Big idea in data science

Using one algorithm (training algorithm) to train another (model algorithm) on data.

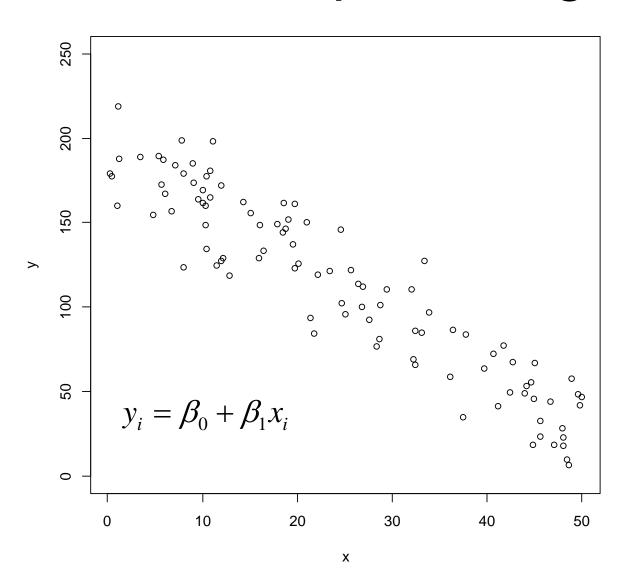
Legendre 1805 - orbits of comets, SSQ.

Model algorithm

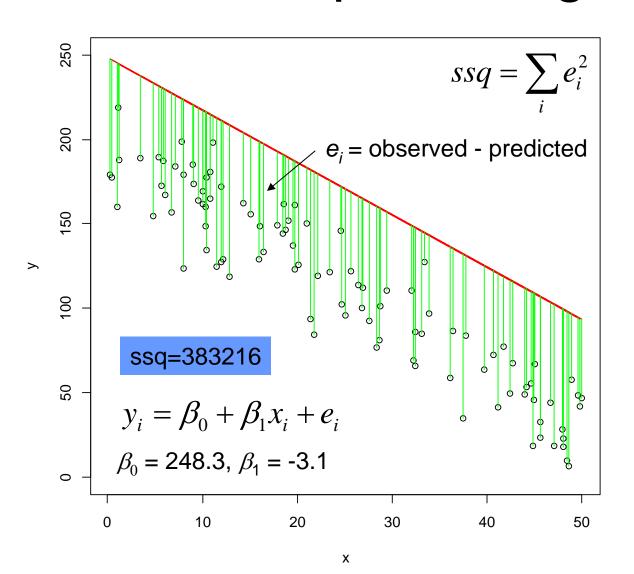


Training algorithm

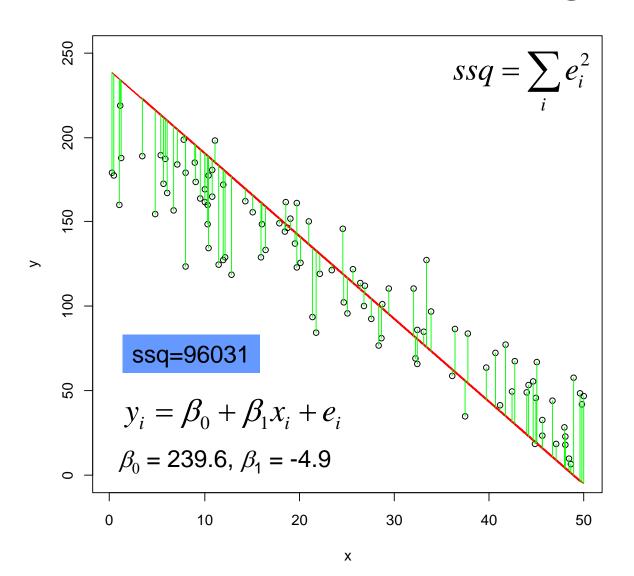
An algorithm to train a model algorithm on data syn. model fitting, calibration



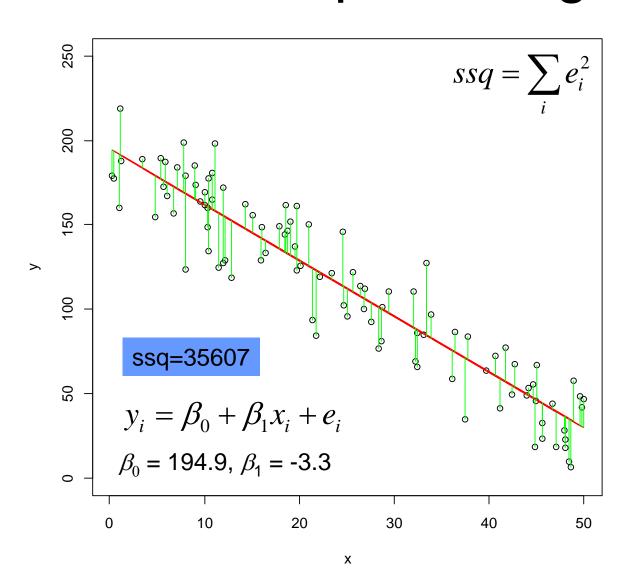
General algorithmic idea:



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General algorithmic idea:

Optimization algorithms

- Systematically try all combinations for β_0 and β_1 Grid search algorithms
- Narrowing in keep changing parameters in the direction that leads to lower SSQ - Descent algorithms
- Try random values for β_0 and β_1 Monte Carlo algorithms
- Solve for parameters using math Analytical or numerical algorithms

Developing an algorithm: an example

Key points:

Pseudocode

3 Phases

Top down refinement

For each value of β_0 For each value of β_1 Calculate sum of squares

Read in data Set up values of β_0 and β_1 to try Set up storage for ssq, β_0 , β_1

For each value of β_0 For each value of β_1 Calculate sum of squares

Store ssq, β_0 , β_1

Plot sum of squares profiles (ssq vs β_0 , ssq vs β_1)

Report best ssq, β_0 , β_1

Plot fitted model with the data

Read in data

Set up values of β_0 and β_1 to try

Set up storage for ssq, β_0 , β_1

For each value of β_0

For each value of β_1

Calculate sum of squares

Store ssq, β_0 , β_1

Plot sum of squares profiles (ssq vs β_0 , ssq vs β_1)

Report best ssq, β_0 , β_1

Plot fitted model with the data

Initialization phase

Calculation phase

Termination phase

Read in data

Set up values of β_0 and β_1 to try

Set up storage for ssq, β_0 , β_1

For each value of β_0

For each value of β_1

Calculate sum of squares

Store ssq, β_0 , β_1

Plot sum of squares profiles (ssq vs β_0 , ssq vs β_1)

Report best ssq, β_0 , β_1

Plot fitted model with the data

Top down refinement

Read in data

Set up values of β_0 and β_1 to try

Set up storage for ssq, β_0 , β_1

For each value of β_0

For each value of β_1

Calculate model predictions

Calculate deviations

Sum squared deviations

Store ssq, β_0 , β_1

Plot sum of squares profiles (ssq vs β_0 , ssq vs β_1)

Report best ssq, β_0 , β_1

Plot fitted model with the data

Top down refinement