Central Tendency

$$\boldsymbol{mean} = \frac{\sum x}{n} = \frac{Sum\ of\ all\ observations}{Totat\ number\ of\ observations}$$

$$\boldsymbol{sample\ mean} = \boldsymbol{\overline{x}} = \frac{\sum x}{n} = \frac{Sum\ of\ all\ samples}{Totat\ number\ of\ samples}$$

$$\boldsymbol{population\ mean} = \boldsymbol{\mu} = \frac{\sum X}{N} = \frac{Sum\ of\ all\ values\ within\ the\ populations}{Totat\ number\ of\ values\ within\ the\ population}$$

$$\boldsymbol{Median = Middle\ Value} = \boldsymbol{\sout{185K}, \sout{197K}, 230K, \sout{252K}, \sout{1.4M}}$$

$$\boldsymbol{Median\ of\ Even\ Numbers} = \boldsymbol{\sout{85K}, 197K, 230K, \sout{252K}}$$

$$\boldsymbol{Median = M = Mean\ of\ 197K\ \&\ 230K} = \frac{\sum \boldsymbol{x}}{\boldsymbol{n}} = \frac{\boldsymbol{197K + 230K}}{\boldsymbol{2}} = \frac{\boldsymbol{427K}}{\boldsymbol{2}} = \boldsymbol{213.5K}$$

*the **Mode** is defined as the most frequently occurring value in a data set.*

Variance

$$Range = R = Max(x) - Min(x)$$

$$Sample\ Variance = s^2 = \frac{\sum(x - \bar{x})^2}{n - 1}$$

$$Sample\ Variance = s^2 = \frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n - 1}$$

$$Population\ Variance = \sigma^2 = \frac{\sum(x - \bar{\mu})^2}{N}$$

$$Sample\ Standard\ Deviation{:}\ \ s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n - 1}}$$

$$Population\ Standard\ Deviation{:}\ \ s = \sqrt{\frac{\sum(x - \bar{\mu})^2}{N}}$$

Probability

$$The\ Probability\ of\ A\ or\ B = P(A\ U\ B) = P(A) + P(B) - P(A \cap B)$$

$$The\ Probability\ of\ A\ and\ B = P(A \cap B) = The\ Intersection\ of\ A\ \&\ B$$

$$The\ Probability\ of\ A^{\circ} = P(A^{\circ}) = 1 - P(A)$$

$$For\ Mutually\ Exclusive\ Events:\ P(A \cap B) = 0$$

$$Probabiliy\ of\ A\ given\ B = P(A\ |B) = \frac{P(A \cap B)}{P(B)} = \frac{The\ Intersection\ of\ A\ \&\ B}{The\ Probability\ of\ B}$$

$$For\ Independent\ Events:\ P(A\ and\ B) = P((A \cap B) = P(A) * P(B)$$

$$The\ Union\ of\ A\ \&\ B = A\ or\ B = (A\ U\ B)$$

$$The\ Intersection\ of\ A\ and\ B = A\ \&\ B = (A \cap B)$$

$$The\ Multiplication\ Rule\ for\ Dependent\ Events:\ P(A\ and\ B) = P(A \cap B) = P(A|B) * P(B)$$

$$The\ Addition\ Rule\ for\ Two\ Events = P(A\ U\ B) = P(A) + P(B) - P(A \cap B)$$

$$For\ Mutually\ Exclusive\ Events:\ P(A \cap B) = 0$$

$$The\ Addition\ Rule\ for\ Mutually\ Excluive\ Events = P(A\ U\ B) = P(A) + P(B)$$

Probability Distributions

$$Normal\ Distribution\ Z\ Transformation: Z = \frac{X - \mu}{\sigma}$$

$$Uniform\ Distribution\ Mean\ Value: \mu = \frac{a + b}{2}$$

$$Exponential\ Distribution\ Probability: P(X = x):\ f(x) = xe^{-\lambda x}$$

$$Exponential\ Distribution\ Cumulative\ Probability: P(X > x):\ f(x) = e^{-\lambda x}$$

$$Exponential\ Distribution\ Cumulative\ Probability: P(X < x):\ \ F(x) = 1 - e^{-\lambda x}$$

$$Exponential\ Distribution\ Mean\ Value = \theta = \frac{1}{\lambda} \quad where \quad \lambda = Occurrence\ Rate$$

$$Weibull\ Distribution\ Reliability: \quad R(t) = e^{-\left(\frac{t}{\theta}\right)^{\beta}}$$

$$Student\ T\ Distribution: t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

$$F\ Distribution: F = \frac{(S_1)^2}{(S_2)^2}$$

Binomial Distribution: Mean(Expected Value): $\mu = n*p$

Binomial Distribution: Standard Deviation: $\sigma = \sqrt{n * p(1 - p)}$

$$Binomial\ Distribution\ Probability: P(X = x) = \binom{n}{x} p^x (1 - p)^{n-x}$$

$$where\ \binom{n}{x} = \frac{n!}{x!\,(n - x)!}$$

Poisson Distribution: Mean (Expected Value): $\mu = \lambda$

Poisson Distribution: Standard Deviation: $\boldsymbol{\sigma} = \sqrt{\boldsymbol{\lambda}}$

$$Poisson\ Distribution\ Probability: f(x) = P(X = x) = \frac{e^{-\lambda} * \lambda^x}{x!}$$

$$Hypergeometric\ Distribution\ Probabibility: f(x) = \frac{\binom{A}{x} * \binom{N-A}{n-x}}{\binom{N}{n}}$$

Point Estimates & Confidence Intervals

$$Variance\ of\ sample\ mean: V(\bar{x}) = \frac{\sigma^2}{n}$$

$$Standard\ Error\ of\ The\ Sample\ Mean: S.E. = \sqrt{\frac{\sigma^2}{n}} = \frac{\sigma}{\sqrt{n}}$$

$$Interval\ Estimate\ of\ Population\ Mean\ (known\ variance)\ : \bar{x} \pm Z_{\frac{\alpha}{2}} * \frac{\sigma}{\sqrt{n}}$$

$$Interval\ Estimate\ of\ Population\ Mean\ (unknown\ variance): \bar{x} \pm t_{\frac{\alpha}{2}} * \frac{s}{\sqrt{n}}$$

$$Confidence\ Interval\ for\ Variance: \quad \frac{(n-1)s^2}{X^2_{1-\alpha/2}} < \sigma^2 < \frac{(n-1)s^2}{X^2_{\alpha/2}}$$

$$Confidence\ Interval\ for\ Standard\ Deviation: \quad \sqrt{\frac{(n-1)s^2}{X^2_{1-\alpha/2}}} < \sigma < \sqrt{\frac{(n-1)s^2}{X^2_{\alpha/2}}}$$

$$Confidence\ Interval\ (Proportion): p \pm Z_{\frac{\alpha}{2}}\sqrt{\frac{p*(1-p)}{n}}$$

Hypothesis Testing

$$Population\ Mean:\ z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

$$Population\ Mean:\ t - statistic = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

$$Population\ Variance -\ Chi\ Squared\ Test\ Statistic: X^2 = \frac{(N-1)s^2}{\sigma^2}$$

$$Population\ Variance -\ Chi\ Squared\ Test\ Statistic: X^2 = \frac{(N-1)s^2}{\sigma^2}$$

$$Two\ Population\ Variances -\ F - Test\ Statistic: F = \frac{s_1^2}{s_2^2}$$

$$Population\ Proportion: Z_O = \frac{\hat{p} - p_O}{\sqrt{\frac{p_O(1-p_O)}{n}}}$$

Process and Performance Capability

$$\boldsymbol{Process\ Capability\ Analysis} = \frac{\boldsymbol{Process\ Specification}}{\boldsymbol{Process\ Performance}}$$

$$C_p = \frac{USL - LSL}{6\sigma}$$

$$C_{pk} = Min\left(C_{p,Lower}, C_{p,Upper}\right) = Min\left(\frac{USL - \tilde{x}}{3s}, \frac{\tilde{x} - LSL}{3s}\right)$$

$$C_{pm} = \frac{C_p}{\sqrt{1 + \frac{(\mu - T)^2}{s^2}}} = \frac{USL - LSL}{6\sqrt{s^2 + (\tilde{x} - T)^2}}$$

$$C_r = \frac{1}{C_p}$$

$$P_p = \frac{USL - LSL}{6\boldsymbol{s_{p_p}}}$$

$$C_p = \frac{USL - LSL}{6\boldsymbol{s_{c_p}}}$$

$$P_{pk} = Min\left(\frac{USL - \tilde{x}}{3\boldsymbol{s_{p_p}}}, \frac{\tilde{x} - LSL}{3\boldsymbol{s_{p_p}}}\right)$$

$$C_{pk} = Min\left(\frac{USL - \tilde{x}}{3\boldsymbol{s_{c_p}}}, \frac{\tilde{x} - LSL}{3\boldsymbol{s_{c_p}}}\right)$$