BONUS ASSIGNMEMT

Due Date: 04/10/2025

Total Points: 5 points (added to the midterm)

Experimenting with Lasso Regularization

Lasso Regularization: LASSO (Least Absolute Shrinkage and Selection Operator), like ridge regression, is a certain modification of linear regression.

The LASSO method has a completely different but also useful advantage. It performs both feature selection and regularization to enhance the prediction accuracy and interpretability of the resulting model. In LASSO, the regularization term has a slightly different form and is called the L1 penalty.

In LASSO, we also minimize the RSS, however, augmented by a regularization term called the L1 penalty.

$$\arg\min_{\beta_0,\ldots,\beta_p} \quad \sum_{i=1}^{n}\left(y_i - \beta_0 - \sum_{j=1}^{p}\beta_j x_{ij}\right)^2 + \lambda\sum_{j=1}^{p}|\beta_j|$$

a) Implement Lasso (L1) regularization for the best-performing model identified in Q3c (Assignment 2) from scratch (without using built-in machine learning libraries). Evaluate its impact on model performance using appropriate evaluation metrics.

b) Apply Lasso regularization using a machine learning library such as scikit-learn (or any other package with built-in Lasso support). Compare the performance of this implementation with the manually implemented version from part (a) in terms of metrics.

c) Compare the performance of Lasso (L1) and Ridge (L2) regularization across various evaluation metrics. Discuss key differences in feature selection, model generalization, and overall effectiveness in improving model performance.