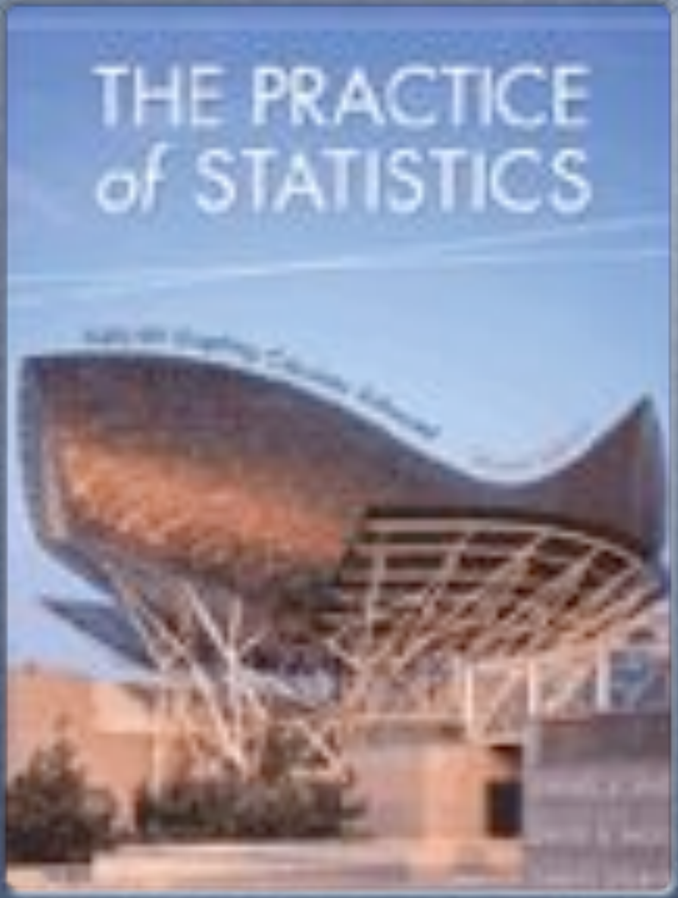
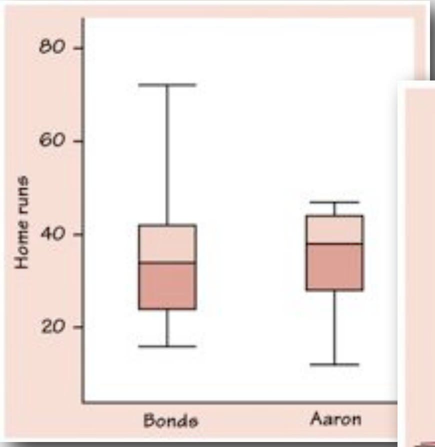
AP Statistics

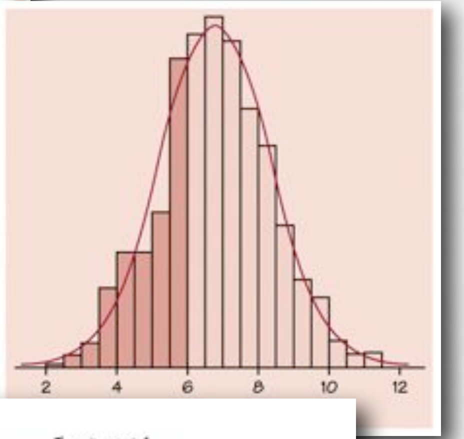
Semester One Review
Part 2
Chapters 6-9

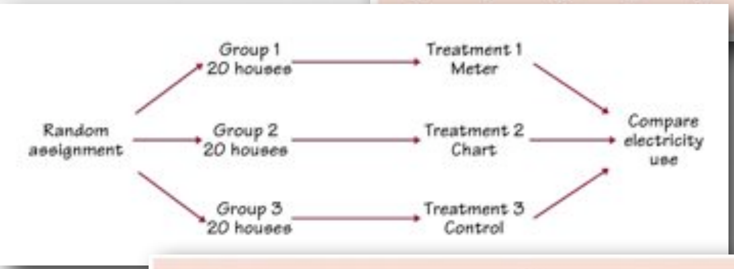


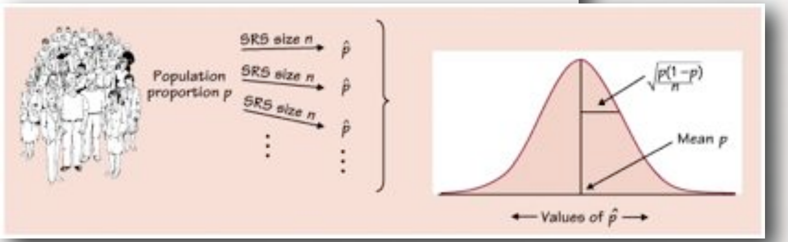
AP Statistics Topics

- [x] Describing Data
- [x] Producing Data
- [ ] Probability
- [ ] Statistical Inference

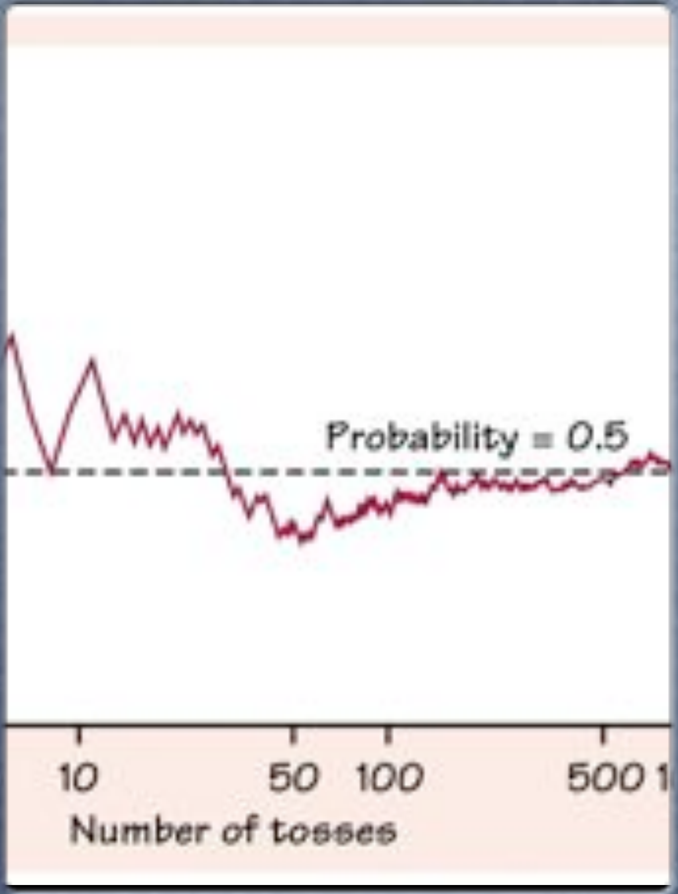








Chapter 6: Probability

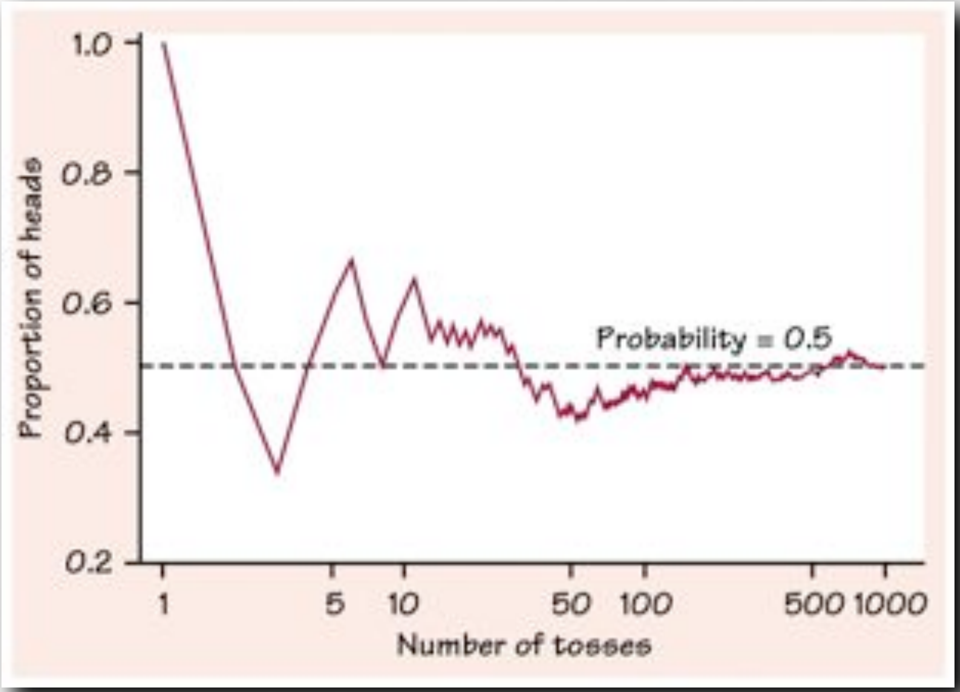


This chapter introduced us to the basic ideas behind probability and the study of randomness. We learned how to calculate and interpret the probability of events in a number of different situations.

Probability

- Probability is a measurement of the likelihood of an event. It represents the proportion of times we'd expect to see an outcome in a long series of repetitions.

$$P(event) = \frac{\#\ success}{\#\ possible}$$



Probability Rules

The following facts/formulas are helpful in calculating and interpreting the probability of an event:

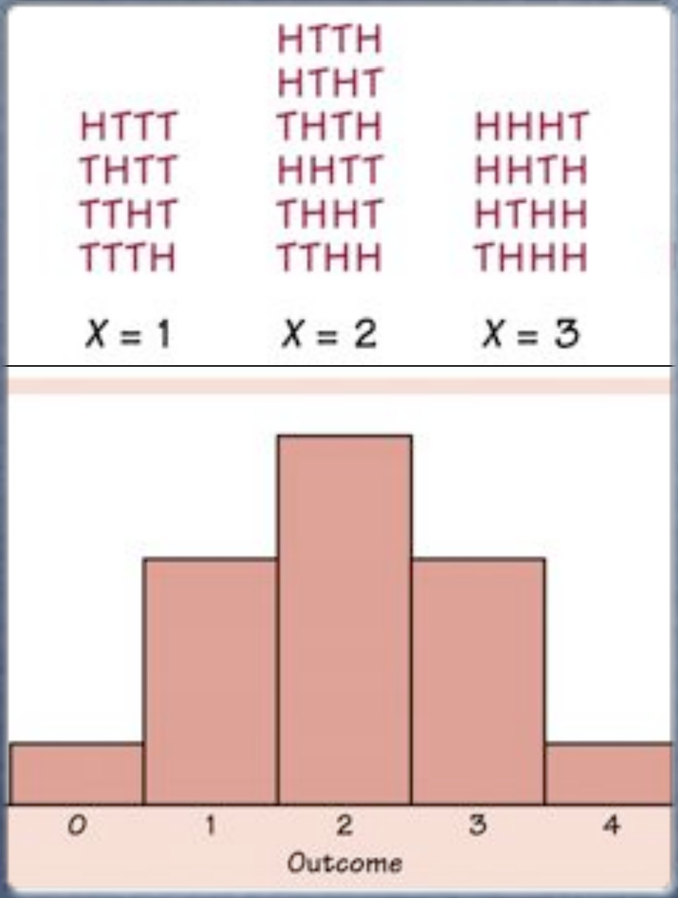
- ☐ $0 \leq P(A) \leq 1$
- ☐ P(SampleSpace) = 1
- ☐ $P(A^C) = 1 - P(A)$
- ☑ P(A or B) = P(A) + P(B) - P(both)
- ☑ P(A then B) = P(A) P(B|A)
- ☑ A and B are independent iff P(B) = P(B|A)

Strategies

- When calculating probabilities, it helps to consider the Sample Space.
  - List all outcomes if possible.
  - Draw a tree diagram or Venn diagram
  - Use the Multiplication Counting Principle
- Sometimes it is easier to use common sense rather than memorizing formulas!

Chapter 7: Random Variables

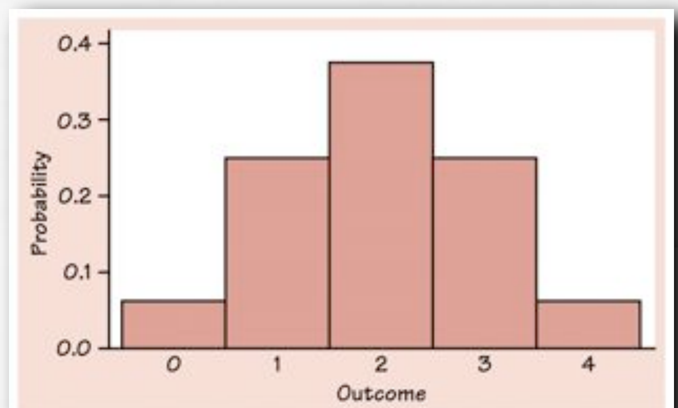
This chapter introduced us to the concept of a random variable.
We learned how to describe an expected value and variability of both discrete and continuous random variables.

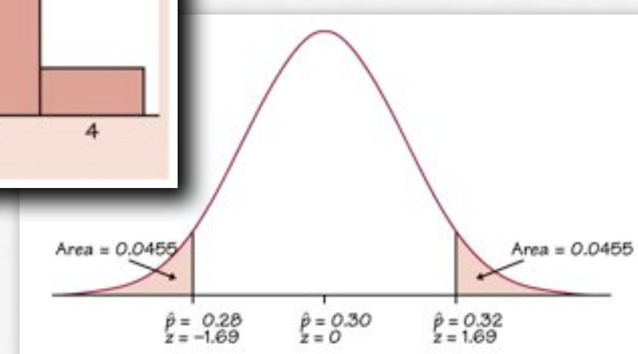


Random Variable

- A Random Variable, X, is a variable whose outcome is unpredictable in the short-term, but shows a predictable pattern in the long run.

- Discrete vs. Continuous





Expected Value

- The Expected Value, E(X)=μ, is the long-term average value of a Random Variable.

- E(X) for a Discrete X

$$E(X) = \mu = \sum x \cdot p(x)$$

X	1	5	20
P(X)	0.5	0.2	0.3

$$\mu = 1(0.5) + 5(0.2) + 20(0.3)$$
$$= .5 + 1 + 6$$
$$= 7.5$$

Variance

- The Variance, Var(X)=σ^2, is the amount of variability from μ that we expect to see in X.
- The Standard Deviation of X, $\sigma = \sqrt{Var(X)}$

☑ Var(X) for a Discrete X

$$Var(X) = \sigma^2 = \sum (x-\mu)^2 \, p(x)$$

X	1	5	20
P(X)	0.5	0.2	0.3

$$\sigma^2 = (1-7.5)^2(0.5) + (5-7.5)^2(0.2) + (20-7.5)^2(0.3)$$
$$= 21.125 + 1.25 + 46.875$$
$$= 69.25$$
$$\sigma = \sqrt{69.25} = 8.32$$

Rules for Means and Variances

- The following rules are helpful when working with Random Variables.

$$\mu_{a+bX} = a + b\mu_X$$

$$\sigma^2_{a+bX} = b^2\sigma^2_X$$

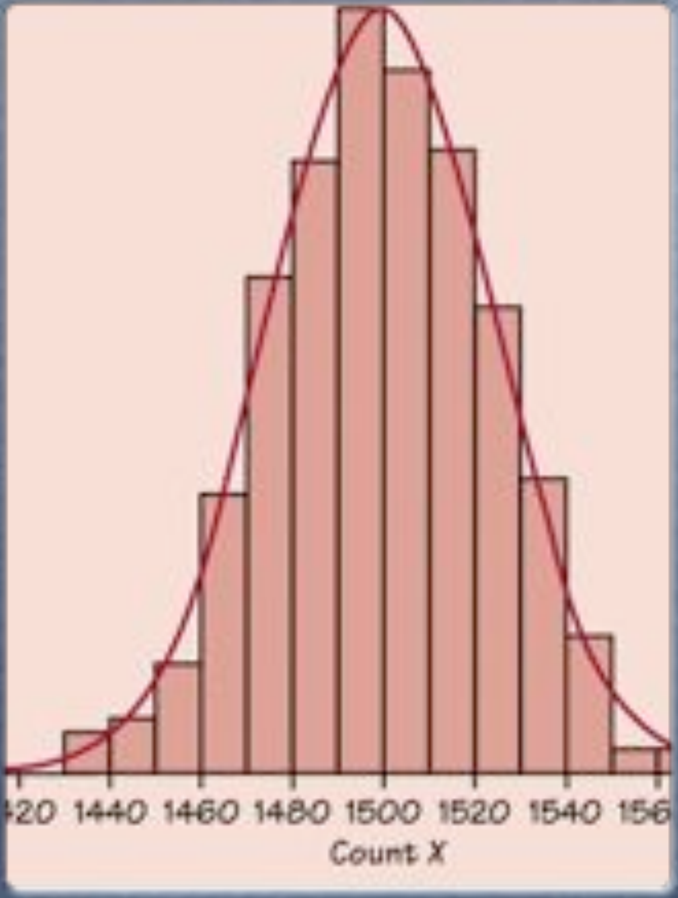
$$\mu_{X \pm Y} = \mu_X \pm \mu_Y$$

$$\sigma^2_{X \pm Y} = \sigma^2_X + \sigma^2_Y$$

Chapter 8: Binomial and Geometric Distributions

This chapter introduced us to the concept of the Binomial and Geometric Settings.

We learned how to calculate the likelihood of events occurring in each of these settings.



Binomial Setting

- Some Random Variables are the result of events that have only two outcomes (success and failure). We define a Binomial Setting to have the following features
  - Two Outcomes - success/failure
  - Fixed number of trials - n
  - Independent trials
  - Equal P(success) for each trial

Binomial Probabilities

- If X is B(n,p), the following formulas can be used to calculate the probabilities of events in X.

$$P(X = k) = {}_{n}C_{k}(p)^{k}(1 - p)^{n-k}$$
$$= binompdf(n, p, k)$$

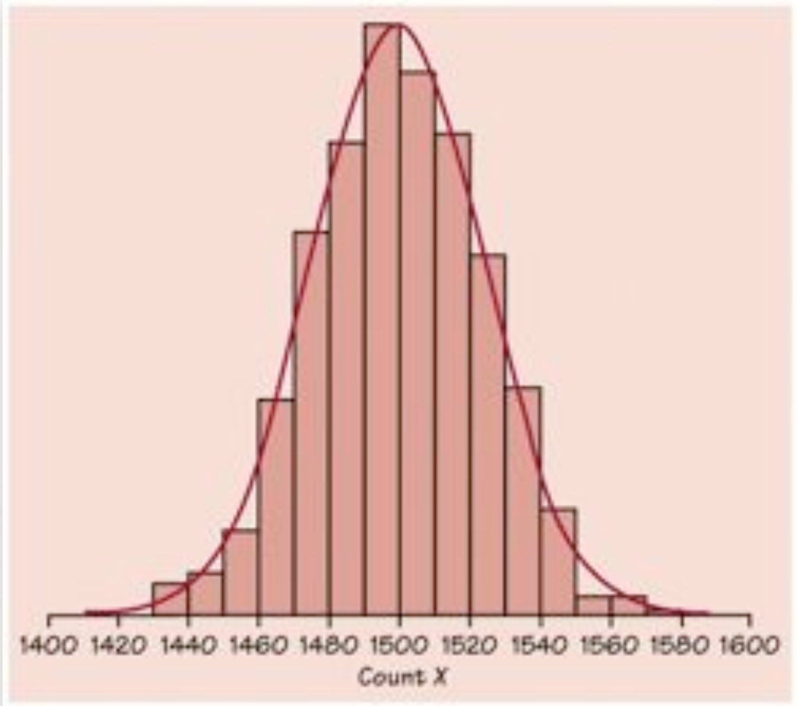
$$P(X \leq k) = binomcdf(n, p, k)$$

Normal Approximation

- If conditions are met, a binomial situation may be approximated by a normal distribution
- If $np \geq 10$ and $n(1-p) \geq 10$, then $B(n,p) \sim$ Normal

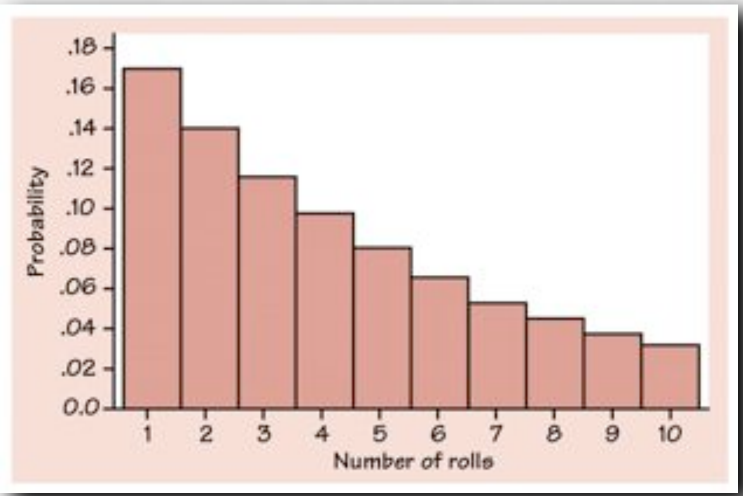
$$\mu_X = np$$

$$\sigma_X = \sqrt{np(1-p)}$$



Geometric Setting

- Some Random Variables are the result of events that have only two outcomes (success and failure), but have no fixed number of trials. We define a Geometric Setting to have the following features
  - Two Outcomes - success/failure
  - No Fixed number of trials
  - Independent trials
  - Equal P(success) for each trial



Geometric Probabilities

- If X is Geometric, the following formulas can be used to calculate the probabilities of events in X.

$$\mu_X = \frac{1}{p}$$

$$\sigma_X = \sqrt{\frac{1-p}{p^2}}$$

$$P(X = k) = (1-p)^{k-1}p$$

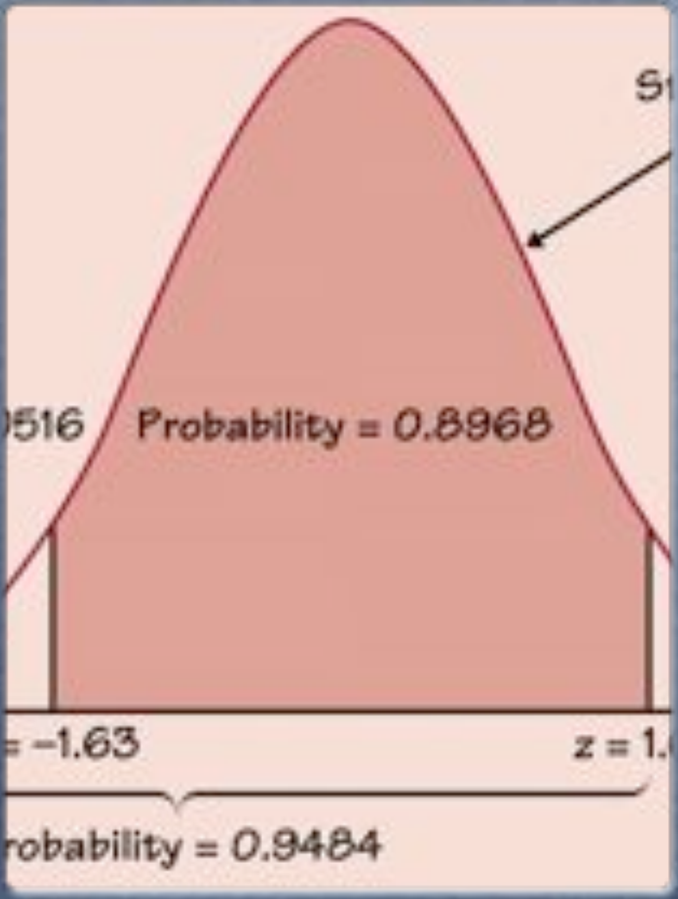
$$= geompdf(p,k)$$

$$P(X > k) = (1-p)^k$$

Chapter 9: Sampling Distributions

This chapter introduced us to the concept of the Sampling Distributions.

These distributions and the calculations based on them will form the basis of our study of inference.

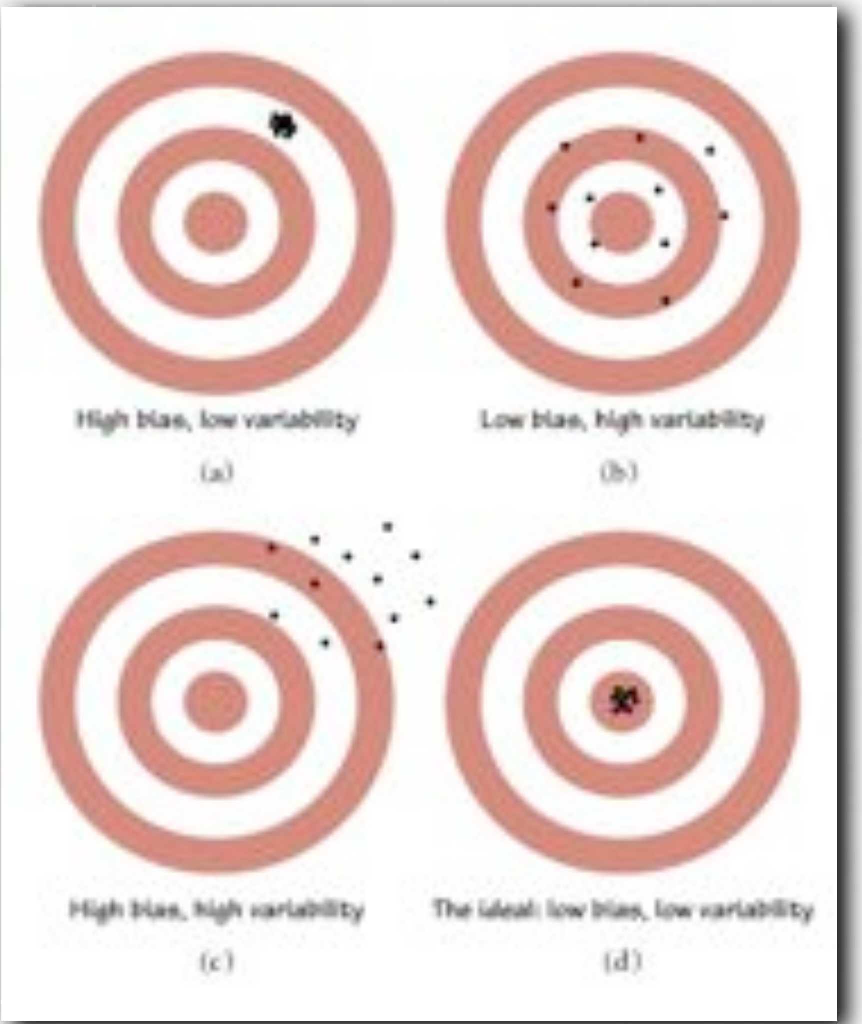


Parameters and Statistics

- Our goal in statistics to to gain information about the population by collecting data from a sample.
  - Parameter
    - Population Characteristic: μ, π
  - Statistic
    - Sample Characteristic: x-bar, p-hat

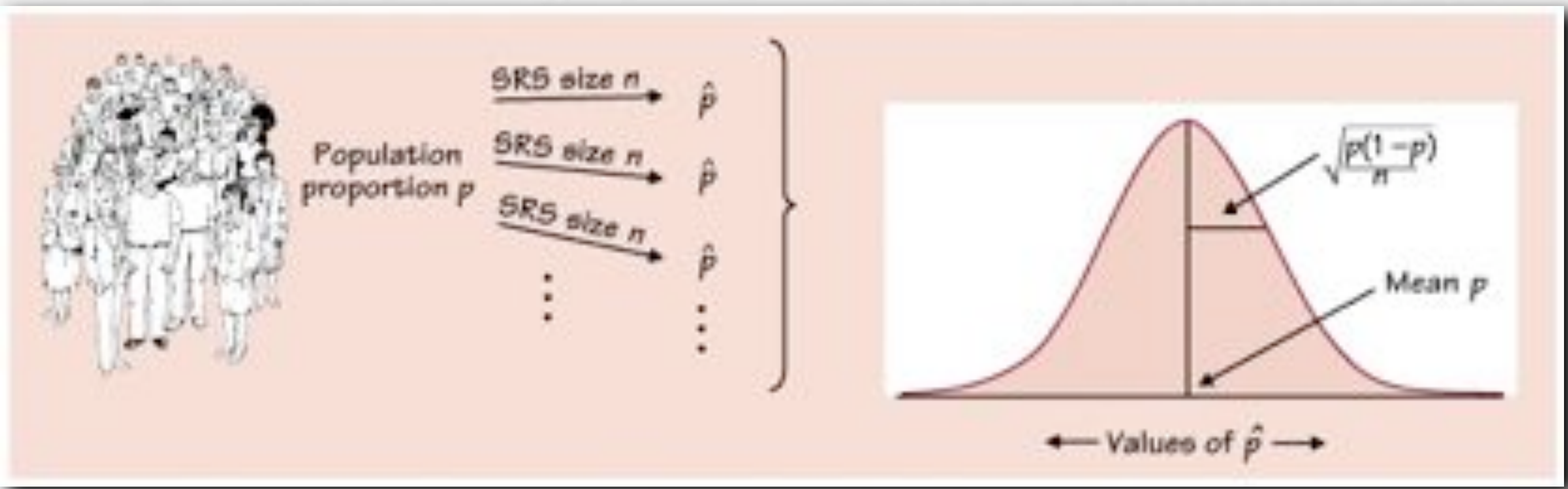
Sampling Distribution

- When we take a sample, we are not guaranteed the statistic we measure is equal to the parameter in question. Further, repeated sampling may result in different statistic values.
- **Bias and Variability**



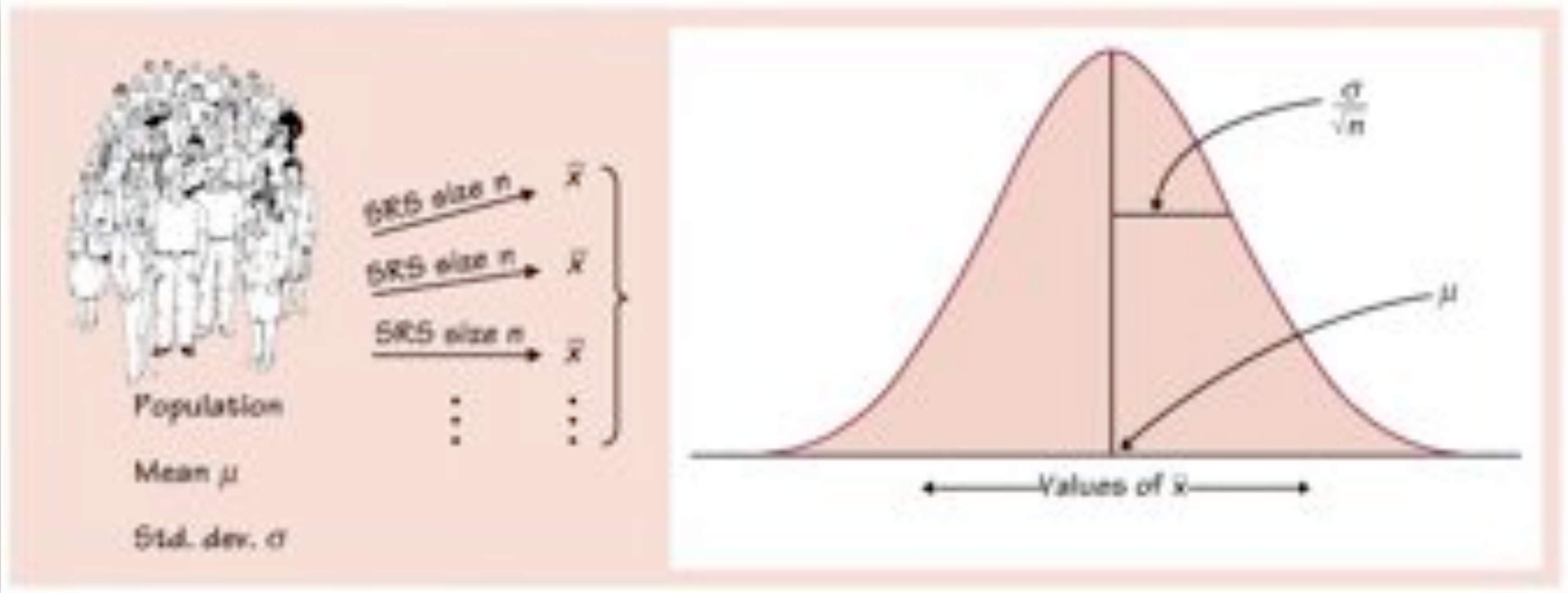
Sampling Distributions

- **Proportions**
- If the population proportion is π and
  - nπ≥10, n(1-π)≥10 and pop>10n
  - Then the distribution of p-hat is approximately normal



Sampling Distributions

- **Means**
- If the population mean is μ (and we know σ)
  - If the population is Normal OR n≥30 (CLT)
  - Then the distribution of x-bar is approximately normal



Sampling Distributions

- If conditions are met, we know what the sampling distribution of a proportion or mean will look like.
- Specifically, we know what sample value we'd expect to see and we know how close repeated samples should come to that expected value.
- Since the distributions are normal, we can calculate the likelihood of observing specific sample values...
  - This is the basis for the inferential calculations we'll study next semester!

Semester One Final Exam

50 Questions
Multiple Choice

Chapters 1-9

Weds: Per 1,3,5
Thurs: Per 2,4,6