ISE 2211 • Exam IV • 2 July 2019 NAME SOLUTION

1) The B+ power supply voltage in a tube guitar amplifier may vary according to a number of factors, including AC line voltage, winding tolerances of the power transformer, bias currents of the tubes, and thermal drift. A sample of 41 voltage measurements was taken and the results are $\bar{x}$ = 441.2 V and s = 7.23 V, with unknown population variance. On the last exam, we wrote a 95% confidence interval on the population mean B+ power supply voltage and found it to be

439.0 < μ < 443.4 (V)

If the power supply voltage is supposed to be 440 V, test the following hypotheses at $\alpha = 0.05$ using the confidence interval approach:

H_0: μ = 440 V

H_a: μ ≠ 440 V

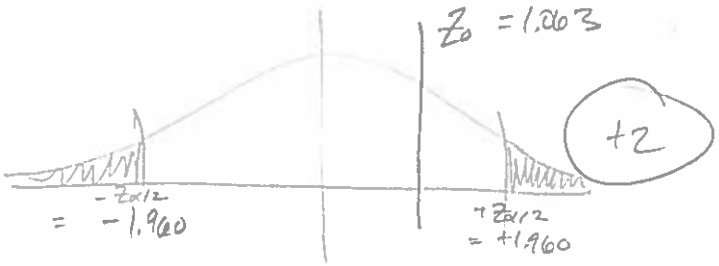
$\mu_0 = 440V$ is within the C.I. (+1)

∴ fail to reject H_0 (+1)

Now test the same hypotheses using the fixed-α approach. Include a sketch of the appropriate distribution to support your work.

$$Z_0 = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} = \frac{441.2 - 440}{7.23/\sqrt{41}} = 1.063$$ (+1)

Critical values: $\pm Z_{\alpha/2} = \pm Z_{.025} = \pm 1.960$ (+1)



(+2)

$Z_0 \not> +Z_{\alpha/2}$ (+1)

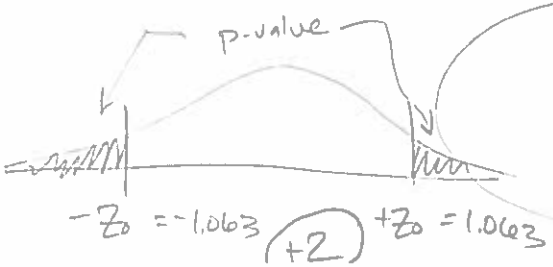
∴ fail to reject H_0 (+1)

Finally, test the hypotheses using the *p*-value approach, with a sketch.

p-value = $P(Z > 1.063) + P(Z < -1.063)$ (+1)

$P(Z < -1.06) = 0.144572$ (+1) (table)

∴ p-value = $0.144572 \times 2 = 0.2891$ (+1)



(+2)

$p > \alpha$ (+1)

∴ fail to reject H_0 (+1)

Test the following hypotheses on the standard deviation of the B+ power supply voltage at $\alpha = 0.05$ using the *p*-value approach:

H_0: $\sigma = 5$ V

H_1: $\sigma > 6$ V

Include a supporting sketch.

$$\chi_0^2 = \frac{(n-1)s^2}{\sigma_0^2} = \frac{40 \cdot 7.23^2}{6^2} = 58.081 \quad (+1)$$

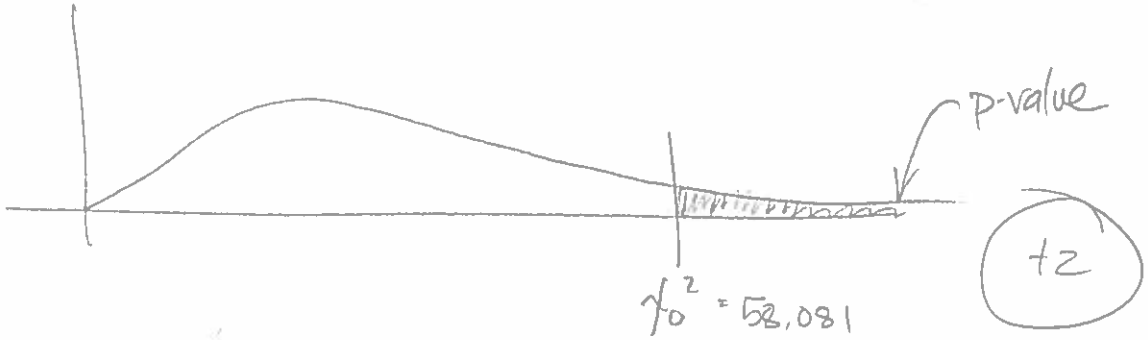
$\chi^2_{.05,40} = 55.76$ (table) (+1)

$\chi^2_{.025,40} = 59.34$ (table) (+1)

$\therefore .025 < \text{p-value} < .05$ (+1)

p-value < 0.05 (+1)

$\therefore$ reject H_0 (+1)



(+2)