Estimation

- **Definition 8.0** A *parameter* is a numerical descriptive measure of a population. *This quantity is usually unknown but it is constant at a given time.*

  Examples: $\mu, \sigma^2, \sigma, \rho$.

- **Definition 7.1** A *sample statistic* is a numerical descriptive measure of a sample. *Its value is calculated from the observations in the sample.*

  Examples: $\bar{x}, s^2, s, \hat{p}$.

- **Definition 8.1** An *estimator* is a rule, often expressed as a formula, that tells how to calculate the value of an estimate based on the measurements contained in a sample.

- **Definition 8.2** Let $\hat{\theta}$ be a point estimator for a parameter θ. Then $\hat{\theta}$ is an *unbiased estimator* if $E(\hat{\theta}) = \theta$. If $E(\hat{\theta}) \neq \theta, \hat{\theta}$ is said to be *biased*.

  Examples:

- **Definition 8.3** The *bias* of a point estimator $\hat{\theta}$ is given by $B(\hat{\theta}) = E(\hat{\theta}) - \theta$.

  Exercise 1: Do problem 8.8 on page 394.

Exercise 2: Do problem 8.13 on page 394.

- **Definition 8.4** The *mean square error* of a point estimator $\hat{\theta}$ is given by $MSE(\hat{\theta}) = E[(\hat{\theta} - \theta)^2]$.
  Note: $MSE(\hat{\theta}) = V(\hat{\theta}) - [B(\hat{\theta})]^2$

Exercise 3: Do problem 8.15 on page 394.

- **Definition 8.5** The *error of estimation* ϵ is the distance between an estimator and its target parameter. That is, $\epsilon = |\hat{\theta} - \theta|$.