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 : ____________________

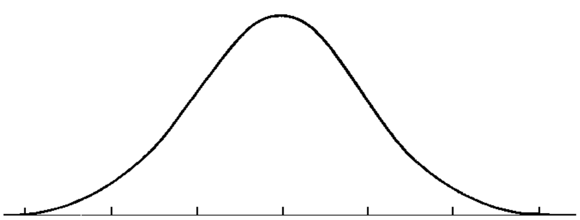
Separate variances

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

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"

n_1 =______

$\overline{X}_1$ =______

s_1 =______

"non-runner"

n_2 =______

$\overline{X}_2$ =______

s_2 =______

SAMPLE DIFFERENCE

df =______

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

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

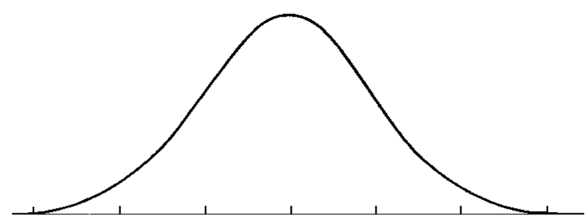
$df =$ ______

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

SE = ______

H_0 : ____________________

H_a : ____________________



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 = __________