

STAT 8010 Exam II

April 2, 2020

Name: _____

Directions

1. Show your work on ALL questions (except those multiple choice questions). Unsupported work will NOT receive full credit.
2. Decimal answers should be exact, or to exactly 3 significant digits.
3. You are allowed the following aids:
 - (a) a one-page A4 cheat sheet
 - (b) A scientific Calculator
4. Write up your work on blank sheets of paper and upload it to Canvas. Please write legibly. **If I cannot read your writing, No credit will be given.**

Use your time wisely. Good Luck!!!

Problem	Points Possible	Points Earned
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

Problem 1

(4 points for each answer.)

(a) Which of the following corresponds to a Type I error in hypothesis testing?

True State	Decision	
	Reject H_0	Fail to reject H_0
H_0 is true	A	B
H_0 is false	C	D

(b) Which of the following is NOT a linear contrast of population means?

$A : \mu_1 - \mu_2$

$B : \mu_2 - \frac{1}{2}\mu_3 - \frac{1}{2}\mu_5$

$C : \mu_1 - \mu_2 + \frac{1}{3}\mu_3 - \frac{1}{4}\mu_4$

$D : \mu_1 + \mu_2 - \mu_3 - \mu_4$

(c) Suppose the standard deviation of random variable X is 6. What is the standard deviation of $\bar{X}_n = \frac{\sum_{i=1}^n X_i}{n}$ with sample size $n = 36$?

$A : 2$

$B : 5$

$C : 1$

$D : \text{Can't be determined without sample mean}$

(d) What is the minimum sample size needed in order to estimate μ such that the 95% CI to be 4 in width if $\sigma = 10$

A : 25

B : 97

C : 961

(f) If the true means of the 4 populations are equal, then $F = \text{MSTr}/\text{MSE}$ should be:

A : more than 10.00

B : close to -1.00

C : close to 1.00

Problem 2

A graduate school administrator would like to know the average GRE Quantitative score for all the applicants. She take a random sample of 64 applicants. Use $\bar{x} = 148$, $s = 8$ to answer the following questions:

(a) Construct a 95% confidence interval (using $t_{0.025, df=63} = 1.998$) for the average GRE Quantitative score for all applicants. **(7 points)**

(b) One of the graduate school administrators would like to know if the average GRE Quantitative score is greater than 145. Conduct a hypothesis test for this assessment (using $t_{0.05, df=63} = 1.669$) and $\alpha = 0.05$ for this test). **(7 points)**

(c) Compute the minimum sample size needed such that the 95% CI for average GRE Quantitative score to be 2 in width if $\sigma = 7.5$ **(6 points)**

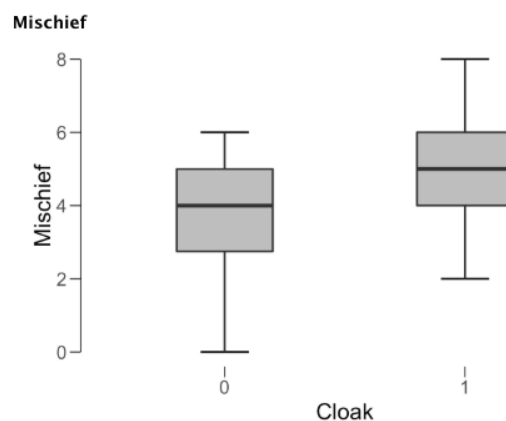
Problem 3

(5 points for each answer.) A researcher would like to examine if invisibility cloak affects the number mischievous acts committed. He conducted an experiment where he randomly assign the “treatment” (0 = without a cloak of invisibility, 1 = with a cloak of invisibility) to 24 study participants and he recorded the number of mischievous acts committed by each participant. Use the JASP output below to answer the following questions.

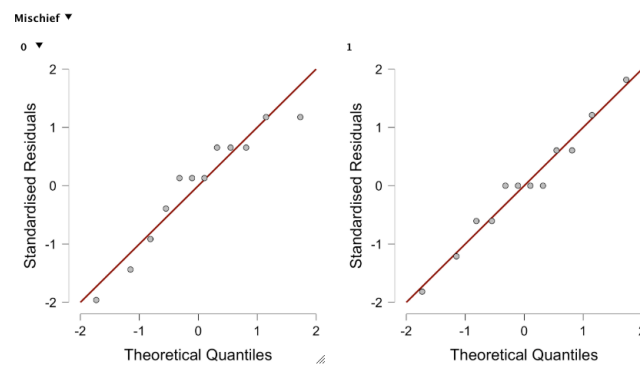
- (a) What is the point estimate of the average difference (Without - With)?

Descriptive Statistics ▼

	Mischief	
	0	1
Valid	12	12
Missing	0	0
Mean	3.750	5.000
Std. Error of Mean	0.552	0.477
Std. Deviation	1.913	1.651
Minimum	0.000	2.000
Maximum	6.000	8.000



(b) Assess the normality assumption using the QQ-plots below.



(c) State the null and alternative hypotheses

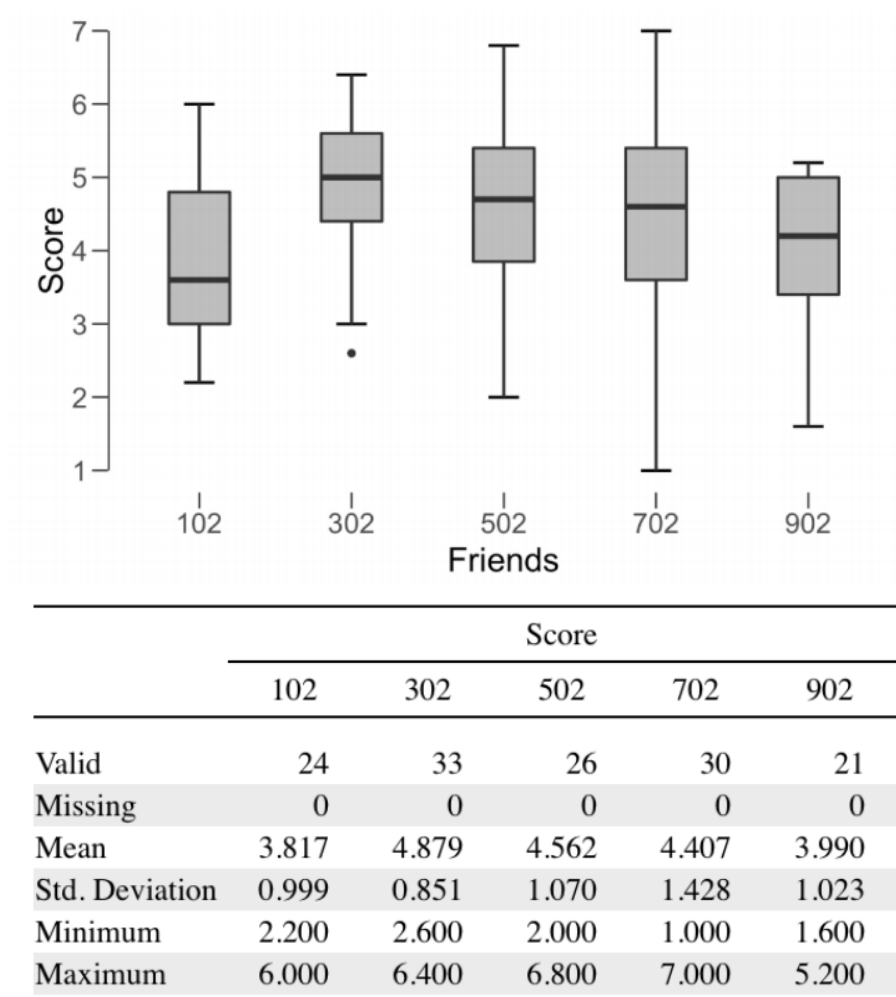
(d) Draw the conclusion at 0.05 level using the JASP output below:

Independent Samples T-Test

							95% CI for Mean Difference	
	Test	Statistic	df	p	Mean Difference	SE Difference	Lower	Upper
Mischief	Student	-1.713	22.000	0.101	-1.250	0.730	-2.763	0.263
	Welch	-1.713	21.541	0.101	-1.250	0.730	-2.765	0.265

Problem 4

(5 points for each answer.) A researcher would like to investigate the relationship between Facebook social attractiveness and the number of Facebook friends. An experiment was conducted where five groups of participant judge the same Facebook profiles, except for the one aspect that was manipulated: the number of friends for that profile. Use the software output below to answer the following questions:



(a) State the null and alternative hypotheses of the overall F test.

(b) Fill in the missing elements in the ANOVA table below:

Source	df	SS	MS	F statistic
Friends	?	SSTr = ?	MSTr = ?	$F_{obs} = ?$
Error	?	SSE = 154.87	MSE =	
Total	133	SSTo = 174.76		

(c) Perform an overall F-test for part (a) at 0.05 level (using $F_{0.95, df_1=4, df_2=129} = 2.442$).

(e) Construct a 95% confidence interval (using $t_{0.025, 129} = 1.9785$) for $L = \mu_{302} - \frac{1}{3}\mu_{502} - \frac{1}{3}\mu_{702} - \frac{1}{3}\mu_{902}$

Problem 5

Suppose concrete cylinders for bridge supports. There are three ways of drying green concrete (A, B, and C), and you want to find the one that gives you the best compressive strength. The concrete is mixed in batches that are large enough to produce exactly three cylinders, and your production engineer believes that there is substantial variation in the quality of the concrete from batch to batch. You have data from 4 batches on each of the 3 drying processes. Use the R output below to answer the following questions:

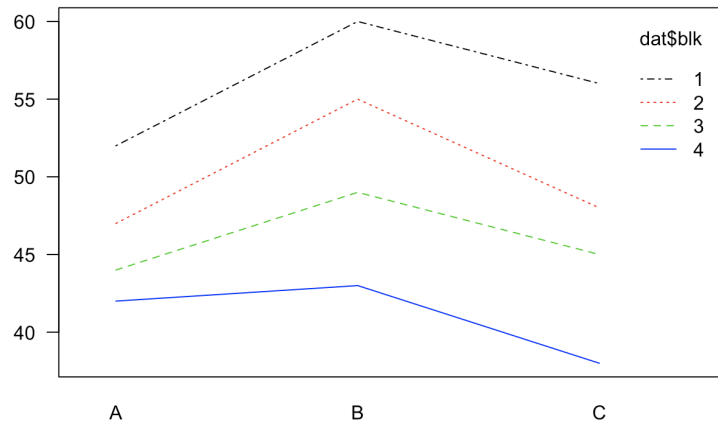
Analysis of Variance Table

Response: x

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
trt	2	74.00	37.00	9.250	0.0146878
blk	3	362.25	120.75	30.188	0.0005124
Residuals	6	24.00	4.00		

- (a) Test, at the 5% level of significance, whether these data provide sufficient evidence that at least one of the three treatments (A, B, and C) affects the average compressive strength. **(7 points)**

(b) Use the interaction plot below to assess the appropriateness of the assumption that treatments have the same effect across blocks. **(7 points)**



(c) Use the R output of Fisher's LSD with Bonferroni correction (Left) and Tukey's HSD (Right) below to determine which pairs are significantly different than each other after accounting for multiple comparisons. **(6 points)**

x groups			diff		lwr	upr	p adj
B	51.75	a	B-A	5.5	1.160805	9.8391953	0.01895344
C	46.75	b	C-A	0.5	-3.839195	4.8391953	0.93415461
A	46.25	b	C-B	-5.0	-9.339195	-0.6608047	0.02848377