

STA130  
TUT0110  
Week5

TA: Gloria  
[shiyi.hou@mail.utoronto.ca](mailto:shiyi.hou@mail.utoronto.ca)

# Agenda



hypothesis testing – type I & type II error



Group discussion



Group presentation



Self-reflection

## Hypothesis testing – two samples

- null hypothesis
- alternative hypothesis

$H_0$  : There is no difference in mean\* improvement scores for individuals in the dolphin treatment group and the control treatment group.

$H_A$  : The mean\* improvement scores are different for individuals in the dolphin treatment group and the control treatment group.

$$H_0 : \mu_{dolphins} = \mu_{control} \quad \text{or} \quad \mu_{dolphins} - \mu_{control} = 0$$

$$H_A : \mu_{dolphins} \neq \mu_{control} \quad \text{or} \quad \mu_{dolphins} - \mu_{control} \neq 0$$

# Vocabularies

- test statistics

$$\text{Test statistic} = \hat{\mu}_{dolphin} - \hat{\mu}_{control} = 4.18 - (-3.46) = 7.64$$

		Test conclusion	
		do not reject $H_0$	reject $H_0$ in favor of $H_A$
Truth	$H_0$ true	okay	Type 1 Error
	$H_A$ true	Type 2 Error	okay

Vocabularies



Type I error



Type II error

# Type I error – false alarm

- Def: Probability of a false positive (type I error) = alpha.
- Alpha typically chosen to be 5% (95% Confidence intervals) because we have a low tolerance for this type of error in research!
  - The smaller the alpha value, the less tolerance for type I error we have.

# Type II error – missed opportunity

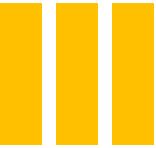
- Def: data appear to be consistent with the null hypothesis, but the null hypothesis is actually not true
- Unfortunately, in practice we don't know if we've committed one of these types of errors.
- The more tests you do, the more likely you'll find a Type 1 error. But you won't know which test(s) resulted in Type 1 errors.

# Real-world example: Somebody is being convicted of murder

- What is the hypothesis and null hypothesis?
  - *Hypothesis: The evidence produced before the court suggests the person is guilty.*
  - *Null hypothesis ( $H_0$ ): This person is innocent*
- How could a type I error occur in this example?
  - *An innocent person is convicted of a crime they didn't commit (a miscarriage of justice)*
- How could a type II error occur in this example?
  - *A guilty person was set free (an error of impunity)*

Any other examples?

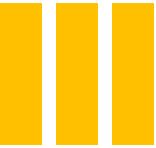
---



# Group Discussion

**Write a few sentences summarizing your conclusions from question 2c.**

- Do you have stronger evidence against the null hypothesis of no difference in median anxiety scores for the two groups, or more evidence against the null hypothesis of no difference in mean anxiety scores?



# Group Discussion

**Discuss their findings with a neighbor.**

- Did you reach similar conclusions?
- Did your conclusions match your expectations before you did the analysis?

# Reminder: delivering a good presentation

## **THE 4 C'S:**

- Calm
- Confident
- Clear
- Concise

# Reminder: good presentation content



What is the main message you want to get across?



Create an (organized) outline of your presentation



Define terms early



Make clear transitions between parts of your presentation



Make your data/figures meaningful



Summarize

# Think-pair-share

- Think about (or review) the oral presentation rubric. Which aspects do you think are most important to an effective presentation?
- Then, share your top three things with a neighbor. Each pair needs to come up with a list of three important things (i.e., come to an agreement to create an agreed upon list).
- Finally, Share with another pair and come up with the top three things that they all think make for a great presentation.
- Now, each group report back to the larger class.

# 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

(a) A health survey asked 200 individuals aged 20-45 living in Toronto to report the number minutes they exercised last week. Researchers were interested in determining whether the average duration of exercise differed between people who consume alcohol and those who do not consume alcohol. Assume the researchers who conducted this study found that people who drank alcohol exercised, on average, 20 minutes per week. In contrast, people who did not drink alcohol exercised 40 minutes per week, on average. The researchers reported  $p=0.249$ .

# Presentation topic

(b) A study was conducted to examine whether the sex of a baby is related to whether or not the baby's mother smoked while she was pregnant. The researchers used a birth registry of all children born in Ontario in 2018, which included approximately 130,000 births. The researchers found that 4% of mothers reported smoking during pregnancy and 52% of babies born to mothers who smoked were male. In contrast, 51% of babies born to mothers who did not smoke were male. The researchers reported a p-value of 0.50.

# Presentation topic

(c) Based on results from a survey of graduates from the University of Toronto, we would like to compare the median salaries of graduates of statistics programs and graduates of computer science programs. 1,000 recent graduates who completed their Bachelor's degree in the last five years were included in the study; 80% of the respondents were female and 20% were male. Among statistics graduates, the median reported income was \$76,000. Among computer science grads, the median reported income was \$84,000. The researchers reported  $p=0.014$ .

# Presentation topic

(d) A team of researchers were interested in understanding millennial's views regarding housing affordability in Toronto. The team interviewed 850 millennials currently living in Toronto. 84% reported that they felt housing prices were unaffordable in the city. Suppose the researchers were interested in testing whether this proportion was different from a study published last year, which found that 92% of millennials reported that housing costs were unaffordable. The researchers reported a p-value of 0.023.

# Presentation topic

(e) Suppose a drug company was interested in testing a new weight-loss drug. They enrolled 20,000 participants and assigned 10,000 to take their new drug, SlimX, and 10,000 to take a placebo. The researchers found that over 2 months, participants who took SlimX lost, on average, 5 lbs. In comparison, the control group lost 4.5 lbs during the same time. The researchers reported a p-value of <0.0001.

# TICKET OUT THE DOOR

Write down one aspect you thought you did well in this week's oral presentation and one aspect you think they could improve.