project3_g12

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Question 1

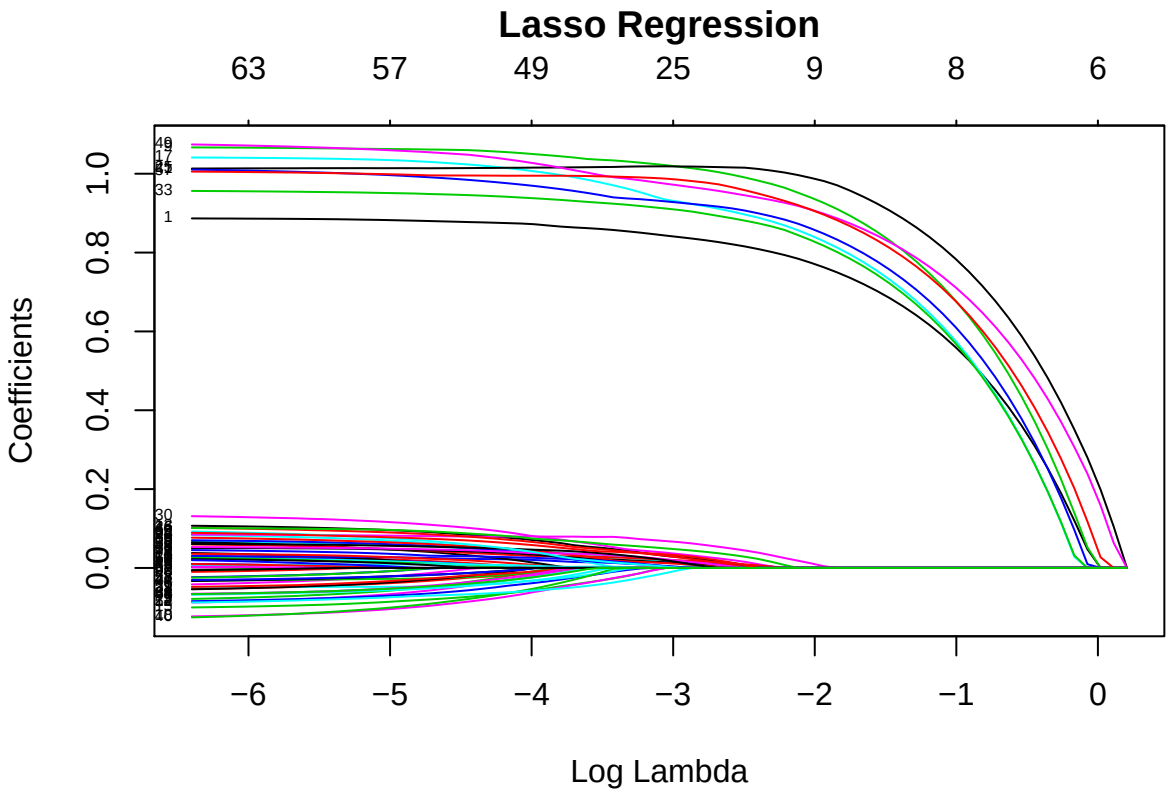
Gurobi Access

All teammates have access to Gurobi through RStudio.

Question 2

Apply both MIQP and Lasso to the given data

Lasso:



Because the plot shows a cut-off at log(λ) = -2, we will use e^{-2} as the penalty term for the Lasso model. We can inspect the remaining non-zero coefficients:

Coef. Number	lasso_beta
1	0.7708
9	0.9356

Coef. Number	lasso_beta
17	0.8392
24	0.009661
25	0.987
33	0.8273
41	0.8573
49	0.9059
57	0.9052

Comparing these to the original coefficients, we check to see if Lasso zeroed any "real" coefficients, or if it added any that were non-siginifcant:

lasso_beta	beta_real
0.7708	1
0.9356	1
0.8392	1
0.0097	0
0.987	1
0.8273	1
0.8573	1
0.9059	1
0.9052	1

As we can see, the Lasso regression actually did keep one coefficient that was zero in the original betas, but its value is 0.009661, which is nearly zero. Overall, the Lasso seems to have done fairly well in estimating the true betas.

MIQP:

Using the k value of 8 and an initial value of M as 0.1, we calculate the maximum M value (0.1) from an initial run of the MIQP. We will continue doubling M and finding the max until M reaches the max value. The results of these iterations are below.

```
## [1] 0.2
## [1] 0.4
## [1] 0.8
## [1] 1.6
```

Using the solution obtained with the max M iteration above, the MIQP model keeps the following coefficients.

Coef. Number	MIQP_beta
1	0.8931
9	1.089
17	0.9921
25	1.116
33	0.9797
41	1.003
49	1.02
57	1.039

Comparing these to the original coefficients, we check to see if MIQP zeroed any "real" coefficients, or if it added any that were non-siginifcant:

MIQP_beta	beta_real
0.8931	1
1.089	1
0.9921	1
1.116	1
0.9797	1
1.003	1
1.02	1
1.039	1

In this case, the MIQP found all of the same coefficents as the original betas without missing any.

Question 3

Prediction Error

The next step is to calculate the actual errors to find which model performed best in estimating the coefficients.

To test the error function, if we compare the real betas against themselves, we would expect for the error to be 0. Running through the function, we obtain 0, so the function is working according to plan.

The Lasso error is 0.0184 and the MIQP error is 0.0045. Based on this calculation, we can determine that MIQP performed better in predicting the actual betas.