

Research and Design, Statistics

Answers for practical lesson 4, June 2nd and 4th, 2010

1. You want to statistically test which of three chairs provides the highest degree of "Satisfaction".
 - a. Which type of research design is used in this study?
→ Between-group design
 - b. What is H(0) and H(a)?
→ H(0): There are no significant differences between chairs with respect to satisfaction.
H(a): The three chairs differ with respect to satisfaction.
 - c. Fill in the ANOVA-table without using SPSS.

$$SS_T: \sum(x_i - x_{grand})^2 ; df_T = n - 1$$

$$SS_B \text{ (model): } \sum n_k (x_k - x_{grand})^2 ; df_M = k - 1$$

$$SS_R \text{ (residual or error): } \sum (x_{ik} - x_k)^2 ; df_R = n - k$$

Grand mean: 3.5; $m_{chair1} = 2.0$; $m_{chair2} = 6.0$; $m_{chair3} = 3.0$;

ANOVA-table

	Sum of Squares	df	Mean Square	F
Between-goups	28.5	2	14.25	16.63
Within-groups	6.0	7	0.857	
Total	34.5	9		

- d. Explain in your own words what the F-value in the ANOVA-table calculates.
→ F is the ratio of variation between conditions and within conditions, i.e., the model and the error variance. It represents the goodness of the model fit, when assuming that variance between conditions are equal. (Significance means the model is **not fitting**. Consequently, there are significant differences.)
- e. Does this F-value represent a significant difference? What is the critical value?
→ Yes. The F-value is significant on the 1%-level. The critical value is 9.55
- f. Prepare a SPSS dataset using these data and check your answers.

ANOVA

satisfaction	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	28,500	2	14,250	16,625	,002
Within Groups	6,000	7	,857		
Total	34,500	9			

Research and Design, Statistics – Practical Lesson 4

2. Satisfaction with four office chairs among the same respondents.

- a. Which type of research design is used in this study?
→ Repeated-measures design
- b. Which statistical analysis can be used to analyze this research question?
→ Repeated measures ANOVA
- c. Which conclusion can be drawn based on the Within-subjects effects table?

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
factor1	Sphericity Assumed	41,750	3	13,917	20,875	,000
	Greenhouse-Geisser	41,750	1,285	32,487	20,875	,005
	Huynh-Feldt	41,750	1,630	25,611	20,875	,002
	Lower-bound	41,750	1,000	41,750	20,875	,010
Error(factor1)	Sphericity Assumed	8,000	12	,667		
	Greenhouse-Geisser	8,000	5,141	1,556		
	Huynh-Feldt	8,000	6,521	1,227		
	Lower-bound	8,000	4,000	2,000		

→ Satisfaction is significantly different across the four chair designs.

- d. Which conclusion can be drawn based on the post-hoc comparison table?

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	chair	Type III Sum of Squares	df	Mean Square	F	Sig.
chair	Level 1 vs. Level 4	51,200	1	51,200	18,963	,012
	Level 2 vs. Level 4	3,200	1	3,200	16,000	,016
	Level 3 vs. Level 4	1,800	1	1,800	1,385	,305
Error(chair)	Level 1 vs. Level 4	10,800	4	2,700		
	Level 2 vs. Level 4	,800	4	,200		
	Level 3 vs. Level 4	5,200	4	1,300		

→ Chair designs 1 and 4, and 2 and 4 differ significantly.

- e. Which of the four concepts would you choose based on these results?
→ Concept 1.

3. Analyze whether the four 5-fingershoes in your dataset differ with respect to the variable 'comfortable'.

a. Perform the analysis of variance in SPSS.

Test of Homogeneity of Variances

liking the product

Levene Statistic	df1	df2	Sig.
,395	3	108	,757

ANOVA

liking the product

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	28,745	3	9,582	3,955	,010
Within Groups	261,675	108	2,423		
Total	290,420	111			

b. Which conclusion can be drawn based on the Levene test?

→ The non-significant Levene test indicates that variances across designs are similar (i.e., homogeneous).

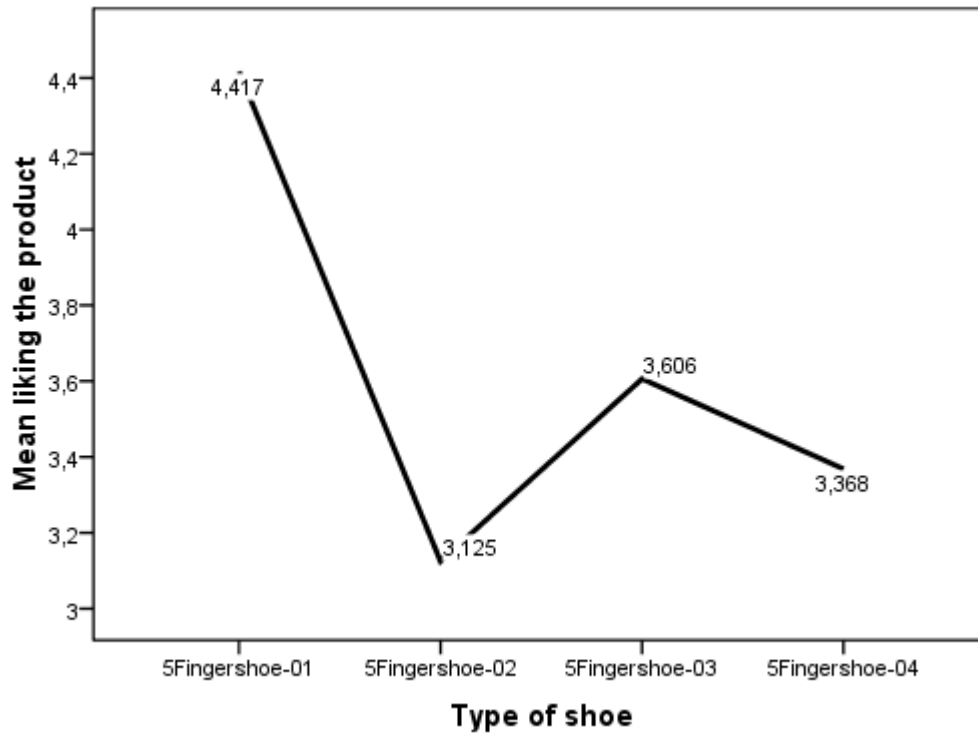
c. Which conclusion can be drawn based on the ANOVA table?

→ The significant F-ratio indicates that the four shoe designs differ significantly in the degree of liking.

d. Do a planned contrast to compare the four designs. What do you conclude?

Step 1: Graphical representation of means for each design.

Step 2: Choose the most different design as Condition A to be tested against the rest.



Planned contrast 1: Shoe-01 versus combination of (Shoe-02, Shoe-03, Shoe-04)

	Shoe-01	Shoe-02	Shoe-03	Shoe-04
Weights	3	-1	-1	-1

Contrast Tests

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
liking the product	Assume equal variances	1	3,15	,953	3,307	108	,001
	Does not assume equal variances	1	3,15	,960	3,282	67,515	,002

→ *Significance of planned contrast 1*: Liking of Shoe-01 is significantly higher than the group of the other three shoe designs.

Planned contrast 2: Shoe-03 versus combination of (Shoe-02 and Shoe-04)

	Shoe-01	Shoe-02	Shoe-03	Shoe-04
Weights	0	-1	2	-1

Contrast Tests

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
liking the product	Assume equal variances	1	,72	,723	,995	108	,322
	Does not assume equal variances	1	,72	,727	,988	65,217	,327

→ *Non-significance of planned contrast 2:* Liking of the three remaining designs Shoe-02, Shoe-03, and Shoe-04 are not significantly different.

Conclusion: Shoe-01 is the best liked of the four. Liking of the remaining three designs is similar.

e. Do a post hoc test to compare the four designs. What do you conclude?

Multiple Comparisons

liking the product Bonferroni

(I) type of shoe	(J) type of shoe	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
5Fingershoe-01	5Fingershoe-02	1,292 [*]	,410	,013	,19	2,39
	5Fingershoe-03	,811	,375	,197	-,20	1,82
	5Fingershoe-04	1,048	,441	,116	-,14	2,23
5Fingershoe-02	5Fingershoe-01	-1,292 [*]	,410	,013	-2,39	-,19
	5Fingershoe-03	-,481	,418	1,000	-1,60	,64
	5Fingershoe-04	-,243	,478	1,000	-1,53	1,04
5Fingershoe-03	5Fingershoe-01	-,811	,375	,197	-1,82	,20
	5Fingershoe-02	,481	,418	1,000	-,64	1,60
	5Fingershoe-04	,238	,448	1,000	-,97	1,44
5Fingershoe-04	5Fingershoe-01	-1,048	,441	,116	-2,23	,14
	5Fingershoe-02	,243	,478	1,000	-1,04	1,53
	5Fingershoe-03	-,238	,448	1,000	-1,44	,97

*. The mean difference is significant at the 0.05 level.

Conclusion: Shoe-01 is the best liked of the four. Liking of the remaining three designs is similar.

f. Which of the four shoes would you choose based on these results?

→ The choice is Shoe-01.

5. You assume that *liking* of a product is influenced by a combination of design and color. Test whether liking differs for design, color, or their interaction.

a. What are your independent and dependent variables?

- Independent variables: shoe design, color
- Dependent variable: liking

b. What design is it? Which test do you choose?

- Design: factorial ANOVA with between-subject design
- Test: univariate ANOVA

c. Run the test in SPSS.

Between-Subjects Factors

		Value Label	N
type of shoe	1	5Fingershoe-01	36
	2	5Fingershoe-02	24
	3	5Fingershoe-03	33
	4	5Fingershoe-04	19
color of shoe	1	black	37
	2	green	39
	3	gray	36

Tests of Between-Subjects Effects

Dependent Variable:liking the product

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	45,741 ^a	11	4,158	1,699	,084
Intercept	1321,349	1	1321,349	540,034	,000
shoe	23,356	3	7,785	3,182	,027
color	2,387	2	1,193	,488	,615
shoe * color	14,010	6	2,335	,954	,460
Error	244,679	100	2,447		
Total	1843,000	112			
Corrected Total	290,420	111			

a. R Squared = ,157 (Adjusted R Squared = ,065)

Conclusion: The main effect for shoe design is significant. The main effect for color and the interaction effect of shoe and color are not significant.

- d. Present your results graphically.
You can use the 'plots' submenu in the main menu with 'shoe' for horizontal axis and 'color' as separate lines.

