12 A | *5. Calculate an F ratio - from summary stats

The **240 students** in a large introduction psychology class are scored on an introversion scale that they filled out in class, and then they are **divided equally into three groups** according to whether they sit near the front, middle, or back of the lecture hall. The means and standard deviations of the introversion scores for each group are as follows:

	Front	Middle	Back
M	28.7	34.3	37.2
SD	11.2	12.0	13.5

Calculate the F ratio**.**

Grand Mean

$$\bar{x}_G = \frac{\sum_{i=1}^{k} \bar{x}_i}{k}$$

Formula 12.7

$$MS_{BetGrp} = n\frac{\sum_{i=1}^{k}(\bar{x}_i - \bar{x}_G)^2}{k-1}$$

Formula 12.5B

$$MS_{WithGrp} = \frac{\sum_{i=1}^{k} s_i^2}{k}$$

Formula 12.7

$$F = \frac{MS_{BetGrp}}{MS_{WithGrp}}$$

Formula 12.4

$$df_{BetGrp} = k - 1$$
$$df_{WithGrp} = n_T - k$$

F (_____ , _____) = _____

12 A | 6. The effect on the F ratio - doubling standard deviation

Suppose the **standard deviations** in Exercise 5 were **twice as large**, as follows:

	Front	Middle	Back
SD	22.4	24.0	27.0

Calculate the F ratio and **compare** it to the F ratio you calculated for exercise 5.

F (_____ , _____) = _____

What is the **effect** on the F ratio of doubling the standard deviation?

12 A | *7. Calculate an F ratio, F critical value, & conclusion

A psychologist is studying the effects of various drugs on the speed of mental arithmetic. In an exploratory study, **32 subjects were divided equally into four drug conditions**, and each subject solves as many problems as he or she can in 10 minutes. The mean number of problems solved follows for each drug group, along with the standard deviations:

	Marijuana	Amphetamine	Valium	Alcohol
M	7	8	5	4
SD	3.25	3.95	3.16	2.07

a) Calculate the F ratio

Formula 12.7

$$MS_{BetGrp} = n\frac{\sum_{i=1}^{k}(\bar{x}_i - \bar{x}_G)^2}{k-1}$$

Grand Mean

$$\bar{x}_G = \frac{\sum_{i=1}^{k}\bar{x}_i}{k}$$

Formula 12.5B

$$MS_{WithGrp} = \frac{\sum_{i=1}^{k}s_i^2}{k}$$

Formula 12.4

$$df_{BetGrp} = k-1$$
$$df_{WithGrp} = n_T - k$$

Formula 12.7

$$F = \frac{MS_{BetGrp}}{MS_{WithGrp}}$$

F (_____ , _____) = _____

b) Find the critical F (alpha = .05) . (table A.7)

F_{CV} (_____ , _____) = _____

c) What can you **conclude** with respect to the null hypothesis?

12 A | 8. The effect on the F ratio - doubling total sample size

If the study in exercise 7 were repeated with a **total of 64 subjects**:

a) What would be the new value for calculated F?

F (_____ , _____) = _____

b) How does the F ratio calculated in part a compare to the F calculated in exercise 7? What general rule relates changes in the F ratio to changes in sample size (when all samples are the same size and all else remains unchanged)?

c) What is the new critical F (alpha = .05)? (table A.7)

F_{CV} (_____ , _____) = _____

12 B	4. one-way ANOVA from a raw dataset	Code: R notebook

A social psychologist wants to know how long people will wait before responding to cries for help from an unknown person and whether the gender or age of the person in need of help makes any difference. One at a time, subjects sit in a room waiting to be called for an experiment. After a few minutes they hear cries for help from the next room, which are actually on a tape recording. The cries are in either an adult male's, an adult female's, or a child's voice; **seven subjects are randomly assigned to each condition**. The dependent variable is the number of seconds from the time the cries begin until the subject gets up to investigate or help. (see data in book)

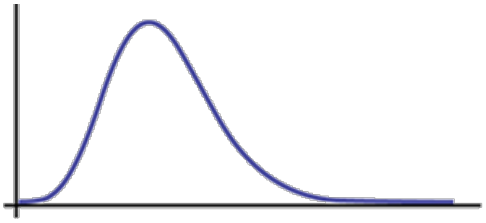
a) Calculate the F ratio. ← from R

F (_____ , _____) = _____

b) Find the critical F (alpha = .05) (table A.7)

F_{CV} (_____ , _____) = _____

H_0 : _____



☐ *Provides evidence against the Null*
☐ *No evidence against the Null*

c) What is your statistical **conclusion**? (in APA format please)

d) Present the results of the ANOVA in a complete summary table. ← from R

	SS	df	MS	F	Sig
Between Groups (caller type)					
Within Groups (residual or error)					
Total					

e) Calculate eta squared using ***formula 12.10*** and compare it the one produced in R (ges or pes)

Formula 12.10

$$ordinary\ \eta^2 = \frac{SS_{effect}}{SS_{total}}$$

η^2=

☐ *Strong*
☐ *Medium*
☐ *Weak*

12 B	5. one-way ANOVA from a raw dataset	Code: R notebook

A psychologist is interested in the relationship between color of food and appetite. To explore this relationship, the researcher bakes small cookies with icing of one of **three different colors** (green, red, or blue). The researcher offers cookies to subjects while they are performing a boring task. Each subject is run individually under the same conditions, except for the color of the icing on the cookies that are available. **Six subjects are randomly assigned to each color**. The number of cookies consumed by each subject during the 30-minute session is shown in the following table: (see book)

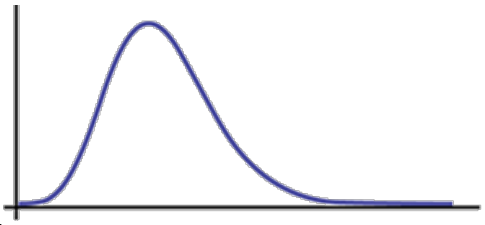
a) Calculate the F ratio.

F (_____ , _____) = _____

b) Find the critical F (alpha = .05) (table A.7)

F_{CV} (_____ , _____) = _____

H_0 : _____



☐ *Provides evidence against the Null*
☐ *No evidence against the Null*

c) What is your statistical **conclusion**? (in APA format please)

d) Present the results of the ANOVA in a summary table. ← from R

	SS	df	MS	F	Sig
Between Groups (icing color)					
Within Groups (residual or error)					
Total					

e) Why do we not discuss the **effect size** on this analysis?

12 B | 6. one-way ANOVA – effect of larger mean values | Code: R notebook

Suppose the data in exercise 5 had turned out differently. In particular, suppose that the number of cookies eaten by the subjects in the green condition remains the same, but each subject in the red condition ate **10 more** cookies that in the previous data set, and each subject in the blue condition ate 20 more. (see modified data in book)

a) Calculate the F ratio.

F (_____ , _____) = _____

b) Which part of the F ratio has **changed** from the previous exercise and which part has remained the **same**?

c) Put your results in a summary table to facilitate comparison with the results of #5 ← from R

	SS	df	MS	F	Sig
Between Groups (icing color)					
Within Groups (residual or error)					
Total					

d) Calculate **omega squared** with formula 12.12 and **adjusted eta squared** with formula 12.14.

Formula 12.12

$$est.\varpi^2 = \frac{SS_{BetGrp} - (k-1)MS_W}{SS_{total} + MS_w}$$

est. ω^2 =

Formula 12.10

$$ordinary\ \eta^2 = \frac{SS_{BetGrp}}{SS_{total}}$$

Formula 12.14

$$modified\ \eta^2 = \eta^2\left(1 - \frac{1}{F}\right)$$

adj η^2 =

Are they the same? Explain.

12 B | 14. Relationship between sample size and effect size

a) Approximately **how many subjects per group** are needed in a four-group experiment if f is expected to be .2 and power must be at least .77 for a .05 test? (hint: begin by assuming df_error will be very large)

G*Power

Selections	Inputs	Outputs
Test Family		
Statistical Test		
Type of power analysis		

n_j =

b) **How many subjects per group** would be needed in part (a) if f were equal to .1? All else being equal, **what happens** to the number of subjects required **when f is cut in half**?

G*Power

Selections	Inputs	Outputs
Test Family		
Statistical Test		
Type of power analysis		

n_j =

c) If you have three groups of eight subjects each and you want power to be at least .80 for a .05 test, approximately, **how large does f have to be**?

G*Power

Selections	Inputs	Outputs
Test Family		
Statistical Test		
Type of power analysis		

f =

12 C	1.Effect size & APA results	Code: R notebook

Perform a one-way ANOVA to test whether the different **experimental conditions** had a significant effect on the **post quiz heart rate**.

Cells = M(SD)

	Easy (n = _____)	Moderate (n = _____)	Hard (n = _____)	Impossible (n = _____)
Post Quiz Heart Rate				

ANOVA's: F (_____ , _____) = _____ , p-value = _____

Request descriptive statistics and an HOV test.

Levene's: F (_____ , _____) = _____ , p-value = _____

~~**Calculate**~~ **Report the eta squared from your ANOVA output**

☐ *Strong* ☐ *Medium* ☐ *Weak*

η^2=

And present your results in APA style.

12 C	2.HOV assumption & APA results	Code: R notebook

Using **college major** as the independent variable, perform a one-way ANOVA to test for significant differences in both **mathquiz** and **statquiz**. Request descriptive statistics and an HOW test.

Cells = M(SD)

	Psychology (n = _____)	Premed (n = _____)	Biology (n = _____)	Sociology (n = _____)	Economics (n = _____)
Math Quiz					
Stat Quiz					

Math quiz

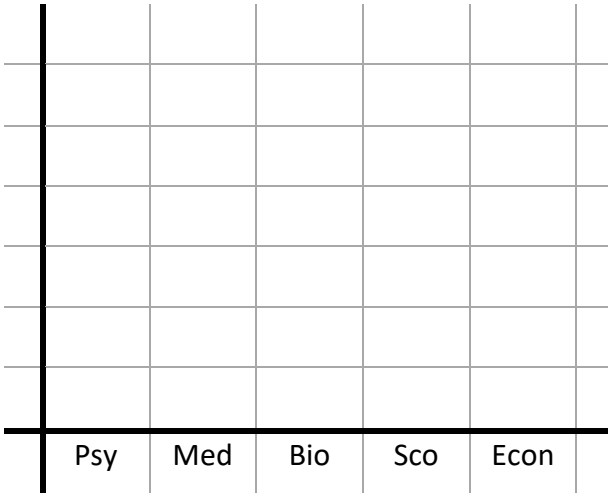
ANOVA's: F (___ , _____) = _____ ,

p-value = _____

Levene's: F (___ , _____) = _____ ,

p-value = _____

η^2=



Stat quiz

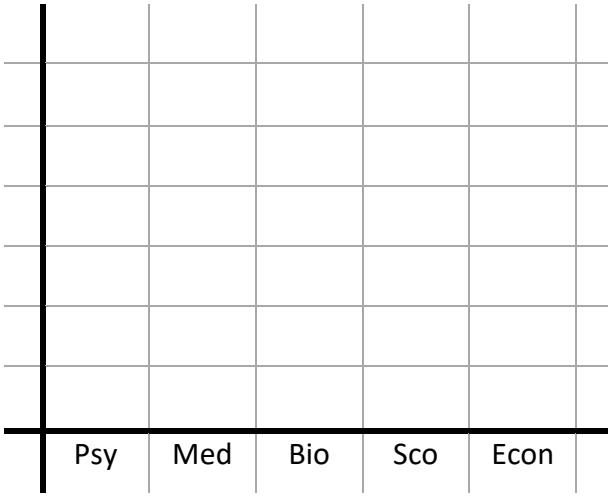
ANOVA's: F (___ , _____) = _____ ,

p-value = _____

Levene's: F (___ , _____) = _____ ,

p-value = _____

η^2=



Based on the **HOV test**, for which DV should you consider **performing an <u>alternative</u>** ANOVA test?

For whichever DV yield a **p value between .05 and .10,** report its results as a **trend**. For whichever DV yield a **p value less than .05**, calculate the corresponding value of **eta squared** (formula 12.10) and report the **ANOVA results**, along with the **means for the groups**, in **APA style.**

12 C	3. HOV assumption & APA results	Code: R notebook

Repeat exercise 2 after using **dplyr::filter()** to **eliminate** all of the psychology and premed students.

Math quiz	Stat quiz
ANOVA's: F (___ , _____) = _____ , **p-value = _____**	**ANOVA's: F (___ , _____) = _____ ,** **p-value = _____**
Levene's: F (___ , _____) = _____ , **p-value = _____**	**Levene's: F (___ , _____) = _____ ,** **p-value = _____**
η^2=	**η^2=**

Based on the **HOV test**, for which DV should you consider **performing an <u>alternative</u>** ANOVA test?

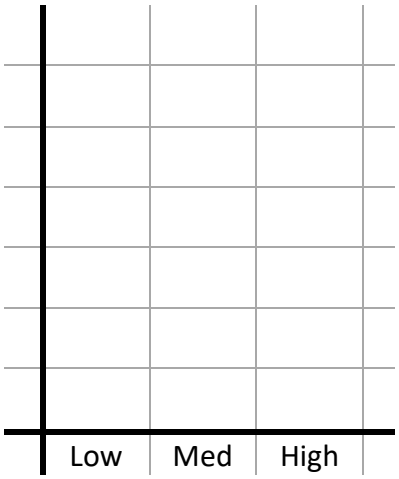
For whichever DV yield a **p value between .05 and .10,** report its results as a **trend**. For whichever DV yield a **p value less than .05**, calculate the corresponding value of **eta squared** (formula 12.10 or the R output ;) and report the **ANOVA results**, along with the **means for the groups**, in **APA style.**

12 C	5. ANOVA APA results	Code: R notebook

Use **dplyr::mutate() & case_when()** to create a grouping variable from phobia, such that group 1 contains those with phobia ratings of 0, 1, or 2; group 2 = 3 or 4; and group 3 = 5 or more (you might call the new variable **phob_group**. Then use **dplyr::mutate()** to create another new variable, **hr_diff**, that equals hr_pre minus hr_base. Perform a **one-way ANOVA** on hr_diff using phob_group as the factor. Request **descriptive** statistics.

Cells = M(SD)

	Low Phobia (n = _____)	Med Phobia (n = _____)	High Phobia (n = _____)
Hear Rate Difference			



ANOVA's: F (___ , _____) = _____ ,

p-value = _____

Levene's: F (___ , _____) = _____ ,

p-value = _____

η^2=

Report your **results in APA style**, including **means** of the three groups. Explain what this ANOVA **demonstrates**, in terms of the variables involved. (formula 12.10or the R output ;)