Chapter 7

Biased estimator A statistic used to estimate a parameter is a biased estimator if the mean of its sampling distribution is not equal to the true value of the parameter being estimated.

Central limit theorem (CLT) Draw an SRS of size n from any population with mean μ and finite standard deviation σ. The central limit theorem (CLT) says that when n is large, the sampling distribution of the sample mean $\bar{x}$ is approximately Normal.

Parameter A number that describes some characteristic of the population. In statistical practice, the value of a parameter is usually not known because we cannot examine the entire population.

Population distribution Gives the values of the variable for all the individuals in the population.

Sampling variability The value of a statistic varies in repeated random sampling.

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.

Sampling distribution of a sample proportion Choose an SRS of size n from a population of size N with proportion p of successes. Let $\hat{p}$ be the sample proportion of successes. Then:

- The **mean** of the sampling distribution of $\hat{p}$ is $\mu_{\hat{p}} = p$.
- The **standard deviation** of the sampling distribution of $\hat{p}$ is

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

as long as the *10% condition* is satisfied: $n \le \frac{1}{10}N$.

- As n increases, the sampling distribution of $\hat{p}$ becomes **approximately Normal**.

Before you perform Normal calculations, check that the *Normal condition* is satisfied: $np \ge 10$ and $n(1-p) \ge 10$.

Sampling distribution of a sample mean Choose an SRS of size n from a population of size N with mean μ and standard deviation σ. Let $\bar{x}$ be the sample mean. Then:

- The **mean** of the sampling distribution of $\bar{x}$ is $\mu_{\bar{x}} = \mu$.
- The **standard deviation** of the sampling distribution of $\bar{x}$ is

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

as long as the *10% condition* is satisfied: $n \le \frac{1}{10} N$.

- If the population has a Normal distribution, then the sampling distribution of $\bar{x}$ also has a Normal distribution. Otherwise, the central limit theorem tells us that the sampling distribution of $\bar{x}$ will be approximately Normal in most cases when $n \ge 30$.

Statistic A number that describes some characteristic of a sample. The value of a statistic can be computed directly from the sample data. We often use a statistic to estimate an unknown parameter.

Unbiased estimator A statistic used to estimate a parameter is an unbiased estimator if the mean of its sampling distribution is equal to the true value of the parameter being estimated.

Variability The variability of a statistic is described by the spread of its sampling distribution. Statistics from larger samples have less variability.