Midterm review

Thursday, February 11

EDUC 15: Statistics for Education Research
UCI School of Education

The midterm is on Tuesday

	Details
When	Tuesday, February 16, in class, 80 minutes
What	Chapters 1 to 9, which are Topics 1 to 8
How	Free response: show your work and explain your thinking
Bring	A calculator, and any print materials, including your own notes
We attach	The z, t and F tables, and a formula sheet in both sets of symbols
Not allowed	Any other device

Today is practice, in pairs. Nothing is scored

Plan for today

Describe: Topics 1 to 4

Probability and sampling: Topics 5 and 6

Tests and intervals: Topics 7 and 8

Each round: work alone for a few minutes, then with a neighbor. Then we compare

One question runs through all of it

Parameter

A fact about the population: μ, σ, σ_M

Usually unknown

Estimate

From our sample: M, $\hat{\sigma}$, $\hat{\sigma}_M$, g

Changes from sample to sample

Every test asks: is our estimate too far from what H_0 says the parameter is?

Describe

Practice 1: Six students

Six Govindpuri students' baseline math scores: 8, 5, 9, 12, 14, 12

a. Find the mean, the median and the mode

b. Find SS, then $\hat{\sigma}$, our estimate of the SD of all Govindpuri students

c. Find the z of the 14 within these six

d. Which scale is math score? Which is the center a student goes to?

Work alone for 3 minutes, then compare with a neighbor

Data: Muralidharan, Singh, and Ganimian (2019).

Practice 1: Answers a and b

X	X – M	$(X - M)^2$
8	-2	4
5	-5	25
9	-1	1
12	2	4
14	4	16
12	2	4
	Sum	**SS = 54**

M = 60 / 6 = 10. Median: (9 + 12) / 2 = 10.5. Mode: 12

$\hat{\sigma} = \sqrt{(54 / 5)} = \sqrt{10.8} = 3.29$

Data: Muralidharan, Singh, and Ganimian (2019).

Practice 1: Answers c and d

$$z = (14 - 10) / 3.29 = 1.22$$

The 14 sits 1.22 standard deviations above the mean of these six

Math score: ratio. A score of 0 means no answers right

Center: nominal. It's a name, with no order

Data: Muralidharan, Singh, and Ganimian (2019).

Parameter or estimate? Hands up

	The number
A	The mean of all 619 Mindspark students at baseline, treated as our population
B	The mean of the six Govindpuri students, 10
C	$\hat{\sigma}$ = 3.29 from the six
D	The SD of the sampling distribution of M, for samples of 16 from the population
E	The mean math score of every fifth grader in Delhi

Hands up for parameter, then for estimate

Probability and sampling

Practice 2: One score or a mean?

Treat all 619 students as a population, with μ = 11.12 and σ = 3.90. Treat their scores as normal

a. What share of students score above 15?

b. What score is the 25th percentile?

c. We draw samples of 16. What are the mean and SD of the sample means?

d. In what share of those samples is M above 12.5?

Sketch a curve and shade it before you open the table

Data: Muralidharan, Singh, and Ganimian (2019).

Practice 2: Answers a and b

a. $z = (15 - 11.12) / 3.90 = 0.99$

The tail beyond $z = 0.99$ is **0.1611**, about 16% of students

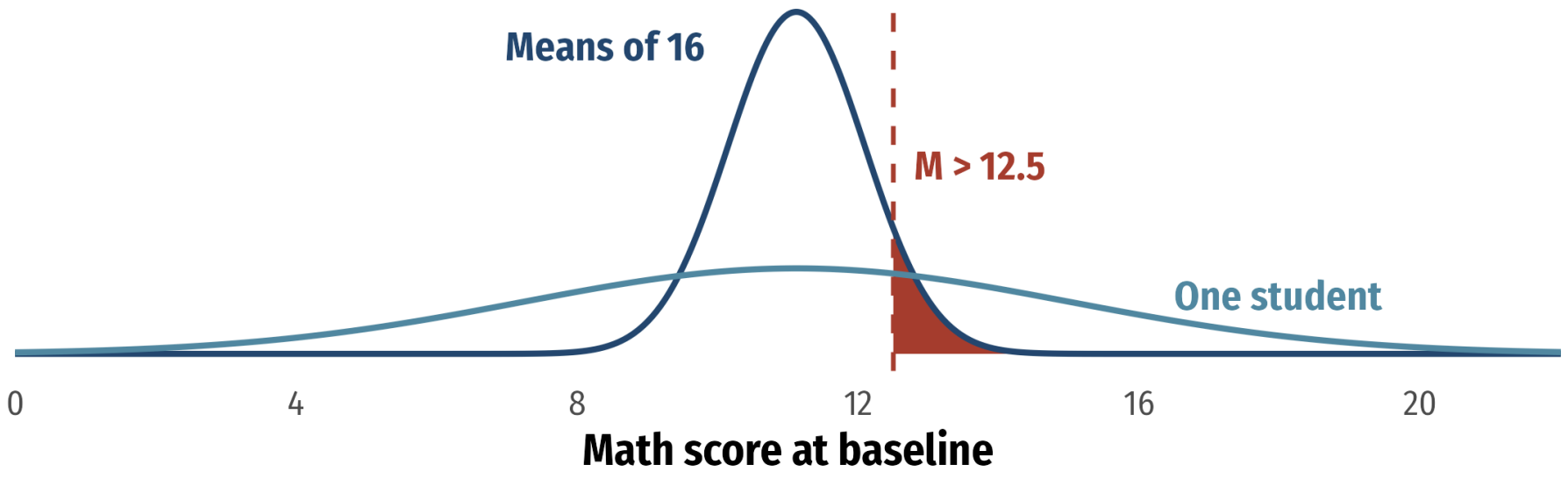
b. A tail of 0.2500 is closest at $z = 0.67$. Below the mean, that's $z = -0.67$

$X = 11.12 + (-0.67) \times 3.90 =$ **8.51**

Going right: X to z to area. Going left: area to z to X

Data: Muralidharan, Singh, and Ganimian (2019).

Practice 2: Answers c and d



c. The mean of the means is 11.12. σ_M = 3.90 / $\sqrt{16}$ = **0.975**

d. z = (12.5 − 11.12) / 0.975 = 1.42, and the tail beyond it is **0.0778**

Data: Muralidharan, Singh, and Ganimian (2019).

Tests and intervals

Practice 3: All of Govindpuri, σ known

Govindpuri's 82 students: M = 11.60. All 619: μ = 11.12 and σ = 3.90

If Govindpuri's students were a random draw from the 619, would a mean this high be too unexpected? Run all four steps, with α = 0.05 and two tails

Work alone, then compare with a neighbor. Then hands: reject or maintain?

Data: Muralidharan, Singh, and Ganimian (2019).

Practice 3: Answer

Step	Our numbers
1. State H_0	H_0: $\mu = 11.12$. H_1: $\mu \neq 11.12$
2. Set the criteria	$\alpha = 0.05$, two tails, so z beyond ±1.96
3. Observe	$\sigma_M = 3.90 / \sqrt{82} = 0.431$, so $z = (11.60 - 11.12) / 0.431 = 1.11$
4. Decide	**Maintain H_0**: z = 1.11 is inside ±1.96, p = 0.265

Govindpuri's mean isn't surprisingly far from 11.12

Maintain, not accept: the test can't show that Govindpuri's μ is exactly 11.12

Data: Muralidharan, Singh, and Ganimian (2019).

Practice 4: Ninth graders, σ unknown

Chhatarpur's 32 ninth graders: M = 12.62 and SS = 299.5 at baseline

a. Test H_0: $\mu = 11.12$ with $\alpha = 0.05$ and two tails. Find $\hat{\sigma}$, $\hat{\sigma}_M$ and t

b. The table skips df = 31. Which row do you use?

c. Find g, and say whether it's large

d. Find a 95% confidence interval for μ. Does it hold 11.12?

Work alone for 4 minutes, then compare with a neighbor

Data: Muralidharan, Singh, and Ganimian (2019).

Practice 4: Answers a and b

$\hat{\sigma} = \sqrt{(299.5 / 31)} = \mathbf{3.11}$

$\hat{\sigma}_M = 3.11 / \sqrt{32} = \mathbf{0.549}$

$t = (12.62 - 11.12) / 0.549 = \mathbf{2.74}$

b. Use df = 30, the next lower row. Its cutoff is ±2.042

A lower df has a wider cutoff, so it's the cautious choice

2.74 is beyond ±2.042: **reject H_0.** $t(31) = 2.74$, $p = 0.010$

Data: Muralidharan, Singh, and Ganimian (2019).

Practice 4: Answers c and d

c. $g = (12.62 - 11.12) / 3.11 = \mathbf{0.48}$

d. $12.62 \pm 2.042 \times 0.549 = \mathbf{[11.50, 13.75]}$

About half an SD. Large next to the effects of real education programs in Topic 7's table

It doesn't hold 11.12, which matches the reject

The test says real. g says how big. The interval says how sure. None of them says why: these are older students

Data: Muralidharan, Singh, and Ganimian (2019).

True or false? Hands up

	Statement
A	p = 0.03 means there's a 3% chance that H_0 is true
B	α is the chance of a Type 1 error when H_0 is true
C	Maintaining H_0 shows the program had no effect
D	A bigger sample raises power
E	A tiny p means a big effect

Hands up for true, then for false. Then fix each false one with a neighbor

The slips we see most

- Dividing SS by n, when $\hat{\sigma}$ needs n − 1
- Forgetting the last square root
- Using σ where the test needs σ_M or $\hat{\sigma}_M$
- Using n for df, when it's n − 1
- Reading the body when you need the tail. Sketch first
- Writing "accept H_0". It's maintain
- Saying the test shows why
- A decision with no numbers. Report t(df) = ..., p = ...

How to get ready

Redo the try-its in the decks, and the by-hand problems from Labs 2, 4 and 5

MindTap for Chapters 1 to 4 is open as practice, all quarter

Make your own notes: you can bring them, so build one page per topic

Practise with the tables we attach: z first, then t

Next steps

Friday, February 12: Lab 6

Quiz, as midterm review. Bring a calculator

Tuesday, February 16

The midterm, in class. Bring a calculator and your notes

Sunday, February 14 at 6 PM: Mastery and Problem Set for Chapter 9