Lecture 22: Inferential statistics

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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

t-test Ratio Logic

(Think: what are some sources of error in our DVs, which result in a lot of variability?)

- Question to ponder:
  - How do we reduce error so that we get larger *t* values? Some common issues:
    - Poorly worded questions (e.g. double-barrelled question, double negatives)
    - Effect of uncontrolled variables (e.g. environmental variables, distractions)
    - Small sample size
    - Between- versus Within-subject designs

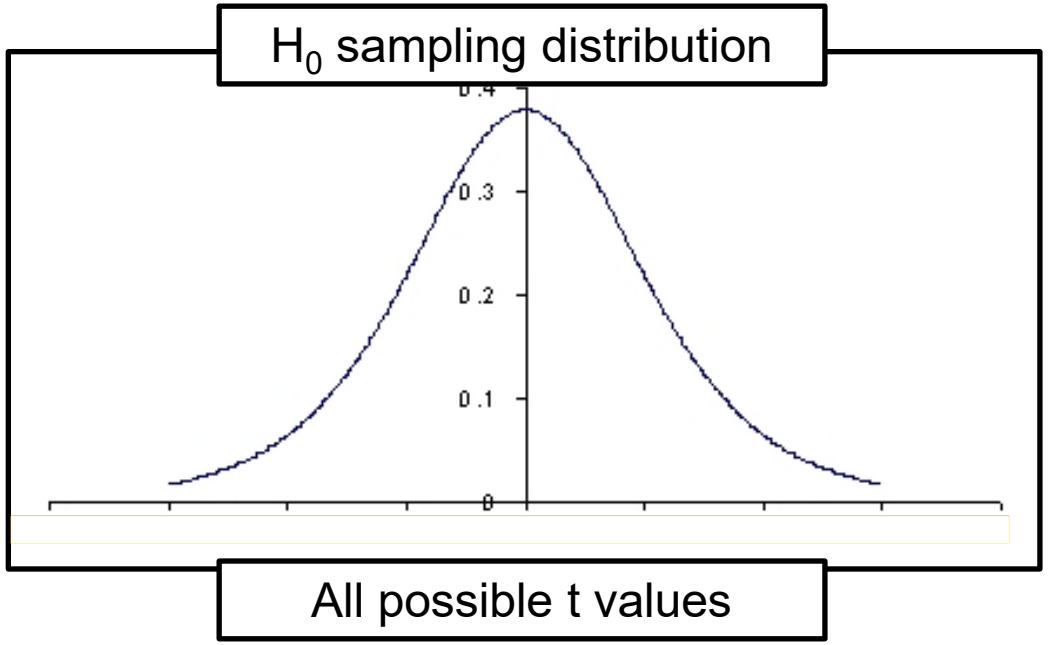
$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Determining if two means are significantly different from each other

- 1. Find "*t* obtained" value
  - Use formula to convert the mean difference and standard deviation into a *t* value
- 2. Refer to sampling distribution of *t* values
  - Find "critical *t*" value for that df and alpha
  - From the table (Appendix C, Table C.2)
  - *Don't need to find this for 217*
- 3. Make a decision
  - Is our statistic value sufficiently rare to consider it *significant?*
  - Is absolute value of $|t_{obt}| > |t_{crit}|$?
    - If yes, reject the null hypothesis
    - If no, retain the null hypothesis

Step 2: Refer to a sampling distribution for comparison

- *t* distribution is actually a *family* of distributions
  - Corresponds to sample size – each sample size has a different *t* distribution
  - Distribution of each possible *t* value if the null hypothesis is true, at each sample size



Step 2: Refer to a sampling distribution for comparison

- To locate the appropriate sampling distribution:
  - Degrees of freedom (*df*) = N – 2 (total sample minus number of groups)
    - *df* is dependent on sample size, and more = better
- To locate the appropriate t_{crit}:
  - Alpha level (α)
    - Stated as probability (0.00 to 1.00) – conventionally 0.05
    - How likely are we to incorrectly reject the null hypothesis?
    - How likely are we to say that means are significantly different, but it's actually due to chance?
    - If the null hypothesis is true, how likely are we to mistakenly say that the null hypothesis is not true?
  - If $|t_{obt}| > |t_{crit}|$, then we reject the null hypothesis

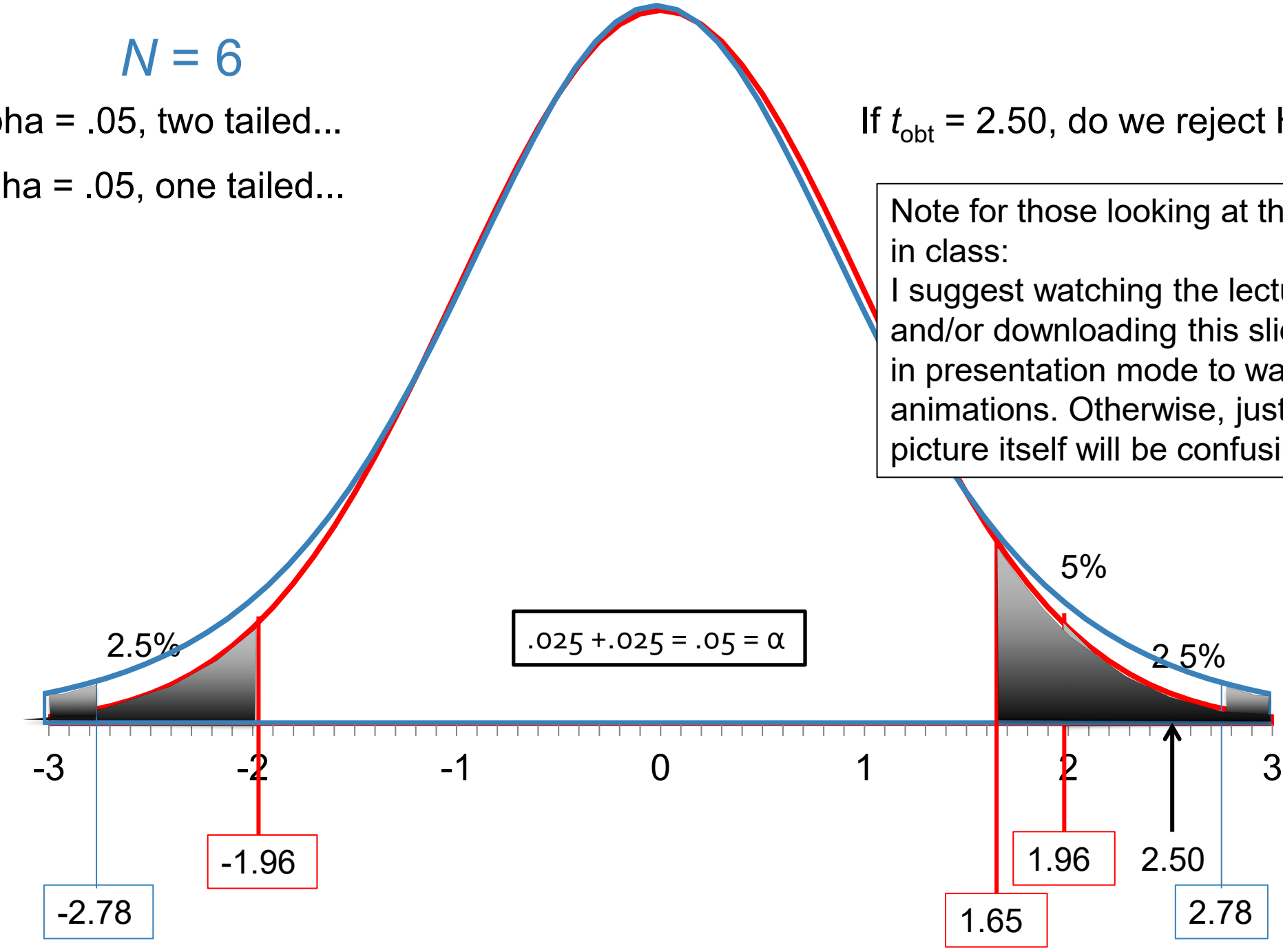
$N = \infty$ $N = 6$

When alpha = .05, two tailed...

When alpha = .05, one tailed...

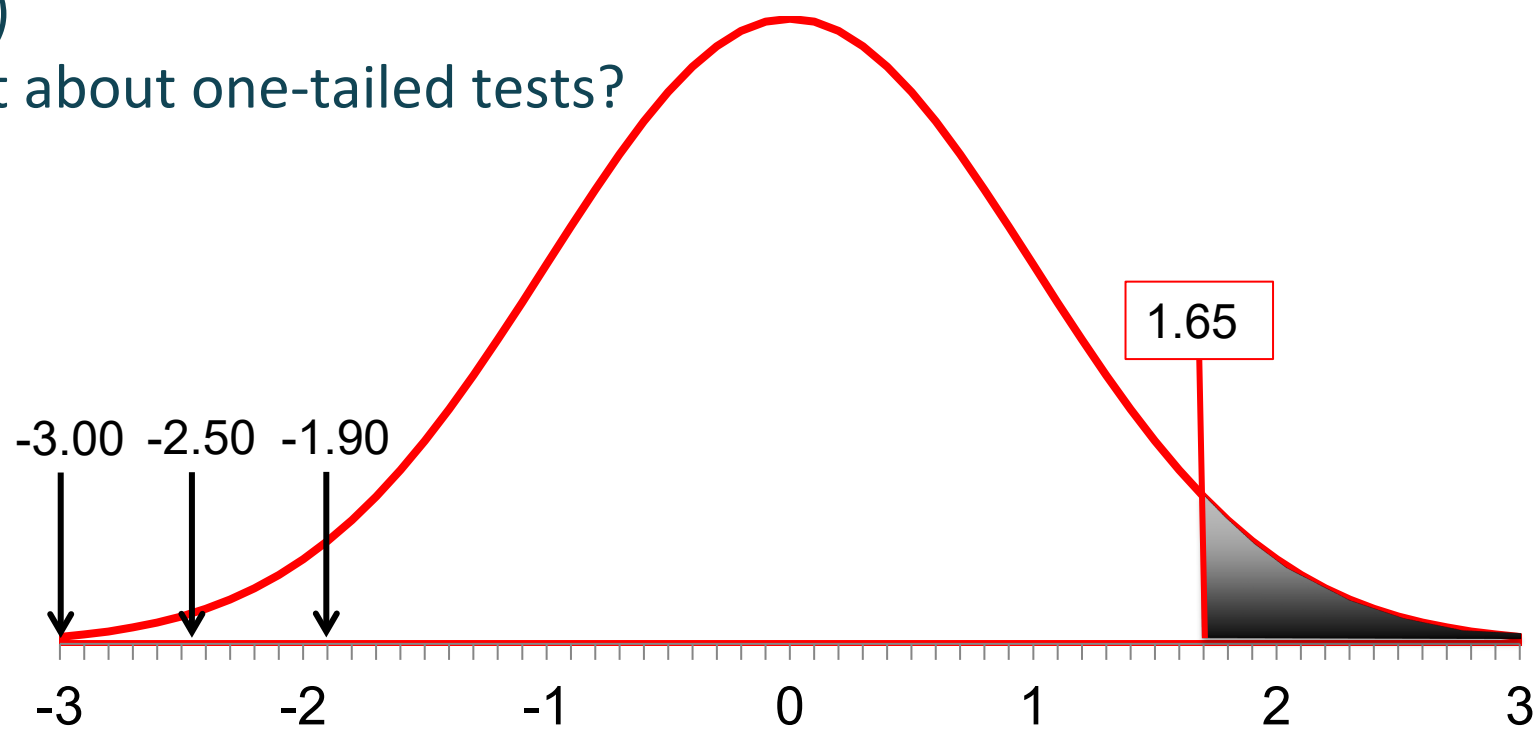
If t_{obt} = 2.50, do we reject H_0?

Note for those looking at this and were not in class:
I suggest watching the lecture recording and/or downloading this slide and seeing it in presentation mode to watch the animations. Otherwise, just looking at this picture itself will be confusing.



Reviewing inferential tests

- $|t_{obt}| > |t_{crit}|$, then reject null hypothesis
  - This rule primarily works for non-directional research hypothesis (i.e. two-tailed tests)
  - What about one-tailed tests?



t test and *F* test

Obtained *t*

- Interval or Ratio DV
- Nominal IV
  - Comparison between 2 levels of IV
- Calculation is a:
  - Signal to Noise Ratio

Obtained *F*

- Interval or Ratio DV
- Nominal IV
  - Comparison between >2 levels of IV
- Calculation is a:
  - Signal to Noise Ratio

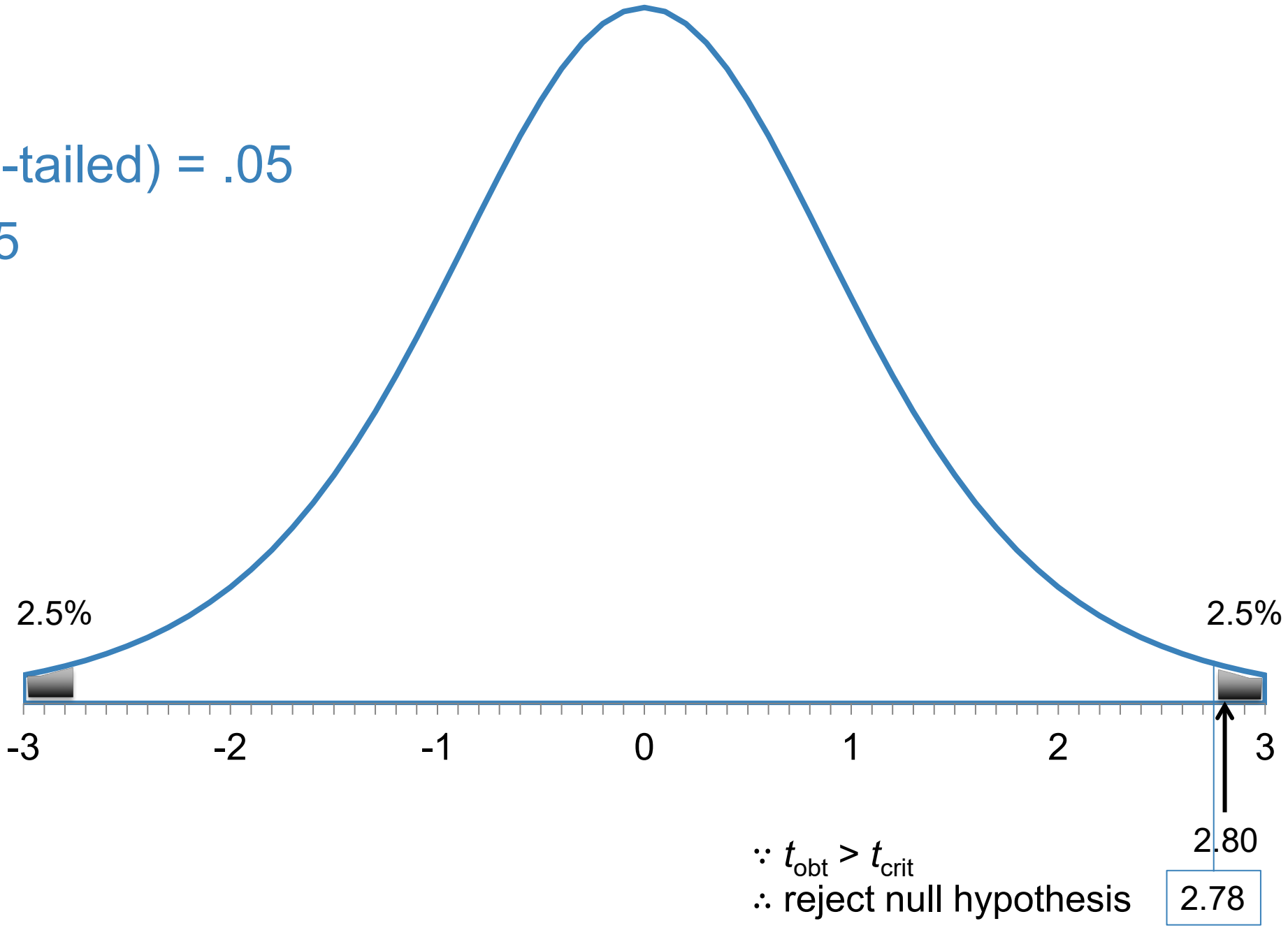
Under one particular condition, $F = t^2$

$N = 6$

$df = ?$

α (two-tailed) = .05

$p < .05$

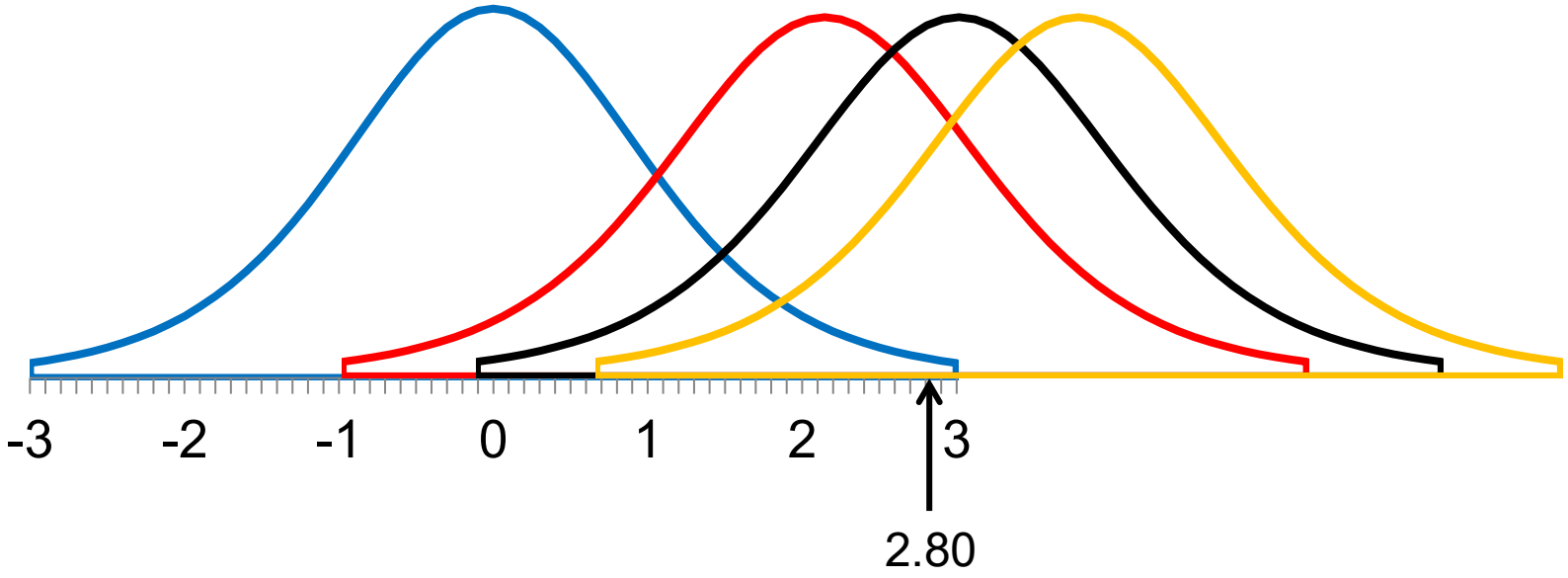


$\because t_{obt} > t_{crit}$

$\therefore$ reject null hypothesis

Statistically Significant

- Statistically significant:
  - Result is ***unlikely*** to be due to chance
  - It is ***unlikely*** that the difference between the two groups has a *t* of 0



Inferential Statistics Overview

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

Errors in Judgment

- 2 types of errors that we can make in making such decisions
  - Type 1 error:
    - H_0 is true in the population, but we rejected H_0
  - Type 2 error:
    - H_0 is not true in the population, but we retained it

Errors in Judgment

		What's true in the Population?	
		H_0 is true	H_0 is not true
Your Decision based on Sample	Reject H_0	Wrong Decision	Correct Decision
	Retain H_0	Correct Decision	Wrong Decision

Errors in Judgment

		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	Correct Decision
	Retain H_o	Correct Decision	Type 2 Error

Errors in Judgment

https://youtu.be/nFm4uCxbMU0

- How do these errors play out in real life?

Type 1 and Type 2 error

		What's true in the Population?	
		Homeopathy doesn't treat cancer	Homeopathy treats cancer
Your Decision based on Sample	Homeopathy treats cancer	Type 1 Error	Correct Decision
	Homeopathy doesn't treat cancer	Correct Decision	Type 2 Error

Type 1 and Type 2 error

		What's true in the Population?	
		Homeopathy doesn't treat cancer	Homeopathy treats cancer
Your Decision based on Sample	Homeopathy treats cancer	Money, does not use empirically supported medicine	Correct Decision
	Homeopathy doesn't treat cancer	Correct Decision	Missed out on cancer treatment; reliance on existing medicine

Type 1 and Type 2 error

		What's true?	
		Not guilty	Guilty
Your Decision	Guilty	Type 1 Error	Correct Decision
	Not guilty	Correct Decision	Type 2 Error

Type 1 and Type 2 error

		What's true?	
		Not guilty	Guilty
Your Decision	Guilty	Innocent person jailed	Correct Decision
	Not guilty	Correct Decision	Guilty person goes free

- For research, Type 1 is more serious than Type 2 due to publication bias

We’re ahead of schedule, and I’m attending the psych convocation ceremony on Wednesday

No class Wednesday