

## AP Statistics – Chapter 9 Notes: Sampling Distributions

### 9.1 – Sampling Distributions

**Parameter** – a number that describes a population (usually unknown)

**Statistics** – a number that describes a sample (used to estimate a parameter)

Symbols used	Sample Statistic	Population Parameter
Proportions	$\hat{p}$	$p$
Means	$\bar{x}$	$\mu$

**Sampling Distribution** – the distribution of all values taken by a statistic in all possible samples of the same size from the same population

A statistic is called an **unbiased estimator** of a parameter if the mean of its sampling distribution is equal to the parameter being estimated

#### Important Concepts for unbiased estimators

- The mean of a sampling distribution will always equal the mean of the population for any sample size
- The spread of a sampling distribution is affected by the sample size, *not the population size*. Specifically, larger sample sizes result in smaller spread.

### 9.2 – Sample Proportions

Choose an SRS of size  $n$  from a large population with population proportion  $p$  having some characteristic of interest.

Let  $\hat{p}$  be the proportion of the sample having that characteristic. Then the mean and standard deviation of the sampling distribution of  $\hat{p}$  are

$$\text{Mean: } \mu_{\hat{p}} = p$$

$$\text{Std. Dev.: } \sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$$

#### CONDITIONS FOR NORMALITY

##### Rule Of Thumb 1

Use the formula for the standard deviation of  $\hat{p}$  only when the size of the population is at least 10 times as large as the sample size.

##### Rule Of Thumb 2

We will use the normal approximation to the sampling distribution of  $\hat{p}$  for values of  $n$  and  $p$  that satisfy  $np \geq 10$  and  $n(1-p) \geq 10$ .

### 9.3 – Sample Means

Suppose that  $\bar{x}$  is the mean of a sample from a large population with mean  $\mu$  and standard deviation  $\sigma$ . Then the mean and standard deviation of the sampling distribution of  $\bar{x}$  are

$$\text{Mean: } \mu_{\bar{x}} = \mu$$

$$\text{Std. Dev.: } \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

#### CONDITIONS FOR NORMALITY

If an SRS is drawn from a population that has the normal distribution with mean  $\mu$  and standard deviation  $\sigma$ , then the sample mean  $\bar{x}$  will have the normal distribution  $N(\mu, \sigma/\sqrt{n})$  for any sample size.

#### Central Limit Theorem

If an SRS is drawn from any population with mean  $\mu$  and standard deviation  $\sigma$ , when  $n$  is large ( $n \geq 30$ ), the sampling distribution of the sample mean  $\bar{x}$  will have the normal distribution  $N(\mu, \sigma/\sqrt{n})$ .