

# Chapter 14

## Column Proportions for Testing Differences Between Outcome Scores (450 Patients)

### General Purpose

In the Chap. 10 the relationship between treatment modality and quality of life (qol) score levels were assessed using a chi-square test of the interaction matrix. Many high qol scores were in the hydrotherapy and physiotherapy treatments, and in the subgroup that received counseling the overall differences from other treatments were statistically significant at  $p < 0.0001$ . In this chapter, using the same data, we will try and test what levels of qol scores were significantly different from one another, and, thus, provide a more detailed about differences in effects.

### Specific Scientific Question

Can the effects of different treatment modalities on outcome score levels previously assessed with a chi-square test of the interaction matrix, be assessed with better precision applying column proportion comparisons using Bonferroni-adjusted z-tests?

### Example

A parallel group study of 450 patients assessed the effect of different complementary treatment modalities on qol score levels. The first 11 patients of the data file is underneath. The entire data file is entitled “qol.sav”, and is in [extras.springer.com](http://extras.springer.com).

treatment	counseling	qol	satdoctor
3	1	4	4
4	0	2	1
2	1	5	4
3	0	4	4
2	1	2	1
2	0	1	4
4	0	4	1
3	0	4	1
4	1	4	4
2	1	3	4
4	1	5	5

treatment = treatment modality (1 = cardiac fitness, 2 = physiotherapy, 3 = wellness, 4 = hydrotherapy)  
 counseling = counseling given (0 = no, 1 = yes)  
 qol = quality of life scores (1 = very low, 5 = very high)  
 satdoctor = satisfaction with treating doctor (1 = very low, 5 = very high)

We will start by opening the data file in SPSS.

**Command:**

Analyze....Descriptive Statistics....Crosstabs....Row(s): enter treatment....Column(s): enter qol....click Cells....mark Observed....mark Columns....mark: Compare column properties....mark: Adjusted p-values (Bonferroni method)....click Continue....click OK.

			Qol score					Total
			Very low	Low	Medium	High	Very high	
Treatment	Cardiac fitness	Count	21 <sub>a</sub>	21 <sub>a</sub>		24 <sub>a</sub>	36 <sub>a</sub>	118
		% within qol score	24,4 %	28,8 %	22,5 %	22,0 %	32,4 %	26,2 %
	Physiotherapy	Count	22 <sub>a</sub>	20 <sub>a</sub>	18 <sub>a</sub>	20 <sub>a</sub>	20 <sub>a</sub>	100
		% within qol score	25,6 %	27,4 %	25,4 %	18,3 %	18,0 %	22,2 %

(continued)

Treatment * qol score crosstabulation								
			Qol score					Total
			Very low	Low	Medium	High	Very high	
	Wellness	Count	22 <sub>a</sub>	14 <sub>a</sub>	12 <sub>a</sub>	30 <sub>a</sub>	25 <sub>a</sub>	104
		% within qol score	26,7 %	19,2 %	16,9 %	27,5 %	22,5 %	23,1 %
	Hydrotherapy	Count	20 <sub>a</sub>	18 <sub>a</sub>	25 <sub>a</sub>	35 <sub>a</sub>	30 <sub>a</sub>	128
		% within qol score	23,3 %	24,7 %	35,2 %	32,1 %	27,0 %	28,4 %
Total		Count	86	73	71	109	111	450
		% within qol score	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %

\* Symbol of multiplication

Each subscript letter denotes a subset of qol score categories whose column proportions do not differ significantly from each other at the .05 level

The above table is in the output sheets. All of the counts in the cells are given with the subscript letter a.

The interpretation of the subscript letters are pretty obvious:

looking in a single row	
a vs a	p>0.10
a vs a,b	0.05 < p < 0.10
a vs b	p < 0.05
a vs c	p < 0.01
a vs d	p < 0.001
b vs a,b	0.05 < p < 0.10

This means, that, in the above table, none of the counts is significantly different from one another. This is consistent with the insignificant chi-square test of Chap. 16. We have clinical arguments that counseling may support the beneficial effects of treatments, and, therefore, perform an analysis with two layers, one in the patients with and one in those without counseling.

**Command:**

Analyze....Descriptive Statistics....Crosstabs....Row(s): enter treatment.... Column(s): enter qol....Layer 1 of 1: enter counseling....click Cells....mark Observed....mark Columns....mark: Compare column properties....mark: Adjusted p-values (Bonferroni method)....click Continue....click OK.

Treatment * qol score * counseling crosstabulation									
Counseling				Qol score					Total
				Very low	Low	Medium	High	Very high	
No	Treatment	Cardiac fitness	Count	19	16	8	8	14	65
			% within qol score	29,2 %	34,8 %	26,7 %	20,0 %	28,6 %	28,3 %
		Phototherapy	Count	8	8	7	7	15b	45
			% within qol score	12,3 %	17,4 %	23,3 %	17,5 %	30,6 %	19,6 %
		Wellness	Count	23	8	6	15	9	61
			% within qol score	35,4 %	17,4 %	20,0 %	37,5 %	18,4 %	26,5 %
		Hydrotherapy	Count	15	14	9	10	11	59
			% within qol score	23,1 %	30,4 %	30,0 %	25,0 %	22,4 %	25,7 %
	Total		Count	65	46	30	40	49	230
			% within qol score	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %
Yes	Treatment	Cardiac fitness	Count	2	5	8	16	22	53
			% within qol score	9,5 %	18,5 %	19,5 %	23,2 %	35,5 %	24,1 %
		Physiotherapy	Count	14	12	11	13	5	55
			% within qol score	66,7 %	44,4 %	26,8 %	18,8 %	8,1 %	25,0 %
		Wellness	Count	0	6	6	15	16	43
			% within qol score	,0 %	22,2 %	14,6 %	21,7 %	25,8 %	19,5 %
		Hydrotherapy	Count	5	4	16	25	19	69
			% within qol score	23,8 %	14,8 %	39,0 %	36,2 %	30,6 %	31,4 %
	Total		Count	21	27	41	69	62	220
			% within qol score	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %

\*Symbol of multiplication

The above table is now shown. It gives the computations for the patients previously counseled separately. Now differences particularly in the patients counseled were larger.

In the cardiac fitness row the very low and very high qol cells the percentages of patients present are 9.5 and 23.2 % (significantly different at  $p < 0.05$  Bonferroni adjusted), and “very low” versus the three scores in between have a trend to significance  $0.05 < p < 0.10$ . The same is true with “very high” versus (vs) the three scores in between. In the physiotherapy row differences were even larger. In the physiotherapy row we have:

1. both 14 vs 11 and 11 vs 5 significantly different at  $p < 0.05$
2. 14 vs 12, 12 vs 11, 11 vs 13, 13 vs 5 with a trend to significantly different at  $0.05 < p < 0.10$ .

Similarly, in the wellness and hydrotherapy rows significant differences and trends to significance were observed.

In the no-counseling patients differences were smaller, but some trends, and two significant differences at  $p < 0.05$  (a vs b) were, nonetheless, observed.

In conclusion, only in the physiotherapy row the low qol fraction is large, in the other three the high qol fractions are large. And so, with respect to qol physiotherapy does not perform very well, and may better be skipped from the program.

Note: Bonferroni adjustment for multiple testing works as follows. In order for p-values to be significant, with two tests they need to be smaller than 0.025, with four tests smaller than 0.0125, with ten tests smaller than 0.005, etc.

## **Conclusion**

When assessing the outcome effects of different treatments, column proportions comparisons of interaction matrices can be applied to precisely find what outcome scores are significantly different from one another. This may provide relevant information about some treatment modalities, and may give cause for some treatment modalities to be skipped.

## **Note**

More background, theoretical and mathematical information of interaction matrices is given in Statistics applied to clinical studies 5th edition, Chap. 3, The analysis of safety data, pp 41–59, Springer Heidelberg Germany, 2012, from the same authors, and in the Chaps. 10–13 of this work.