Please find below the most useful formulas in EC122. To use them properly, you need to know when they are applicable (what are the assumptions, what must be given in the question).

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i, \quad s_x^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2 = \frac{1}{n-1}\left(\sum_{i=1}^{n} x_i^2 - n\bar{x}^2\right)$$

$$\text{Skewness} = \frac{1}{ns_x^3}\sum_{i=1}^{n}(x_i - \bar{x})^3 = \frac{1}{ns_x^3}\left(\sum_{i=1}^{n} x_i^3 - 3(n-1)\bar{x}s_x^2 - n\bar{x}^3\right)$$

$$P(B_j|A) = \frac{P(A \cap B_j)}{P(A)} = \frac{P(A \cap B_j)}{\sum_{k=1}^{n} P(A \cap B_k)} = \frac{P(A|B_j) \cdot P(B_j)}{\sum_{k=1}^{n} P(A|B_k) \cdot P(B_k)}$$

$$\mu_X = E(X) = \sum_i x_i p(x_i), \quad \sigma^2 = E(X - E(X))^2 = E(X^2) - [E(X)]^2 = \sum_{i=1}^{n} x_i^2 p(x_i) - \mu_X^2$$

$$E(a + bX) = a + bE(X), \quad Var(a + bX) = b^2 Var(X)$$

$$E(\bar{X}) = E(X) = \mu_X, \quad Var(\bar{X}) = \frac{1}{n}Var(X) = \frac{\sigma^2}{n}$$

Distribution	Probability density function	Mean	Variance
Uniform	$f(x) = \begin{cases} \frac{1}{b-a} & \text{if } a \le x \le b \\ 0 & \text{otherwise} \end{cases}$	$\frac{1}{2}(a+b)$	$\frac{1}{12}(b-a)^2$
Bernoulli	$P(B=1) = \pi,\ P(B=0) = 1-\pi$	π	$\pi(1-\pi)$
Binomial	$P(S=k) = \pi^k(1-\pi)^{n-k}\frac{n!}{k!(n-k)!}$	$n\pi$	$n\pi(1-\pi)$
Poisson	$P(X=k) = \frac{e^{-\mu}\mu^k}{k!}$	μ	μ
Normal	$f(x) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$	μ	σ^2

$$\pi \in \left[\bar{p} - z_{\alpha/2}\sqrt{\frac{\bar{p}(1-\bar{p})}{n}},\ \bar{p} + z_{\alpha/2}\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}\right]$$

$$\pi_1 - \pi_2 \in \left[(\bar{p} - \bar{q}) - z_{\alpha/2}\sqrt{\frac{\bar{p}(1-\bar{p})}{n} + \frac{\bar{q}(1-\bar{q})}{m}},\ (\bar{p} - \bar{q}) + z_{\alpha/2}\sqrt{\frac{\bar{p}(1-\bar{p})}{n} + \frac{\bar{q}(1-\bar{q})}{m}}\right]$$

$$\mu_X \in \left[\bar{x} - z_{\alpha/2}\frac{\sigma_X}{\sqrt{n}},\ \bar{x} + z_{\alpha/2}\frac{\sigma_X}{\sqrt{n}}\right]$$

$$\mu_X \in \left[\bar{x} - t_{n-1,\alpha/2}\frac{s_x}{\sqrt{n}},\ \bar{x} + t_{n-1\alpha/2}\frac{s_x}{\sqrt{n}}\right]$$

$$\mu_X - \mu_Y \in \left[(\bar{x} - \bar{y}) - z_{\alpha/2}\sqrt{\frac{\sigma_X^2}{n} + \frac{\sigma_Y^2}{m}},\ (\bar{x} - \bar{y}) + z_{\alpha/2}\sqrt{\frac{\sigma_X^2}{n} + \frac{\sigma_Y^2}{m}}\right]$$

$$\mu_X - \mu_Y \in \left[(\bar{x}-\bar{y}) - t_{n+m-2,\alpha/2}\sqrt{\frac{s_p^2}{n}+\frac{s_p^2}{m}},\ (\bar{x}-\bar{y}) + t_{n+m-2,\alpha/2}\sqrt{\frac{s_p^2}{n}+\frac{s_p^2}{m}} \right]$$

$$\text{where,}\quad s_p^2 = \frac{(n-1)s_X^2 + (m-1)s_Y^2}{n+m-2}$$

$$\sigma_X^2 \in \left[\frac{(n-1)s_x^2}{\chi^2_{n-1,\alpha/2}}, \frac{(n-1)s_x^2}{\chi^2_{n-1,1-\alpha/2}} \right]$$

$$Z = \frac{\bar{P}-\pi}{\sqrt{\frac{\pi(1-\pi)}{n}}} \sim N(0,1), \quad Z = \frac{(\bar{P}-\bar{Q})-(\pi-\pi)}{\sqrt{\frac{\bar{r}(1-\bar{r})}{n}+\frac{\bar{r}(1-\bar{r})}{m}}} \sim N(0,1), \quad \bar{r} = \left(\frac{n}{n+m}\right)\bar{p} + \left(\frac{m}{n+m}\right)\bar{q}$$

$$Z = \frac{\bar{X}-\mu}{\sigma_X/\sqrt{n}} \sim N(0,1), \quad Z = \frac{(\bar{X}-\bar{Y})-(\mu_X-\mu_Y)}{\sqrt{\frac{\sigma_X^2}{n}+\frac{\sigma_Y^2}{m}}} \sim N(0,1), \quad T = \frac{\bar{X}-\mu}{S_X/\sqrt{n}} \sim t_{n-1}$$

$$T = \frac{(\bar{X}-\bar{Y})-(\mu_X-\mu_Y)}{\sqrt{\frac{S^2}{n}+\frac{S^2}{m}}} \sim t_{n+m-2}, \quad S^2 = \left(\frac{n-1}{n+m-2}\right)\cdot S_X^2 + \left(\frac{m-1}{n+m-2}\right)\cdot S_Y^2$$

$$C = \frac{(n-1)S_X^2}{\sigma_X^2} \sim \chi^2_{n-1}, \quad C = \sum_{i=1}^{k}\frac{(O_i-E_i)^2}{E_i} \sim \chi^2_{k-1}, \quad C = \sum_{i=1}^{k}\sum_{j=i}^{l}\frac{(O_{ij}-E_{ij})^2}{E_{ij}} \sim \chi^2_{(k-1)(l-1)}$$

$$F = \frac{S_X^2}{S_Y^2} \sim F_{n-1,m-1}, \quad F = \frac{SSB/(k-1)}{SSW/(n-k)} \sim F_{k-1,n-k}$$

$$n = n_1 + \ldots + n_k, \quad \text{SST} = \sum_{i=1}^{k}\sum_{j=1}^{n_i} x_{ij}^2 - n\bar{x}^2, \quad \text{SSB} = \sum_{i=1}^{k} n_i\bar{x}_i{}^2 - n\bar{x}^2, \quad \text{SST} = \text{SSB} + \text{SSW}$$

$$s_{xy} = \frac{1}{n-1}\sum_{i=1}^{n}(x_i-\bar{x})(y_i-\bar{y}) = \frac{1}{n-1}\left(\sum_{i=1}^{n}x_iy_i - n\bar{x}\bar{y}\right)$$

$$r_{xy} = \frac{\sum_{i=1}^{n}x_iy_i - n\bar{x}\bar{y}}{\sqrt{\left(\sum_{i=1}^{n}x_i^2 - n\bar{x}^2\right)\left(\sum_{i=1}^{n}y_i^2 - n\bar{y}^2\right)}} = \frac{s_{xy}}{s_x\cdot s_y}$$

$$t = \frac{r_{xy}\sqrt{n-2}}{\sqrt{1-r_{xy}^2}} \sim t_{n-2}$$

$$\hat{y}_i = b_0 + b_1x_i, \quad b_1 = \frac{\sum_{i=1}^{n}x_iy_i - n\bar{x}\bar{y}}{\sum_{i=1}^{n}x_i^2 - n\bar{x}^2} = \frac{s_{xy}}{s_x^2} = r_{xy}\cdot\frac{s_y}{s_x}, \quad b_0 = \bar{y} - b_1\bar{x}$$

$$\text{SST} = \sum_{i=1}^{n}(y_i - \bar{y})^2, \quad \text{SSE} = e_i^2 = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2 = \sum_{i=1}^{n}(y_i - b_0 - b_1 x_i)^2$$

$$\text{SST} = \text{SSR} + \text{SSE}, \quad R^2 = \frac{\text{SSR}}{\text{SST}} = 1 - \frac{\text{SSE}}{\text{SST}} = r_{xy}^2$$

$$s_e^2 = \frac{1}{n-2}\sum_{i=1}^{n} e_i^2 = \frac{n-1}{n-2}(s_y^2 - b_1^2 \cdot s_x^2)$$

$$s_{b_1}^2 = \frac{s_e^2}{\sum_{i=1}^{n}(x_i - \bar{x})^2} = \frac{s_e^2}{\sum_{i=1}^{n} x_i^2 - n\bar{x}^2}$$

$$t = \frac{b_1 - \beta}{s_{b_1}} \sim t_{n-2}$$

$$\beta \in \left[b_1 - t_{\alpha/2,n-2} \cdot s_{b_1}, \;\; b_1 + t_{\alpha/2,n-2} \cdot s_{b_1}\right]$$