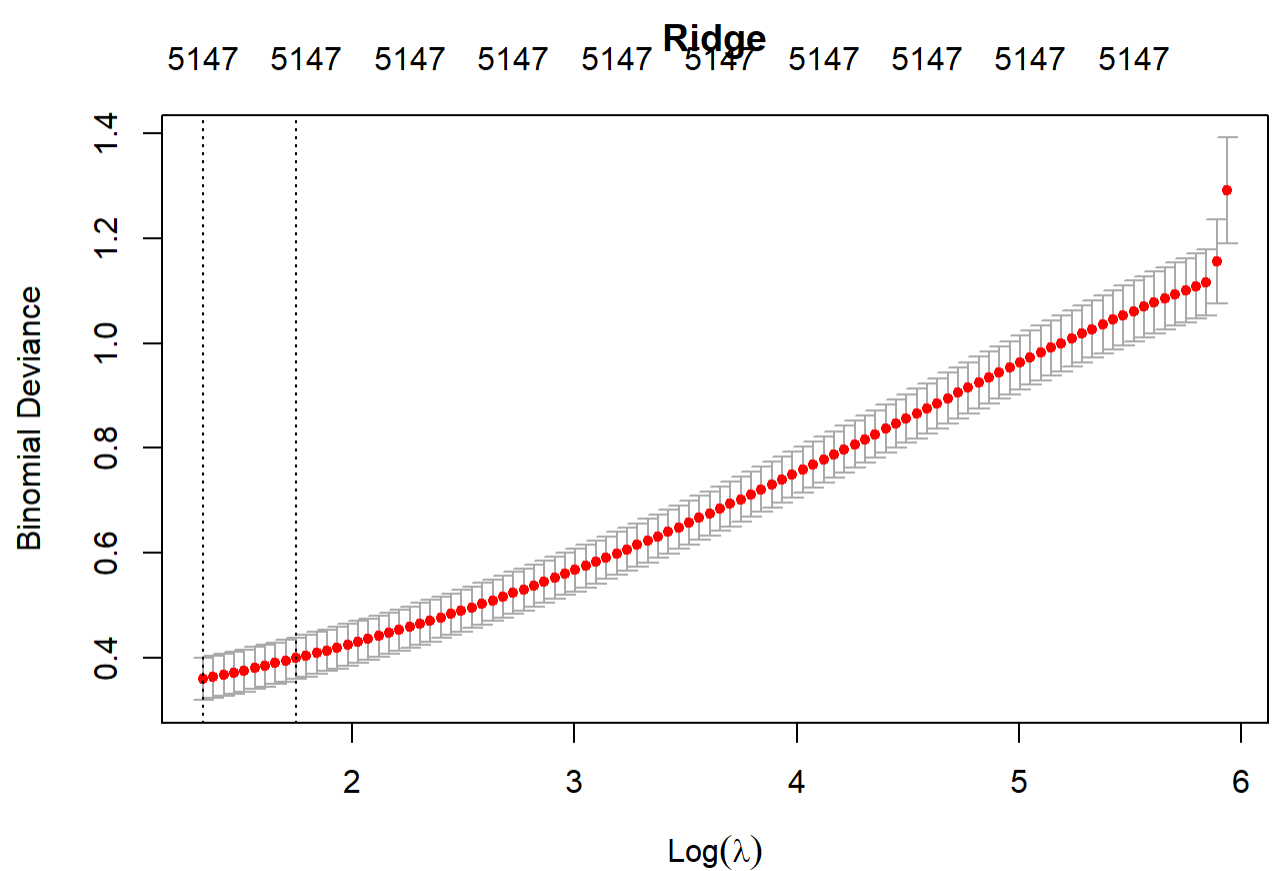
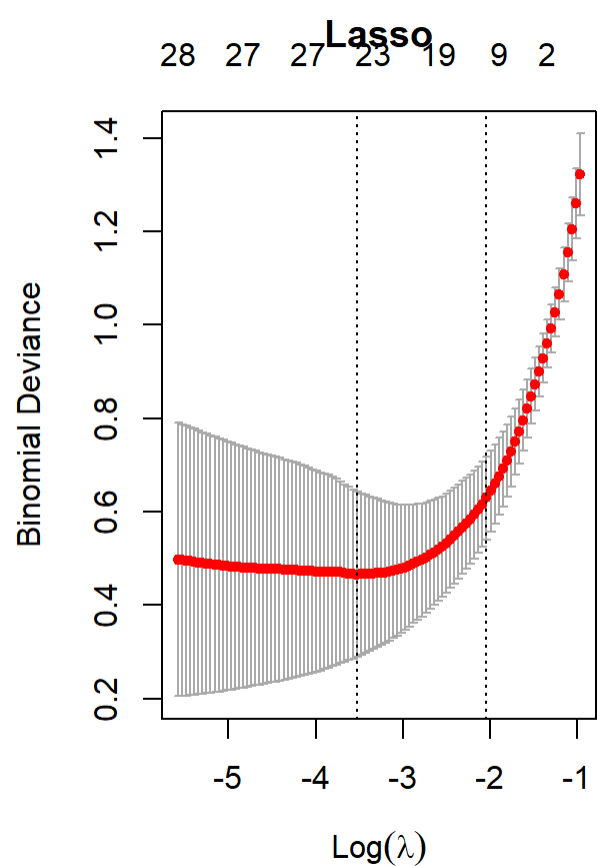
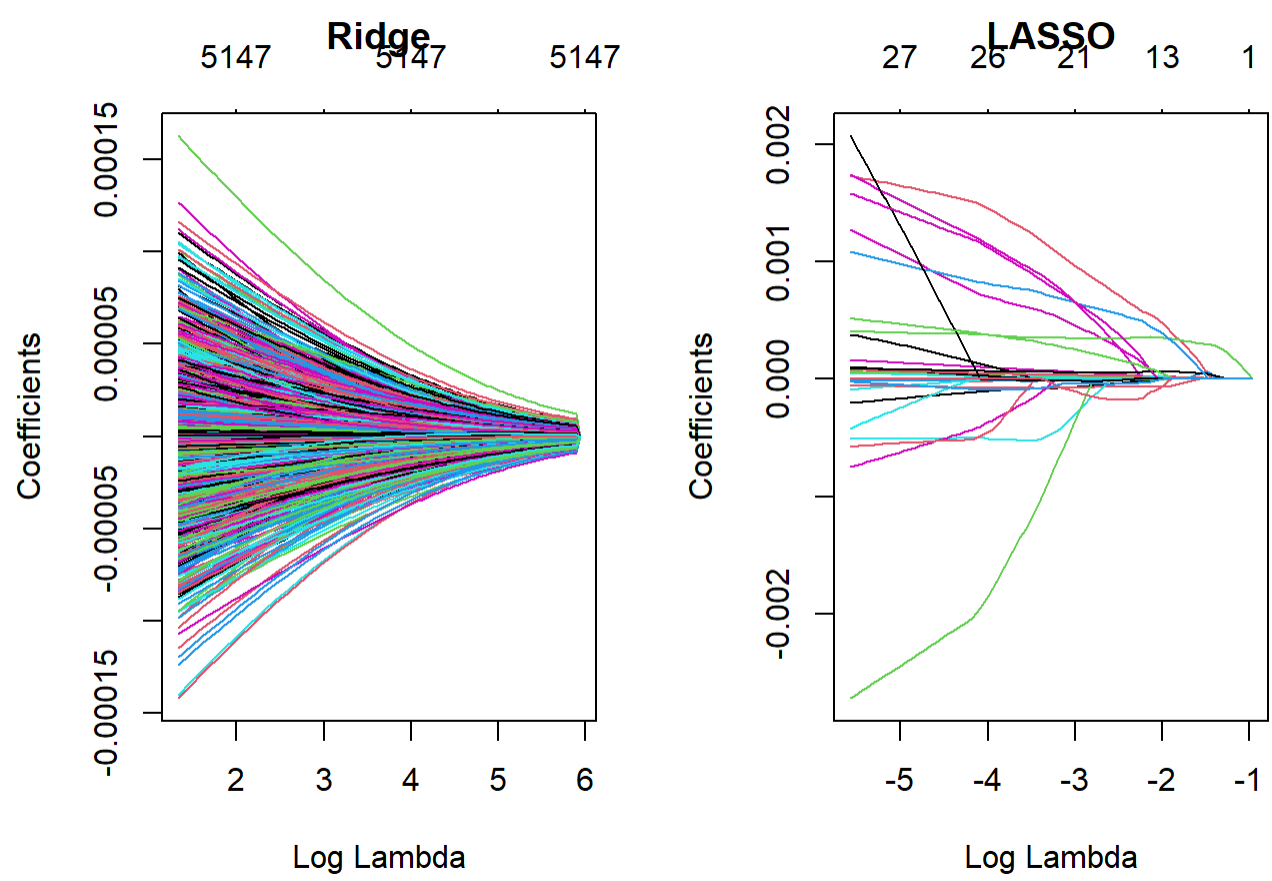


Name: Alvee Chowdhury

Answer:1

The plots are:



Summary of the 7 models

Models	lambda/k values	Accuracy	standard deviation of Accuracy
LASSO	0.029	0.944	0.093
LASSO	0.130	0.917	0.114
Ridge	3.780	0.973	0.037
Ridge	5.745	0.960	0.060
KNN	5.000	0.874	0.033
KNN	7.000	0.846	0.062
KNN	9.000	0.847	0.034

Answer 2

## 'data.frame':	777 obs. of 18 variables:
## \$ Private	: Factor w/ 2 levels "No","Yes": 2 2 2 2 2 2 2 2 2 ...
## \$ Apps	: num 1660 2186 1428 417 193 ...
## \$ Accept	: num 1232 1924 1097 349 146 ...
## \$ Enroll	: num 721 512 336 137 55 158 103 489 227 172 ...
## \$ Top10perc	: num 23 16 22 60 16 38 17 37 30 21 ...
## \$ Top25perc	: num 52 29 50 89 44 62 45 68 63 44 ...
## \$ F.Undergrad	: num 2885 2683 1036 510 249 ...
## \$ P.Undergrad	: num 537 1227 99 63 869 ...
## \$ Outstate	: num 7440 12280 11250 12960 7560 ...
## \$ Room.Board	: num 3300 6450 3750 5450 4120 ...
## \$ Books	: num 450 750 400 450 800 500 500 450 300 660 ...
## \$ Personal	: num 2200 1500 1165 875 1500 ...
## \$ PhD	: num 70 29 53 92 76 67 90 89 79 40 ...
## \$ Terminal	: num 78 30 66 97 72 73 93 100 84 41 ...
## \$ S.F.Ratio	: num 18.1 12.2 12.9 7.7 11.9 9.4 11.5 13.7 11.3 11.5 ...
## \$ perc.alumni	: num 12 16 30 37 2 11 26 37 23 15 ...
## \$ Expend	: num 7041 10527 8735 19016 10922 ...
## \$ Grad.Rate	: num 60 56 54 59 15 55 63 73 80 52 ...

Summary of the 6 models

Models	CV RMSE	Test RMSE
additive linear model	1957.20	2177.78
elastic net model	1944.72	2191.65
elastic net model (all interactions)	1810.58	2006.59
well-tuned KNN	1869.65	2055.36
well-tuned KNN(with interactions)	1897.08	2052.57
default-tuned random forest	1702.51	1825.47

We see that elastic net model performs the worst since since it has the highest CV and test RMSE. The default-tuned random forest model performs the best since has the lowest CV and test error. The elastic net model that also considers all two-way interactions performs better than the elastic net model using additive predictors. On the other hand, the well-tuned KNN model performs better than the well-tuned KNN model that also considers all two-way interactions.

Answer 3

The linear model assumes that f(x) has a linear functional form whereas KNN lets the data tell us what the actual type of the functional form f(X) has. So k-NN method can work with non-linear models too.

Answer 4

- The true decision boundaries is non-linear. We see that C4 performs best since it has lowest test RMSE. Since C4 has non-linear transformations of the predictors, even linear models will have non-linear decision boundaries.
- Model 4 performs the best since it has the lowest test RMSE.
- Model 1, 2 and 3 have high training and test RMSE. So they are all underfitting. No model is overfitting since all 3 models: model 1,2 and 3 have high train RMSE and lower test RMSE.
- Model 2 and 3 are performing unbiased estimation. They both have low squared bias than the more complex model.Model 2 perform best since it has lowest MSE with lowest bias-varinace tradeoff,i.e.,it has significantly lowest bias squared and the variance slightly above the lowest one.

Answer 5

- k=5 performs the best since it has the lowest test classification error. The second classifier with a cut-off of predicted probability: c = 0.5 since it has the highest accuracy.
- QDA with a flat prior performs the best in terms of prediction since its test error is the lowest at 0.14.
- It performs poorly since there are a small number of predictors.
- QDA performs better than LDA. This is because of the different feature covariance matrices of the different classes.
- The QDA flat prior performs better.Using a flat prior is better than estimating directly from data. The test data has uniform proportion of classes.
- Class "B" is the easiest to classify since it has the least overlap with other classes A,C and D.

Answer 6

a)There are 72 observations and 5148 predictors. b) Yes enough values were considered. We can see a clear U shaped curve. c) No enough values were considered. We donot see a clear U shaped curve. More Smaller values of lambda should have been considered. The shape of the plot clearly shows that. d) k-nearest neighbor performed worse than the penalized methods. Since we have 5148 predictors, clearly our data has high dimensionality. So it performs worst. It will improve if we scale the predictors. e) Ridge model with lambda = 3.779559 since it has the highest accuracy. For Question 2 of HA03 f) I prefer the default-tuned random forest since it has the least CV and test RMSE. g) The best tuning parameters for elastic net model:

	alpha <dbl>	lambda <dbl>
15	0.2	36.27709
1 row		

The best tuning parameters for elastic net model (with interactions):

	alpha <dbl>	lambda <dbl>
16	0.2	95.01587
1 row		

Since, for elastic net model alpha = 0.1 which is closer to 0, it is closer to ridge. For elastic net model (with interactions), alpha=0.5 it is omewhere in between ridge and LASSO with equally likely. h) Yes, I scaled the predictors when I used the k-NN approach. Yes, since it reduces the error rate. i) The well-tuned KNN model performs better than the well-tuned KNN model that considered all two-way interactions. This is because, since the second model is considering all two-way interactions, the data set has high dimensionality. j) The dataset is from 1995. The out-of-state tuition at, University of Illinois at Urbana-Champaign at that time was \$7560.