Exercise 36  Logistic Regression

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

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>number, y</td>
<td>18</td>
<td>63</td>
<td>294</td>
<td>424</td>
<td>834</td>
<td>854</td>
<td>904</td>
<td>1054</td>
<td>1054</td>
<td>1054</td>
</tr>
</tbody>
</table>

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, \(\lambda\) 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 \(t\):

<table>
<thead>
<tr>
<th>(t) (in s)</th>
<th>0</th>
<th>30</th>
<th>60</th>
<th>90</th>
<th>120</th>
<th>150</th>
<th>180</th>
<th>210</th>
<th>240</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n)</td>
<td>0</td>
<td>306</td>
<td>552</td>
<td>655</td>
<td>768</td>
<td>863</td>
<td>901</td>
<td>919</td>
<td>956</td>
</tr>
</tbody>
</table>

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 \(\lambda\), 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.
Exercise 37  Frequent Itemset Mining

Please use the Apriori algorithm for solving this exercise!

a) Find the frequent/maximal/closed item sets for the following transaction vector and $s_{min} = 3$:

```
1:  a  d  f
2:  b  d
3:  b  c
4:  b  d  e
5:  c  d  f
6:  a  c  d  e
7:  b  c  d
8:  a  b  d
9:  b  c  e  g
10: a  b  d
```

b) Find an example of a transaction database for which the number of maximal item sets goes down if the minimum support is reduced; or explain in some other way why it is possible that the number of maximal item sets can also become smaller if the minimum support is reduced.