Formula Card Exam 2 STA3123

Steps for constructing the **Confidence Interval for the True Difference between the Population Means (large, independent samples):**

Step 1 Gather Data from Problem, Calculate $\bar{X}_1 - \bar{X}_2$, and Calculate $\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}}$.

Step 2 Find $Z_{\alpha/2}$

Step 3 Use the results from steps 2 and 1 to get the margin of error, E = $Z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}}$

Step 4 Form $\left[(\bar{X}_1 - \bar{X}_2) - E, (\bar{X}_1 - \bar{X}_2) + E\right]$

Steps to test a hypothesis for the True Difference between the Population Means (large, independent samples):

1. Express the original claim symbolically *
2. Identify the Null and Alternative hypothesis*
3. Record the data from the problem
4. Calculate the test statistic $z = \frac{\left(\bar{X}_1 - \bar{X}_2\right) - D_0}{\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}}}$
5. Determine your rejection region
6. Find the initial conclusion
7. Word your final conclusion

*note the claim, the null, and the alternative will vary, for example one case could be: $H_0 : \mu_1 = \mu_2$ $H_A : \mu_1 \neq \mu_2$

Steps for constructing the **Confidence Interval for the True Difference between the Population Means (Small, independent samples with equal variances):**

Step 1 Gather Data from Problem, Calculate $\bar{X}_1 - \bar{X}_2$, and Calculate $S_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$

Step 2 Find $t_{\alpha/2}$ using $n_1 + n_2 - 2$ as the degrees of freedom

Step 3 Find E = $t_{\alpha/2}\sqrt{\frac{S_p^2}{n_1}+\frac{S_p^2}{n_2}}$

Step 4 Form $\left[(\bar{X}_1 - \bar{X}_2) - E, (\bar{X}_1 - \bar{X}_2) + E\right]$

Note: Do not assume equal variances for the small sample size problems unless I specify. That means you will use the **Welch-Satterthwaite method below** unless I say otherwise.

Steps for constructing the Confidence Interval for the True Difference between the Population Means (Small, independent samples with unequal variances): Welch-Satterthwaite method

Step 1 Gather Data from Problem, Calculate $\overline{X}_1 - \overline{X}_2$, Calculate $A = \frac{s_1^2}{n_1}$, Calculate $B = \frac{s_2^2}{n_2}$, and Calculate $\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$

Step 2 Find $t_{\alpha/2}$ using degrees of freedom = $\frac{(A+B)^2}{\frac{A^2}{n_1 - 1} + \frac{B^2}{n_2 - 1}}$ *(truncate to the nearest whole number)

Step 3 Find E = $t_{\alpha/2}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$

Step 4 Form $\left[(\overline{X}_1 - \overline{X}_2) - E, (\overline{X}_1 - \overline{X}_2) + E\right]$

Steps to test a hypothesis for the True Difference between the Population Means (Small, independent samples with equal variances):

1. Express the original claim symbolically *
2. Identify the Null and Alternative hypothesis*
3. Record the data from the problem
4. Calculate the test statistic $t = \frac{\left(\overline{X}_1 - \overline{X}_2\right) - D_0}{\sqrt{\frac{S_p^2}{n_1} + \frac{S_p^2}{n_2}}}$, $where\ S_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$,

   and d.f.= $n_1 + n_2 - 2$

5. Determine your rejection region
6. Find the initial conclusion
7. Word your final conclusion

*note the claim, the null, and the alternative will vary, for example one case could be: $H_0 : \mu_1 = \mu_2$ $H_A : \mu_1 \neq \mu_2$

Steps to test a hypothesis for the True Difference between the Population Means (Small, independent samples with unequal variances):

1. Express the original claim symbolically *
2. Identify the Null and Alternative hypothesis*
3. Record the data from the problem
4. Calculate the test statistic $t = \dfrac{\left(\overline{X}_1 - \overline{X}_2\right) - D_0}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$,

   where t has degrees of freedom = $\dfrac{(A+B)^2}{\dfrac{A^2}{n_1 - 1} + \dfrac{B^2}{n_2 - 1}}$ and $A = \dfrac{s_1^2}{n_1}$ and $B = \dfrac{s_2^2}{n_2}$

5. Determine your rejection region
6. Find the initial conclusion
7. Word your final conclusion

*note the claim, the null, and the alternative will vary, for example one case could be: $H_0 : \mu_1 = \mu_2$, $H_A : \mu_1 \neq \mu_2$

Hypothesis test for Comparing Two Population Means: Matched Pairs (dependent t-test)

1. Express the original claim symbolically: $\mu_d > 0$ *
2. Identify the Null and Alternative hypothesis: $H_0 : \mu_d \leq 0$, $H_A : \mu_d > 0$ *
3. Record the data from the problem: $\overline{X}_d, S_d, n_d,$ *and* α
4. Calculate the test statistic: $t = \dfrac{\overline{X}_d - \mu_d}{\dfrac{S_d}{\sqrt{n_d}}}$
5. Determine your rejection region
6. Find the initial conclusion
7. Word your final conclusion

*note the pair of hypotheses will vary depending on the problem.

Confidence Interval for Paired Differences:

$$\left[\overline{X}_d - t_{\alpha/2}\frac{S_d}{\sqrt{n_d}}, \overline{X}_d + t_{\alpha/2}\frac{S_d}{\sqrt{n_d}}\right]$$

Hypothesis Test for Comparing Two Population Proportions (Independent Sampling)

1. Express the original claim symbolically: $p_1 < p_2$ *
2. Identify the Null and Alternative hypothesis: $\begin{matrix} H_0 : (p_1 - p_2) \geq 0 \\ H_A : (p_1 - p_2) < 0 \end{matrix}$ *
3. Record the data from the problem: $\hat{p}_1, \hat{p}_2, \alpha$
4. Calculate the test statistic:
$$z \approx \frac{(\hat{p}_1 - \hat{p}_2)}{\sqrt{\hat{p}\hat{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}, where\ \hat{p} = \frac{x_1 + x_2}{n_1 + n_2}$$
5. Determine your rejection region
6. Find the initial conclusion
7. Word your final conclusion

*note the pair of hypotheses will vary depending on the problem.

Confidence Interval for $(p_1 - p_2)$ **:**

$$(\hat{p}_1 - \hat{p}_2) \pm z_{\alpha/2}\sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}} \approx (\hat{p}_1 - \hat{p}_2) \pm z_{\alpha/2}\sqrt{\frac{\hat{p}_1 \hat{q}_1}{n_1} + \frac{\hat{p}_2 \hat{q}_2}{n_2}}$$

Hypothesis Test for Comparing Two Population Variances: Independent Sampling

1. Express the original claim symbolically: $\frac{\sigma_L^2}{\sigma_S^2} > 1$ (The smaller on bottom always)*
2. Identify the Null and Alternative hypothesis: $\begin{matrix} H_0 : \frac{\sigma_L^2}{\sigma_S^2} \leq 1 \\ H_A : \frac{\sigma_L^2}{\sigma_S^2} > 1 \end{matrix}$ *
3. Record the data from the problem
4. Calculate the test statistic: $F = \frac{(S_L)^2}{(S_S)^2}$
5. Determine your critical value and rejection region: (see the F-Tables)
   Steps to determine the critical value for an F-test:
   a. Determine the number of tails and alpha (divide alpha in half if two-tails)
   b. Determine the table to use based on step a.
   c. Use the numerator degree of freedom for the top row of table and the denominator degree of freedom for the left column of the table.
6. Find the initial conclusion
7. Word your final conclusion

*note the pair of hypotheses will vary depending on the problem.