05b_least_squares

October 16, 2019

1 Least squares

The following is an example from Lecture 06.

The result of census of the population of Switzerland between 1900 and 2010 (in thousands) is summarized in the following table:

year	population
1900	3315
1910	3753
1920	3880
1930	4066
1941	4266
1950	4715
1960	5429
1970	6270
1980	6366
1990	6874
2000	7288
2010	7783

- Is it possible to estimate the number of inhabitants of Switzerland during the year when there has not been census, for example in 1945 and 1975?

- Is it possible to predict the number of inhabitants of Switzerland in 2020?

```
[5]: %matplotlib inline
from numpy import *
from matplotlib.pyplot import *

year = array([1900, 1910, 1920, 1930, 1941, 1950, 1960, 1970, 1980, 1990, 2000,␣
 ↪2010])
population = array([3315, 3753, 3880, 4066, 4266, 4715, 5429, 6270, 6366, 6874,␣
 ↪7288, 7783])

assert len(year) is len(population)
n = len(year)
B = matrix([ones(n), year, year**2]).T
```

```
BT = B.T

y = matrix(population).T

a = linalg.solve(BT*B, BT*y)
a0 = float(a[0])
a1 = float(a[1])
a2 = float(a[2])
print(a0, a1, a2)

xx = linspace(1900,2010,100)
f = lambda x: a0 + a1*x + a2*x**2

_ = plot(xx, f(xx))
_ = scatter(year, population, color='r')




print(f(1945))
print(f(1975))
print(f(2020))
```

```
501596.69896291976 -549.8998014613501 0.1513877127640438
4745.087199790636
6051.288177001872
8521.523173396941
```