CP Statistics – Chapter 7 Notes: Sampling Distributions

7.1 – What is a Sampling Distribution?

Parameter – A **parameter** is a number that describes some characteristic of the population
Statistic – A **statistic** is a number that describes some characteristic of a sample

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

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 or variability.

7.2 – 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

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

With the Z-Statistic: $z = \frac{\hat{p}-p}{\sqrt{\frac{p(1-p)}{n}}}$

CONDITIONS FOR NORMALITY

The 10% Condition
Use the formula for the standard deviation of $\hat{p}$ only when the size of the sample is no more than 10% of the population size ($n \leq \frac{1}{10}N$).

The Large Counts Condition
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 $n(1-p) \geq 10$.

7.3 – Sample Means

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

Mean: $\mu_{\bar{x}} = \mu$ **Std. Dev.**: $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

With the Z-Statistic: $z = \frac{\bar{x}-\mu}{\sigma/\sqrt{n}}$

CONDITIONS FOR NORMALITY

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