EDUC/PSY 6600

Research Design & Analysis I

Name:

Unit 2 Assignment

Groundwork for Inference

Please complete the following exercises. Feel free to work with classmates, but each student must turn in ***UNIQUE*** *work, not photocopies or identical replicates. When applicable, use* ***APA format*** *in communicating your results in text.* ***Show your work!*** *If any question involves any math at all, show your work. When it doubt, write it out. Always show more than you think you need.*

1) WRITE-UP - Textbook Problems

Cohen Chap		Exercises	Pts	Off
5	A	*1, 2, *5, 6, 7, 9, 10	5	
	B	*1, *8, 9, *10 **11, 12, 13 ←Advance Section**	5	
	C	3, 4	2	
6	A	*1, 2, 4, *5, 6	5	
	B	*1, 2, *4, 5, 8	5	
	C	1, 2, 3	2	
7	A	*7, 8	2	
	B	*3, *4, 6	3	
	C	1, 5	2	
8	A	3, 9, *10	3	
	B	6	1	
	C	2 (altered) *(Use G-Power, no syntax or code)*	1	

2) SUMMARY – Supplementary Reading

The ASA's Statement on p-Values: Context, Process, and Purpose		Pts	Off
Half Page	Read the article and summarize the main points for future reference.	5	

3) R SYNTAX – Section C: Ihno's data set – add to the skeleton R notebook and knit to .pdf & upload

Cohen Chap		Exercises	Pts	Off
5	C	3, 4	2	
6	C	1, 2, 3	2	
7	C	1, 2, 3, 4, 5	5	

Grading

		Earned	Possible
CORRECTNESS	*a subset of spot-checked items: must show work, especially items from back of book or done in class*		50
COMPLETENESS	*more than one item is missing or skipped: 25/50 roughly half the assignment is completed: 10/50*		50
			100

5	A	*1. Calculated z-value → p-value … 1-tailed & 2-tailed

a) If the **calculated z** for an experiment equals **1.35**, what is the corresponding **p-value**?

1-tail: p = ________ 2-tail: p = ________

b) If the **calculated z** for an experiment equals **- 0.7**, what is the corresponding **p-value**?

1-tail: p = ________ 2-tail: p = ________

c) If the **calculated z** for an experiment equals **2.2**, what is the corresponding **p-value**?

1-tail: p = ________ 2-tail: p = ________

5	A	2. alpha → critical z-value … 1-tailed & 2-tailed

a) If **alpha** were set to the unusual value of **.08,** what would be the magnitude of the **critical z**?

1-tail: z_{cv} = ________ 2-tail: z_{cv} = ________

b) If **alpha** were set to the unusual value of **.03**, what would be the magnitude of the **critical z**?

1-tail: z_{cv} = ________ 2-tail: z_{cv} = ________

c) If **alpha** were set to the unusual value of **.007**, what would be the magnitude of the **critical z**?

1-tail: z_{cv} = ________ 2-tail: z_{cv} = ________

5	A	*5. sample mean → p-value (2-tailed)

An English professor suspects that her current class **of 36 students** is unusually good at verbal skills. She looks up the verbal SAT score for each student and is pleased to find that the **mean for the class is 540**.

Assuming that the general population of students has a **mean verbal SAT score of 500** with a **standard deviation of 100**, what is the **two-tailed** p value corresponding to this class?

POPULATION PARAMETERS

μ = ________

σ = ________

n = ________

SAMPLE STATISTICS

$\bar{X}$ = ________

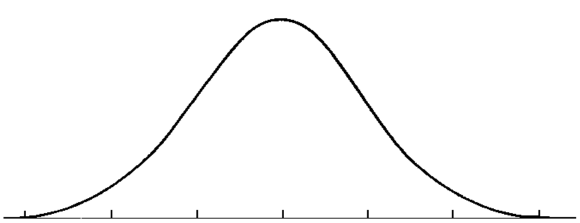
$\sigma_{\bar{X}}$ = ________

Standard Error for the Mean

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

Formula 5.1

$$z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$



z = __________

2-tail: p = __________

5	A	6. Very large z-score

Consider a situation in which you have **calculated the z score** for a group of participants and have obtained the unusually high value of **20**.

Which of the following statements would be **true**, and which would be **false**?
Explain your answer in each case.

a.) You must have made a calculation error because z scores cannot get so high.

☐ TRUE ☐ FALSE **EXPLAIN**.

b.) The null hypothesis cannot be true.

☐ TRUE ☐ FALSE **EXPLAIN**.

c.) The null hypothesis can be rejected, even if a very small alpha is used.

☐ TRUE ☐ FALSE **EXPLAIN**.

d.) The difference between the sample mean and the hypothesized population mean must have been quite large.

☐ TRUE ☐ FALSE **EXPLAIN**.

5	A	7. Very large z-score

Suppose the z score mentioned in Exercise 6 involved the measurement of height for a group of men. If **μ = 69 inches** and **σ = 3 inches**, **how** can a group of men have a **z score equal to 20**?

Give a **numerical example** illustrating how this can occur.

5	A	9. One-tail vs. Two-tails

Describe a situation in which a **one-tailed** hypothesis test seems justified.

Describe a situation in which a **two-tailed** test is clearly called for.

5	A	10. One-tail vs. Two-tails

Describe a case in which it would probably be appropriate to use an **alpha smaller** than the conventional .05 (e.g., .01).

Describe a case in which it might be appropriate to use an unusually **large alpha** (e.g., .1).

5	B	*1. Hypothesis test: Mean (z-score)

A psychiatrist is testing a new antianxiety drug, which seems to have the potentially harmful side effect of lowering the heart rate. For a **sample of 50** medical students whose pulse was measured after 6 weeks of taking the drug, the **mean heart rate was 70 beats per minute** (bpm).

If the mean heart rate for the **population** is **72 bpm** with a **standard deviation of 12**, can the psychiatrist conclude that the new drug lowers heart rate significantly? (Set alpha = .05 and perform a one-tailed test.)

POPULATION PARAMETERS

μ = _______

σ = _______

n = _______

SAMPLE STATISTICS

$\bar{X}$ = _______

$\sigma_{\bar{X}}$ = _______

H₀ : __________

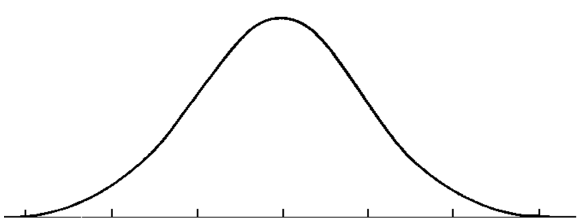
Hₐ : __________

Standard Error for the Mean

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

Formula 5.1

$$z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$



z = __________

1-tail: p = __________

☐ *Provides evidence that new drug lowers heart rate*

☐ *No evidence that the new drug lowers heart rate*

5	B	*8. sample mean → p-value (2-tailed)

Imagine that you are testing a new drug that seems to <u>**raise**</u> the number of T cells in the blood and therefore has enormous potential for the treatment of disease. After treating **100 patients**, you find that their **mean T cell count is 29.1**. Assume that **μ and σ (hypothetically) are 28 and 6**, respectively.

POPULATION PARAMETERS

μ = ______

σ = ______

n = ______

SAMPLE STATISTICS

$\bar{X}$ = ______

$\sigma_{\bar{X}}$ = ______

H₀ : __________

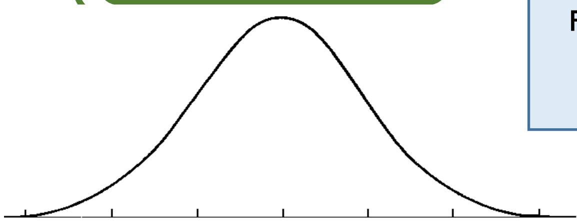
Hₐ : __________

Standard Error for the Mean

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

Formula 5.1

$$z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$



z = __________

2-tail: p = __________

a.) Test the null hypothesis at the **.05 level, two-tailed.**

☐ *Provides evidence that new drug increases T cells*
☐ *No evidence that the new drug increases T cells*

b.) Test the same hypothesis at the **.10 level, two-tailed**.

☐ *Provides evidence that new drug increases T cells*
☐ *No evidence that the new drug increases T cells*

c.) **Describe** in practical terms what it would mean to **commit a Type I error** in this example.

d.) **Describe** in practical terms what it would mean to **commit a Type II error** in this example.

e.) How might you **justify** the use of .10 for alpha in similar experiments?

5	B	9. Effect of the Population SD on the z-score

a) Assuming everything else in the previous problem stayed the same, what would happen to your **calculated z** if the **population standard deviation (σ) were 3 instead of 6**?

Standard Error for the Mean

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

Formula 5.1

$$z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$

z = __________ → __________

b) What **general statement** can you make about how changes in σ affect the calculated value of z ?

5	B	*10. Sample size requirements

Referring to Exercise 8, suppose that **mean ($\bar{X}$) is equal to 29.1** *regardless of the sample size*.

How large would n have to be for the calculated z to be statistically significant at the **.01 level (two-tailed)?**

Formula 5.1

$$z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$

n = __________

5	B	11. Define 'alpha'

Alpha stands for which of the following?

a) The proportion of experiments that will attain statistical significance ☐ TRUE

b) The proportion of experiments for which the null hypothesis is true that will attain statistical significance ☐ TRUE

c) The proportion of statistically significant results for which the null hypothesis is true ☐ TRUE

d) The proportion of experiments for which the null hypothesis is true ☐ TRUE

5	B	12. Errors in hypothesis testing

In the last few years, an organization has conducted **200 clinical trials** to test the effectiveness of antianxiety drugs.

Suppose, however, that **all** of those drugs were obtained from the same **fraudulent** supplier, which was later revealed to have been sending only inert substances (e.g., distilled water, sugar pills) instead of real drugs. If **alpha = .05** was used for all hypothesis tests…

How many **of these 200** experiments would you expect to **yield significant** results?

How many **Type I errors** would you expect?

How many **Type II errors** would you expect?

5	B	13. Errors in hypothesis testing

Since she arrived at the university, Dr. Pine has been very productive and successful. She has already performed **20 experiments** that have **each** attained the **.05** level of statistical significance.

What is your best guess for the number of **Type I errors** she has made so far?

For the number of **Type II errors**?

5	C	3. Hypothesis test: Mean (z-score)

a) **In the past** 10 years, previous stats classes who took the same **mathquiz** that Ihno's students took **averaged 28** with a **standard deviation of 8.5**. What is the **two-tailed p value** for Ihno's students with respect to that past population? *(Don't forget that the N for mathquiz is not 100.)*

write code to find mean & n in your R syntax file

POPULATION PARAMETERS

μ = ______

σ = ______

n = ______

SAMPLE STATISTICS

$\bar{X}$ = ______

$\sigma_{\bar{X}}$ = ______

H₀ : ________

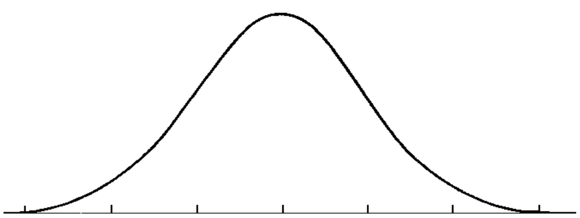
Hₐ : ________

Standard Error for the Mean

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

Formula 5.1

$$z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$



z = ________

2-tail: p = ________

Would you say that Ihno's class performed **significantly better** than previous classes?

☐ ***Provides evidence*** *Ihno's class performed* ***significantly better*** *than previous classes*

☐ ***No evidence*** *that Ihno's class performed any differently than previous classes*

EXPLAIN.

5	C	3. Hypothesis test: Mean (z-score)

b) **In the past** 10 years, previous stats classes who took the same **statquiz** that Ihno's students took **averaged 6.1** with a s**tandard deviation of 2.5**. What is the **two-tailed p value** for Ihno's students with respect to that past population?

write code to find mean & n in your R syntax file

POPULATION PARAMETERS

μ = ______

σ = ______

n = ______

SAMPLE STATISTICS

$\bar{X}$ = ______

$\sigma_{\bar{X}}$ = ______

H₀ : __________

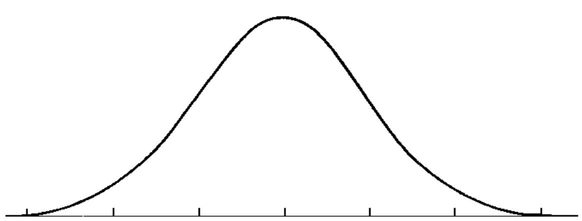
Hₐ : __________

Standard Error for the Mean

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$$

Formula 5.1

$$z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}}$$



z = __________

2-tail: p = __________

Would you say that Ihno's class performed **significantly better** than previous classes?

☐ ***Provides evidence*** *Ihno's class performed* ***significantly better*** *than previous classes*

☐ ***No evidence*** *that Ihno's class performed any differently than previous classes*

EXPLAIN.

5	C	4. Hypothesis test: Mean (z-score)

Test both the **mathquiz** and **statquiz** variables for their resemblance to **normal distributions**.

Based on **skewness**, **kurtosis**, and the **Shapiro-Wilk statistic**, which variable has a sample distribution that is **not** very consistent with the *assumption of normality in the population*?

MATHQUIZ	**Skewness** __________ **Kurtosis** __________ **Shapiro-Wilk** stat = ________ p = ________	<-- Type **R code** into Skeleton and Knit to get **pdf** including output ☐ ***NORMAL*** *(or normal'ish)* ☐ ***NOT NORMAL*** *Sketch a plot you made in R by hand (histogram &/or qq plot)*
STATQUIZ	**Skewness** __________ **Kurtosis** __________ **Shapiro-Wilk** stat = ________ p = ________	<-- Type **R code** into Skeleton and Knit to get **pdf** including output ☐ ***NORMAL*** *(or normal'ish)* ☐ ***NOT NORMAL*** *Sketch a plot you made in R by hand (histogram &/or qq plot)*

6	A	*1. Standard Error for the Mean

Formula 6.1

$$s_{\bar{X}} = \frac{s}{\sqrt{n}}$$

The unbiased **variance** (s^2) **200** participants is **55**.

a) What is the value of the estimated **standard error of the mean** ($s_{\bar{X}}$)?

$s_{\bar{X}}$ = __________

b) If the variance were the same but the sample were increased to **1800 participants**, what would be the new value of $s_{\bar{X}}$?

$s_{\bar{X}}$ = __________

6	A	2. Sample Mean: z-score and p-value

A survey of **144 college students** reveals a mean beer consumption **rate of 8.4** beers per week, with a **standard deviation of 5.6**.

a) If the **national average is seven** beers per week, what is **the z score** for the college students? What **p value** does this correspond to?

POPULATION PARAMETERS

H_0: μ = ______

n = ______

SAMPLE STATISTICS

$\bar{X}$ = ______

SD: s_X = _____ → SE: $s_{\bar{X}}$ = ______

Formula 6.1

$$s_{\bar{X}} = \frac{s}{\sqrt{n}}$$

Formula 6.2A

$$z = \frac{\bar{X} - \mu}{s_{\bar{X}}}$$

z = __________

2-tail: p = __________

b) If the **national average were four** beers per week, what would the **z score** be? What can you say about the **p value** in this case?

z = __________

2-tail: p = __________

6	A	4. One Sample Mean: df and Critical Values of t

a.) In a one-group t test based on a sample of **20 participants**, what is the value for df?

df = __________

b.) What are the **two-tailed critical t** values for alpha = .05? For alpha = .01?

α =.05: t_{cv} = ________ α =.01: t_{cv} = ________

c.) What is the **one-tailed critical t** for alpha = .05? For alpha = .01?

α =.05: t_{cv} = ________ α =.01: t_{cv} = ________

6	A	*5. One Sample Mean: t-score and Critical Values of t (change n)

Twenty-two stroke patients performed a maze task. The **mean** number of trials ($\bar{X}$) for success was **14.7** with **s = 6.2**. If the **population mean** (μ) for this task is **6.5…**

a.) What is the calculated value for t ? What is the critical t for a **.05**, **two-tailed** test?

POPULATION PARAMETERS

H_0: μ = ______

n = ______

SAMPLE STATISTICS

$\bar{X}$ = ______

SD: s_X = ______ → SE: $s_{\bar{X}}$ = ______

Formula 6.1

$$s_{\bar{X}} = \frac{s}{\sqrt{n}}$$

Formula 6.3

$$t = \frac{\bar{X} - \mu}{s_{\bar{X}}}$$

$$df = n - 1$$

t(___) = ________

tCV = ________

b.) If only **11 patients** had been run but the data were the same as in part a, what would be the calculated value for t ?

t(___) = ________

tCV = ________

How does this value compare with the t value calculated in part a?

6	A	6. One Sample Mean: t-score and Critical Values of t (change n)

a.) Referring to **part a** of Exercise 5, what would the **calculated t value** be if **s = 3.1** (all else remaining the same)?

t(___) = ________

b.) Comparing the t values you calculated for Exercises 5a and 6a, what can you say about the relation between t and the sample standard deviation?

6	B	*1. One Sample Mean: t-test

A high school is proud of its advanced chemistry class, in which its **16 students** scored an **average of 89.3** on the statewide exam, with **s = 9**.

a.) Test the null hypothesis that the advanced class is just a random selection from the state population **(μ = 84.7),** using alpha = **.05 (two**-tailed).

POPULATION PARAMETERS

H_0: μ = ______

n = ______

SAMPLE STATISTICS

$\bar{X}$ = ______

SD: s_X = _____ → SE: $s_{\bar{X}}$ = ______

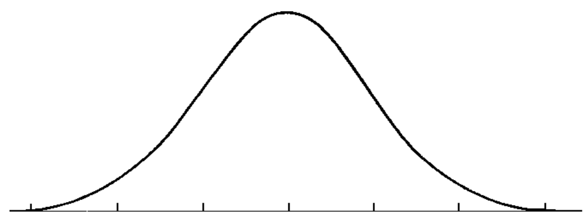
Formula 6.1

$$s_{\bar{X}} = \frac{s}{\sqrt{n}}$$

Formula 6.3

$$t = \frac{\bar{X} - \mu}{s_{\bar{X}}}$$

$$df = n - 1$$



t(___) = _________

t_{CV} = _________

2-tail: p = ______________

☐ ***Provides evidence*** *the advanced chemistry class at this school is not a random selection from the state.*

☐ ***No evidence*** *that the advanced chemistry class at this school is not a random selection from the state.*

b.) Test the same hypothesis at the **.01 level (two**-tailed).

☐ ***Provides evidence*** *the advanced chemistry class at this school is not a random selection from the state.*

☐ ***No evidence*** *that the advanced chemistry class at this school is not a random selection from the state*

Considering your decision with respect to the null hypothesis, what type of error (Type I or Type II) **could you be making**?

☐ Type I
☐ Type II

6	B	2. One Sample: t-test for Mean

Are serial killers more introverted than the general population?

A sample of **14 serial killers** serving life sentences was tested and found to have a **mean** introversion score ($\bar{X}$) of **42** with **s = 6.8**. If the **population mean (μ) is 36**, are the serial killers significantly more introverted at the .05 level? (Perform the appropriate **one-tailed test**, *although normally it would not be justified*.)

POPULATION PARAMETERS

H_0: μ = ______

n = ______

SAMPLE STATISTICS

$\bar{X}$ = ______

SD: s_X = ______ → SE: $s_{\bar{X}}$ = ______

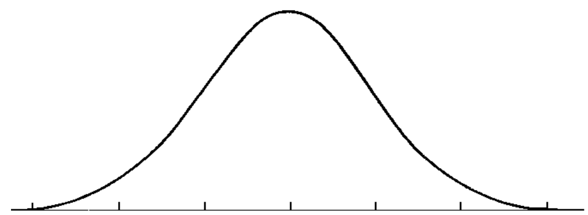
Formula 6.1

$$s_{\bar{X}} = \frac{s}{\sqrt{n}}$$

Formula 6.3

$$t = \frac{\bar{X} - \mu}{s_{\bar{X}}}$$

$$df = n - 1$$



t(___) = ________

t_{CV} = ________

1-tail: p = ____________

EXPLAIN CONCLUSION: Are serial killers more introverted than the general population?

- ☐ Yes
- ☐ NO

6	B	*4. One Sample: Confidence Interval for the Mean

A psychologist studying the dynamics of marriage wanted to know how many hours per week the average American couple spends discussing marital problems. The sample **mean** ($\bar{X}$) of **155 randomly selected** couples turned out to be **2.6 hours**, with **s = 1.8.**

a.) Find the **95% confidence interval for the mean** (μ) of the population.

POPULATION PARAMETERS

μ ← 95% CI for

n = ______

SAMPLE STATISTICS

$\bar{X}$ = ______

SD: s_X = ______ → SE: $s_{\bar{X}}$ = ______

Formula 6.1
$s_{\bar{X}} = \frac{s}{\sqrt{n}}$

Formula 6.3
$df = n - 1$

Formula 6.6
$\bar{X} \pm t_{CV} \cdot s_{\bar{X}}$

t_{CV} = __________

95% CI: (______________ , ______________)

b.) A European study had already estimated the population mean to be **3 hours per week** for European couples. Are the American couples **significantly different** from the European couples at the **.05 level?**

☐ Yes
☐ NO

Show how your answer to part a makes it easy to answer part b.

6	B	5. Sample Size ← width of CI

If the psychologist in exercise 4 wanted the **width of the confidence interval to be only half an hour**, how many couples would have to be sampled?

Formula 6.5
$n = \left(\frac{4s}{W}\right)^2$

n = __________

6	B	8. One Sample: Confidence Interval for the Mean

A psychologist would like to know how many casual friends are in the average person's social network. She interviews a random sample of people and determines for each the **number of friends** or social acquaintances they see or talk to at least once a year. The data are as follows:

5, 11, 15, 9, 7, 13, 23, 8, 12, 7, 10, 11, 21, 20, 13

a.) Find the **90% confidence interval for the mean** number of friends for the entire population.

POPULATION PARAMETERS

μ ← CI for

n = ______

SAMPLE STATISTICS

$\bar{X}$ = ______

SD: s_X = _____ → SE: $s_{\bar{X}}$ = ______

Formula 6.1
$s_{\bar{X}} = \frac{s}{\sqrt{n}}$

Formula 6.3
$df = n - 1$

Formula 6.6
$\bar{X} \pm t_{CV} \cdot s_{\bar{X}}$

t_{CV} = _________

90% CI: (____________ , ____________)

b.) Find the **95%** CI.

t_{CV} = _________

95% CI: (____________ , ____________)

c.) If a previous researcher had predicted a **population mean of 10** casual friends per person, could that prediction be **rejected as an hypothesis at the .05 level, twotailed**?

☐ Yes
☐ NO

EXPLAIN.

6	C	1. One Sample: Confidence Interval for the Mean

Perform **one-sample t tests** to determine whether the baseline, pre-, or postquiz **anxiety scores** of Ihno's students differ significantly (α = **.05, two**-tailed) from the mean **(μ = 18**) found by a very large study of college students across the country. Find the **95% CI for the population mean** for each of the three anxiety measures.

Type **R code** into Skeleton and Knit to get **pdf** including output

	Sample Mean	**95% CI** (71.63, 72.91)	**Test value = 18** t(99) = 24.744, p=.013	**Ihno's different?**
Baseline				☐ Different ☐ Same
Pre-quiz				☐ Different ☐ Same
Post-Quiz				☐ Different ☐ Same

6	C	2. One Sample: Confidence Interval for the Mean

Perform a one-sample t test to determine whether the average **baseline heart rate** of Ihno's **male** students differs significantly from the mean HR **(μ = 70**) for college-aged men at the **.01 level, two**-tailed. Find the **99% CI** for the population mean represented by Ihno's male students.

	Sample Mean	**99% CI** (71.63, 72.91)	**Test value = 70** t(99) = 24.744, p=.013	**Ihno's different?**
MALE Baseline				☐ Different ☐ Same

6	C	3. One Sample: Confidence Interval for the Mean

Perform a one-sample t test to determine whether the average **postquiz heart rate** of Ihno's **female** students differs significantly (α = .**05, two**-tailed) from the mean resting HR **(μ = 72**) for college-aged women. Find the **95% CI** for the population mean represented by Ihno's female students.

	Sample Mean	**95% CI** (71.63, 72.91)	**Test value = 72** t(99) = 24.744, p=.013	**Ihno's different?**
FEMALE Post-Quiz				☐ Different ☐ Same

7	A	*7. Two Independent Samples: Mean Difference Hypothesis Test

In a study of a new treatment for phobia, the data for the experimental group were $\overline{X_1}$ = 27 . 2 , s_1 = 4, and n_1 = 15. The data for the control group were $\overline{X_2}$ = 34 . 4 , s_2 = 14, and n_2 = 15.

a.) Calculate the **separate-variances** t value.

experimental

$n_1 =$______

$\overline{X_1} =$______

$s_1 =$______

control

$n_2 =$______

$\overline{X_2} =$______

$s_2 =$______

SAMPLE DIFFERENCE

$df =$______

$\overline{X_1} - \overline{X_2} =$________

SE = __________

H₀ : ____________________

Hₐ : ____________________

Separate variances

$$SE = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

Formula 7.8

$$t = \frac{\overline{D} - 0}{SE}$$

$$\min(n_1, n_2) - 1 < df < n_1 + n_2 - 2$$

t(_______ **) =** ________

b.) Calculate the **pooled-variance** t value.

SAMPLE DIFFERENCE

$df =$______

$\overline{X_1} - \overline{X_2} =$________

$s_p^2 =$________

SE = __________

Pooled variance - Formula 7.6

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

$$SE = \sqrt{s_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

Formula 7.8

$$t = \frac{\overline{D} - 0}{SE}$$

$$df = n_1 + n_2 - 2$$

t(_______ **) =** ________

7	A	8. Experiment: true or quasi

a.) Design a **true experiment** involving two groups (i.e., the experimenter decides, at random, in which group each participant will be placed).

b.) Design a **quasi-experiment** (i.e., an observational study) involving groups not created, but only selected, by the experimenter.

How are your **conclusions** from this experiment **limited**, even if the results are statistically significant?

7	B	*3. Two Independent Samples: Mean Difference Hypothesis Test

On the first day of class, a third-grade teacher is told that **12 of his students are "gifted,"** as determined by IQ tests, and the **remaining 12 are not**. In reality, the two groups have been carefully matched on IQ and previous school performance.

At the end of the school year, the gifted students have a grade **average of 87.2** with **s = 5.3**, whereas the other students have an **average of 82.9,** with **s = 4.4**.

Perform a t test to decide whether you can conclude from these data that false expectations can affect student performance; use alpha = **.05, two**-tailed. **← use separate variances (not pooled)**

"gifted"

n_1 =______

$\overline{X}_1$ =______

s_1 =______

"not gifted"

n_2 =______

$\overline{X}_2$ =______

s_2 =______

SAMPLE DIFFERENCE

df =______

$\overline{X}_1 - \overline{X}_2$ =________

SE = __________

H0 : ____________________

Ha : ____________________

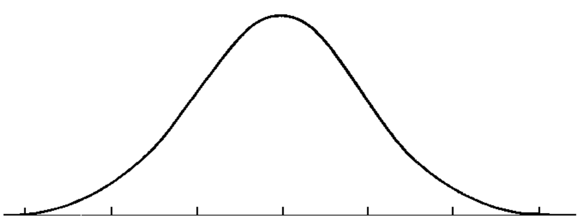
Separate variances

$$SE = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

Formula 7.8

$$t = \frac{\overline{D} - 0}{SE}$$

$$\min(n_1, n_2) - 1 < df < n_1 + n_2 - 2$$



t(________ **) =** _________

t_{CV} = _________

CONCLUSION:

7	B	*4. Two Independent Samples: Mean Difference Confidence Interval

A researcher tested the diastolic blood pressure of **60 marathon runners** and **60 nonrunners**. The **mean** for the runners was **75.9** mmHg with **s = 10**, and the **mean** for the nonrunners was **80.3** mmHg with s = **8**.

"runners"	"non-runner"	SAMPLE DIFFERENCE
$n_1 =$ ______	$n_2 =$ ______	$df =$ ______
$\overline{X}_1 =$ ______	$\overline{X}_2 =$ ______	$\overline{X}_1 - \overline{X}_2 =$ ________
$s_1 =$ ______	$s_2 =$ ______	SE = ________

a.) Find the 95% confidence interval for the difference of the population means.

← **use separate variances (not pooled)**

Separate variances

$$SE = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

$$\min(n_1, n_2) - 1 < df < n_1 + n_2 - 2$$

Formula 7.10

$$\overline{X}_1 - \overline{X}_2 \pm t_{CV} \cdot SE$$

95% CI: (____________ , ____________)

b.) Find the 99% confidence interval for the difference of the population means.

99% CI: (____________ , ____________)

c.) Use the confidence intervals you found in parts a and b to test the null hypothesis that running has no effect on blood pressure at the **.05 and .01** levels, **two** tailed.

H_0 : ____________________ **H_a :** ____________________

Alpha = .05	Alpha = .01
☐ Runners are different	☐ Runners are different
☐ no difference	☐ no difference

7	B	6. Two Independent Samples: Mean Difference Hypothesis Test

A psychologist is studying the concentration of a certain enzyme in saliva as a possible indicator of chronic anxiety level.
A **sample of 12** anxiety neurotics yields a **mean** enzyme concentration of **3.2** with **s = .7**. For comparison purposes, a sample of **20 subjects** reporting low levels of anxiety is measured and yields a **mean** enzyme concentration of **2.3**, with **s = .4**.

a.) Perform a t test (alpha **= .05, two**-tailed) to determine whether the two populations sampled **differ** with respect to their mean saliva concentration of this enzyme. **← use pooled variances (not separate)**

"neurotics"

n_1 =______

$\overline{X_1}$ =______

s_1 =______

"low anx"

n_2 =______

$\overline{X_2}$ =______

s_2 =______

SAMPLE DIFFERENCE

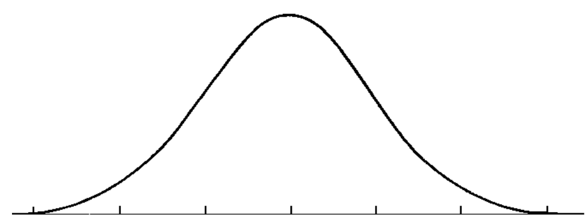
df =______

$\overline{X_1} - \overline{X_2}$ =______

SE = ______

H₀ : ____________________

Hₐ : ____________________



Pooled variance - Formula 7.6

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

$$SE = \sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

Formula 7.8

$$t = \frac{\overline{D} - 0}{SE}$$
$$df = n_1 + n_2 - 2$$

t(________ **) =** __________

t_{CV} = __________

CONCLUSION:

b.) Based on your answer to part a, what **type of error** (Type I or Type II) might you be making?

- ☐ Type I
- ☐ Type II

7	C	1. Two Independent Samples: Mean Difference Hypothesis Test

Perform a two-sample t test to determine whether there is a statistically significant **difference** in **baseline heart rate** **between the men and the women** of Ihno's class.

Type **R code** into Skeleton and Knit to get **pdf** including output

Do you have homogeneity of variance? **Explain.**

- ☐ yes
- ☐ no

Report your **results** as they might appear in a journal article.
Include the **95% CI** for this gender difference.

7	C	2. Two Independent Samples: Mean Difference Hypothesis Test

Perform a two-sample t test to determine whether there is a statistically significant **difference** in **phobia** **between the men and the women** of Ihno's class.

Type **R code** into Skeleton and Knit to get **pdf** including output

Do you have homogeneity of variance? **Explain.**

- ☐ yes
- ☐ no

Report your **results** as they might appear in a journal article.
Include the **95% CI** for this gender difference.

7	C	3. Two Independent Samples: Mean Difference Hypothesis Test

Perform a two-sample t test to determine whether the students in the **"impossible to solve"** condition exhibited significantly **higher postquiz HEART RATES** than the students in the **"easy to solve"** condition.

Type **R code** into Skeleton and Knit to get **pdf** including output

Is this t test significant at the .05 level? **Explain.**

☐ yes
☐ no

Is this t test significant at the .01 level? **Explain.**

☐ yes
☐ no

Find the 99% CI for the difference of the two population means.

99% CI: (______________ , ______________)

7	C	4. Two Independent Samples: Mean Difference Hypothesis Test

Perform a two-sample t test to determine whether the students in the **"impossible to solve"** condition exhibited significantly **higher postquiz ANXIETY** than the students in the **"easy to solve"** condition.

Type **R code** into Skeleton and Knit to get **pdf** including output

Is this t test significant at the .05 level? **Explain.**

☐ yes
☐ no

Is this t test significant at the .01 level? **Explain.**

☐ yes
☐ no

Find the 99% CI for the difference of the two population means.

99% CI: (______________ , ______________)

7	C	5. Two Independent Samples: Mean Difference Hypothesis Test

Perform a two-sample t test to determine whether **coffee drinkers** exhibited significantly higher **postquiz heart rates** than **nondrinkers** at the .05 level.

Type **R code** into Skeleton and Knit to get **pdf** including output

t(_______) = _________

2-tail: p = ______________

- ☐ Coffee drinkers are different
- ☐ no difference

Is this t test significant at the **.01** level?

- ☐ Coffee drinkers are different
- ☐ no difference

Find the **99%** CI for the **difference** of the two population means…

99% CI: (_____________ , _____________)

… and explain its connection to your decision regarding the null hypothesis at the .01 level.

8	A	3. Cohen's d

If the **mean** verbal SAT score is **510** for women and **490** for men, what is the **d** ?

d = ________

8	A	9. Extremely large t-value

The **t value** calculated for a particular two group experiment was **– 23**.

Which of the following can you conclude?

- ☐ a. A calculation error must have been made.
- ☐ b. The number of participants must have been large.
- ☐ c. The effect size must have been large.
- ☐ d. The expected t was probably large.
- ☐ e. The alpha level was probably large.

Explain your choice.

8	A	*10. Cohen's d

Suppose you are in a situation in which it is **more important to reduce Type II errors** than to worry about Type I errors.

Which of the following could be helpful in reducing Type II errors?

- ☐ a. Make alpha unusually large (e.g., .1).
- ☐ b. Use a larger number of participants.
- ☐ c. Try to increase the effect size.
- ☐ d. All of the above.
- ☐ e. None of the above.

Explain your choice.

8	B	6. Power & Sample Size

A **drug** for treating headaches has a side effect of lowering diastolic blood pressure **by 8 mmHg** compared to a **placebo**. If the **population standard deviation** is known to be **6** mmHg,

a.) What would be the **power** of an experiment (α = .**01, two**-tailed) comparing the drug to a placebo using **15 participants per** group?

power = __________

b.) How **many participants** would you need **per group** to attain **power = .95, with α = .01, two**-tailed?

n = __________

8	C	2. Power & Sample Size -- USE G*Power SOFTWARE --

~~Given the adjusted effect size from part a of the previous exercise,~~

I am changing this problem!

How many participants of each gender (assuming equal sample sizes) would be needed for power to be **.8**, with alpha = **.05, two**-tailed test?

For a small effect size (d = .2)

n = __________

For a medium effect size (d = .5)

n = __________

For a large effect size (d = .8)

n = __________