Lecture 16 Errors & Powers

agenda

lecture	type I/II errors and power
review	review hypothesis tests for one and two proportions
activity	get into groups and work on a problem; share your results with the class
hw 6	Discuss expectations for hw 6

Significance Level α

We always set the significance level before performing a hypothesis test. What does it actually mean?

Decision Errors

α = 0.05 means we are allowing for 5% error. Type I to be exact.

		Test Conclusion	
		Reject H_0	Fail to Reject H_0
Truth	H_0 true	Type I Error	:)
	H_A true	:)	Type II Error

Example

Which is worse: type I or type II?

Let H_0 = drug does not work vs. H_A: drug works

- Type I Error = Reject $H_0 \mid H_0$ true – we said drug works, but it actually doesn't
- Type II Error = Fail to reject $H_0 \mid H_A$ true – said drug doesn't work, but it actually does

p-values and α

α

Significance Level

The maximum p-value for which we will reject the null hypothesis (a limit on the type I error rate)

- $\alpha = P(\text{Reject } H_0 | H_0 \text{ true})$

p

p-value

The probability of seeing something as or more extreme than what we saw in our sample, assuming the null hypothesis is true

- probability of committing a type I error in our data set

Errors

Type I Error

Reject H_0 | H_0 true

α = P(Reject H_0| H_0 true)

= P(Type I Error)

Type II Error

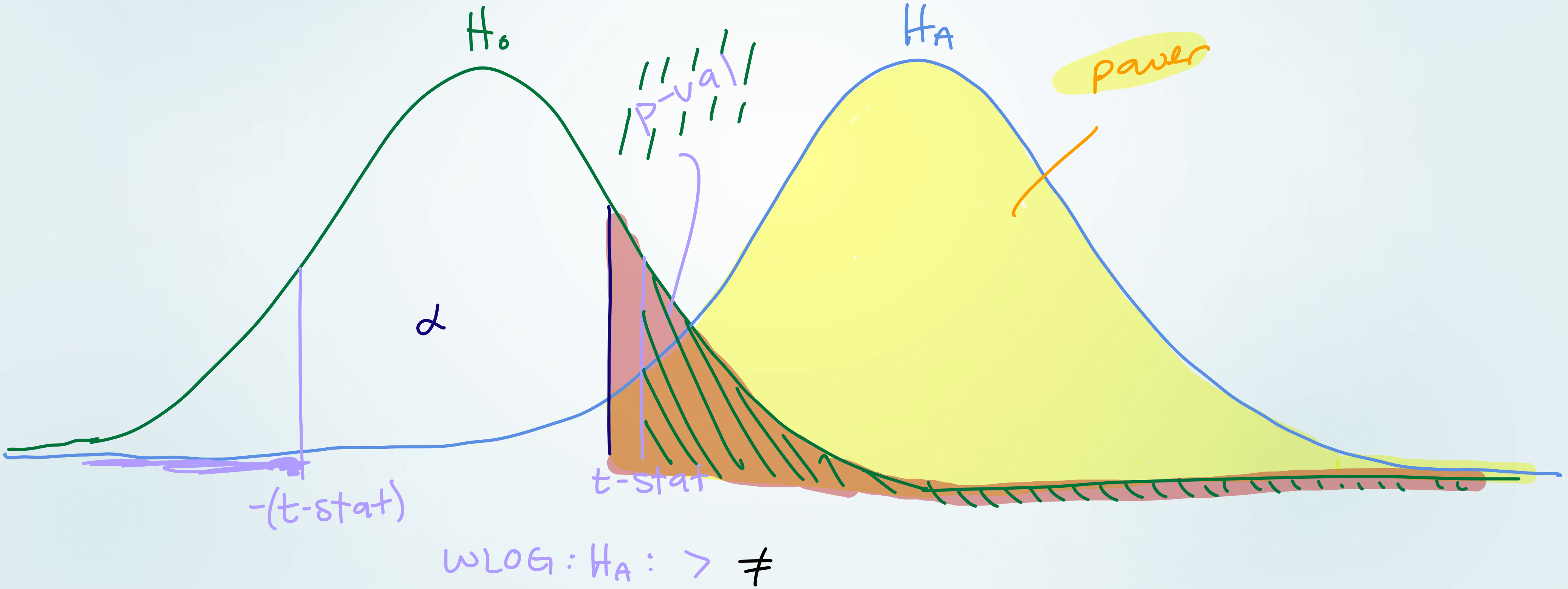
Fail to reject H_0 | H_A true

β = P(fail to reject H_0 | H_A true)

= P(Type II Error)

Power

Power = P(Reject H_0| H_A true) = 1 - β



A 2010 Pew Research foundation poll indicates that among 1,099 randomly selected college graduates, 33% watch The Daily Show. Meanwhile, 22% of the 1,110 randomly selected people with a high school degree but no college degree in the poll watch The Daily Show. Do the data provide convincing evidence of a difference between the proportions of college graduates and those with a high school degree or less who watch The Daily Show.

parameter: $p_1 - p_2$ → 1 = college grads
2 = HS grads

1) Write the hypotheses.

H_0: $p_1 - p_2 = 0$

H_A: $p_1 - p_2 \neq 0$

2) In the context of the problem, define the errors below

- Type I Error = we say $p_1 \neq p_2$, but actually $p_1 = p_2$
- Type II Error = we say $p_1 = p_2$, but actually $p_1 \neq p_2$

A 2010 Pew Research foundation poll indicates that among 1,099 randomly selected college graduates, 33% watch The Daily Show. Meanwhile, 22% of the 1,110 randomly selected people with a high school degree but no college degree in the poll watch The Daily Show. Do the data provide convincing evidence of a difference between the proportions of college graduates and those with a high school degree or less who watch The Daily Show?

2) Conditions:

- Independence

both graups randomly selected

- Normality

$$\left.\begin{array}{l} n_1 \hat{p}_1 = 1099 \times 0.33 = 362 \\ n_1 (1-\hat{p}_1) = 1099 \times 0.67 = 1099 - 362 = 737 \\ n_2 \hat{p}_2 = 1110 \times 0.22 = 244 \ ; \ n_2 (1-\hat{p}_2) = 864 \end{array}\right\} \geq 5$$

A 2010 Pew Research foundation poll indicates that among 1,099 randomly selected college graduates, 33% watch The Daily Show. Meanwhile, 22% of the 1,110 randomly selected people with a high school degree but no college degree in the poll watch The Daily Show. Do the data provide convincing evidence of a difference between the proportions of college graduates and those with a high school degree or less who watch The Daily Show?

3) Test statistic:

$$z = \frac{\hat{p}_1 - \hat{p}_2 - 0}{\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}} = 5.7710$$

4) P-value: ≈ 0 $\quad 8 \times 10^{-9}$

5) Decision and conclusion in context: Reject H

A 2010 Pew Research foundation poll indicates that among 1,099 randomly selected college graduates, 33% watch The Daily Show. Meanwhile, 22% of the 1,110 randomly selected people with a high school degree but no college degree in the poll watch The Daily Show. Do the data provide convincing evidence of a difference between the proportions of college graduates and those with a high school degree or less who watch The Daily Show?

What type of error could we have made? Type I or Type II?

What is the probability that we made that error?

8×10^{-9}