

THE POWER OF P-VALUES: UNDERSTANDING STATISTICAL “FAILURE”

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WHERE DO YOU COME ACROSS P-VALUES?

- scholarly journal articles
 - chi-square test
 - t-test
 - Regression
 - Correlation
 - AND more

P-VALUES IN ACADEMIC RESEARCH: EXAMPLE

Research Question

Choose a statistical test

Hypothesis testing: Create a hypothesis about the POPULATION.

Null Hypothesis

Alternative Hypothesis

Choose a significance level (alpha .05)

Calculate the statistic and find the corresponding p-value

If the p-value is $\leq .05$ reject the null hypothesis

If the p-value is $> .05$ fail to reject the null hypothesis

Analyze your results!

WHAT IS A P-VALUE?

- “Informally, the p-value is the probability under a specific statistical model that a statistical summary of the data (e.g., the sample mean difference between two groups) would be equal to or more extreme than its observed value” (Wasserstein & Lazar 2016).

IN PLAIN ENGLISH...

If the null hypothesis is true, then what's the probability that we'd have our test statistic or one more extreme?

HOW DO WE INTERPRET A P-VALUE LESS THAN ALPHA (.05)?

$P=.0217$

Correct Interpretation: Your result is statistically significant.

Correct Interpretation: Assuming that the null hypothesis is true you'd obtain the observed test statistic or larger in 2.17% of studies because of random sampling error.

BE CAREFUL

Statistically significant does not mean substantively significant

BE CAREFUL

- danger in using large samples
 - will almost certainly lead to rejection of the null hypothesis (Tabachnick & Fidell, 2013)
- small samples may not be able to detect small effects/differences (Torgerson & Torgerson, 2008)

HOW DO WE INTERPRET A P-VALUE GREATER THAN THE SIGNIFICANCE LEVEL (ALPHA .05)?

- $P = .1$
- Fail to reject the null hypothesis
- Bias toward publishing research with statistically significant results
- Limited opportunities to publish

WHAT SHOULD YOU DO?

- Look beyond p-values - think about substantive significance
- Look for analysis of the effect size and/or confidence intervals

STATISTICAL “FAILURE”

- Small P-values do not represent substantive/real-world significance
- It's important to analyze real-world or substantive significance

REFERENCES

- Tabachnick, B.G. & Fidell, L.S. (2013). *Using multivariate statistics*. UK: Pearson.
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- Wasserstein, R.L & Lazar, N.A. (2016). The ASA's statement on p-values: context, process, and purpose. *The American Statistician*, 70(2), 129-133.