MATH 338

EXAM 2 – WRITTEN PORTION

TUESDAY, JULY 18, 2017

Your name: ______________________

Your scores (to be filled in by Dr. Wynne):

Problem 1:	____/10
Problem 2:	____/7.5
Problem 3:	____/9.5
Problem 4:	____/9
Total:	____/36

You have 60 minutes to complete this exam. This exam is closed book and closed notes with the exception of your formula sheet.

For full credit, show all work except for final numerical calculations (which can be done using a scientific calculator).

1. Do college men or women tend to experience more severe negative consequences if they engage in excessive drinking? Suls and Barton (2003) asked 111 male and 112 female college students at a large Midwestern university to indicate a numerical response to this question on a scale from 1 (women experience more negative consequences) to 7 (men experience more). The midpoint of the scale was 4.

On average, women rated the statement at 3.04, with a standard deviation of 1.39. Men's ratings averaged 3.45 and had a standard deviation of 1.33.

A) [6 pts] Evaluate the statistical validity of the following claims in the paper: "Men and women thought that women would suffer more [negative] consequences as a result of excessive drinking; men's mean responses differed significantly from the midpoint, $t(110) = 25.50$, $p < .001$, as did women's, $t(111) = 24.19$, $p < .001$."

B) [2 pts] Check <u>all</u> assumptions necessary to perform the statistical test(s) done in part (A).

C) [2 pts] Based on parts (A) and (B), do you trust the authors' conclusions? Why or why not?

2. A 2007 article in the Journal of Chemical Education suggests using a one-way ANOVA to compare three different methods of standardization used when determining the concentration of an analyte in an unknown solution. Students are asked to find the concentrations of three hydrocarbons in a single unknown vial using gas chromatography, standardizing their results using each of the three methods. A one-way ANOVA analysis is used to determine whether the concentration depends on the method.

A) [2 pts] Based on the description of this study, assuming that the uncertainty in concentration is normally distributed, is a one-way ANOVA appropriate to analyze the results? Why or why not?

B) [2.5 pts] Fill in the missing values in the example ANOVA table from the paper:

Source	DF	Sum of Sq.	Mean Sq.	F	Pr (>F)
Between Groups		1784.7			0.0024
Within Groups	6				
Total	8	2059.2	257.4		

C) [3 pts] The paper makes the following statements about one-way ANOVA. For each statement, if it is statistically valid, write, "Valid." Otherwise, change the statement to make it valid.

"The three quantitative methods should give similar values for the three analytes … This is the null hypothesis (H_0: $\bar{x}_1 = \bar{x}_2 = \bar{x}_3$)."

"If students find that their results do not support the null hypothesis then they use the Tukey multiple-comparison method for obtaining confidence intervals for the differences between means."

"The results in [the table in part (B)] show that the null hypothesis should be rejected because the calculated P value of 0.002 is less than the set α value of 0.05."

Problem 3. In 2009, a group of mice spent 3 months aboard the International Space Station. Three mice survived, and were compared to a group of three mice who spent those 3 months in equivalent cages, on Earth.

In one experiment, after all the mice were sacrificed, researchers measured the red blood cell count (in millions per microliter of blood) in the six mice. The table below summarizes the findings:

Group	Mean	Standard Deviation
Space	11.27	0.39
Earth	10.02	1.68

A) [6 pts] Assuming red blood cell counts are normally distributed, construct and interpret a 99% confidence interval for the difference of the population mean red blood cell counts for mice in space vs. mice on Earth.

B) [2 pts] Based on your answer to part (A), can you conclude (at the 1% significance level) that mice in space and mice on Earth have different population mean blood cell counts? Why or why not?

C) [1.5 pts] If more space mice had survived (and assuming that the number of space mice would be compared with an equal number of control Earth mice), which of the following would have changed in your analysis from part (A)? Circle all that would change.

Confidence Level Degrees of Freedom Critical Value

4. Assume that when your lab's centrifuge is working, and you set it to 4000 revolutions per minute (RPM), the actual angular velocity is normally distributed with mean 4000 RPM and (theoretical) standard deviation 50 RPM. You take 6 independent measurements and perform a one-sided hypothesis test, using $\alpha = 0.05$, to determine whether the centrifuge is slower than it should be.

A) [5 pts] What is the power of this hypothesis test to detect the specific alternative that the centrifuge is 1.5% too slow (i.e., that the true population mean velocity is 3940 RPM)?

B) [2 pts] For this test, what would be a Type I Error? What is the probability of committing it?

C) [2 pts] For this test, what would be a Type II Error? What is the probability of committing it?

Extra Space. The tables below show a number of critical values *z* for the standard normal variable $Z \sim N(0,1)$ and the corresponding cumulative proportions, corresponding to P(Z $\leq$ z).

z-score	Cumulative Proportion
-3.00	0.0013
-2.50	0.0062
-2.00	0.0228
-1.65	0.0495
-1.28	0.1003
-1.00	0.1587
-0.67	0.2514

z-score	Cumulative Proportion
0.67	0.7486
1.00	0.8413
1.28	0.8997
1.65	0.9505
2.00	0.9772
2.50	0.9938
3.00	0.9987

Refer to the following tables for t* and z* critical values for confidence intervals:

df	C = 0.90 (90%)	C = 0.95 (95%)	C = 0.98 (98%)	C = 0.99 (99%)	C = 0.999 (99.9%)
1	6.314	12.71	31.82	63.66	636.62
2	2.920	4.303	6.965	9.925	31.60
3	2.353	3.182	4.541	5.841	12.92
4	2.132	2.776	3.747	4.604	8.610
5	2.015	2.571	3.365	4.032	6.869
6	1.943	2.447	3.143	3.707	5.959
10	1.812	2.228	2.764	3.169	4.587
≈30	1.697	2.042	2.457	2.750	3.646
≈50	1.676	2.009	2.403	2.678	3.496
≈100	1.660	1.984	2.364	2.626	3.390
≈1000	1.646	1.962	2.330	2.581	3.300

	C = 0.90 (90%)	C = 0.95 (95%)	C = 0.98 (98%)	C = 0.99 (99%)	C = 0.999 (99.9%)
z* values	1.645	1.960	2.326	2.576	3.291

For a two-sided hypothesis test, use the column corresponding to C = 1 – α

For a one-sided hypothesis test, use the column corresponding to C = 1 - 2α

The rest of this space to be used for extra work: