KEY

Stat 205 Exam II

Write clearly and show steps for partial credit. This exam is open book. There are five problems.

---

1. (30 points) Androstenedione is a steroid that is thought by some athletes to improve strength. Researchers investigated this claim by giving androstenedione to one group of men and a placebo to a control group of men. One of the variables measured in the experiment was the increase in "lat pull-down strength" in pounds of each subject after four weeks; a lat pull-down is a type of weight lifting exercise. The Welch-Satterthwaite approximation gives 16.5 degrees of freedom. The data are summarized in the following table.

	Andro	Control
n	10	9
$\bar{y}$	20.0	14.4
s	12.5	13.3

(a) The researchers want to show that androstenedione *improves* strength. Carefully define μ_1 and μ_2 and state the appropriate null and alternative hypotheses for this experiment.
ANSWER μ_1 is the mean increase in lat-pull down weight (lbs) for the population taking androstenedione and μ_1 is the mean increase in lat-pull down weight for those that are not. The experimenters want to test $H_0 : \mu_1 = \mu_2$ versus $H_A : \mu_1 > \mu_2$. That is, they want to show that androstenedione *increases* the average amounnt of weight lifted.

(b) Find the standard error $SE_{\bar{y}_1 - \bar{y}_2}$.
ANSWER

$$SE_{\bar{y}_1 - \bar{y}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} = \sqrt{\frac{12.5^2}{10} + \frac{13.3^2}{9}} = 5.94 \text{ lbs.}$$

(c) Find the test statistic t_s. ANSWER

$$t_s = \frac{\bar{y}_1 - \bar{y}_2}{SE_{\bar{y}_1 - \bar{y}_2}} = \frac{20.0 - 14.4}{5.94} = 0.94.$$

(d) Find a bound for the p-value for the test in part (a) using the table in the back of the book.
ANSWER You can use 16 or 17 degrees of freedom; either way

$$0.2 > p > 0.1.$$

(e) Formally state the conclusions of your hypothesis test, at the $\alpha = 0.05$ significance level, in words.
ANSWER At the 5% significance level we accept $H_0 : \mu_1 = \mu_2$, that there is no difference between androstenedione and placebo in terms of improving strength.

2. (20 points) In a randomized clinical trial dialysis patients were given 160 mg of aspirin daily to prevent blood clots in their shunts (a shunt is the Teflon tube surgically attached to the patient that connects to the dialysis machine). Out of $n = 19$ dialysis patients total, $y = 6$ developed blood clots. Let p be the proportion of all dialysis patients taking aspirin that develop blood clots, as in the study. Compute *and interpret* a 95% Agresti-Coull confidence interval for the proportion p.

ANSWER

$$\tilde{p} = \frac{y+2}{n+4} = \frac{6+2}{19+4} = 0.348.$$

$$SE_{\tilde{p}} = \sqrt{\frac{\tilde{p}(1-\tilde{p})}{n+4}} = \sqrt{\frac{0.348(1-0.348)}{19+4}} = 0.099.$$

$$\tilde{p} \pm 1.96 SE_{\tilde{p}} = 0.348 \pm 1.96(0.099) = (0.154, 0.542).$$

With 95% confidence, the probability of blood clots among dialysis patients when taking aspirin is between 0.154 and 0.542. Restated: With 95% confidence, the proportion of dialysis patients developing blood clots when taking aspirin is between 0.154 and 0.542.

---

3. (20 points) The time (in minutes) that a drug takes to relieve an irritated eye (measured by redness) was measured for $n = 20$ subjects. The sample mean is $\bar{y} = 4.255$ minutes and standard deviation is $s = 3.455$ minutes. Construct *and interpret* a 95% confidence interval for the true mean relief time μ.

ANSWER The standard error is

$$SE_{\bar{y}} = \sqrt{s^2/n} = \sqrt{3.455^2/20} = 0.773.$$

Using $df = n - 1 = 19$, we have $t_{0.025} = 2.093$, so the 95% confidence interval is

$$\bar{y} \pm t_{0.025} SE_{\bar{y}} = 4.255 \pm 2.093(0.773) = (2.64, 5.87).$$

With 95% confidence, the mean time to eye-relief is between 2.64 and 5.87 minutes.

4. (20 points) Although most women stop using marijuana once they get pregnant, a bit less than 3% still use it through during pregnancy. Neonatal exposure to marijuana has been linked to attention deficits and impulsiveness in children. A prospective study recorded marijuana use of women while pregnant and recorded the Swanson, Noland, and Pelham (SNAP) score of their kids (measures attention deficit and impulsiveness) once they reached 10 years of age. In the following table are SNAP scores for mothers who did not smoke marijuana versus those that smoked on average more than 0.9 joints (marijuana cigarette) per day. We want to test the hypothesis that there's no difference in the distribution of SNAP scores between non-using and using mothers.

	SNAP Scores		
less than	0 joints / day	≥ 0.9 joints / day	less than
0	7.3	8.6	8
0	7.7	8.7	8
0	7.8	9.0	8
0	8.0	9.8	12
0	8.2	9.9	12
0	8.4	10.1	12
0	8.4	10.2	12
3	8.5	10.6	13
3	9.1	10.7	13
3	9.2		
3	9.2		
3	9.5		
7	10.3		
$K_1 = 19$			$K_2 = 98$

(a) Compute the Wilcoxin-Mann-Whitney counts K_1 and K_2, and the test statistic U_s.
ANSWER $K_1 = 19$, $K_2 = 98$, and $U_s = 98$.

(b) Check that $K_1 + K_2 = n_1 \times n_2$.
ANSWER

$$K_1 + K_2 = 19 + 98 = 117 \text{ and } n_1 \times n_2 = 13 \times 9 = 117.$$

(c) Compute the p–value for the test by bounding. Use a two-sided alternative.
ANSWER According to the table on p. 681,

$$0.01 > p > 0.002.$$

(d) Do you reject that the distributions are the same at the 5% significance level? Why or why not?
ANSWER Since $p < 0.01$, $p < \alpha = 0.05$ and we reject that the distributions are the same (at the 5% significance level).

5. (20 points) Circle TRUE or FALSE in the statements below.

(a) TRUE or FALSE: A Type I error is accepting the null hypothesis H_0 when the alternative H_A is true.

(b) Mary Anne gathered data on which can jump higher, cats or dogs. She ended up *not* rejecting $H_0 : \mu_c = \mu_d$ (she accepted that the average height dogs and cats can jump is the same).
TRUE or FALSE: The only kind of error Mary Anne could have made is Type I.

(c) Say in an experiment comparing how much elephants eat on two different diets resulted in a 95% confidence interval for $\mu_1 - \mu_2$ that is $(40.7, 115.7)$ kilograms.
TRUE or FALSE: We *reject* $H_0 : \mu_1 = \mu_2$ at the 5% significance level.

(d) TRUE or FALSE: t tests are always valid when samples sizes are large enough.

(e) TRUE or FALSE: The sample proportion $\hat{p} = y/n$ always equals the true proportion p.

(f) TRUE or FALSE: The Wilcoxin-Mann-Whitney test assumes that the two populations are normal.

(g) TRUE or FALSE: The standard error estimates the standard deviation of an estimator.

(h) TRUE or FALSE: The central limit theorem tells us that sample means are approximately normally distributed in large samples, regardless of what the population density looks like.

(i) TRUE or FALSE: p-values can be larger than one.

(j) TRUE or FALSE: The person responsible for inventing the t test worked at the Guinness brewery.