Problem statement for machine learning

Formal problem statement, an analyst has to set

1) an algebraic structure for the dataset from measurements
2) a data generation hypothesis from 1)
3) a model, or a mixture from 2)
4) an error function (quality criteria with restrictions) from 2)
5) an optimization algorithm from 3) and 4)

The result of the model construction is a Cartesian product

$$\{\textbf{models} \times \textbf{data sets} \times \textbf{quality critea}\}.$$

Def: *Big data rejects the i.i.d. (independent and identically distributed random variables) data generation hypothesis from 2). It requests a mixture model.*

Quality criteria for model generation and selection

Three sources of quality criteria

1. Business: model operation productivity, agent impact to environment
2. Theory: statistical hypothesis, bayesian inference
3. Technology: optimization requirements, resources

The main criteria of model quality

- Precision: MAPE, AUC
- Stability (diversity): std deviation for prediction, covariance of parameters
- Complexity: structure complexity, MDL, evidence of model