**Practice Exam #4: Chapters 8 - 9** **NAME** ANSWER KEY

Math 160

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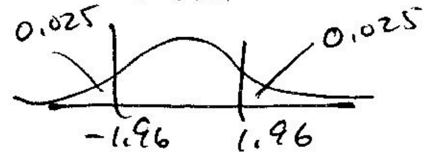
**100 points. Show all work to receive full credit. You may use a calculator. CHECK YOUR WORK!!!!**

**<u>Write down all formulas or calculator commands used to receive credit!!!!!!!!</u>**

**1.** (15 pts) When people smoke, the nicotine that they absorb is converted to cotine, which can be measured. A sample of 40 smokers has a mean cotine level of 172.5. Assuming that $\sigma$ is known to be 149.5, use a 0.05 significance level to test the claim that the mean cotine level of all smokers is equal to 240. (Use traditional or P-value method). $\sigma = 149.5 \Rightarrow Z_{TEST}$

$H_o$: $\mu = 240$ (CLAIM)




$H_1$: $\mu \neq 240$

$$Z_{TEST} = \frac{\bar{X}-\mu}{\sigma/\sqrt{n}} = \frac{172.5-240}{149.5/\sqrt{40}} = -2.8556 = \boxed{-2.86}$$

Test statistic: $Z_{TEST} = -2.86$

Critical value(s): $\pm 1.96$

Null Hypothesis conclusion:

REJECT Ho

P-VALUE $= 2\,\text{NORMALCDF}(\cancel{-2.86, 1000})$ $-1000, -2.86$

$= 2(0.0021183)$

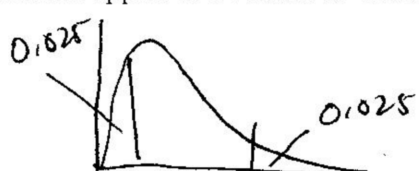
$= \boxed{0.0042}$

Conclusion on claim:

THERE IS SUFFICIENT EVIDENCE TO WARRANT REJECTION OF THE CLAIM

**2.** (15 pts) The Stewart Aviation Products Company uses a new production method to manufacture aircraft altimeters. A sample random sample of 81 altimeters is tested in a pressure chamber, and the errors in altitude are recorded as positive values (for readings that are too high) or negative values (for readings that are too low). The sample has a standard deviation of 52.3 ft. At a 0.05 significance level, test the claim that the new production line has errors with a standard deviation different from 43.7 ft. which was the standard deviation for the old production method. If it appears that the standard deviation has changed, does the new production method appear to be better or worse than the old method?

$\chi^2_{TEST}$ $\alpha = 0.05$




$H_o$: $\sigma = 43.7$ FT

$H_1$: $\sigma \neq 43.7$ FT (CLAIM)

$$\chi^2_{TEST} = \frac{(n-1)s^2}{\sigma^2} = \frac{(80)(52.3)^2}{43.7^2} = 114.586$$

Test statistic: $\chi^2_{TEST} = 114.586$

Critical value(s): 57.153, 106.629

Null Hypothesis conclusion:

REJECT Ho

PVALUE $= 2\chi^2\text{cdf}(114.586, 1000, 80)$

$= \underline{0.0136}$

Conclusion on claim:

THERE IS SUFFICIENT EVIDENCE TO SUPPORT THE CLAIM.

3. (20 pts) Olympic Winners. Listed below are the winning times (in seconds) of men in the 100-meter dash for consecutive summer Olympic games, listed in order by row. Assuming that these results are sample data randomly selected from the population of all past and future Olympic games, test the claim that the mean time is less than 10.5 sec.

12.0 11.0 11.0 11.2 10.8 10.8 10.8 10.6 10.3 10.4
10.5 10.2 10.0 10.14 10.06 10.25. $\Rightarrow L_1$

t-TEST

1 VARSTATS $L_1 \Rightarrow \bar{x} = 10.628$

$s = 0.57853$

$\alpha = 0.05$

$H_o$: $\mu = 10.5$ sec

$H_1$: $\mu < 10.5$ sec (CLAIM)

0.05

$t_{CRIT} = -1.753$

Test statistic: 0.987

Critical value(s): $-1.753$

$t_{TEST} = \dfrac{\bar{x} - \mu}{s/\sqrt{n}} = \dfrac{10.628 - 10.5}{0.57853/\sqrt{16}}$

$= 0.98741 = 0.987$

~~tcdf~~ P-VALUE = tcdf (−1000, 0.987, 15)

= 0.8304

Null Hypothesis conclusion:
FAIL TO REJECT Ho

Conclusion on claim:
THERE IS NOT SUFFICIENT EVIDENCE TO SUPPORT THE CLAIM.

4. (15 pts) A study was conducted to determine whether magnets are effective at treating back pain. One group was given the magnet treatment, while the other group was given a placebo treatment. The results are shown below where measurements are in centimeters on a pain scale. Do not assume the population standard deviations are equal. Using a significance level of 0.01, test the claim that the magnets have a measurable effect on back pain.

2SAMPLE T-TEST df = 22

| (1) Magnet | (2) Placebo |
|---|---|
| $n_1 = 23$ | $n_2 = 25$ |
| $\bar{x}_1 = 0.47$ | $\bar{x}_2 = 0.32$ |
| $s_1 = 0.95$ | $s_2 = 1.45$ |

$T_{TEST} = 0.427$

P-VALUE = tcdf (0.427, 1000, 22)

= 0.3368

$t_{CRIT}$ = INVT (0.01, 22) = 2.508

$H_o$: $\mu_M = \mu_P$

$H_1$: $\mu_{M(1)} > \mu_{P(2)}$ (CLAIM)

Test statistic: 0.427

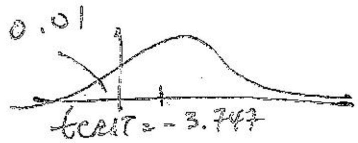
Critical value(s): ~~0.3368~~ 2.508

Null Hypothesis conclusion:
FAIL TO REJECT Ho

Conclusion on claim:
THERE IS NOT SUFFICIENT EVIDENCE TO SUPPORT THE CLAIM.

5. (20 pts) A researcher claims that listening to Mozart improves scores on math quizzes. A random sample of five students took math quizzes, first before then after listening to Mozart. Test the claim that listening to Mozart improves scores on math quizzes. Use a 0.01 level of significance.

| | | | | | | |
|---|---|---|---|---|---|---|
| Before | 75 | 50 | 80 | 85 | 95 | $\Rightarrow L_1$ |
| After | 85 | 45 | 85 | 95 | 95 | $\Rightarrow L_2$ |




$L_1 - L_2 \Rightarrow L_3$ 1VARSTATS $L_3$

$\bar{d} = -4.0000$
$s_d = 6.5192$

$t_{TEST} = \dfrac{\bar{d} - \mu_d}{s_d/\sqrt{n}} = \dfrac{-4.0000 - 0}{6.5192/\sqrt{5}} = \underline{-1.372}$

$H_0$: $\mu_d = 0$

$H_1$: $\mu_d < 0$ (CLAIM)

Test statistic: $-1.372$

Critical value(s): $-3.747$

$t_{CRIT} = \text{INVT}(0.01, 4) = -3.747$

Null Hypothesis conclusion:

FAIL TO REJECT Ho

P-VALUE = tcdf (-1000, -1.372, 4) = 0.1210

Conclusion on claim:

THERE IS NOT SUFFICIENT EVIDENCE TO SUPPORT THE CLAIM.

6. (15 pts) In a random sample of 360 women, 65% favored stricter gun control laws. In a random sample of 220 men, 60% favored stricter gun control laws. Test the claim that the proportion of women who favor gun control is higher than the proportion of men favoring stricter gun control. Use a significance level of 0.05.

2 PROP Z TEST

$H_0$: $p_W = p_M$ $\quad p_1 = p_2$

$H_1$: $p_W > p_M$ or $p_1 > p_2$ (CLAIM)

$n_1 = 360$ $\quad n_2 = 220$

$x_1 = 0.65(360) = 234$ $\quad x_2 = (0.6)(220) = 132$

Test statistic: 1.21

Critical value(s): 1.645

$Z = 1.21$

P-VALUE = NORMALCDF (1.21, 1000) = 0.1131

Null Hypothesis conclusion:

FAIL TO REJECT Ho

Conclusion on claim:

**EXTRA CREDIT ON BACK**

**BONUS** *(10 points)*

A section of Highway 405 in Los Angeles has a speed limit of 65 mph and recorded speeds are listed below for randomly selected cars traveling on northbound and southbound lanes.

| | |
|---|---|
| I-405 North: | 68 68 72 73 65 74 73 72 68 65 65 73 66 71 68 74 66 71 65 73 |
| I-405 South: | 59 75 70 56 66 75 68 75 62 72 60 73 61 75 58 74 60 73 58 75 |

$\bar{X} = 67.25$ $S_X = 7.188$

A. Using the speeds for the northbound lanes, find the mean, median, standard deviation, variance, and range.

I405 N $\Rightarrow$ L3 1 VAR STATS L3

$\bar{X} = 69.5$ MPH, $\tilde{X} = 69.5$ MPH, $S = 3.41$ MPH, $S^2 = 11.63$ (MPH)$^2$

RANGE = 9 MPH

B. Using all the speeds combined, test the claim that the mean is greater than the posted speed limit of 65 mph.

ALL SPEEDS IN L3.

$\bar{X} = 68.375$

$S_X = 5.669$

$\sigma$ NOT KNOWN $\rightarrow$ t-TEST

$H_0: \mu = 65$

$H_1: \mu > 65$ (CLAIM)

$t_{CRIT} = 1.685$

$t_{TEST} = \frac{\bar{X} - \mu}{S/\sqrt{n}} = \underline{3.765}$

$P = 0.0003$

REJECT $H_0$

THERE IS SUFFICIENT EVIDENCE TO SUPPORT THE CLAIM.

C. Do the northbound speeds appear to come from a normally distributed population? Explain. NO. APPEAR TO BE UNIFORMALLY DISTRIBUTED

D. Assuming that the speeds are from normally distributed populations, test the claim that the mean speed on the northbound lanes is equal to the mean speed on the southbound lanes.

$H_0: \mu_N = \mu_S$ (CLAIM)

$H_1: \mu_N \neq \mu_S$

2 SAMPLE T-TEST

$t_{TEST} = 1.265$

P-VALUE = 2 tcdf(1.265, 1000, 19)

$= 0.2212$

FAIL TO REJECT CLAIM

THERE IS NOT SUFFICIENT EVIDENCE TO WARRANT REJECTION OF THE CLAIM.

$t_{CRIT} = INVT(0.025, 19) = \pm 2.093$