$E(X) = \mu_X = \sum_{i=1}^{n} x_i p_i$	$Var(X) = \sigma_X^2 = E[(X- \mu_X)^2] = \sum_{i=1}^{n}(x_i - \mu_X)^2 p_i$
$\Pr(X = x) = \sum_{i=1}^{n} \Pr(X = x, Y = y_i)$	$\Pr(Y = y \mid X = x) = \frac{\Pr(X = x, Y = y)}{\Pr(X = x)}$
$E(Y \mid X = x) = \sum_{i=1}^{n} y_i \Pr(Y = y_i \mid X = x)$	$Var(Y \mid X = x) = \sum_{i=1}^{n} [y_i - E(Y \mid X = x)]^2 \Pr(Y = y_i \mid X = x)$
$E(Y) = \sum_{i=1}^{k} E(Y \mid X = x_i) \Pr(X = x_i)$ $= E[E(Y \mid X)]$	$Cov(X,Y) = \sigma_{XY} = E[(X - \mu_X)(Y - \mu_Y)]$ $= \sum_{i=1}^{n} \sum_{j=1}^{k} (x_j - \mu_X)(y_i - \mu_Y) \Pr(X = x_j, Y = y_i)$
$Corr(X,Y) = \rho_{XY} = \frac{\sigma_{XY}}{\sigma_X \sigma_Y}$ $= \frac{Cov(X,Y)}{\sqrt{Var(X)Var(Y)}}$	$E(aX + bY) = a\mu_X + b\mu_Y$ $Var(X) = E(X^2) - \mu_X^2$ $Var(aX + bY + c) = a^2\sigma_X^2 + b^2\sigma_Y^2 + 2ab\sigma_{XY}$ $Cov(X, Y) = E(XY) - \mu_X\mu_Y$ $Cov(a + bX + cV, Y) = b\sigma_{XY} + c\sigma_{VY}$
$Z = \frac{X - \mu}{\sigma}$	$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i, \quad s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(X_i - \bar{X})^2$
$Z = \frac{(\bar{X} - \mu)}{\sigma/\sqrt{n}}$	$t = \frac{(\bar{X} - \mu)}{s/\sqrt{n}}$

$$\Pr\left[\bar{X} - \left(\frac{s}{\sqrt{n}}\right) t_{n-1,\alpha/2} \leq \mu \leq \bar{X} + \left(\frac{s}{\sqrt{n}}\right) t_{n-1,\alpha/2}\right] = 1 - \alpha$$

$$\boldsymbol{Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i}$$

$$\hat{\beta}_1 = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sum_{i=1}^{n}(X_i - \bar{X})^2} = \frac{\sum_{i=1}^{n} X_i Y_i - n\bar{X}\bar{Y}}{\sum_{i=1}^{n} X_i^2 - n\bar{X}^2} \qquad Var(\hat{\beta}_1) = \frac{\sigma^2}{\sum_{i=1}^{n}(X_i - \bar{X})^2}$$

$$\hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X}$$

$$\boldsymbol{Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki} + \varepsilon_i}$$

$$\sum_{i=1}^{n}(Y_i - \bar{Y})^2 = \sum_{i=1}^{n}(\hat{Y}_i - \bar{Y})^2 + \sum_{i=1}^{n} e_i^2$$

TSS = ESS + RSS

$$F = \frac{ESS/k}{RSS/(n-k-1)}$$

$$R^2 = \frac{\text{ESS}}{\text{TSS}} = 1 - \frac{\text{RSS}}{\text{TSS}} = 1 - \frac{\sum_{i=1}^{n} e_i^2}{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}$$

$$\bar{R}^2 = 1 - \frac{\sum_{i=1}^{n} e_i^2/(n-k-1)}{\sum_{i=1}^{n}(Y_i - \bar{Y})^2/(n-1)} = 1 - (1 - R^2)\frac{n-1}{n-k-1}$$