HW 5 - Due Tuesday October 4, 2016 in moodle and hardcopy in class.

Upload R file to Moodle with name: HW5_490IDS_YourClassID.R

Do Not remove any of the comments. These are marked by

Please ensure that no identifying information (other than yur class ID)

is on your paper copy, including your name

#For this problem we will start with a simulation in order to find out how large n needs

#to be for the binomial distribution to be approximated by the normal

#distribution.

#We will take m samples from the binomial distribution for some n and p.

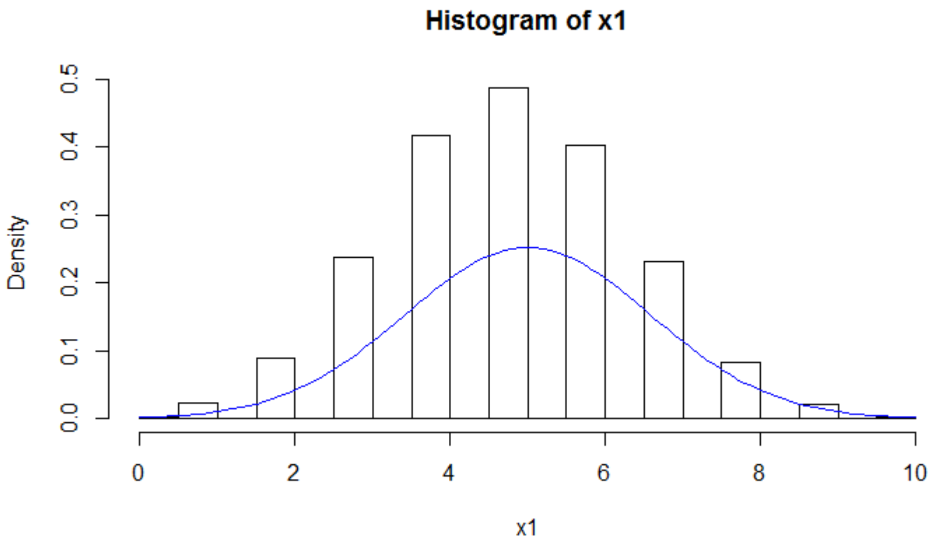
#1.(4pts.) Let's let p=1/2, use the rbinom function to generate the sample of size m.

#Add normal curves to all of the plots.

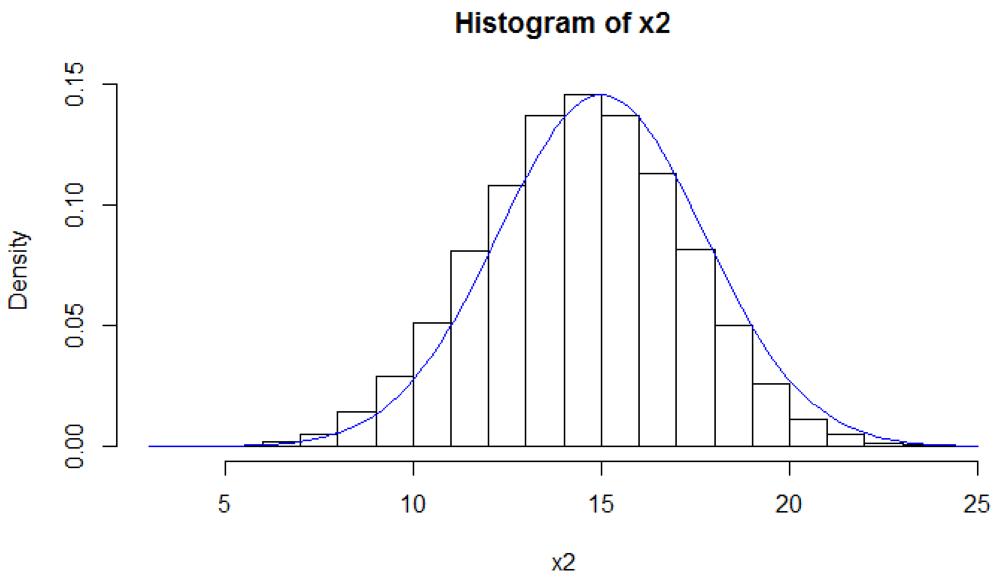
#Use 3 values for n, 10, 30, and 50. Display the histograms as well as your

#code below.

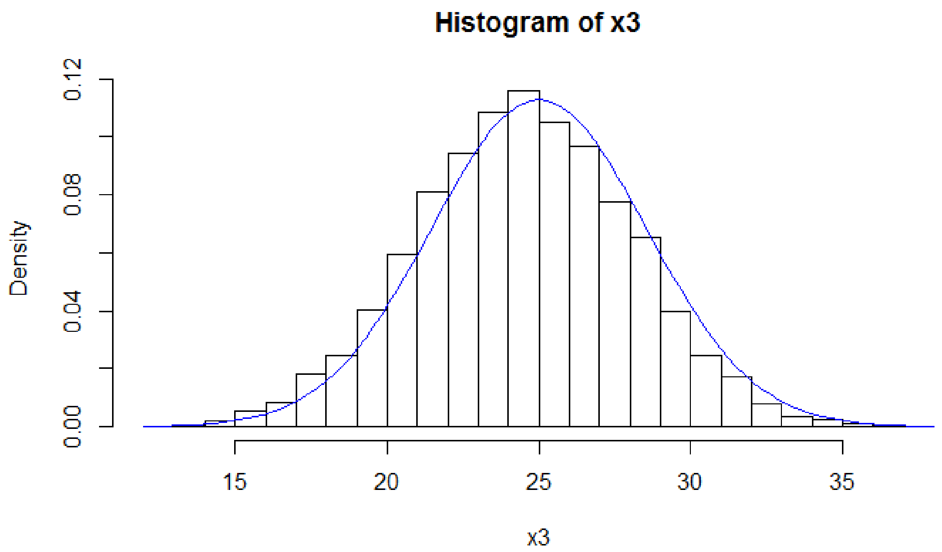
```
> m = 10000
> x1 = rbinom(m, size = 10, prob = 0.5)
> hist(x1, freq = FALSE, breaks = 20)
> curve(dnorm(x, 10*0.5, sqrt(10*0.5*0.5)), col="blue", lwd=1, add=TRUE)
```




```
> x2 = rbinom(m, size = 30, prob = 0.5)
> hist(x2, freq = FALSE, breaks = 20)
> curve(dnorm(x, 30*0.5, sqrt(30*0.5*0.5)), col="blue", lwd=1, add=TRUE)
```




```
> x3 = rbinom(m, size = 50, prob = 0.5)
> hist(x3, freq = FALSE, breaks = 20)
> curve(dnorm(x, 50*0.5, sqrt(50*0.5*0.5)), col="blue", lwd=1, add=TRUE)
```



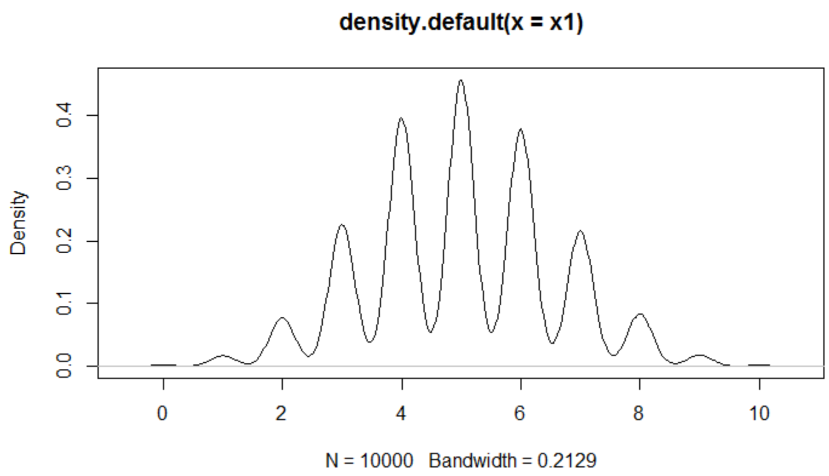
#1b.)(3pts.) Now use the techniques described in class to improve graphs.

Explain each step you choose including why you are making the change. You

might consider creating density plots, changing color, axes, labeling, legend, and others for example.

Creating density plot to get a smoothed histogram makes it easier to compare with the normal curve.

plot(density(x1))



The default bandwidth is small. To make it bigger can show the outline clearly.

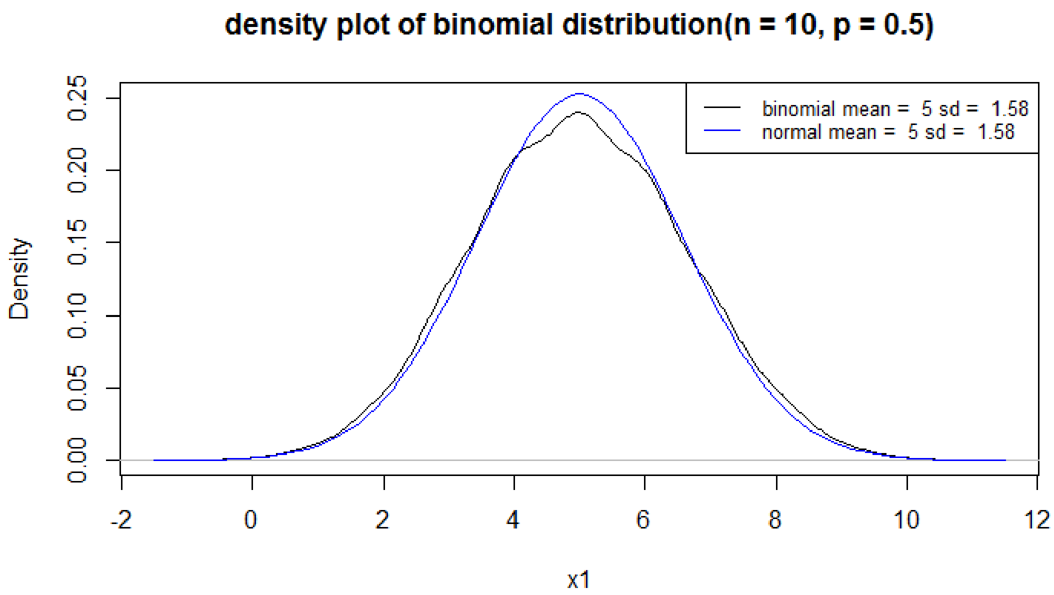
```
> plot(density(x1, bw = 0.5), ylim = c(0,0.25), xlab = "x1", main = "densi
ty plot of binomial distribution(n = 10, p = 0.5)")
> curve(dnorm(x, 10*0.5, sqrt(10*0.5*0.5)), col="blue", lwd=1, add=TRUE)
```

The normal curve has a higher height than that of density plot, so I enlarge the range for the scale of y axis.

Setting the normal curve a different color to make comparison with the binomial distribution.

```
> legend("topright", legend = paste("", c("binomial","normal"), "mean = ",
 c(5,5), "sd = ", c(1.58,1.58)), lwd=1, col = c("black", "blue"), cex=0.8,
 text.font = 1.5)
```

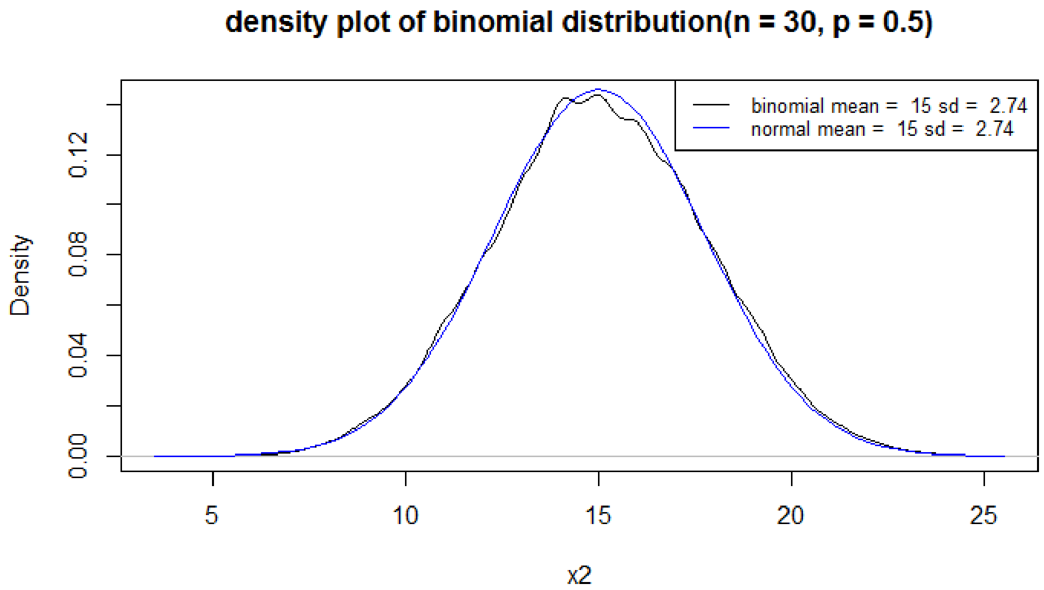
A legend with mean and sd can make it clear to identify the two curves.



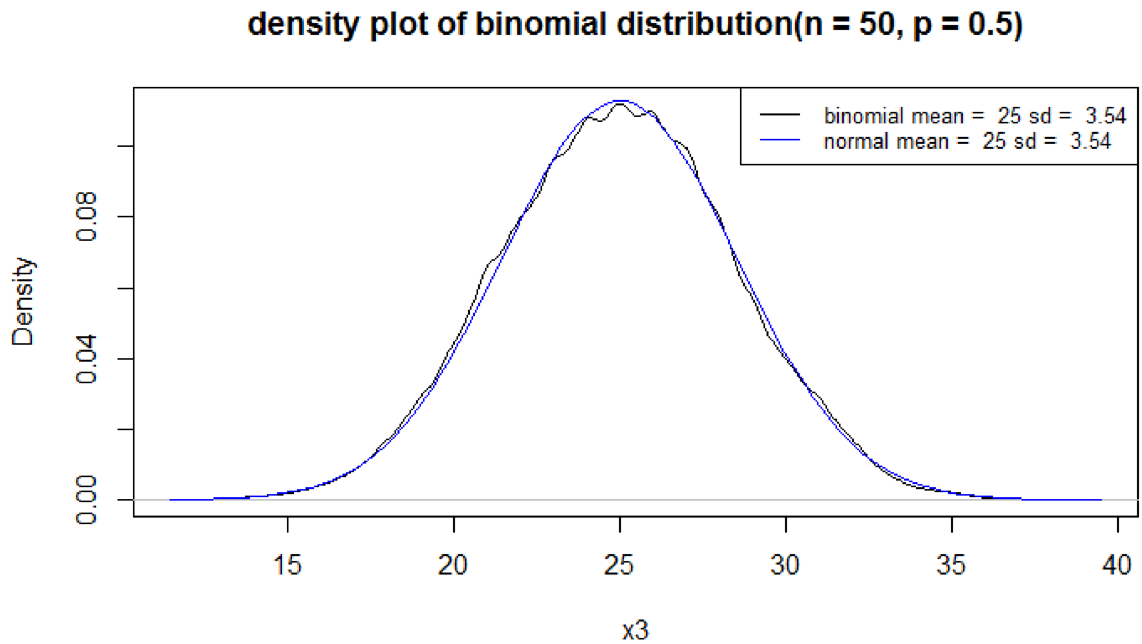

```
> plot(density(x2, bw = 0.5), xlab = "x2", main = "density plot of binomia
l distribution(n = 30, p = 0.5)")
> curve(dnorm(x, 30*0.5, sqrt(30*0.5*0.5)), col="blue", lwd=1, add=TRUE)
```

The normal curve has an approximate height with that of density plot, so there is no need to change the range of y axis.

```
> legend("topright", legend = paste("", c("binomial","normal"), "mean = ",
 c(15,15), "sd = ", c(2.74,2.74)), lwd=1, col = c("black", "blue"), cex=0.
8, text.font = 1.5)
```




```
> plot(density(x3, bw = 0.5), xlab = "x3", main = "density plot of binomia
l distribution(n = 50, p = 0.5)")
> curve(dnorm(x, 50*0.5, sqrt(50*0.5*0.5)), col="blue", lwd=1, add=TRUE)
> legend("topright", legend = paste("", c("binomial","normal"), "mean = ",
 c(25,25), "sd = ", c(3.54,3.54)), lwd=1, col = c("black", "blue"), cex=0.
8, text.font = 1.5)
```



#Q2.) (2pts.)

#Why do you think the Data Life Cycle is crucial to understanding the opportunities

#and challenges of making the most of digital data? Give two examples.

Such opportunities and difficulties lie in data capture, storage, searching, sharing, analysis,

and visualization, which are key elements in the Data Life Cycle.

Information is increasing at an exponential rate, but information processing methods are improving relatively slowly.

Currently, a limited number of tools are available to completely address the issues in Big Data analysis.

For example, Hadoop cannot solve the real problems of storage, searching, sharing, visualization,

and real-time analysis ideally in terms of Data Life Cycle. For large-scale data analysis, SAS, R, and Matlab are unsuitable.

Graph lab provides a framework that calculates graph-based algorithms but it does not manage data effectively.

Therefore, proper tools to adequately exploit Big Data are still lacking. (Khan et al., 2014)

Data Life Cycle is crucial to develop proper tools and to solve data processing problems

based on the before and after steps during the cycle.

Also, challenges in Big Data analysis include "data inconsistency and incompleteness, scalability, timeliness, and security".

(Khan et al., 2014). Prior to data analysis, data must be well constructed based on the Data Life Cycle.

However, considering the variety of datasets, the efficient representation, access, and analysis

of unstructured or semistructured data are still challenging (Khan et al., 2014).

Therefore, numerous data preprocessing techniques, including data cleaning, integration,

transformation, and reduction, should be applied to remove noise and correct inconsistencies.

Data Life Cycle is crucial to the achievement of data consistency and completeness considering

the bond between different segments in the cycle.

Khan, N., Yaqoob, I., Hashem, I. A. T., Inayat, Z., Mahmoud Ali, W. K., Alam, M., … Gani, A. (2014). Big Data: Survey, Technologies, Opportunities, and Challenges. The Scientific World Journal, 2014, 712826. http://doi.org/10.1155/2014/712826

###Part 2###

#3.) San Francisco Housing Data

#

Load the data into R.

load(url("http://www.stanford.edu/~vcs/StatData/SFHousing.rda"))

(2 pts.)

What is the name and class of each object you have loaded into your workspace?

Your code below

```
objects()
class(cities)
class(housing)
```

Your answer here

```
# > objects()
# [1] "cities"  "housing"
# > class(cities)
# [1] "data.frame"
# > class(housing)
# [1] "data.frame"
# There are two data frame class objects. One is "cities", and the other is "housing".
```

What are the names of the vectors in housing?

Your code below

```
names(housing)
```

Your answer here

```
# > names(housing)
# [1] "county"  "city"    "zip"     "street"  "price"   "br"      "lsqft"   "bsqft"   "year"
# [10] "date"    "long"    "lat"     "quality" "match"   "wk"
```

How many observations are in housing?

Your code below

```
dim(housing)
```

Your answer here

There are 281506 observations.

Explore the data using the summary function.

Describe in words two problems that you see with the data.

Write your response here

summary(cities)

summary(housing)

In the cities object, there are NAs in the longitude and latitude variables. The names of

the cities are not shown as a variable (column) in the object.

In the housing object, there are many NAs in zip, lsqft, bsqft, year, long, lat, quality and match variables.

The Max of year is 3894, which is unreasonable. The Min is 0, which is inappropriate.

The calculation of min, 1st Qu, median, etc seems inappropriate to date and wk.

Q5. (2 pts.)

We will work the houses in Albany, Berkeley, Piedmont, and Emeryville only.

Subset the data frame so that we have only houses in these cities

and keep only the variables city, zip, price, br, bsqft, and year

Call this new data frame BerkArea. This data frame should have 4059 observations

and 6 variables.

```
> BerkArea = housing[housing$city %in% c("Albany","Berkeley","Piedmont","E
meryville"), c("city","zip","price","br","bsqft","year")]
```

Data	
BerkArea	4059 obs. of 6 variables

Q6. (2 pts.)

We are interested in making plots of price and size of house, but before we do this

we will further subset the data frame to remove the unusually large values.

Use the quantile function to determine the 99th percentile of price and bsqft

and eliminate all of those houses that are above either of these 99th percentiles

Call this new data frame BerkArea, as well. It should have 3999 observations.

```
> pricelimit = quantile(BerkArea$price, 0.99)
```

```
> bsqftlimit = quantile(BerkArea$bsqft, 0.99, na.rm = TRUE)
> pricelimit
    99%
2285500
> bsqftlimit
    99%
4035.76
> BerkArea = BerkArea[BerkArea$price<=pricelimit & BerkArea$bsqft<=bsqftli
mit,]
```

Data	
BerkArea	3999 obs. of 6 variables

Q7 (2 pts.)

Create a new vector that is called pricepsqft by dividing the sale price by the square footage

Add this new variable to the data frame.

```
> pricepsqft = BerkArea$price / BerkArea$bsqft
> BerkArea["pricepsqft"] = pricepsqft
```

Q8 (2 pts.)

Create a vector called br5 that is the number of bedrooms in the house, except

if this number is greater than 5, it is set to 5. That is, if a house has 5 or more

bedrooms then br5 will be 5. Otherwise it will be the number of bedrooms.

```
> br5 = ifelse(BerkArea$br>5, 5, BerkArea$br)
```

Q9 (4 pts. 2 + 2 - see below)

Use the rainbow function to create a vector of 5 colors, call this vector rCols.

When you call this function, set the alpha argument to 0.25 (we will describe what this does later)

Create a vector called brCols of 4059 colors where each element's

color corresponds to the number of bedrooms in the br5.

For example, if the element in br5 is 3 then the color will be the third color in rCols.

(2 pts.)

rCols = rainbow(n = 5, alpha = 0.25)

brCols = rCols[br5]

######

We are now ready to make a plot.

Try out the following code

plot(pricepsqft ~ bsqft, data = BerkArea,

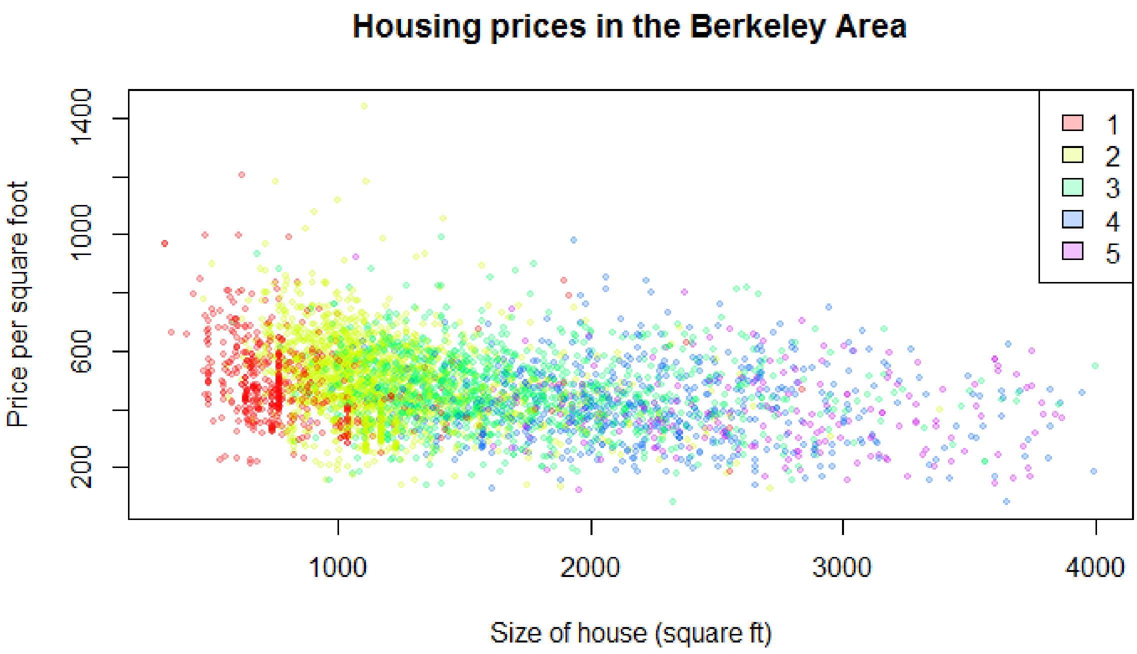
main = "Housing prices in the Berkeley Area",

xlab = "Size of house (square ft)",

ylab = "Price per square foot",

col = brCols, pch = 19, cex = 0.5)

legend(legend = 1:5, fill = rCols, "topright")



(2 pts.)

What interesting features do you see that you didn't know before making this plot?

In general, prices per square foot slightly go down as the size of houses increases. For

houses which have about 2000 square feet or so, the number of bedrooms vary from 3 to 5.

Prices per square foot of house with one bedroom and two bedrooms have larger range than those

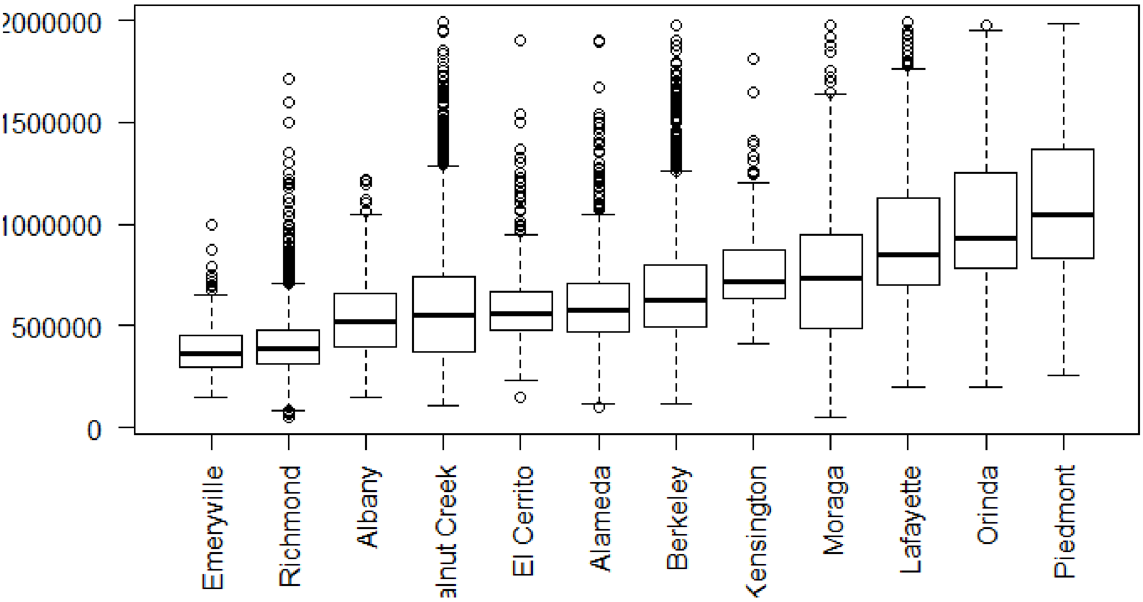
of houses with more than 4 bedrooms.

(2 pts.)

Replicate the boxplots presented in class, with the boxplots sorted by median housing price (slide 45 of the lecture notes)

```
> someCities = c("Albany", "Berkeley", "El Cerrito", "Emeryville", "Piedmo
nt", "Richmond", "Lafayette", "Walnut Creek", "Kensington","Alameda", "Ori
nda", "Moraga")
> shousing = housing[housing$city %in% someCities & housing$price < 200000
0,]
> shousing$city = as.character(shousing$city)
> bymedian = with(shousing, reorder(city, price, median))
```

```
> boxplot(shousing$price ~ bymedian, las = 2)
```



For BerkArea data frame:

```
> BerkArea$city = as.character(BerkArea$city)
> boxplot.median = with(BerkArea, reorder(city, price, median))
> boxplot(BerkArea$price ~ boxplot.median, las = 2)
```