Part I: <u>Summary of Confidence Intervals:</u>

(I) CI for the Population Mean μ:

Case 1: Large sample ($n \geq 30$):

CI: $(\bar{x} - E, \bar{x} + E)$

$E = z_c \frac{s}{\sqrt{n}}$

$z_c = NORM.S.INV\left(\frac{1+c}{2}\right)$

Determining the ample size: $n = \left(\frac{z_c\, s}{E}\right)^2$

Case 2: Small sample, Population is normal, σ is given: Same as case 1.

Case 3: Small sample, Population is normal, σ is unknown:

CI: $(\bar{x} - E, \bar{x} + E)$

$E = t_c \frac{s}{\sqrt{n}}$

$DF = n - 1;$

$t_c = T.INV\left(\frac{1+c}{2}, DF\right)$

(II) CI for the Population Proportion p:

First ensure that $n\,\hat{p} \geq 10$ and $n\,\hat{q} \geq 10$; where : $\hat{p} = \frac{x}{n}$ is the sample proportion and $\hat{q} = 1 - \hat{p}$.

Next,

CI: $(\hat{p} - E, \hat{p} + E)$

$E = z_c \sqrt{\frac{\hat{p}\,\hat{q}}{n}}$

$z_c = NORM.S.INV\left(\frac{1+c}{2}\right).$

Determining the sample size: $n = \hat{p}\,\hat{q}\left(\frac{z_c}{E}\right)^2.$

(III) **CI for the Population Standard Deviation σ:**

CI Lower Limit for σ: $\sqrt{\frac{(n-1)\,s^2}{\chi_R^2}}$

CI Upper Limit for σ: $\sqrt{\frac{(n-1)\,s^2}{\chi_L^2}}$

$\chi_R{}^2 := CHISQ.INV\left(\frac{1+c}{2}, DF\right)$

$\chi_L{}^2 := CHISQ.INV\left(\frac{1-c}{2}, DF\right)$

$DF = n - 1;$

Part II Hypothesis Testing Summary:

(I) Hypothesis testing for a population mean μ: (large sample: $n \ge 30$)

	Right Tailed Problem	Left-Tailed Problem	Two Tailed Problem:
Hypotheses:	$Null: \quad H_a: \mu \le \mu_o$ $Alternative: H_a: \mu > \mu_o$	$Null: \quad H_a: \mu \ge \mu_o$ $Alternative: H_a: \mu < \mu_o$	$Null: \quad H_a: \mu = \mu_o$ $Alternative: H_a: \mu \ne \mu_o$
Test Statistic z	$z = \frac{\left(\bar{x} - \mu_o\right)\sqrt{n}}{s}$	$z = \frac{\left(\bar{x} - \mu_o\right)\sqrt{n}}{s}$	$z = \frac{\left(\bar{x} - \mu_o\right)\sqrt{n}}{s}$
P-Value:	$P\left(Z \ge z\right)$	$P\left(Z \le z\right)$	$\begin{cases} 2P\left(Z \ge z\right) \text{ if } z \text{ is positive} \\ 2P\left(Z \le z\right) \text{ if } z \text{ is negative} \end{cases}$
Decision:	$Reject\ H_o\ if\ \ Pvalue \le \alpha$	$Reject\ H_o\ if\ \ Pvalue \le \alpha$	$Reject\ H_o\ if\ \ Pvalue \le \alpha$

(II) Hypothesis testing for a population mean μ: (small sample, population is Normal, σ is unknown)

	Right Tailed Problem	Left-Tailed Problem	Two Tailed Problem:
Hypotheses:	$Null: \quad H_a: \mu \le \mu_o$ $Alternative: H_a: \mu > \mu_o$	$Null: \quad H_a: \mu \ge \mu_o$ $Alternative: H_a: \mu < \mu_o$	$Null: \quad H_a: \mu = \mu_o$ $Alternative: H_a: \mu \ne \mu_o$
Test Statistic t	$t = \frac{\left(\bar{x} - \mu_o\right)\sqrt{n}}{s}$	$t = \frac{\left(\bar{x} - \mu_o\right)\sqrt{n}}{s}$	$t = \frac{\left(\bar{x} - \mu_o\right)\sqrt{n}}{s}$
P-Value:	$P\left(T \ge t\right)$	$P\left(T \le t\right)$	$\begin{cases} 2P\left(T \ge t\right) \text{ if } t \text{ is positive} \\ 2P\left(T \le t\right) \text{ if } t \text{ is negative} \end{cases}$

Decision:	$Reject\ H_o\ if\ \ Pvalue \le \alpha$	$Reject\ H_o\ if\ \ Pvalue \le \alpha$	$Reject\ H_o\ if\ \ Pvalue \le \alpha$

(III) Hypothesis testing for a population Proportion p:

	Right Tailed Problem	**Left-Tailed Problem**	**Two Tailed Problem:**
Hypotheses:	$Null: \quad H_a:\ p \le p_o$ $Alternative:\ H_a:\ p > p_o$	$Null: \quad H_a:\ p \ge p_o$ $Alternative:\ H_a:\ p < p_o$	$Null: \quad H_a:\ p = p_o$ $Alternative:\ H_a:\ p \ne p_o$
Test Statistic z	$z = \dfrac{\hat{p} - p_o}{\sqrt{\dfrac{p_o q_o}{n}}}$	$z = \dfrac{\hat{p} - p_o}{\sqrt{\dfrac{p_o q_o}{n}}}$	$z = \dfrac{\hat{p} - p_o}{\sqrt{\dfrac{p_o q_o}{n}}}$
P-Value:	$P(Z \ge z)$	$P(Z \le z)$	$\begin{cases} 2P(Z \ge z) & if\ \ z\ is\ positive \\ 2P(Z \le z) & if\ \ z\ is\ negative \end{cases}$
Decision:	$Reject\ H_o\ if\ \ Pvalue \le \alpha$	$Reject\ H_o\ if\ \ Pvalue \le \alpha$	$Reject\ H_o\ if\ \ Pvalue \le \alpha$

(IV) Hypothesis testing for a population Proportion Standard Deviation σ:

	Right Tailed Problem	**Left-Tailed Problem**	**Two Tailed Problem:**
Hypotheses:	$Null: \quad H_a:\ \sigma \le \sigma_o$ $Alternative:\ H_a:\ \sigma > \sigma_o$	$Null: \quad H_a:\ \sigma \ge \sigma_o$ $Alternative:\ H_a:\ \sigma < \sigma_o$	$Null: \quad H_a:\ \sigma = \sigma_o$ $Alternative:\ H_a:\ \sigma \ne \sigma_o$
Test Statistic χ^2	$\chi^2 = \dfrac{(n-1)s^2}{\sigma_o^2}$	$\chi^2 = \dfrac{(n-1)s^2}{\sigma_o^2}$	$\chi^2 = \dfrac{(n-1)s^2}{\sigma_o^2}$
P-Value:	$P(\mathrm{X}^2 \ge \chi^2)$	$P(\mathrm{X}^2 \le \chi^2)$	$\begin{cases} 2P(\mathrm{X}^2 \ge \chi^2) & if\ \ \chi^2 \ge \chi_R^2 \\ 2P(\mathrm{X}^2 \le \chi^2) & if\ \ \chi^2 \le \chi_L^2 \end{cases}$
Decision:	$Reject\ H_o\ if\ \ Pvalue \le \alpha$	$Reject\ H_o\ if\ \ Pvalue \le \alpha$	$Reject\ H_o\ if\ \ Pvalue \le \alpha$

Part III: Summary of Continuous Probability Formulas in Excel

1. **The Normal Distribution:**

(i) Standard Normal Distribution Z

$$P(Z \le z): \quad \underline{= NORM.S.DIST(z,1)}$$

$$z: \quad \underline{= NORM.S.INV(P(Z \le z))}$$

$P(Z \le z)$ **represents the area on the left of** z

(ii) Non-Standard Normal Distribution X

$$P(X \le x): \quad \underline{= NORM.DIST(x,\mu,\sigma,1)}$$

$$x: \quad \underline{= NORM.INV(P(X \le x),\mu,\sigma)}$$

$P(X \le x)$ **represents the area on the left of** x

2. **The T Distribution T (DF = n – 1)**

$$P\left(T \le t\right): \quad \underline{= T.DIST\left(t, df\right)}$$

$$t: \quad \underline{= T.INV\left(P\left(T \le t\right), df\right)}$$

$P\left(T \le t\right)$ **represents the area on the left of** t

3. **The Chi-squared Distribution X^2 (DF = n – 1)**

$$P\left(\mathrm{X}^2 \le \chi^2\right): \quad \underline{= CHISQ.DIST\left(\chi^2, df, 1\right)}$$

$$\chi^2: \quad \underline{= CHISQ.INV\left(P\left(\mathrm{X}^2 \le \chi^2\right), df\right)}$$

$P\left(\mathrm{X}^2 \le \chi^2\right)$ **represents the area on the left of** χ^2