STATISTICAL LEARNING - INTRODUCTION

统计学习

课程介绍

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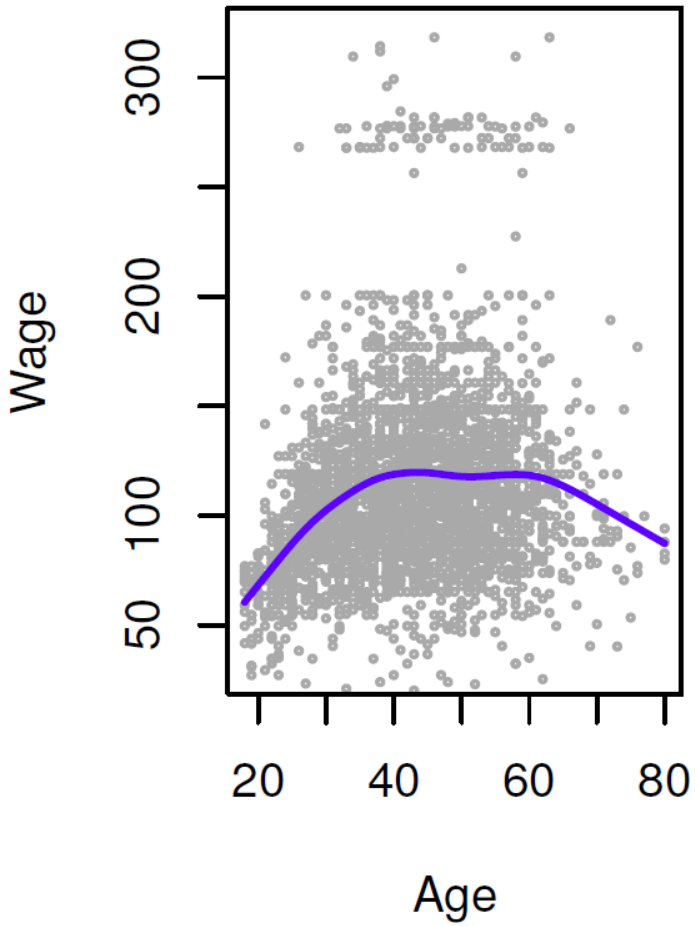
Outline

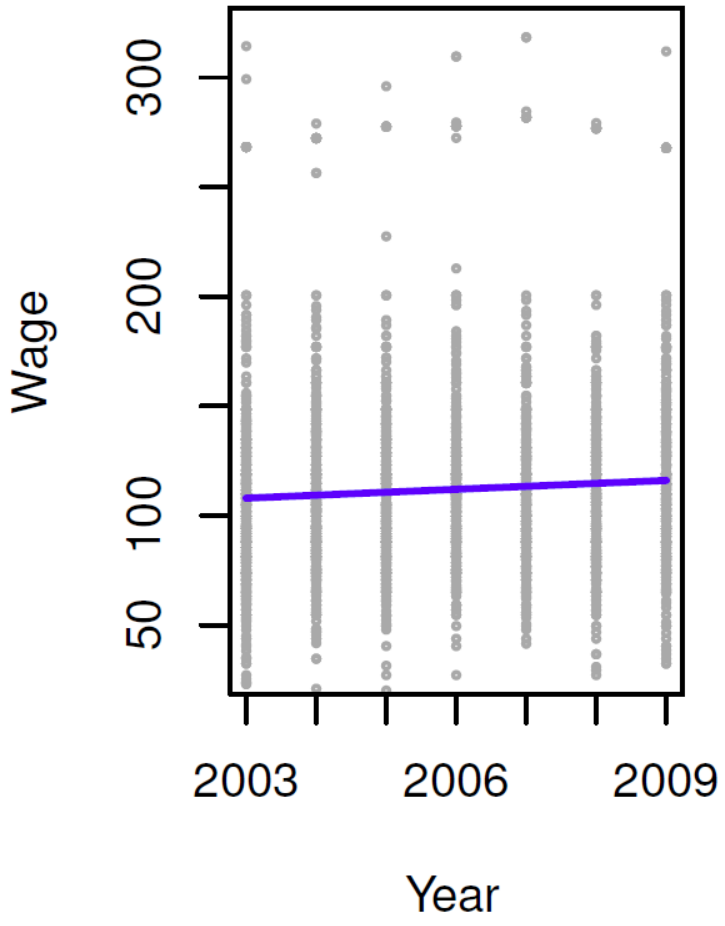
- An overview of statistical learning
- Schedules (教学安排)
- Grading policy (考核方法)
- Textbooks & references
- A brief history of statistical learning

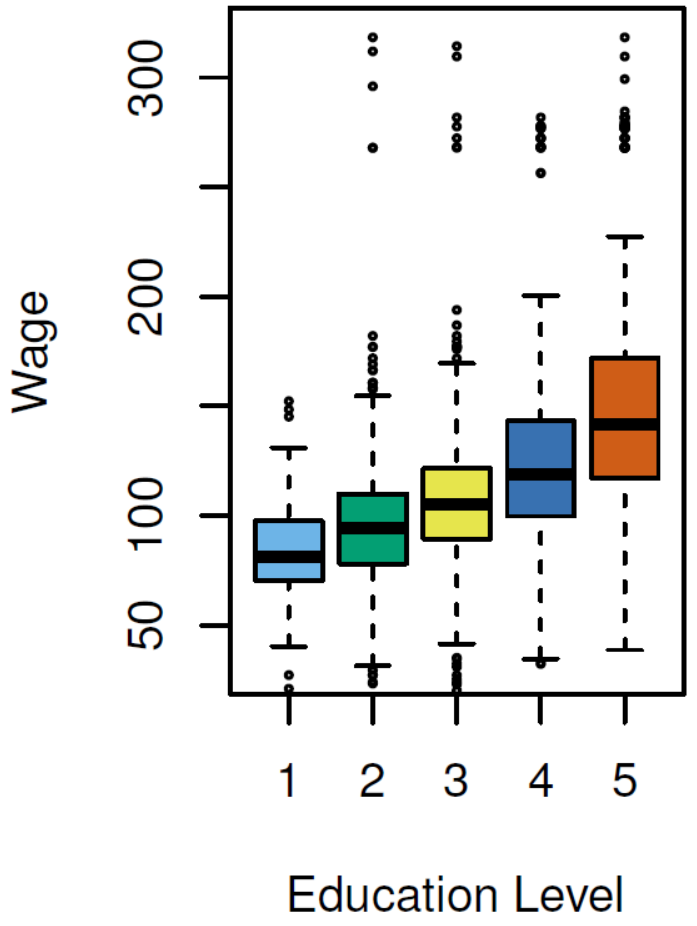
An overview of statistical learning

Wage data

- Income survey data for males in central Atlantic region of USA (Wage)
- Understand the association between an employee's wage and a number of factors, such as age, education, and the calendar year



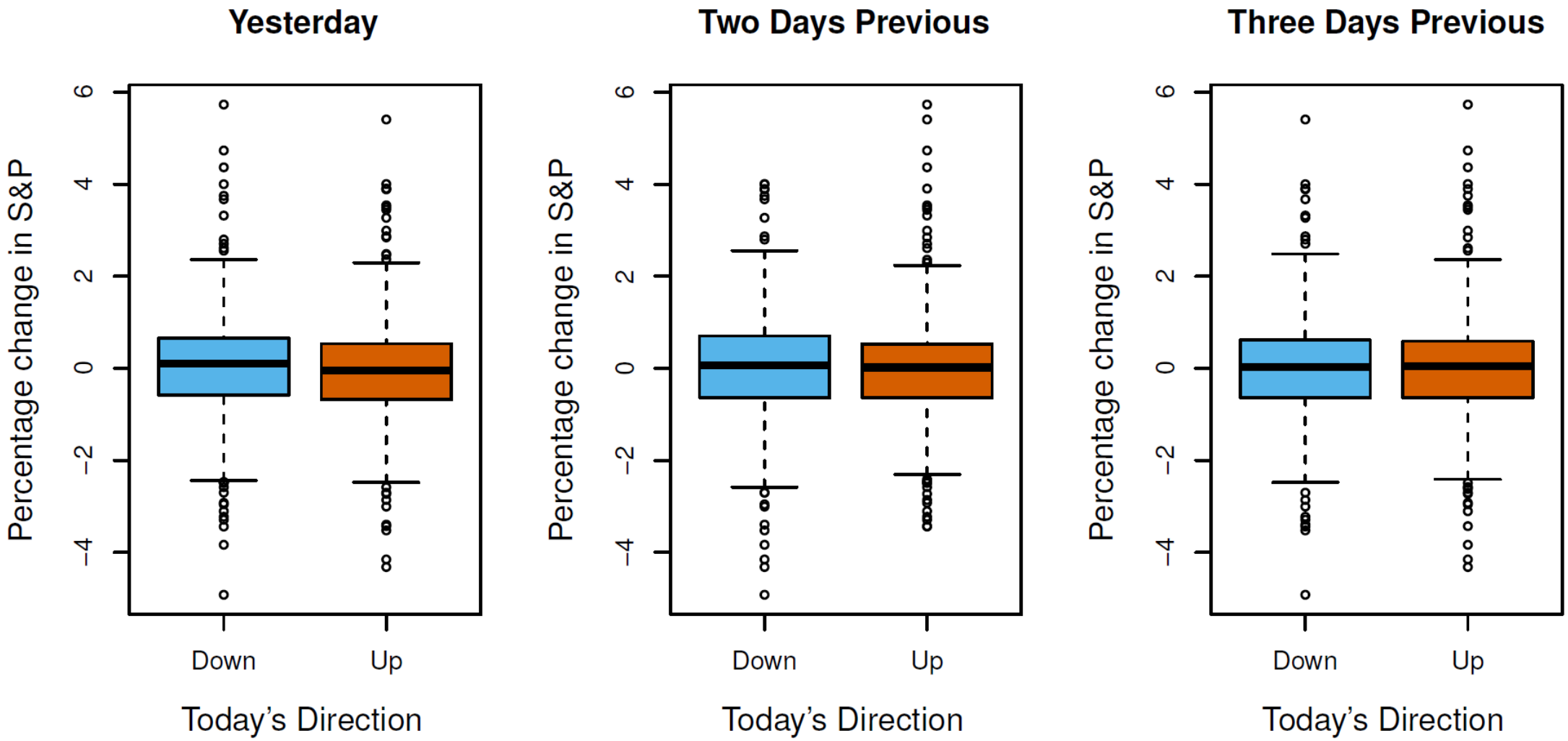




Some of the figures and tables in this presentation are taken from "*An Introduction to Statistical Learning, with Applications in R*" (Springer) with permission from the authors: G. James, D. Witten, T. Hastie, and R. Tibshirani

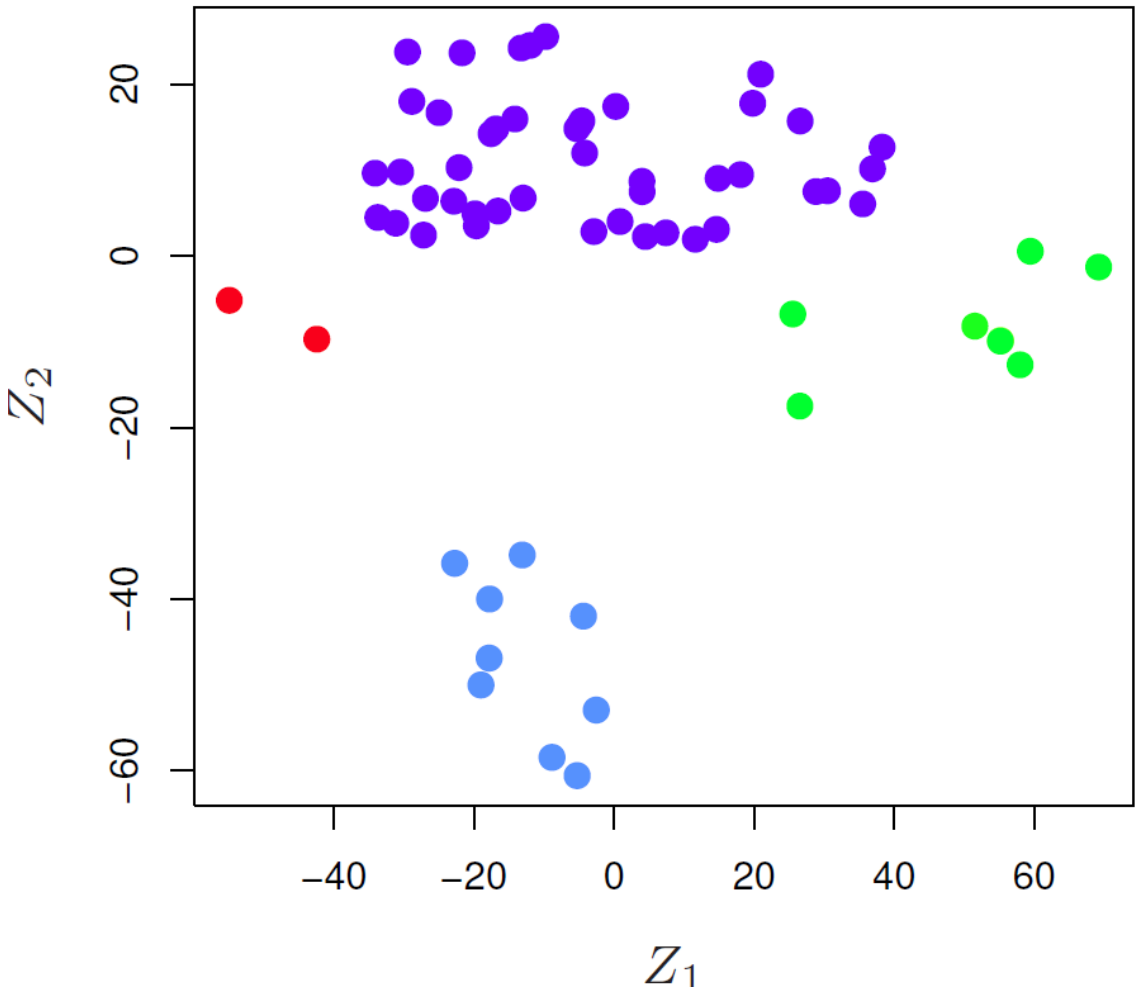
Stock market data

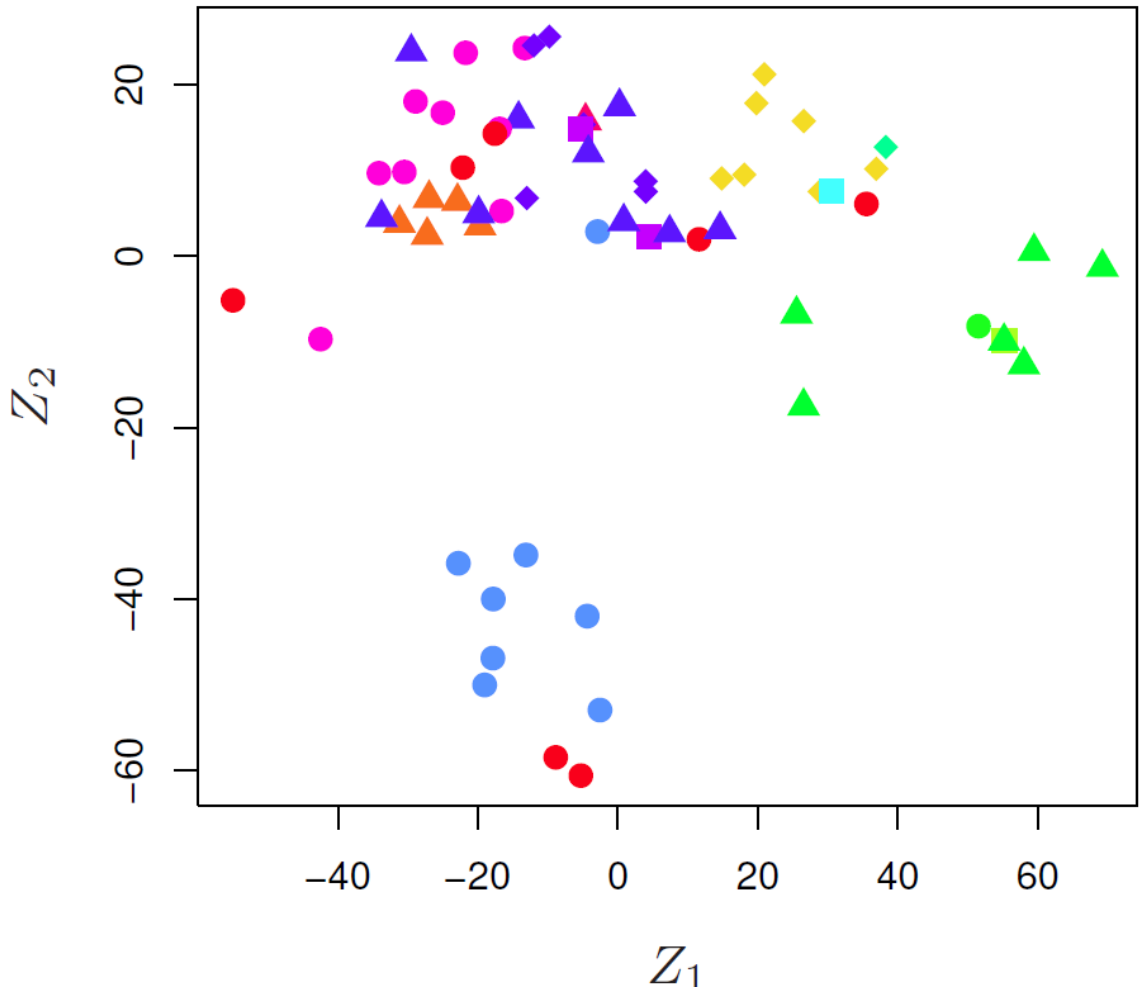
- Daily percentage returns for S&P 500 stock index over a 5-year period (Smarket)
- Predict whether the index will increase or decrease on a given day using the past 5 day's percentage changes in the index


Yesterday
Two Days Previous
Three Days Previous
Percentage change in S&P
6
4
2
0
−2
−4
Down
Up
Today's Direction

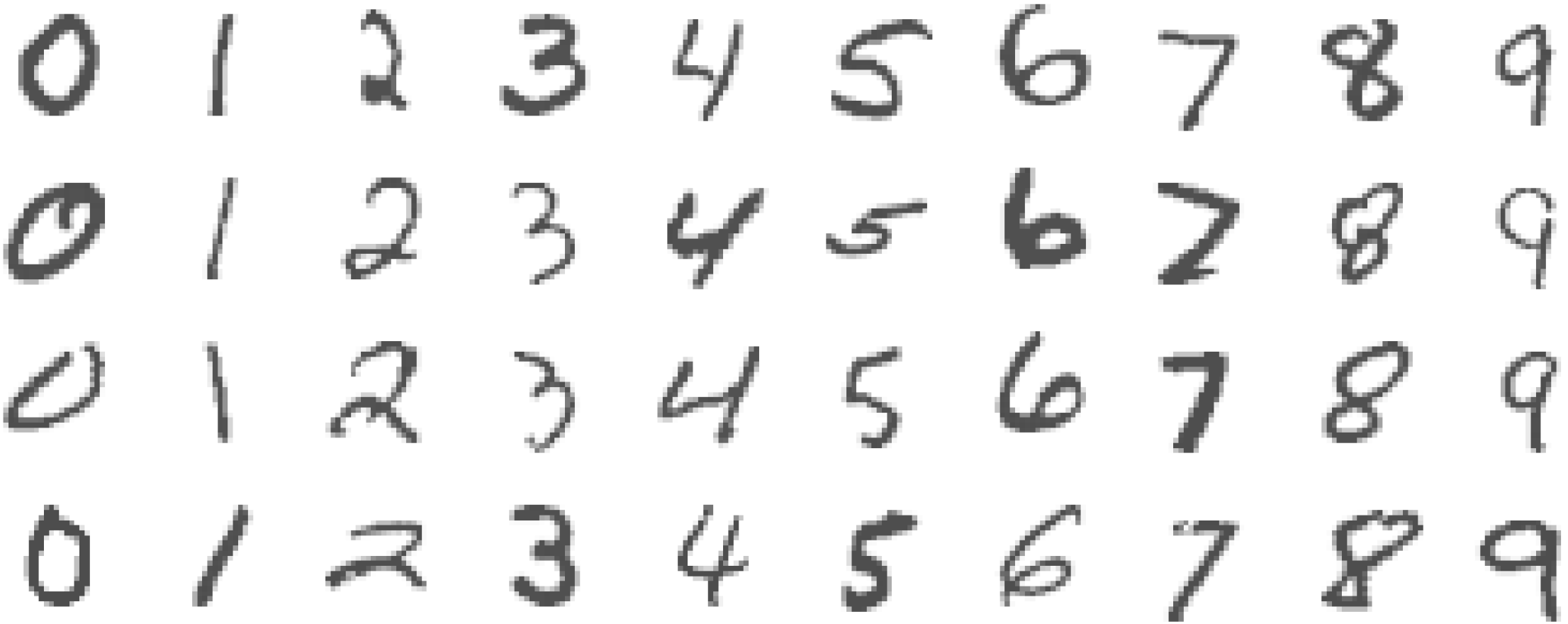
Gene expression data

- Gene expression measurements for 64 cancer cell lines (NCI60)
- Determine whether there are subgroups among 64 cancer cell lines based on 6830 gene expression measurements

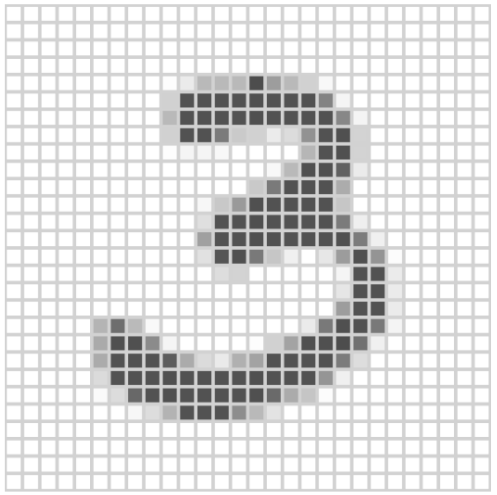

Z_2
20
0
−20
−40
−60
−40
−20
0
20
40
60
Z_1

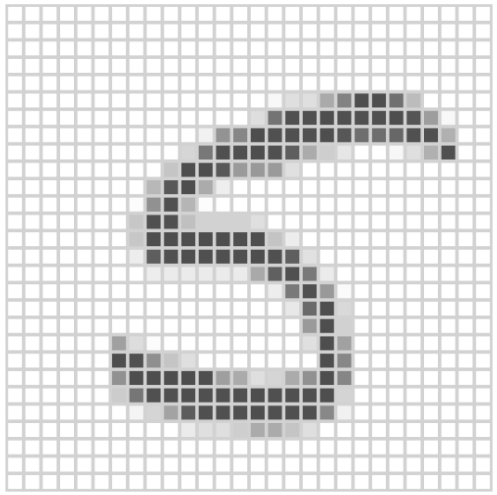

Z_2
20
0
−20
−40
−60
−40
−20
0
20
40
60
Z_1

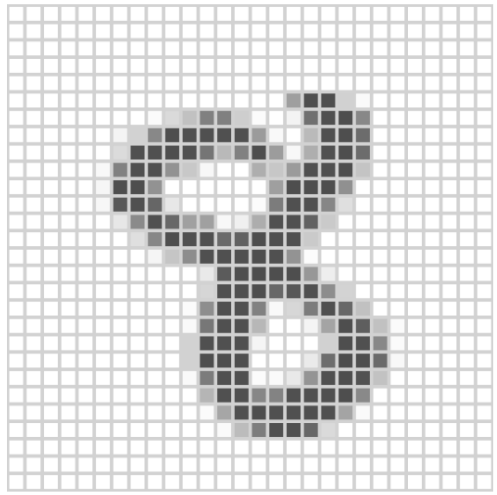
Handwritten digits from the MNIST corpus



- Modified National Institute of Standards and Technology
- 28×28 grayscale images
- Features: the 784 pixel grayscale values (0-255)
- Labels: the digit classes (0-9)
- 60K training and 10K test images

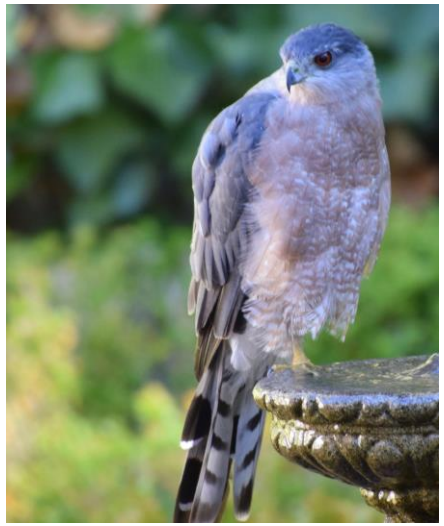


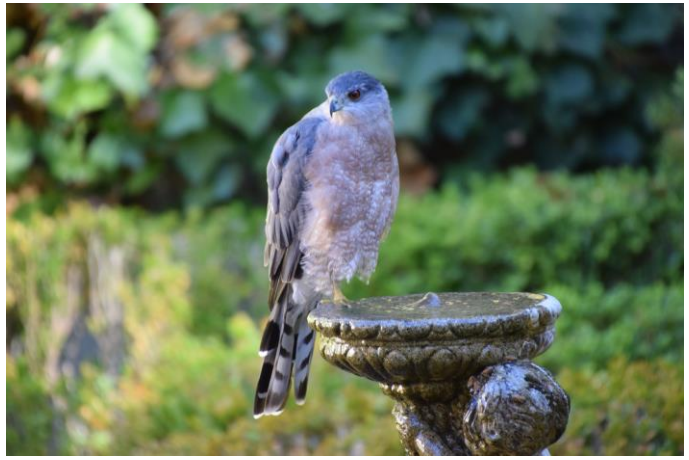




Images from the CIFAR100 database

- Canadian Institute for Advanced Research
- 32×32 color natural images, with 100 classes
- 50K training and 10K test images
- Each image is a $32 \times 32 \times 3$ array of 8-bit numbers (0-255)
- The last dimension represents the color channel (R, G, B)

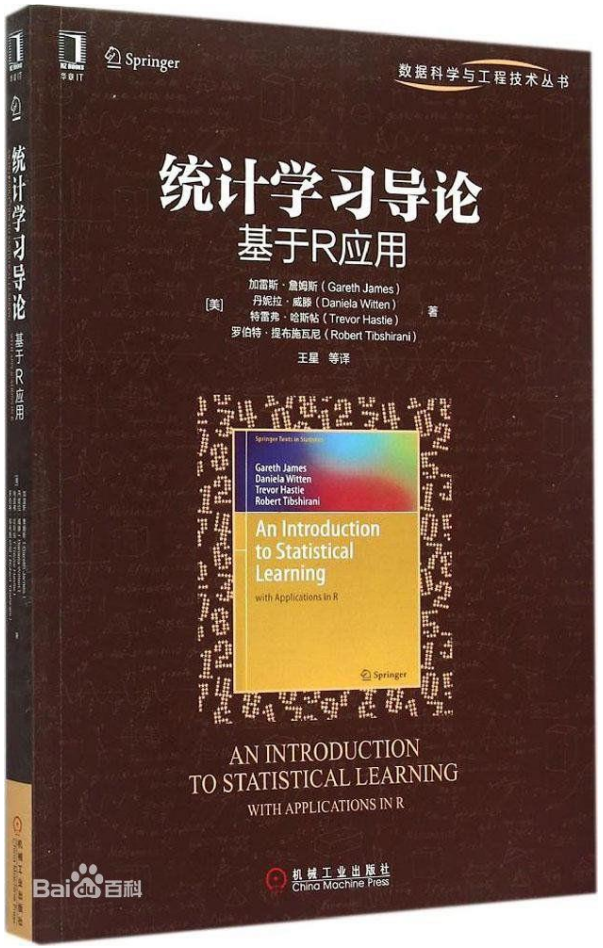





Schedules (教学安排)

- Basic terminology and concepts
- Linear regression and classification
- Resampling methods
- Model selection and regularization
- Nonlinear methods
- Tree-based methods
- Support vector machines
- Neural networks and deep learning
- Unsupervised learning
- Oral presentation and quizzes

Textbooks & references


Springer
数据科学与工程技术丛书
统计学习导论
基于R应用
加雷斯·詹姆斯（Gareth James）
丹妮拉·威滕（Daniela Witten）
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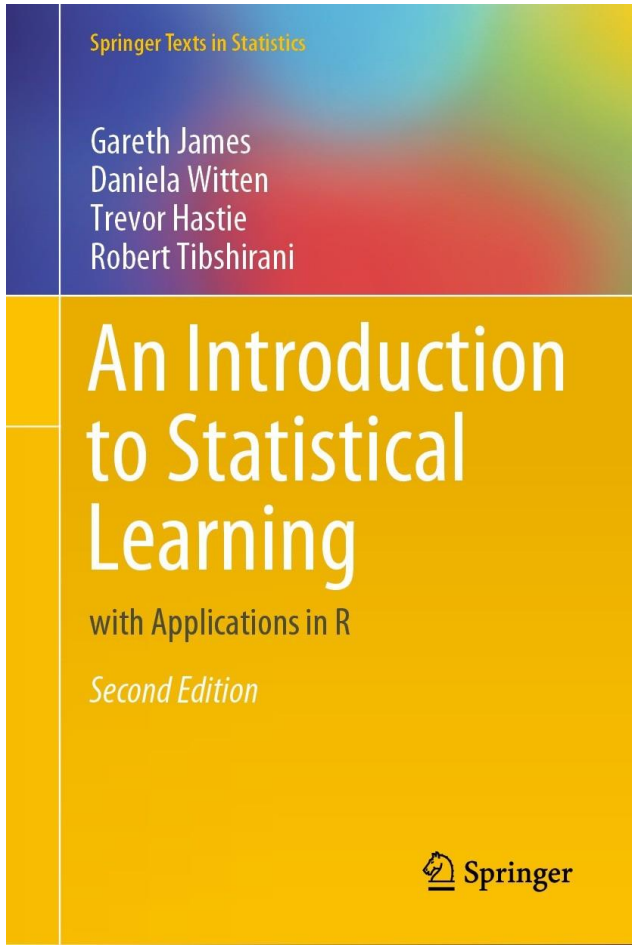
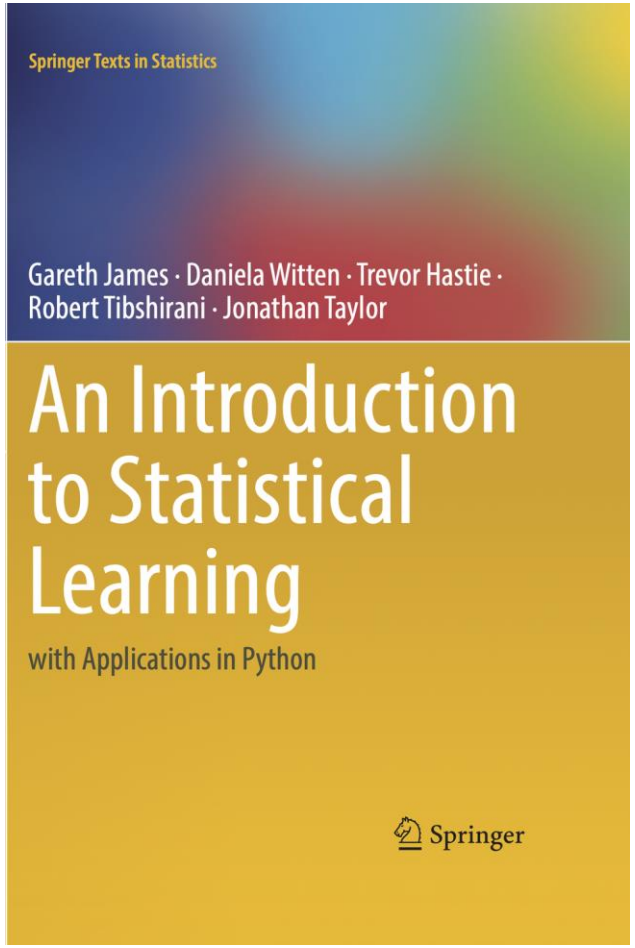
罗伯特·提布施瓦尼（Robert Tibshirani）
[美] 著
王星 等译
Gareth James
Daniela Witten
Trevor Hastie
Robert Tibshirani
An Introduction to Statistical Learning
with Applications in R
AN INTRODUCTION
TO STATISTICAL LEARNING
WITH APPLICATIONS IN R
机械工业出版社
China Machine Press
Baidu百科


Springer Texts in Statistics
Gareth James
Daniela Witten
Trevor Hastie
Robert Tibshirani
An Introduction to Statistical Learning
with Applications in R
Second Edition
Springer

An Introduction of Statistical Learning

- by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani
- Book website: https://www.statlearning.com/
  - Data sets, .R/Rmarkdown files
  - Slides and video lectures
  - Book PDF and errata


Springer Texts in Statistics
Gareth James · Daniela Witten · Trevor Hastie ·
Robert Tibshirani · Jonathan Taylor
An Introduction to Statistical Learning
with Applications in Python
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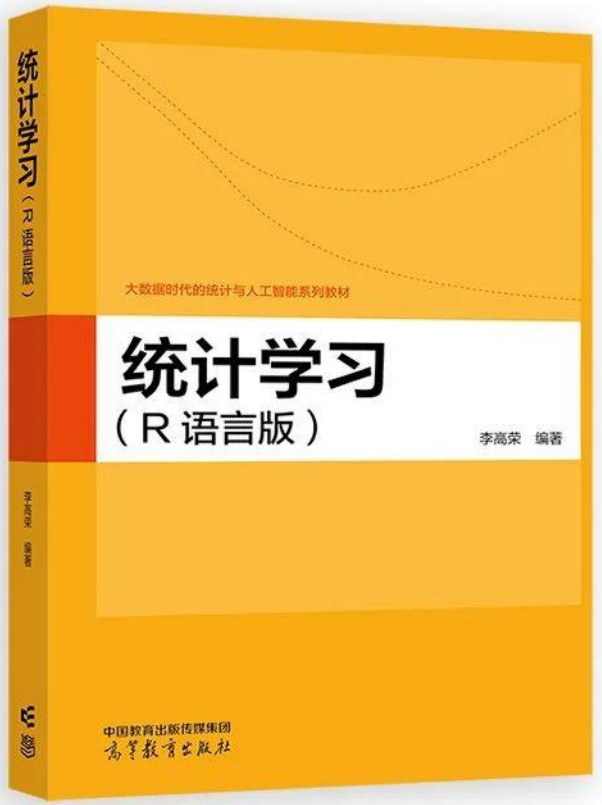
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（R语言版）
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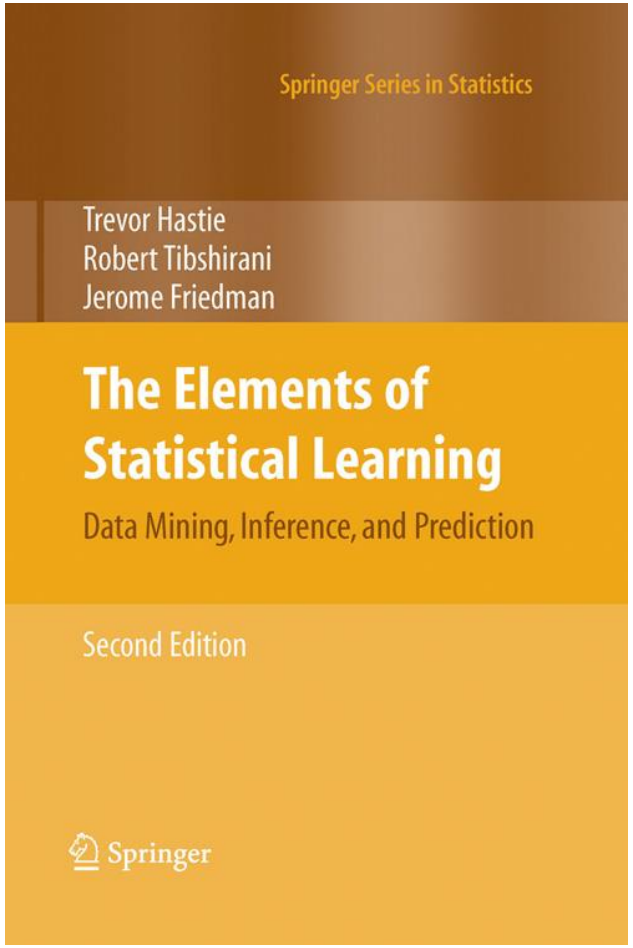

Springer Series in Statistics
Trevor Hastie
Robert Tibshirani
Jerome Friedman
The Elements of Statistical Learning
Data Mining, Inference, and Prediction
Second Edition
Springer

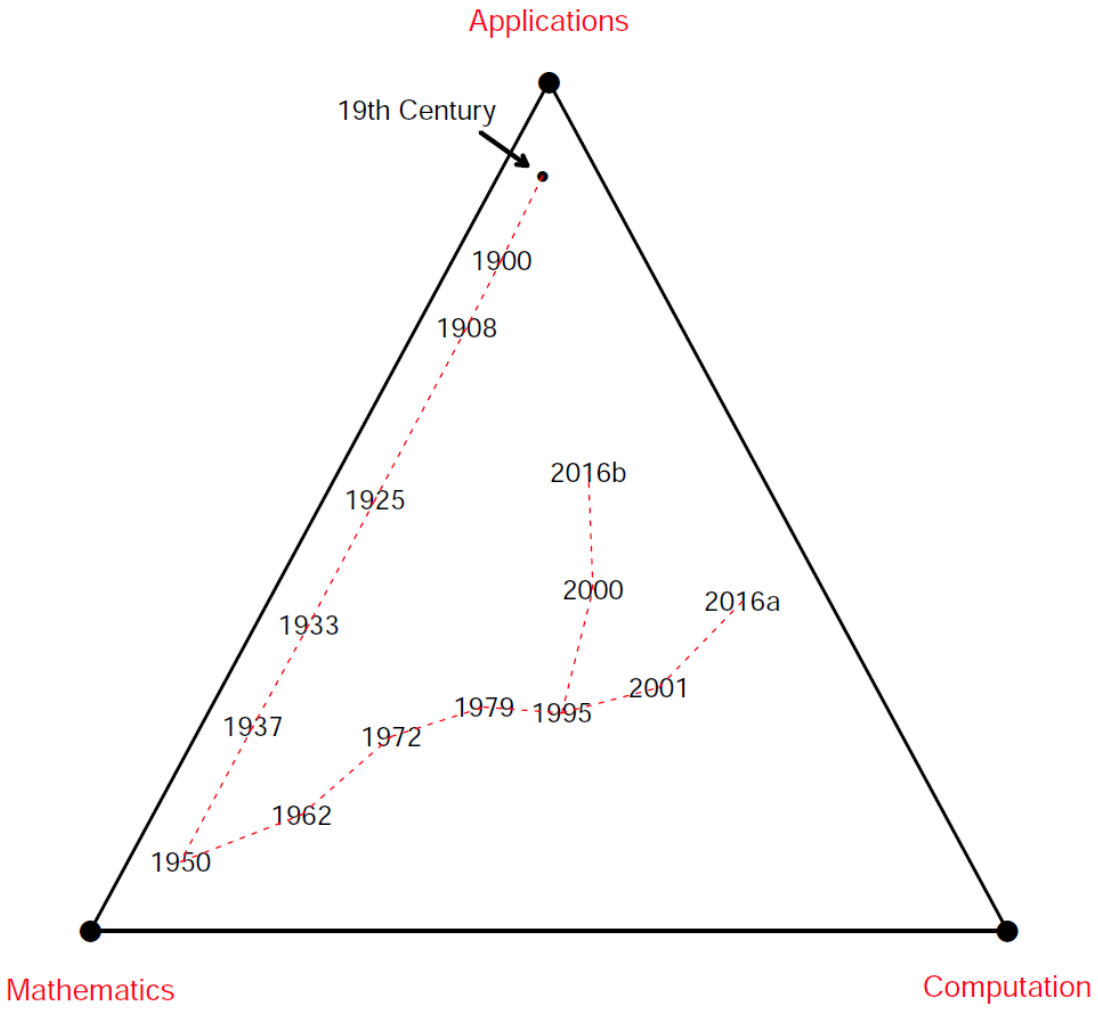
Grading policy (考核方法)

- Homework (30%)
  - 不按时交作业1次扣3分
- Group project (40%)
  - 大作业按贡献打分
- In-class quizz (30%)

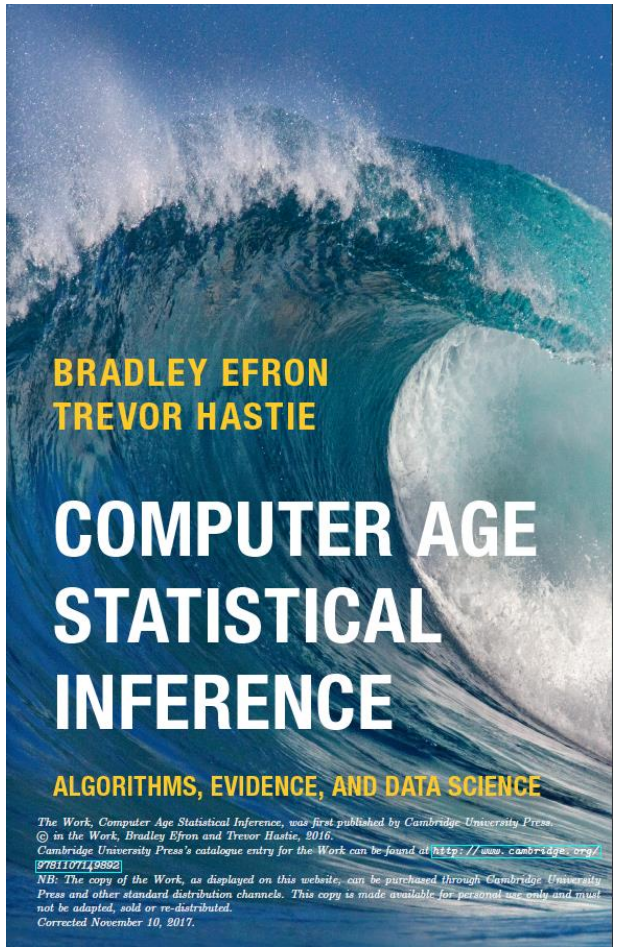
Group project

- A proposal (May 08)
  - Questions/problems, data sets, methods
- Oral presentations (June 05)
- A report (June 08)

A brief history of statistical learning



Development of the statistics discipline since the end of the 19th century. This figure is taken from "*Computer Age Statistical Inference*" (Cambridge)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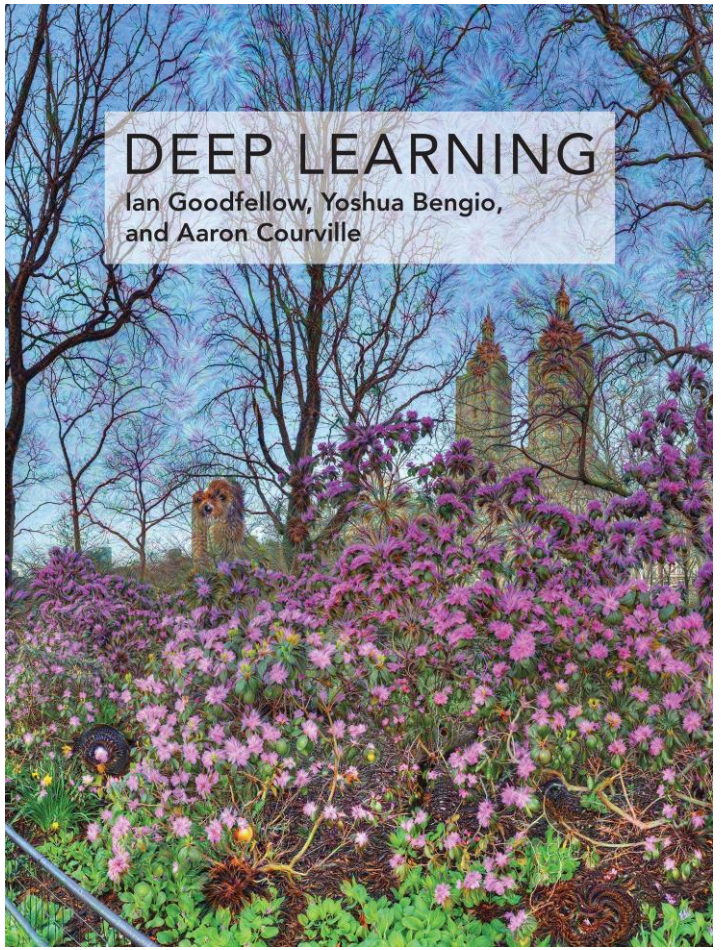
DEEP LEARNING
Ian Goodfellow, Yoshua Bengio,
and Aaron Courville