Probability (Chapter 9) Date: DAY 1

Standards/Objectives:
1) know and compare/contrast the **Central Limit Theorem** vs. the **"Law of Large Numbers"**
2) understand the difference between **sampling distributions** vs. univariate distributions
3) understand that a large **sample size** will produce a normal sampling distribution (regardless of population distribution)

Agenda/Activities:
1A) Central Limit Theorem vs. Law of Large Numbers
2A) Sampling Distribution vs. Univariate Distribution - LQ female heights
3A) Producing "Normality" from an Abnormal Distribution

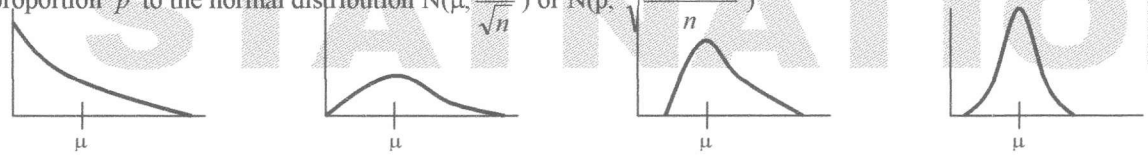
1A) **Central Limit Theorem** – the shape of a sampling distribution of $\bar{x}$ (or $\hat{p}$) will become increasingly **normal** as the sampling size increases (regardless of original population distribution)

focus on the _____ of the sampling distribution (based on sampling size n, not number of sample N)

"Law of Large Numbers" – you get a better idea of what **real mean** μ (or real proportion π) is the more you sample

focus on the _____ (based on the number of samples N, not sampling size n)

Central Limit Theorem (with Law of Large Numbers): the sampling distribution of the sample mean $\bar{x}$ or the sample proportion $\hat{p}$ to the normal distribution $N(\mu, \frac{\sigma}{\sqrt{n}})$ or $N(p, \sqrt{\frac{p(1-p)}{n}})$



n = 2 n = 10 n = 20 n = 100

2A) LQ female heights: $\mu = 64.5$, $\sigma = 2$
Sampling Distribution vs. Univariate Distribution: we are looking at distributions of sampling means (averages), not just individual data (univariates)

Sampling Distribution – the sampling distribution of a statistic is the distribution of values taken by the statistic in all possible samples of the same size from the same population (i.e., the ideal pattern that would emerge if we looked at all possible sample size)

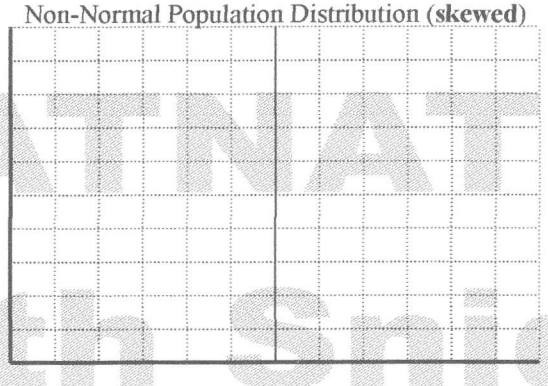
ACTIVITY:
- each student samples a group of 10 girls' heights (MATH / PRB / 6:randNorm (64.5, 2, 10)) and find the *mean* height of those 10 girls; repeat the process for a group of 25 and a group of 100 girls
- record mean heights on whiteboard dotplot and onto teacher's calculator (n=10→L_1, n=25→L_2, n=100→L_3)
- fill out chart: n = sampling size, N = number of samples

N	$\bar{x}$	s	N
10			
25			
100			

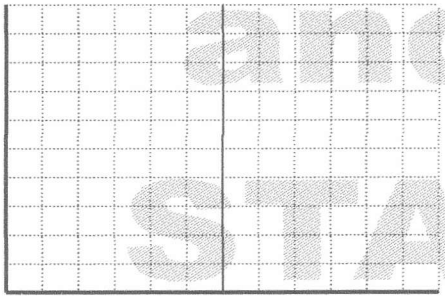
KEY CONCEPT: as n increases, $\mu_{\bar{x}} \rightarrow$ _____ and $\sigma \rightarrow$ _____ or $\hat{p} \rightarrow$ _____ and $\sigma \rightarrow$ _____

3A) Producing "Normality" from an Abnormal Population Distribution
www.rossmanchance.com/applets/OneSample.html
www.stat.tamu.edu/~west/ph/sampledist.html

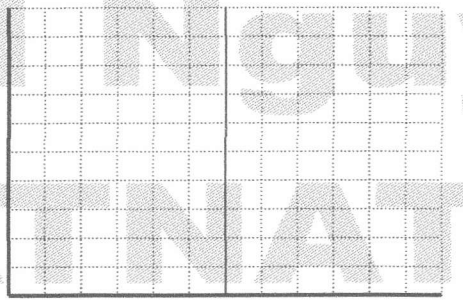
Non-Normal Population Distribution (**skewed**)



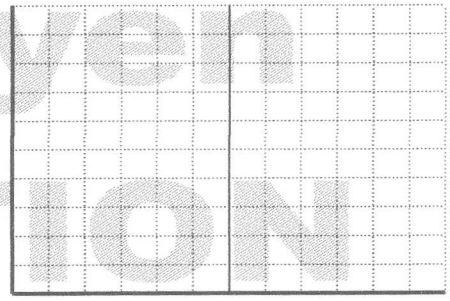
Sampling Distribution
(N = 100, **n = 1**)



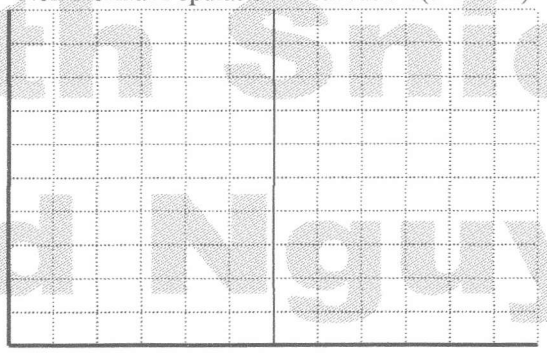
Sampling Distribution
(N = 100, **n = 10**)



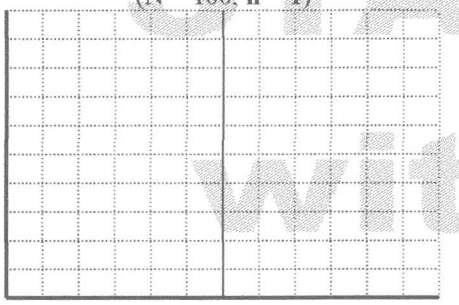
Sampling Distribution
(N = 100, **n = 100**)



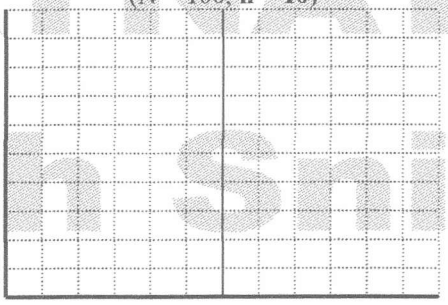
Non-Normal Population Distribution (**uniform**)



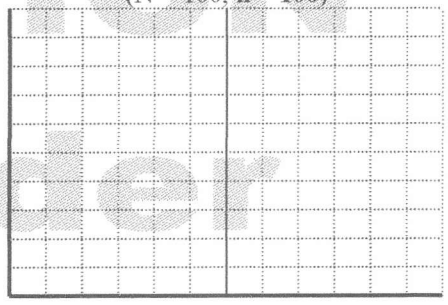
Sampling Distribution
(N = 100, **n = 1**)



Sampling Distribution
(N = 100, **n = 10**)



Sampling Distribution
(N = 100, **n = 100**)



KEY CONCEPTS:
*even if we have a skewed/nonnormal population, a large sample size n will produce a normal sampling distribution
*sampling size n (not number of trials N) must be large to get "normal distribution"

Probability (Chapter 9) Date: DAY 2

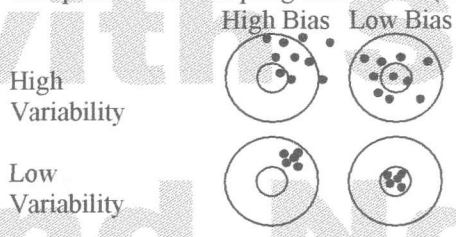
Standards/Objectives:
1) know and compare/contrast **parameters vs. statistics**
2) understand **bias** and **variability** and how they affect center and spread
3) more on Sampling Distributions and the **Central Limit Theorem**
4) know the **sampling size requirements** (for means and for proportions)

Agenda/Activities:
1A) Parameters vs. Statistics
2A) Bias vs. Variability
2B) Ranking Bias and Variability
3A) PWRPT - Chap 9 Sampling Distribution of Means and Proportions
4A) Sampling Size Requirements
4B) ACTIVITIES: Coin Flips, Cancer Rate

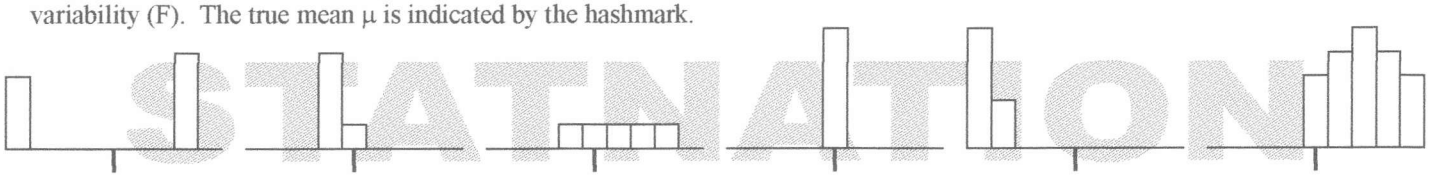
1A) **Parameter** (population) – a number that describes the population
(in practice, the value of the parameter is typically not known)
Statistic (sample) – a number that can be computed from the sample data without making use of any unknown parameters
(in practice, we use a statistic to estimate a known parameter)

Notations:	Actual (population)	Statistic (estimate/sample)
Mean		
Std Dev		
Proportions		

2A) **Bias** of a Statistic – center of sampling distribution ≠ true value of the parameter (lack of accuracy, miss "true" value of μ)
Variability of a Statistic – the spread of the sampling distribution (lack of precision, affected by sample size)



2B) ACTIVITY: Rate each diagram from lowest bias (1) to highest bias (6) THEN from lowest variability (A) to highest variability (F). The true mean μ is indicated by the hashmark.



GOAL: We want to _____
How: To do this, we need to increase the sampling size, which has the effect of:

1) making the mean of the sampling distribution match the parameter: $\mu_{\bar{x}} \rightarrow \mu$ (or $\bar{x} \rightarrow \mu$) and

2) lowers the variability: $s_{mean} = \frac{\sigma}{\sqrt{n}}$ and $s_{proportion} = \sqrt{\frac{p(1-p)}{n}}$.

Why: Once we have a "large enough" sample size, we have a normal distribution and normal curves, which then allows us to use z-scores!

3A) PWRPT – Chap 9 Sampling Distribution of Means & Proportions

4A) Question: When is n "large enough"?

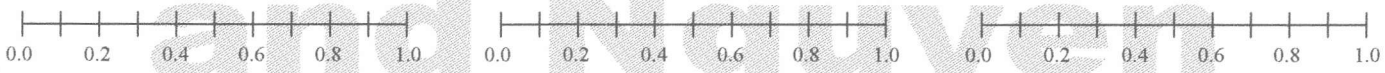
1) for means, _____

2) for proportions, sample size requirement is "sliding scale": _____

4B) ACTIVITY – Coin Flip

Flip a coin and record the *proportion of heads* on a dotplot for:

n = 10 n = 20 n = 50



- Describe in the dotplot, in terms of bias and variability.

- What do you expect would happen if n = 1000 (center and spread)?

ACTIVITY – Cancer Rate

Use the table of random digits (be sure to label "cancer" or "no cancer") to simulate a cancer rate of 20%, recorded on dotplot:

n = 10 n = 20 n = 50

- Describe in the dotplot, in terms of bias and variability.

- What do you expect would happen if n = 1000 (center and spread)?

*talk about sampling size requirements (for proportions)

BONUS: Without any simulation, describe what you would expect to happen if you rolled a pair of dice 1000 times?

Probability (Chapter 9) Date: DAY 3

Standards/Objectives:
1) review **parameters vs. statistics**
2) Quiz 9.1

Agenda/Activities:
1A) WS - Section 9.1 Review
1B) WS - 9.1A
2A) QUIZ 9.1B

1A) WS – Sect 9.1 Review (parameter vs. statistic)

1B) WS – 9.1A (poll of fear of neighborhood crime)

2A) QUIZ 9.1B

Probability (Chapter 9) Date: DAY 4

Standards/Objectives:
1) review sampling means vs. proportions (emphasis on proportions)

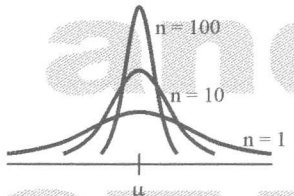
Agenda/Activities:
1A) Means vs. Proportions (with requirements/conditions)
1B) PWRPT - 9.2 Sample Proportions
1C) ACTIVITY - Dice Roll
1D) Book Exercise 9.15, 9.17

1A) Mean and Standard Deviation for MEANS

Given $\bar{x}$ is the mean of an SRS of size n drawn from a large population with mean μ and standard deviation σ:

1) mean of the sampling distribution $\bar{x} \rightarrow \mu$

2) standard deviation of the sampling distribution $s \rightarrow \frac{\sigma}{\sqrt{n}}$



Sampling Size Rules (SIN)

WHAT
1) **S**RS
2) **I**ndependence
3) **N** ≥ 30

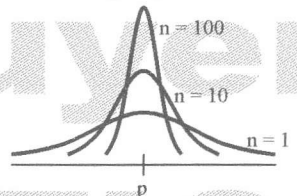
WHY
1) **S**ample is *representative* (minimizes bias)
2) **I**ndependent – the outcome of one mean does not influence any other mean outcome
3) **N**ormality → normal curve (according to CLT), (minimizes bias)

Mean and Standard Deviation for PROPORTIONS

Given $\hat{p}$ is the mean of an SRS of size n drawn from a large population with mean p and standard deviation σ:

1) mean of the sampling distribution $\hat{p} \rightarrow p$

2) std deviation of the sampling distribution $s \rightarrow \sqrt{\frac{p(1-p)}{n}}$



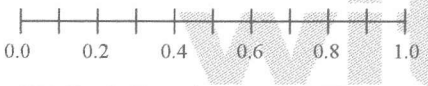
Sampling Size Rules (SNaP)

WHAT
1) **S**RS
2) **N**p ≥ 10, nq ≥ 10
3) **P**op size ≥ 10x sample size

WHY
1) **S**ample is *representative* (minimizes bias)
2) **N**ormality → *normal curve* (minimizes variability)
3) **P**roportion *p* is "stable" → so that *w/o replacement* will act like *w/replacement* and thus not violate/change theoretical probabilities

1B) PWRPT – 9.2 Sample Proportions

1C) ACTIVITY – Dice Roll
Roll die 60 times, record sampling distribution of proportions of getting "1"



1D) Book Exercises 9.15, 9.17

Probability (Chapter 9) Date: DAY 5

Standards/Objectives:
1) Sampling Means vs. Proportions (emphasis on means)

Agenda/Activities:
1A) PWRPT - 9.3 Sample Means
1B) Example Problems

1A) PWRPT – 9.3 Sample Means

1B) Example Problems:

- The weight of LQ freshmen boys, which is normally distributed, has a mean of 140 lbs. and a standard deviation of 7 lbs. What is the probability that you select 1 boy at random who weights 150+ lbs? 10 random boys at random with average weight 150+ lbs?

- Kobe Bryant scores 26 pts per game, with a standard deviation of 4 pts. Assuming his points per game distribution is normal, what is probability that you go to 30 random games and he averages 20 pts or less (for those games)?

Probability (Chapter 9) Date: DAY 6

Standards/Objectives:
1) practice with means and proportions
2) **converting** proportions into means
3) understand and calculate with **margins of errors**

Agenda/Activities:
1A) Practice WS
2A) Proportions → Means
3A) Margin of Error

1A) Practice

- Example 1: Proposition 30 (Tax for Education)

A poll conducted on Prop 30 had an approval rating of .48, with n = 1566. What is the probability that it will pass?

- Example 2: Coin Flip

If you flip a coin 500 times, what is the probability that you get 275 or more heads?

- Example 3: Marijuana Ballot

A poll conducted on 1501 voters regarding the legalization of marijuana had a 42% approval rating. What is the probability it will pass? What is the probability your next sample's approval rating will be between 40% and 45%?

- Example 4: LQ SAT Scores

The mean SAT score is 1600, with a standard deviation of 200. If we sample 30 LQ students, what is probability they average 1675 or higher?

2A) Example: What is the probability that you roll 100 out of 500 "1's" on a die? Do this as a proportion and as a mean.

3A) "Margin of Error" (for Example 1 above)

Estimate $\pm z^*(\sigma)$, where z^* is the _____

Probability (Chapter 9) Date: DAY 7

Standards/Objectives:
1) Quiz 9.2

Agenda/Activities:
1A) Practice for Quiz
1B) QUIZ 9.2A

1A) Example: Candidate X has a 49% approval rating in Ohio, according to survey of 1500. What is probability that he will win this election?

1B) Quiz 9.2A

Probability (Chapter 9) Date: DAY 8

Standards/Objectives:
1) Quiz 9.3

Agenda/Activities:
1A) Practice for Quiz
1B) QUIZ 9.3

1A) Example: The height of LQ boys (which is normally distributed) has a mean of 67" with a standard deviation of 2". What is probability that a randomly chosen boy is 70"? 10 randomly chosen boys average 70"?

1B) Quiz 9.3

Probability (Chapter 9) Date: DAY 9

Standards/Objectives:
1) Test 9

Agenda/Activities:
1A) TEST 9

1A) Test Chap 9: 20 MC (600 pts) and 1 FRQ (200 pts)

Probability (Chapter 9) Date: DAY 10

Standards/Objectives:
1) go over Test 9

Agenda/Activities:
1A) go over Test 9

1A) go over Test 9