S&DS 101
Intro Statistics: Life Sciences

Overview

Questions about the homework so far

Randomization tests for a single proportion

Randomization tests for a single proportion in R

If time: theories of hypothesis testing

Randomization tests for a single proportion

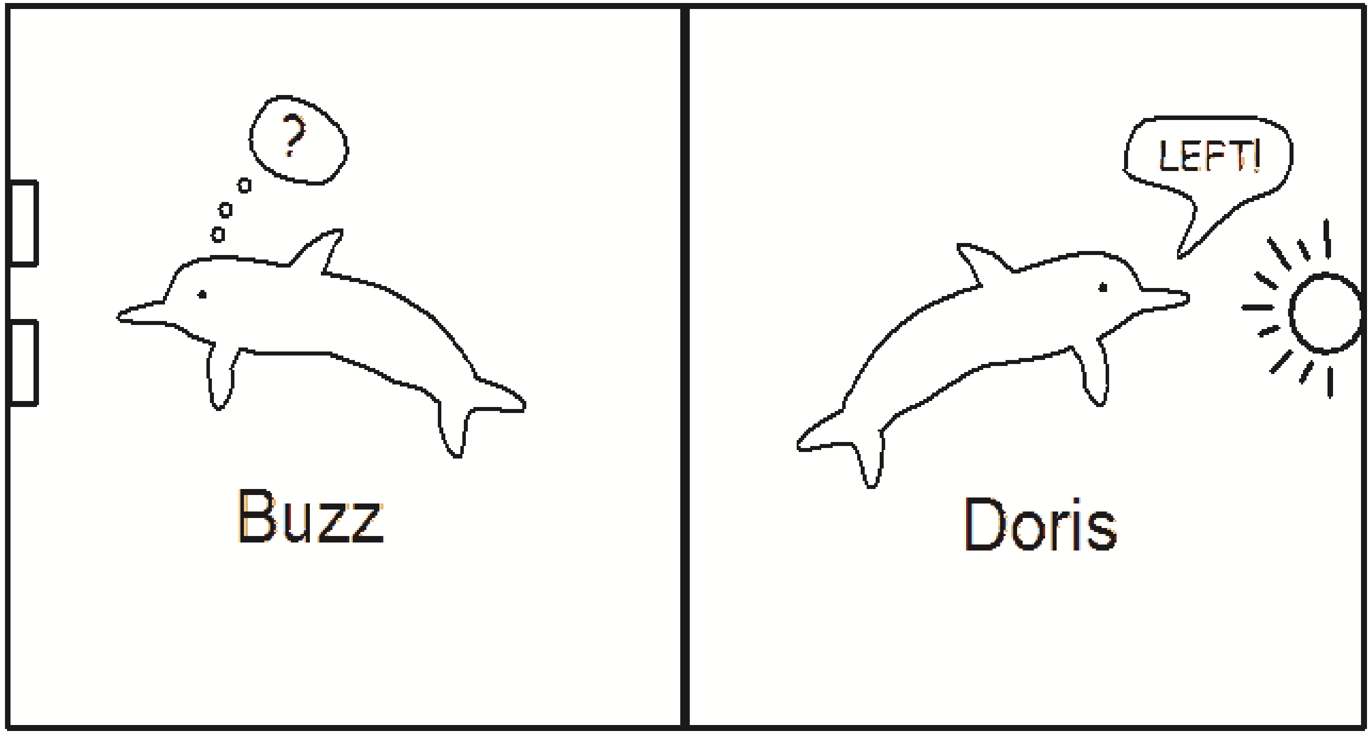
Are dolphins capable of abstract communication?

Dr. Jarvis Bastian is the 1960’s wanted to know whether dolphins are capable of abstract communication

He used an old headlight to communicate with two dolphins (Doris and Buzz)

- Stead light = push button on right to get food
- Flashing = push button on the left to get food

A canvas was then put in the middle of the pool with Doris on one side and buzz on the other



Left

Right

Buzz got 15 out of 16 trials correct

Questions about the experiment

1. What are the cases here?

2. What is the variable of interest and is it categorical or quantitative?

3. What is the observed statistic - and what symbols should we use to denote it?

4. What is the population parameter we are trying to estimate - and what symbol should we use to denote it?

5. Do you think the results are due to chance?
    - i.e., how many correct answers do you think Buzz would have gotten if he was guessing?

6. Are dolphins capable of abstract communication?

The dolphin communication study

If Buzz was just guessing, what would we expect the value of the parameter to be?

$\pi = 0.5$

If Buzz was not guessing, what would we expect the value of the parameter to be?

$\pi > 0.5$

Chance models

How can we assess whether 15 out of 16 correct trials ($\hat{p}$ = .975) is beyond what we would expect by chance?

If buzz was guessing we can model his guesses as a coin flip:

Heads = correct guess

Tails = incorrect guess

Chance models

To really be sure, how many repetitions of flipping a coin 16 times should we do?

Any ideas how to do this?

How to estimate p-values in R?

We can simulate coin flipping using the rbinom() function

```
flip_simulations <- rbinom(num_sims, size, prob)
```

num_sims: the number of simulations run

- Typically we do around 10,000 repeats

size: the number of trials on each simulation

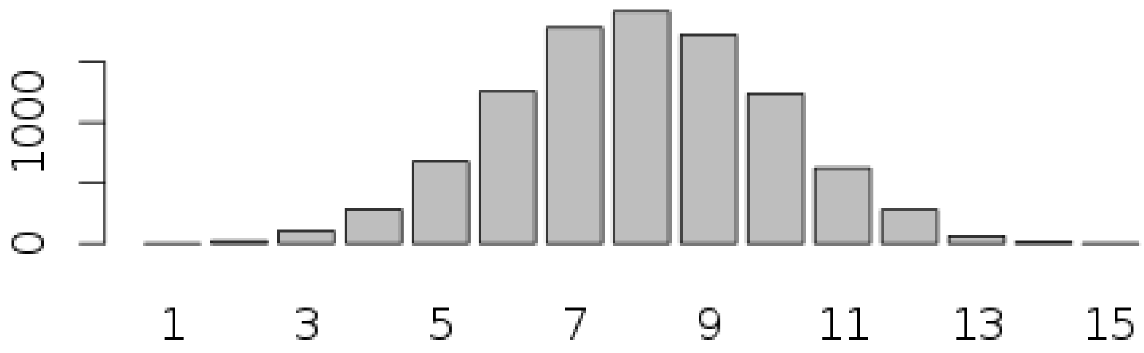
- 16 for Doris/Buzz

prob: the probability of success on each trial

- .5 Doris/Buzz

Simulating Flipping 16 coins 10,000

0	0
1	1
2	22
3	105
4	283
5	679
6	1257
7	1786
8	1920
9	1726
10	1238
11	623
12	279
13	63
14	15
15	3
16	0



Is it likely that Buzz was guessing?

Are dolphins capable of abstract communication?

Hypothesis testing in 5 easy steps!

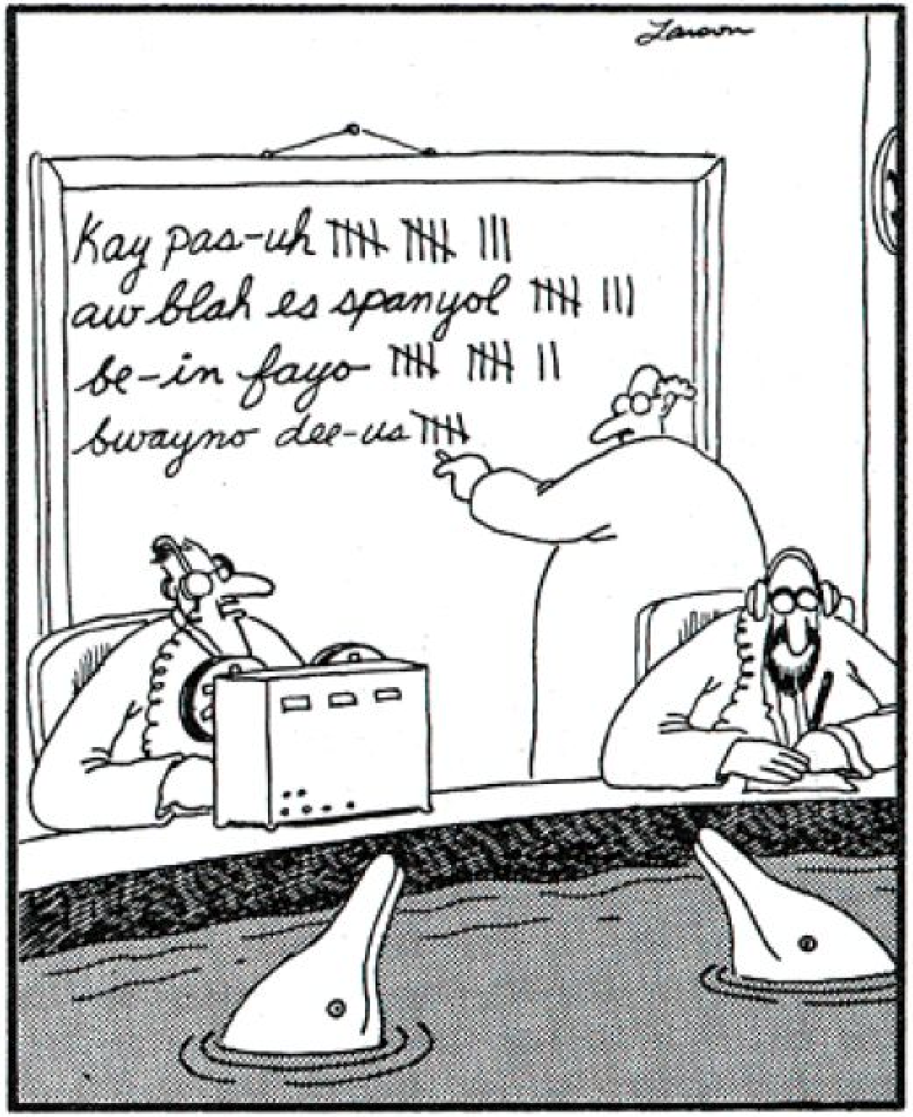
1. State the null hypothesis… and the alternative hypothesis
   - Buzz is just guessing so the results are due to chance: $H_0: \pi = 0.5$
   - Buzz is getting more correct results than expected by chance: $H_A: \pi > 0.5$

2. Calculate the observed statistic
   - Buzz got 15 out of 16 guesses correct, or $\hat{p} = .973$

3. Create a null distribution that is consistent with the null hypothesis
   - i.e., what statistics would we expect if Buzz was just guessing

4. Examine how likely the observed statistic is to come from the null distribution
   - What is the probability that the dolphins would guess 15 or more correct?
   - i.e., what is the p-value

5. Make a judgement
   - If we have a small p-value, this means that $\pi = .5$ is unlikely and so $\pi > .5$
   - i.e., we say our results are 'statistically significant'



"Matthews ... we're getting another one of those strange 'aw blah es span yol' sounds."

Let’s try the analysis in R…