Some Useful Formulas

- Sample standard deviation:

$$S=\sqrt{\frac{\sum\left(x-\bar{x}\right)^2}{n-1}}=\sqrt{\frac{\left(\sum x^2-\frac{\left(\sum x\right)^2}{n}\right)}{n-1}}=\sqrt{\frac{\sum x^2-n(\bar{x})^2}{n-1}}$$

- $P\left(E_1 \text{ or } E_2\right)=P\left(E_1\right)+P\left(E_2\right)-P\left(E_1 \text{ and } E_2\right)$

- **Conditional Probability:** $P\left(E_1|E_2\right)=\frac{P\left(E_1 \text{ and } E_2\right)}{P\left(E_2\right)}$

- **Binomial:** $P\left(x\right)=\frac{n!}{x!\left(n-x!\right)}p^x q^{n-x}$, $\mu=E\left(X\right)=np$, $\sigma=\sqrt{npq}$

- **Poisson:** $P\left(x\right)=\frac{\left(\lambda t\right)^x e^{-\lambda t}}{x!}$, $\mu=\lambda t$, $\sigma=\sqrt{\lambda t}$

- **Hyeprgeometric:** $P\left(x\right)=\frac{C_{n-x}^{N-X}\,C_x^X}{C_n^N}$

- **Uniform:** $f\left(x\right)=\begin{cases}\frac{1}{a-b} & \text{if } a\le x\le b\\ 0 & \text{otherwise}\end{cases}$

- **Exponential:** $P\left(0\le x\le a\right)=1-e^{-\lambda a}$

- **Sampling Error =** Statistics Value – Parameter Value.

- $\mu_{\bar{x}}=\mu$, $\sigma_{\bar{x}}=\frac{\sigma}{\sqrt{n}}$

If the population is finite and sampling is without replacement $\sigma_{\bar{x}}=\frac{\sigma}{\sqrt{n}}\sqrt{\frac{N-n}{N-1}}$

- $\mu_{\bar{p}}=p$, $\sigma_{\bar{p}}=\sqrt{\frac{p(1-p)}{n}}$,

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- **Confidence interval estimate for** $\mu(\sigma\ known)$ $\bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$
- **Confidence interval estimate for** $\mu(\sigma\ unknown)$ $\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$
- **Required sample size**: $n = \frac{z_{\alpha/2}^2 \sigma^2}{e^2} = \left(\frac{z_{\alpha/2}\sigma}{e}\right)^2$
- **Confidence interval for population proportion :** $\bar{p} \pm z_{\alpha/2}\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$
- **Required sample size is**: $n = \frac{z_{\alpha/2}^2\, p(1-p)}{e^2}$
- **The confidence interval for μ1 – μ2** ($(\sigma_1, \sigma_2\ are\ known)$

  is: $\left(\bar{x}_1 - \bar{x}_2\right) \pm z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$
- **Ifσ1 and σ2 unknown, and we have large samples, then: The confidence interval for μ1 – μ2** is: $\left(\bar{x}_1 - \bar{x}_2\right) \pm z_{\alpha/2}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$
- **If σ1 and σ2 unknown, and small samples:** $\left(\bar{x}_1 - \bar{x}_2\right) \pm t_{\alpha/2}\, s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$, where

$$s_p = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}}$$

- **Paired Samples**: $\bar{d} \pm t_{\alpha/2} \frac{s_d}{\sqrt{n}}$
- **The confidence interval for the difference between two population proportions**

  $\left(\bar{p}_1 - \bar{p}_2\right) \pm z_{\alpha/2}\sqrt{\frac{\bar{p}_1(1-\bar{p}_1)}{n_1} + \frac{\bar{p}_2(1-\bar{p}_2)}{n_2}}$