

EXS 511

MANOVA

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MANOVA

- **Multiple** Analysis of Variance
- Like ANOVA, but can examine combined effect of **multiple** dependent variables
- Several mathematical ways of calculating F (will see these on output)
 - Wilk's lambda (**most commonly reported**)
 - Pillai's trace (best for **small sample sizes**)
 - Hotelling's trace
 - Roy's largest root

If significant, then what?

- If find significance, need to do follow-up Univariate ANOVA's
 - Identifies which independent variables contribute to the overall results
 - Can correct for multiple ANOVA's using Bonferroni correction ($\alpha/\#DV$)

Data considerations when using MANOVA

- Check for multicollinearity
- DV – continuous or discrete; if related it should be linear
- # of cases per cell > # DV
- Check for homogeneity
- Normal distributions
- If equal sample sizes of sufficient number of subjects – ok
 - Do outlier check

MANOVA SPSS data, p. 442

- Examining fear of crime (explained p. 300)
- One independent variable – 3 levels
 - Group 1 – victim multiple times
 - Group 2 – victim once
 - Group 3 – never been a victim
- Three dependent variables
 - # of security measures (doors/windows)
 - # times/week out on own
 - Subjective report of crime anxiety (0-20)
- HYP: difference b/w groups in overall fear of crime

SPSS

- File name: manova.sav
- Perform MANOVA
 - Check for multicollinearity
 - Analyze→Correlate→Bivariate
 - Check for normalcy
 - Analyze→Descriptives (skewness)
 - Run Manova
 - Analyze→GLM→Multivariate
- Review Output
- See p. 305 in SPSS manual on how to report results

Check for Homogeneity

Box's Test of Equality of Covariance Matrices

Box's M	9.965
F	.694
df1	12
df2	3532.846
Sig.	.759

Not significant, so have not violated assumption

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept+group

Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
security	.678	2	27	.516
outings	.369	2	27	.695
report	.456	2	27	.638

For each dependent variable

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

a. Design: Intercept+group

Multivariate Tests^a

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.984	513.563 ^b	3.000	25.000	.000	.984
	Wilks' Lambda	.016	513.563 ^b	3.000	25.000	.000	.984
	Hotelling's Trace	61.628	513.563 ^b	3.000	25.000	.000	.984
	Roy's Largest Root	61.628	513.563 ^b	3.000	25.000	.000	.984
group	Pillai's Trace	.919	7.375	6.000	52.000	.000	.460
	Wilks' Lambda	.101	17.906 ^b	6.000	50.000	.000	.682
	Hotelling's Trace	8.713	34.852	6.000	48.000	.000	.813
	Roy's Largest Root	8.690	75.312 ^b	3.000	26.000	.000	.897

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept+group

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	security	1.900 ^a	2	.950	.224	.801	.016
	outings	58.400 ^b	2	29.200	7.860	.002	.368
	report	305.267 ^c	2	152.633	49.002	.000	.784
Intercept	security	554.700	1	554.700	138.036	.000	.836
	outings	456.300	1	456.300	122.833	.000	.820
	report	4489.833	1	4489.833	1447.360	.000	.982
group	security	1.800	2	.900	.224	.801	.016
	outings	58.400	2	29.200	7.860	.002	.368
	report	305.267	2	152.633	49.002	.000	.784
Error	security	198.699	27	7.359			
	outings	100.300	27	3.715			
	report	84.100	27	3.115			
Total	security	665.000	30				
	outings	615.000	30				
	report	4879.000	30				
Corrected Total	security	110.300	29				
	outings	158.700	29				
	report	389.367	29				

a. R Squared = .016 (Adjusted R Squared = -.057)

b. R Squared = .368 (Adjusted R Squared = .321)

c. R Squared = .784 (Adjusted R Squared = .768)

With Bonferroni adjustment ($\alpha=.05/3$) then need $p<.017$ for sign. Only outings and report measures differed significantly

SPSS

- File name: manova.sav
- Perform MANOVA
- Review Output
- See p. 305 in SPSS manual on how to report results
- Then add post hoc findings, if necessary

For Next Week

- Quiz on Regression and Chi Square
 - Part B problem will be on REGRESSION
- Next Monday's office hours changed to 1:30 – 3:00 pm
- Read athletic training MANOVA study and be ready to discuss.

Read over article

- Athletic Training MANOVA article
- Emailed to you as pdf file
- Muscle Temperature is Affected by Overlying Adipose when Cryotherapy is Administered
- Purpose
- Independent variable
- Dependent variables
- Statistical results
- Conclusions