

- Let $\mathbf{X} = [X_1 \ X_2 \ \cdots \ X_n]^\top$.

- Covariance matrix:

$$K_{\mathbf{X}} = E(\mathbf{X} - E\mathbf{X})(\mathbf{X} - E\mathbf{X})^\top = [\text{cov}(X_i, X_j)]_{i,j=1}^n$$

- Correlation matrix: $\tilde{K}_{\mathbf{X}} = E\mathbf{X}\mathbf{X}^\top = [EX_i X_j]$

- Relations between $K_{\mathbf{X}}$ and $\tilde{K}_{\mathbf{X}}$:

$$K_{\mathbf{X}} = \tilde{K}_{\mathbf{X}} - (E\mathbf{X})(E\mathbf{X})^\top$$

$$K_{\mathbf{X}} = \tilde{K}_{\mathbf{X} - E\mathbf{X}}$$

- These are vector generalizations of

$$\text{var} X = EX^2 - (EX)^2$$

$$\text{var} X = E(X - EX)^2$$