11	A	*2. Independent groups: test difference in means

Can the depression of psychotherapy patients be reduced by treating them in a room painted in bright primary colors, as compared to a room with a more conservative look with wood paneling? **Ten** patients answered depression questionnaires after receiving therapy in a primary-colored room, and 10 patients answered the same questionnaire after receiving therapy in a traditional room. Mean depression was lower in the colored room ($\bar{X}_{color} = 35$) than the traditional room ($\bar{X}_{trad} = 39$) ; the standard deviations wer$s_{color} = 7$ and $s_{trad} = 5$, respectively.

a) Calculate the **t value** for the test of two **independent** means

Formula 7.8

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2 + s_2^2}{n}}}$$

$$df = n_1 + n_2 - 2$$

t(___) = _________

b) Is this t value **significant** at the **.05 (two**-tailed) level? *(check df)*

☐ YES, evidence of a difference -or- ☐ No evidence of a difference

t_{CV} = _________

11	A	*3. Matched pairs: test difference in means

Suppose that the patients in Exercise 2 had been **matched in pairs**, based on general depression level, before being assigned to groups.

a) If the correlation were only **.1**, how high would the **matched t value** be?

Formula 11.2

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2 + s_2^2}{n} - \frac{2\rho s_1 s_2}{n}}}$$

$$df = n - 1$$

t(___) = _________

b) Is this matched t value **significant** at the **.05 (two**-tailed) level? *(check df)*

☐ YES, evidence of a difference -or- ☐ No evidence of a difference

t_{CV} = _________

Explain any discrepancy between this result and the decision you made in part b of Exercise 2.

c) How high would the **matched t value** be if the correlation were **.3**?

t(___) = _________

d) If the correlation were **.5**?

t(___) = _________

11	A	7. Matched pairs experiments

a) Design an experiment for which it would be reasonable for the researcher to match the participants into pairs

b) Design an experiment in which it would be difficult to match participants into pairs.

11	A	*8. Matched pairs: very large t

Suppose that the matched **t value** for a before-after experiment turns out to be **15.2**

Which of the following can be concluded?

- ☐ a.) The before and after scores must be highly correlated.
- ☐ b.) A large number of participants must have been involved.
- ☐ c.) The before and after means must be quite different (as compared to the standard deviation of the difference scores).
- ☐ d.) The null hypothesis can be rejected at the .05 level.
- ☐ e.) No conclusion is possible without more information.

11	B	3. Matched pairs vs. Direct Difference	Code: R notebook

a) Using the data from Exercise 9B6, which follows, determine whether there is a **significant** tendency for verbal GRE scores to **improve** on the second testing. Calculate the **matched t** in terms of the Pearson correlation coefficient already calculated for that exercise.
(paired t-test)

t(___) = _________ **2-tail: p =** _______________

b) Recalculate the **matched t** test according to the **direct-difference method…**
(compute differences & do a 1-sample t-test)

t(___) = _________ **2-tail: p =** _______________

Verbal GRE (1)	Verbal GRE (2)	Direct Difference
540	570	
510	520	
580	600	
550	530	
520	520	

… and compare the result to your answer for part a.

11	B	*8. Matched pairs t-test & Confidence interval	Code: R notebook

A cognitive psychologist is testing the theory that short-term memory is **mediated** by subvocal rehearsal. This theory can be tested by reading aloud a string of letters to a participant, who must repeat the string correctly after a brief delay. If the theory is correct, there will be more errors when the list contains letters that sound alike (e.g., G and T) than when the list contains letters that look alike (e.g., P and R). Each participant gets both types of letter strings, which are **randomly mixed** in the same experimental session. The number of errors for each type of letter string for each participant are shown in the following table:

ID #	Letters that SOUND alike	Letters that LOOK alike
1	8	4
2	5	5
3	6	3
4	10	11
5	3	2
6	4	6
7	7	4
8	11	6
9	9	7

a) Perform a **matched** t test (α = **.05, one**-tailed) on the data above. (paired t-test)

…and state your **conclusions**.

t(___) = _________

1-tail: p = ______________

b) Find the **95% confidence interva**l for the **population <u>difference</u>** for the two types of letters.

95% CI: (_____________ , _____________)

11	B	9. Matched pairs: t-test for mean differences vs. correlation

Use R to find the **correlation coefficient** and the **regression slope** in Exercise 10B6: **Code: R notebook**

r(____) = _________

a) Calculate the **matched t value** to test whether there is a significant difference (α = **.05, two**-tailed) between the spatial ability and math scores. (paired t-test)

t(___) = _________

2-tail: p = ______________

b) Explain how the **Pearson r** for paired data can be very **high** and statistically **significant**, while the **matched t test** for the same data **fails** to attain significance.

11	B	*11. Matched pairs: power	(do using table A.3 & G*Power)

Imagine that an experiment is being planned in which there are two groups, each containing 25 participants. The (unmatched) effect size (d) is estimated to be about .4. (in G*Power: Effect size dz is the $d_{matched}$)

a) If the groups are to be **matched**, and the **correlation** is expected to be .5, what is the **power** of the matched t test being planned, with alpha = **.05** and a **two**-tailed test?

Formula 11.5

$$d_{match} = d\sqrt{\frac{1}{2(1-\rho)}}$$

Formula 8.10

$$\delta_{match} = d_{match}\sqrt{n_{pairs}}$$

G*Power	Selections	Inputs	Outputs
	Test Family		
	Statistical Test		
	Type of power analysis		

Power = __________ by hand/Table A.3 –or- __________ by G*Power

b) If the correlation in the preceding example were **.7**, and all else remained the same, what would the power be?

Formula 11.5

$$d_{match} = d\sqrt{\frac{1}{2(1-\rho)}}$$

Formula 8.10

$$\delta_{match} = d_{match}\sqrt{n_{pairs}}$$

G*Power	Selections	Inputs	Outputs
	Test Family		
	Statistical Test		
	Type of power analysis		

Power = __________ by hand/Table A.3 –or- __________ by G*Power

11	B	*13. Matched pairs: sample size estimations (do using table A.3 & G*Power)

A matched t test is being planned to evaluate a new method for learning foreign languages. From previous research, an (**unmatched**) **effect size** of **.3**, and a **correlation** of **.6** are expected.

a) How **many participants** would be needed in each matched group to have **power** = .75, with a **two-tailed** test at **alpha** = .05?

Formula 11.5

$$d_{match} = d\sqrt{\frac{1}{2(1-\rho)}}$$

Formula 8.11

$$n = \left(\frac{\delta_{match}}{d_{match}}\right)^2$$

G*Power Selections	Inputs	Outputs
Test Family		
Statistical Test		
Type of power analysis		

n = _________ by hand/Table A.3 –or- _________ by G*Power

b) What would your answer to part (a) be if **alpha** were changed to .01?

Formula 11.5

$$d_{match} = d\sqrt{\frac{1}{2(1-\rho)}}$$

Formula 8.11

$$n = \left(\frac{\delta_{match}}{d_{match}}\right)^2$$

G*Power Selections	Inputs	Outputs
Test Family		
Statistical Test		
Type of power analysis		

n = _________ by hand/Table A.3 –or- _________ by G*Power

11	C	1. Matched pairs t-test	Code: R notebook

A) Perform a matched-pairs **t test** to determine whether there is a significant ***increase*** in **heart rate** from **baseline** to **pre quiz**.

t(___) = _________

2-tail: p = _______________

- ☐ YES, evidence of a difference
- ☐ No evidence of a difference

B) Repeat the paired t test separately for **Men** and **Women**.

Men: **t(___) = _________** **2-tail: p = _______________**

- ☐ YES, evidence of a difference
- ☐ No evidence of a difference

Women: **t(___) = _________** **2-tail: p = _______________**

- ☐ YES, evidence of a difference
- ☐ No evidence of a difference

11	C	2. Matched pairs t-test	Code: R notebook

A) Perform a matched-pairs **t test** to determine whether there is a significant ***increase*** in **anxiety** from **baseline** to **pre quiz**.

t(___) = _________

2-tail: p = _______________

- ☐ YES, evidence of a difference
- ☐ No evidence of a difference

B) Perform a matched-pairs **t test** to determine whether there is a significant ***decrease*** in **anxiety** from **pre quiz** to **post quiz**.

t(___) = _________

2-tail: p = _______________

- ☐ YES, evidence of a difference
- ☐ No evidence of a difference

11	C	3. Matched pairs t-test	Code: R notebook

Perform a matched-pairs **t test** to determine whether there is a significant difference in mean scores between the **experimental stats quiz** and the **regular stats quiz**.

t(___) = _________

2-tail: p = _______________

Is the **correlation** between the two quizzes statistically significant?

r = _________

2-tail: p = _______________

Explain any **discrepancy** between the significance of the **correlation** and the significance of the matched **t test**.