Group 3: Regression

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Members: Achka Pieer, Rickayzen Philipp, Würf Jerome, Tauscher Johannes, Popov Tomislav

1. Introduction

- Our data set and model selection are based on the book "The elements of statistical Learning"
- Our group focuses on linear regression problems
- A linear regression model is denoted function as $E(Y|X)$
  - Y is the continuous output space on R
  - X is the input space where an instance is a vector $\mathbf{x}$ containing multiple measurements
- Benefits:
  - The trained models are interpretable
  - Reasonable performance on problems with sparse or low signal-to-noise data

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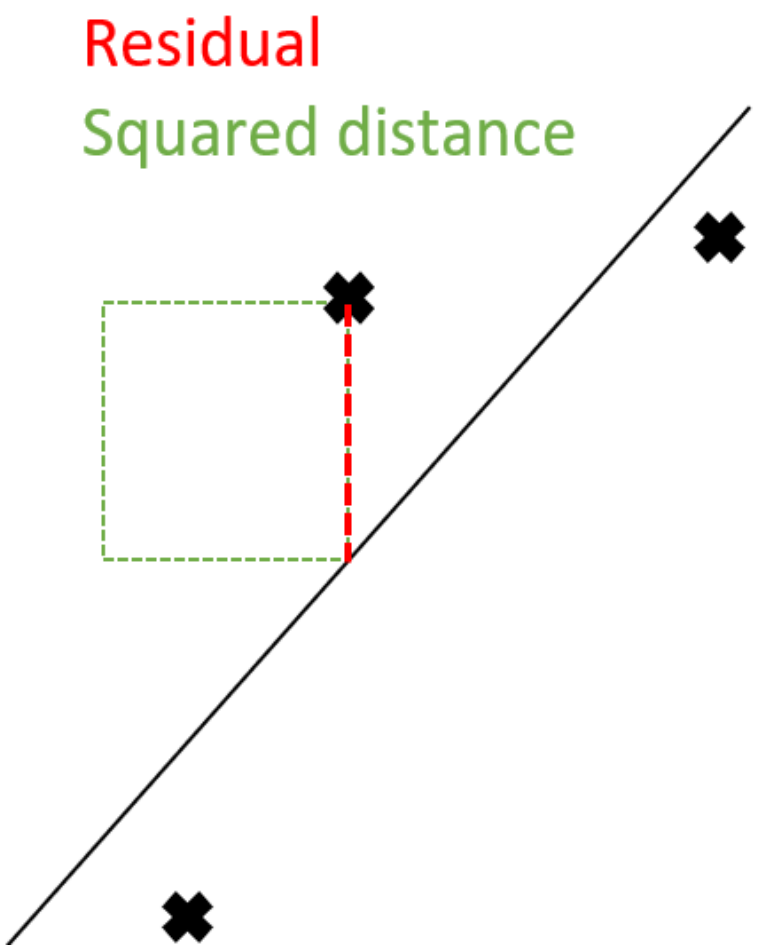
1.i Basic idea behind regression

- $S(a)$: Sum of squared residuals
- $S(a) = \Sigma_{i=1}^{N}(y_i - a^T x_i)^2$
  $= (y - Xa)^t(y - Xa)$
- Optimal line be reducing S(a)
- $a^* = arg\ \min_a S(a) \Rightarrow \nabla S(a) = 0$
- Problems:
  - Heavily influcened by outlies
  - Tends to overfit



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2. Our Dataset

- Generate data set
- TODO: Jonny

3. Comparison of Regression Models

1. Implement models using python libraries
2. Implement selected models from scratch
3. Evaluate and compare the implemented models

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3.i Least Angle

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3.ii Partial Least Squares

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3.iii Ridge Regression

- TODO: Jerome

3.iv Lasso

- TODO: Jerome

3.v Locally Weighted Regression (LWR)

- Linear regression: $S(a) = (y - Xa)^T (y - Xa)$
- weighted regression:
  - certain data points get more weight than others
  - $S(a) = (y - Xa)^T W (y - Xa)$
- Locally weighted regression:
  - Idea: local points weight points in proximity higher
  - in total E independent weighted regressions
  - $S(a) = (y - Xa)^T W_E (y - Xa)$
  - e.g. $w_i = e^{\frac{-(x_i - x)^2}{2\tau^2}}$

3.vi Radial Basis Function Regression (RBFR)

- Idea: transform data into a higher dimension and then perform linear regression
- basis function: depends on distance to centre
- radial basis function: $\phi(x) = \phi(||x||)$
- linearly combine set of linear basis functions
- $S(a) = (y - \Phi(X)w)^T(y - \Phi(X)w)$

4. Evaluation

- TODO: Jerome
- Scores
- Performance test

5. Literature

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