Psy 420 Final Exam
Fall 06
Ainsworth

Key

Name_____

Psy 420 Final

A researcher is studying the effect of Yoga, Meditation, Anti-Anxiety Drugs and taking Psy 420 and the anxiety levels of the participants. Twenty participants were randomly assigned to one of four treatment groups and each participant was given a measure of anxiety before (CV) and after (DV) the treatment.

	Yoga		Meditation		Drugs		Psy 420	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
	11	7	10	7	12	10	13	11
	10	5	11	8	11	10	13	13
	11	6	13	8	12	11	11	11
	10	5	11	8	12	12	12	10
	10	5	10	7	12	9	14	13
Sum	52	28	55	38	59	52	63	58
Mean	10.4	5.6	11	7.6	11.8	10.4	12.6	11.6

$T_x = 229$
$T_y = 176$
$\Sigma X^2 = 2649$
$\Sigma Y^2 = 1676$
$\Sigma XY = 2062$
$GM_x = 11.45$
$GM_y = 8.8$

1. Perform a BG ANCOVA on the data above. Include a summary table of the adjusted SS/MS and a test of significance for the effect. (35 points)

$$SS_A = \frac{28^2+38^2+52^2+58^2}{5} - \frac{176^2}{20} = 1659.2 - 1548.8 = 110.4$$

$$SS_{S/A} = 1676 - 1659.2 = 16.8$$

$$SS_{Total} = 1676 - 1548.8 = 127.2$$

$$SS_{A(x)} = \frac{52^2+55^2+59^2+63^2}{5} - \frac{229^2}{20} = 2635.8 - 2622.05 = 13.75$$

$$SS_{S/A(x)} = 2649 - 2635.8 = 13.2$$

$$SS_{Total(x)} = 2649 - 2622.05 = 26.95$$

$$SP_{Total} = 2062 - \frac{176(229)}{20} = 2062 - 2015.2 = 46.8$$

$$SP_{S/A} = 2062 - \frac{52(28)+55(38)+59(52)+63(58)}{5} = 2062 - 2053.6 = 8.4$$

$$SS'_A = 110.4 - \left[\frac{46.8^2}{26.95} - \frac{8.4^2}{13.2}\right] = 110.4 - [81.27 - 5.35] = 110.4 - [75.92] = 34.48$$

$$SS'_{S/A} = 16.8 - \frac{8.4^2}{13.2} = 16.8 - 5.35 = 11.45$$

Source	SS	df	MS	F
A'	34.48	3	11.493	15.06
S/A'	11.45	15	0.763	
CV		1		
Total'	45.93	19		

Fcrit(3,25) = 2.99, since 25.09 > 2.99, reject h0.

2. Calculate the adjusted means for each group. (5 points)

$$B_{S/A} = \frac{8.4}{13.2} = .6363$$

$$\bar{Y}'_{yoga} = 5.6 - .6363(10.4 - 11.45) = 5.6 - .6363(-1.05) = 5.6 + .67 = 6.27$$

$$\bar{Y}'_{meditation} = 7.6 - .6363(11 - 11.45) = 7.6 - .6363(-.45) = 7.6 + .29 = 7.89$$

$$\bar{Y}'_{drugs} = 10.4 - .6363(11.8 - 11.45) = 10.4 - .6363(.35) = 10.4 - .22 = 10.18$$

$$\bar{Y}'_{420} = 11.6 - .6363(12.6 - 11.45) = 11.6 - .6363(1.15) = 11.6 - .73 = 10.87$$

3. Remembering that it is an ANCOVA, perform a comparison of Yoga vs. psy 420. (10 points)

$$SS'_{A_{comp}} = \frac{n(\sum w_j \bar{Y}'_j)^2}{\sum w_j^2} = \frac{5\left(1(6.27) - 1(10.87)\right)^2}{1^2 + 1^2} = 52.9$$

$$SS_{A_{comp(x)}} = \frac{n(\sum w_j \bar{X}_j)^2}{\sum w_j^2} = \frac{5\left(1(10.4) - 1(12.6)\right)^2}{1^2 + 1^2} = 12.1$$

$$MS'_{error(A_{comp})} = MS'_{S/A}\left(1 + \frac{SS_{A_{comp(x)}}}{SS_{S/A(x)}}\right) = .763\left(1 + \frac{12.1}{13.2}\right) = 1.46$$

$$F_{A_{comp}} = \frac{SS'_{A_{comp}}}{MS'_{error(A_{comp})}} = \frac{52.9}{1.46} = 36.23$$

Fcrit(1,25)=4.24, since 36.23 > 4.24 reject ho.

4. What is multicollinearity? In the above data, the CV and DV are correlated at about .80. Does this show a problem with multicollinearity? Why, or why not? (5 points)

Any acceptable definition of multicollinearity will do. The .80 is somewhat problematic and is at the bottom range of what would be indicative of multicollinear variables.

5. What is homogeneity of regression? Explain it in the context of the above data set (use the IV, CV and DV above). (5 points)

Something like, the slope relating pretest to posttest should be roughly equal across the yoga, meditation, drugs and 420 groups.

Part 2: Output Interpretation

Problem #1

A chef is interested in whether soaking long grain white rice before steaming it will improve the flavor. She creates 4 groups and feeds them white rice that has been soaked for different amounts of time. She randomly assigns 24 participants to eat rice that has been soaked either 5, 10, 15 or 20 minutes (Soaking Time) and has them rate the rice from 1-25 (Rating). In order to control for different levels of liking white rice she asked everyone how often they have eaten rice in the last month (Liking). Results are shown below.

Soaking Time							
a_1 = 5 min		a_2 = 10 min		a_3 = 15 min		a_4 = 20 min	
Liking	Rating	Liking	Rating	Liking	Rating	Liking	Rating
2	4	2	6	10	16	8	12
10	12	16	18	18	22	10	14
10	12	14	18	10	18	14	18
8	12	8	10	12	18	8	12
6	10	10	14	4	12	14	18
4	6	6	10	18	24	16	18

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
SOAKING	1	5 minutes	6
	2	10 minutes	6
	3	15 minutes	6
	4	20 minutes	6

Descriptive Statistics

Dependent Variable: RATING

SOAKING	Mean	Std. Deviation	N
1 5 minutes	9.33	3.502	6
2 10 minutes	12.67	4.844	6
3 15 minutes	18.33	4.274	6
4 20 minutes	15.33	3.011	6
Total	13.92	5.021	24

Levene's Test of Equality of Error Variances[a]

Dependent Variable: RATING

F	df1	df2	Sig.
.922	3	20	.448

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept+LIKING+SOAKING

Tests of Between-Subjects Effects

Dependent Variable: RATING

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	560.910[a]	4	140.228	140.798	.000	.967
Intercept	94.572	1	94.572	94.957	.000	.833
LIKING	296.410	1	296.410	297.615	.000	.940
SOAKING	53.045	3	17.682	17.754	.000	.737
Error	18.923	19	.996			
Total	5228.000	24				
Corrected Total	579.833	23				

a. R Squared = .967 (Adjusted R Squared = .960)

Estimated Marginal Means

1. Grand Mean

Dependent Variable: RATING

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
13.917[a]	.204	13.490	14.343

a. Covariates appearing in the model are evaluated at the following values: LIKING = 9.92.

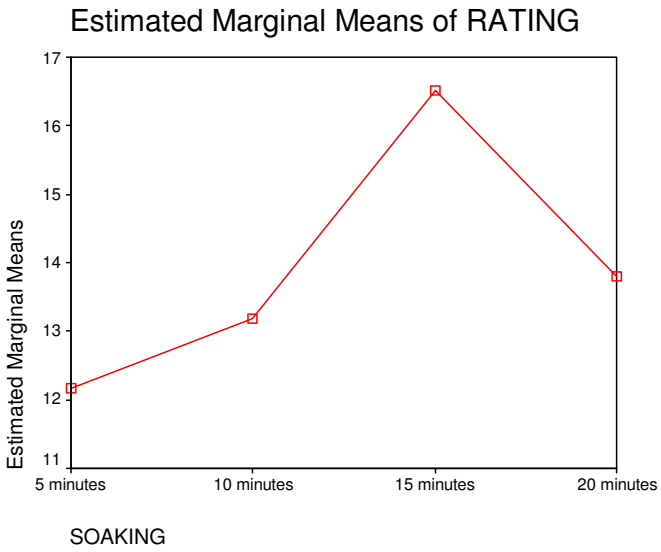
2. SOAKING

Dependent Variable: RATING

SOAKING	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1 5 minutes	12.167[a]	.439	11.247	13.086
2 10 minutes	13.175[a]	.408	12.320	14.030
3 15 minutes	16.517[a]	.421	15.636	17.398
4 20 minutes	13.808[a]	.417	12.935	14.680

a. Covariates appearing in the model are evaluated at the following values: LIKING = 9.92.

Profile Plots



6. Is the covariate significantly adjusting the scores? How do you know? (5 points)

Yes, because the test for liking is significant

7. What are the adjusted means? (5 points)

5 minutes = 12.167, 10 minutes = 13.175, 15 minutes = 16.517, 20 minutes = 13.808

8. Any problems with homogeneity of variance? What is being tested in the Levene's test (what's different than previous analyses)? (5 points)

No problem (it's not significant). It's different in ANCOVA because the test is on the adjusted scores

9. What follow-up tests would you perform? Be specific and include relevant info (means, etc.). (5 points)

Anything that sounds relevant should be OK, they need to have the means and to mention whether they would do

Problem #2

A marketing firm is interested in whether consumers really prefer High Definition televisions over regular TVs and if the size of the TV makes a difference as well. They randomly select 10 people and have 5 of them watch regular TVs (19, 32 and 54 inches) and 5 watch high definition TVs (19, 32 and 54 inches). The firm decides to control for the amount of hours the person watches TV per week. Results are shown below.

	CV	Television Size		
	Hours TV/Week	19’	32’	54’
Regular	7	2	8	7
	8	3	8	6
	8	4	8	5
	11	4	9	8
	13	2	7	9
High Definition	15	9	8	20
	14	10	8	18
	13	8	10	16
	15	12	8	20
	14	11	12	20

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

SIZE	Dependent Variable
1	NINETEEN
2	THIRTY2
3	FIFTY4

Between-Subjects Factors

		Value Label	N
TV_TYPE	1	Regular	5
	2	High Definition	5

Descriptive Statistics

	TV_TYPE	Mean	Std. Deviation	N
NINETEEN	1 Regular	3.00	1.000	5
	2 High Definition	12.60	1.673	5
	Total	7.80	5.224	10
THIRTY2	1 Regular	8.00	.707	5
	2 High Definition	9.20	1.789	5
	Total	8.60	1.430	10
FIFTY4	1 Regular	7.00	1.581	5
	2 High Definition	18.80	1.789	5
	Total	12.90	6.420	10

Mauchly's Test of Sphericity[b]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[a]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
SIZE	.917	.522	2	.770	.923	1.000	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b.
Design: Intercept+HOURS_WK+TV_TYPE
Within Subjects Design: SIZE

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
SIZE	Sphericity Assumed	3.245	2	1.622	.938	.415	.118
	Greenhouse-Geisser	3.245	1.846	1.758	.938	.409	.118
	Huynh-Feldt	3.245	2.000	1.622	.938	.415	.118
	Lower-bound	3.245	1.000	3.245	.938	.365	.118
SIZE * HOURS_WK	Sphericity Assumed	10.178	2	5.089	2.941	.086	.296
	Greenhouse-Geisser	10.178	1.846	5.513	2.941	.092	.296
	Huynh-Feldt	10.178	2.000	5.089	2.941	.086	.296
	Lower-bound	10.178	1.000	10.178	2.941	.130	.296
SIZE * TV_TYPE	Sphericity Assumed	25.633	2	12.817	7.408	.006	.514
	Greenhouse-Geisser	25.633	1.846	13.884	7.408	.008	.514
	Huynh-Feldt	25.633	2.000	12.817	7.408	.006	.514
	Lower-bound	25.633	1.000	25.633	7.408	.030	.514
Error(SIZE)	Sphericity Assumed	24.222	14	1.730			
	Greenhouse-Geisser	24.222	12.924	1.874			
	Huynh-Feldt	24.222	14.000	1.730			
	Lower-bound	24.222	7.000	3.460			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	SIZE	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
SIZE	Linear	.239	1	.239	.169	.694	.024
	Quadratic	3.005	1	3.005	1.473	.264	.174
SIZE * HOURS_WK	Linear	4.458	1	4.458	3.139	.120	.310
	Quadratic	5.720	1	5.720	2.804	.138	.286
SIZE * TV_TYPE	Linear	.106	1	.106	.074	.793	.011
	Quadratic	25.527	1	25.527	12.514	.010	.641
Error(SIZE)	Linear	9.942	7	1.420			
	Quadratic	14.280	7	2.040			

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
NINETEEN	1.051	1	8	.335
THIRTY2	3.747	1	8	.089
FIFTY4	1.263	1	8	.294

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept+HOURS_WK+TV_TYPE
Within Subjects Design: SIZE

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	34.188	1	34.188	15.364	.006	.687
HOURS_WK	2.823	1	2.823	1.269	.297	.153
TV_TYPE	108.599	1	108.599	48.803	.000	.875
Error	15.577	7	2.225			

Estimated Marginal Means

1. Grand Mean

Measure: MEASURE_1

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
9.767[a]	.272	9.123	10.411

a. Covariates appearing in the model are evaluated at the following values: HOURS_WK = 11.80.

2. TV_TYPE

Measure: MEASURE_1

TV_TYPE	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1 Regular	6.440[a]	.549	5.143	7.737
2 High Definition	13.093[a]	.549	11.796	14.391

a. Covariates appearing in the model are evaluated at the following values: HOURS_WK = 11.80.

3. SIZE

Measure: MEASURE_1

SIZE	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	7.800[a]	.463	6.706	8.894
2	8.600[a]	.445	7.549	9.651
3	12.900[a]	.396	11.964	13.836

a. Covariates appearing in the model are evaluated at the following values: HOURS_WK = 11.80.

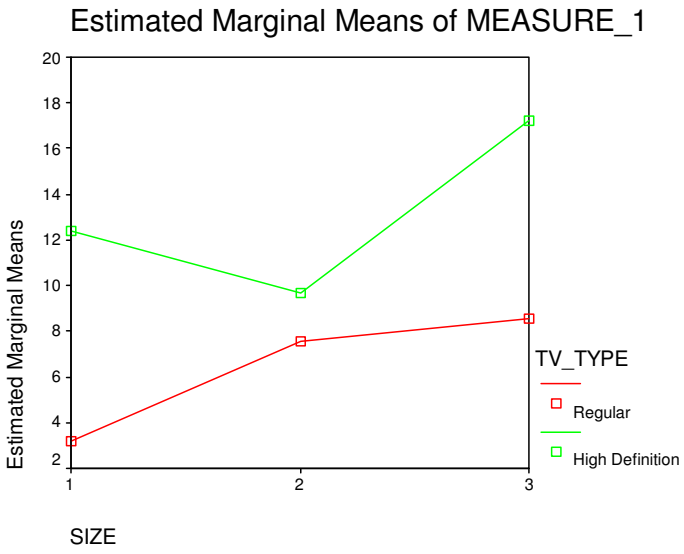
4. TV_TYPE * SIZE

Measure: MEASURE_1

TV_TYPE	SIZE	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1 Regular	1	3.206[a]	.932	1.001	5.410
	2	7.554[a]	.895	5.437	9.672
	3	8.560[a]	.797	6.674	10.446
2 High Definition	1	12.394[a]	.932	10.190	14.599
	2	9.646[a]	.895	7.528	11.763
	3	17.240[a]	.797	15.354	19.126

a. Covariates appearing in the model are evaluated at the following values: HOURS_WK = 11.80.

Profile Plots



10. Is the covariate significantly adjusting the scores? How do you know? (5 points)

No, because hours_wk is not significant

11. What kind of design is this? (5 points)

Mixed

12. Which effects are significant after controlling for the covariate? (6 points)

TV_type and size*TV_type

13. Is there a difference between small and large TVs? How do you know? (8 points

No, because the linear contrast is not significant. Or they could have said no because the effect for TV is not significant

14. Based on the output, is there a problem with any of the assumptions? Explain your answer. (6 points)

The test for sphericity and for homogeneity of variance are all fine.