Tutorial 5

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Exercise: Oxygen saturation

The following data presents the hemoglobin saturation depending on the oxygen pressure:
Oxygen:
x = [3.08, 4.61, 6.77, 10.15, 12.31, 15.38, 18.77, 22.77, 25.85, 30.15, 36.00, 45.23, 51.69, 61.85, 75.38, 87.08, 110.5]
Hemoglobin:
y = [2.21, 3.59, 6.08, 10.50, 14.09, 19.34, 28.45, 40.33, 50.00, 60.50, 69.89, 80.11, 83.98, 88.95, 93.37, 95.86, 98.07]

Fit the data to the formula

$$Y = 100 \cdot \frac{\sum_{j=0}^{4} j\alpha_j [O_2]^j}{4 \cdot \sum_{j=0}^{4} \alpha_j [O_2]^j} \tag{1}$$

for the portion Y of occupied Hemoglobin binding sites.

Implementation:

- Define a function `oxygen(x, a)` that computes the model prediction Y from oxygen levels $[O_2]$, denoted by x and values α_j, denoted by a.
- Define a function `optim(x, y, a)` to fit the parameters α to the data, use `curve_fit()` from LsqFit within.
- Generate a plot showing the data points, the model prediction prior to optimization and after optimization.
- Calculate and plot for different length of j (j=0:4, j=0:3, j=0.2). What is the difference? What is the maximal degree j_{max} needed to fit the data accurately?

Cathedral exercise

Episcopal churches have two towers. Freiburg is a diocesan town. Why does the cathedral have only one tower?