Chapter 35
Unpaired Binary Data (Chi-Square Test, 55 Patients)

1 General Purpose

2×2 Crosstabs, otherwise called 2×2 contingency table or 2×2 interaction matrices, are data file that consist of two binary variables, one outcome and one predictor variable. They are used to assess whether one treatment or the presence of one particular patient characteristic is at risk of a particular outcome. The methodology is very popular in clinical research. E.g., safety assessments of new medicines make often use of it.

2 Schematic Overview of Type of Data File

Outcome binary	predictor binary
.	.
.	.
.	.
.	.
.	.
.	.
.	.

3   Primary Scientific Question

Is a treatment or the presence of a particular patient-characteristic at risk of a particular outcome.

4   Data Example

In 55 hospitalized patients the risk of falling out of bed was assessed. The question to be answered was: is there a significant difference between the risk of falling out of bed at the departments of surgery and internal medicine. The first 10 patients of the 55 patient file is underneath.

Fall out of bed	Department
1,00	,00
1,00	,00
1,00	,00
1,00	,00
1,00	,00
1,00	,00
1,00	,00
1,00	,00
1,00	,00
1,00	,00

fall out bed 0 = no, 1 = yes
department 0 = surgery, 1 = internal medicine

5   Crosstabs

The data file is in extras.springer.com, and is entitled "chapter35unpairedbinary".
   We will start by opening the data in SPSS. For analysis the statistical model Crosstabs in the module Descriptive Statistics is required.

Command:
Analyze....Descriptive   Statistics....Crosstabs....Row(s):   enter   department....
   Column(s): enter falloutofbed....click OK.

Department * falloutofbed crosstabulation
Count

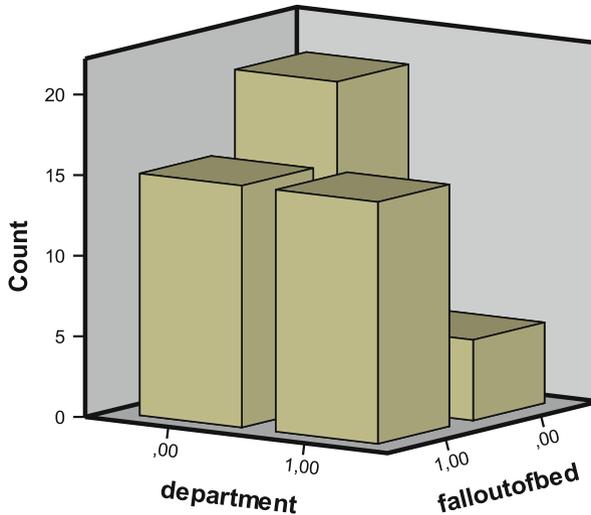|		Falloutofbed		
		,00	1,00	Total
Department	,00	20	15	35
	1,00	5	15	20
Total		25	30	55

The output sheet shows a 2×2 contingency table. It shows that at both departments the same numbers of patients fall out of bed. However, at the department of surgery many more patients do *not* fall out of bed than at the internal department.

6   3-D Bar Chart

Next we will try and draw a three dimensional graph of the data.

Command:
Graphs....3-d Bar Charts....X-axis represents: mark Groups of Cases....Z-axis represents: mark Group of Cases....click Define....X-Category Axis: enter department....Z-Category Axis: enter falloutofbed....click OK.

The above graph is in the output. At both departments approximately the same numbers of patients fall out of bed. However, at department-0 (surgery) many more patients do not fall out of bed than at department-1 (internal medicine).

7   Statistical Analysis: Chi-Square Test

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

Command:

Analyze....Descriptive Statistics....Crosstabs....Row(s): enter department.... Column(s): enter falloutofbed....click Statistics....mark Chi-square....click Continue....click OK.

Chi-square tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5,304[a]	1	,021		
Continuity Correction[b]	4,086	1	,043		
Likelihood Ratio	5,494	1	,019		
Fisher's Exact Test				,027	,021
Linear-by-Linear Association	5,207	1	,022		
N of Valid Cases	55				

[a]0 cells (,0 %) have expected count less than 5. The minimum expected count is 9,09
[b]Computed only f or a 2×2 table

The above chi-square test (Pearson Chi-Square) table shows that a significant difference between the surgical and internal departments exists in patterns of patients falling out of bed. The p-value equals 0,021, and this is much smaller than 0,05. Several contrast tests are given in the table. They produce approximately similar p-values. This supports the accuracy of the chi-square test for these data.

8   Conclusion

2×2 Crosstabs consist of two binary variables, one outcome and one predictor variable. They are used to assess whether the presence of one particular patient characteristic is at risk of a particular outcome. The methodology is very popular in clinical research. E.g., safety assessments of new medicines make often use of it.

9   Note

More background, theoretical, and mathematical information of binary data and crosstabs is given in Statistics applied to clinical studies 5th edition, Chap. 3, Springer Heidelberg Germany, 2012, from the same authors.