CSCI 3022

intro to data science with probability & statistics

Lecture 18
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More *p*-values and hypothesis testing

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Two-Sample Testing for Difference of Means

$$z = \frac{(\mu_1 - \mu_2) - c}{\sqrt{\frac{s_1^2}{m} + \frac{s_2^2}{n}}}$$

- **Example**: Data on calorie intake both for a sample of teens that reported that they do not typically eat fast food and another sample of teens who said they did usually eat fast food is as follows:

Fast Food	Sample Size	Sample Mean	Sample SD
No (pop 2)	663 n	2258 μ_2	1519 s_2
Yes (pop 1)	413 m	2637 μ_1	1138 s_1

α

- Does this data provide statistical evidence at the 0.05 significance level that true average calorie intake for teens who typically eat fast food exceeds that of teens who do not typically eat fast food by more than 200 cals per day?

$H_0: \mu_1 - \mu_2 = 200$

$H_1: \mu_1 - \mu_2 > 200$

$$z = \frac{(2637 - 2258) - 200}{\sqrt{\frac{1138^2}{413} + \frac{1519^2}{663}}} \approx 2.20$$

p-value = ??

Two-Sample Testing for Difference of Means

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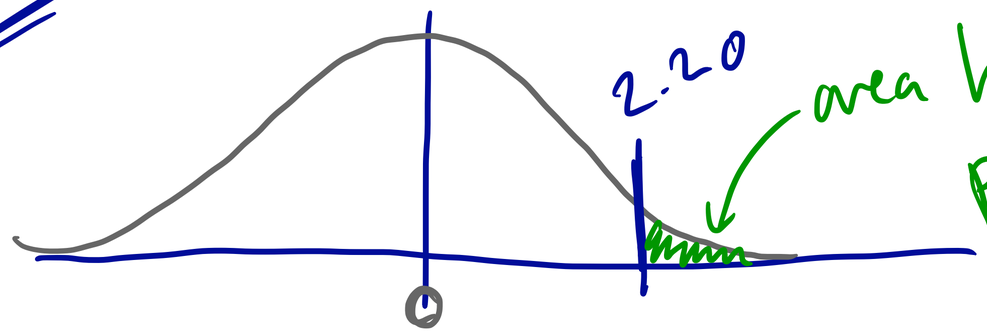
No	663	2258	1519
Yes	413	2637	1138

$\alpha = 0.05$

- Does this data provide statistical evidence at the 0.05 significance level that true average calorie intake for teens who typically eat fast food exceeds that of teens who do not typically eat fast food by more than 200 cals per day?

$z = 2.20$



area here = p value

$Pr(Z \geq 2.20)$

Is p-value $< \alpha$

$Pr(Z \geq 2.20) < 0.05$

Common p-value misunderstandings

- **Misconception #1**: If p = 0.05, the Null hypothesis only has a 5% chance of being true.

WRONG.

p-value is $Pr(\text{obs our data} \mid H_0)$

Common p-value misunderstandings

- **Misconception #2**: If p is very small then your alt hypothesis is very likely to be significant.

Significance at what value of α?

Type I error rate

Nope

Common p-value misunderstandings

- **Misconception #3**: A statistically significant effect is equivalent to a substantial effect

we can tell from the data

Nope

large effect.

Reject H_0 in favor of alt. Hyp. H_1

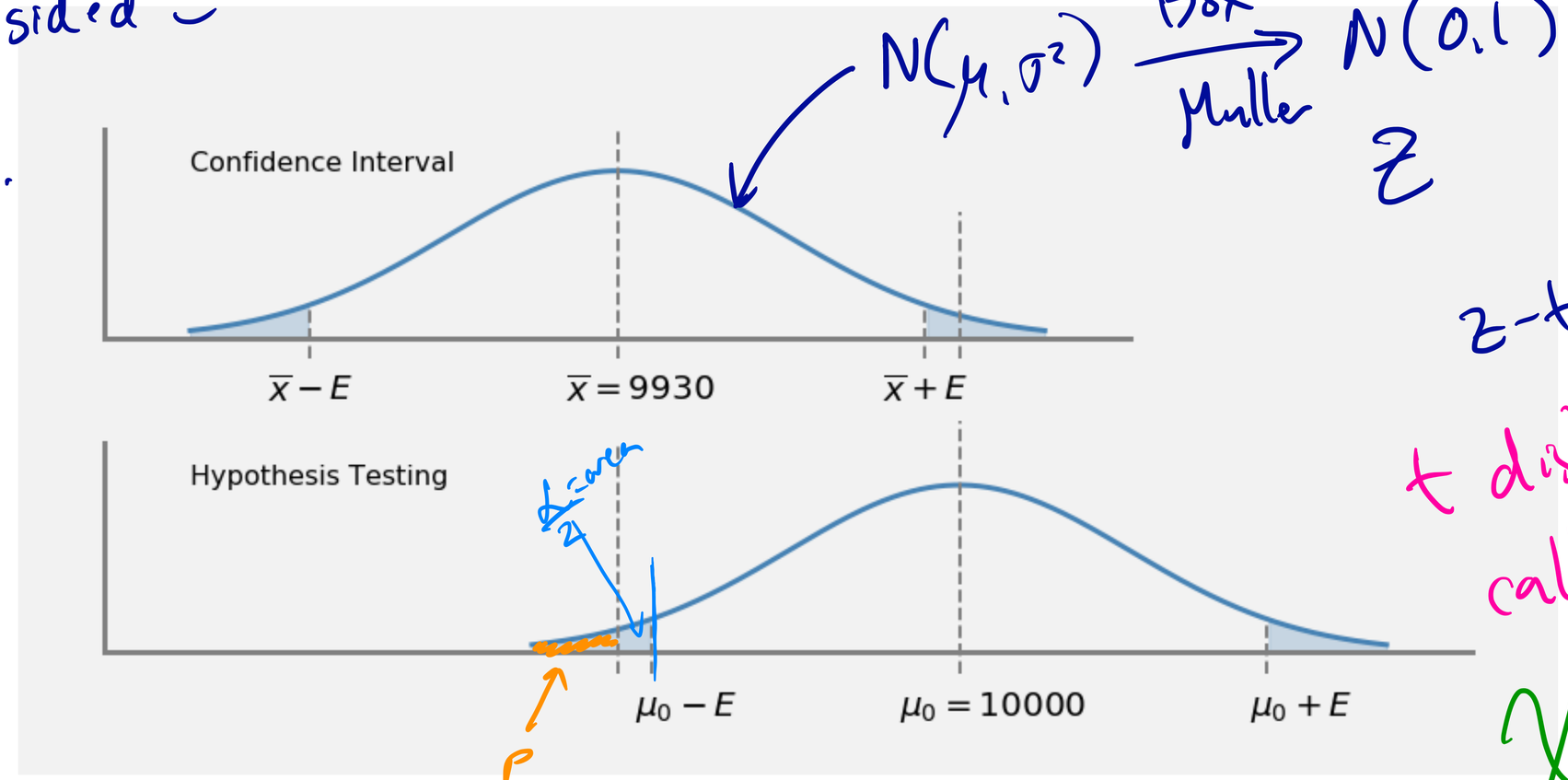
$\theta = \theta_0$

$\theta > \theta_0$

"effect size" vs. "effect significance"

CIs vs Critical Regions vs P-Values

- Confidence Intervals, Critical Regions, and P-Values are three sides to the same coin.



Let’s notebooks!