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.