Chapter 28
Non-linear Modeling on a Pocket Calculator

1 General Purpose

Non-linear relationships in clinical research are often linear after logarithmic transformations. Odds ratios, log likelihood ratios, Markov models and many regression models are models that make use of it. An example with real data is given. We have to add that logarithmic transformation is not always successful, and that alternative methods are available like Box Cox transformation, and computationally intensive methods like spline and Loess modeling (see Chap. 24. In: Statistics Applied to Clinical Studies, Springer New York, 5th edition, 2012, and Chap. 14 of SPSS for Starters Part 2, Springer New York, 2012, both from the same authors). However, these methods generally require statistical software and can not be executed on a pocket calculator. This chapter assesses simply logarithmic transformation of the outcome variable for linearization of survival data.

2 Schematic Overview of Type of Data File

Outcome	Predictor
.	.
.	.
.	.
.	.
.	.
.	.
.	.
.	.

(continued)

T.J. Cleophas, A.H. Zwinderman, *Clinical Data Analysis on a Pocket Calculator*,
DOI 10.1007/978-3-319-27104-0_28

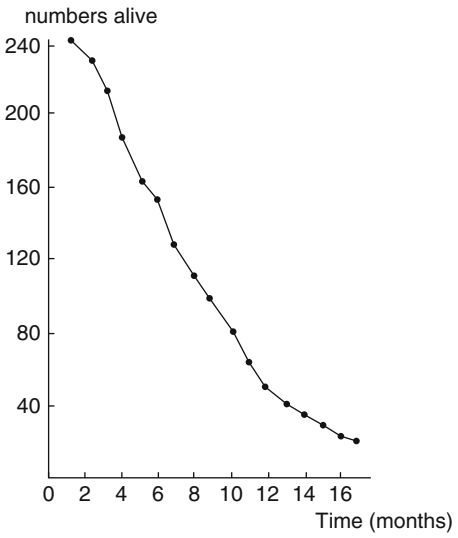
Outcome	Predictor
.	.

3 Primary Scientific Question

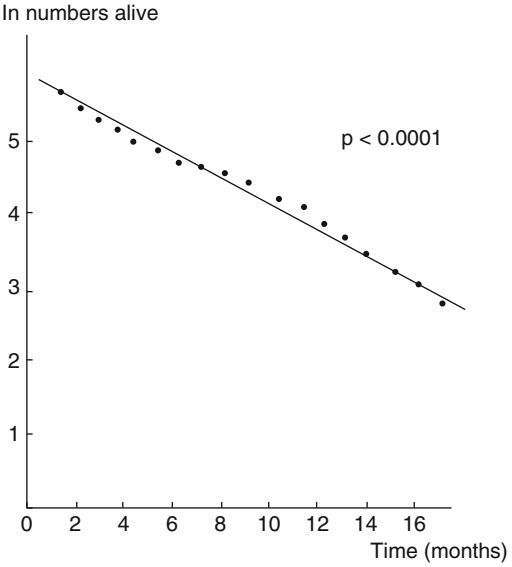
Can logarithmic transformation of survival data linearize survival patterns.

4 Data Example

The underneath figure shows the survivals of 240 patients with small cell carcinomas.



The underneath figure shows the natural logarithms of these survivals. It can be observed that logarithmic transformation of the numbers of patients alive readily produces a close to linear pattern.



The equation of the above regression line of the data $y = a + bx$ with $a =$ intercept and $b =$ regression coefficient can be calculated from a pocket calculator.

5 Calculation of Linear Regression Parameters from a Pocket Calculator

Some pocket calculators offer linear regression. An example is given (see also Chap. 8).

x-values	y-values
Temp (°C)	Atmospheric pressure (hpa)
10	1003
15	1005
20	1010
25	1011
30	1014

Electronic Calculator (see Chap. 1) can be used for the purpose.

Press:
on. . ..mode. . ..3. . ..1. . ..10. . ., ...1003. . ..M+ . . ..15. . .., ... 1005. . .. M+ . . ...
etc. . ...M+....shift....s-var....▶....▶....1.....a is given. . ..shift....s-var ....▶....▶
....2.....b is given. . .. shift....s-var....▶....▶....3.....r is given. . ..

Interpretation of a, b and r.: a is the intercept of the best fit regression line with equation $y = a + bx$; b is the regression coefficient, otherwise called direction coefficient of the regression line; r is Pearson's correlation coefficient, it runs from -1 to $+1$, 0 means no relationships between x and y, -1 and $+1$ mean a very strong negative and positive relationship respectively.

6 Conclusion

Non-linear relationships in clinical research are often linear after logarithmic transformations. Odds ratios, log likelihood ratios, Markov models and many regression models are models that make use of it. An example with real data is given. We have to add that logarithmic transformation is not always successful, and that alternative methods are available. However, these alternative methods, generally, require statistical software, and can not be executed on a pocket calculator.

7 Note

More background, theoretical and mathematical information is given in Statistics Applied to Clinical Studies, Springer New York, 5th edition, Chap. 24, 2012, and SPSS for Starters Part 2, Springer New York, 2012, Chap. 14, both from the same authors.