

Chapter 47

Poisson Regression for Binary Outcomes (52 Patients)

1 General Purpose

Poisson regression cannot only be used for counted rates but also for binary outcome variables. Poisson regression of binary outcome data is different from logistic regression, because it uses a log instead of logit (log odds) transformed dependent variable. It tends to provide better statistics.

2 Schematic Overview of Type of Data File

Outcome	predictor	weight
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.

3 Primary Scientific Question

Can Poisson regression be used to estimate the presence of an illness. Presence means a rate of 1, absence means a rate of 0. If each patient is measured within the same period of time, no weighting variable has to be added to the model. Rates of

0 or 1, do, after all, do exist in practice. We will see how this approach performs as compared to the logistic regression, traditionally, used for binary outcomes. The data file is below.

4 Data Example

In 52 patients with parallel-groups of two different treatments the presence or not of torsades de pointes was measured. The first ten patients of the data file given below. The entire data file is entitled chapter47poissonbinary, and is in extras.springer.com. We will start by opening the data file in SPSS.

```
Treat  Presence of torsade de pointes.
,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    1,00
```

5 Data Analysis, Binary Logistic Regression

First, we will perform a traditional binary logistic regression with torsade de pointes as outcome and treatment modality as predictor.

For analysis the statistical model Binary Logistic Regression in the module Regression is required.

Command:

```
Analyze...Regression...Binary Logistic...Dependent: torsade...Covariates:
treatment...click OK.
```

Variables in the equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 ^a	VAR00001	1,224	,626	3,819	1	,051	3,400
	Constant	-,125	,354	,125	1	,724	,882

^aVariable(s) entered on step 1: VAR00001

The above table shows that the treatment is not statistically significant. A Poisson regression will be performed subsequently.

6 Data Analysis, Poisson Regression

For analysis the module Generalized Linear Models is required. It consists of two submodules: Generalized Linear Models and Generalized Estimation Models. The first submodule covers many statistical models like gamma regression (Chap. 30), Tweedie regression (Chap. 31), Poisson regression (Chaps. 21 and the current chapter), and the analysis of data files with both paired continuous outcomes and predictors (Chap. 3). The second is for analyzing paired binary outcomes (Chap. 42).

Command:

Analyze...Generalized Linear Models...Generalized Linear Models ...mark Custom...Distribution: Poisson ...Link Function: Log...Response: Dependent Variable: torsade... Predictors: Factors: treat...click Model...click Main Effect: enter "treat"...click Estimation: mark Robust Tests...click OK.

Parameter estimates

Parameter	B	Std. error	95 % Wald confidence interval		Hypothesis test		
			Lower	Upper	Wald chi-square	df	Sig.
(Intercept)	-,288	,1291	-,541	-,035	4,966	1	,026
[VAR00001=,00]	-,470	,2282	-,917	-,023	4,241	1	,039
[VAR00001 = 1,00]	0 ^a						
(Scale)	1 ^b						

Dependent Variable: torsade

Model: (Intercept), VAR00001

^aSet to zero because this parameter is redundant

^bFixed at the displayed value

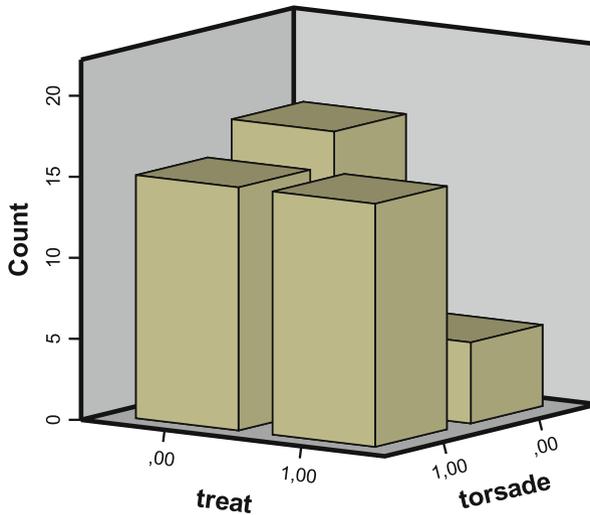
The above table shows the results of the Poisson regression. The predictor treatment modality is statistically significant at $p = 0.039$. According to the Poisson model the treatment modality is a significant predictor of torsades de pointes.

7 Graphical Analysis

We will check with a 3-dimensional graph of the data if this result is in agreement with the data as observed.

Command:

Graphs...Legacy Dialog...3-D Bar: X-Axis mark: Groups of Cases, Z-Axis mark: Groups of Cases...Define 3-D Bar: X Category Axis: treatment, Z Category Axis: torsade...OK.



The above graph shows that in the 0-treatment (placebo) group the number of patients with torsades de pointe is virtually equal to that of the patients without. However, in the 1-treatment group the number is considerably smaller. The treatment seems to be efficacious.

8 Conclusion

Poisson regression is different from linear en logistic regression, because it uses a log transformed dependent variable. For the analysis of yes/no rates Poisson regression is very sensitive and probably better than standard regression methods. The methodology is explained.

9 Note

More background, theoretical and mathematical information about Poisson regression is given in *Statistics applied to clinical studies* 5th edition, Chap. 23, Springer Heidelberg Germany, 2012, from the same authors.