Intro to R Markdown

How to

- start sections
- italicize, get bold text
- packages
- insert R code
  - code that isn't evaluated
  - results with hidden code(?)
  - make "random" results repeat

Hypothesis tests: first look

Do an analysis of soccer picks by Paul the Octopus:

- accurately picked 8 out of 8 matches in 2010 World Cup
  - method
  - 7 matches involved Germany, 8th was the final
- accurately picked 4 out of 6 German matches in UEFA Euro 2008

Other items:

- parameter vs. statistic
- null and alternative hypotheses, null distribution
- meaning of P-value
- conclusion
  - significance level α
  - statistical significance
  - no such thing as "accepting a null hypothesis"
  - from "How Not to Be Wrong", by Jordan Ellenberg: Bible codes, Baltimore stockbroker

- relevant commands: `dbinom()`, `pbinom()`, `binom.test()`

- asymmetric distributions: Binom(20, 0.25), test stat is 9 "correct" answers

- Recall: We can get an approximate P-value using simulation

Type I and II errors

- A conclusion following an hypothesis test comes under uncertainty, will be wrong some of the time (*error*)

- Definitions:

  Type I error: Null hypothesis is, in fact true, but we reject it.

  Type II error: Null hypothesis is false, but we fail to reject it.

- Roughly speaking,

$$P(\text{Type I error}) = P(\text{rejection of } \mathbf{H_0} \mid \mathbf{H_0} \text{ is true}) \approx \alpha.$$

- Use β to denote $P(\text{Type II error})$. Intuitively, β rises as α shrinks, but β is more difficult to quantify.

  Computing β comes down to calculating the probability of *not* falling in the **rejection region**.

- The **power** of a test is the probability of rejecting a false null hypothesis, so power equals $1 - \beta$ (making it similarly difficult to calculate).

Example: 100 flips of a coin. Consider hypotheses

$$\mathbf{H}_0: \ \pi = 0.5 \qquad \mathbf{H}_a: \ \pi \neq 0.5.$$

Taking $\alpha = 0.05$, compute the rejection region for the count X of heads to be $[0, 39] \cup [61, 100]$. Then compute and graph β for each alternative value $\pi_a = 0, 0.01, 0.02, \ldots, 0.99, 1.00$.