

# Practical Statistical Learning

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# Preface

These notes are based on a course in statistical learning developed by John Marten and Feng Liang at UIUC using the text **The Elements of Statistical Learning** by Hastie, Tibshirani and Friedman <https://hastie.su.domains/ElemStatLearn/>.



# Chapter 1

## Introduction

**Notes** [[lec\\_W1.1\\_Introduction\\_Statistical\\_Learning.pdf](#)] [[lec\\_W1.2\\_kNN\\_vs\\_LinearRegression.pdf](#)]  
[[lec\\_W1.2\\_kNN\\_vs\\_LinearRegression\\_figs.pdf](#)] [[lec\\_W1.3\\_Introduction\\_LearningTheory.pdf](#)]

**R/Python Code:** [[Rcode\\_W1\\_SimulationStudy.html](#)] [[Rcode\\_W1\\_Examples\\_from\\_ESL.html](#)]  
[[Python\\_W1\\_SimulationStudy.html](#)]

## 1.1 Introduction to Statistical Learning

### 1.1.1 Types of learning problems

### 1.1.2 Challenge of supervised learning

### 1.1.3 Curse of dimensionality

### 1.1.4 A glimpse of learning theory

### 1.1.5 1.5 Bias and variance tradeoff

## 1.2 Least squares vs. nearest neighbors

### 1.2.1 Introduction to LS and kNN

### 1.2.2 2.2 Simulation study with R

### 1.2.3 2.3 Compute Bayes rule

### 1.2.4 Discussion



## Chapter 2

# Linear Regression

**Notes** [[lec\\_W2.1\\_LinearRegression\\_MLR.pdf](#)] [[lec\\_W2.2\\_LinearRegression\\_Geometry.pdf](#)]  
[[lec\\_W2.3\\_LinearRegression\\_Practice.pdf](#)] [[lec\\_W2\\_appendix\\_SLR.pdf](#)]

**R/Python Code** [[Rcode\\_W2\\_LinearRegression.html](#)] [[Python\\_W2\\_LinearRegression\\_1.html](#)]  
[[Python\\_W2\\_LinearRegression\\_2.html](#)]

- 2.1 Good predictions: Squared error loss and in-sample error**
- 2.2 Matrices and least-squares estimates**
- 2.3 Regression inference**
- 2.4 Prediction using least-squares**
- 2.5 Geometric interpretation**
  - 2.5.1 Basic concepts in vector spaces**
  - 2.5.2 LS and projection**
- 2.6 Practical issues**
  - 2.6.1 Using R**
  - 2.6.2 Interpret LS coefficients**
  - 2.6.3 Handle categorical variables**
  - 2.6.4 Outliers and rank deficiency**

## Chapter 3

# Variable Selection and Regularization

**Notes** [[lec\\_W3\\_VariableSelection.pdf](#)] [[lec\\_W3\\_PCR.pdf](#)] [[lec\\_W3\\_More\\_on\\_Ridge\\_Lasso.pdf](#)]

**R/Python Code** [[Rcode\\_W3\\_VarSel\\_SubsetSelection](#)] [[Rcode\\_W3\\_VarSel\\_RidgeLasso](#)]

### 3.1 Subset selection

### 3.2 Ridge regression

### 3.3 Lasso regression



## Chapter 4

# Regression Trees



## Chapter 5

# Nonlinear Regression

5.1 Polynomials

5.2 Regression Splines

5.3 Smoothing Splines

5.4 Sines and cosines

5.5 A glimpse of wavelets





## Chapter 6

# Clustering Analysis



## Chapter 7

# Latent Structure Models



## Chapter 8

# More on Clustering



## Chapter 9

# Discriminant Analysis





## Chapter 10

# Logistic Regression



## Chapter 11

# Support Vector Machines



## Chapter 12

# Classification Trees and Boosting



## Chapter 13

# Recommender System





## Chapter 14

# Introduction to Deep Learning