Chapter 40
Trend Tests for Binary Data (106 Patients)

1 General Purpose

Trend tests are wonderful, because they provide markedly better sensitivity for demonstrating incremental effects from incremental treatment dosages, than traditional statistical tests. In the Chap. 15 trend tests for continuous outcome data are reviewed. In the current chapter trend tests for binary outcome data are assessed.

2 Schematic Overview of Type of Data File

Outcome binary	predictor
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3 Primary Scientific Question

Do incremental dosages of a medicine cause incremental numbers of patients to become responders.

T.J. Cleophas, A.H. Zwinderman, *SPSS for Starters and 2nd Levelers*,
DOI 10.1007/978-3-319-20600-4_40

4 Data Example

In a 106 patient study the primary scientific question was: do incremental dosages of an antihypertensive drug cause incremental numbers of patients to become normotensive. The entire data file is in extras.springer.com, and is entitled "chapter40trendbinary".

Responder	Treatment
1,00	1,00
1,00	1,00
1,00	1,00
1,00	1,00
1,00	1,00
1,00	1,00
1,00	1,00
1,00	1,00
1,00	1,00
1,00	1,00
1,00	2,00

responder: normotension 1, hypertension 0
treatment: incremental treatment dosages 1–3

5 A Contingency Table of the Data

The underneath contingency table shows that with incremental dosages the odds of responding rises from 0.67 to 1.80.

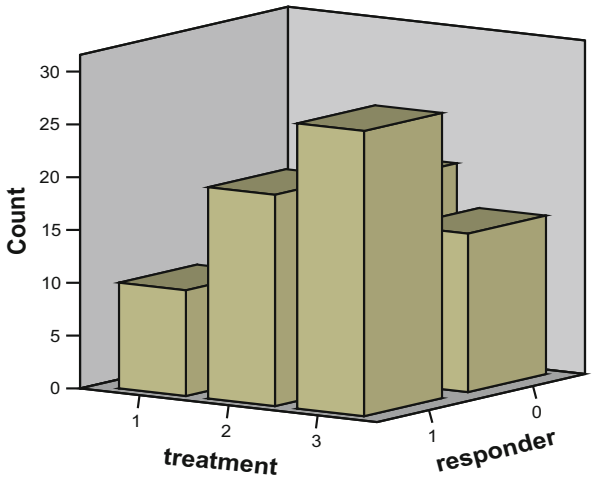
	Dosage 1	Dosage 2	Dosage 3
Numbers responders	10	20	27
Numbers non-responders	15	19	15
Odds of responding	0.67(10/15)	1.11(20/19)	1.80(27/15)

First, we will try and summarize the data in a graph. Start by opening the data file in SPSS.

6 3-D Bar Charts

Command:

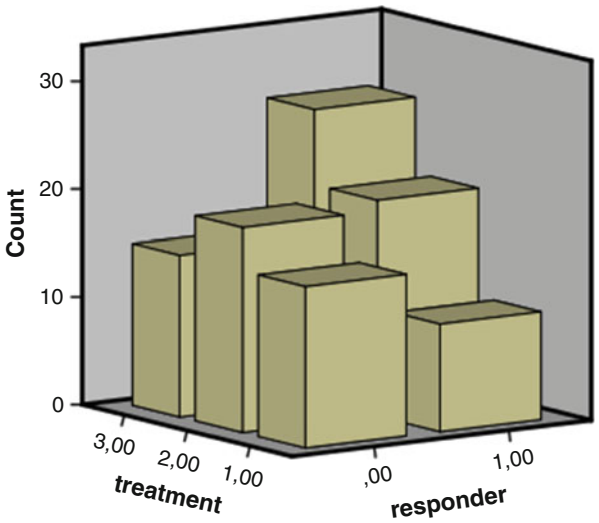
Graphs....Legacy Dialogs....3-D Bar Charts....X-axis represents....mark Groups of cases....Z-axis represents....mark Groups of cases....click Define....X Category Axis: treatment....Z Category Axis: responders....click OK.



The above graph is shown in the output sheets. The treatment-1-responder-0 bar is invisible.

Command:

Double-click the graph in order to activate it....“Chart Editor” comes up....click Rotating 3-D chart....3-D Rotation....Horizontal: enter 125....the underneath graph comes up showing the magnitude of the treatment-1-responder-zero bar.



The above two graphs show, that incremental treatment dosages of an antihypertensive drug seem to cause incremental numbers of responders (patients becoming normotensive). However, the numbers of non-responders are the controls, and their pattern is, equally, important. We, first, will perform a multiple groups chi-square test in order to find out, whether there is any significant difference in the data.

7 Multiple Groups Chi-Square Test

For analysis the statistical model Crosstabs in the module Descriptive Statistics is required.

Command:
Analyze....Descriptive Statistics....Crosstabs....Row(s): responder....Column(s): treatment....Statistics....Chi-Square Tests....click OK.

Chi-square tests

	Value	df	Asy mp. Sig. (2-sided)
Pearson chi-square	3,872[a]	2	,144
Likelihood ratio	3,905	2	,142
Linear-by-linear association	3,829	1	,050
N of valid cases	106		

[a]0 cells (,0%) have expected count less than 5. The minimum expected count is 11,56

The above table shows that, indeed, the Pearson chi-square value for multiple groups testing is not significant with a chi-square value of 3,872 and a p-value of 0,144, and we have to conclude that there is, thus, no significant difference between the odds of responding to the three dosages.

8 Chi-Square Test for Trends

Subsequently, a chi-square test for trends can be executed, a test, that, essentially, assesses, whether the above odds of responding (number of responder/numbers of non-responders per treatment group) increase significantly. The "linear-by-linear association" from the same table is appropriate for the purpose. It has approximately the same chi-square value, but it has only 1 degree of freedom, and, therefore, it reaches statistical significance with a p-value of 0,050. There is, thus, a significant incremental trend of responding with incremental dosages.

Chi-square tests

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N of valid cases	106		

[a]0 cells (,0%) have expected count less than 5. The minimum expected count is 11,56

The trend in this example can also be tested using logistic regression with responding as outcome variable and treatment as independent variable (enter the latter as covariate, not as categorical variable).

9 Conclusion

Trend tests provide markedly better sensitivity for demonstrating incremental effects from incremental treatment dosages, than traditional statistical tests. In the Chap. 16 trend tests for continuous outcome data are reviewed. In the current chapter trend tests for binary outcome data are assessed.

10 Note

More background, theoretical, and mathematical information of trend testing is given in Statistics applied to clinical studies 5th edition, Chap. 27, Springer Heidelberg Germany, 2012, from the same authors.