Intelligent Data Analysis Summer 2013
C. Braune

Exercise Sheet 10

Exercise 36 Logistic Regression

The following table shows the number of American intercontinental ballistic missiles (ICBMs) in the years from 1960 to 1969:

year, x	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
number, y	18	63	294	424	834	854	904	1054	1054	1054

Find a best fit curve for this data set using logistic regression ($Y = 1060$)! Draw the original data and sketch the curve $y = \frac{1060}{1+e^{a+bx}}$!

Additional Exercise Exponential Regression

Radioactive substances decay according to the law $N(t) = N_0 e^{-\lambda t}$, where t is the time, λ a substance-specific decay parameter, N_0 the number of atoms of the substance at the beginning and $N(t)$ the number of remaining atoms at time point t. With the help of Geiger–Müller counter the following values n were measured for the number of α particles that were emitted by a small amount of a radioactive substance up to different time points t:

t (in s)	0	30	60	90	120	150	180	210	240
n	0	306	552	655	768	863	901	919	956

Each counted α particle indicates that one atom of the radioactive substance decayed. Determine the half-life of the radioactive substance! What element is this substance?

Procedure: Find a best fit curve $n = n_0(1 - e^{a+bt})$!
(Hint: You have to find a transformation that reduces the problem to the problem of finding a best fit line (regression line); $n_0 = 1000$.) Although the value for a may differ from zero with this approach, $-b$ may be seen as an approximation of the decay parameter λ, from which the half-life can easily be determined. The half-life of a substance is the time after which only half of the originally present atoms remain.

Additional Exercise

An additional exercise will be given during class to be solved then.