Sec 7.1

Success Criteria

- Know difference between a parameter and a statistic
- Simulate a sampling distribution

Population

All "individuals" about which we want to draw a conclusion

Parameter

A fixed number (mean μ, proportion p, standard deviation σ) that describes a population... exact value seldom known

Sample

Subset of a population obtained through an SRS (to reduce bias)

Statistic

- A number (mean $\bar{x}$, proportion $\hat{p}$ ← p-hat, standard deviation s) that describes a sample
- Varies depending on sample (Random Variable)

Goal of Inference

$\bar{X} \longrightarrow \mu$

$\hat{p} \longrightarrow p$

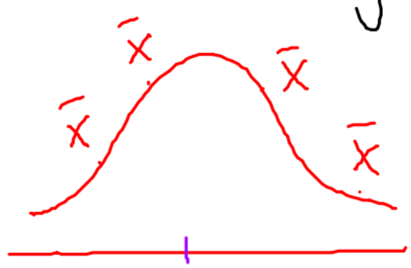
$s \longrightarrow \sigma$

Making A Sampling Distribution

1) Take large # samples of same size

2) Calculate mean ($\bar{x}$) or proportion ($\hat{p}$) for each sample

3) Make histogram of every $\bar{x}$ or $\hat{p}$



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

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

?

Unbiased Estimator

If the center (mean or median) of a sampling distribution equals the true value of a population parameter then the statistic is considered an Unbiased estimate

Simulation (Heights Of 16yo Females)

$\downarrow$ National Center for Health Statistics

$N(64'', 2.5'')$

Simulation (Heights of 16yo Females)

1) Get heights from 50 random 16yo females

$\boxed{\text{MATH}}$ → PRB → randNorm (64, 2.5, 50) → $\boxed{\text{STO}}$ → L_1

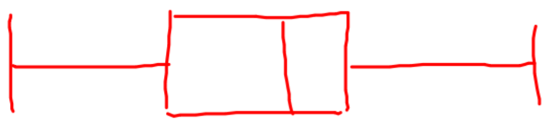
2) Calculate $\bar{x}$ of sample

$\boxed{\text{STAT}}$ → CALC → 1-Var Stats (L_1)

3) Get $\bar{x}$'s from <u>many</u> student samples

Simulation (Cont)

4) Examine shape of $\bar{x}$'s:



> symmetric

5) Compare mean/standard deviation of x's to population parameters

$\mu_{\bar{x}} = 63.87 \approx \mu = 64$

$\sigma_{\bar{x}} = .34 \rightarrow$ Smaller than σ of 2.5

Ex Survivor (P. 424, Figure 7.7)

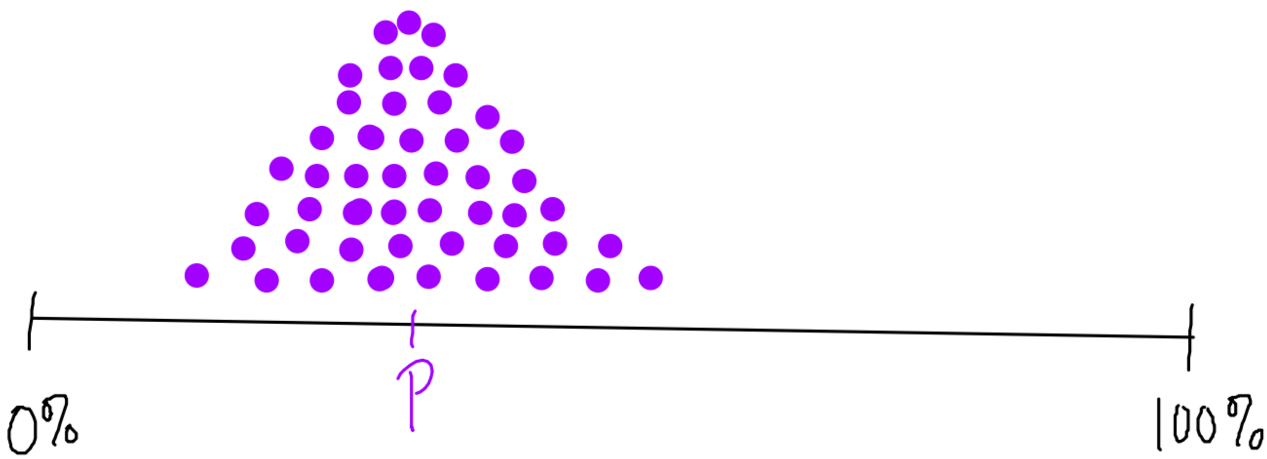
Larger samples produce less variability

Sec 7.2

Success Criteria

- Calculate mean and standard deviation of a distribution of sample proportions
- Determine if a distribution of sample proportions is Normal
- Calculate probabilities from a Normal distribution of sample proportions

Ex What proportion of LN students own an iPhone?

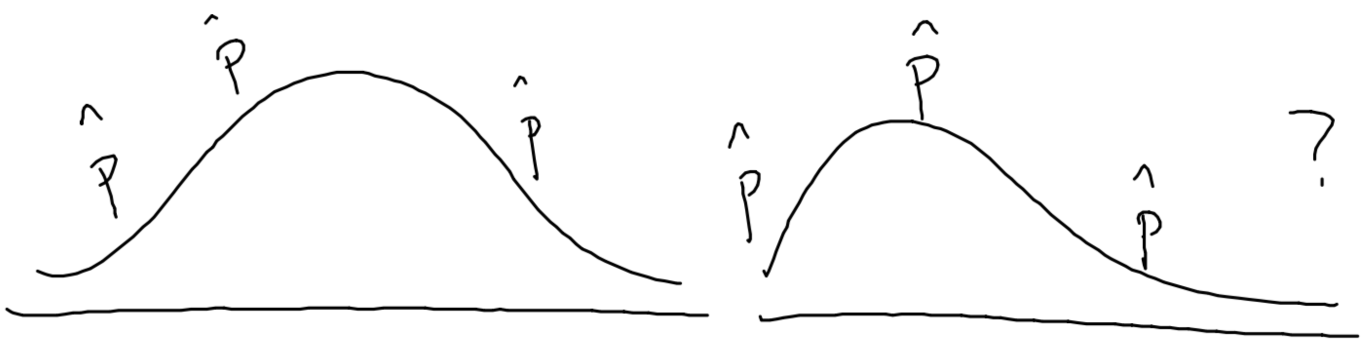


$\hat{p}$ • Proportion of sample (n = 200) owning an iPhone

Sampling Distribution of $\hat{p}$

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

2) $\sigma_{\hat{p}} = \sqrt{\dfrac{p(1-p)}{n}}$ if $N > 10n$



Sampling Distribution of $\hat{p}$

3) Approximately Normal if:

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

Sample proportions are fundamentally binomial...

Ex An SRS of 1540 adults were asked "Do you jog?" Assuming 15% of all adults jog, what is the probability that less than 13% of the adults in this sample jog?

1) Check for a normal sampling distribution:

$np \geq 10?$ $\quad$ $n(1-p) \geq 10?$

$(1540)(.15) \geq 10?$ $\quad$ $(1540)(.85) \geq 10?$

$231 \geq 10$ ✓ $\quad$ $1309 \geq 10$ ✓

2) Check if it's safe to use Stand Dev formula:

$N > 10n?$

$N > 10(1540) > 15{,}400$ adults ✓

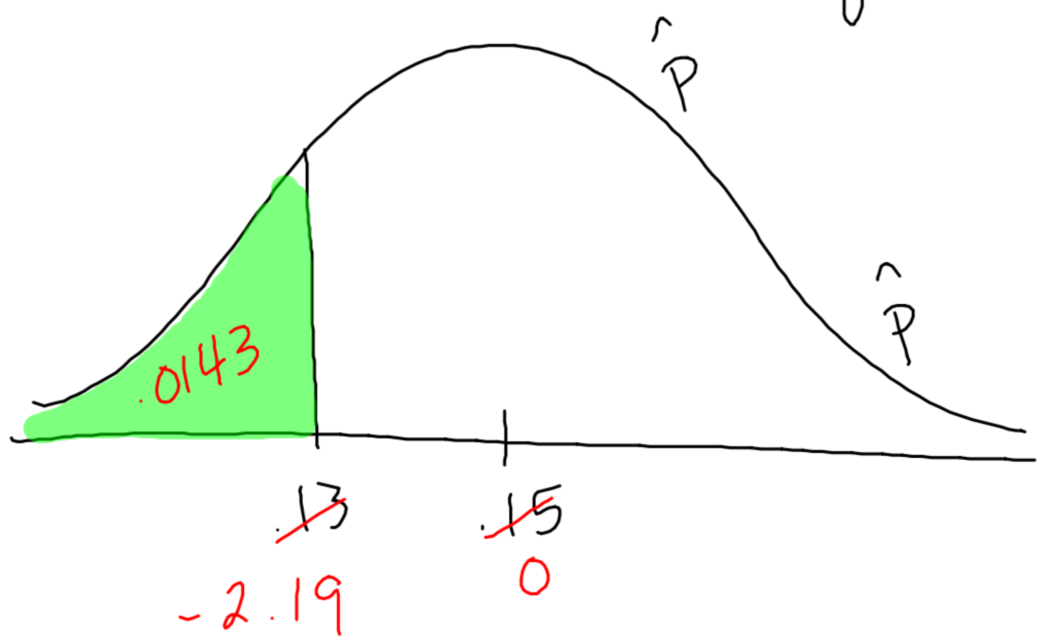
3) Find μ and σ of Sampling Distribution

$$\mu_{\hat{p}} = p = .15$$

$$\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{(.15)(.85)}{1540}} = .0091$$

4) Find probability

$\sigma = .0091$

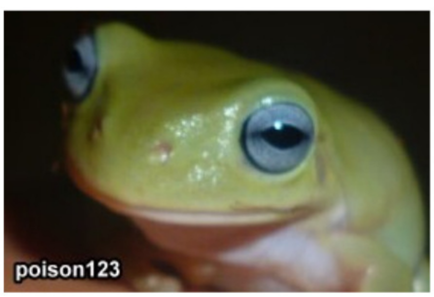


normalcdf(0, .13, .15, .0091) ≈ .0139

5) Answer question in context:

Assuming that 15% of all adults jog, the probability that less than 13% of adults in this sample jog is .0139

Ex Assume 30% of all frogs have blue eyes...
Tyler takes an SRS sample of 50 frogs. What is the probability that 25% - 35% of his sample has blue eyes?



1) Sampling Distribution Approx Normal ?

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

$(50)(.30) \geq 10$? $(50)(.70) \geq 10$?

$15 \geq 10$ ✓ $35 \geq 10$ ✓

2) Stand Deviation Formula Safe To Use ?

$N > 10n$?

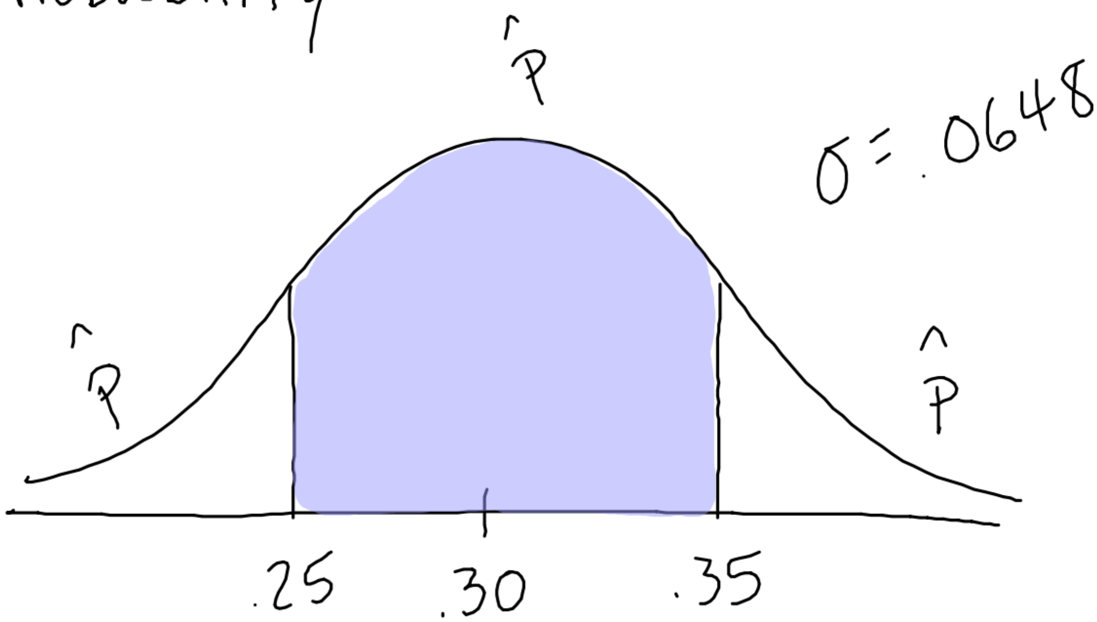
$N > 10(500) > 5000$ frogs ... probably ?

3) Find μ and σ of Sampling Distribution

$$\mu_{\hat{p}} = p = .30$$

$$\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{(.30)(.70)}{50}} = .0648$$

4) Find Probability



normalcdf(.25, .35, .30, .0648) ≈ .5596

5) Answer question in context

Assuming 30% of all frogs have blue eyes, the probability that 25% - 35% of Tyler's sample of frogs have blue eyes is .5596

Sec 7.3

Success Criteria

- Calculate mean and standard deviation of a distribution of sample means
- Determine if a distribution of sample means is Normal
- Calculate probabilities from a Normal distribution of sample means

Sampling Distribution of Means

Calculate $\bar{x}$ from <u>many</u> samples

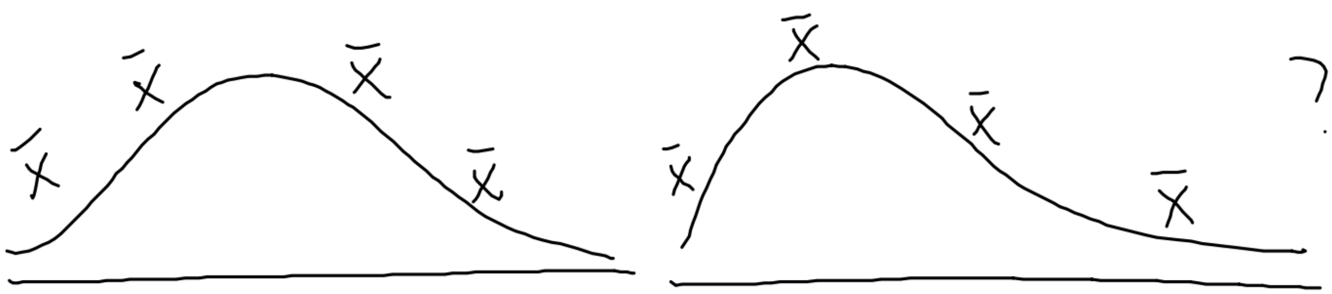
$\downarrow$

Display distribution

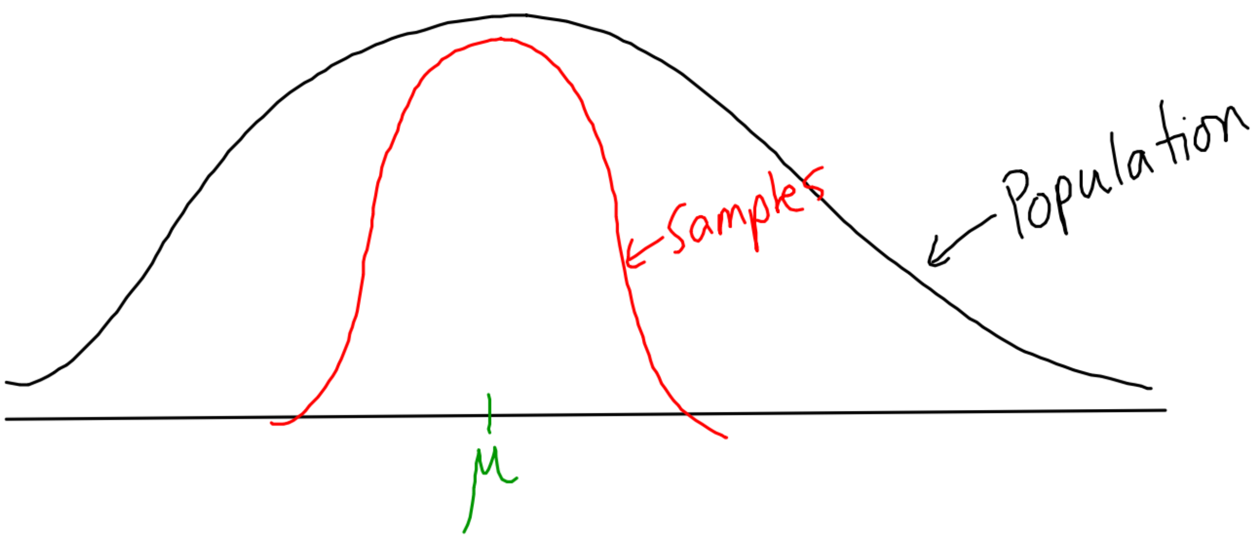
Sampling Distribution of Means

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

2) $\sigma_{\bar{x}} = \dfrac{\sigma}{\sqrt{n}}$ if $N > 10n$

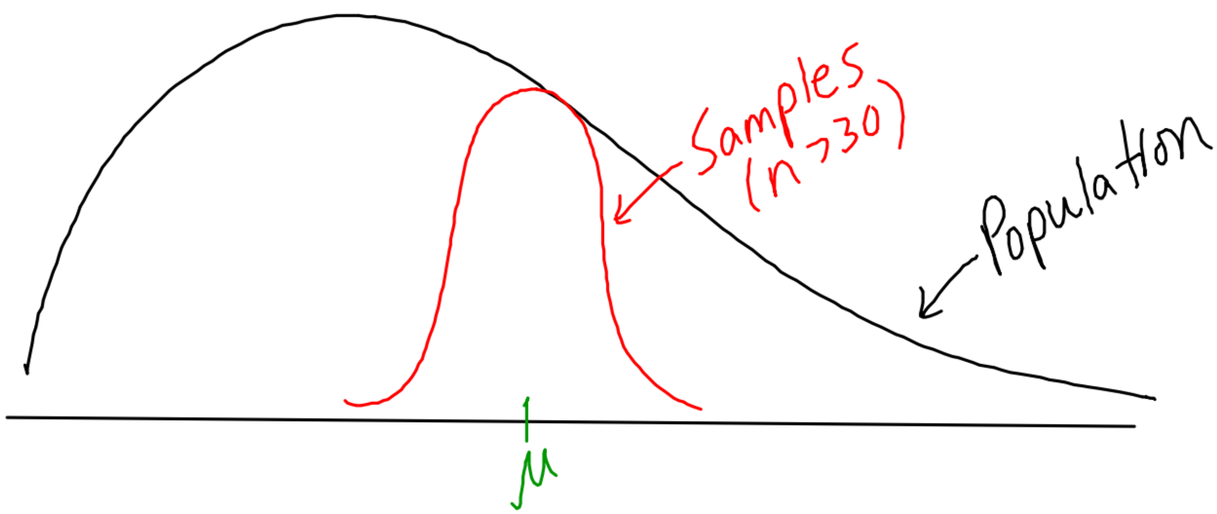


3- a) If population distribution is approximately Normal then the sampling distribution is as well



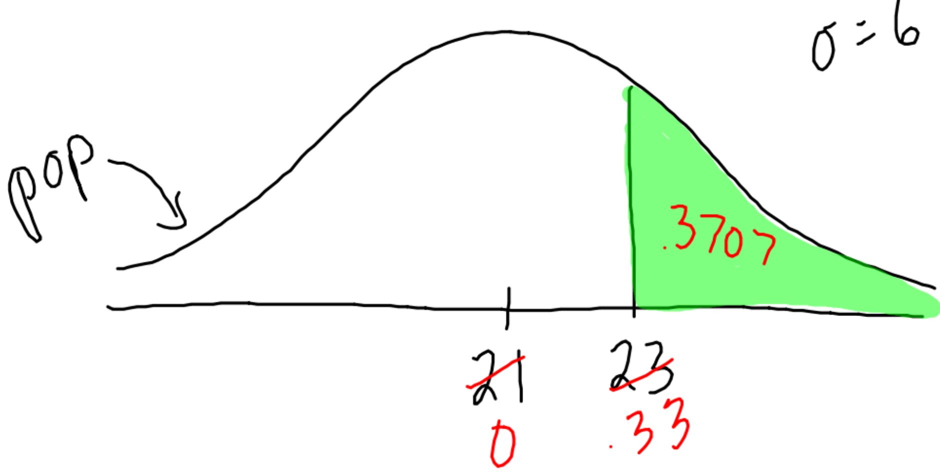
3-b) If population distribution is <u>not</u> Normal (or unknown), the sampling distribution will be approximately Normal if n is large (>30)

Central Limit Thereom



Ex ACT scores $\rightarrow N(21, 6)$

1) What is the probability that a random student has an ACT score > 23?



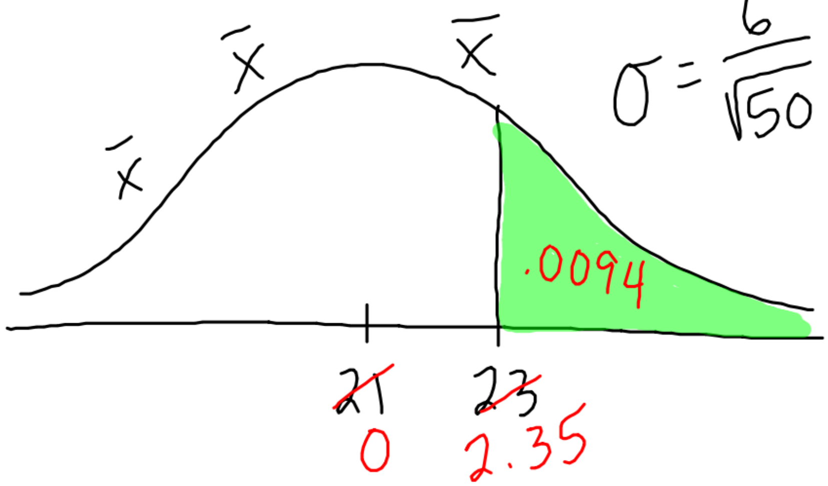
normalcdf(23, 100, 21, 6) $\approx$ .3694

Assuming the average ACT score is 21, the probability of a random student scoring more than 23 is about 37% which is not unlikely

2) What is the probability that the mean score of 50 students > 23?

a) Samp dist would be normal since pop dist is normal

b) $\sigma = \frac{6}{\sqrt{50}} = .8485$

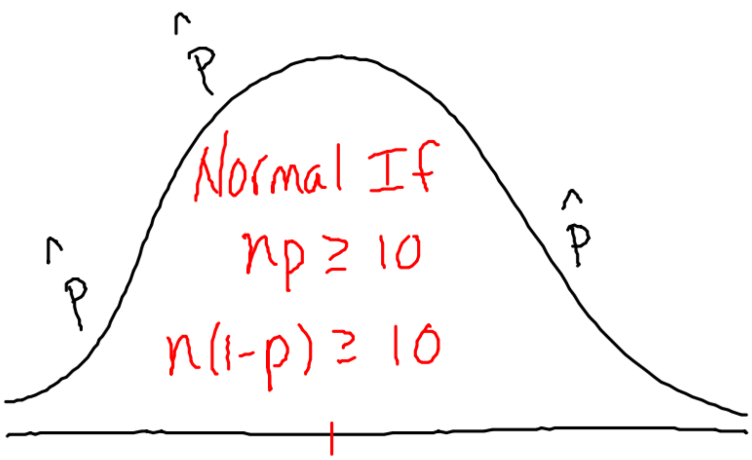


normalcdf(23, 100, 21, .8485) ≈ .0092

c) Assuming the average ACT score is 21, the probability of this sample having an average ACT score of 23 is less than 1% (.0091) which is very unlikely

Review

Sample Proportions (P.437)



Normal If

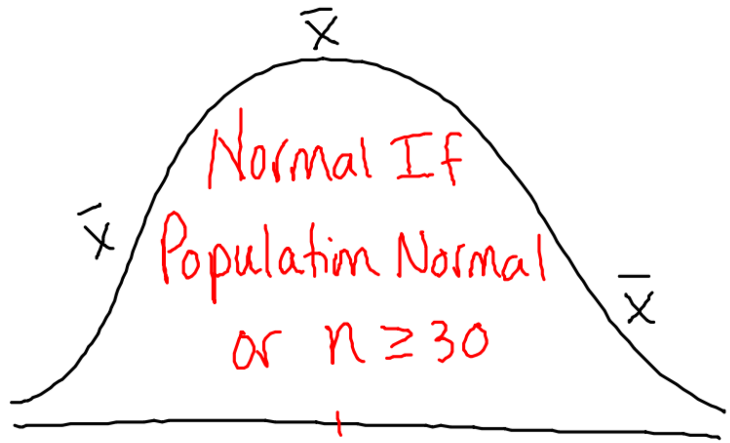
$np \geq 10$

$n(1-p) \geq 10$

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

$\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$ if $N > 10n$

Sample Means (P.452)



Normal If

Population Normal

or $n \geq 30$

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

$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$ if $N > 10n$