- Common Criteria includes:
  1. Principle of Unbiased Estimation;
  2. Minimum Variance among unbiased estimators;
  3. Minimum Mean Square Error (MSE);
- bias$(\hat{\theta}) = E\left(\hat{\theta}\right) - \theta$
- $MSE(\hat{\theta}) = V(\hat{\theta}) + Bias(\hat{\theta})^2 = E(\hat{\theta} - \theta)^2$
- The k^{th} population moment: $E(X^k)$
- The k^{th} sample moment: $\frac{1}{n}\sum_{i=1}^{n} X_i^k$

Steps of Method of Moments:

Step 1 Identify how many parameters we need to estimate.(Let's say m).

Step 2 Find the first m population moments: $E(X), E(X^2) \ldots, E(X^m)$

Step 3 Find the first m sample moments: $\frac{1}{n}\sum_{i=1}^{n} X_i, \quad \frac{1}{n}\sum_{i=1}^{n} X_i^2, \ldots, \quad \frac{1}{n}\sum_{i=1}^{n} X_i^m$

Step 4 Equalize each of the population moments to the corresponding sample moment.

$$\begin{aligned} E(X) &= \frac{1}{n}\sum_{i=1}^{n} X_i \\ E(X^2) &= \frac{1}{n}\sum_{i=1}^{n} X_i^2 \\ \ldots & \\ E(X^m) &= \frac{1}{n}\sum_{i=1}^{n} X_i^m \end{aligned}$$

Step 5 The solutions for the above equations are the moment estimators for the parameters.

Steps of Maximum Likelihood Estimation:

Step 1: Find the likelihood function $L(\theta; x) = \prod_{i=1}^{n} f(X_i, \theta)$.

Step 2: Find the natural logarithm of the likelihood function $l(\theta) = l(\theta; x) = \log L(\theta; x)$.

Step 3: Take a derivative of $l(\theta)$ for each of the parameter. (If you have m parameters you need m derivatives).

Step 4: Equalize each of the derivative with 0.

Step 5: Solve the equations to find solutions. The solutions are the MLE estimators for the parameters.