AP Statistics – Chapter 8 Notes: Estimating with Confidence

8.1 – Confidence Interval Basics

Point Estimate
A ***point estimator*** is a statistic that provides an estimate of a population parameter. The value of that statistic from a sample is called a ***point estimate***.

The Idea of a Confidence Interval
A ***C% confidence interval*** gives an interval of plausible values for a parameter. The interval is calculated from the data and has the form: **point estimate ± margin of error**

The difference between the point estimate and the true parameter value will be less than the margin of error in C% of all samples.

The ***confidence level C*** gives the overall success rate of the method for calculating the confidence interval. That is, in C% of all possible samples, the method would yield an interval that captures the true parameter value.

Interpreting Confidence Intervals
To interpret a C% confidence interval for an unknown parameter, say, "We are C% confident that the interval from _____ to _____ captures the actual value of the [population parameter in context]."

Interpreting Confidence Levels
To say that we are *95% confident* is shorthand for "If we take many samples of the same size from this population, about 95% of them will result in an interval that captures the actual parameter value."

8.2 – Estimating a Population Proportion

Conditions for Inference about a Population Proportion

- **Random Sample** - The data are a random sample from the population of interest.
- **10% Rule** - The sample size is no more than 10% of the population size: $n \leq \frac{1}{10}N$
- **Large Counts** - Counts of successes and failures must be 10 or more: $n\hat{p} \geq 10$ and $n(1-\hat{p}) \geq 10$

Standard Error of a Sample Proportion $\hat{p}$ is

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

One-Proportion z-interval
The form of the confidence interval for a population proportion is

$$\hat{p} \pm z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

Sample size for a desired margin of error
To determine the sample size (n) for a given margin of error m in a 1-proportion z interval, use formula

$$n = p^*(1-p^*)\left(\frac{z^*}{m}\right)^2$$

where p* = 0.5, unless another value is given. Remember, that we will always round up to ensure a slightly smaller margin of error than is required.

8.3 – Estimating a Population Mean

Conditions for Inference about a Population Mean

- **Random Sample -** The data are a random sample from the population of interest.
- **10% Rule** - The sample size is no more than 10% of the population size: $n \le \frac{1}{10}N$
- **Large Counts/Normality** – If the sample size is large ($n \ge 30$), then we can assume normality for any shape of distribution. When sample is smaller than 30, the *t* procedures can be used except in the presence of outliers or strong skewness. Construct a quick graph of the data to make an assessment.

Standard Error

When the standard deviation of a statistic is estimated from the data, the result is called the *standard error* of the statistic. The standard error of the sample mean is

$$\frac{s}{\sqrt{n}}$$

One-Sample t-Interval for Estimating a Population Mean

The form of the confidence interval for a population mean with $n-1$ degrees of freedom is

$$\bar{x} \pm t^* \frac{s}{\sqrt{n}}$$

Paired Differences t-interval

To compare the responses to the two treatments in a paired data design, apply the one-sample *t* procedures to the observed differences.

For example, suppose that pre and post test scores for 10 individuals in a summer reading program are:

Subject	1	2	3	4	5	6	7	8	9	10
Pre-test	25	31	28	27	30	31	22	18	24	30
Post-test	28	30	34	35	32	31	26	16	28	36
Difference	3	-1	6	8	2	0	4	-2	4	6

We would then use the data in the “difference” row and perform one-sample *t* analysis on it.