

Math 680, Fall 2020

Homework 3 Due: Friday, 11/6/2020

General Instructions:

- Turn in all your HW through Canvas.
 - All the HW files (except the R code) should be saved as a single PDF, and named in the form “Last-name_hw3.pdf”.
 - The code should be saved as “Last-name_hw3_code.r”.
 - Test your R code before submission to make sure it can be executed successfully by the “source()” function.
1. Read the paper “Regression Shrinkage and Selection via the LASSO” by Tibshirani (1996). Summarize your understanding in three sentences.
 2. Exercise 2.7(a)(b) in the textbook.
 3. Exercise 2.8 in the textbook.
 4. **(k-Nearest Neighbor for Classification)**
You may use the functions *knn* or *knn1* in the *R* library “class” for this problem. Submit your codes along with your results.
 - (a) Fit k-nearest neighbor classifier with a range of values k for the training data in Scenario 1 (generated in Question 4 of HW1), $k = \{1, 4, 7, 10, 13, 16, 30, 45, 60, 80, 100, 150, 200\}$. Report both training and testing errors for each k-NN classifier.

Plot two curves: the training error vs the degree of freedom n/k , and the testing error vs n/k , in one same figure (Similar to Figure 2.4 in the textbook).

- (b) Repeat (a) for the training data in Scenario 2 (generated in Question 4 of HW2).
- (c) Based on the plots obtained in (a) and (b), describe the different patterns between two curves. How should you choose the best k and recommend your best k for each scenario.

5. Classify the 1's, 2's, 3's for the zip code data.

- (i) Use the k -nearest neighbor classification with $k = 1, 3, 5, 7, 15$. Show both the training and test error for each choice.
- (ii) Implement the LDA method and report its training and testing errors. **Note:** Before carrying out the LDA analysis, you are suggested to delete variable 16 first from the data, since the variable takes a constant value and it can cause the singularity of the covariance matrix. In general, a constant variable does not have a discriminating power to separate two classes.