HW2 - STAT 4510/7510 - Spring 2024

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Due Wednesday, Feb. 7, 11:30 pm (upload PDF to Canvas)

Instructions: Please list your name and student number clearly. In order to receive credit for a problem, your solution must show sufficient detail so that the grader can determine how you obtained your answer.

Use R Markdown to create a WORD file. Before submitting, make sure you convert the WORD file to a PDF. All R code should be included, as well as all output produced. Upload your work to the Canvas course site.

Problem 1

Complete Chapter 2, problem 8 (p. 54), parts (a), (b), (c.i), (c.ii), and (c.iii). You need not complete the remaining parts or beyond sub-part (iii) of part (c).

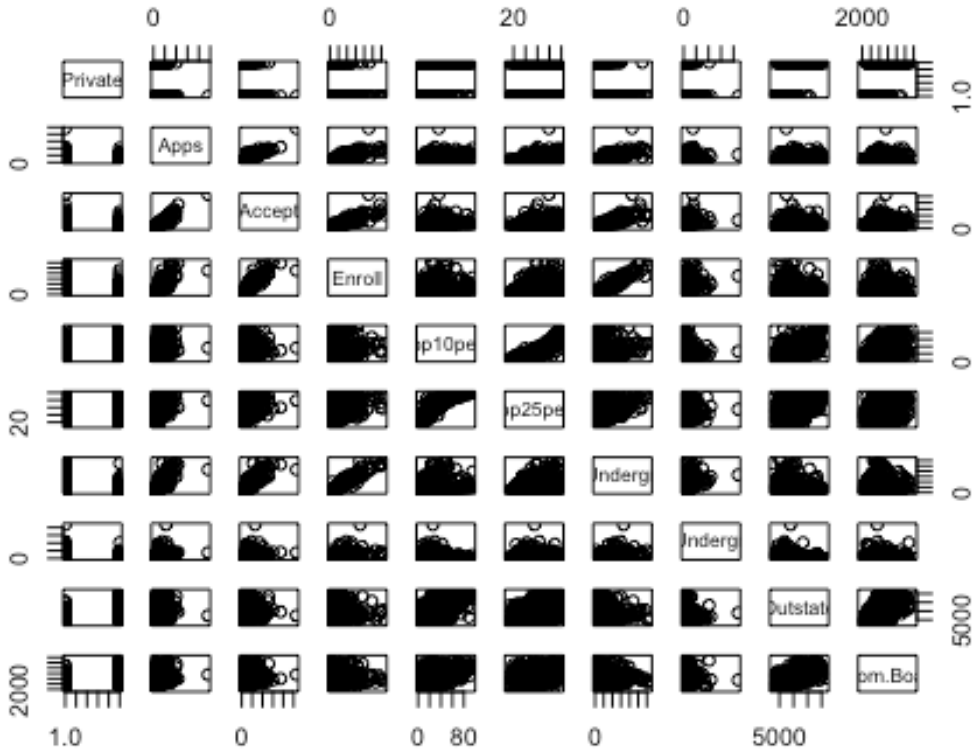
```
library(e1071)
library(caTools)
library(class)

college<-read.csv("College.csv")
rownames(college)<-college[,1]
View(college)
college<-college[,-1]
View(college)
summary(college)
```

```
##    Private                 Apps           Accept          Enroll
##  Length:777         Min.   :   81   Min.   :   72   Min.   :  35
##  Class :character   1st Qu.:  776   1st Qu.:  604   1st Qu.: 242
##  Mode  :character   Median : 1558   Median : 1110   Median : 434
##                     Mean   : 3002   Mean   : 2019   Mean   : 780
##                     3rd Qu.: 3624   3rd Qu.: 2424   3rd Qu.: 902
##                     Max.   :48094   Max.   :26330   Max.   :6392
##    Top10perc       Top25perc      F.Undergrad     P.Undergrad
##  Min.   : 1.00   Min.   :  9.0   Min.   :  139   Min.   :    1.0
##  1st Qu.:15.00   1st Qu.: 41.0   1st Qu.:  992   1st Qu.:   95.0
##  Median :23.00   Median : 54.0   Median : 1707   Median :  353.0
##  Mean   :27.56   Mean   : 55.8   Mean   : 3700   Mean   :  855.3
##  3rd Qu.:35.00   3rd Qu.: 69.0   3rd Qu.: 4005   3rd Qu.:  967.0
##  Max.   :96.00   Max.   :100.0   Max.   :31643   Max.   :21836.0
##     Outstate       Room.Board       Books           Personal
##  Min.   : 2340   Min.   :1780   Min.   :  96.0   Min.   : 250
##  1st Qu.: 7320   1st Qu.:3597   1st Qu.: 470.0   1st Qu.: 850
##  Median : 9990   Median :4200   Median : 500.0   Median :1200
```

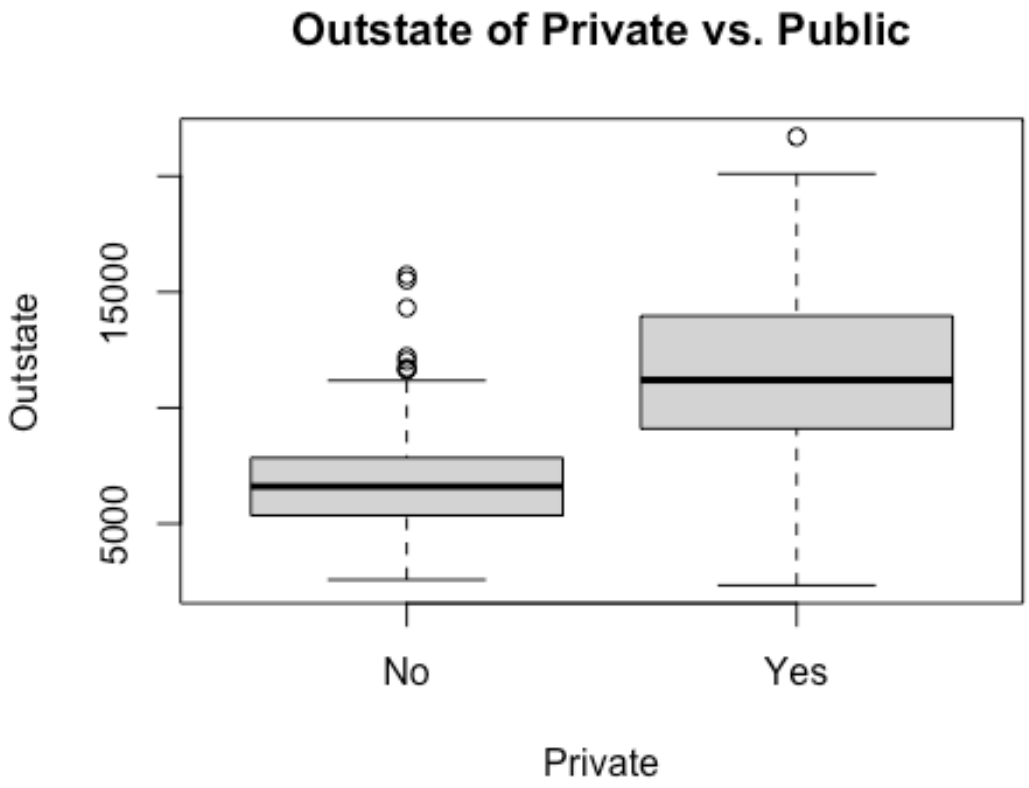
```
##  Mean   :10441   Mean   :4358   Mean   : 549.4   Mean   :1341
##  3rd Qu.:12925   3rd Qu.:5050   3rd Qu.: 600.0   3rd Qu.:1700
##  Max.   :21700   Max.   :8124   Max.   :2340.0   Max.   :6800
##       PhD            Terminal       S.F.Ratio      perc.alumni
##  Min.   :  8.00   Min.   : 24.0   Min.   : 2.50   Min.   : 0.00
##  1st Qu.: 62.00   1st Qu.: 71.0   1st Qu.:11.50   1st Qu.:13.00
##  Median : 75.00   Median : 82.0   Median :13.60   Median :21.00
##  Mean   : 72.66   Mean   : 79.7   Mean   :14.09   Mean   :22.74
##  3rd Qu.: 85.00   3rd Qu.: 92.0   3rd Qu.:16.50   3rd Qu.:31.00
##  Max.   :103.00   Max.   :100.0   Max.   :39.80   Max.   :64.00
##      Expend         Grad.Rate
##  Min.   : 3186   Min.   : 10.00
##  1st Qu.: 6751   1st Qu.: 53.00
##  Median : 8377   Median : 65.00
##  Mean   : 9660   Mean   : 65.46
##  3rd Qu.:10830   3rd Qu.: 78.00
##  Max.   :56233   Max.   :118.00
```

```
college$Private<-as.factor(college$Private)
pairs(college[,1:10])
```




```
plot(college$Private,college$Outstate,
     main = "Outstate of Private vs. Public",
```

```
     xlab = "Private",
     ylab = "Outstate")
```



Problem 2

Continue working with the `College.csv` data set from problem 1.

(a) Split the data into a 80% training and 20% test set. Set a seed of 10 for consistent results. How many observations are in each of the two sets?

```
set.seed(10)
split<-sample.split(college,SplitRatio = 0.8)

training_set<-subset(college, split == TRUE)
test_set<-subset(college, split == FALSE)

nrow(training_set)

## [1] 605

nrow(test_set)

## [1] 172
```

There is a total of 605 of observations in the training set and 172 observations in the test set.

(b) We want to try to predict whether a college is private using K nearest neighbors. Install the `class` package (if you haven't already done so), and remember to run `library(class)`, which contains the `knn()` function. Change `Private` to a factor variable. Then predict the classes of your test set using the `knn()` function with `k=8`. What is the misclassification rate?

```
train_scale<-scale(training_set[,-1])
test_scale<-scale(test_set[,-1])

classifier_knn<-knn(train=train_scale,
                    test=test_scale,
                    cl=training_set$Private,
                    k=8)

cm<-table(test_set$Private, classifier_knn)


misClassError<- 1 - (sum(diag(cm)) / sum(cm))
print(paste('Misclassification Rate = ',misClassError))

## [1] "Misclassification Rate =  0.0813953488372093"
```

The misclassification rate for k=8 is approximately 0.08.

(c) Repeat the KNN analysis using a values of `k = 5`, `k = 10`, `k = 15`, and `k = 20`. Find the misclassification rate for each value of k and comment on your results.

```
k_values <- c(5, 10, 15, 20)

knn_classifier <- sapply(k_values, function(k) {
  classifier_knn <- knn(train = train_scale,
                        test = test_scale,
                        cl = training_set$Private,
                        k = k)
  cm <- table(test_set$Private, classifier_knn)

  misClassError <- 1 - (sum(diag(cm)) / sum(cm))
})

accuracy_data <- data.frame(K = k_values, Accuracy = 1 - knn_classifier)

print(accuracy_data)

##    K  Accuracy
## 1  5 0.9244186
## 2 10 0.9302326
## 3 15 0.9244186
## 4 20 0.9244186
```

Out of the 4 K values, highest misclassification rate are when K = 10 and k = 5, 15, 20 have the same misclassification rate.