Bechdel Test”.

Building a prior model

1. What percentage of all recent movies do you think pass the Bechdel test?
2. If you were to make a model for p , the proportion of recent movies that would pass the Bechdel test, what would it look like?
 - Where would it be centered (approximately)?
 - Would it be symmetric or skewed?
 - How sure are you about p ?

3. Modify the parameters in the `plot_beta()` function below to tune and plot your prior distribution for p , the proportion of recent movies that pass the Bechdel test.

Note: It may take some playing around before you land on a plot that is close to your prior understanding of π . It is OK (and encouraged) to experiment and try multiple values for the parameters! It is also OK if your prior is different from the priors of your classmates.

```
# Change up the alpha and beta values (both must be positive)
library(bayesrules)
plot_beta(alpha = 2, beta = 2)
```

4. You just collected some data on 20 recent movies. It turns out that 9 of these pass the Bechdel test. What's the posterior distribution of p ?
5. To quickly plot the prior, likelihood, and posterior you can use the `plot_beta_binomial()` function in the `bayesrules` package. Modify the `plot_beta_binomial()` function below to plot your prior, the likelihood, and the posterior:

```
plot_beta_binomial(alpha = 2, beta = 2, y = 0, n = 2)
```

6. In addition to plotting, we can also describe the prior and posterior models of p with numeric summaries using the `summarize_beta_binomial()` function found in the `{bayesrules}` package.. Modify the `summarize_beta_binomial()` below to incorporate information on your prior and data that 9 out of 20 movies passed the Bechdel test.

```
summarize_beta_binomial(alpha = 2, beta = 2, y = 0, n = 2)
```

What does each number tell us? Is your posterior mean closer to the prior mean or the sample proportion?

Your turn 2: Using domain expertise

Set up the equations you would use to tune a Beta(a , b) model that accurately reflects the given prior information. If you have time, use R to find the parameters.

Often, there's no single "right" answer, but rather multiple "reasonable" answers.

1. A scientist has created a new test for a rare disease. They expect that the test is accurate 80% of the time with a variance of 0.05.
2. Your friend tells you "I think that I have a 80% chance of getting a full night of sleep tonight, and I am pretty certain." When pressed further, they put their chances between 70% and 90%.