this inference time: for μ

next inference time: for p

read: DD ch. 1-11 (B)
DD ch. 1-3 (A)

read: LN pp. 137-16

AMS 7
8 May 18

today: ① LN pp. 137→

$\boxed{Q_1}$ Is the difference between 25.0°C ($\bar{y}$) & 24.3°C (theoretical mean) practically significant? (large in biological terms)

$\boxed{A_1}$ (best) consult an expert on (intertidal) crabs)

(helpful)

$$\frac{25.0°C - 24.3°C}{24.3°C} = \frac{0.7\cancel{°C}}{24.3\cancel{°C}} \doteq 2.9\%$$

Is a 2.9% diff. between data & theory big enough to matter?

Rough rule of thumb:

relative differences of 5% or more are often (but not always) pract sig;

relative differences smaller than 5% can still be pressing if they accumulate over time

intertidal crabs

pop.

all crabs similar to those in sample in all relevant ways

sample

the observed crabs

image data

inference

e. temp.

N = ?
(big)

like [redacted] SRS

= IID

e. temp.

25.8

⋮

25.4

n = 25

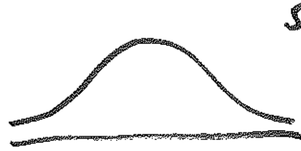
mean $\bar{y} = 25.0°C$

SD $s = 1.34°C$

mean $\mu = ?$

SD $\sigma = ?$

pop hist.



sample hist

to specify pop., answer this $\boxed{Q:}$ what is the broadest scope of valid generalizability outward from the sample dataset?

hypokalemia

pop.
whole
known
general

at random
(IID)

sample
part
unknown
specific = particular

$\bar{y}$ = unknown (?)

$\boxed{\text{probability}}$
(easier)

μ = known $\left(\begin{array}{c}\text{deductive}\\ \text{reasoning}\end{array}\right)$ = (deduction)

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crabs

pop.
whole
unknown
general

IID

sample
part
known
particular
$\bar{y}$ = known

$\boxed{\text{statistics}}$
(harder)

μ = unknown (?) $\left(\begin{array}{c}\text{inductive}\\ \text{reasoning}\end{array}\right)$ = (induction)

= (statistical) inference

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crabs inferential summary

pop.	unknown pop. quantity of main interest	μ = pop. mean internal temp. after equil. to 24.3°C
sample	estimate of μ	$\bar{y}$ = 25.0°C
[illegible]	give-or-take for $\bar{y}$ as est. of μ	$\hat{SE}(\bar{y}) = \frac{s}{\sqrt{n}} \doteq 0.27°C$
	95% conf. interval	$\bar{y} \pm (2.064)(0.27°C) = (24.44°C, 25.56°C)$

(25.0°C − 0.56°C, 25.0°C + 0.56°C)

④

pop | sample | imag. data

all possible values of $\bar{y}$

actual like IID

y

$\begin{bmatrix} y_1 \\ \vdots \\ y_n \end{bmatrix}$ $n = 25$

mean $\bar{y} = 25.0°C$

(*) SD $s = 1.34°C$

mean $\mu = ?$

SD $\sigma = ?$

pop. hist.

hyp. IID

$n = 25$

mean $\bar{y} = ?$

(ex. 25.2°C)

$\begin{bmatrix} 25.0°C \\ 25.2 \\ \vdots \end{bmatrix}$ $\bar{y}$

$M \to \infty$

long run mean

EV of $\bar{y}$ = μ

est. long run SD

$\hat{SE}$ of $\bar{y}$ = $\frac{s}{\sqrt{n}} = 0.27°C$

long run hist.

$\hat{SE}$ 0.27°C

**

μ

expected value

EV of $\bar{y}$

R-22

$= E_{IID}(\bar{y}) = \mu$

sig. or take for $\bar{y}$

or est. of μ

(standard error of $\bar{y}$) = SE of $\bar{y}$

$= SE_{IID}(\bar{y}) = \frac{\sigma}{\sqrt{n}}$

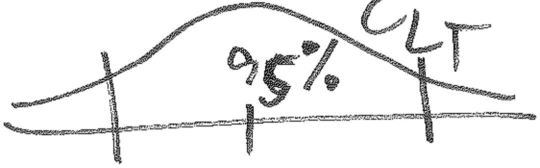
$\boxed{\hat{SE}(\bar{y}) = \frac{s}{\sqrt{n}}} = \frac{1.34°C}{\sqrt{25}} \doteq 0.27°C$ really important

estimated SE of $\bar{y}$ (formula

stat. inf as of 1907

William Gosset (1908)
- hops
- yeast
- barley
- water

$\hat{SE}$ 0.27°C

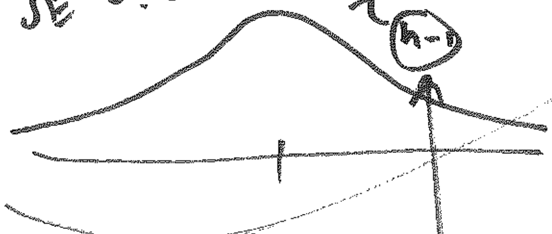


long run hist. of $\bar{y}$

μ

$\hat{SE}$ 0.27°C

t_{n-1} curve

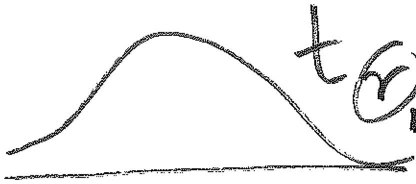


long run hist of $\bar{y}$, accounting for uncertainty in σ

μ

degrees of freedom

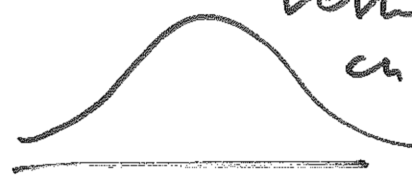
$\boxed{n = 25 \quad n-1 = 24}$



t_ν curve

nu "new"

$\rightarrow$



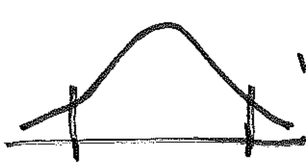
normal curve

as $\nu \to \infty$

t table p. L-142

t_{24} curve

−2.064 +2.064

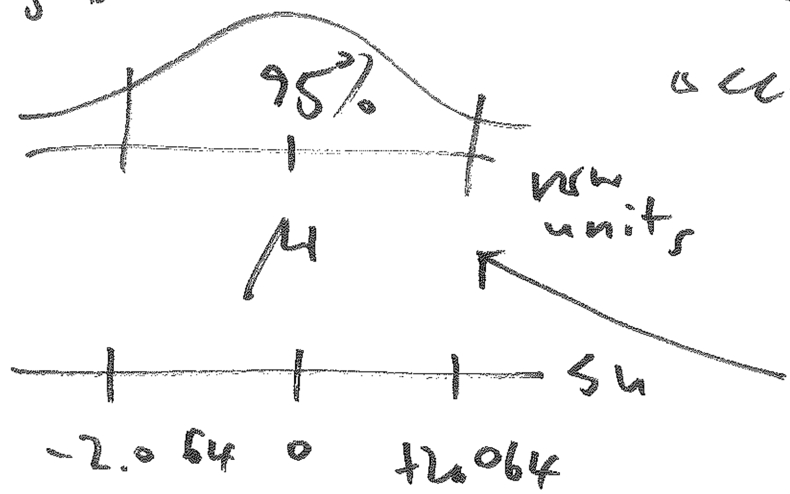


normal curve

−1.96 +1.96

$\hat{SE}$ 0.276

l.r. hist. of $\bar{Y}$, accounting for uncertainty in σ



$\mu + 2.064\,\hat{SE}$

$= \mu + (2.064)(0.276)$

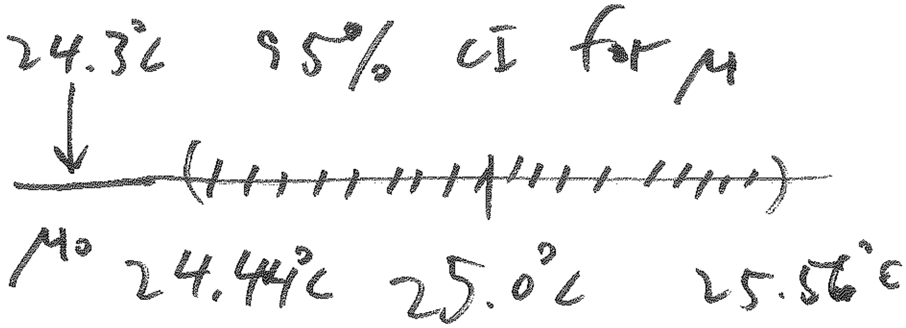
$$P_F\left(\mu - 2.064\,\hat{SE} \le \bar{Y} \le \mu + 2.064\,\hat{SE}\right) \doteq 95\%$$

↑ rel. freq.

Neyman's confidence trick

$$P_F\left(\bar{Y} - 2.064\,\hat{SE} \le \mu \le \bar{Y} + 2.064\,\hat{SE}\right) \doteq 95\%$$

Let's use $\bar{Y} \pm \underbrace{2.064}_{t_{n-1}^{0.95}}\,\hat{SE}$ as a 95% confidence interval for μ (CI)



μ_0 = theory value of μ = 24.3°C

at 95% level of confidence, the theory value of 24.3°C is <u>not</u> supported by the data; the diff. between $\bar{y}$ (25.0°C) & μ_0 (24.3°C) <u>is</u> <u>statistically significant</u> (statsig)