P-values and confidence intervals

Steve Simon, P.Mean Consulting
- Facebook: www.facebook.com/pmean
- LinkedIn: www.linkedin.com/in/pmean
- Main website: www.pmean.com
- Newsletter: www.pmean.com/news
- Twitter: twitter.com/profmean

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2. Learning objectives

- In this hour, you will learn how to:
  - distinguish between statistical significance and clinical significance;
  - define and interpret p-values; and
  - describe the advantages of confidence intervals.

3. Outline

1. Pop quiz
2. Definitions
3. What is a p-value?
4. Practice exercises
5. What is a confidence interval?
6. More practice exercises
7. Repeat of pop quiz

Please feel free to ask questions at anytime

4. Pop quiz

A research paper computes a p-value of 0.45. How would you interpret this p-value?

1. Strong evidence for the null hypothesis
2. Strong evidence for the alternative hypothesis
3. Little or no evidence for the null hypothesis
4. Little or no evidence for the alternative hypothesis
5. None of these answers are correct.
6. I do not know the answer.

5. Pop quiz

A research paper computes a confidence interval for a relative risk of 0.82 to 3.94. What does this confidence interval tell you.

1. The result is statistically significant and clinically important.
2. The result is not statistically significant, but is clinically important.
3. The result is statistically significant, but not clinically important.
4. The result is not statistically significant, and not clinically important.
5. The result is ambiguous.
6. I do not know the answer.

6. Definitions

- Population

7. Definitions

- Population
- Sample

8. Definitions

- Population
- Sample
- Type I error

9. Definitions

- Population
- Sample
- Type I error
- Type II error

10. What is a p-value?

- A p-value is a **measure of how much evidence we have against the null hypothesis**.
- The smaller the p-value, the more evidence we have against H0.

11. What is a p-value?

- Suppose that a drug company alleges that **only 50% of all patients who take a certain drug will have an adverse event of some kind**. You believe that the adverse event rate is much higher. **In a sample of 12 patients, all twelve have an adverse event**.
- P-value = 0.000244.

12. What is a p-value?

A **small p-value** means **lots of evidence against the null hypothesis**.

A **large p-value** means **little or no evidence against the null hypothesis**.

A p-value is NOT the probability that the null hypothesis is true.

13. What is a p-value?

A large p-value should not automatically be construed as evidence in support of the null hypothesis.

Instead of just the p-value, look for

1. a **power calculation**; and/or
2. a **confidence interval**.

Also be cautious about a small p-value.

14. Practice exercise: interpret the p-values shown in the abstract.

Use the PICO format.

- P = Patient population
- I = Intervention
- C = Control/Comparison group
- O = Outcome

15. **What is a confidence interval?**

- A confidence interval is a range of values that tries to quantify **uncertainty associated with the sampling process**.
- Consider it as a **range of plausible values**.

16. **What is a confidence interval?**

- Wide interval = poor precision
- Narrow interval = good precision
- It is unethical to conduct research if you know that your confidence interval will be so wide as to be uninformative.

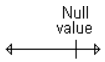
17. **What is a confidence interval?**

- Consider a recent study of homoeopathic treatment of pain and swelling after oral surgery.
  - P= patients undergoing oral surgery
  - I=homeopathic treatment
  - C=patients taking placebo.
  - O=swelling after 3 days.
- Homoeopathy led to 1 mm less swelling on average.
- The 95% confidence interval, however, ranged from -5.5 to 7.5 mm.

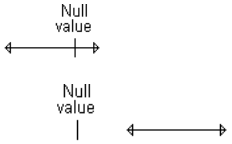
18. **What is a confidence interval?**

- Look for two things:
  1. Does the interval contain a value that implies no change or no effect?

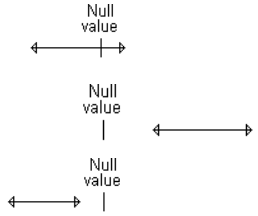
19. **No change,…**



20. **No change, a positive change,…**



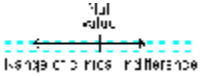
21. **No change, a positive change, and a negative change**



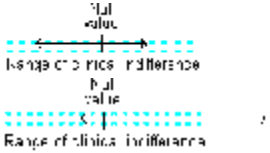
22. **What is a confidence interval?**

- Look for two things:
  1. Does the interval contain a value that implies no change or no effect?
  2. Does the interval lie entirely inside the range of clinical indifference?

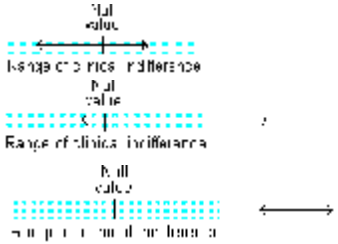
23. **A true null finding,…**



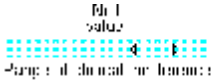
24. **A true null and an ambiguous finding, …**



25. **A true null, an ambiguous, and a true positive finding.**



26. **Statistical significance without practical significance**



27. Practice exercise: interpret the confidence interval(s) shown in the abstract.

28. Repeat of pop quiz

A research paper computes a p-value of 0.45. How would you interpret this p-value?

1. Strong evidence for the null hypothesis
2. Strong evidence for the alternative hypothesis
3. Little or no evidence for the null hypothesis
4. Little or no evidence for the alternative hypothesis
5. More than one answer above is correct.
6. I do not know the answer.

29. Repeat of pop quiz

A research paper computes a confidence interval for a relative risk of 0.82 to 3.94. What does this confidence interval tell you.

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