-Check grades on WebCT
-lab 3 due next Fri.

Statistical Inference
10/28/08

- Case Study: Intertidal crabs (p. 139)
- Probability (deductive) reasoning - reasoning from the whole population to the sample
- Statistical Inference - resoning from the sample to the whole population
- Making the model:

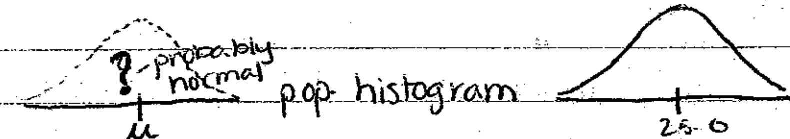
Population: all relevent crabs (need to talk to the biologist)

Sample: observed crabs

body temp. at which they equilibrate

N = big $\xrightarrow[\text{= IID}]{\text{like SRS}}$ $n = 25$

mean = μ | mean = $\bar{y}$ = 25.0 °C
SD = σ | SD = s = 1.39 °C



pop. histogram | Sample histogram

-Inferential summary:

pop.	unknown pop. quantity of main interest	μ = pop mean body temp. at which these crabs equilibrate to 24.3 °C
sample	Estimate of μ	25.0 °C (from sample $\bar{y}$)
	give or take for $\bar{y}$ as estimate for μ	$\widehat{SE}_{IID}(\bar{y}) = s/\sqrt{n}$ = .27 °C
	95% CI for μ	$\bar{y} \pm 2.064 \frac{s}{\sqrt{n}}$ = (24.5, 25.5) °C

} need to look at imaginary data set

I think μ is around 25 °C, give or take .27 °C.

→

Imaginary ← hypothetical random samples

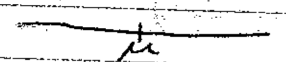
Possible $\bar{y}$

$\begin{bmatrix} 25.0 \\ 24.8 \\ \vdots \end{bmatrix}$ M (# of rows in imaginary data set)
↳ goes to ∞ (long run)

long-run mean (expected value) = μ

est. long-run ~~sample~~ standard deviation (standard error) = .27°C

long-run histogram of $\bar{y}$:



- expected value ($\mathcal{EV}$ of $\bar{y}$)($\mathcal{E}_{IID}(\bar{y})$) : μ
  (formula 3, p. 25)
- Standard error of $\bar{y}$ ($S\mathcal{E}$ of $\bar{y}$)($S\mathcal{E}_{IID}(\bar{y})$):
  $\sigma / \sqrt{n}$ (best guess for σ = s)
  ↳ $s/\sqrt{n}$ (estimated standard error)

standard error "hat" = estimate ⟶ $\hat{S\mathcal{E}}_{IID}(\bar{y}) = 1.34/\sqrt{25} = .268$°C

- long-run histogram of $\bar{y}$, accounting for uncertainty of σ (because we used s to determine $\hat{S\mathcal{E}}(\bar{y})$ since σ was unknown). Use "t-curve."
  * as n gets larger, the t-curve approaches the normal curve

Developed by Gosset ⟶  ← t-curve w/ n-1 degrees of freedom

- more area under tails than in normal curve.
- to find areas under t-curve, use t-table (p. 142)

- Confidence Intervals (Neyman) - interval on number line at which we're pretty (95%) confident that μ can be found in
  - start at $\bar{y}$, go to $t_{n-1}^{.95}\,\hat{S\mathcal{E}}$ either way →

95% CI for μ: $\bar{y} \pm t_{n-1}^{.95} \hat{SE}$
$= 25.0 \pm 2.064\,(.27)$
$= (24.5,\ 25.5)$

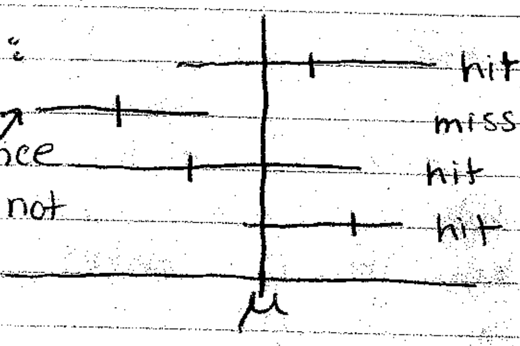
(formula 5, p. 25)

- Can make different confidence intervals by using different t values (i.e. 90%, 99%, etc.)
    - to get higher confidence interval, amount of data contained will go up as well.
- because the value 24.3°C is outside our 95% confidence interval, we do not support this scientist's theory.

- Statistically significant - when μ_0 is not in 95% CI, the difference is stat sig
- Highly statistically significant - when μ_0 is not in a 99% CI, the difference is highly stat sig.
- Practically significant - depends on outside information (i.e. is the difference between 24.3°C and 25°C practically significant? Need to understand the effects of change in temperature on the crabs.)
    - Needs to be first question. If difference is not practically significant, it doesn't matter if its statsig.
- Real significant difference - hard to attribute to unlucky random sampling (we know our difference is real because we did a 95% CI)
- Meaning of confidence interval - if we were to repeat this process over + over, then 95% of the time, the true pop. mean μ will fall within the confidence interval, and 5% of the time it won't →

Visually:

This confidence interval does not include μ!



$\therefore$ we do not know if our CI is one of the hits, but we assume that 95% of the time it will be.

- our confidence is in the process of creating the CIs, not in any one CI.