The Minimum Description Length Principle

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Minimum Description Length Principle

Rissanen 1978, 1987, 1996,
Barron, Rissanen and Yu 1998

- 'MDL' is a method for inductive inference…
  - machine learning
  - pattern recognition
  - statistics
- …based on ideas from data compression (information theory)
- In contrast to most other methods, MDL automatically deals with overfitting, arguably the central problem in machine learning and statistics

Minimum Description Length Principle

- MDL is based on the correspondence between ‘regularity’ and ‘compression’:
  - The more you are able to compress a sequence of data, the more regularity you have detected in the data
  - Example:

001001001001001001001001:::001

010110111001001110100010101:::010

Minimum Description Length Principle

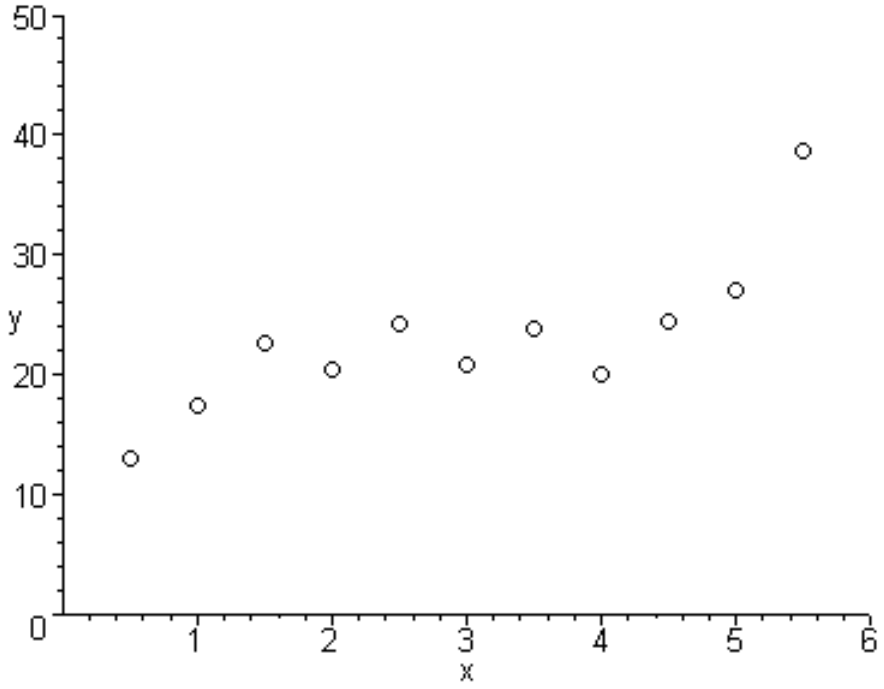
- MDL is based on the correspondence between ‘regularity’ and ‘compression’:
  - The more you are able to compress a sequence of data, the more regularity you have detected in the data…
  - …and thus the more you have learned from the data:
    - ‘inductive inference’ as trying to find regularities in data (and using those to make predictions of future data)

Model Selection/Overfitting

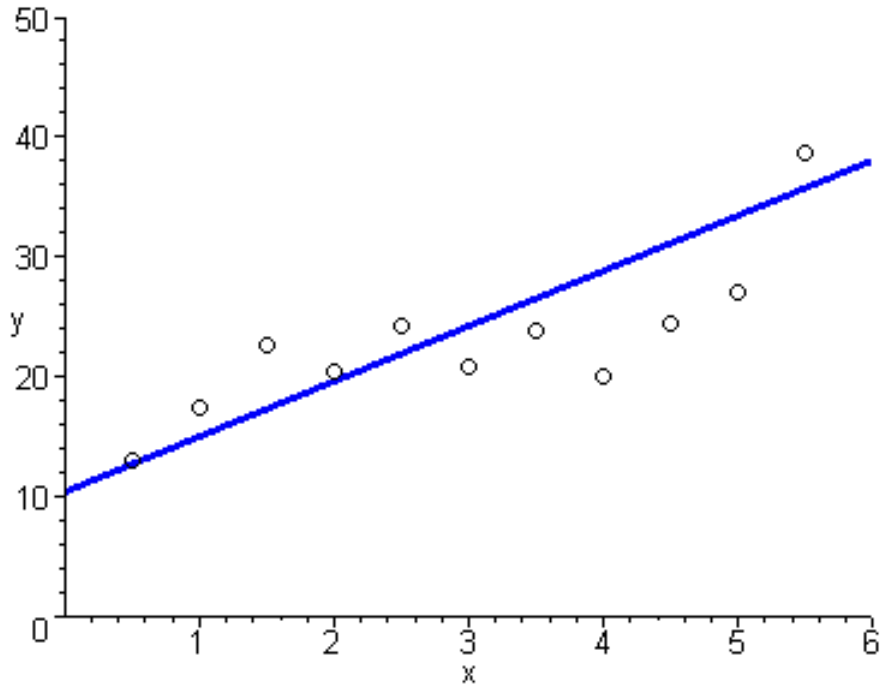
Given data D and hypothesis spaces/models $M_1, M_2 M_3, \ldots$, which model *best explains* the data?

- Need to take into account
  - Complexity of models
  - Error (minus Goodness-of-fit)
- Example:
  - Selecting the degree of a polynomial in regression
  - Sum of squared errors

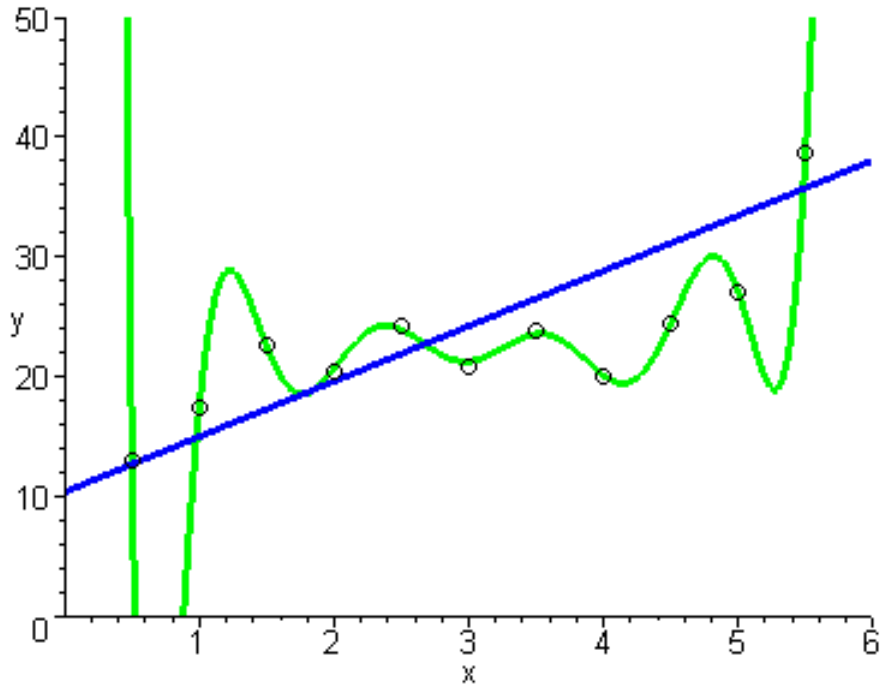
Example: Regression



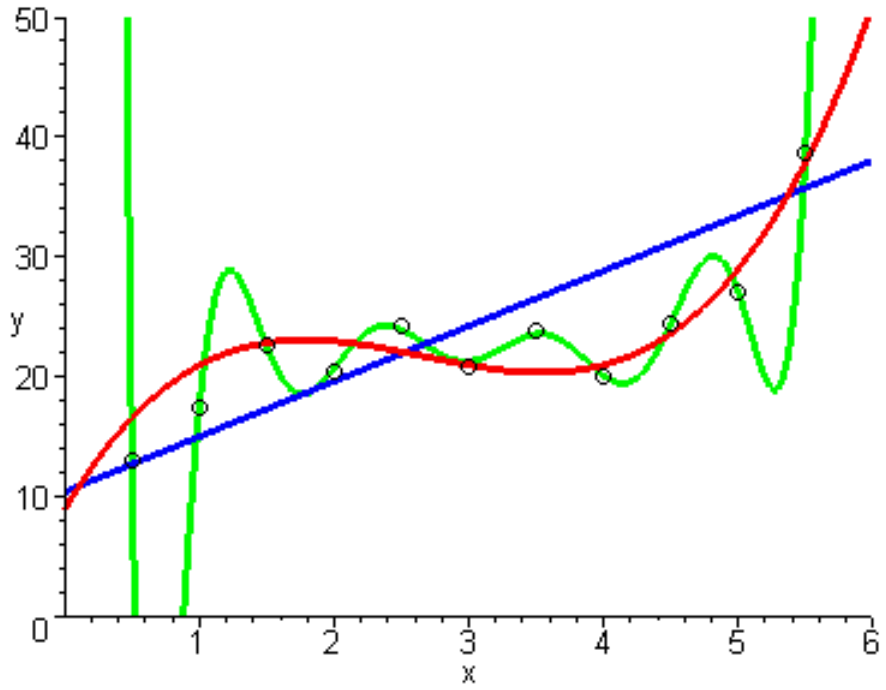
Example: Regression



Example: Regression



Example: Regression



Example: Regression