Homework\_1

Lastname\_Firstname

2023-01-27

## 1.

* You do not need to turn anything in for this.

## 2.

### ISLR Chapter 2 Conceptual Exercise 1 (5 pts)

### (a)

Better and more flexible since the sample size is large and having a low number of predictors. Since this is true, its better than an inflexible method and will perform better.

### (b)

Worse and less flexible/inflexible since the observations are small, along with a large number of predictors. This means it would also overfit the model and not perform well.

### (c)

Better and more flexible since since the relationship between the predictor and response is highly non-linear. This means the data would perform well and have more degrees of freedom. Measuring how much the predictions depend on the response values- relationship making it more flexible and being a jumpy model.

### (d)

Worst and less flexible/inflexible since the var of error is usually non-constant and may increase with the value of the response and variance. This means the error terms would not perform well and overfit from high variance.

### ISLR Chapter 2 Conceptual Exercise 2 (5 pts)

### (a)

Regression problem based on the measurements of salary/wages/etc.Interested inference since we are measuring variables based on the relationship for the CEO. n = 500 for total, # of firms in the data collected p = 3 for profit, # of employees, and industry

### (b)

Classification problem based on binary outcomes, which also tells us its a prediction problem. n = 20 # of products p = 13 for 10 other variables, price charged for product, marketing budget, and competition price.

### (c)

Regression and prediction based on the weekly data and recording in the % of change in the markets. n = 52 in # of weeks of a year p = 3 for the % change in the US market, the % change in the British market, and the % change in the German market

### ISLR Chapter 2 Conceptual Exercise 5 (5 pts)

## 3. (5 pts)

Regression or Classification:

Very flexible advantages: with enough data-predictors can be very accurate and it decreases the bias, fit data well, low MSE

less flexible disadvantages: requires significant amount of data, limited ability to do inference, computing f estimate may be expensive, overfitting and increase variance, harder to understand scientifically

More flexible would be better with more data or has non-linearity, while inflexible would be better with less data with few variables or has linear patterns.

## 4.

Regression -> Classification - Change the response variable from continuous to categorical

We could take the CEO salary and putting the salary into certain categories like $0-10,000, $10000-50000, $50000-10000, etc.

Classification -> Regression - Change the response variable from categorical to continuous

We could change the success or failure into probability percentages like 0-100% for each product and give the price equivalent for the profit.

Regression -> Classification - Change the response variable from continuous to categorical

We could change the % change of the weekly exchange rate into categories like putting into 0-10%, 10-20%, 20-30%, 30-40%, etc.

### ISLR Chapter 2 Applied Exercise 8 (10 pts)

### (a)

college <- read.csv("College.csv")

### (b)

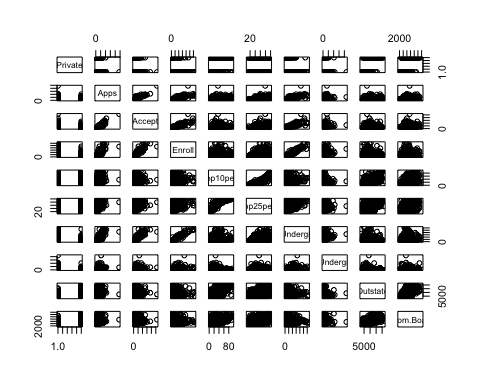
rownames(college) <- college[, 1]  
View(college)  
  
college <- college[, -1]  
View(college)

### (c)

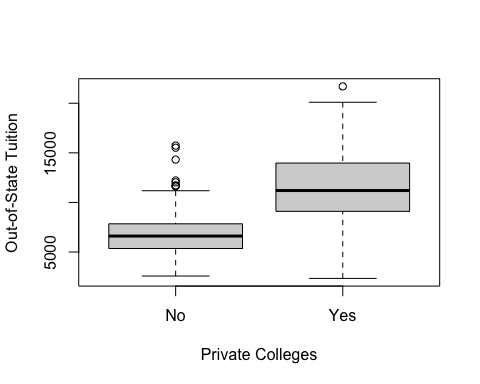
summary(college)

## 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) #quantitative response is only private so change this variable  
pairs(college[, 1:10])



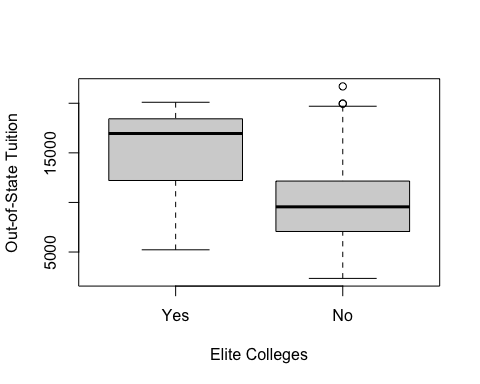
plot(Outstate ~ Private, data = college, xlab = "Private Colleges", ylab = "Out-of-State Tuition")



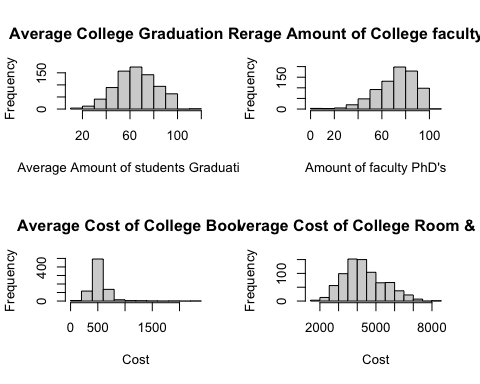
Elite <- rep ("No", nrow(college))  
Elite[college$Top10perc > 50] <- " Yes "  
Elite <- as.factor(Elite)  
college <- data.frame(college , Elite)  
  
summary(Elite)

## Yes No   
## 78 699

plot(Outstate ~ Elite, data = college, xlab = "Elite Colleges", ylab = "Out-of-State Tuition")

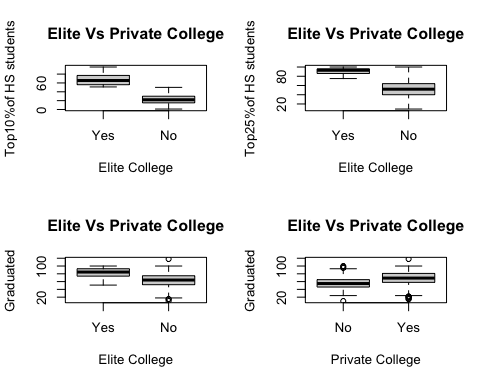


par(mfrow = c(2, 2))  
  
hist(college$Grad.Rate, main = "Average College Graduation Rate", xlab = "Average Amount of students Graduating")  
hist(college$PhD, main = "Average Amount of College faculty PhD's", xlab = "Amount of faculty PhD's")  
hist(college$Books, main = "Average Cost of College Books", xlab = "Cost")  
hist(college$Room.Board, main = "Average Cost of College Room & Board", xlab = "Cost")



Exploting more

par(mfrow = c(2, 2))  
  
plot(college$Top10perc ~ college$Elite, main ="Elite Vs Private College", xlab="Elite College", ylab = "Top10%of HS students")  
plot(college$Top25perc ~ college$Elite, main ="Elite Vs Private College", xlab="Elite College", ylab = "Top25%of HS students")  
  
plot(college$Grad.Rate ~ college$Elite, main ="Elite Vs Private College", xlab="Elite College", ylab = "Graduated")  
plot(college$Grad.Rate ~ college$Private, main ="Elite Vs Private College", xlab="Private College", ylab = "Graduated")



Brief Summary:

After exploring the data, we found out that there are both positives and negatives in attending a Private or Elite college. In the box plots above, we can see that most top 10% of high school students tend to attend elite colleges but a low percentage tend to not accept for various reasons we don’t know. Another factor was finding out how top 25% of high schools students and their attendance rate towards elite college, and we found out that they tend to increasingly accept into elite colleges compared to their counterparts at 10% of high school students. Additionally, we found out that the graduation rate at elite colleges tend to be high than those at private colleges but their are many outliers to this exception.

### ISLR Chapter 2 Applied Exercise 9 (10 pts)

### (a)

Quantitative: mpg, cylinders, displacement, horsepower, weight, acceleration, year Qualitative: origin, name

library(ISLR)  
#na.string gets rid of unwanted 'strings' like ? in this data   
auto <- read.csv("Auto.csv", na.strings = "?")   
  
auto <- na.omit(auto)

### (b) ask about

sapply(auto[, 1:7], range)

## mpg cylinders displacement horsepower weight acceleration year  
## [1,] 9.0 3 68 46 1613 8.0 70  
## [2,] 46.6 8 455 230 5140 24.8 82

### (c)

sapply(auto[, 1:7], mean)

## mpg cylinders displacement horsepower weight acceleration   
## 23.445918 5.471939 194.411990 104.469388 2977.584184 15.541327   
## year   
## 75.979592

sapply(auto[, 1:7], sd)

## mpg cylinders displacement horsepower weight acceleration   
## 7.805007 1.705783 104.644004 38.491160 849.402560 2.758864   
## year   
## 3.683737

### (d)

set <- auto[-c(10:85), c(1:7)]  
sapply(set, range)

## mpg cylinders displacement horsepower weight acceleration year  
## [1,] 11.0 3 68 46 1649 8.5 70  
## [2,] 46.6 8 455 230 4997 24.8 82

sapply(set, mean)

## mpg cylinders displacement horsepower weight acceleration   
## 24.404430 5.373418 187.240506 100.721519 2935.971519 15.726899   
## year   
## 77.145570

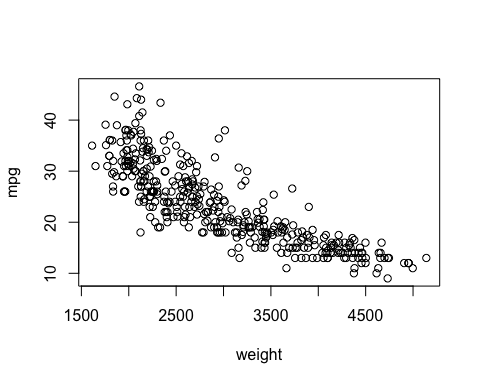
sapply(set, sd)

## mpg cylinders displacement horsepower weight acceleration   
## 7.867283 1.654179 99.678367 35.708853 811.300208 2.693721   
## year   
## 3.106217

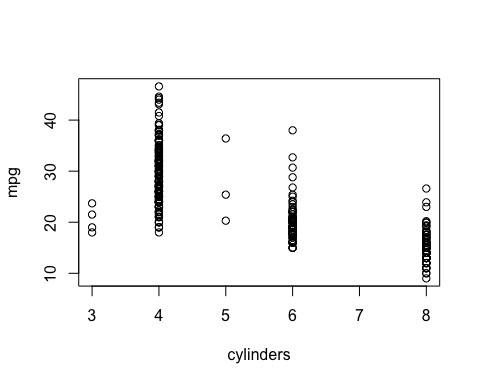
### (e)

It seems that more weight means that we have less mpg, more cylinders equals less mpg, more horsepower equals to less mpg, and it seems cars mpg has become more efficient over the years, espcially in the 80’s.

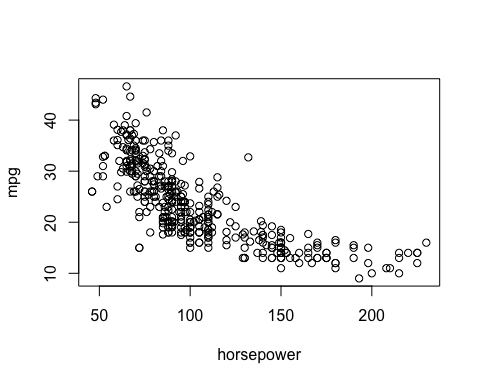
plot(mpg ~ weight, data = auto)



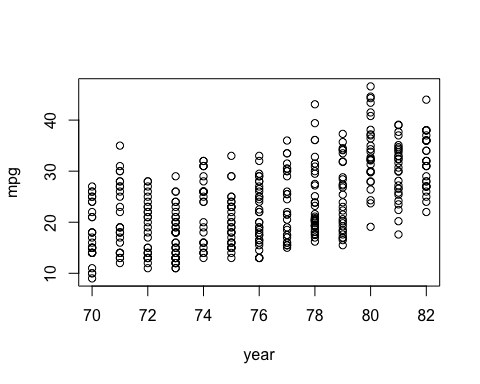
plot(mpg ~ cylinders, data = auto)



plot(mpg ~ horsepower, data = auto)



plot(mpg ~ year, data = auto)



### (f)

Yes, since we can see that a lot of the predictor variables shown give us a relationships that we could trust, especially year. But some may not based so we should be careful of overfitting a model. For example, mpg has a strong, linear relationship with horsepower and weight.

### ISLR Chapter 2 Applied Exercise 10 (10 pts)

### (a)

“A data frame with 506 rows and 13 variables.” 506 rows + 13 columns “A data set containing housing values in 506 suburbs of Boston.”

library(ISLR2)

##   
## Attaching package: 'ISLR2'

## The following objects are masked from 'package:ISLR':  
##   
## Auto, Credit

Boston

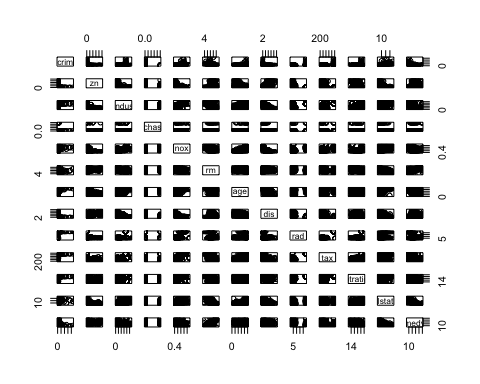
## crim zn indus chas nox rm age dis rad tax ptratio lstat  
## 1 0.00632 18.0 2.31 0 0.5380 6.575 65.2 4.0900 1 296 15.3 4.98  
## 2 0.02731 0.0 7.07 0 0.4690 6.421 78.9 4.9671 2 242 17.8 9.14  
## 3 0.02729 0.0 7.07 0 0.4690 7.185 61.1 4.9671 2 242 17.8 4.03  
## 4 0.03237 0.0 2.18 0 0.4580 6.998 45.8 6.0622 3 222 18.7 2.94  
## 5 0.06905 0.0 2.18 0 0.4580 7.147 54.2 6.0622 3 222 18.7 5.33  
## 6 0.02985 0.0 2.18 0 0.4580 6.430 58.7 6.0622 3 222 18.7 5.21  
## 7 0.08829 12.5 7.87 0 0.5240 6.012 66.6 5.5605 5 311 15.2 12.43  
## 8 0.14455 12.5 7.87 0 0.5240 6.172 96.1 5.9505 5 311 15.2 19.15  
## 9 0.21124 12.5 7.87 0 0.5240 5.631 100.0 6.0821 5 311 15.2 29.93  
## 10 0.17004 12.5 7.87 0 0.5240 6.004 85.9 6.5921 5 311 15.2 17.10  
## 11 0.22489 12.5 7.87 0 0.5240 6.377 94.3 6.3467 5 311 15.2 20.45  
## 12 0.11747 12.5 7.87 0 0.5240 6.009 82.9 6.2267 5 311 15.2 13.27  
## 13 0.09378 12.5 7.87 0 0.5240 5.889 39.0 5.4509 5 311 15.2 15.71  
## 14 0.62976 0.0 8.14 0 0.5380 5.949 61.8 4.7075 4 307 21.0 8.26  
## 15 0.63796 0.0 8.14 0 0.5380 6.096 84.5 4.4619 4 307 21.0 10.26  
## 16 0.62739 0.0 8.14 0 0.5380 5.834 56.5 4.4986 4 307 21.0 8.47  
## 17 1.05393 0.0 8.14 0 0.5380 5.935 29.3 4.4986 4 307 21.0 6.58  
## 18 0.78420 0.0 8.14 0 0.5380 5.990 81.7 4.2579 4 307 21.0 14.67  
## 19 0.80271 0.0 8.14 0 0.5380 5.456 36.6 3.7965 4 307 21.0 11.69  
## 20 0.72580 0.0 8.14 0 0.5380 5.727 69.5 3.7965 4 307 21.0 11.28  
## 21 1.25179 0.0 8.14 0 0.5380 5.570 98.1 3.7979 4 307 21.0 21.02  
## 22 0.85204 0.0 8.14 0 0.5380 5.965 89.2 4.0123 4 307 21.0 13.83  
## 23 1.23247 0.0 8.14 0 0.5380 6.142 91.7 3.9769 4 307 21.0 18.72  
## 24 0.98843 0.0 8.14 0 0.5380 5.813 100.0 4.0952 4 307 21.0 19.88  
## 25 0.75026 0.0 8.14 0 0.5380 5.924 94.1 4.3996 4 307 21.0 16.30  
## 26 0.84054 0.0 8.14 0 0.5380 5.599 85.7 4.4546 4 307 21.0 16.51  
## 27 0.67191 0.0 8.14 0 0.5380 5.813 90.3 4.6820 4 307 21.0 14.81  
## 28 0.95577 0.0 8.14 0 0.5380 6.047 88.8 4.4534 4 307 21.0 17.28  
## 29 0.77299 0.0 8.14 0 0.5380 6.495 94.4 4.4547 4 307 21.0 12.80  
## 30 1.00245 0.0 8.14 0 0.5380 6.674 87.3 4.2390 4 307 21.0 11.98  
## 31 1.13081 0.0 8.14 0 0.5380 5.713 94.1 4.2330 4 307 21.0 22.60  
## 32 1.35472 0.0 8.14 0 0.5380 6.072 100.0 4.1750 4 307 21.0 13.04  
## 33 1.38799 0.0 8.14 0 0.5380 5.950 82.0 3.9900 4 307 21.0 27.71  
## 34 1.15172 0.0 8.14 0 0.5380 5.701 95.0 3.7872 4 307 21.0 18.35  
## 35 1.61282 0.0 8.14 0 0.5380 6.096 96.9 3.7598 4 307 21.0 20.34  
## 36 0.06417 0.0 5.96 0 0.4990 5.933 68.2 3.3603 5 279 19.2 9.68  
## 37 0.09744 0.0 5.96 0 0.4990 5.841 61.4 3.3779 5 279 19.2 11.41  
## 38 0.08014 0.0 5.96 0 0.4990 5.850 41.5 3.9342 5 279 19.2 8.77  
## 39 0.17505 0.0 5.96 0 0.4990 5.966 30.2 3.8473 5 279 19.2 10.13  
## 40 0.02763 75.0 2.95 0 0.4280 6.595 21.8 5.4011 3 252 18.3 4.32  
## 41 0.03359 75.0 2.95 0 0.4280 7.024 15.8 5.4011 3 252 18.3 1.98  
## 42 0.12744 0.0 6.91 0 0.4480 6.770 2.9 5.7209 3 233 17.9 4.84  
## 43 0.14150 0.0 6.91 0 0.4480 6.169 6.6 5.7209 3 233 17.9 5.81  
## 44 0.15936 0.0 6.91 0 0.4480 6.211 6.5 5.7209 3 233 17.9 7.44  
## 45 0.12269 0.0 6.91 0 0.4480 6.069 40.0 5.7209 3 233 17.9 9.55  
## 46 0.17142 0.0 6.91 0 0.4480 5.682 33.8 5.1004 3 233 17.9 10.21  
## 47 0.18836 0.0 6.91 0 0.4480 5.786 33.3 5.1004 3 233 17.9 14.15  
## 48 0.22927 0.0 6.91 0 0.4480 6.030 85.5 5.6894 3 233 17.9 18.80  
## 49 0.25387 0.0 6.91 0 0.4480 5.399 95.3 5.8700 3 233 17.9 30.81  
## 50 0.21977 0.0 6.91 0 0.4480 5.602 62.0 6.0877 3 233 17.9 16.20  
## 51 0.08873 21.0 5.64 0 0.4390 5.963 45.7 6.8147 4 243 16.8 13.45  
## 52 0.04337 21.0 5.64 0 0.4390 6.115 63.0 6.8147 4 243 16.8 9.43  
## 53 0.05360 21.0 5.64 0 0.4390 6.511 21.1 6.8147 4 243 16.8 5.28  
## 54 0.04981 21.0 5.64 0 0.4390 5.998 21.4 6.8147 4 243 16.8 8.43  
## 55 0.01360 75.0 4.00 0 0.4100 5.888 47.6 7.3197 3 469 21.1 14.80  
## 56 0.01311 90.0 1.22 0 0.4030 7.249 21.9 8.6966 5 226 17.9 4.81  
## 57 0.02055 85.0 0.74 0 0.4100 6.383 35.7 9.1876 2 313 17.3 5.77  
## 58 0.01432 100.0 1.32 0 0.4110 6.816 40.5 8.3248 5 256 15.1 3.95  
## 59 0.15445 25.0 5.13 0 0.4530 6.145 29.2 7.8148 8 284 19.7 6.86  
## 60 0.10328 25.0 5.13 0 0.4530 5.927 47.2 6.9320 8 284 19.7 9.22  
## 61 0.14932 25.0 5.13 0 0.4530 5.741 66.2 7.2254 8 284 19.7 13.15  
## 62 0.17171 25.0 5.13 0 0.4530 5.966 93.4 6.8185 8 284 19.7 14.44  
## 63 0.11027 25.0 5.13 0 0.4530 6.456 67.8 7.2255 8 284 19.7 6.73  
## 64 0.12650 25.0 5.13 0 0.4530 6.762 43.4 7.9809 8 284 19.7 9.50  
## 65 0.01951 17.5 1.38 0 0.4161 7.104 59.5 9.2229 3 216 18.6 8.05  
## 66 0.03584 80.0 3.37 0 0.3980 6.290 17.8 6.6115 4 337 16.1 4.67  
## 67 0.04379 80.0 3.37 0 0.3980 5.787 31.1 6.6115 4 337 16.1 10.24  
## 68 0.05789 12.5 6.07 0 0.4090 5.878 21.4 6.4980 4 345 18.9 8.10  
## 69 0.13554 12.5 6.07 0 0.4090 5.594 36.8 6.4980 4 345 18.9 13.09  
## 70 0.12816 12.5 6.07 0 0.4090 5.885 33.0 6.4980 4 345 18.9 8.79  
## 71 0.08826 0.0 10.81 0 0.4130 6.417 6.6 5.2873 4 305 19.2 6.72  
## 72 0.15876 0.0 10.81 0 0.4130 5.961 17.5 5.2873 4 305 19.2 9.88  
## 73 0.09164 0.0 10.81 0 0.4130 6.065 7.8 5.2873 4 305 19.2 5.52  
## 74 0.19539 0.0 10.81 0 0.4130 6.245 6.2 5.2873 4 305 19.2 7.54  
## 75 0.07896 0.0 12.83 0 0.4370 6.273 6.0 4.2515 5 398 18.7 6.78  
## 76 0.09512 0.0 12.83 0 0.4370 6.286 45.0 4.5026 5 398 18.7 8.94  
## 77 0.10153 0.0 12.83 0 0.4370 6.279 74.5 4.0522 5 398 18.7 11.97  
## 78 0.08707 0.0 12.83 0 0.4370 6.140 45.8 4.0905 5 398 18.7 10.27  
## 79 0.05646 0.0 12.83 0 0.4370 6.232 53.7 5.0141 5 398 18.7 12.34  
## 80 0.08387 0.0 12.83 0 0.4370 5.874 36.6 4.5026 5 398 18.7 9.10  
## 81 0.04113 25.0 4.86 0 0.4260 6.727 33.5 5.4007 4 281 19.0 5.29  
## 82 0.04462 25.0 4.86 0 0.4260 6.619 70.4 5.4007 4 281 19.0 7.22  
## 83 0.03659 25.0 4.86 0 0.4260 6.302 32.2 5.4007 4 281 19.0 6.72  
## 84 0.03551 25.0 4.86 0 0.4260 6.167 46.7 5.4007 4 281 19.0 7.51  
## 85 0.05059 0.0 4.49 0 0.4490 6.389 48.0 4.7794 3 247 18.5 9.62  
## 86 0.05735 0.0 4.49 0 0.4490 6.630 56.1 4.4377 3 247 18.5 6.53  
## 87 0.05188 0.0 4.49 0 0.4490 6.015 45.1 4.4272 3 247 18.5 12.86  
## 88 0.07151 0.0 4.49 0 0.4490 6.121 56.8 3.7476 3 247 18.5 8.44  
## 89 0.05660 0.0 3.41 0 0.4890 7.007 86.3 3.4217 2 270 17.8 5.50  
## 90 0.05302 0.0 3.41 0 0.4890 7.079 63.1 3.4145 2 270 17.8 5.70  
## 91 0.04684 0.0 3.41 0 0.4890 6.417 66.1 3.0923 2 270 17.8 8.81  
## 92 0.03932 0.0 3.41 0 0.4890 6.405 73.9 3.0921 2 270 17.8 8.20  
## 93 0.04203 28.0 15.04 0 0.4640 6.442 53.6 3.6659 4 270 18.2 8.16  
## 94 0.02875 28.0 15.04 0 0.4640 6.211 28.9 3.6659 4 270 18.2 6.21  
## 95 0.04294 28.0 15.04 0 0.4640 6.249 77.3 3.6150 4 270 18.2 10.59  
## 96 0.12204 0.0 2.89 0 0.4450 6.625 57.8 3.4952 2 276 18.0 6.65  
## 97 0.11504 0.0 2.89 0 0.4450 6.163 69.6 3.4952 2 276 18.0 11.34  
## 98 0.12083 0.0 2.89 0 0.4450 8.069 76.0 3.4952 2 276 18.0 4.21  
## 99 0.08187 0.0 2.89 0 0.4450 7.820 36.9 3.4952 2 276 18.0 3.57  
## 100 0.06860 0.0 2.89 0 0.4450 7.416 62.5 3.4952 2 276 18.0 6.19  
## 101 0.14866 0.0 8.56 0 0.5200 6.727 79.9 2.7778 5 384 20.9 9.42  
## 102 0.11432 0.0 8.56 0 0.5200 6.781 71.3 2.8561 5 384 20.9 7.67  
## 103 0.22876 0.0 8.56 0 0.5200 6.405 85.4 2.7147 5 384 20.9 10.63  
## 104 0.21161 0.0 8.56 0 0.5200 6.137 87.4 2.7147 5 384 20.9 13.44  
## 105 0.13960 0.0 8.56 0 0.5200 6.167 90.0 2.4210 5 384 20.9 12.33  
## 106 0.13262 0.0 8.56 0 0.5200 5.851 96.7 2.1069 5 384 20.9 16.47  
## 107 0.17120 0.0 8.56 0 0.5200 5.836 91.9 2.2110 5 384 20.9 18.66  
## 108 0.13117 0.0 8.56 0 0.5200 6.127 85.2 2.1224 5 384 20.9 14.09  
## 109 0.12802 0.0 8.56 0 0.5200 6.474 97.1 2.4329 5 384 20.9 12.27  
## 110 0.26363 0.0 8.56 0 0.5200 6.229 91.2 2.5451 5 384 20.9 15.55  
## 111 0.10793 0.0 8.56 0 0.5200 6.195 54.4 2.7778 5 384 20.9 13.00  
## 112 0.10084 0.0 10.01 0 0.5470 6.715 81.6 2.6775 6 432 17.8 10.16  
## 113 0.12329 0.0 10.01 0 0.5470 5.913 92.9 2.3534 6 432 17.8 16.21  
## 114 0.22212 0.0 10.01 0 0.5470 6.092 95.4 2.5480 6 432 17.8 17.09  
## 115 0.14231 0.0 10.01 0 0.5470 6.254 84.2 2.2565 6 432 17.8 10.45  
## 116 0.17134 0.0 10.01 0 0.5470 5.928 88.2 2.4631 6 432 17.8 15.76  
## 117 0.13158 0.0 10.01 0 0.5470 6.176 72.5 2.7301 6 432 17.8 12.04  
## 118 0.15098 0.0 10.01 0 0.5470 6.021 82.6 2.7474 6 432 17.8 10.30  
## 119 0.13058 0.0 10.01 0 0.5470 5.872 73.1 2.4775 6 432 17.8 15.37  
## 120 0.14476 0.0 10.01 0 0.5470 5.731 65.2 2.7592 6 432 17.8 13.61  
## 121 0.06899 0.0 25.65 0 0.5810 5.870 69.7 2.2577 2 188 19.1 14.37  
## 122 0.07165 0.0 25.65 0 0.5810 6.004 84.1 2.1974 2 188 19.1 14.27  
## 123 0.09299 0.0 25.65 0 0.5810 5.961 92.9 2.0869 2 188 19.1 17.93  
## 124 0.15038 0.0 25.65 0 0.5810 5.856 97.0 1.9444 2 188 19.1 25.41  
## 125 0.09849 0.0 25.65 0 0.5810 5.879 95.8 2.0063 2 188 19.1 17.58  
## 126 0.16902 0.0 25.65 0 0.5810 5.986 88.4 1.9929 2 188 19.1 14.81  
## 127 0.38735 0.0 25.65 0 0.5810 5.613 95.6 1.7572 2 188 19.1 27.26  
## 128 0.25915 0.0 21.89 0 0.6240 5.693 96.0 1.7883 4 437 21.2 17.19  
## 129 0.32543 0.0 21.89 0 0.6240 6.431 98.8 1.8125 4 437 21.2 15.39  
## 130 0.88125 0.0 21.89 0 0.6240 5.637 94.7 1.9799 4 437 21.2 18.34  
## 131 0.34006 0.0 21.89 0 0.6240 6.458 98.9 2.1185 4 437 21.2 12.60  
## 132 1.19294 0.0 21.89 0 0.6240 6.326 97.7 2.2710 4 437 21.2 12.26  
## 133 0.59005 0.0 21.89 0 0.6240 6.372 97.9 2.3274 4 437 21.2 11.12  
## 134 0.32982 0.0 21.89 0 0.6240 5.822 95.4 2.4699 4 437 21.2 15.03  
## 135 0.97617 0.0 21.89 0 0.6240 5.757 98.4 2.3460 4 437 21.2 17.31  
## 136 0.55778 0.0 21.89 0 0.6240 6.335 98.2 2.1107 4 437 21.2 16.96  
## 137 0.32264 0.0 21.89 0 0.6240 5.942 93.5 1.9669 4 437 21.2 16.90  
## 138 0.35233 0.0 21.89 0 0.6240 6.454 98.4 1.8498 4 437 21.2 14.59  
## 139 0.24980 0.0 21.89 0 0.6240 5.857 98.2 1.6686 4 437 21.2 21.32  
## 140 0.54452 0.0 21.89 0 0.6240 6.151 97.9 1.6687 4 437 21.2 18.46  
## 141 0.29090 0.0 21.89 0 0.6240 6.174 93.6 1.6119 4 437 21.2 24.16  
## 142 1.62864 0.0 21.89 0 0.6240 5.019 100.0 1.4394 4 437 21.2 34.41  
## 143 3.32105 0.0 19.58 1 0.8710 5.403 100.0 1.3216 5 403 14.7 26.82  
## 144 4.09740 0.0 19.58 0 0.8710 5.468 100.0 1.4118 5 403 14.7 26.42  
## 145 2.77974 0.0 19.58 0 0.8710 4.903 97.8 1.3459 5 403 14.7 29.29  
## 146 2.37934 0.0 19.58 0 0.8710 6.130 100.0 1.4191 5 403 14.7 27.80  
## 147 2.15505 0.0 19.58 0 0.8710 5.628 100.0 1.5166 5 403 14.7 16.65  
## 148 2.36862 0.0 19.58 0 0.8710 4.926 95.7 1.4608 5 403 14.7 29.53  
## 149 2.33099 0.0 19.58 0 0.8710 5.186 93.8 1.5296 5 403 14.7 28.32  
## 150 2.73397 0.0 19.58 0 0.8710 5.597 94.9 1.5257 5 403 14.7 21.45  
## 151 1.65660 0.0 19.58 0 0.8710 6.122 97.3 1.6180 5 403 14.7 14.10  
## 152 1.49632 0.0 19.58 0 0.8710 5.404 100.0 1.5916 5 403 14.7 13.28  
## 153 1.12658 0.0 19.58 1 0.8710 5.012 88.0 1.6102 5 403 14.7 12.12  
## 154 2.14918 0.0 19.58 0 0.8710 5.709 98.5 1.6232 5 403 14.7 15.79  
## 155 1.41385 0.0 19.58 1 0.8710 6.129 96.0 1.7494 5 403 14.7 15.12  
## 156 3.53501 0.0 19.58 1 0.8710 6.152 82.6 1.7455 5 403 14.7 15.02  
## 157 2.44668 0.0 19.58 0 0.8710 5.272 94.0 1.7364 5 403 14.7 16.14  
## 158 1.22358 0.0 19.58 0 0.6050 6.943 97.4 1.8773 5 403 14.7 4.59  
## 159 1.34284 0.0 19.58 0 0.6050 6.066 100.0 1.7573 5 403 14.7 6.43  
## 160 1.42502 0.0 19.58 0 0.8710 6.510 100.0 1.7659 5 403 14.7 7.39  
## 161 1.27346 0.0 19.58 1 0.6050 6.250 92.6 1.7984 5 403 14.7 5.50  
## 162 1.46336 0.0 19.58 0 0.6050 7.489 90.8 1.9709 5 403 14.7 1.73  
## 163 1.83377 0.0 19.58 1 0.6050 7.802 98.2 2.0407 5 403 14.7 1.92  
## 164 1.51902 0.0 19.58 1 0.6050 8.375 93.9 2.1620 5 403 14.7 3.32  
## 165 2.24236 0.0 19.58 0 0.6050 5.854 91.8 2.4220 5 403 14.7 11.64  
## 166 2.92400 0.0 19.58 0 0.6050 6.101 93.0 2.2834 5 403 14.7 9.81  
## 167 2.01019 0.0 19.58 0 0.6050 7.929 96.2 2.0459 5 403 14.7 3.70  
## 168 1.80028 0.0 19.58 0 0.6050 5.877 79.2 2.4259 5 403 14.7 12.14  
## 169 2.30040 0.0 19.58 0 0.6050 6.319 96.1 2.1000 5 403 14.7 11.10  
## 170 2.44953 0.0 19.58 0 0.6050 6.402 95.2 2.2625 5 403 14.7 11.32  
## 171 1.20742 0.0 19.58 0 0.6050 5.875 94.6 2.4259 5 403 14.7 14.43  
## 172 2.31390 0.0 19.58 0 0.6050 5.880 97.3 2.3887 5 403 14.7 12.03  
## 173 0.13914 0.0 4.05 0 0.5100 5.572 88.5 2.5961 5 296 16.6 14.69  
## 174 0.09178 0.0 4.05 0 0.5100 6.416 84.1 2.6463 5 296 16.6 9.04  
## 175 0.08447 0.0 4.05 0 0.5100 5.859 68.7 2.7019 5 296 16.6 9.64  
## 176 0.06664 0.0 4.05 0 0.5100 6.546 33.1 3.1323 5 296 16.6 5.33  
## 177 0.07022 0.0 4.05 0 0.5100 6.020 47.2 3.5549 5 296 16.6 10.11  
## 178 0.05425 0.0 4.05 0 0.5100 6.315 73.4 3.3175 5 296 16.6 6.29  
## 179 0.06642 0.0 4.05 0 0.5100 6.860 74.4 2.9153 5 296 16.6 6.92  
## 180 0.05780 0.0 2.46 0 0.4880 6.980 58.4 2.8290 3 193 17.8 5.04  
## 181 0.06588 0.0 2.46 0 0.4880 7.765 83.3 2.7410 3 193 17.8 7.56  
## 182 0.06888 0.0 2.46 0 0.4880 6.144 62.2 2.5979 3 193 17.8 9.45  
## 183 0.09103 0.0 2.46 0 0.4880 7.155 92.2 2.7006 3 193 17.8 4.82  
## 184 0.10008 0.0 2.46 0 0.4880 6.563 95.6 2.8470 3 193 17.8 5.68  
## 185 0.08308 0.0 2.46 0 0.4880 5.604 89.8 2.9879 3 193 17.8 13.98  
## 186 0.06047 0.0 2.46 0 0.4880 6.153 68.8 3.2797 3 193 17.8 13.15  
## 187 0.05602 0.0 2.46 0 0.4880 7.831 53.6 3.1992 3 193 17.8 4.45  
## 188 0.07875 45.0 3.44 0 0.4370 6.782 41.1 3.7886 5 398 15.2 6.68  
## 189 0.12579 45.0 3.44 0 0.4370 6.556 29.1 4.5667 5 398 15.2 4.56  
## 190 0.08370 45.0 3.44 0 0.4370 7.185 38.9 4.5667 5 398 15.2 5.39  
## 191 0.09068 45.0 3.44 0 0.4370 6.951 21.5 6.4798 5 398 15.2 5.10  
## 192 0.06911 45.0 3.44 0 0.4370 6.739 30.8 6.4798 5 398 15.2 4.69  
## 193 0.08664 45.0 3.44 0 0.4370 7.178 26.3 6.4798 5 398 15.2 2.87  
## 194 0.02187 60.0 2.93 0 0.4010 6.800 9.9 6.2196 1 265 15.6 5.03  
## 195 0.01439 60.0 2.93 0 0.4010 6.604 18.8 6.2196 1 265 15.6 4.38  
## 196 0.01381 80.0 0.46 0 0.4220 7.875 32.0 5.6484 4 255 14.4 2.97  
## 197 0.04011 80.0 1.52 0 0.4040 7.287 34.1 7.3090 2 329 12.6 4.08  
## 198 0.04666 80.0 1.52 0 0.4040 7.107 36.6 7.3090 2 329 12.6 8.61  
## 199 0.03768 80.0 1.52 0 0.4040 7.274 38.3 7.3090 2 329 12.6 6.62  
## 200 0.03150 95.0 1.47 0 0.4030 6.975 15.3 7.6534 3 402 17.0 4.56  
## 201 0.01778 95.0 1.47 0 0.4030 7.135 13.9 7.6534 3 402 17.0 4.45  
## 202 0.03445 82.5 2.03 0 0.4150 6.162 38.4 6.2700 2 348 14.7 7.43  
## 203 0.02177 82.5 2.03 0 0.4150 7.610 15.7 6.2700 2 348 14.7 3.11  
## 204 0.03510 95.0 2.68 0 0.4161 7.853 33.2 5.1180 4 224 14.7 3.81  
## 205 0.02009 95.0 2.68 0 0.4161 8.034 31.9 5.1180 4 224 14.7 2.88  
## 206 0.13642 0.0 10.59 0 0.4890 5.891 22.3 3.9454 4 277 18.6 10.87  
## 207 0.22969 0.0 10.59 0 0.4890 6.326 52.5 4.3549 4 277 18.6 10.97  
## 208 0.25199 0.0 10.59 0 0.4890 5.783 72.7 4.3549 4 277 18.6 18.06  
## 209 0.13587 0.0 10.59 1 0.4890 6.064 59.1 4.2392 4 277 18.6 14.66  
## 210 0.43571 0.0 10.59 1 0.4890 5.344 100.0 3.8750 4 277 18.6 23.09  
## 211 0.17446 0.0 10.59 1 0.4890 5.960 92.1 3.8771 4 277 18.6 17.27  
## 212 0.37578 0.0 10.59 1 0.4890 5.404 88.6 3.6650 4 277 18.6 23.98  
## 213 0.21719 0.0 10.59 1 0.4890 5.807 53.8 3.6526 4 277 18.6 16.03  
## 214 0.14052 0.0 10.59 0 0.4890 6.375 32.3 3.9454 4 277 18.6 9.38  
## 215 0.28955 0.0 10.59 0 0.4890 5.412 9.8 3.5875 4 277 18.6 29.55  
## 216 0.19802 0.0 10.59 0 0.4890 6.182 42.4 3.9454 4 277 18.6 9.47  
## 217 0.04560 0.0 13.89 1 0.5500 5.888 56.0 3.1121 5 276 16.4 13.51  
## 218 0.07013 0.0 13.89 0 0.5500 6.642 85.1 3.4211 5 276 16.4 9.69  
## 219 0.11069 0.0 13.89 1 0.5500 5.951 93.8 2.8893 5 276 16.4 17.92  
## 220 0.11425 0.0 13.89 1 0.5500 6.373 92.4 3.3633 5 276 16.4 10.50  
## 221 0.35809 0.0 6.20 1 0.5070 6.951 88.5 2.8617 8 307 17.4 9.71  
## 222 0.40771 0.0 6.20 1 0.5070 6.164 91.3 3.0480 8 307 17.4 21.46  
## 223 0.62356 0.0 6.20 1 0.5070 6.879 77.7 3.2721 8 307 17.4 9.93  
## 224 0.61470 0.0 6.20 0 0.5070 6.618 80.8 3.2721 8 307 17.4 7.60  
## 225 0.31533 0.0 6.20 0 0.5040 8.266 78.3 2.8944 8 307 17.4 4.14  
## 226 0.52693 0.0 6.20 0 0.5040 8.725 83.0 2.8944 8 307 17.4 4.63  
## 227 0.38214 0.0 6.20 0 0.5040 8.040 86.5 3.2157 8 307 17.4 3.13  
## 228 0.41238 0.0 6.20 0 0.5040 7.163 79.9 3.2157 8 307 17.4 6.36  
## 229 0.29819 0.0 6.20 0 0.5040 7.686 17.0 3.3751 8 307 17.4 3.92  
## 230 0.44178 0.0 6.20 0 0.5040 6.552 21.4 3.3751 8 307 17.4 3.76  
## 231 0.53700 0.0 6.20 0 0.5040 5.981 68.1 3.6715 8 307 17.4 11.65  
## 232 0.46296 0.0 6.20 0 0.5040 7.412 76.9 3.6715 8 307 17.4 5.25  
## 233 0.57529 0.0 6.20 0 0.5070 8.337 73.3 3.8384 8 307 17.4 2.47  
## 234 0.33147 0.0 6.20 0 0.5070 8.247 70.4 3.6519 8 307 17.4 3.95  
## 235 0.44791 0.0 6.20 1 0.5070 6.726 66.5 3.6519 8 307 17.4 8.05  
## 236 0.33045 0.0 6.20 0 0.5070 6.086 61.5 3.6519 8 307 17.4 10.88  
## 237 0.52058 0.0 6.20 1 0.5070 6.631 76.5 4.1480 8 307 17.4 9.54  
## 238 0.51183 0.0 6.20 0 0.5070 7.358 71.6 4.1480 8 307 17.4 4.73  
## 239 0.08244 30.0 4.93 0 0.4280 6.481 18.5 6.1899 6 300 16.6 6.36  
## 240 0.09252 30.0 4.93 0 0.4280 6.606 42.2 6.1899 6 300 16.6 7.37  
## 241 0.11329 30.0 4.93 0 0.4280 6.897 54.3 6.3361 6 300 16.6 11.38  
## 242 0.10612 30.0 4.93 0 0.4280 6.095 65.1 6.3361 6 300 16.6 12.40  
## 243 0.10290 30.0 4.93 0 0.4280 6.358 52.9 7.0355 6 300 16.6 11.22  
## 244 0.12757 30.0 4.93 0 0.4280 6.393 7.8 7.0355 6 300 16.6 5.19  
## 245 0.20608 22.0 5.86 0 0.4310 5.593 76.5 7.9549 7 330 19.1 12.50  
## 246 0.19133 22.0 5.86 0 0.4310 5.605 70.2 7.9549 7 330 19.1 18.46  
## 247 0.33983 22.0 5.86 0 0.4310 6.108 34.9 8.0555 7 330 19.1 9.16  
## 248 0.19657 22.0 5.86 0 0.4310 6.226 79.2 8.0555 7 330 19.1 10.15  
## 249 0.16439 22.0 5.86 0 0.4310 6.433 49.1 7.8265 7 330 19.1 9.52  
## 250 0.19073 22.0 5.86 0 0.4310 6.718 17.5 7.8265 7 330 19.1 6.56  
## 251 0.14030 22.0 5.86 0 0.4310 6.487 13.0 7.3967 7 330 19.1 5.90  
## 252 0.21409 22.0 5.86 0 0.4310 6.438 8.9 7.3967 7 330 19.1 3.59  
## 253 0.08221 22.0 5.86 0 0.4310 6.957 6.8 8.9067 7 330 19.1 3.53  
## 254 0.36894 22.0 5.86 0 0.4310 8.259 8.4 8.9067 7 330 19.1 3.54  
## 255 0.04819 80.0 3.64 0 0.3920 6.108 32.0 9.2203 1 315 16.4 6.57  
## 256 0.03548 80.0 3.64 0 0.3920 5.876 19.1 9.2203 1 315 16.4 9.25  
## 257 0.01538 90.0 3.75 0 0.3940 7.454 34.2 6.3361 3 244 15.9 3.11  
## 258 0.61154 20.0 3.97 0 0.6470 8.704 86.9 1.8010 5 264 13.0 5.12  
## 259 0.66351 20.0 3.97 0 0.6470 7.333 100.0 1.8946 5 264 13.0 7.79  
## 260 0.65665 20.0 3.97 0 0.6470 6.842 100.0 2.0107 5 264 13.0 6.90  
## 261 0.54011 20.0 3.97 0 0.6470 7.203 81.8 2.1121 5 264 13.0 9.59  
## 262 0.53412 20.0 3.97 0 0.6470 7.520 89.4 2.1398 5 264 13.0 7.26  
## 263 0.52014 20.0 3.97 0 0.6470 8.398 91.5 2.2885 5 264 13.0 5.91  
## 264 0.82526 20.0 3.97 0 0.6470 7.327 94.5 2.0788 5 264 13.0 11.25  
## 265 0.55007 20.0 3.97 0 0.6470 7.206 91.6 1.9301 5 264 13.0 8.10  
## 266 0.76162 20.0 3.97 0 0.6470 5.560 62.8 1.9865 5 264 13.0 10.45  
## 267 0.78570 20.0 3.97 0 0.6470 7.014 84.6 2.1329 5 264 13.0 14.79  
## 268 0.57834 20.0 3.97 0 0.5750 8.297 67.0 2.4216 5 264 13.0 7.44  
## 269 0.54050 20.0 3.97 0 0.5750 7.470 52.6 2.8720 5 264 13.0 3.16  
## 270 0.09065 20.0 6.96 1 0.4640 5.920 61.5 3.9175 3 223 18.6 13.65  
## 271 0.29916 20.0 6.96 0 0.4640 5.856 42.1 4.4290 3 223 18.6 13.00  
## 272 0.16211 20.0 6.96 0 0.4640 6.240 16.3 4.4290 3 223 18.6 6.59  
## 273 0.11460 20.0 6.96 0 0.4640 6.538 58.7 3.9175 3 223 18.6 7.73  
## 274 0.22188 20.0 6.96 1 0.4640 7.691 51.8 4.3665 3 223 18.6 6.58  
## 275 0.05644 40.0 6.41 1 0.4470 6.758 32.9 4.0776 4 254 17.6 3.53  
## 276 0.09604 40.0 6.41 0 0.4470 6.854 42.8 4.2673 4 254 17.6 2.98  
## 277 0.10469 40.0 6.41 1 0.4470 7.267 49.0 4.7872 4 254 17.6 6.05  
## 278 0.06127 40.0 6.41 1 0.4470 6.826 27.6 4.8628 4 254 17.6 4.16  
## 279 0.07978 40.0 6.41 0 0.4470 6.482 32.1 4.1403 4 254 17.6 7.19  
## 280 0.21038 20.0 3.33 0 0.4429 6.812 32.2 4.1007 5 216 14.9 4.85  
## 281 0.03578 20.0 3.33 0 0.4429 7.820 64.5 4.6947 5 216 14.9 3.76  
## 282 0.03705 20.0 3.33 0 0.4429 6.968 37.2 5.2447 5 216 14.9 4.59  
## 283 0.06129 20.0 3.33 1 0.4429 7.645 49.7 5.2119 5 216 14.9 3.01  
## 284 0.01501 90.0 1.21 1 0.4010 7.923 24.8 5.8850 1 198 13.6 3.16  
## 285 0.00906 90.0 2.97 0 0.4000 7.088 20.8 7.3073 1 285 15.3 7.85  
## 286 0.01096 55.0 2.25 0 0.3890 6.453 31.9 7.3073 1 300 15.3 8.23  
## 287 0.01965 80.0 1.76 0 0.3850 6.230 31.5 9.0892 1 241 18.2 12.93  
## 288 0.03871 52.5 5.32 0 0.4050 6.209 31.3 7.3172 6 293 16.6 7.14  
## 289 0.04590 52.5 5.32 0 0.4050 6.315 45.6 7.3172 6 293 16.6 7.60  
## 290 0.04297 52.5 5.32 0 0.4050 6.565 22.9 7.3172 6 293 16.6 9.51  
## 291 0.03502 80.0 4.95 0 0.4110 6.861 27.9 5.1167 4 245 19.2 3.33  
## 292 0.07886 80.0 4.95 0 0.4110 7.148 27.7 5.1167 4 245 19.2 3.56  
## 293 0.03615 80.0 4.95 0 0.4110 6.630 23.4 5.1167 4 245 19.2 4.70  
## 294 0.08265 0.0 13.92 0 0.4370 6.127 18.4 5.5027 4 289 16.0 8.58  
## 295 0.08199 0.0 13.92 0 0.4370 6.009 42.3 5.5027 4 289 16.0 10.40  
## 296 0.12932 0.0 13.92 0 0.4370 6.678 31.1 5.9604 4 289 16.0 6.27  
## 297 0.05372 0.0 13.92 0 0.4370 6.549 51.0 5.9604 4 289 16.0 7.39  
## 298 0.14103 0.0 13.92 0 0.4370 5.790 58.0 6.3200 4 289 16.0 15.84  
## 299 0.06466 70.0 2.24 0 0.4000 6.345 20.1 7.8278 5 358 14.8 4.97  
## 300 0.05561 70.0 2.24 0 0.4000 7.041 10.0 7.8278 5 358 14.8 4.74  
## 301 0.04417 70.0 2.24 0 0.4000 6.871 47.4 7.8278 5 358 14.8 6.07  
## 302 0.03537 34.0 6.09 0 0.4330 6.590 40.4 5.4917 7 329 16.1 9.50  
## 303 0.09266 34.0 6.09 0 0.4330 6.495 18.4 5.4917 7 329 16.1 8.67  
## 304 0.10000 34.0 6.09 0 0.4330 6.982 17.7 5.4917 7 329 16.1 4.86  
## 305 0.05515 33.0 2.18 0 0.4720 7.236 41.1 4.0220 7 222 18.4 6.93  
## 306 0.05479 33.0 2.18 0 0.4720 6.616 58.1 3.3700 7 222 18.4 8.93  
## 307 0.07503 33.0 2.18 0 0.4720 7.420 71.9 3.0992 7 222 18.4 6.47  
## 308 0.04932 33.0 2.18 0 0.4720 6.849 70.3 3.1827 7 222 18.4 7.53  
## 309 0.49298 0.0 9.90 0 0.5440 6.635 82.5 3.3175 4 304 18.4 4.54  
## 310 0.34940 0.0 9.90 0 0.5440 5.972 76.7 3.1025 4 304 18.4 9.97  
## 311 2.63548 0.0 9.90 0 0.5440 4.973 37.8 2.5194 4 304 18.4 12.64  
## 312 0.79041 0.0 9.90 0 0.5440 6.122 52.8 2.6403 4 304 18.4 5.98  
## 313 0.26169 0.0 9.90 0 0.5440 6.023 90.4 2.8340 4 304 18.4 11.72  
## 314 0.26938 0.0 9.90 0 0.5440 6.266 82.8 3.2628 4 304 18.4 7.90  
## 315 0.36920 0.0 9.90 0 0.5440 6.567 87.3 3.6023 4 304 18.4 9.28  
## 316 0.25356 0.0 9.90 0 0.5440 5.705 77.7 3.9450 4 304 18.4 11.50  
## 317 0.31827 0.0 9.90 0 0.5440 5.914 83.2 3.9986 4 304 18.4 18.33  
## 318 0.24522 0.0 9.90 0 0.5440 5.782 71.7 4.0317 4 304 18.4 15.94  
## 319 0.40202 0.0 9.90 0 0.5440 6.382 67.2 3.5325 4 304 18.4 10.36  
## 320 0.47547 0.0 9.90 0 0.5440 6.113 58.8 4.0019 4 304 18.4 12.73  
## 321 0.16760 0.0 7.38 0 0.4930 6.426 52.3 4.5404 5 287 19.6 7.20  
## 322 0.18159 0.0 7.38 0 0.4930 6.376 54.3 4.5404 5 287 19.6 6.87  
## 323 0.35114 0.0 7.38 0 0.4930 6.041 49.9 4.7211 5 287 19.6 7.70  
## 324 0.28392 0.0 7.38 0 0.4930 5.708 74.3 4.7211 5 287 19.6 11.74  
## 325 0.34109 0.0 7.38 0 0.4930 6.415 40.1 4.7211 5 287 19.6 6.12  
## 326 0.19186 0.0 7.38 0 0.4930 6.431 14.7 5.4159 5 287 19.6 5.08  
## 327 0.30347 0.0 7.38 0 0.4930 6.312 28.9 5.4159 5 287 19.6 6.15  
## 328 0.24103 0.0 7.38 0 0.4930 6.083 43.7 5.4159 5 287 19.6 12.79  
## 329 0.06617 0.0 3.24 0 0.4600 5.868 25.8 5.2146 4 430 16.9 9.97  
## 330 0.06724 0.0 3.24 0 0.4600 6.333 17.2 5.2146 4 430 16.9 7.34  
## 331 0.04544 0.0 3.24 0 0.4600 6.144 32.2 5.8736 4 430 16.9 9.09  
## 332 0.05023 35.0 6.06 0 0.4379 5.706 28.4 6.6407 1 304 16.9 12.43  
## 333 0.03466 35.0 6.06 0 0.4379 6.031 23.3 6.6407 1 304 16.9 7.83  
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## 335 0.03738 0.0 5.19 0 0.5150 6.310 38.5 6.4584 5 224 20.2 6.75  
## 336 0.03961 0.0 5.19 0 0.5150 6.037 34.5 5.9853 5 224 20.2 8.01  
## 337 0.03427 0.0 5.19 0 0.5150 5.869 46.3 5.2311 5 224 20.2 9.80  
## 338 0.03041 0.0 5.19 0 0.5150 5.895 59.6 5.6150 5 224 20.2 10.56  
## 339 0.03306 0.0 5.19 0 0.5150 6.059 37.3 4.8122 5 224 20.2 8.51  
## 340 0.05497 0.0 5.19 0 0.5150 5.985 45.4 4.8122 5 224 20.2 9.74  
## 341 0.06151 0.0 5.19 0 0.5150 5.968 58.5 4.8122 5 224 20.2 9.29  
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## 343 0.02498 0.0 1.89 0 0.5180 6.540 59.7 6.2669 1 422 15.9 8.65  
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## 345 0.03049 55.0 3.78 0 0.4840 6.874 28.1 6.4654 5 370 17.6 4.61  
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## 347 0.06162 0.0 4.39 0 0.4420 5.898 52.3 8.0136 3 352 18.8 12.67  
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## 349 0.01501 80.0 2.01 0 0.4350 6.635 29.7 8.3440 4 280 17.0 5.99  
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## 351 0.06211 40.0 1.25 0 0.4290 6.490 44.4 8.7921 1 335 19.7 5.98  
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## 353 0.07244 60.0 1.69 0 0.4110 5.884 18.5 10.7103 4 411 18.3 7.79  
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## 356 0.10659 80.0 1.91 0 0.4130 5.936 19.5 10.5857 4 334 22.0 5.57  
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## 372 9.23230 0.0 18.10 0 0.6310 6.216 100.0 1.1691 24 666 20.2 9.53  
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## 386 16.81180 0.0 18.10 0 0.7000 5.277 98.1 1.4261 24 666 20.2 30.81  
## 387 24.39380 0.0 18.10 0 0.7000 4.652 100.0 1.4672 24 666 20.2 28.28  
## 388 22.59710 0.0 18.10 0 0.7000 5.000 89.5 1.5184 24 666 20.2 31.99  
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## 400 9.91655 0.0 18.10 0 0.6930 5.852 77.8 1.5004 24 666 20.2 29.97  
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## 402 14.23620 0.0 18.10 0 0.6930 6.343 100.0 1.5741 24 666 20.2 20.32  
## 403 9.59571 0.0 18.10 0 0.6930 6.404 100.0 1.6390 24 666 20.2 20.31  
## 404 24.80170 0.0 18.10 0 0.6930 5.349 96.0 1.7028 24 666 20.2 19.77  
## 405 41.52920 0.0 18.10 0 0.6930 5.531 85.4 1.6074 24 666 20.2 27.38  
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## 408 11.95110 0.0 18.10 0 0.6590 5.608 100.0 1.2852 24 666 20.2 12.13  
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## 410 14.43830 0.0 18.10 0 0.5970 6.852 100.0 1.4655 24 666 20.2 19.78  
## 411 51.13580 0.0 18.10 0 0.5970 5.757 100.0 1.4130 24 666 20.2 10.11  
## 412 14.05070 0.0 18.10 0 0.5970 6.657 100.0 1.5275 24 666 20.2 21.22  
## 413 18.81100 0.0 18.10 0 0.5970 4.628 100.0 1.5539 24 666 20.2 34.37  
## 414 28.65580 0.0 18.10 0 0.5970 5.155 100.0 1.5894 24 666 20.2 20.08  
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## 429 7.36711 0.0 18.10 0 0.6790 6.193 78.1 1.9356 24 666 20.2 21.52  
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## 469 15.57570 0.0 18.10 0 0.5800 5.926 71.0 2.9084 24 666 20.2 18.13  
## 470 13.07510 0.0 18.10 0 0.5800 5.713 56.7 2.8237 24 666 20.2 14.76  
## 471 4.34879 0.0 18.10 0 0.5800 6.167 84.0 3.0334 24 666 20.2 16.29  
## 472 4.03841 0.0 18.10 0 0.5320 6.229 90.7 3.0993 24 666 20.2 12.87  
## 473 3.56868 0.0 18.10 0 0.5800 6.437 75.0 2.8965 24 666 20.2 14.36  
## 474 4.64689 0.0 18.10 0 0.6140 6.980 67.6 2.5329 24 666 20.2 11.66  
## 475 8.05579 0.0 18.10 0 0.5840 5.427 95.4 2.4298 24 666 20.2 18.14  
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## 477 4.87141 0.0 18.10 0 0.6140 6.484 93.6 2.3053 24 666 20.2 18.68  
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## 479 10.23300 0.0 18.10 0 0.6140 6.185 96.7 2.1705 24 666 20.2 18.03  
## 480 14.33370 0.0 18.10 0 0.6140 6.229 88.0 1.9512 24 666 20.2 13.11  
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## 482 5.70818 0.0 18.10 0 0.5320 6.750 74.9 3.3317 24 666 20.2 7.74  
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## 491 0.20746 0.0 27.74 0 0.6090 5.093 98.0 1.8226 4 711 20.1 29.68  
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## 502 0.06263 0.0 11.93 0 0.5730 6.593 69.1 2.4786 1 273 21.0 9.67  
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## 504 0.06076 0.0 11.93 0 0.5730 6.976 91.0 2.1675 1 273 21.0 5.64  
## 505 0.10959 0.0 11.93 0 0.5730 6.794 89.3 2.3889 1 273 21.0 6.48  
## 506 0.04741 0.0 11.93 0 0.5730 6.030 80.8 2.5050 1 273 21.0 7.88  
## medv  
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?Boston  
  
dim(Boston)

## [1] 506 13

### (b)

pairs(Boston)



par(mfrow = c(2, 2))  
plot(Boston$crim, Boston$medv, data = Boston, xlab = "per capita crime rate by town", ylab ="median value of homes")

## Warning in plot.window(...): "data" is not a graphical parameter

## Warning in plot.xy(xy, type, ...): "data" is not a graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "data" is not a  
## graphical parameter  
  
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## graphical parameter

## Warning in box(...): "data" is not a graphical parameter

## Warning in title(...): "data" is not a graphical parameter

plot(Boston$rm, Boston$medv, data = Boston, xlab = "average number of rooms per dwelling", ylab ="median value of homes")

## Warning in plot.window(...): "data" is not a graphical parameter

## Warning in plot.xy(xy, type, ...): "data" is not a graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "data" is not a  
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## graphical parameter

## Warning in box(...): "data" is not a graphical parameter

## Warning in title(...): "data" is not a graphical parameter

plot(Boston$crim, Boston$age, data = Boston, xlab = "per capita crime rate by town", ylab ="units built prior to 1940")

## Warning in plot.window(...): "data" is not a graphical parameter

## Warning in plot.xy(xy, type, ...): "data" is not a graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "data" is not a  
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## Warning in box(...): "data" is not a graphical parameter

## Warning in title(...): "data" is not a graphical parameter

plot(Boston$lstat, Boston$medv, data = Boston, xlab = "lower status of the population (percent)", ylab ="median value of homes")

## Warning in plot.window(...): "data" is not a graphical parameter

## Warning in plot.xy(xy, type, ...): "data" is not a graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "data" is not a  
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## graphical parameter

## Warning in box(...): "data" is not a graphical parameter

## Warning in title(...): "data" is not a graphical parameter



plot(Boston$crim, Boston$lstat, data = Boston, xlab = "per capita crime rate by town", ylab ="lower status of the population")

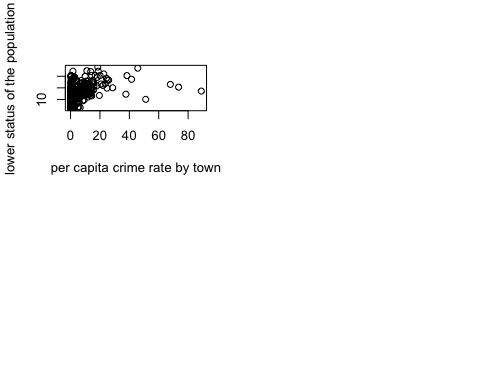
## Warning in plot.window(...): "data" is not a graphical parameter

## Warning in plot.xy(xy, type, ...): "data" is not a graphical parameter

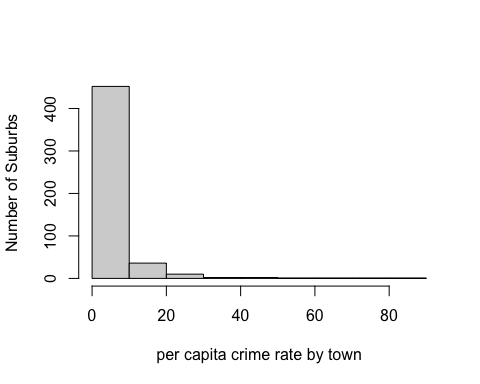
## Warning in axis(side = side, at = at, labels = labels, ...): "data" is not a  
## graphical parameter  
  
## Warning in axis(side = side, at = at, labels = labels, ...): "data" is not a  
## graphical parameter

## Warning in box(...): "data" is not a graphical parameter

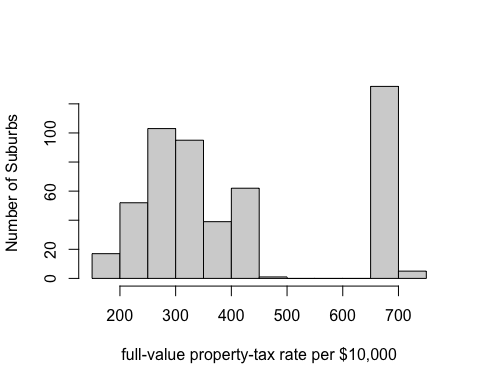
## Warning in title(...): "data" is not a graphical parameter

 In graph one, we can say as crime rates rise, then the median value of homes drop. In graph two, we can say that the more dwellings the home has or increases, then the more the median house prices increase. In graph three, we can see the more old the home is, then there is an increase in crime.  
In graph four, we can see that the lower the status of the population, then the median home value decreases. ### (c) Yes, it seems that we can say that crime rates can increase based on factors of old housing or lower status of the population. There seems to be a relationship between these few things and potentially more factors based on our plotted graphs shown. ### (d)

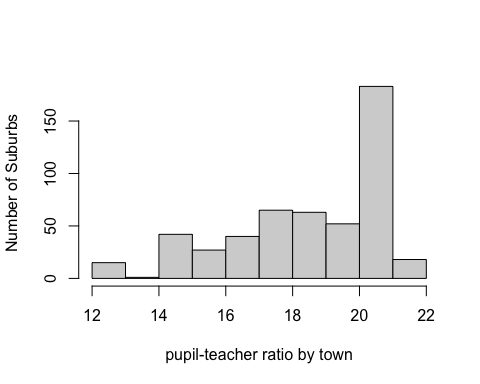
hist(Boston$crim, xlab = "per capita crime rate by town", main = "", ylab = "Number of Suburbs")



hist(Boston$tax, xlab = "full-value property-tax rate per $10,000", main = "", ylab = "Number of Suburbs")



hist(Boston$ptratio, xlab = "pupil-teacher ratio by town", main = "", ylab = "Number of Suburbs")

 In graph one, we can see that the suburbs have less crime rate and most fall around 0, which is quite good. In graph two, we can see that the suburbs has more property tax rate per $10,000 around 650-700 and a smaller but almost equivalent amount around 250-350. In graph three, we can see that the suburbs has a fair amount of pupil-teachers by town around and a big increase at 20-21. ### (e) Census tracts in this data for the Charles river is bounded by 35 suburbs.

Charles <- subset(Boston, chas == 1)  
nrow(Charles)

## [1] 35

### (f)

The median pupil-teacher ratio is around 19 in the towns of this data set.

median(Boston$ptratio)

## [1] 19.05

### (g)

median(Boston$medv)

## [1] 21.2

### (h)

There will be around 64 suburbs with more than 7 dwellings. There will be around 13 suburbs with more than 8 dwellings.

dwellings <- subset(Boston, rm > 7)  
nrow(dwellings)

## [1] 64

dwellings2 <- subset(Boston, rm > 8)  
nrow(dwellings2)

## [1] 13