

Chapter 43

Repeated Measures Binary Data (Cochran's Q Test), (139 Patients)

1 General Purpose

With repeated observations in one patient, the paired property of the observations has to be taken into account because of the, generally, positive correlation between paired observations in one person. with two repeated observations Mc Nemar's test is adequate (Chap. 41). However, with three or more observations Cochran's Q test should be applied.

2 Schematic Overview of Type of Data File

Outcome binary	outcome binary	outcome binary
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.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.

3 Primary Scientific Question

Is there a significant difference between the numbers of responders who have been treated differently three times.

4 Data Example

In 139 patients three treatments are given in a three period crossover design. The scientific question was: is there a significant difference between the numbers of responders who have been treated differently three times.

Treatment 1	Treatment 2	Treatment 3
,00	,00	,00
,00	,00	1,00
,00	,00	1,00
,00	,00	1,00
,00	,00	1,00
,00	,00	,00
,00	1,00	,00
,00	1,00	1,00
,00	1,00	1,00
,00	,00	1,00

0 = no responder, 1 = yes responder

The above table gives three paired observations in each patient (each row). The paired property of these observations has to be taken into account, because of the, generally, positive correlation between paired observations. Cochran’s Q test is appropriate for that purpose.

5 Analysis: Cochran’s Q Test

The data file is in extras.springer.com, and is entitled “chapter43repeatedmeasuresbinary”. Start by opening the data file in SPSS. For analysis the statistical model K Related Samples in the module Nonparametric Tests is required.

Command:

Analyze...Nonparametric Tests...Legacy Dialogs...K Related Samples...mark Cochran’s Q...Test Variables: treat 1, treat 2, treat 3....click OK.

Frequencies

	Value	
	0	1
Treat 1	93	46
Treat 2	75	64
Treat 3	67	72

Test statistics	N	139
	Cochran's Q	10,133 ^a
	df	2
	Asymp. Sig.	,006

^a0 is treated as a success

The above tables, in the output sheets show that the test is, obviously, highly significant with a p-value of 0,006. This means, that there is a significant difference between the treatment responses. However, we do not yet know where: between the treatments 1 and 2, 2 and 3, or between 1 and 3. For that purpose three separate McNemar's tests have to be carried out.

6 Subgroups Analyses with McNemar's Tests

Command:

Analyze....Nonparametric Tests....Legacy Dialogs....2 Related Samples....mark McNemar....Test Pairs; Pair 1....Variable 1: enter treat 1....Variable 2: enter treat 2....click OK.

Test statistics ^a		Treat 1 & treat 2
	N	139
	Chi-square ^b	4,379
	Asymp. Sig.	,036

^aMcNemar Test

^bContinuity Corrected

The above output table shows that the difference between treatment 1 and 2 is statistically significant at $p = 0,036$. Subsequently, treatment 1 and 3, and 2 and 3 have to be tested against one another.

Test statistics ^a		Treat 1 & treat 3
	N	139
	Chi-square ^b	8,681
	Asymp. Sig.	,003

^aMcNemar Test

^bContinuity Corrected

Test statistics ^a		Treat 2 & treat 3
	N	139
	Chi-square ^b	,681
	Asymp. Sig.	,409

^aMcNemar Test

^bContinuity Corrected

The above three separate McNemar's tests show, that there is no difference between the treatments 2 and 3, but there are significant differences between 1 and 2, and 1 and 3. If we adjust the data for multiple testing, for example, by using $p=0,01$ instead of $p=0,05$ for rejecting the null-hypotheses, then the difference between 1 and 2 loses its significance, but the difference between treatment 1 and 3 remains statistically significant.

7 Conclusion

With repeated observations in one patient, the paired property of the observations has to be taken into account. With two repeated observations Mc Nemar's test is adequate. However, with three or more observations Cochran's Q test should be applied.

8 Note

McNemar's test for comparing two repeated binary outcomes is reviewed in the Chap. 41.