ISE 2211 • Exam V • 3 November 2017 NAME SOLUTION

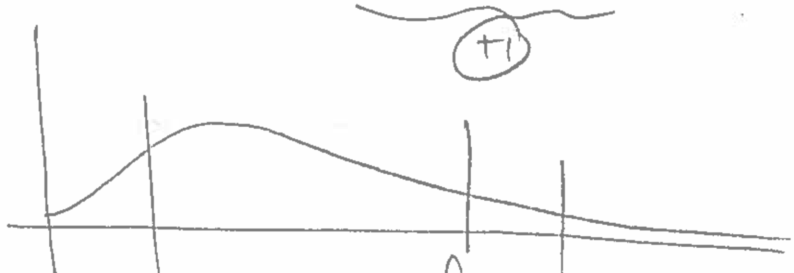
1) Last week, Joe Tritschler investigated the standard deviation in thickness of 1x4s because he suspected they weren't planed correctly. This week, he investigated the standard deviations of the boards from two different lumberyards. Selecting ten from supplier #1 and eight from supplier #2, he measured $s_1 = 0.12''$ and $s_2 = 0.068''$. Test the following hypotheses and state whether you would reject or fail to reject the null hypothesis that the two lumberyards plane boards with equal standard deviations at the $\alpha = 0.05$ level of significance.

$H_0: \sigma_1 = \sigma_2$
$H_1: \sigma_1 \neq \sigma_2$

$$f_0 = \frac{s_1^2}{s_2^2} = \frac{.12^2}{.068^2} = 3.114 \quad (+1)$$

$$f_{\alpha/2, n_1-1, n_2-2} = f_{.025,9,7} = 4.82 \quad (+1)$$

$$f_{1-\alpha/2, n_1-1, n_2-2} = \frac{1}{\underbrace{f_{\alpha/2, n_2-1, n_1-1}}_{(+1)}} = \frac{1}{f_{.025,7,9}} = \frac{1}{4.20} = 0.2381 \quad (+1)$$



f_0 $= 3.114$

$f_{1-\alpha/2, n_1-1, n_2-2}$ $= .2381$

$f_{\alpha/2, n_1-1, n_2-2}$ $= 4.82$

$f_0 \not> f_{\alpha/2}$ fail to reject (+1) that they are equal

[only (-1) if d.o.f. are reversed in either part]

Write a 95% C.I. on the ratio of population standard deviations and verify that it draws the same conclusion as the fixed-α hypothesis test above.

$$f_{\alpha/2, n_2-1, n_1-1} = f_{.025,7,9} = 4.20 \quad (+1)$$

$$f_{1-\alpha/2, n_2-1, n_1-1} = \frac{1}{f_{\alpha/2, n_1-1, n_2-1}} = \frac{1}{f_{.025,9,7}} = \frac{1}{4.82} = 0.2075 \quad (+1)$$

$$0.6462 < \frac{\sigma_1^2}{\sigma_2^2} < 13.08 \quad (+1) \quad \Rightarrow \quad 0.8038 < \frac{\sigma_1}{\sigma_2} < 3.6 \quad (+1)$$

Contains 1 ; ∴ no significant difference in std. dev (+1) [consistent]

2) Last month, Joe Tritschler bought 27 bags of Gardetto's®-brand snack mix and determined that out of a random sample of 328 pieces, 72 were rye chips. Wondering if a sample of Gardetto's®-brand snack mix from a different Kroger would yield different results, Joe Tritschler bought a bunch *more* bags and counted 69 rye chips out of 312 total pieces. Write a 90% C.I. on the difference in population proportions between the two samples and use it to test the following hypotheses:

$H_0: p_1 = p_2$
$H_1: p_1 \neq p_2$

$$\hat{p}_1 = \frac{x_1}{n_1} = \frac{72}{328} = 0.2195 \quad +1$$

$$\hat{p}_2 = \frac{x_2}{n_2} = \frac{69}{312} = 0.2212 \quad +1$$

$$Z_{\alpha/2} = Z_{.1/2} = Z_{.05} = 1.645 \quad +1$$

$$p_1 - p_2 : \quad 0.2195 - 0.2212 \pm 1.645 \sqrt{\frac{.2195(1-.2195)}{328} + \frac{.2212(1-.2212)}{312}}$$

$$-.0017 \pm 1.645 \sqrt{0.001074}$$

$$-0.05561 < p_1 - p_2 < 0.05221 \quad +1$$

∴ contains zero ; ∴ fail to reject Ho +1

∴ evidence suggests proportions are insignificantly different

3) It is hypothesized that the magnitude of $1/f$ noise in a specific input transistor may vary from manufacturer to manufacturer. 10 two-channel servo amplifiers were constructed with brand A in channel 1 and brand B in channel 2. What type of hypothesis test is ideal in this situation, and what is it testing?

Paired t-test (+1)

mean difference (+1)

[NOT difference in means!]

Write a 95% C.I. on μ_D if $\bar{d}$ = 7.2 μV and s_D = 3.9 μV. Use it to state whether you'd reject or fail to reject the null hypothesis that the $1/f$ noise is the same between brands of transistors.

μ_D : $\bar{d} \pm t_{\alpha/2,n-1} S_d/\sqrt{n}$

pairs!

$t_{\alpha/2,n-1} = t_{.025,9} = 2.262$ (+1)

$7.2 \pm 2.262 \cdot 3.9/\sqrt{10}$

$4.410 < \mu_D < 9.990$ [μV] (+1)

does not contain zero;

reject Ho @ $\alpha = 0.05$ (+1)

there is a significant difference in noise levels between brands

1) Aircraft electrical wiring often has a conformal coating that makes it more reliable under situations where it may be exposed to fire, seawater, or high-voltage spikes due to lightning and electromagnetic pulses. A new manufacturing process has been introduced that supposedly reduces the variance in coating thickness; however, it is unknown what effect this has on the mean coating thickness. Population variances are unknown but assumed to be unequal. Sixteen samples of each process are analyzed with the following results: $\bar{x}_1 = 82$ µm, $s_1 = 6.2$ µm, $\bar{x}_2 = 80$ µm, $s_2 = 3.8$ µm. Test the following hypotheses on the difference in means of coating thickness at the $\alpha = 0.05$ level of significance and state whether you would reject or fail to reject H_0:

$H_0: \mu_1 - \mu_2 = \Delta_0 = 0$

$H_1: \mu_1 - \mu_2 \neq \Delta_0$

$$T_0^* = \frac{\bar{X}_1 - \bar{X}_2 - \Delta_0}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

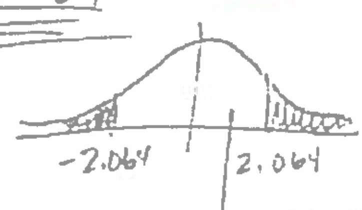
$$= \frac{82 - 80 - 0}{\sqrt{\frac{6.2^2}{16} + \frac{3.8^2}{16}}} = \underline{1.10013} \quad +1$$

$$V = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{(S_1^2/n_1)^2}{n_1 - 1} + \frac{(S_2^2/n_2)^2}{n_2 - 1}} = \frac{3.305^2}{0.3848 + 0.054}$$

$$= 24.876$$

+1 rounded down to $\underline{v = 24}$

$$t_{\alpha/2, v} = t_{.025, 24} = \underline{2.064} \quad +1$$



Since T_0^* does not fall outside the rejection bounds of ± 2.064, we fail to reject H_0. +1