**Model Selection**
Sampling : Bootstrap and Cross-validation

Motivations
Three classes of method
Subset Selection
Shrinkage
Dimension Reduction PCA
Summary

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We could improve simple least square regression by variable selection and feature engineering (precisely here it's feature selection).

- Despite its simplicity, the linear model has distinct advantages in terms of its interpretability and often shows good predictive performance.
- Hence we discuss in this lecture some ways in which the simple linear model can be improved, by replacing ordinary least squares fitting with some alternative fitting procedures.

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How to select among the p variables / predictors ?

1. **Subset Selection** : We identify a subset of the p predictors that we believe to be related to the response. We then fit a model using least squares on the reduced set of variables.

2. **Shrinkage** : We fit a model involving all p predictors, but the estimated coefficients are shrunken towards zero relative to the least squares estimates. This shrinkage (also known as **regularization**) has the effect of reducing variance and can also perform variable selection. How to handle variety of datas (see 3V description later)

3. **Dimension Reduction** : We project the p predictors into a M-dimensional subspace, where M < p. This is achieved by computing M different linear combinations, or projections, of the variables. Then these M projections are used as predictors to fit a linear regression model by least squares.

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image Yann Le Cun ML cake

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- These methods refit a model of interest to samples formed from the training set, in order to obtain additional information about the fitted model.

- For example, they provide estimates of test-set prediction error, and the standard deviation and bias of our parameter estimates

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