Hypothesis testing on rates

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January 22, 2015

Today

- Using samples to estimate true rates.
- Bootstrap method for hypothesis testing on rates.
- Bootstrap method for finding a confidence interval.

How do you estimate the true rate?

- Examples of rates:
  - The rate of a coin landing heads
  - The rate of a new medication being effective on patients
- What is the formula for estimating the rate from samples?
  - If a coin lands heads 56 times and tails 54 times, the rate of landing heads is 56 / (56 + 54)
  - If a new medication works on 300 patients but does not work on 150 patients, the rate of medication being effective is 300 / (300 + 150)
- In general, the success rate is equal to

$$\frac{\#succeses}{\#successes + \#failures}$$

Inference on true rates

- Inference means you try to get close to the answer or the truth.
- Unfortunately, we never know the true rate of anything really. . . :(

What kind of question can we answer?

- Is the rate of medication being effective more than 0.7?
- Is the rate of a coin landing heads more 0.5?
  - If the rate is > 0.5, then we learn that the coin is crooked or not symmetric.

Hypothesis testing

- Instead we ask, what is the probability that the rate is > 0.7?
  - The hypothesis is the rate is > 0.7. <— We will test this.
- Instead we ask, what is the probability that the rate is > 0.5?
  - The hypothesis is the rate is > 0.5. <— We will test this.
- If the probability of the hypothesis is > 0.95, we accept it and conclude that the hypothesis is true.
  - 0.95 is agreed upon by people.

Bootstrap hypothesis testing on rates

The general procedure is

- Generate a bunch of rate*s (using `bootstrap` function)
- Compute the probability that the hypothesis is true

Let's do Bootstrapping in R

```
library(bootstrap)
medication_data = c(rep(0,150), rep(1,300))
crazybootstrapthingie=
  bootstrap(medication_data, nboot=10000, theta=mean)
sum(crazybootstrapthingie$thetastar> 0.7)
```

```
## [1] 594
```

```
sum(crazybootstrapthingie$thetastar> 0.7) / 10000
```

```
## [1] 0.0594
```