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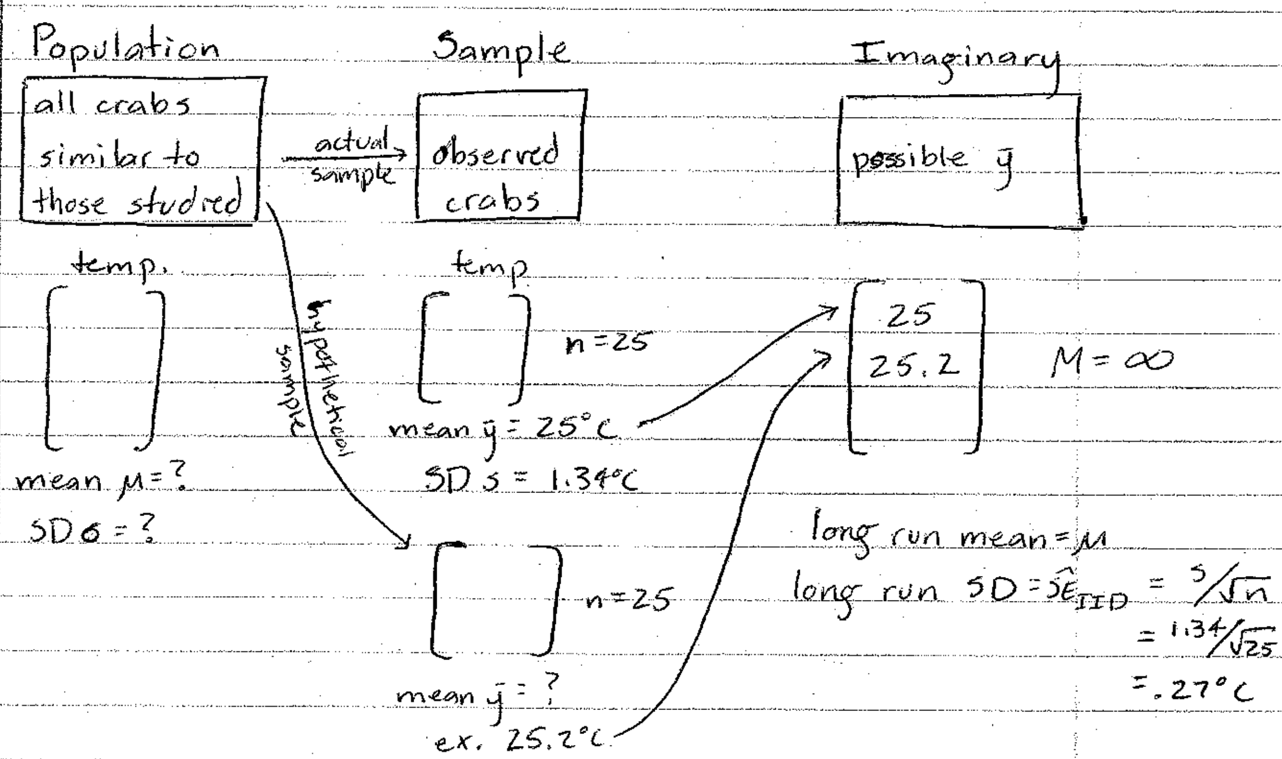
Chapter 4: Statistical Inference

- Confidence Intervals

• Case Study: Intertidal Crabs
  - theory: body temp. should be 24.3°, but we got 25°



* unlike in chapter 3, where the population mean μ was known and we were trying to find the sample mean $\bar{y}$, here the sample mean $\bar{y}$ is known and we are trying to find the true value of the population mean μ.

* Crucial distinction between probability and statistics:
  · when a population is known and you're wondering how a random sample from it might come out, that's <u>probability</u>.

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- when a sample is known and you're wondering what population it might have come from, that's <u>statistics</u>.

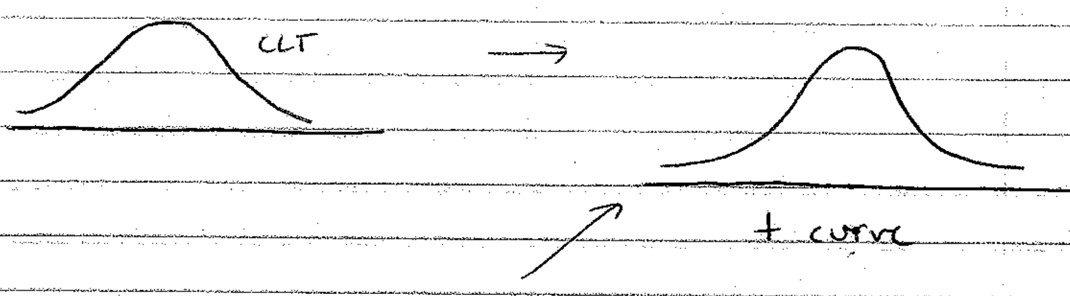
* In our crab example, we will be using statistics
  - Inductive reasoning (inference)
    - backwards from sample to population.

<u>Inferential Summary</u>

population	Unknown pop. quantity of interest	μ = pop. mean temp. when intertidal crabs would equilibrate
sample	Estimate of μ	$\bar{y} = 25°C$
Imaginary	Give or take for $\bar{y}$ of μ	$SE(\bar{y}) = \frac{s}{\sqrt{n}} = .27°C$
	95% CI for μ	$\bar{y} \pm (t_{n-1}^{.95}) s/\sqrt{n} = (24.4, 25.6)$

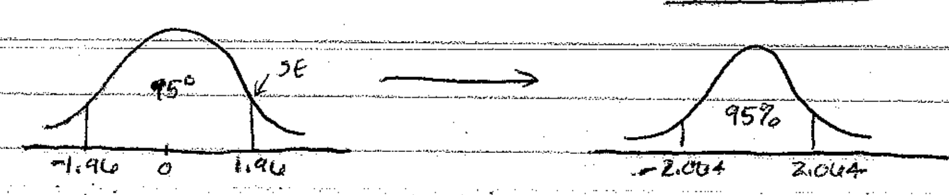
long run histogram of $\bar{y}$:

long run hist. of $\bar{y}$ <u>accounting for uncertainty in σ</u>:



* Right histogram = t_{n-1} curve on $(n-1)$ degrees of freedom

<u>Normal</u> <u>T_{24} Curve</u>



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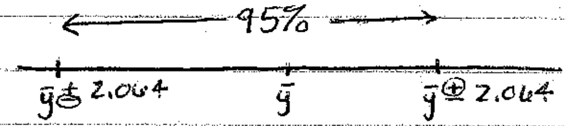
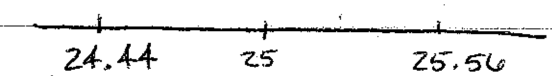


- 95% = confidence interval (CI) for μ: $\bar{y} \pm \underbrace{(t_{n-1}^{.95})}_{2.064} \underbrace{\hat{SE}(\bar{y})}_{\frac{s}{\sqrt{n}}}$

- for our example:



- So, should μ really be 24.3 for the crabs? no, because 24.3 is not in our 95% confidance interval

- look and see if μ_0 (theoretical) is in the 95% CI or not. If not, data do not support theory of 95% confidence level. If it is in interval, data do support it at that level.

- difference between μ_0 (24.3°C) and $\bar{y}$ (25°C) is statistally significant (large in statistical terms) because 24.3°C is not in 95% CI.