Lecture 23: Inferential statistics

Wednesday, November 22, 2023

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Lectures: MWF 12:00 PM – 1:00 PM (003); 1:00 PM – 2:00 PM (004); 2:00 PM – 3:00 PM (010)
Office hours: Tuesdays 2:00 PM – 4:00 PM

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Type 1 and Type 2 error

		What's true in the Population?	
		H_o is true	H_o is not true
Your Decision based on Sample	Reject H_o	Type 1 Error α	Correct Decision $1 - \beta$
	Retain H_o	Correct Decision $1 - \alpha$	Type 2 Error β

- Power:
  - Probability of correctly rejecting a false null hypothesis
  - The ability to detect an effect *if one truly exists*

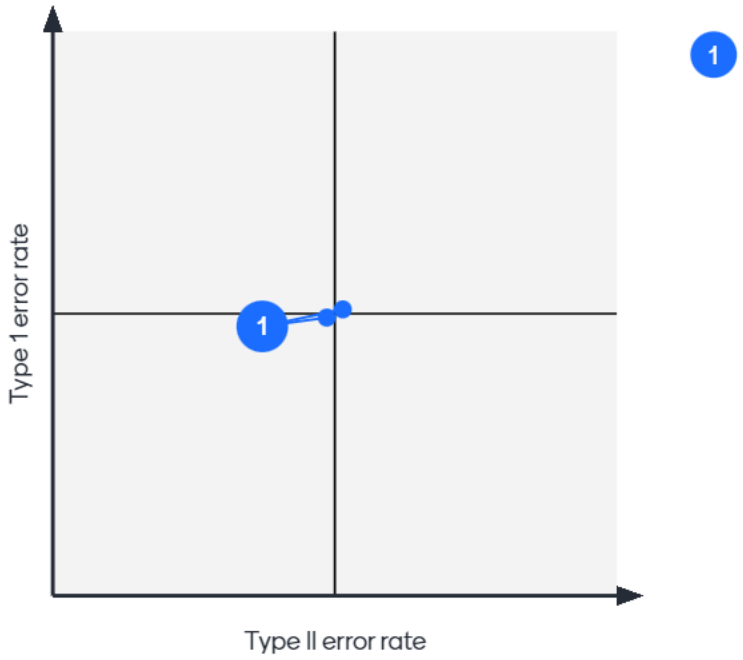
Type 1 and Type 2 error

- Power and Type 2 error rate (different sides of same coin) depend on 3 factors:
  - Sample size
  - Magnitude of effect (effect size)
  - Alpha level

Type 1 and Type 2 error

- Sample size
  - Greater the sample size, greater the power
  - Less error in data to detect effect
- Magnitude of effect (effect size)
  - The larger the difference is in the population, the easier it is to detect, thus greater power
- Alpha level
  - The larger our alpha level, the easier it is to find data consistent with research hypothesis (reject null hypothesis), thus greater power

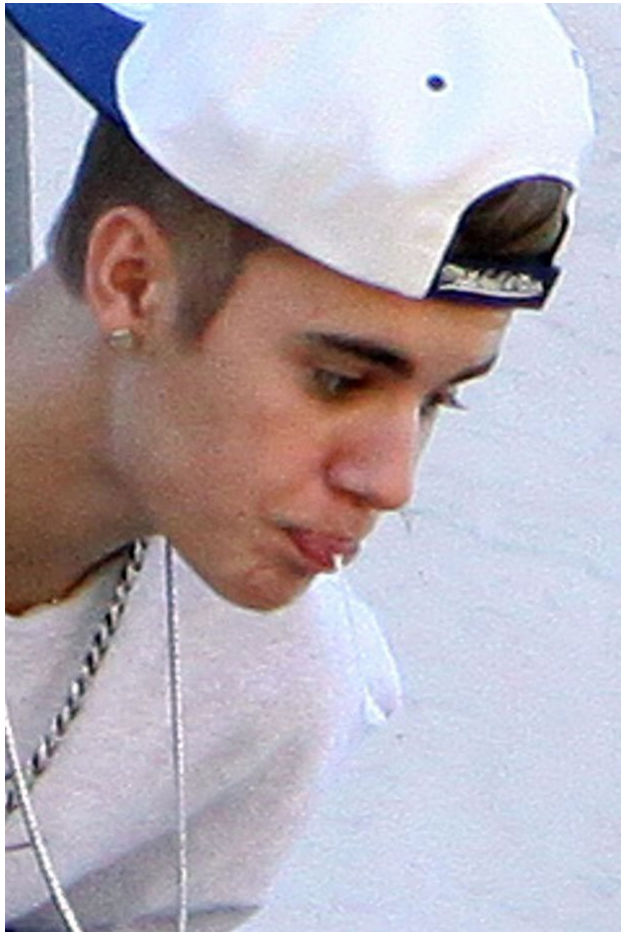
As the size of an effect increases, what happens to Type I error rate and Type 2 error rate? -1 = Decreases, 0 = No Change; 1 = Increases



p hacking

- A set of ethically questionable research practises (QRPs) researcher use to get significant results
  - Data peeking
  - Creative data trimming
  - Outcome-reporting bias
  - Adding covariates
  - HARKing (Hypothesizing After the Results are Known)

  - Spit in the face of science and ethics



Based on: http://davidjjohnson.wordpress.com/2013/08/08/wired-suggests-p-hacking-as-a-cheat-code/

Inferential Statistics Overview

- Null & Research Hypotheses
- Sampling distribution
- *t*-test logic
- Statistically significant
- Type 1 and Type 2 errors
- Apply your understanding

Learning objectives

- Explain the relationship between a sample and a population.
- Describe at least three errors in judgment people commonly make.
- Discuss the importance of relying on base rate data from large samples rather than small samples or single cases.
- Define the gambler's fallacy.
- Generate a null hypothesis and a research hypothesis
- List the 3 steps in hypothesis testing.
- Explain how a sampling distribution is made
- Explain the logic of the numerator and denominator in the t-ratio.
- Explain the meaning of "statistically significant."
- Compare an obtained statistic to a critical value and decide what to do with the null hypothesis.
- Explain when a researcher would use an F test rather than a t test to analyze data.
- Distinguish between Type I and Type II errors.
- Define *alpha* and *power* (in hypothesis testing context).
- Describe the relationship among effect size, power, Type I error rate, and Type II error rate
- Define and describe *p* hacking

Learning objectives

- By the end of today, you'll be able to
  - Describe the pros and cons of quantitative versus qualitative methods
  - Compare and contrast quantitative and qualitative methods
  - Define naturalistic observation, systematic observation, case studies, and archival research
  - Recognise examples of each of the above methods
  - Appreciate the important role that qualitative methods play in research

Goals of science

- Describe behaviour
- Predict behaviour
- Explain behaviour
- Determine causes of behaviour

Reign of quantitative research

Quantitative methods

- *Unit of analysis*: Numerical data
- *Method of analysis*: Statistical analysis

Qualitative methods

- *Unit of analysis*: Personal experience and open-ended responses
- *Method of analysis*: Interpretation of responses

Quantitative vs. Qualitative methods

- Quantitative methods
  - Pros:
    - Excellent for testing hypotheses
    - Allow for effects and differences to be measurable and tangible
    - Allow us to determine if differences are *likely* to be due to chance – helps draw valid conclusions
  - Cons:
    - Limits understanding of behaviours and thoughts to numerical representations of them
    - Validity of turning thoughts and behaviours into numbers?

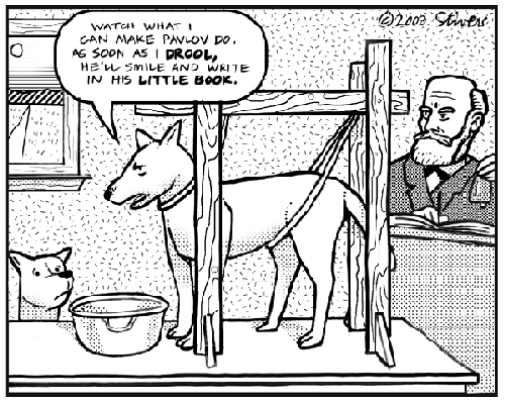
Quantitative vs. Qualitative methods

- Qualitative methods
  - Pros:
    - Excellent for generating and testing hypotheses
    - Allow for in-depth verbal understanding of human behaviour
    - Escapes issues related to distilling thoughts and behaviours into numbers
  - Cons:
    - Conclusions drawn may be due to random chance or personal biases
    - Can be extremely time-consuming and difficult to interpret

Other methods…

- Naturalistic observation
  - Obtain/gather/record information from people in the “field”
  - Can sidestep ethically problematic experimental manipulations

Caption: Watch what I can make Pavlov do. As soon as I drool, he'll smile and write in his little book.



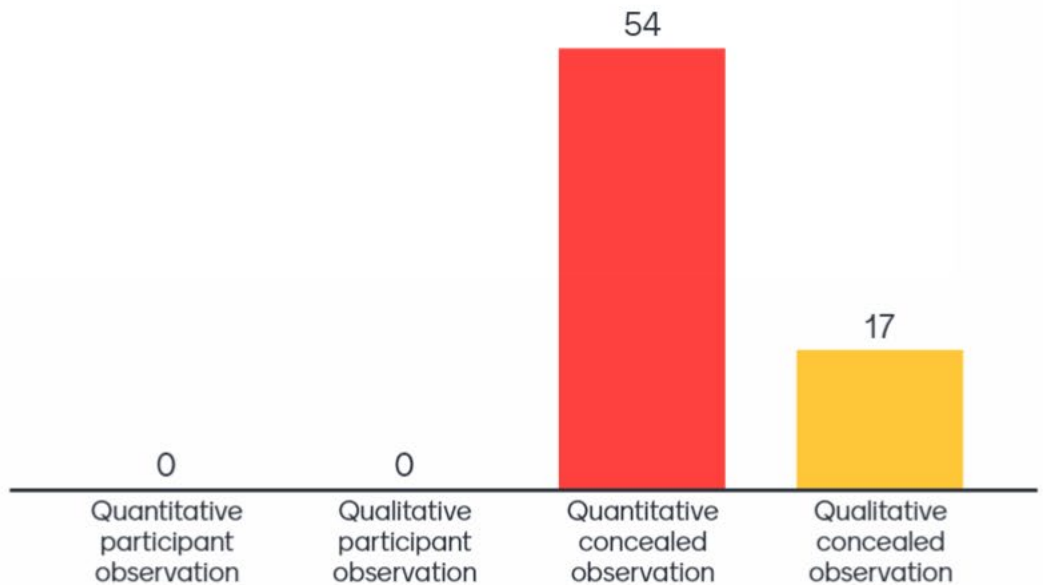
Other methods…

- Participant observation
  - The observer is participating along with the people being observed
  - Purpose is made known to people in the group

Other methods…

- Concealed observation
  - Either the observation itself is concealed, or the purpose of the observations is concealed
  - Ethical considerations may be problematic

A researcher is studying hand washing in a women's washroom. To do this, the researcher hides in a bathroom stall in a campus women's washroom.



Other methods...