

AP 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

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

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

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

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

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

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

$$N(\mu, \sigma/\sqrt{n}).$$

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