STA130 TUT0110 Week4

TA: Gloria

shiyi.hou@mail.utoronto.ca

Reminder:

- Tutorial and OH are two separate thing.
- OH are Tues 2-5pm, Wed 12-3pm and Thurs 11am – 2pm @ HS390.

Addressing last week's feedback

- For the midterm/exam: need to know the meaning of the code, don't need to write the code from scratch
- To download the tutorial slides, :

  https://gloriahou1.github.io/STA130winter2020/
- Time on writing activity
- Future Tutorials Structure
- Application of Statistics/Data Science

Agenda

Vocabularies: hypothesis testing

Group discussion

How to give oral presentations

Group presentation

Vocabularies

- hypothesis testing
- null hypothesis
- alternative hypothesis
- assumption

Null hypothesis (H_0): The Wheel of Destiny spinner is fair

$$H_0 : p_{red} = 0.5$$

Alternative hypothesis (H_A or H_a or H_1): The Wheel of Destiny spinner is not fair

$$H_A : p_{red} \neq 0.5$$

```
pvalue <- sim %>%
  filter(p_red >= 0.64 | p_red <= 0.36) %>%
  summarise(p_value = n() / repetitions)
```

Vocabularies

- simulation
- simulation statistic
- sample
- population
- random
- loop

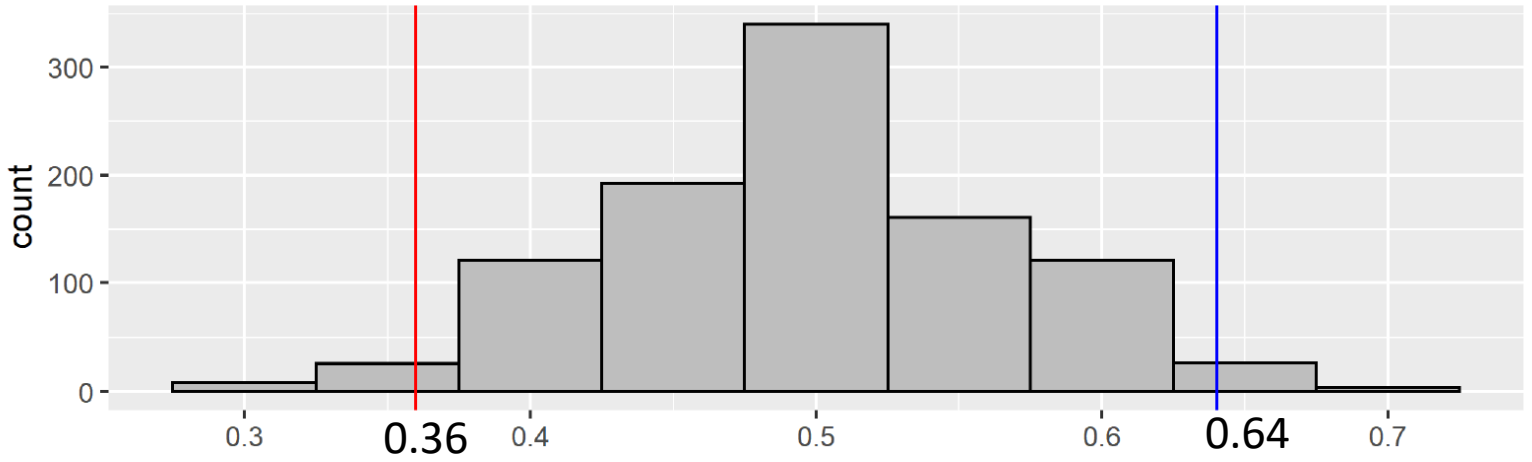
```
coin <- c("heads", "tails")
flips <- sample(coin,
                size = 50,
                prob = c(0.5, 0.5),
                replace = TRUE)
flips
```

```
for (i in 1:repetitions){
  new_sim <- sample(c("red", "black"),
                    size = n_observations,
                    prob = c(0.5, 0.5),
                    replace = TRUE)
  sim_p <- sum(new_sim == "red") / n_observations

  simulated_stats[i] <- sim_p; # add new value to vector of results
}
```

Vocabularies

- statistic
- test statistic
- parameter
- observed value
- sampling distribution
- meaningful difference
- “at least as extreme”/ “as extreme or more extreme”

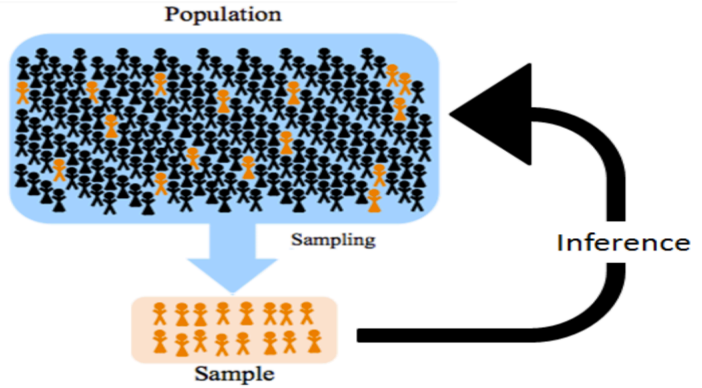


Vocabularies

- probability
- p-value
- statistically significant
- significance level
- strength of evidence

  e.g. strong, moderate, weak, or no evidence
- generalize
- inference

P-value	Evidence
p-value > 0.10	no evidence against H_0
0.05 < p-value < 0.10	weak evidence against H_0
0.01 < p-value < 0.05	moderate evidence against H_0
0.001 < p-value < 0.01	strong evidence against H_0
p-value < 0.001	very strong evidence against H_0



Interpret p-values

- In technical terms, a p-value is the probability of obtaining an effect (1)at least as extreme as (2)the one in your sample data, (3)assuming the truth of the null hypothesis.
- Important notes:
  - P-value can't be zero
  - Never accept the null-hypothesis.
  - Statistical significance level is predefined.
  - Evidence of statistical significance is either present or not present. (no "almost")

What does p-value mean?

- For example, suppose that a vaccine effectiveness study produced a p-value of 0.04. This p-value indicates that if the vaccine had no effect, you'd obtain the observed difference or more in 4% of studies due to random sampling error.
- Critically, p-values address only one question: **how likely** are your data, assuming a true null hypothesis?
- It does not measure support for the alternative hypothesis.

What doesn’t p-value mean?

- Statistical significance does not mean practical significance.
  - Getting a low p-value and conclude a difference is statistically significant, doesn’t mean the difference will automatically be important.
  - For example, a large clinical trial investigating a new weight loss drug found that people who took their drug loss 0.1 pounds more over the course of a year compared to those who took their competitor’s drug (p=0.0001). While this is a statistically significant difference, it’s likely not clinically meaningful
- Statistically significant just means a result is unlikely due to chance alone!

Group Discussion

- For Question 1, what would you expect to happen your p-value if you used 10 simulations versus 10,000 simulations? Explain.

Group Discussion

- Approximately 10% of the general population is left-handed. Suppose that the university is conducting a study to see if this percentage is the same among their students. This would help inform classroom renovations to ensure sufficient left-handed (and right-handed) seating. Suppose 500 students are randomly selected and asked whether or not they are left-handed. Suppose that 63 of these 500 students respond that they are left-handed. Say you used R to estimate the sampling distribution of the test statistic under the assumption that the prevalence of left-handedness among University of Toronto students matches the general population and you computed the p-value of the above hypothesis test based on this sampling distribution.
- Which of the following statements is/are valid description of the P-value you computed.

Group Discussion

- i. The probability that the proportion of U of T students who are left-handed matches the general population.
- ii. The probability that the proportion of U of T students who are left-handed does not match the general population.
- iii. The probability of obtaining a number of left-handed students in a sample of 500 students at least as extreme as the result in this study.
- iv. The probability of obtaining a number of left-handed students in a sample of 500 students at least as extreme as the result in this study, if the prevalence of left-handedness among all U of T students matches the general population.

What makes a good presentation?

Oral presentation

- Form a group of 4 people: prepare for a group presentation.
  - Each group will have 20 minutes to prepare
  - Each group will present for 5 minutes
  - Each group member needs to speak
  - Submit an outline for your presentation on Quercus

Prepare for your presentation

- Contextualize the problem
- Summarize the methods. E.g. State hypotheses; define the test statistic; etc.
- Summarize their findings
- Conclusion
- Limitations (optional, but good practice). E.g. sample size, study design issues, etc.

Presentation topic