COM S 474/574  
Introduction to Machine Learning

Spring 2022

Homework 4

1 Directions:

* Due: Thursday February 24, 2022 at 9pm. Late submissions will be accepted for 24 hours with a 15% penalty. (the enforcement is strict, beginning at 9:01pm, except for extreme situations; having a poor wifi connection or minor computer problems is not sufficient for the penalty to be waived.)
* Upload the homework to Canvas as a single pdf file.
* If the graders cannot easily read your submission (writing is illegible, image is too dark,

or if the contrast is too low) then you might receive a zero or only partial credit.

* Any non-administrative questions must be asked in office hours or (if a brief response is sufficient) Piazza.

2 Problems  
Problem 1. [24 points total (5,5,3,3,4,4)]

Suppose you use lasso to fit a linear model for a data set. Let β∗(λ) denote the lasso solution for a specific λ (i.e. the coefficient vector you get for that λ).

Provide explanations for your answers to the following questions.

(a).  Describe how the training MSE changes as a function of λ, including λ = 0 and as λ → ∞.

The MSE increase as λ increase from 0 because it makes the model less flexible which leads to increment in training MSE.

(b).  Describe how the hold-out MSE changes as a function of λ, including λ = 0 and as λ → ∞.

The MSE initially decrease and eventually start increas as we saw in the class (2/15/2022)

(c).  Describe β∗(0).

OLS. No penalty on β’s

(d).  Describe what happens to β∗(λ) as λ grows.

We will only have β0 to fit with and end up using hold-out data to select.

(e).  If you used ridge regression instead of lasso, explain how your answers to (a).-(d). would differ.

The ridge regression will result very similar to the results of the lasso, but it might have a bit larger MSE. But (c) and (d) will result very similar.

(f).  We discussed the “constrained form” of lasso, with a constraint of the form

Text

Description automatically generated with medium confidence

λ-> 0: large enough t (t->∞)

λ-> ∞: small t (t->0)

Text, letter

Description automatically generated

https://www4.stat.ncsu.edu/~lu/ST7901/lecture%20notes/2019Lect6\_shrink\_lasso.pdf