Panel 1

#6 from exam: Data 10, 8, 12, 10 Find 95% confidence interval.

(1) $\bar{x}, s$

x	x^2
10	100
8	64
12	144
10	100
40	408

$$s^2 = \frac{1}{n-1}\left(\sum x^2 - \frac{(\sum x)^2}{n}\right) =$$

$$s^2 = \frac{1}{3}\left(408 - \frac{40 \cdot 40}{4}\right) = \frac{8}{3} = 2.6$$

a) $\bar{x} = \frac{40}{4} = 10$, $s = 1.64$

b) 10

c) $s/\sqrt{n} = \frac{1.64}{\sqrt{4}} = 0.82$

d.) Multiplier. 1.96 $\Rightarrow$ $\bar{x} \pm 1.96 \cdot 0.82$

$10 - 1.96 \cdot 0.82 = 8.39$

$10 + 1.96 \cdot 0.82 = 11.61$

1

Panel 2

Multiplier for Confidence interval

	large samples ($n > 30$)	small samples ($n < 30$)
90%	1.645	t-table
95%	1.96	$df = n-1$
99%	2.54	degree of freedom
	(z-table)	

Multiplier is based on Central Limit Theorem, which works better if sample size is large. Sample size should be > 30.

Thus, the previous computation is not good, because $n < 30$ ($n=4$).

2

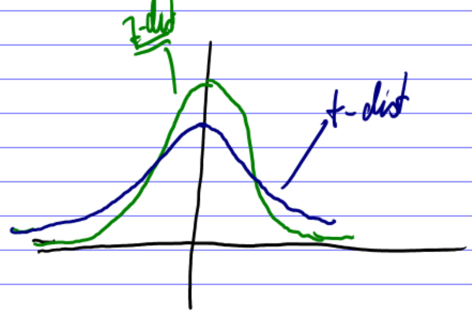
Panel 3

For $n=4$, $df = n-1 = 3$, 95% confidence interval gives

(3) Multiplier: 3.182

So $\bar{x} \pm 3.182 \cdot 0.82$ → $10 - 2.6 = 7.4$, $10 + 2.6 = 12.6$

t-distribution (p. 593 in book) is more "conservative" than $N(0,1)$



3

Panel 4

Confidence Intervals

(1) $\bar{x} = \#$, $s = \#$

(2) standard error $s/\sqrt{n}$

(3) Multiplier
- $n > 30$: z-table, i.e. 1.645, 1.96, 2.58
- $n < 30$: t-table with $df = n-1$

(4) Compute $\bar{x} - \text{mult.} \cdot s/\sqrt{n}$, $\bar{x} + \text{mult.} \cdot s/\sqrt{n}$

4

Panel 5

Example: 95% for Age of US citizens

z table

95% confidence interval results:

μ : mean of Variable

Std. Dev. not specified

Variable	n	Sample Mean	Std. Err.	L. Limit	U. Limit
AGE	2013	47.708397	0.38672173	46.950436	48.466354

46.95 to 48.47

(A) larger

(B) smaller

95% confidence interval results:

μ : mean of Variable

Variable	Sample Mean	Std. Err.	DF	L. Limit	U. Limit
AGE	47.708397	0.38672173	2012	46.949978	48.466812

~~46.95 to 48.47~~

n is very large, so both answers are the same!

5

Panel 6

You want to estimate μ: confidence interval

Want to know if a given mean μ is correct:

Hypothesis Testing

(German: fett)

Ex: You buy 2% milk. That really means that average fat content of this type of milk is 2.0%.

Manufacturer's claim: you suspect it is a lie!

6

Panel 7

To prove him wrong: get $n = 100$ gallons of "2%" milk,

measure $\bar{x}$ fat content of your sample

say $\bar{x} = 1.99999$ → probably 2% is not a lie.

$\bar{x} = 1.5$ → he is lying

Want to formalize this: Stat. Test

7

Panel 8

All Statistical Tests have 4 components:

1. Null-Hypothesis H_0: (status quo assumption)
2. Alternative Hypothesis H_a: (what you suspect is true)
3. Test statistics: (some number)
4. Compute probability "that H_0 is true even though you reject it"

8

Panel 9

Ex: Machine dispenses coffee with caffein content 109 mg. according to the manufacturer. You think this is not true!

Select sample of $n = 81$ cups and find $\bar{x} = 110$, $s = 5.0$

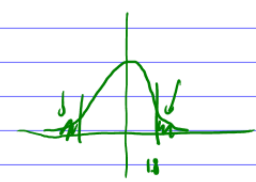
$H_0: \mu = 109$ i.e. manufacturer is right as default.

$H_a: \mu \neq 109$

assume H_0 is true

Compute $z = \dfrac{\bar{x} - \mu}{s/\sqrt{n}} = \dfrac{110 - 109}{5/\sqrt{81}} = \dfrac{1}{5/9} = 9/5 = \underline{1.8}$

Compute $2P(z > 1.8) = 2 \cdot 0.0359 = \underline{0.07}$



9

Panel 10

Two possible answers: $\Rightarrow$ reject H_0 and accept H_a if p small

$\Rightarrow$ test is inconclusive

Test about Mean:

$H_0: \mu = \#$

$H_a: \mu \neq \#$

$z = \dfrac{\bar{x} - \mu}{s/\sqrt{n}}$

$p = 2P(z > \#)$ If $p < 0.05$, reject H_0 and accept H_a else inconclusive.

10