MATH 10

INTRODUCTORY STATISTICS

Ramesh Yapalparvi

Week 6

- **Chapter 10 – Estimation**

difference between means

- **Chapter 8 – Advanced Graphs**

- **Chapter 11 – Logic of Hypothesis Testing** ← today's lecture

FINALLY: significance testing, type I/II errors, one/two tailed tests etc.

Chapter 11, Section 2 – Null and Alternative Hypothesis

- **Null hypothesis**: no effect, or that any effect is due to chance alone.
- **Alternative hypothesis:** the opposite of the null hypothesis.

- E.g. do people who drink lots of green tea live longer?
- Mathematically: variable of interest is life span (how long they lived).
- We can see if the mean life span of people who drink lots of green tea is higher than the mean life span of the population.

Chapter 11, Section 2 – Null and Alternative Hypothesis

- E.g. do people who drink lots of green tea live longer?
- Mathematically: variable of interest is life span (how long they lived).
- We can see if the mean life span of people who drink lots of green tea is higher than the mean life span of the country.

- Yes, there could be a third/confounding variable causing people who drink lots of green tea to live longer. E.g. healthier lifestyles.
- But we are not trying to prove causality here, just trying to see if the mean life span is different.

Chapter 11, Section 2 – Null and Alternative Hypothesis

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- H_0: $\mu_{green\ tea} = \mu_{country}$
- H_A: $\mu_{green\ tea} \neq \mu_{country}$

Chapter 11, Section 3 – Significance Testing

- Probability value or p-value = assuming that the null hypothesis is correct, what is the probability of getting our data?

- Significance level α = the threshold for rejecting the null hypothesis.
- If your p-value is below your significance level, you reject the null hypothesis.

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- When null is rejected, the effect is "statistically significant at the α significance level".
- Then, we accept or might accept the alternative hypothesis.
- If the null is NOT rejected, we never accept the null! Lack of significance is not evidence for the null.

Chapter 11, Section 5 – One and Two Tailed Tests

- Two tailed -> $H_0: \mu_{green\ tea} = \mu_{country}$, $H_A: \mu_{green\ tea} \neq \mu_{country}$
- One tailed -> $H_0: \mu_{green\ tea} = \mu_{country}$, $H_A: \mu_{green\ tea} > \mu_{country}$

- Ethical issue: it is easier to pass
- How? Report both tests.

- For the exam: we will tell you which test to use or which test we are using.

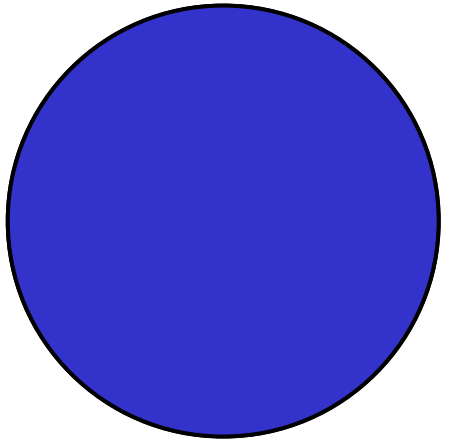
Break time!! \o/

- Break starts after I hand out the exercise.

12 minutes

- Circle is a timer that becomes blue. O_o →

(please ignore if it glitches)



Chapter 11, Section 4 – Type I and II Errors

- Type I

Rejecting a true null hypothesis.

- Type II

Not rejecting a false null hypothesis.

- Important for exam: we NEVER accept the null hypothesis.
- So, lack of significance does not support the conclusion that the null is true.

Psychology journal bans *P* values

Test for reliability of results 'too easy to pass', say editors.

Chris Woolston

26 February 2015 | Clarified: 09 March 2015

A controversial statistical test has finally met its end, at least in one journal. Earlier this month, the editors of *Basic and Applied Social Psychology* (*BASP*) announced that the journal would no longer publish papers containing *P* values because the statistics were too often used to support lower-quality research[1].

Authors are still free to submit papers to *BASP* with *P* values and other statistical measures that form part of 'null hypothesis significance testing' (NHST), but the numbers will be removed before publication. Nerisa Dozo, a PhD student in psychology at the University of Queensland in Brisbane, Australia, tweeted:

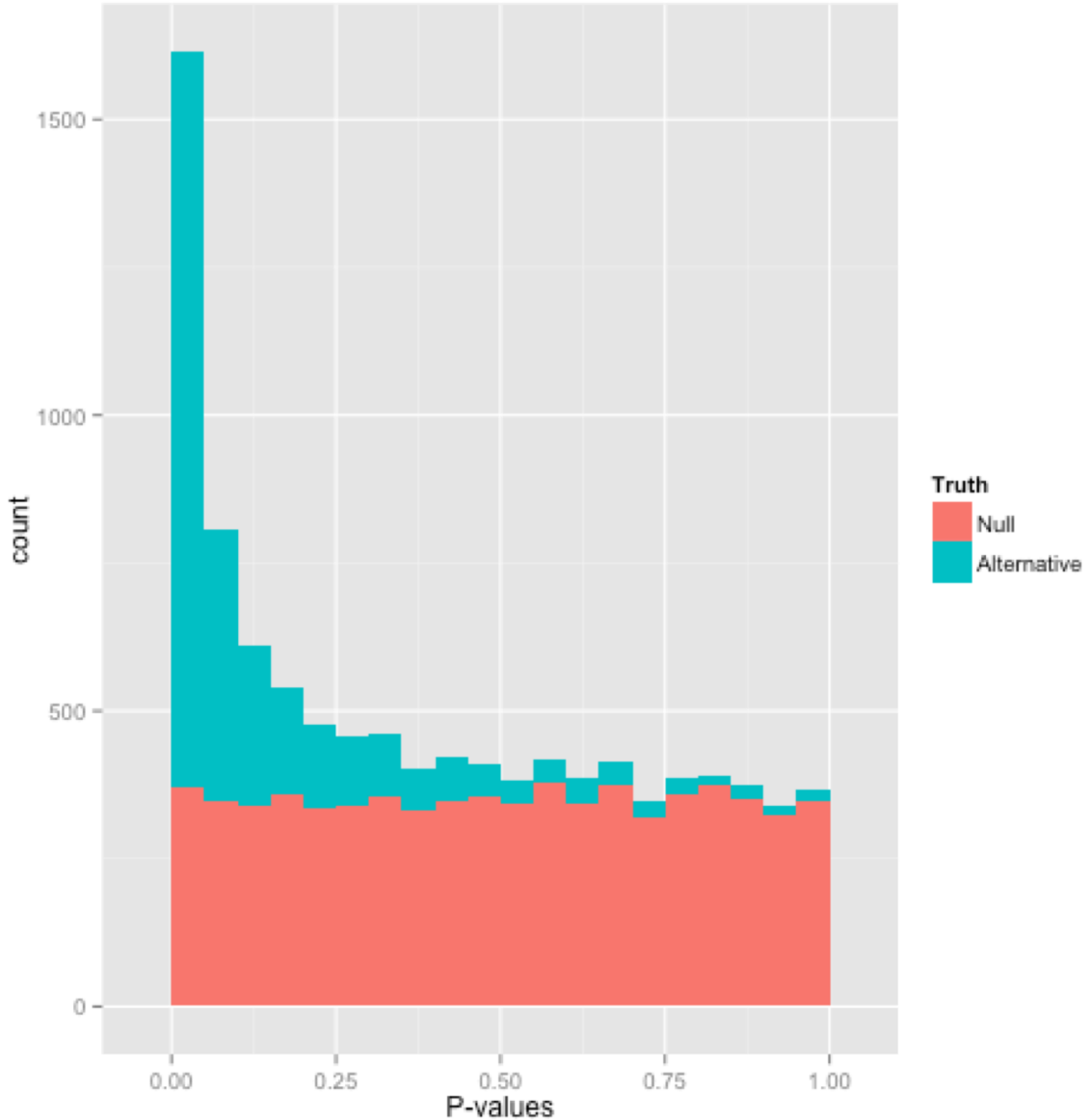
Statisticians issue warning over misuse of *P* values

Policy statement aims to halt missteps in the quest for certainty.

Monya Baker

07 March 2016

Misuse of the *P* value — a common test for judging the strength of scientific evidence — is contributing to the number of research findings that cannot be reproduced, the American Statistical Association (ASA) warns in a statement released today[1]. The group has taken the unusual step of issuing principles to guide use of the *P* value, which it says cannot determine whether a hypothesis is true or whether results are important.



Chapter 11, Section 8 – Steps in Hypothesis Testing

1. Specify a null hypothesis.
2. Specify a significance level.
3. Compute probability value.
4. Compare p-value and significance level.

Lower the p-value, the more confidence you have in rejecting the null hypothesis, but it is not an all-or-none decision.

Chapter 11, Section 9 – Confidence Intervals

- Confidence intervals are connected to significant tests.
- If a $(1-\alpha)\%$ confidence interval constructed from the data does not contain the mean in the null hypothesis…
- Then you will reject the null hypothesis at the α significance level.
- You can see this using an illustration.

Chapter 11, Section 10 – Misconceptions

Extremely important for the exams.

- Is the p-value the probability that the null hypothesis is false?
- Does a low p-value indicate a large effect?
- If an outcome is not statistically significant, does it mean that the null hypothesis is true?