LASSO Regression as a Quadratic Program

MATH 5593 - Linear Programming

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Outline

Introduction

Project Motivation

- We wanted to explore the statistical technique known as L_1, or, LASSO regression from a linear programming perspective.
- Vanderbei claims LASSO works as an LP, so surely it can be done in AMPL.
- If so, does this approach reach the same conclusions as standard statistical libraries?
- We thought these questions would be a fun way to bridge the gap between statistics and linear programming.

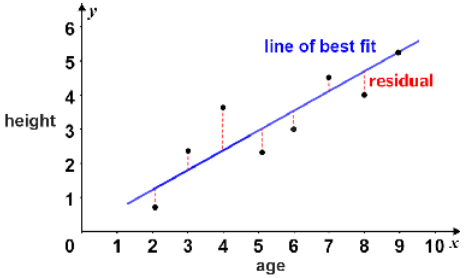
Project Goals

- To convince ourselves, we perfomed this regression in two ways.
- First, using the python library “statsmodels” on a simple dataset.
- Second, using our own AMPL model on the same dataset.
- Lastly, we compare the model coefficients. Are they the same?

Background information

What is regression?

- Regreesion fits a line, plane or hyperplane through a set of points in n dimensional space.
- This fitting is done by treating the "response" variable as a function of other "predictor" variables.
- The fit is improved by minimizing the lines overall distance from the points, otherwise known as the residuals.
- This is known as minimizing the "residual sum of squares", or, RSS.



Penalized Regression

- Having more predictors can often improve model performance, but at the cost of increased complexity.
- There are many consequences to overly complex models, so penalized regression models attempt to help with this.
- LASSO regression is surprise, a type of penalized regression.

Penalized Regression Structure

Penalized regression is made up of two chunks. The RSS part shared with linear regression, and a new penalty chunk.

$$\text{Linear Regression:} \quad \min \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

$$\text{LASSO Regression:} \quad \min \underbrace{\sum_{i=1}^{n} (y_i - \hat{y}_i)^2}_{\text{RSS}} + \underbrace{\lambda \sum_{j=1}^{p} |b_j|}_{\text{Penalty}}$$

$$\hat{y}_i = \sum_{j=1}^{p} b_j x_{ij}$$

Use meaningful titles that actually provide information

Wow!

- Some
- Interesting
- Points

A Section

Make your presentation interactive

What about a question to the audience?

Make your presentation interactive

What about a question to the audience?

Followed by the answer.

Thank You

Questions?

Backup slides go here