Sec 9.1

Population

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

Parameter

A number (mean μ, proportion p, standard deviation σ) that describes an <u>entire</u> population

Sample

Subset of population obtained through SRS ← reduce bias

Statistic

A number (mean $\overline{x}$, proportion $\hat{p}$ standard deviation s) which describes a sample

Goal of Inference

$\bar{X} \longrightarrow \mu$

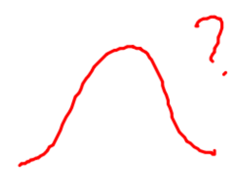
$\hat{p} \longrightarrow p$

$s \longrightarrow \sigma$

Sampling Distribution

Describes how a statistic ($\bar{x}$ or $\hat{p}$) varies in <u>all</u> possible samples of same size

Making A Sample Distribution

1) Take a large # of samples of same size
2) Calculate sample mean ($\bar{x}$) or sample proportion ($\hat{p}$) for each sample
3) Make a histogram of $\bar{x}$ or $\hat{p}$ 

<u>Ex</u> Survivor (Pp 494-495)

Larger samples produce less variability

<u>Ex</u> Figure 9.9 (P. 500)

Low bias and low variability

9.3

Sampling Distribution (of Means)

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

Mean of sample means is an unbiased estimator of population mean

2) $\sigma_{\bar{x}} = \dfrac{\sigma}{\sqrt{n}}$

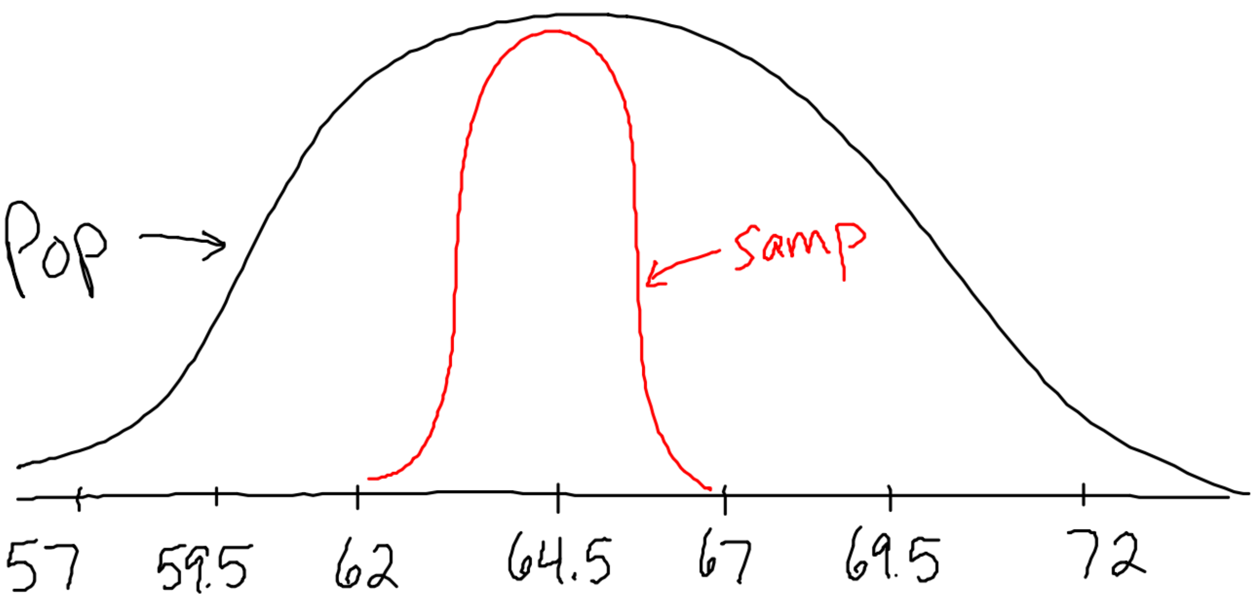
As n increases,
variability decreases

3-a) If population distribution is normal ( ) then sampling distribution is normal

b) If population distribution is <u>not</u> normal (or not known) then sampling distribution is normal if n is "large"

Central Limit Theorem →

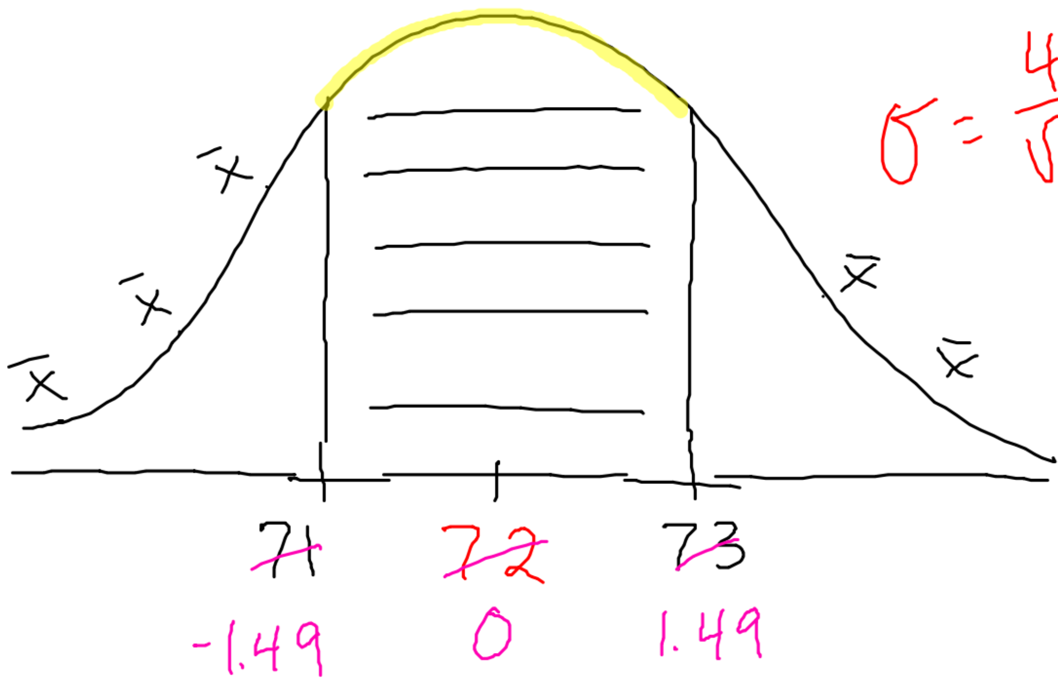
Ex Women's height $N(64.5, \sigma = 2.5)$



SRS $(n = 100) \rightarrow \mu = 64.5, \ \sigma = \frac{2.5}{\sqrt{100}} = .25$

Ex Ft. Harrison, average height of gorillas is 72" ($\sigma = 4"$) ... Indiana Jones captures an SRS 36 gorillas. What is the probability that the average height of his sample is between 71" and 73"?

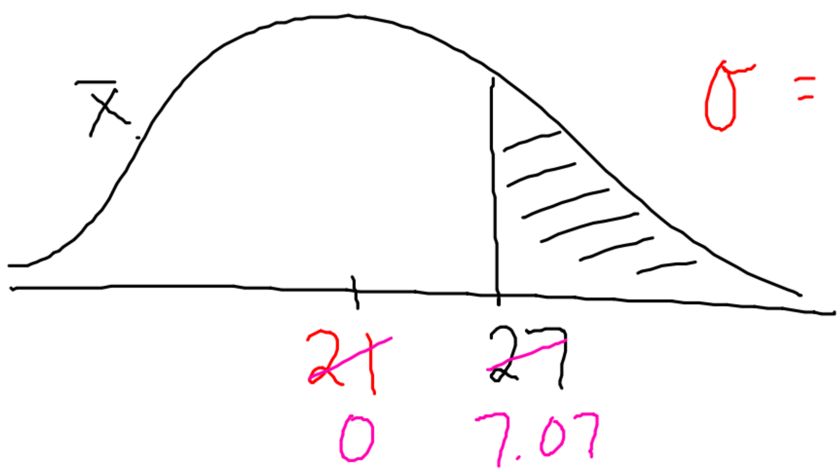
$\sigma = \frac{4}{\sqrt{36}} = .6667$



normalcdf$(71, 73, 72, .6667) \approx .8664$

ACT Scores → $N(21, 6)$

What is the probability that the mean score of 50 students ≥ 27



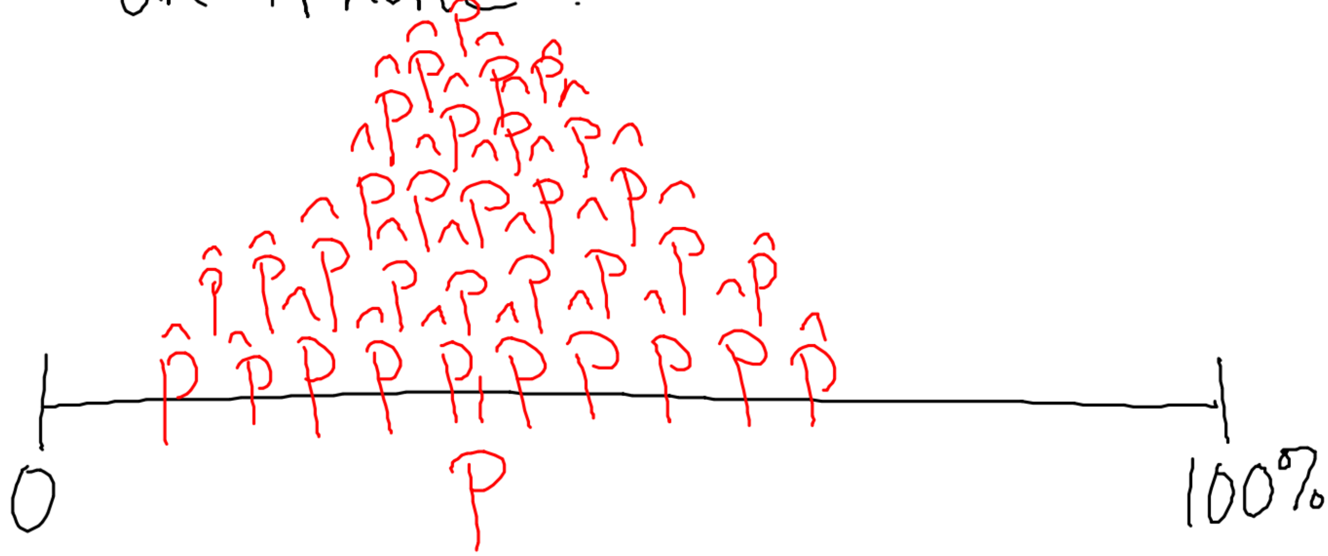
$\sigma = \frac{6}{\sqrt{50}} = .8485$

normalcdf(27, 36, 21, .8485) ≈ .000000000007

9.2

Sample Proportions

<u>Ex</u> What % of LN students own an iPhone?



Sampling Distribution (of Proportions)

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

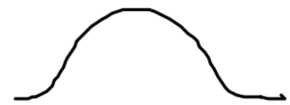
2) $\sigma_{\hat{p}} = \sqrt{\dfrac{p(1-p)}{n}}$ if $N > 10n$

3) Normal distribution if:

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

Ex Assume that 30% of frogs at Ft. Harrison have blue eyes.

Harry takes an SRS sample of 50 frogs; what is the probability that 25%-35% of his frogs have blue eyes?

1) Check for normality 

$np \geq 10$?

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

$15 \geq 10$ ✓

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

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

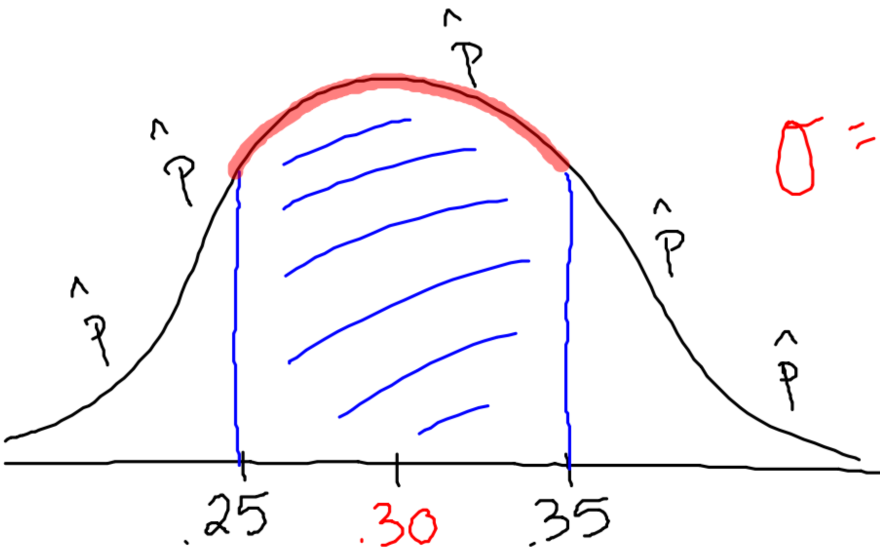
$35 \geq 10$ ✓

2) Check standard deviation condition:

$N > 10n$

$N > 10(50)$

$N > 500$ ... probably!

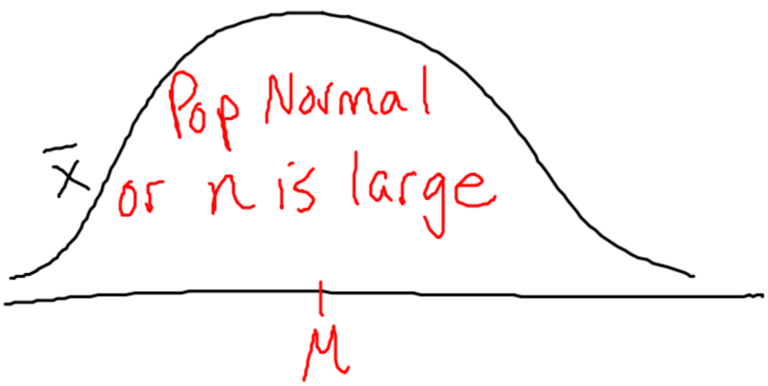


$$\sigma = \sqrt{\frac{(.30)(.70)}{50}} = .0648$$

normalcdf$(.25, .35, .30, .0648) \approx .5597$

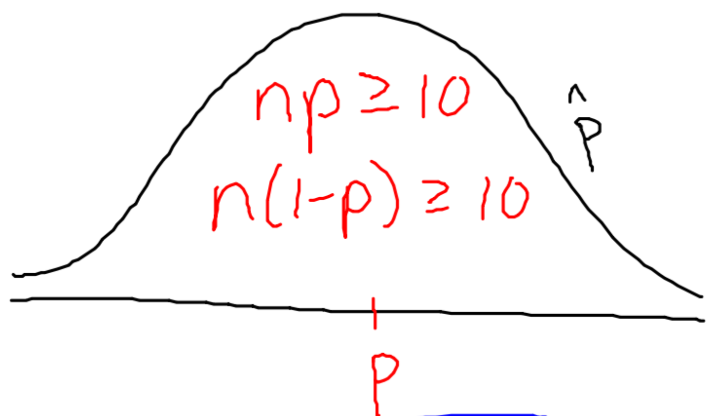
Sampling Distributions

means



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

proportions



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

(if $N > 10n$)