AMS 7
27 Oct 15
①

this time: point & interval estimation for means & proportions

read: LN pp. L 161 - L 173

next time: sample size determination; testing

today: LN pp. L-137 →

if your regular disc. sec. is on Friday, go to section (will help with midterm), turn in midterm by midnight Fri in box outside Baskin 357 c

$\boxed{Q1}$ is the diff. between $\bar{y} = 25.0°C$ & theory temp 24.3°C large in practical terms (practically significant)?

$\boxed{A.}$ Not clear on biological grounds, but

$$\frac{25.0°C - 24.3°C}{24.3°C} = \frac{+0.7°C}{24.3°C} = \text{about a } 3\% \text{ increase}$$

hard to tell

pop

all intertidal crabs similar to sampled in all relevant ways,

body temp (°C)

$N = ?$ (big)

mean $\mu = ?$

SD $\sigma = ?$

pop. hist.

equil. to 24.3°C

actual like SRS ≐ IID

sample

the observed intertidal crabs

body temp (°C)

25.8

24.6

⋮

25.4

$n = 25$

mean $\bar{y} = 25.0$°C

SD $s = 1.34$°C

sample hist

hypothetical IID

$n = 25$

hyp IID

mean $\bar{y} = ?$

(ex. 24.8°C)

$n = 25$

mean $\bar{y} = ?$

(ex. 25.4°C)

⋮

imag data

possible values of $\bar{y}$

25.0°C

24.8

25.4

⋮

$M \to \infty$

long run mean

EV of $\bar{y}$ $= \mu$

est. long run SD

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

SE 0.27°C

CLT

long run hist.

μ

EV

(easier) (random)

pop probability sample

(whole) (deduction) → (part)

(general) (particular)

(induction)

(statistical) (inference)

statistics

(harder)

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inferential summary

(imag. data) + (sample) (pop.)

unknown (pop.) quantity of main interest	μ = mean body temp (°C) of all pop. crabs if equilibrated to 24.3°C
(point) estimate of μ	$\bar{y} = 25.0°C$
give or take for $\bar{y}$ as an estimate of μ	$\hat{SE}(\bar{y}) = \frac{s}{\sqrt{n}} \doteq 0.27°C$
95% interval for μ	$\bar{y} \pm 2\,\hat{SE}(\bar{y}) = (24.4, 25.5)$

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

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

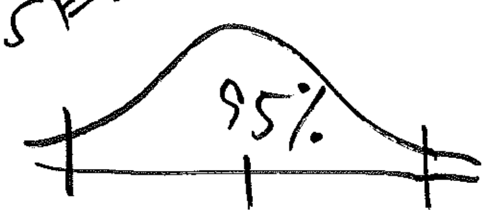
noise = uncertainty

hat

estimated SE of $\bar{y}$ = $\boxed{\widehat{SE}_{IID}(\bar{y}) = \frac{s}{\sqrt{n}}}$

$= \frac{1.34°c}{\sqrt{25}} = 0.27°c$

SE 0.27°c



$\mu - 2(0.27°c) = \mu - 2\frac{s}{\sqrt{n}}$ $\quad$ μ EV $\quad$ $\mu + 2(0.27°c) = \mu + 2\frac{s}{\sqrt{n}}$

-2 $\quad$ 0 $\quad$ +2 $\quad$ SU(z)

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

about 95% of the time, $\bar{y}$ will fall within 2 $\widehat{SE}$ of μ

therefore $\boxed{\bar{y} \pm 2\,\hat{SE}(\bar{y})}$ is a good interval guess for μ (μ is 95% highly likely to be in that interval)

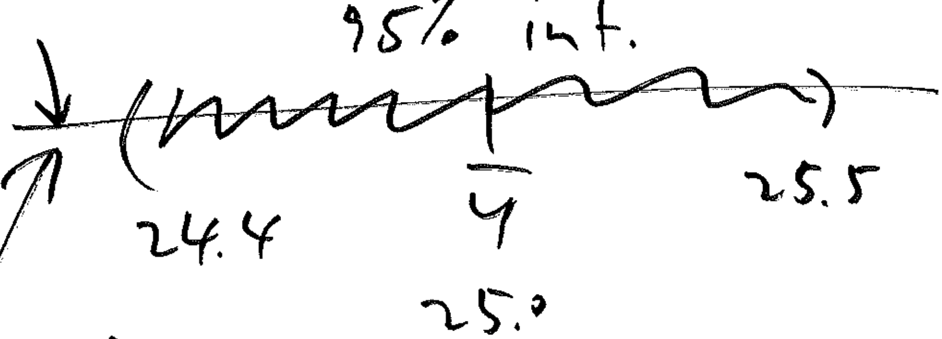
Jerzy (Jerry) Neyman (? - 1981)

(1927)

a 95% (confidence) interval for μ

$25.0°C \pm 2\underbrace{(0.27°C)}_{0.54°C}$ Approx.

$(24.4°C, 25.5°C)$

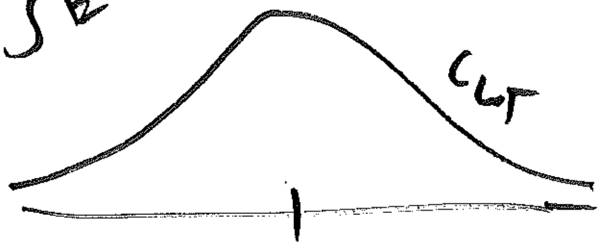


Since theory value (24.3) is not in 95% int, data do not support theory

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

approx.

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



we cheated by replacing σ with s

1908

William Gossett

brewer @ Guinness

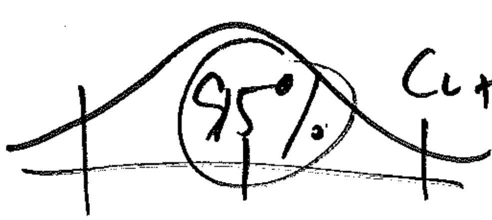
& data analyst

"Student"

correct curve

degrees of freedom (d.f.)

with n obs, use $\boxed{t_{n-1}\ (d.f.)}$



25.0°C ± 2 $\hat{SE}$

$\bar{y} \pm 2.064\ \hat{SE}$

t_{n-1}