

## **Analytics with R**

### **Course Introduction**

- ✓ Introduction to Modern Statistical Learning Approaches
- ✓ Summary of different methods we will cover in the course
- ✓ What is Statistical Learning?
- ✓ Inference vs. Prediction
- ✓ Supervised vs. Unsupervised Learning Problems
- ✓ Regression vs. Classification
- ✓ Testing Principles

### **Lab Class1: Introduction to R**

- ✓ Basic Commands
- ✓ Graphics
- ✓ Indexing Data
- ✓ Loading Data

### **Assessing the Accuracy of a Statistical Learning Method**

- ✓ Less Flexible vs. More Flexible Methods
- ✓ Training vs. Test Error Rates
- ✓ Nearest Neighbors Methods
- ✓ Bayes Classifier
- ✓ Bias/Variance ideas

### **Review of Linear Regression**

- ✓ Linear Regression Model
- ✓ Using Least Squares to Fit the Model
- ✓ Testing Statistical Significance
- ✓ Dealing with Categorical Variables

### **Lab Class 2: Linear Regression**

- ✓ Using the `lm()` Function to Fit Linear Regression Models in R

### **Logistic Regression**

- ✓ Using the Logistic Function for Classification
- ✓ Estimating Regression Coefficients

- ✓ Estimating Probabilities

### **Linear Discriminant Analysis**

- ✓ Bayes Theorem for Classification
- ✓ Estimating the Bayes Classifier
- ✓ Confusion Matrices
- ✓ Quadratic Discriminant Analysis

### **Lab Class 3: Logistic Regression and LDA**

- ✓ Using the `glm()` Function to Fit Logistic Regression Models in R
- ✓ Using the `lda()` and `qda()` Functions to Fit LDA in R

### **Re-sampling Methods**

- ✓ Cross Validation
- ✓ The Bootstrap

### **Lab Class 4: The Cross-Validation and the Bootstrap**

- ✓ The validation set approach
- ✓ LOOC Validation
- ✓ K-Fold Cross Validation

### **Variable Selection**

- ✓ Best Subset Regression
- ✓ Leave Out Samples
- ✓ BIC and AIC
- ✓ Cross Validation
- ✓ Illustrations on Real Estate Data

### **Lab Class 4: kNN, Best Subset Regression**

- ✓ Using the `knn()` Function to Implement Nearest Neighbors
- ✓ Using the `gsubsets()` Function to Implement Best Subset Regression

### **Shrinkage and Dimension Reduction Methods**

- ✓ Ridge Regression
- ✓ LASSO
- ✓ Illustrations on the Real Estate Data

- ✓ Principal Components Regression
- ✓ Partial Least Squares

## Lab Class5: Shrinkage Methods

- ✓ Ridge Regression Using the `lm.ridge()` Function
- ✓ LASSO Using the `lars()` Function
- ✓ Identifying Important Housing Variables

## Moving beyond Linear Methods

- ✓ Introduction to Non-Linear Regression
- ✓ Polynomial Regression
- ✓ Splines
- ✓ Illustrations on S&P and Simulated Data Sets

## Generalized Additive Models

- ✓ Extending Linear Regression to Allow For Non-Linear Relationships
- ✓ Extending Logistic Regression to Allow For Non-Linear Relationships
- ✓ Predicting Tomorrow's Change in the S&P Given Movements Over the Last Week

## Lab Class 6: Polynomial Regression, Splines and GAM

- ✓ Using the `poly()` Function to Implement Polynomial Regression
- ✓ Fitting Splines Using the `smooth.spline()` Function
- ✓ Producing a Generalized Additive Model Using the `gam()` Function.
- ✓ Illustrations on the S&P Data

## Tree Methods

- ✓ Decision Trees
- ✓ Regression vs. Classification Trees
- ✓ Pruning Trees

## Bagging and Boosting

- ✓ Ensemble Classifiers i.e. Using Multiple Classifications to Improve Prediction Accuracy
- ✓ The Bootstrap Method
- ✓ Using the Bootstrap to Produce a Bagged Classifier
- ✓ An Alternative Ensemble Classifier
- ✓ AdaBoost and Other Boosting Methods

## Lab Class 7: Tree Methods

- ✓ Using the `tree()` Function to Grow Regression and Classification Trees
- ✓ Using the `gbm` Package to Implement Boosting Procedures

## Support Vector Machines (SVM)

- ✓ The Support Vector Classifier
- ✓ Computing the SVM for Classification
- ✓ The SVM as a Penalization Method

## Lab Class 9

- ✓ Using the `svm()` Function to Produce a Support Vector Machine

## Clustering Methods

- ✓ K-means Clustering
- ✓ Hierarchical Clustering

## Lab Class 10: Clustering

- ✓ Using the `kmeans()` Function to Implement K-means Clustering
- ✓ Using the `hclust()` Function to Implement Hierarchical Clustering

## Class 27.Project

## Class 28.Project Presentations

## Class 29.Project Presentations