STAT 432: Basics of Statistical Learning

Quiz II - Review Questions

Exercise 1

Two models were fit using **ridge** regression. One with $\lambda = 0.1$ and the other with $\lambda = 0.002$. Which was fit using $\lambda = 0.1$?

Model **A**:

```
## (Intercept)          x1          x2          x3          x4          x5
##     -0.7618      0.3647      0.1893      1.0853      0.7744      1.3136
```

Model **B**:

```
## (Intercept)          x1          x2          x3          x4          x5
##     -0.5782      0.3322      0.1869      0.9741      0.6806      1.1916
```

Exercise 2

Two models were fit using the **lasso**. One with $\lambda = 0.1$ and the other with $\lambda = 0.002$. Which was fit using $\lambda = 0.1$?

Model **A**:

```
## (Intercept)          x1          x2          x3          x4          x5
##      0.2709      0.0000      0.0000      0.5547      0.2724      0.8676
```

Model **B**:

```
## (Intercept)          x1          x2          x3          x4          x5
##     -0.7445      0.3581      0.1838      1.0772      0.7665      1.3075
```

Exercise 3

Two models were selected, one using backwards AIC and the other using backwards BIC. Which was found using backwards BIC?

Model **A**:

```
## (Intercept)          x5
##      0.5515      1.1272
```

Model **B**:

```
## (Intercept)          x3          x4          x5
##     -0.4745      1.0845      0.7446      1.3418
```

Exercise 4

Suppose we estimate the regression coefficients in a linear regression model by minimizing

$$\sum_{i=1}^{n}\left(y_i - \beta_0 - \sum_{j=1}^{p}\beta_j x_{ij}\right)^2 \text{ subject to } \sum_{j=1}^{p}\beta_j^2 \leq s.$$

for a particular value of s. Draw a plot that indicates how train and test RMSE are affected by the choice of s. Assume that simply minimizing RSS would result in a model that overfits. Also assume that a model with only the intercept would underfit.

Exercise 5

Continue with the setup from Exercise 4. Consider using this model to make a prediction. What happens to **variance** as s is increased from 0?

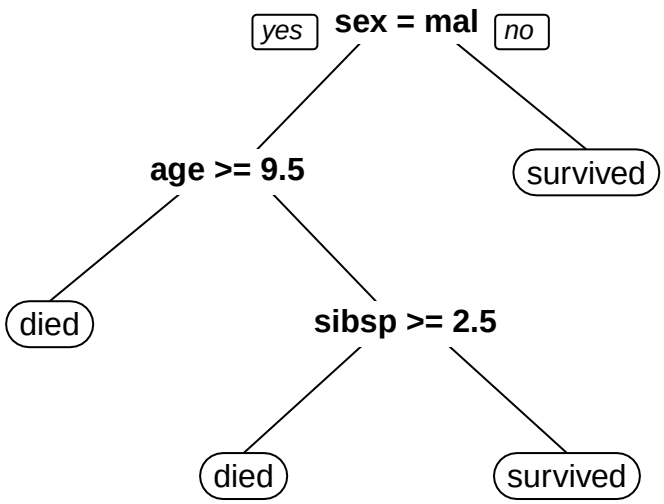
Exercise 6

Continue with the setup from Exercise 4. Consider using this model to make a prediction. What happens to **squared bias** as s is increased from 0?

Exercise 7

A tree model was fit to training data for a classification problem. Below is a sample of the data used, where `survived` is the response. We are attempting to predict the survival status of passengers of the Titanic:

pclass	survived	sex	age	sibsp	parch
1st	survived	female	29.0000	0	0
1st	survived	male	0.9167	1	2
1st	died	female	2.0000	1	2
1st	died	male	30.0000	1	2
1st	died	female	25.0000	1	2



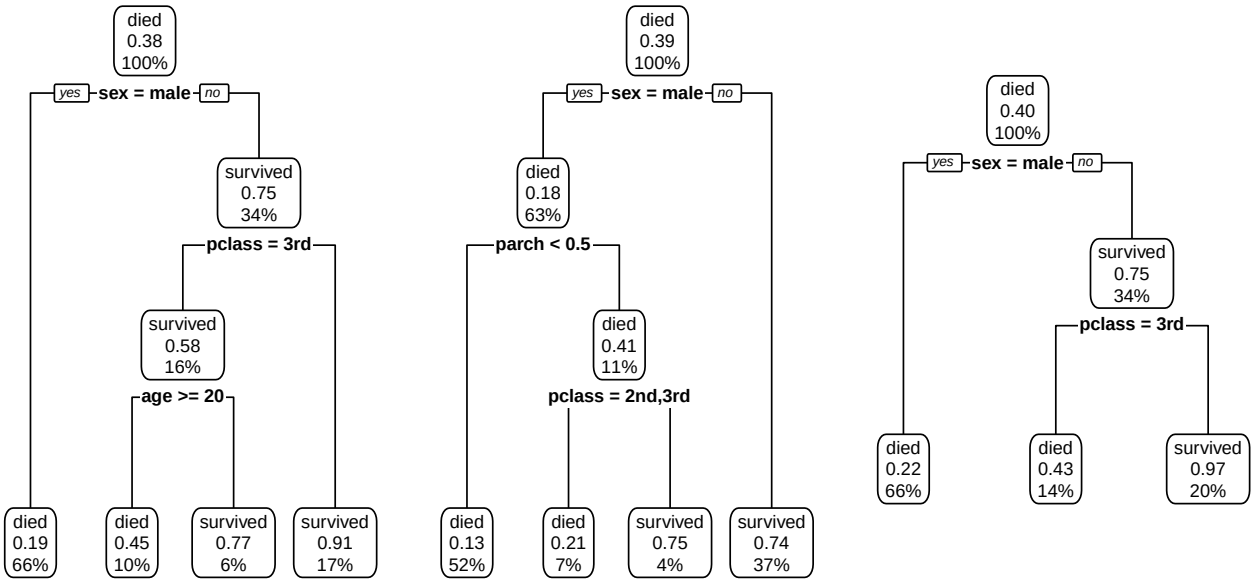
Predict the outcome of `survived` for the following three test passengers:

pclass	sex	age	sibsp	parch
1st	male	71	0	0
1st	female	48	1	0
2nd	male	3	1	1

Exercise 8

A bagged tree model (using a total of 3 trees) was fit to training data for a classification problem. Below is a sample of the data used, where `survived` is the response. We are attempting to predict the survival status of passengers of the Titanic:

pclass	survived	sex	age	sibsp	parch
1st	survived	female	29.0000	0	0
1st	survived	male	0.9167	1	2
1st	died	female	2.0000	1	2
1st	died	male	30.0000	1	2
1st	died	female	25.0000	1	2

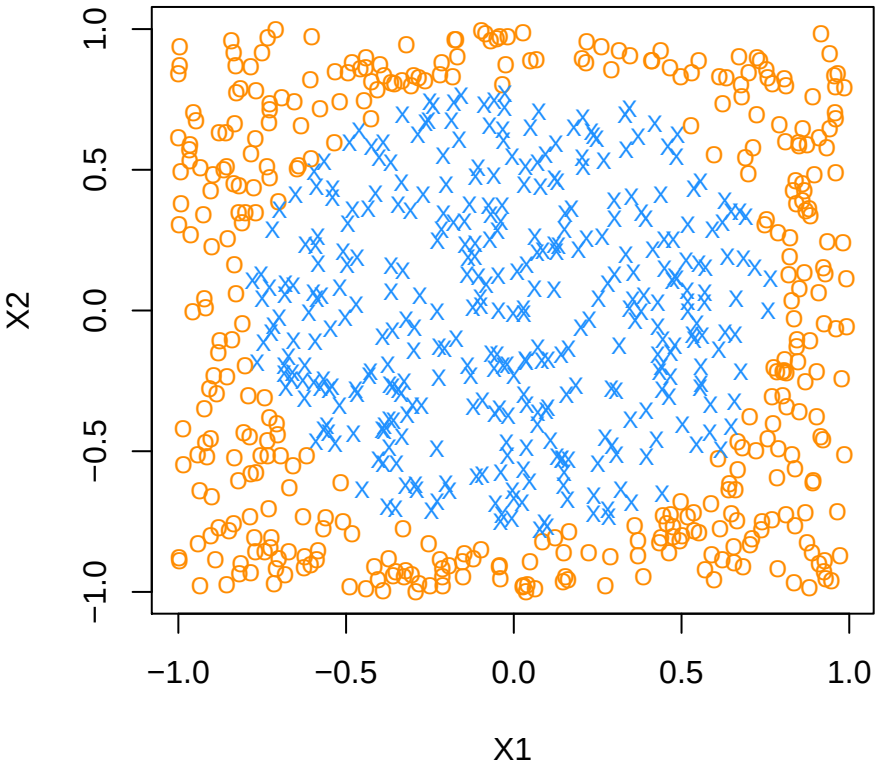


Predict the outcome of `survived`, and predicted probability of surviving for the following test passengers:

pclass	sex	age	sibsp	parch
1st	male	71	0	0
1st	female	48	1	0

Exercise 9

Consider fitting classification methods to the data in the plot below. For each part below, specify which of the two methods will perform better.



(a) Additive Logistic Regression or k-Nearest Neighbors?

(b) Additive Logistic Regression or a single Decision Tree?

(c) Additive Logistic Regression or a Random Forest?

(d) A single decision tree or a Random Forest?

Solutions

- 1. B
- 2. A
- 3. A
- 4. Test: U-shaped. Train: Decrease as s increases.
- 5. Increase.
- 6. Decrease.
- 7. Died. Survived. Survived.
- 8. Died. (0.18) Survived. (0.8733)
- 9. KNN. Tree. RF. RF.