ECE 492-45 Homework 9

Material Covered: Regularization, SVM

Problem 1 (20 points) [Ridge and Lasso in R] Complete ISLR-6.6.

Problem 2 (20 points) [Analytic Solution of Ridge Regression] Ridge regression in matrix-vector form can be written as follows:

$$\underset{\underset{\sim}{\beta}}{\text{minimize}} \ \ ||\underset{\sim}{y} - X\underset{\sim}{\beta}||^2 + \lambda ||\underset{\sim}{\beta}||^2 \tag{1}$$

where λ is a fixed, positive number and X is a matrix of predictors.

(a) Show using matrix calculus that the ridge regression coefficients estimates have the following analytic form

$$\hat{\underset{\sim}{\beta}}^{\text{R}} = \left(X^T X + \lambda I\right)^{-1} X^T \underset{\sim}{y}. \tag{2}$$

(b) Under what condition does $\hat{\underset{\sim}{\beta}}^{\text{R}}$ reduce to the least-squares estimator $\hat{\underset{\sim}{\beta}}^{\text{LS}}$?

(c) Now, assume there is only one predictor and no intercept, i.e., $X = \underset{\sim}{x}$. Show that $\text{Var}(\hat{\beta}^{\text{R}}) < \text{Var}(\hat{\beta}^{\text{LS}})$.

Problem 3 (20 points) [SVM in R] Complete ISLR-9.6.

Problem 4 (20 points) [Maximal Margin Classifier] Complete ISLR-9.7.2(b), 9.7.3.

(This homework has only four problems. Please start to work on your group project proposal early.)