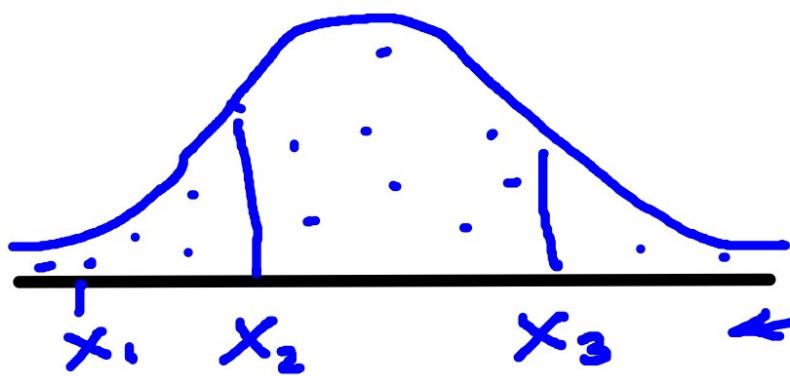


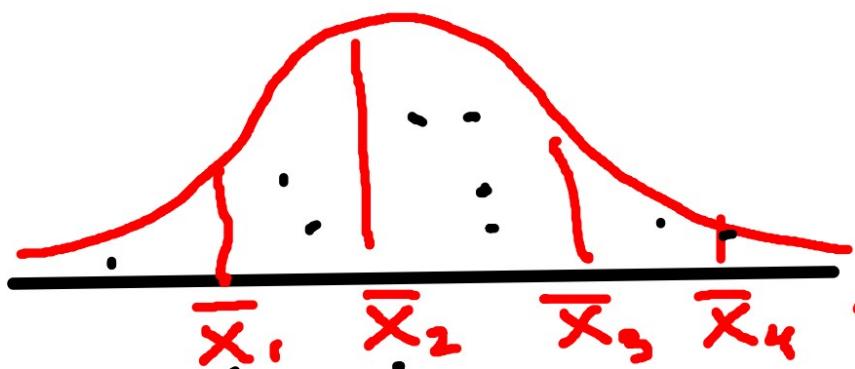
sample size  $n=1$

Population Distribution



individual data values

Sampling Distribution



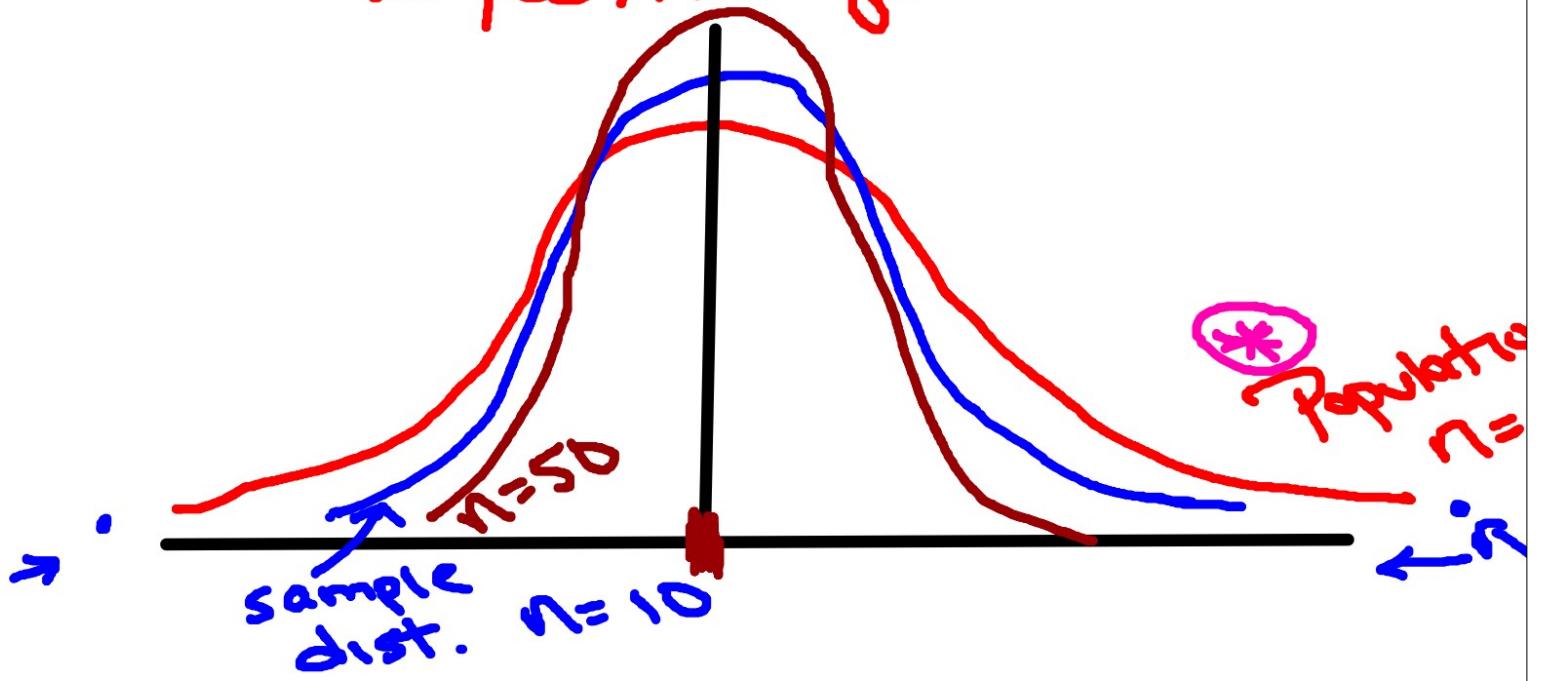
$n = 10$

means of a sample

Population	<u>Statistic</u>	Sample
(mu) $\mu$	<u>MEAN</u>	$\bar{X}$
(sigma) $\sigma$	STANDARD DEVIATION	$S$
P	Proportion	$\hat{P}$
Pop. size $\rightarrow N$	Sample size	$n$ ↗

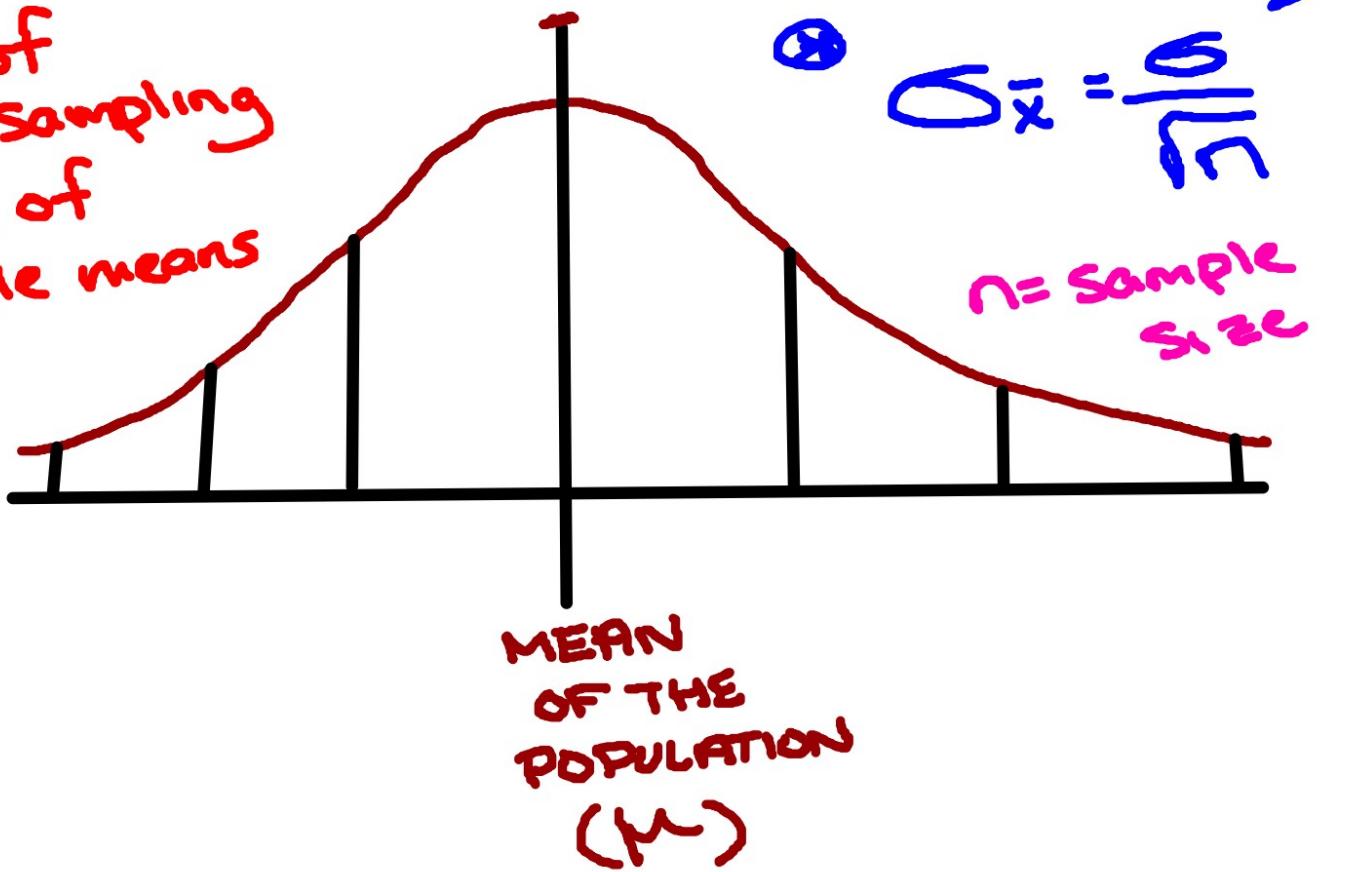
Quantitative Data (MEANS)  
\*unit of measure

Categorical Data (Proportions)  
\*yes/no questions



## Sampling Dist. for sample means ( $\bar{x}$ )

S.D. of  
the sampling  
dist. of  
sample means



\* Sketch a normal distribution for the sampling dist. of sample means, given the mean test score is 500 and the S.D of the population is 100 ( $\sigma$ ) for a sample size of  $n=25$ .

③

$$S\bar{x} = \frac{S}{\sqrt{n}} = \frac{100}{\sqrt{25}} = \frac{100}{5} = 20$$



68% of samples of size 25, would give an  $\bar{x}$  between 480 & 520.



Sampling  
Dist

$$\underline{400}, \underline{500} \Rightarrow \bar{x} = 450$$

$$\underline{500}, \underline{600} \Rightarrow \bar{x} = 550 \quad \bar{n}=2$$

$$\underline{400}, \underline{600} \Rightarrow \bar{x} = 500$$

$$400, 500, 600 \\ \bar{x} = 500$$

$$\bar{x} = 500 \quad \checkmark$$

$\bar{n}=3$

## \* Conditions for formulas (Universal Conditions)

Sampling Dist. for  
sample means ( $\bar{x}$ )

$$*\mu_{\bar{x}} = \mu$$

$$*\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

Independence Condition 1. Random Sample ✓  
Condition 2.  $\underline{10n} < \text{Population Size}$  ✓

## \* Normality Check \*

Check if the distribution is  
not known to be normal.

Quantitative Data: ③  $n \geq 30$   
("n" is at least 30)

## \* Central Limit Theorem (CLT)



$n = 30$  \* If  $n \geq 30$   
then our sampling  
d.st. is approx.  
NORMAL

Herpetologists (snake specialists) found that a certain species of reticulated python have an average length of 20.5 feet with a standard deviation of 2.3 feet. The scientists collect a random sample of 30 adult pythons and measure their lengths. In their sample the mean length was 19.5 feet long. One of the herpetologists fears that pollution might be affecting the natural growth of the pythons. Do you think this sample result is unusually small? Explain.

$$\textcircled{1} \quad \mu = 20.5$$

① Random Samp. ✓

②  $10n < \text{Pop. Size}$  ✓

$$\sigma = 2.3 \checkmark$$

$$\begin{aligned} \checkmark n = 30 \checkmark & \quad \text{FOR } n: \quad * \mu_{\bar{x}} = \mu = 20.5 \checkmark \\ & * \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{2.3}{\sqrt{30}} \approx 0.42 \end{aligned}$$

$$\checkmark \bar{x} = 19.5$$

③ \* Normality Check:  $n \geq 30 \checkmark$

$$Z = \frac{\bar{x} - \mu}{\left(\frac{\sigma}{\sqrt{n}}\right)} = \frac{19.5 - 20.5}{0.42} \approx -2.38 \quad \begin{array}{l} (.0087) \\ \hline .8710 \end{array}$$

$$\underline{.0087} \approx .871.$$

\* There is a .871. chance we would get a sample mean of 19.5 feet or less if the population mean is 20.5.



Standardized  
value

(Sample)      (population)  
statistic - parameter  
\* S.D of  
statistic

Statistic → Sample

$(\bar{x})$

$$Z = \frac{\bar{x} - \mu}{\left(\frac{\sigma}{\sqrt{n}}\right)}$$

Parameter → population

$(\mu)$

SD of stat :  $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

# Categorical Data (Proportions)

Sampling Dist. for Sample Proportion

\* Formulas:  $\mu_{\hat{p}} = p$

$$\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$$

\* Normality Check:  $np \geq 10$  (MEMO!)  
 $n(1-p) \geq 10$

1. It is generally believed that electrical problems affect about 14% of new cars. An automobile mechanic conducts diagnostic tests on 128 new cars on the lot.

(NORMAL)

- a. Describe the sampling distribution for the sample proportion by naming the model and telling its mean and standard deviation. Justify your answer.

$$P = .14$$

$$n = 128$$

- Random Samp. ✓
- $10n < \text{Pop. Size}$  ✓

$$\hat{\mu}_p = p = \boxed{.14}$$

\* When NO S.D is given  
you generally are  
dealing with  
proportions.

NORMALITY

$$np \geq 10$$

$$128(.14) \geq 10$$

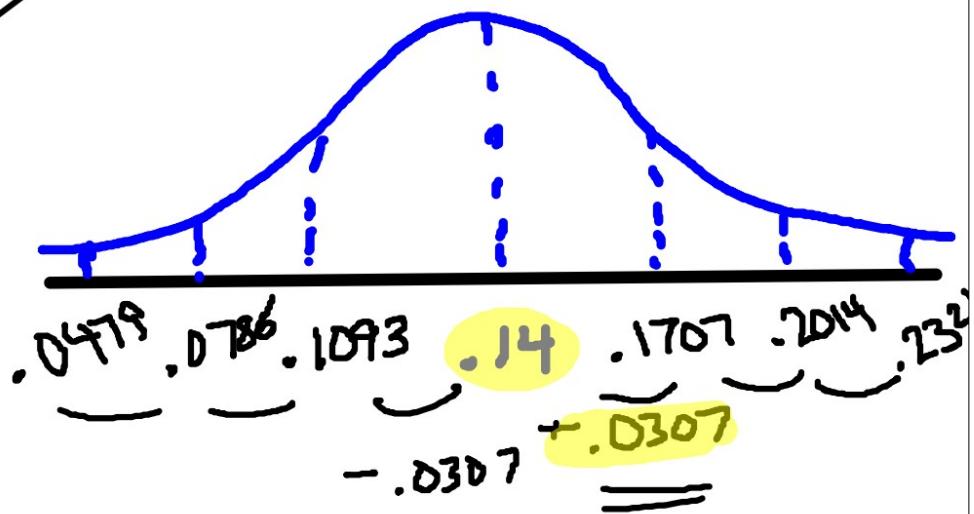
$$n(1-p) \geq 10$$

$$128(.86) \geq 10$$

$$\hat{\sigma}_p = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{(0.14)(0.86)}{128}} \approx \boxed{0.0307}$$

$$\hat{\mu_p} = .14 \quad \checkmark \text{ (NORMAL)}$$

$$\hat{\sigma_p} = \underline{\underline{.0307}} \quad \checkmark$$



b. Sketch and clearly label the model.

- c. What is the probability that in this group over 18% of the new cars will be found to have electrical problems?

$$n = 128 \quad \hat{p} = .18 \quad Z = \frac{\hat{P} - P}{\sigma_{\hat{P}}}$$

$$P = \mu_{\hat{P}} = .14$$

$$\sigma_{\hat{P}} = .0307 \quad Z = \frac{.18 - .14}{.0307} = 1.30 \quad (.9032)$$

over 18%

$$* 1 - .9032 \approx .0968 \leftarrow \text{prob}$$

1) A population of manufactured products where the random variable  $X$  is the weight of the item. Prior experience has shown that the weight has a distribution with mean 5.0 ounces and standard deviation of 2.0 ounces. (NORMAL) ✓

a. What is the probability that the weight of an item randomly selected will be more than 6.5 ounces?

$$n = 1 \quad \text{Sample} \quad \equiv$$

b. Using proper notation, show the distribution of  $\bar{x}$  ↗ sample mean

c. What is the probability that if the manufacturer takes a sample of 100 items, that it has a mean weight between 5.1 and 5.5 ounces?

$$\mu = 5$$

$$a) Z = \frac{6.5 - 5}{2} = \frac{1.5}{2} = .75$$

$$\sigma = 2$$

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{2}{\sqrt{100}} = 0.2$$

$$1 - .7734 \\ * .2266$$

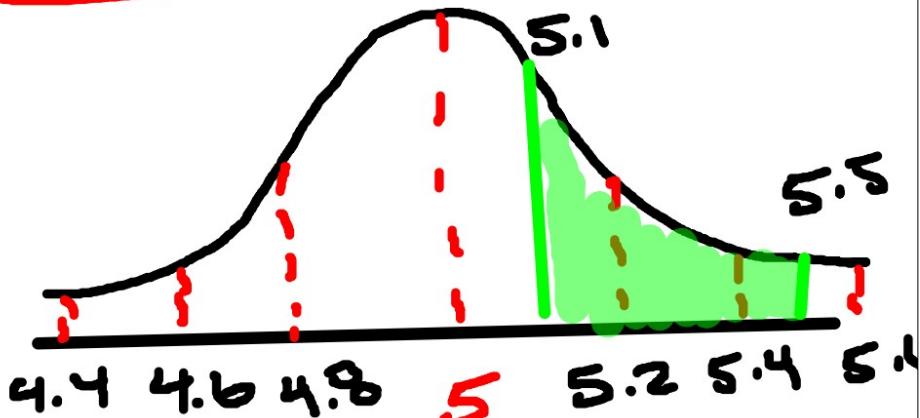
.7734

b. Distribution of  $\bar{x}$  (NORMAL)  
for a sample size of 100.

$$\mu = 5$$

$$\sigma = 2$$

$$n = 100$$



$$*\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{2}{\sqrt{100}}$$

$$z = \frac{5.1 - 5}{2} = .5 \quad (.6915)$$

$$\sigma_{\bar{x}} = .2$$

$$z = \frac{5.5 - 5}{2} = 2.5 \quad (.9938)$$

$$.9938 - .6915 \approx .3023$$

① Decide if the data is  
Categorical (proportion) or  
quantitative (means)

- Know the two universal conditions
  - Normality check for proportions & means  $\leftarrow$   
 $n \geq 30$
- $$np \geq 10$$
- $$n(1-p) \geq 10$$

- How to calculate mean & SD of sampling dist. (Formulas)   
 for means & proportions

$$\mu_{\bar{x}} = \mu$$

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

$$\mu_{\hat{p}} = p$$

$$\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$$

- Use the formulas to calculate Z-Scores.