Final_project

Edgar Rosales,

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```
library(caret)
```

```
## Loading required package: ggplot2
```

```
## Loading required package: lattice
```

Part 1:data importing and pre-processing

house_data, which originated from house_sales.csv and imported through the read.csv function, provides a dataset that consists of 21,613 ojbects and 21 different variables. These variables consist of numerics (int & num) and character strings.

```
house_data <- read.csv("house_sales.csv", na.strings = "")
str(house_data)
```

```
## 'data.frame':    21613 obs. of  21 variables:
##  $ id           : num  7.13e+09 6.41e+09 5.63e+09 2.49e+09 1.95e+09 ...
##  $ date         : chr  "20141013T000000" "20141209T000000" "20150225T000000" "20141209T000000" ...
##  $ price        : num  221900 538000 180000 604000 510000 ...
##  $ bedrooms     : num  3 3 2 4 3 4 3 3 3 3 ...
##  $ bathrooms    : num  1 2.25 1 3 2 4.5 2.25 1.5 1 2.5 ...
##  $ sqft_living  : num  1180 2570 770 1960 1680 ...
##  $ sqft_lot     : num  5650 7242 10000 5000 8080 ...
##  $ floors       : num  1 2 1 1 1 1 2 1 1 2 ...
##  $ waterfront   : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ view         : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ condition    : int  3 3 3 5 3 3 3 3 3 3 ...
##  $ grade        : int  7 7 6 7 8 11 7 7 7 7 ...
##  $ sqft_above   : int  1180 2170 770 1050 1680 3890 1715 1060 1050 1890 ...
##  $ sqft_basement: int  0 400 0 910 0 1530 0 0 730 0 ...
##  $ yr_built     : int  1955 1951 1933 1965 1987 2001 1995 1963 1960 2003 ...
##  $ yr_renovated : int  0 1991 0 0 0 0 0 0 0 0 ...
##  $ zipcode      : int  98178 98125 98028 98136 98074 98053 98003 98198 98146 98038 ...
##  $ lat          : num  47.5 47.7 47.7 47.5 47.6 ...
##  $ long         : num  -122 -122 -122 -122 -122 ...
##  $ sqft_living15: int  1340 1690 2720 1360 1800 4760 2238 1650 1780 2390 ...
##  $ sqft_lot15   : int  5650 7639 8062 5000 7503 101930 6819 9711 8113 7570 ...
```

taking care of missing data

```r
colSums(is.na(house_data))
```

```
##            id          date         price      bedrooms     bathrooms
##             0             0             0          1134          1068
##   sqft_living      sqft_lot        floors    waterfront          view
##          1110          1044             0             0             0
##     condition         grade    sqft_above sqft_basement      yr_built
##             0             0             0             0             0
##  yr_renovated       zipcode           lat          long sqft_living15
##             0             0             0             0             0
##    sqft_lot15
##             0
```

```r
house_data_clean <- na.omit(house_data)

colSums(is.na(house_data_clean))
```

```
##            id          date         price      bedrooms     bathrooms
##             0             0             0             0             0
##   sqft_living      sqft_lot        floors    waterfront          view
##             0             0             0             0             0
##     condition         grade    sqft_above sqft_basement      yr_built
##             0             0             0             0             0
##  yr_renovated       zipcode           lat          long sqft_living15
##             0             0             0             0             0
##    sqft_lot15
##             0
```

checking for any duplicated rows

```r
#Checking for duplicated rows
duplicates <- house_data_clean[duplicated(house_data_clean), ]

#Display the duplicated rows
print(duplicates)
```

```
##  [1] id            date          price         bedrooms      bathrooms
##  [6] sqft_living   sqft_lot      floors        waterfront    view
## [11] condition     grade         sqft_above    sqft_basement yr_built
## [16] yr_renovated  zipcode       lat           long          sqft_living15
## [21] sqft_lot15
## <0 rows> (or 0-length row.names)
```

```r
# Convert 'date' to Date format
house_data_clean$date <- as.Date(house_data_clean$date, format="%Y%m%dT%H%M%S")
str(house_data_clean)
```

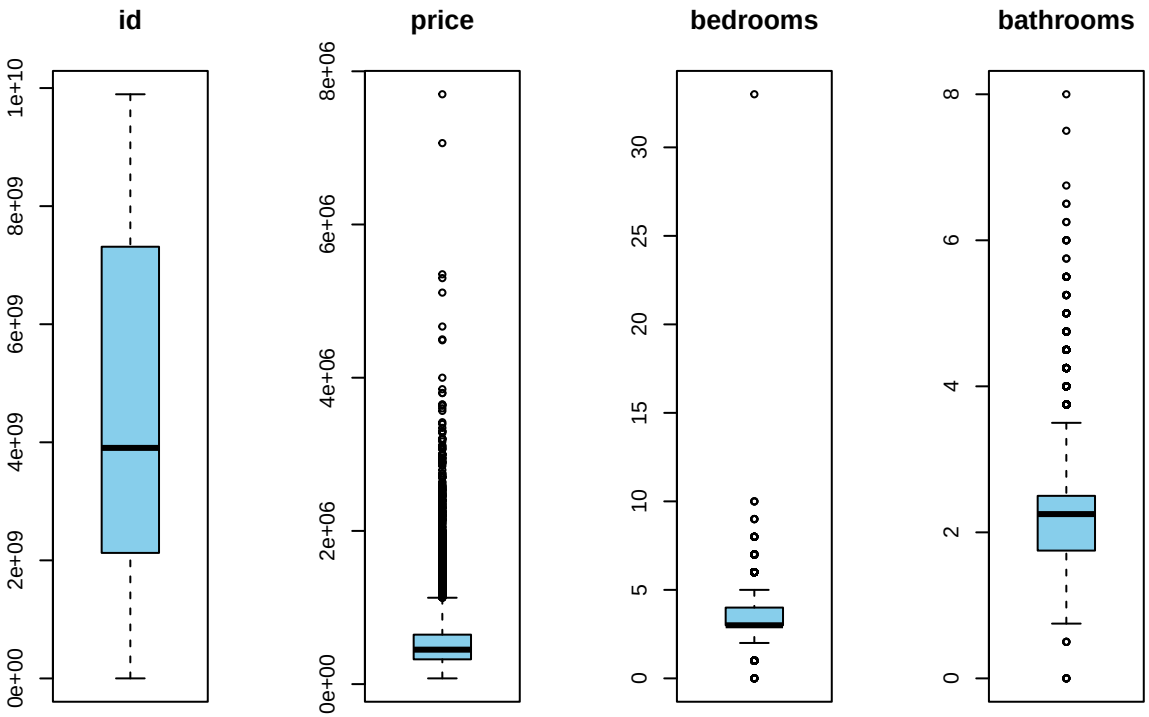
```
## 'data.frame':    17618 obs. of  21 variables:
##  $ id           : num  7.13e+09 6.41e+09 5.63e+09 2.49e+09 1.95e+09 ...
##  $ date         : Date, format: "2014-10-13" "2014-12-09" ...
##  $ price        : num  221900 538000 180000 604000 510000 ...
```

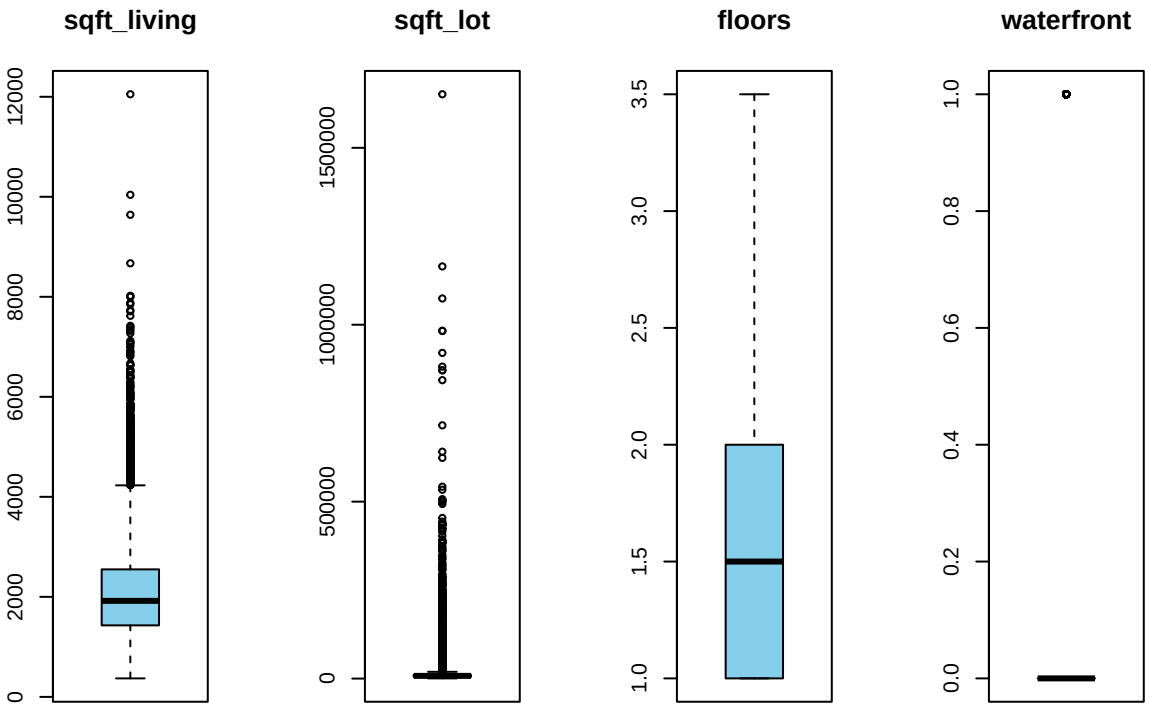
```
##  $ bedrooms     : num  3 3 2 4 3 4 3 3 3 3 ...
##  $ bathrooms    : num  1 2.25 1 3 2 4.5 2.25 1.5 1 2.5 ...
##  $ sqft_living  : num  1180 2570 770 1960 1680 ...
##  $ sqft_lot     : num  5650 7242 10000 5000 8080 ...
##  $ floors       : num  1 2 1 1 1 1 2 1 1 2 ...
##  $ waterfront   : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ view         : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ condition    : int  3 3 3 5 3 3 3 3 3 3 ...
##  $ grade        : int  7 7 6 7 8 11 7 7 7 7 ...
##  $ sqft_above   : int  1180 2170 770 1050 1680 3890 1715 1060 1050 1890 ...
##  $ sqft_basement: int  0 400 0 910 0 1530 0 0 730 0 ...
##  $ yr_built     : int  1955 1951 1933 1965 1987 2001 1995 1963 1960 2003 ...
##  $ yr_renovated : int  0 1991 0 0 0 0 0 0 0 0 ...
##  $ zipcode      : int  98178 98125 98028 98136 98074 98053 98003 98198 98146 98038 ...
##  $ lat          : num  47.5 47.7 47.7 47.5 47.6 ...
##  $ long         : num  -122 -122 -122 -122 -122 ...
##  $ sqft_living15: int  1340 1690 2720 1360 1800 4760 2238 1650 1780 2390 ...
##  $ sqft_lot15   : int  5650 7639 8062 5000 7503 101930 6819 9711 8113 7570 ...
##  - attr(*, "na.action")= 'omit' Named int [1:3995] 11 13 19 24 25 27 32 33 38 39 ...
##   ..- attr(*, "names")= chr [1:3995] "11" "13" "19" "24" ...
```

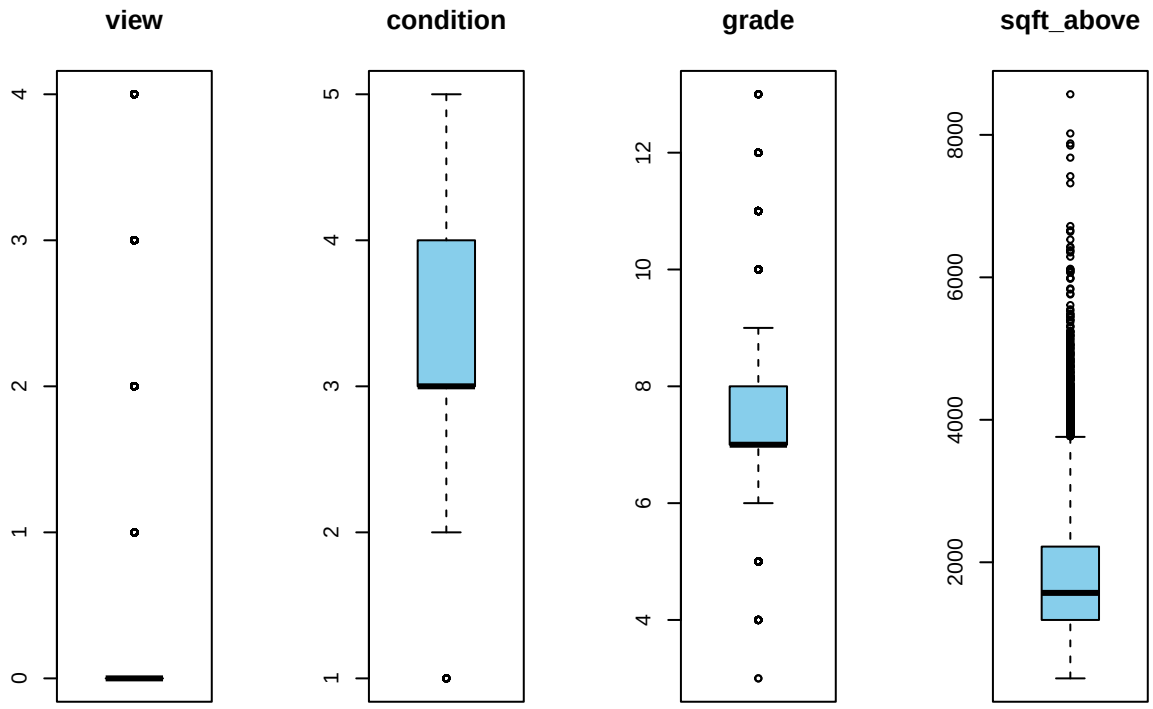
handling outliers

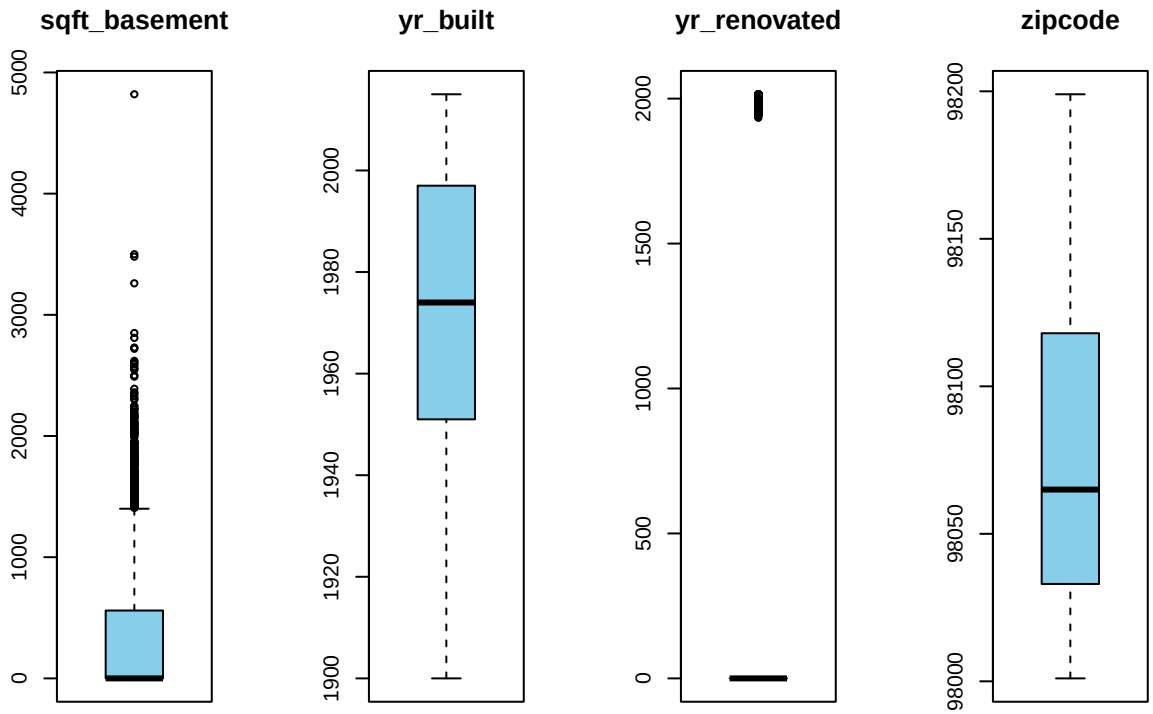
Here we are showing an example of what our data looks like before we handle outliers

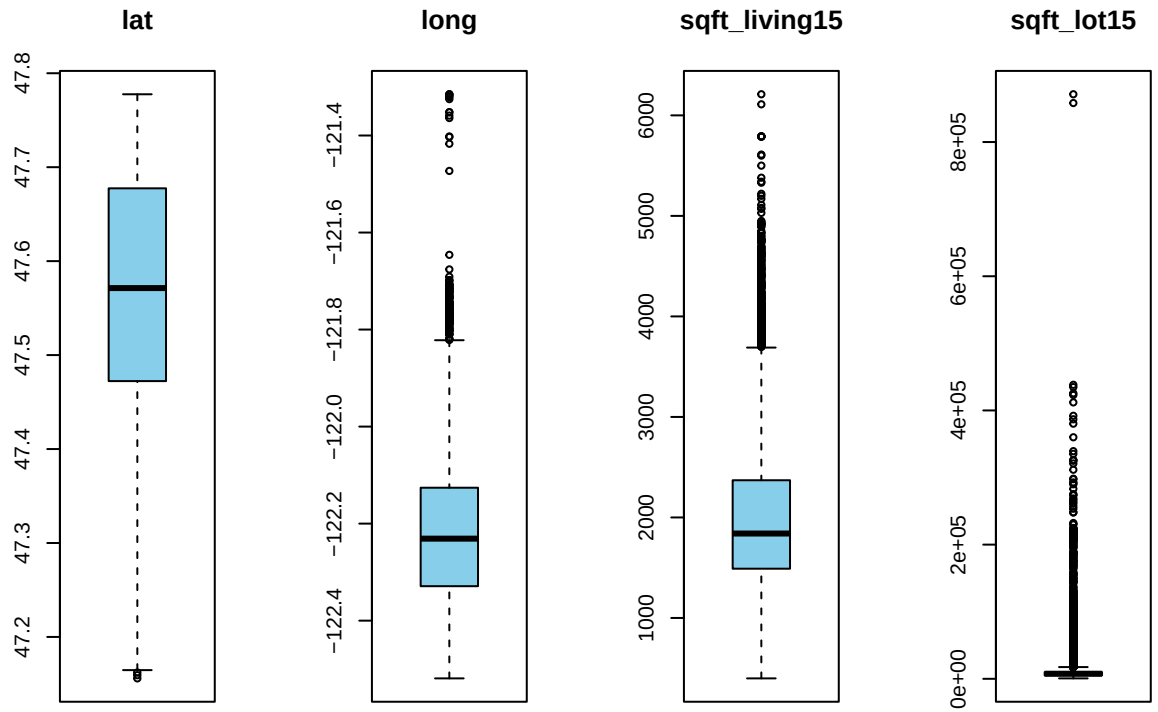
```r
# Boxplot for every numeric variable
par(mfrow = c(1, 4))  # Set the layout for multiple plots, adjust based on the number of variables
for (i in 1:ncol(house_data_clean)) {
  if (is.numeric(house_data_clean[, i])) {
    boxplot(house_data_clean[, i], main = names(house_data_clean)[i], col = "skyblue", border = "black"
  }
}
```


id
0e+00
2e+09
4e+09
6e+09
8e+09
1e+10
price
0e+00
2e+06
4e+06
6e+06
8e+06
bedrooms
0
5
10
15
20
25
30
bathrooms
0
2
4
6
8


sqft_living
0
2000
4000
6000
8000
10000
12000
sqft_lot
0
500000
1000000
1500000
floors
1.0
1.5
2.0
2.5
3.0
3.5
waterfront
0.0
0.2
0.4
0.6
0.8
1.0


view
condition
grade
sqft_above
0
1
2
3
4
1
2
3
4
5
4
6
8
10
12
2000
4000
6000
8000


sqft_basement
0
1000
2000
3000
4000
5000
yr_built
1900
1920
1940
1960
1980
2000
yr_renovated
0
500
1000
1500
2000
zipcode
98000
98050
98100
98150
98200

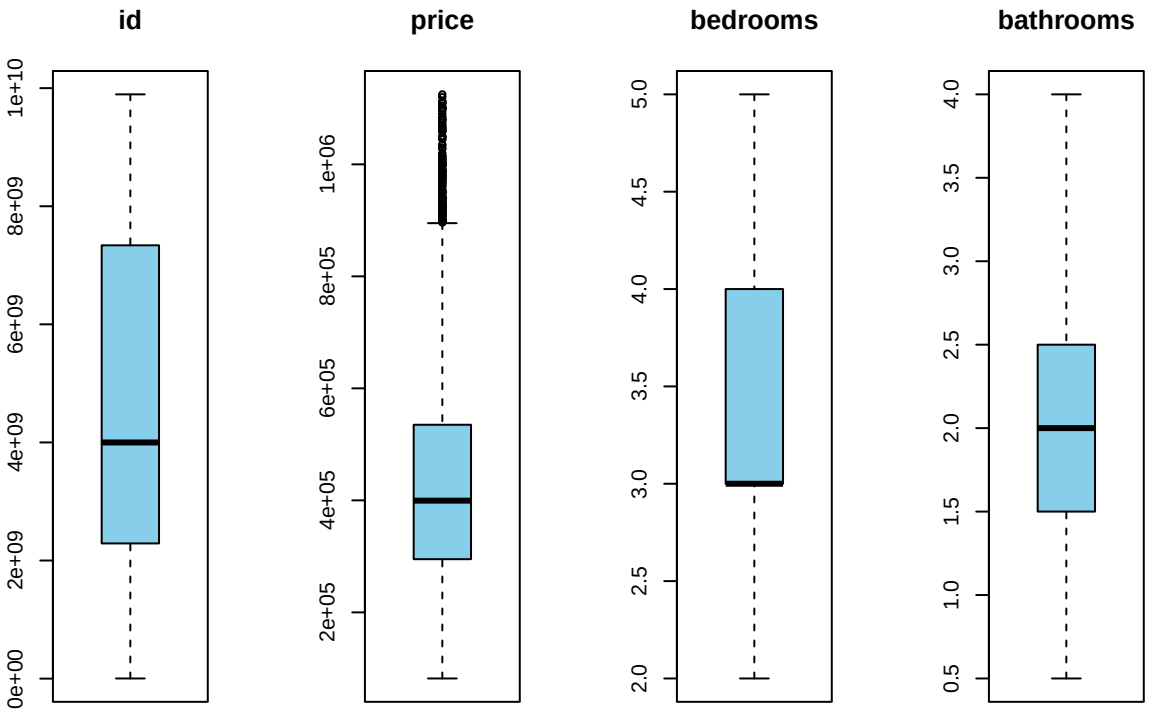


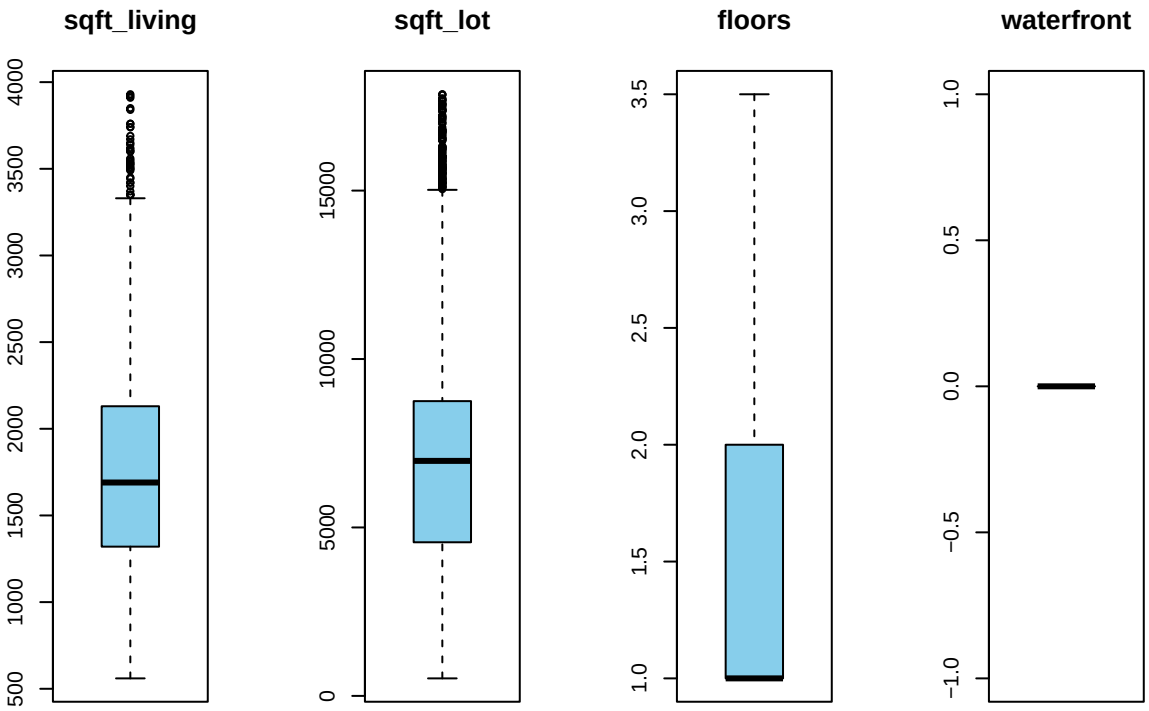
here we are showing the changes in boxblots after adjusting for outliers

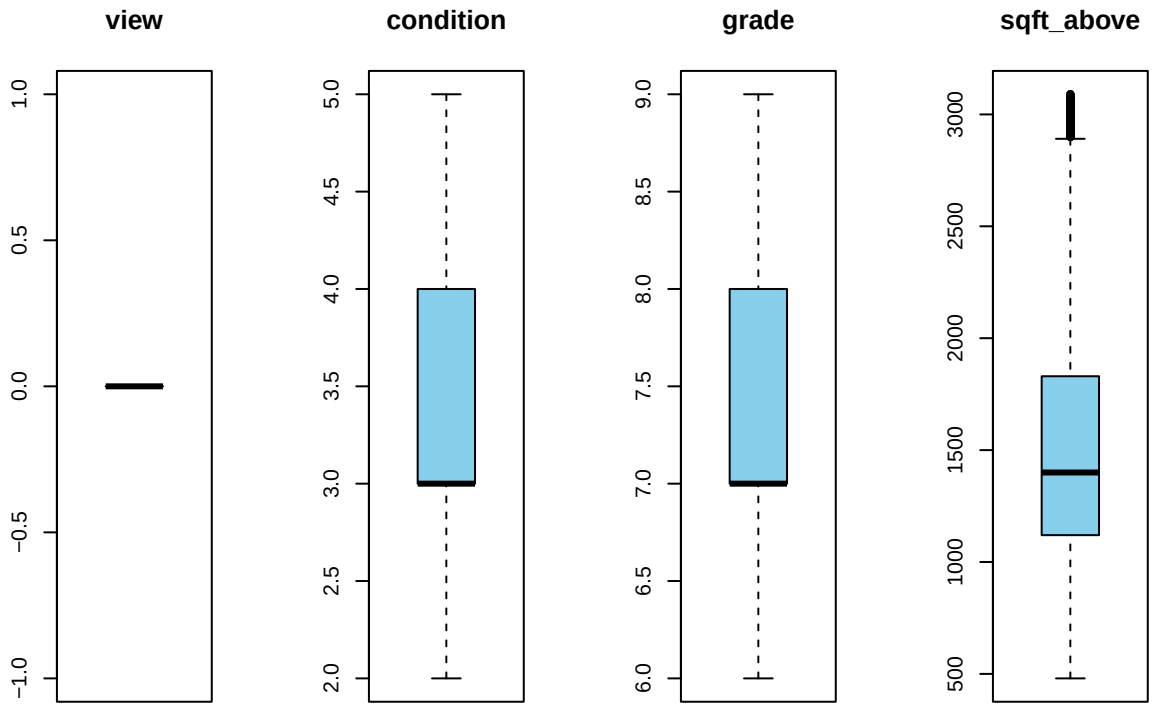
```
#Specify the constant multiplier for outlier detection
k <- 1.5

# Loop through each numeric variable
for (col in names(house_data_clean)) {
  if (is.numeric(house_data_clean[[col]])) {
    # Calculate Q1, Q3, and IQR for the current variable
    Q1 <- quantile(house_data_clean[[col]], 0.25)
    Q3 <- quantile(house_data_clean[[col]], 0.75)
    IQR <- Q3 - Q1

    #Identify outliers for the current variable
    outliers <- house_data_clean[[col]] < Q1 - k * IQR | house_data_clean[[col]] > Q3 + k * IQR

    #Remove outliers from the dataset
    house_data_clean <- house_data_clean[!outliers, ]
  }
}
```

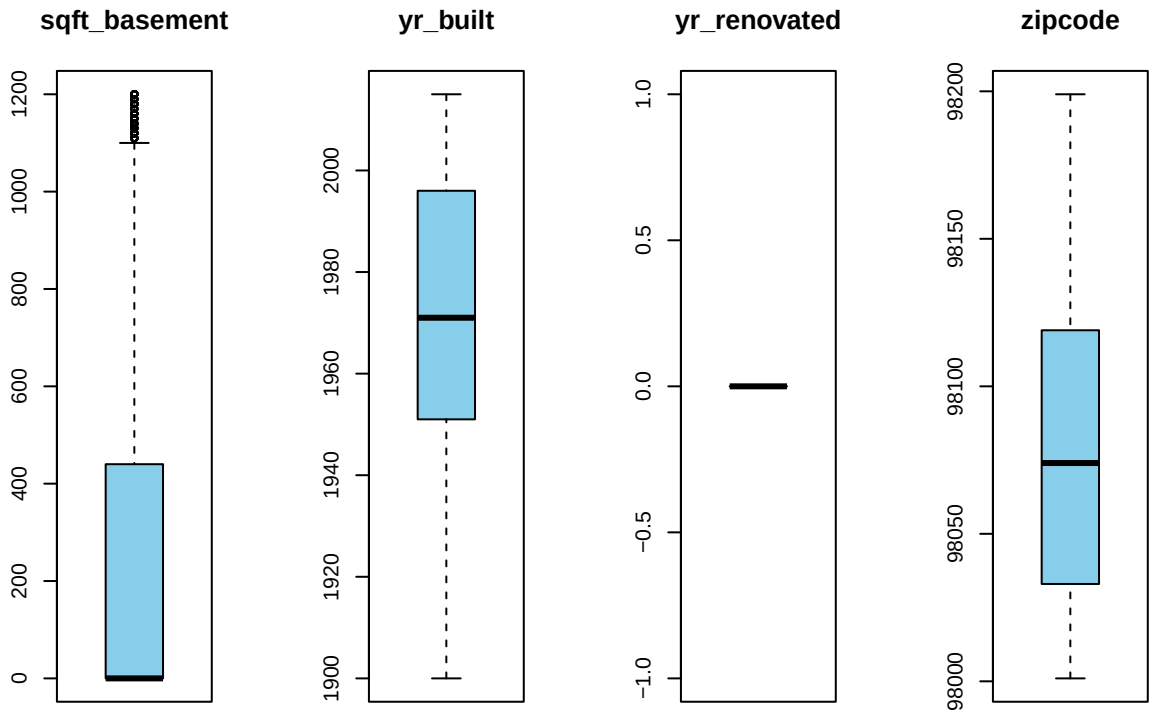
```
par(mfrow = c(1, 4))
for (i in 1:ncol(house_data_clean)) {
  if (is.numeric(house_data_clean[, i])) {
    boxplot(house_data_clean[, i], main = names(house_data_clean)[i], col = "skyblue", border = "black"
  }
```

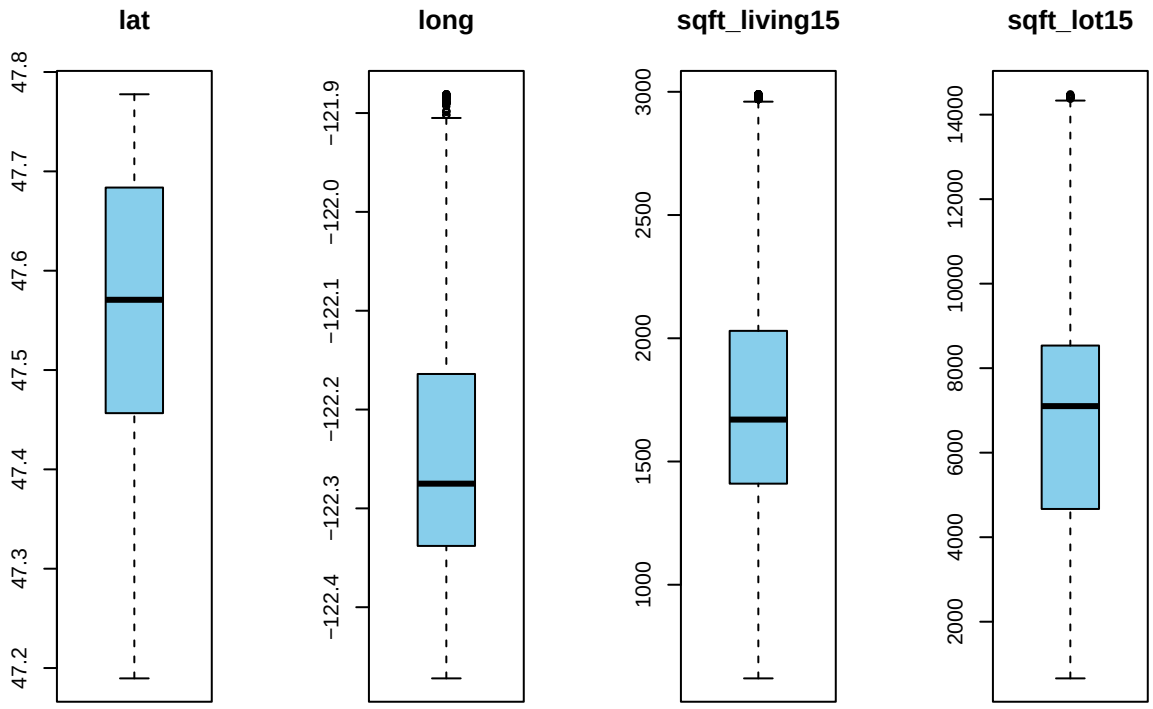
```
}
```


id
price
bedrooms
bathrooms
0e+00
2e+09
4e+09
6e+09
8e+09
1e+10
2e+05
4e+05
6e+05
8e+05
1e+06
2.0
2.5
3.0
3.5
4.0
4.5
5.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0


sqft_living
500
1000
1500
2000
2500
3000
3500
4000
sqft_lot
0
5000
10000
15000
floors
1.0
1.5
2.0
2.5
3.0
3.5
waterfront
−1.0
−0.5
0.0
0.5
1.0


view
condition
grade
sqft_above
1.0
0.5
0.0
−0.5
−1.0
5.0
4.5
4.0
3.5
3.0
2.5
2.0
9.0
8.5
8.0
7.5
7.0
6.5
6.0
3000
2500
2000
1500
1000
500


sqft_basement
0
200
400
600
800
1000
1200
yr_built
1900
1920
1940
1960
1980
2000
yr_renovated
−1.0
−0.5
0.0
0.5
1.0
zipcode
98000
98050
98100
98150
98200

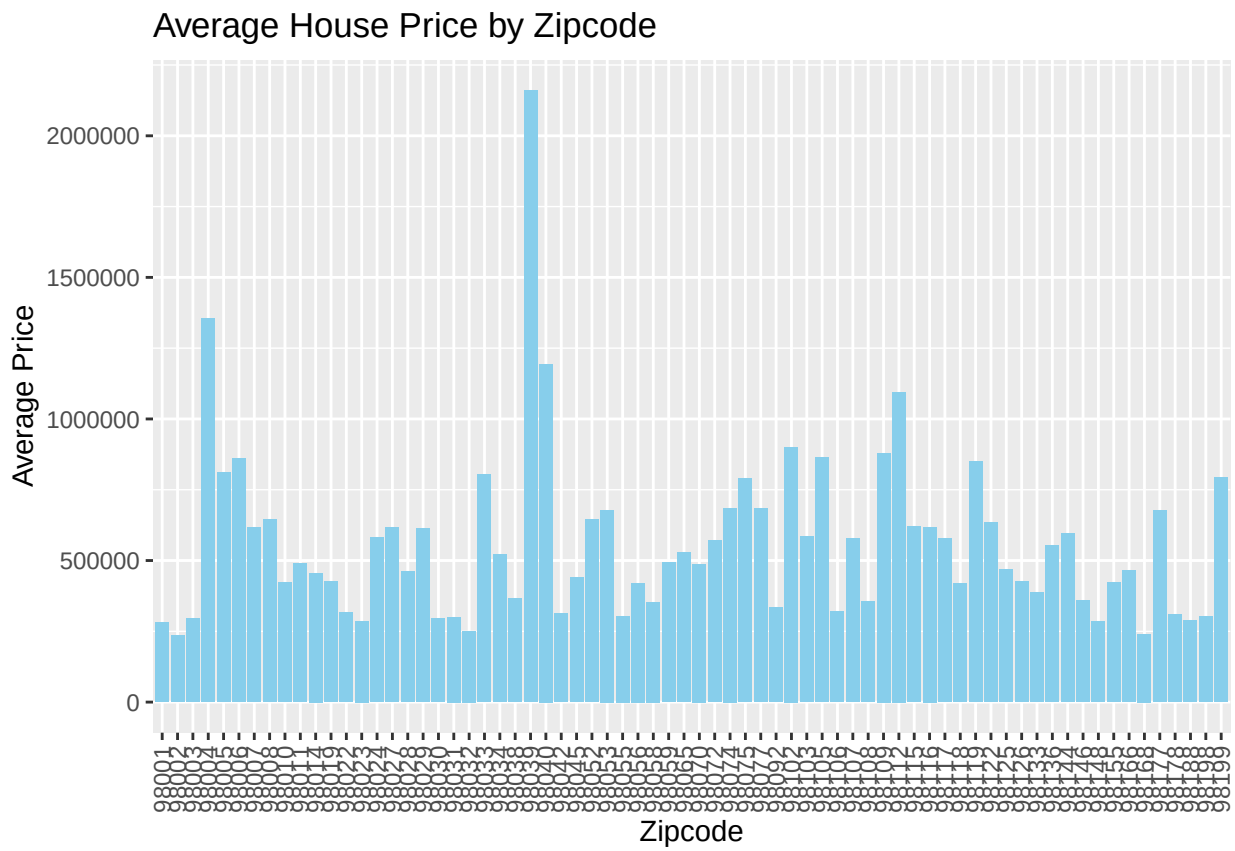


Here we use the aggregate function to group taverage house value per zipcode

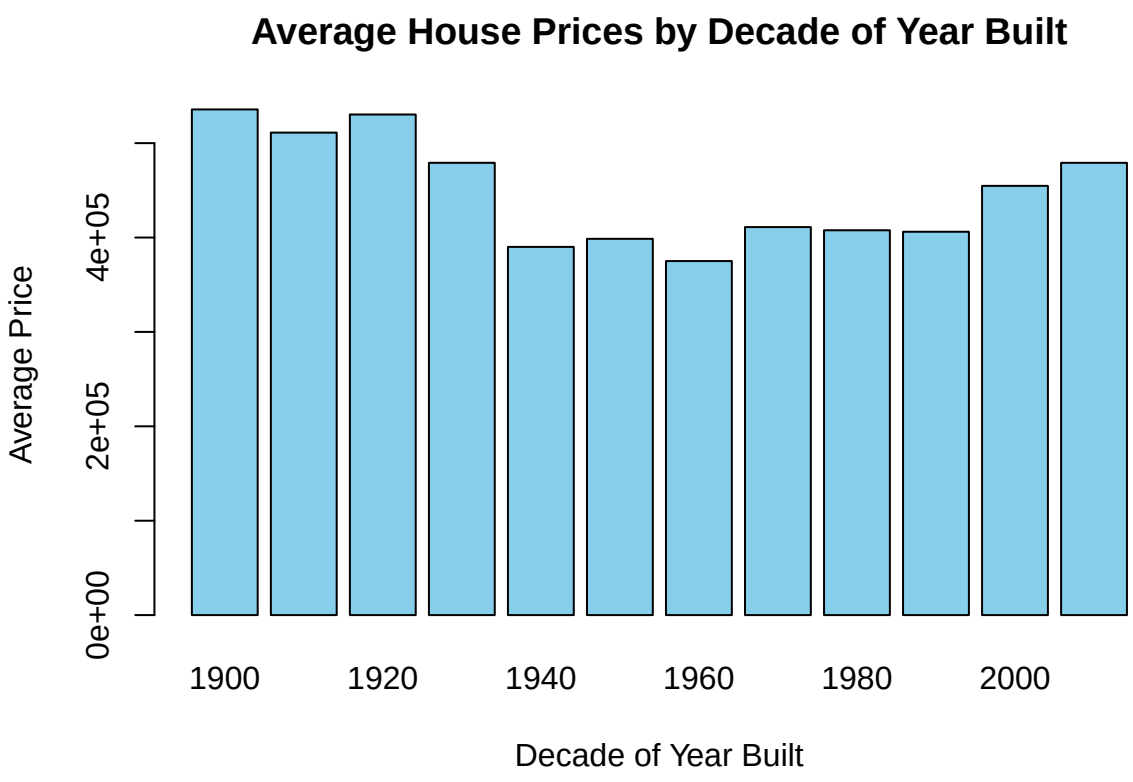
```
zip_prices <- aggregate(house_data$price, by = list(zipcode = house_data$zipcode), FUN = mean)
colnames(zip_prices) <- c("zipcode", "mean_price")

head(zip_prices)
```

```
##   zipcode mean_price
## 1   98001   280804.7
## 2   98002   234284.0
## 3   98003   294111.3
## 4   98004  1355927.1
## 5   98005   810164.9
## 6   98006   859684.8
```

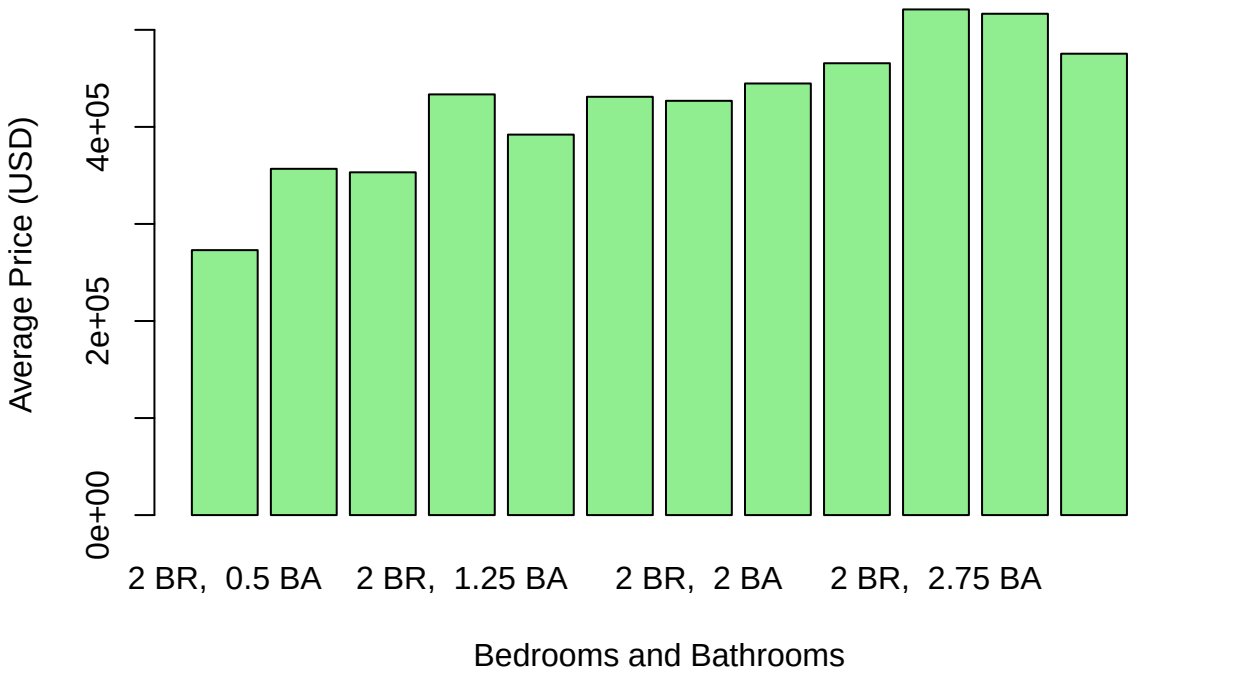
```
library(ggplot2)


ggplot(zip_prices, aes(x = factor(zipcode), y = mean_price)) +
  geom_bar(stat = "identity", fill = "skyblue") +
  labs(title = "Average House Price by Zipcode", x = "Zipcode", y = "Average Price") +
  theme(axis.text.x = element_text(angle = 90, vjust = .5, hjust=2))
```

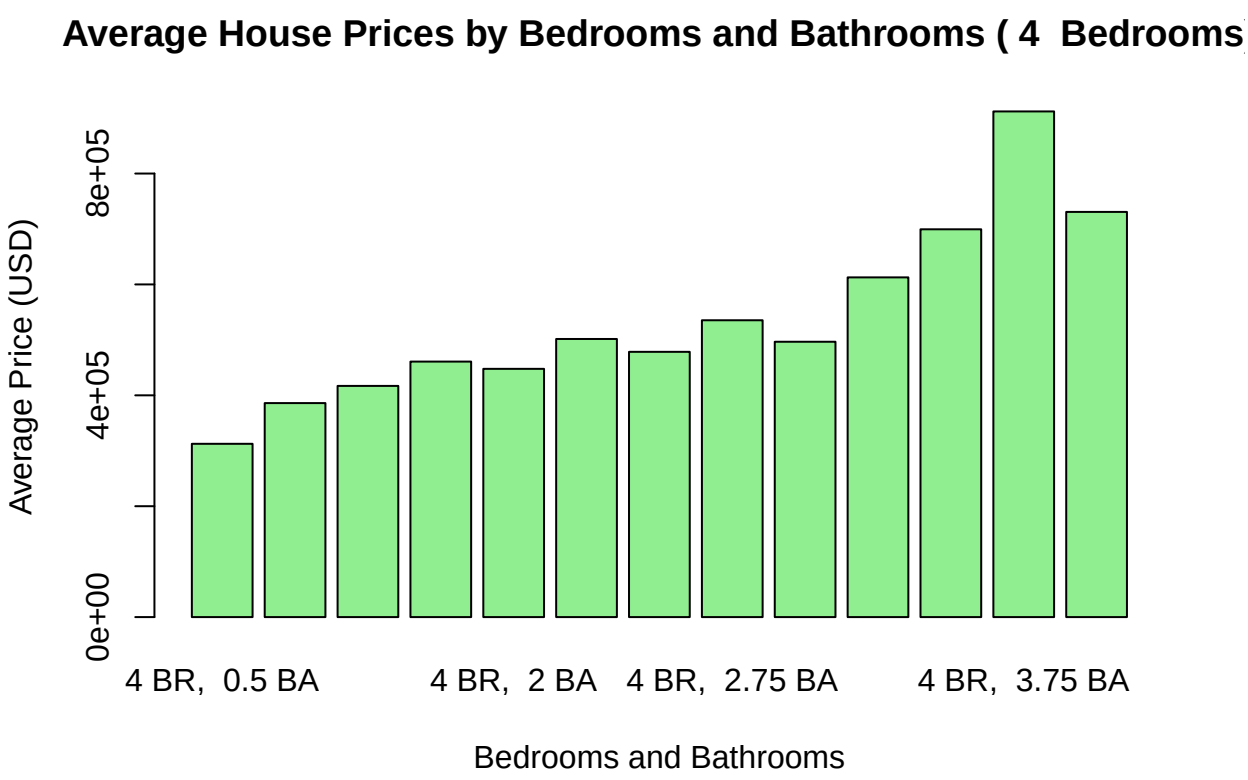


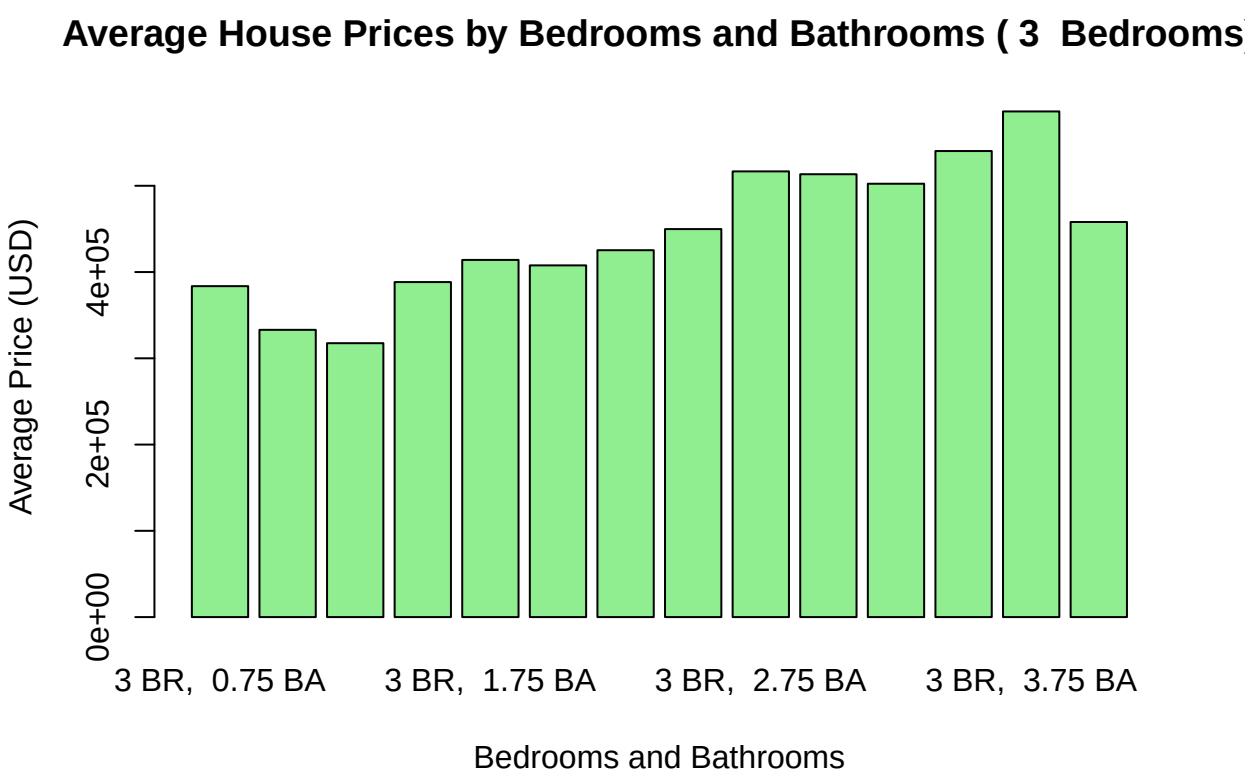

```
house_data_clean$decade_built <- 10 * (house_data_clean$yr_built %/% 10)  # Create a decade category
avg_price_by_decade <- aggregate(house_data_clean$price, by = list(decade_built = house_data_clean$deca
colnames(avg_price_by_decade) <- c("decade_built", "avg_price")


barplot(avg_price_by_decade$avg_price, names.arg = avg_price_by_decade$decade_built, col = "skyblue", ma
```

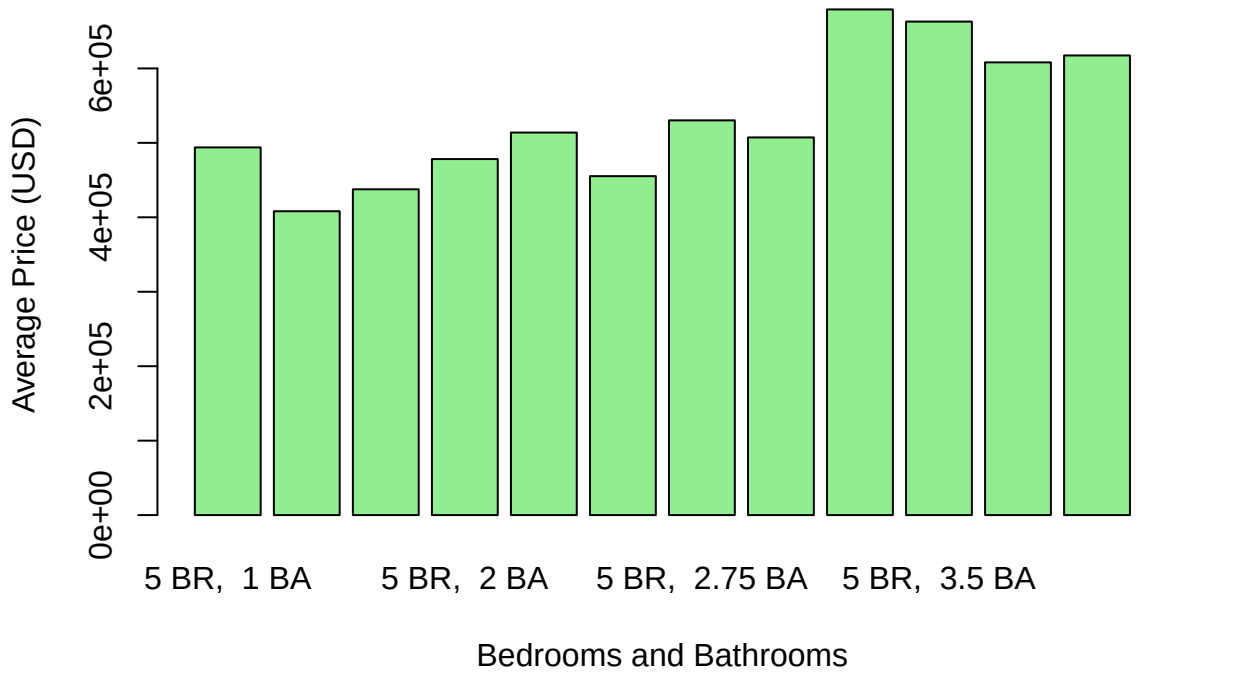



```r
#Aggregate average house prices by bedrooms and bathrooms
avg_price_bed_bath <- aggregate(house_data_clean$price, by = list(bedrooms = house_data_clean$bedrooms,
colnames(avg_price_bed_bath) <- c("bedrooms", "bathrooms", "avg_price")

#new column with formatted labels
avg_price_bed_bath$label <- paste(avg_price_bed_bath$bedrooms, "BR, ", avg_price_bed_bath$bathrooms, "BA

#Get unique values of 'bedrooms'
unique_bedrooms <- unique(avg_price_bed_bath$bedrooms)

#separate bar charts for each unique number of bedrooms
for (bedroom_value in unique_bedrooms) {
  #Subset data for the current number of bedrooms
  subset_data <- subset(avg_price_bed_bath, bedrooms == bedroom_value)

  #new column with formatted labels
  subset_data$label <- paste(subset_data$bedrooms, "BR, ", subset_data$bathrooms, "BA")

  # Bar chart
  barplot(subset_data$avg_price, beside = TRUE, names.arg = subset_data$label, col = "lightgreen",
          main = paste("Average House Prices by Bedrooms and Bathrooms (", bedroom_value, " Bedrooms)")
          xlab = "Bedrooms and Bathrooms", ylab = "Average Price (USD)")
}
```


Average House Prices by Bedrooms and Bathrooms (2 Bedrooms
Average Price (USD)
0e+00
2e+05
4e+05
2 BR, 0.5 BA
2 BR, 1.25 BA
2 BR, 2 BA
2 BR, 2.75 BA
Bedrooms and Bathrooms


Average House Prices by Bedrooms and Bathrooms (4 Bedrooms
Average Price (USD)
0e+00
4e+05
8e+05
4 BR, 0.5 BA
4 BR, 2 BA
4 BR, 2.75 BA
4 BR, 3.75 BA
Bedrooms and Bathrooms


Average House Prices by Bedrooms and Bathrooms (3 Bedrooms
Average Price (USD)
0e+00
2e+05
4e+05
3 BR, 0.75 BA
3 BR, 1.75 BA
3 BR, 2.75 BA
3 BR, 3.75 BA
Bedrooms and Bathrooms



feature construction

```r
house_data_clean$age <- 2023 - house_data_clean$yr_built
```

```r
house_data_clean$bed_bath_ratio <- house_data_clean$bedrooms / house_data_clean$bathrooms
```

```r
house_data_clean$total_sqft <- house_data_clean$sqft_living + house_data_clean$sqft_lot
```

```r
house_data_clean$month_sold <- as.numeric(substr(house_data_clean$date, 5, 6))
```

```r
house_data_clean$price_per_sqft <- house_data_clean$price / house_data_clean$sqft_living
```

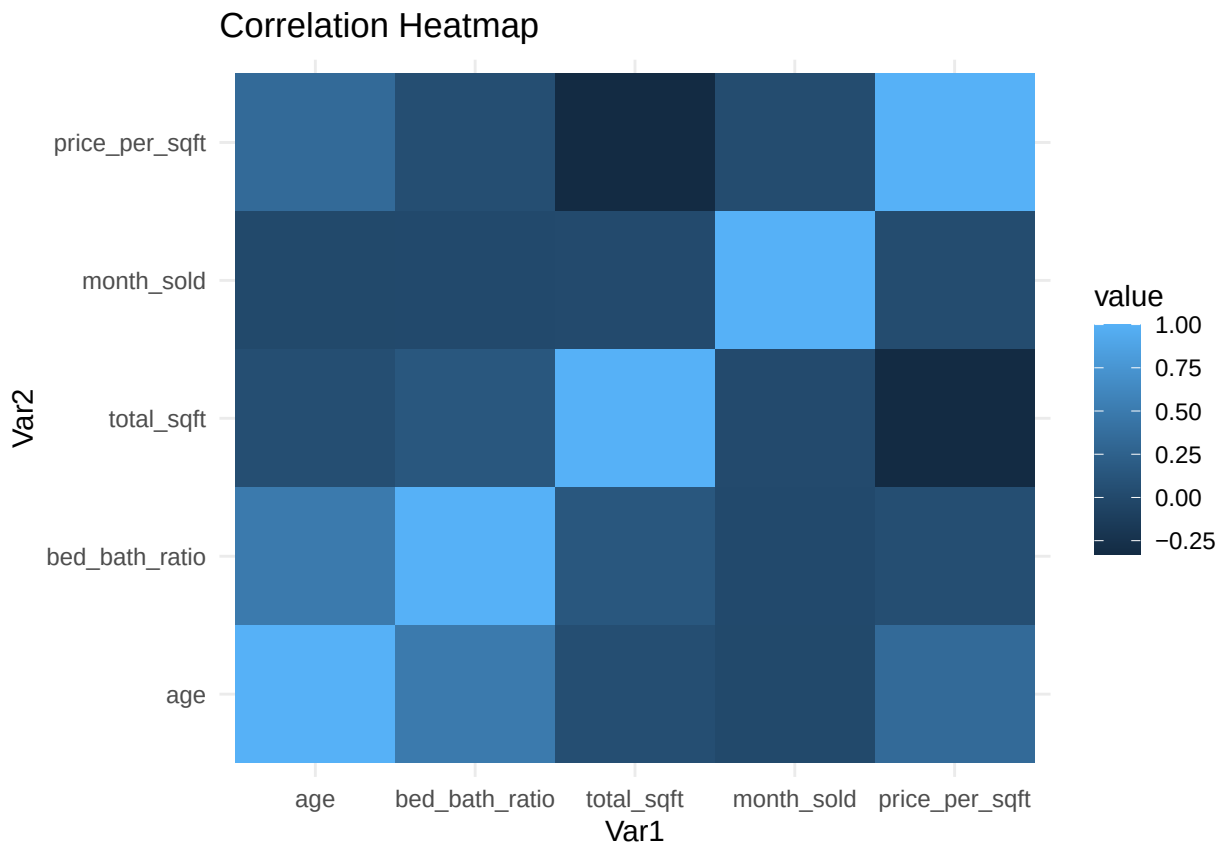
Normalizing

```r
#Function to perform Min-Max scaling
min_max_scaling <- function(x) {
  return((x - min(x)) / (max(x) - min(x)))
}

#Columns to normalize
columns_to_normalize <- c("age", "bed_bath_ratio", "total_sqft", "month_sold", "price_per_sqft")

#Min-Max scaling to selected columns
house_data_clean[columns_to_normalize] <- lapply(house_data_clean[columns_to_normalize], min_max_scalin
```

```r
#summary statistics of normalized features
summary(house_data_clean[columns_to_normalize])
```

```
##       age          bed_bath_ratio      total_sqft       month_sold
##  Min.   :0.0000   Min.   :0.00000   Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.1652   1st Qu.:0.09722   1st Qu.:0.2501   1st Qu.:1.0000
##  Median :0.3826   Median :0.14881   Median :0.3740   Median :1.0000
##  Mean   :0.3892   Mean   :0.16406   Mean   :0.3706   Mean   :0.7777
##  3rd Qu.:0.5565   3rd Qu.:0.18750   3rd Qu.:0.4773   3rd Qu.:1.0000
##  Max.   :1.0000   Max.   :1.00000   Max.   :1.0000   Max.   :1.0000
##  price_per_sqft
##  Min.   :0.0000
##  1st Qu.:0.1261
##  Median :0.2208
##  Mean   :0.2404
##  3rd Qu.:0.3223
##  Max.   :1.0000
```

```r
# Calculate correlation matrix
correlation_matrix <- cor(house_data_clean[columns_to_normalize])

# Create a heatmap of the correlation matrix
library(ggplot2)
library(reshape2)

# Melt the correlation matrix for visualization
correlation_melted <- melt(correlation_matrix)

# Create the heatmap
ggplot(data = correlation_melted, aes(x = Var1, y = Var2, fill = value)) +
  geom_tile() +
  theme_minimal() +
  labs(title = "Correlation Heatmap")
```



Part2

Identify categorical, ordinal and numerical veriables

```
# Display the structure of the dataframe
str(house_data_clean)
```

```
## 'data.frame':    11263 obs. of  27 variables:
##  $ id            : num  7.13e+09 5.63e+09 2.49e+09 1.95e+09 1.32e+09 ...
##  $ date          : Date, format: "2014-10-13" "2015-02-25" ...
##  $ price         : num  221900 180000 604000 510000 257500 ...
##  $ bedrooms      : num  3 2 4 3 3 3 3 3 2 3 ...
##  $ bathrooms     : num  1 1 3 2 2.25 1.5 1 2.5 1 1.75 ...
##  $ sqft_living   : num  1180 770 1960 1680 1715 ...
##  $ sqft_lot      : num  5650 10000 5000 8080 6819 ...
##  $ floors        : num  1 1 1 1 2 1 1 2 1 1 ...
##  $ waterfront    : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ view          : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ condition     : int  3 3 5 3 3 3 3 3 4 4 ...
##  $ grade         : int  7 6 7 8 7 7 7 7 7 7 ...
##  $ sqft_above    : int  1180 770 1050 1680 1715 1060 1050 1890 860 1370 ...
##  $ sqft_basement : int  0 0 910 0 0 0 730 0 300 0 ...
##  $ yr_built      : int  1955 1933 1965 1987 1995 1963 1960 2003 1942 1977 ...
##  $ yr_renovated  : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ zipcode       : int  98178 98028 98136 98074 98003 98198 98146 98038 98115 98074 ...
##  $ lat           : num  47.5 47.7 47.5 47.6 47.3 ...
```

```
##  $ long          : num  -122 -122 -122 -122 -122 ...
##  $ sqft_living15 : int  1340 2720 1360 1800 2238 1650 1780 2390 1330 1370 ...
##  $ sqft_lot15    : int  5650 8062 5000 7503 6819 9711 8113 7570 6000 10208 ...
##  $ decade_built  : num  1950 1930 1960 1980 1990 1960 1960 2000 1940 1970 ...
##  $ age           : num  0.522 0.713 0.435 0.243 0.174 ...
##  $ bed_bath_ratio: num  0.3229 0.1875 0.0972 0.1198 0.0972 ...
##  $ total_sqft    : num  0.28 0.488 0.287 0.434 0.37 ...
##  $ month_sold    : num  0 1 0 1 1 1 1 1 1 0 ...
##  $ price_per_sqft: num  0.1426 0.2075 0.3131 0.3066 0.0888 ...
##  - attr(*, "na.action")= 'omit' Named int [1:3995] 11 13 19 24 25 27 32 33 38 39 ...
##   ..- attr(*, "names")= chr [1:3995] "11" "13" "19" "24" ...
```

```
# Assuming 'house_data' is your data frame
categorical_vars <- c("waterfront", "view", "zipcode")

# Checking the unique values in each categorical variable
sapply(house_data_clean[categorical_vars], function(x) unique(x))
```

```
## $waterfront
## [1] 0
##
## $view
## [1] 0
##
## $zipcode
##  [1] 98178 98028 98136 98074 98003 98198 98146 98038 98115 98107 98019 98103
## [13] 98133 98092 98002 98112 98052 98027 98117 98058 98056 98119 98007 98148
## [25] 98105 98042 98166 98122 98144 98001 98034 98125 98008 98116 98118 98059
## [37] 98023 98102 98168 98029 98006 98109 98177 98030 98126 98040 98155 98053
## [49] 98031 98024 98108 98106 98032 98072 98033 98055 98011 98005 98075 98188
## [61] 98004 98010 98199 98022 98065 98077 98014 98070 98039
```

```
categorical_vars
```

```
## [1] "waterfront" "view"       "zipcode"
```

Identifying N

```
# Assuming 'house_data' is your data frame
ordinal_vars <- c("condition", "grade")

# Checking the unique values in each ordinal variable
sapply(house_data_clean[ordinal_vars], function(x) unique(x))
```

```
##      condition grade
## [1,]         3     7
## [2,]         5     6
## [3,]         4     8
## [4,]         2     9
```

```r
# Assuming 'house_data_clean' is your data frame
numerical_vars <- sapply(house_data_clean, is.numeric)
numerical_vars
```

```
##             id           date          price       bedrooms      bathrooms
##           TRUE          FALSE           TRUE           TRUE           TRUE
##    sqft_living       sqft_lot         floors     waterfront           view
##           TRUE           TRUE           TRUE           TRUE           TRUE
##      condition          grade     sqft_above  sqft_basement       yr_built
##           TRUE           TRUE           TRUE           TRUE           TRUE
##   yr_renovated        zipcode            lat           long  sqft_living15
##           TRUE           TRUE           TRUE           TRUE           TRUE
##     sqft_lot15   decade_built            age bed_bath_ratio     total_sqft
##           TRUE           TRUE           TRUE           TRUE           TRUE
##     month_sold price_per_sqft
##           TRUE           TRUE
```

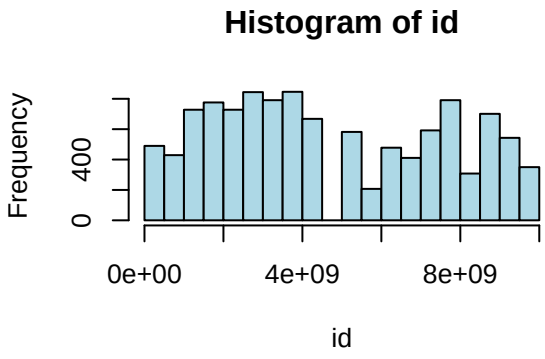
Measures of centraility and distribution

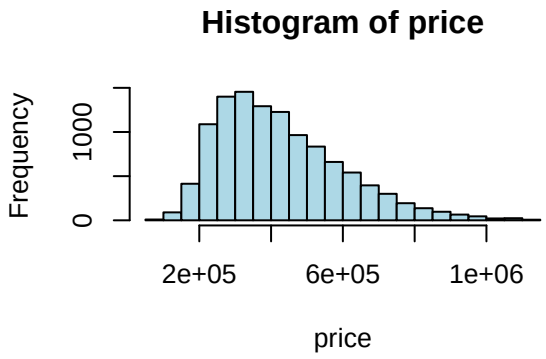
```r
# Assuming 'house_data_clean' is your data frame
numerical_vars <- sapply(house_data_clean, is.numeric)
numerical_vars <- names(numerical_vars[numerical_vars])

# Display summary statistics for numerical variables
summary_stats <- summary(house_data_clean[numerical_vars])

# Print summary statistics
print(summary_stats)
```

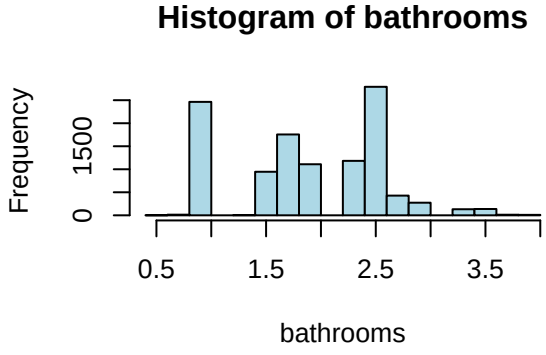
```
##        id                 price            bedrooms       bathrooms
##  Min.   :2.800e+06   Min.   :  82000   Min.   :2.000   Min.   :0.500
##  1st Qu.:2.290e+09   1st Qu.: 295000   1st Qu.:3.000   1st Qu.:1.500
##  Median :3.999e+09   Median : 399500   Median :3.000   Median :2.000
##  Mean   :4.684e+09   Mean   : 428819   Mean   :3.221   Mean   :1.938
##  3rd Qu.:7.338e+09   3rd Qu.: 535000   3rd Qu.:4.000   3rd Qu.:2.500
##  Max.   :9.895e+09   Max.   :1125000   Max.   :5.000   Max.   :4.000
##   sqft_living      sqft_lot         floors        waterfront      view
##  Min.   : 560   Min.   :  520   Min.   :1.000   Min.   :0    Min.   :0
##  1st Qu.:1320   1st Qu.: 4560   1st Qu.:1.000   1st Qu.:0    1st Qu.:0
##  Median :1690   Median : 6976   Median :1.000   Median :0    Median :0
##  Mean   :1746   Mean   : 6801   Mean   :1.455   Mean   :0    Mean   :0
##  3rd Qu.:2130   3rd Qu.: 8750   3rd Qu.:2.000   3rd Qu.:0    3rd Qu.:0
##  Max.   :3930   Max.   :17859   Max.   :3.500   Max.   :0    Max.   :0
##    condition         grade         sqft_above   sqft_basement       yr_built
##  Min.   :2.000   Min.   :6.000   Min.   : 480   Min.   :   0.0   Min.   :1900
##  1st Qu.:3.000   1st Qu.:7.000   1st Qu.:1120   1st Qu.:   0.0   1st Qu.:1951
##  Median :3.000   Median :7.000   Median :1400   Median :   0.0   Median :1971
##  Mean   :3.433   Mean   :7.328   Mean   :1524   Mean   : 221.6   Mean   :1970
##  3rd Qu.:4.000   3rd Qu.:8.000   3rd Qu.:1830   3rd Qu.: 440.0   3rd Qu.:1996
##  Max.   :5.000   Max.   :9.000   Max.   :3090   Max.   :1200.0   Max.   :2015
##   yr_renovated    zipcode           lat             long        sqft_living15
##  Min.   :0     Min.   :98001   Min.   :47.19   Min.   :-122.5   Min.   : 620
```

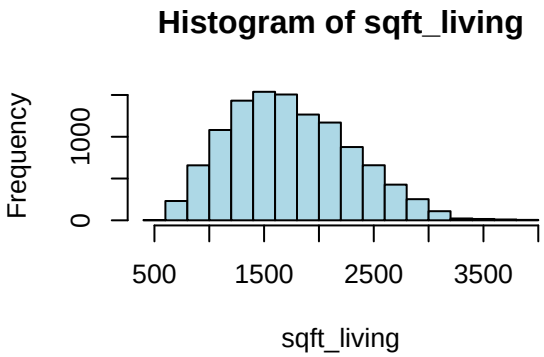
```
##  1st Qu.:0     1st Qu.:98033   1st Qu.:47.46   1st Qu.:-122.3   1st Qu.:1410
##  Median :0     Median :98074   Median :47.57   Median :-122.3   Median :1670
##  Mean   :0     Mean   :98082   Mean   :47.56   Mean   :-122.2   Mean   :1741
##  3rd Qu.:0     3rd Qu.:98119   3rd Qu.:47.68   3rd Qu.:-122.2   3rd Qu.:2030
##  Max.   :0     Max.   :98199   Max.   :47.78   Max.   :-121.9   Max.   :2990
##    sqft_lot15     decade_built       age         bed_bath_ratio
##  Min.   :  659   Min.   :1900   Min.   :0.0000   Min.   :0.00000
##  1st Qu.: 4668   1st Qu.:1950   1st Qu.:0.1652   1st Qu.:0.09722
##  Median : 7102   Median :1970   Median :0.3826   Median :0.14881
##  Mean   : 6698   Mean   :1966   Mean   :0.3892   Mean   :0.16406
##  3rd Qu.: 8535   3rd Qu.:1990   3rd Qu.:0.5565   3rd Qu.:0.18750
##  Max.   :14482   Max.   :2010   Max.   :1.0000   Max.   :1.00000
##    total_sqft       month_sold     price_per_sqft
##  Min.   :0.0000   Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.2501   1st Qu.:1.0000   1st Qu.:0.1261
##  Median :0.3740   Median :1.0000   Median :0.2208
##  Mean   :0.3706   Mean   :0.7777   Mean   :0.2404
##  3rd Qu.:0.4773   3rd Qu.:1.0000   3rd Qu.:0.3223
##  Max.   :1.0000   Max.   :1.0000   Max.   :1.0000
```

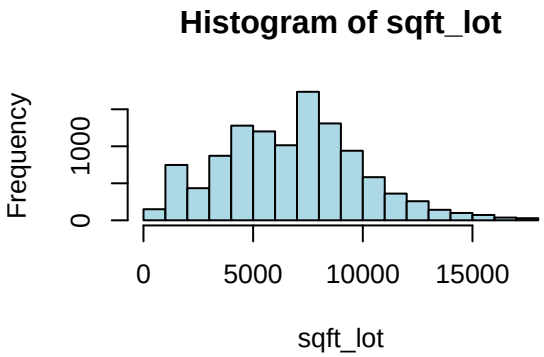
```r
# Create histograms for numerical variables
par(mfrow = c(2, 2))  # Set up a 2x2 grid for subplots

for (var in numerical_vars) {
  hist(house_data_clean[[var]], main = paste("Histogram of", var), xlab = var, col = "lightblue", borde
}
```

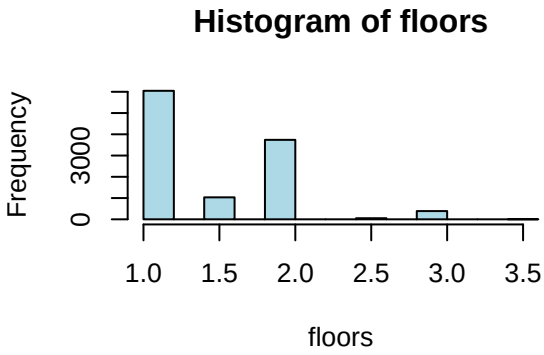


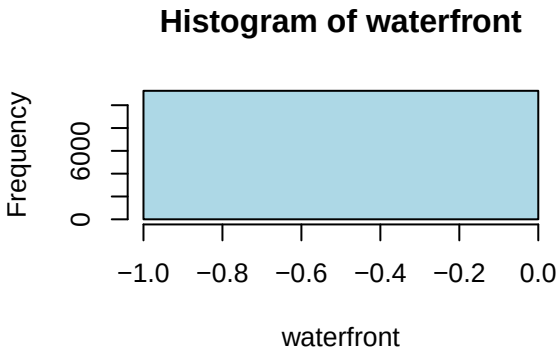


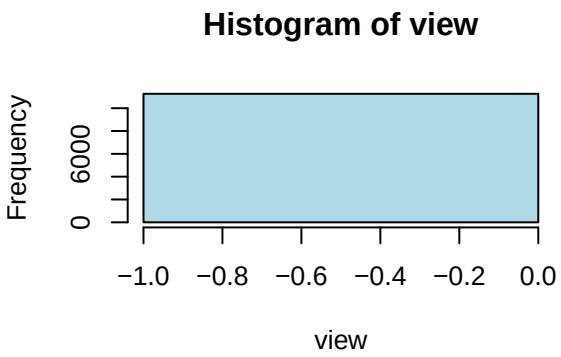


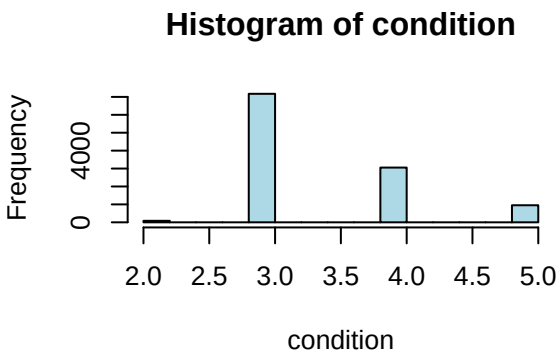

Histogram of sqft_living
Frequency
0
1000
500
1500
2500
3500
sqft_living

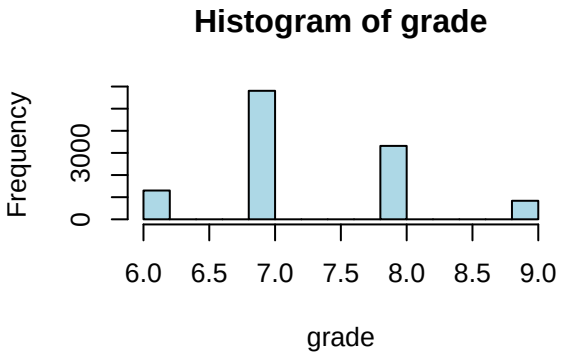

Histogram of sqft_lot
Frequency
0
1000
0
5000
10000
15000
sqft_lot

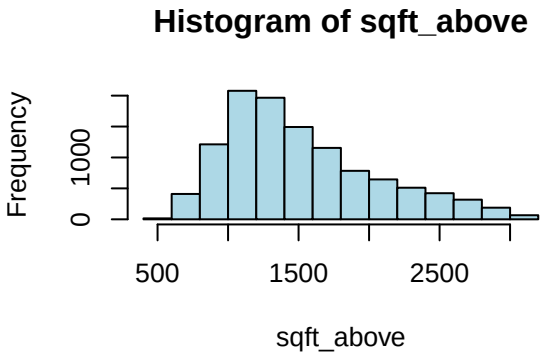

Histogram of floors
Frequency
0
3000
1.0
1.5
2.0
2.5
3.0
3.5
floors

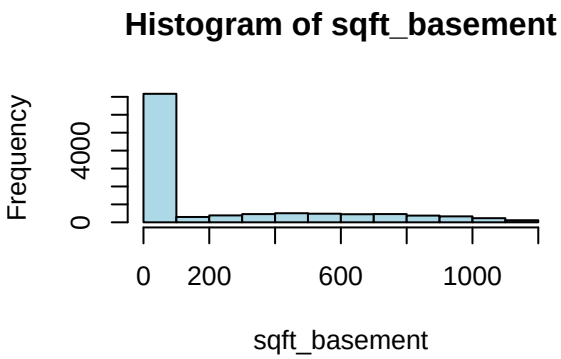

Histogram of waterfront
Frequency
0
6000
−1.0
−0.8
−0.6
−0.4
−0.2
0.0
waterfront

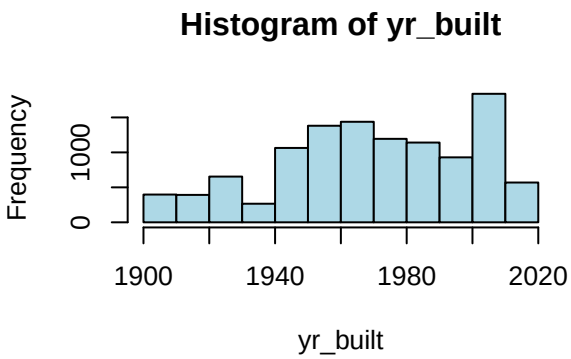

Histogram of view
Frequency
0
6000
−1.0
−0.8
−0.6
−0.4
−0.2
0.0
view

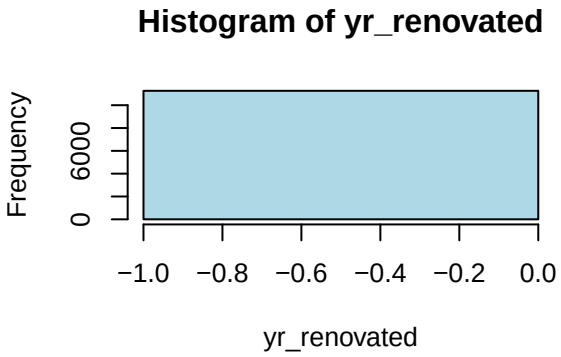

Histogram of condition
Frequency
0
4000
2.0
2.5
3.0
3.5
4.0
4.5
5.0
condition

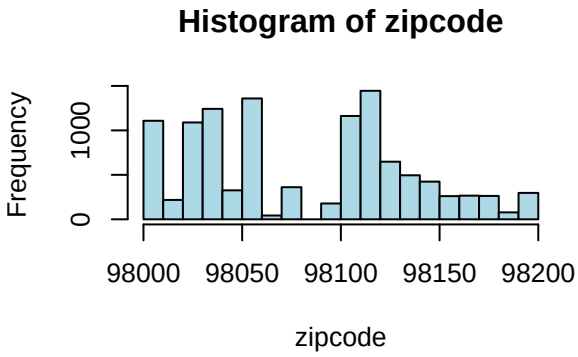

Histogram of grade
Frequency
0
3000
6.0
6.5
7.0
7.5
8.0
8.5
9.0
grade

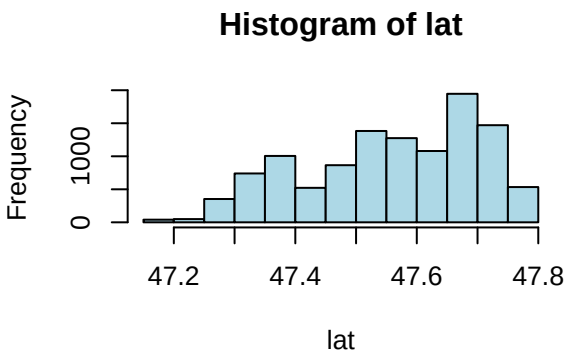

Histogram of sqft_above
Frequency
0
1000
500
1500
2500
sqft_above

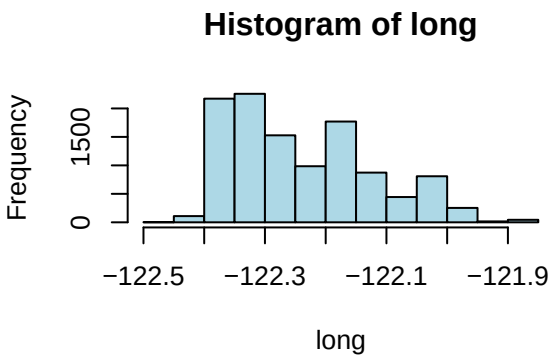

Histogram of sqft_basement
Frequency
0
4000
0
200
600
1000
sqft_basement

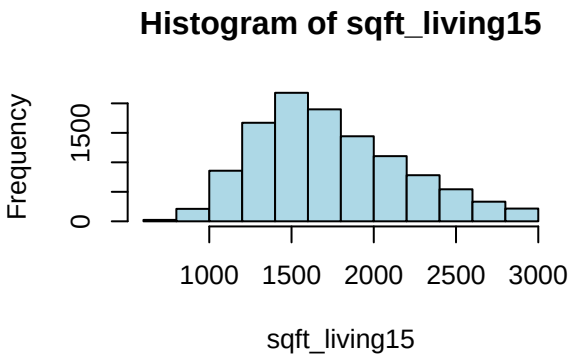

Histogram of yr_built
Frequency
0
1000
1900
1940
1980
2020
yr_built

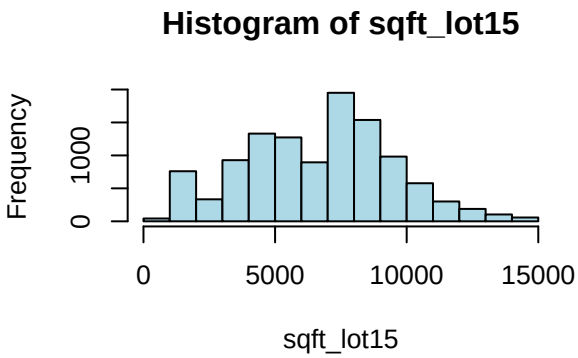

Histogram of yr_renovated
Frequency
0
6000
−1.0
−0.8
−0.6
−0.4
−0.2
0.0
yr_renovated

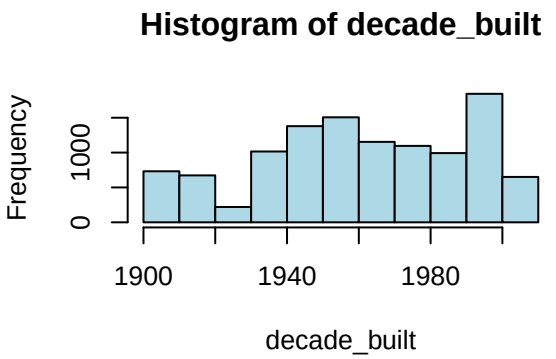

Histogram of zipcode
Frequency
0
1000
98000
98050
98100
98150
98200
zipcode

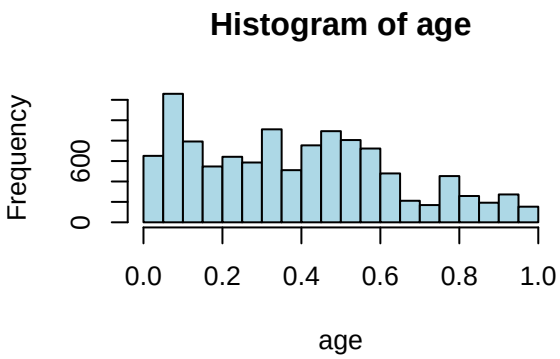

Histogram of lat
Frequency
0
1000
47.2
47.4
47.6
47.8
lat

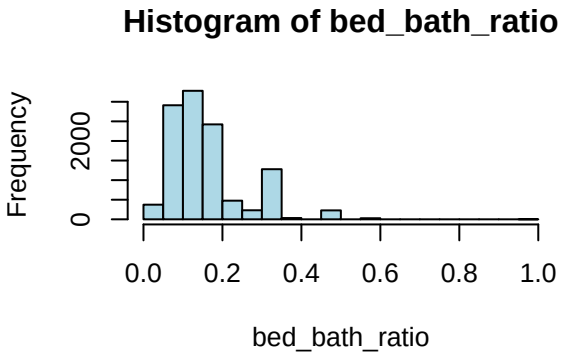

Histogram of long
Frequency
0
1500
−122.5
−122.3
−122.1
−121.9
long

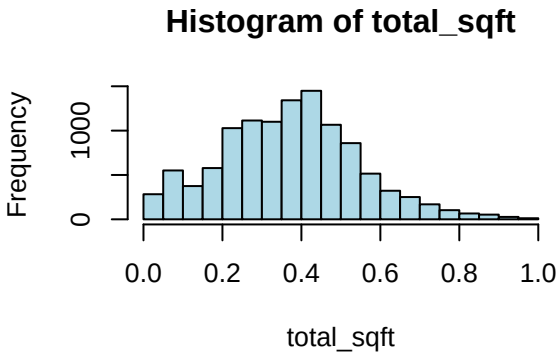

Histogram of sqft_living15
Frequency
0
1500
1000
1500
2000
2500
3000
sqft_living15

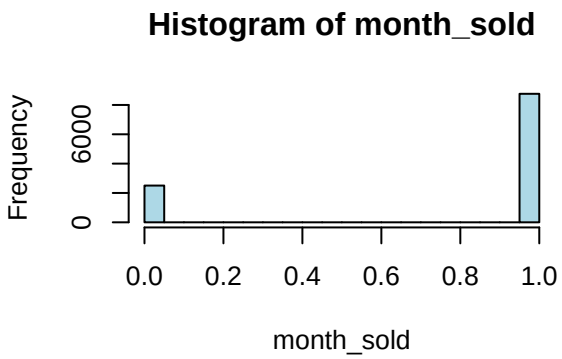

Histogram of sqft_lot15
Frequency
0
1000
0
5000
10000
15000
sqft_lot15

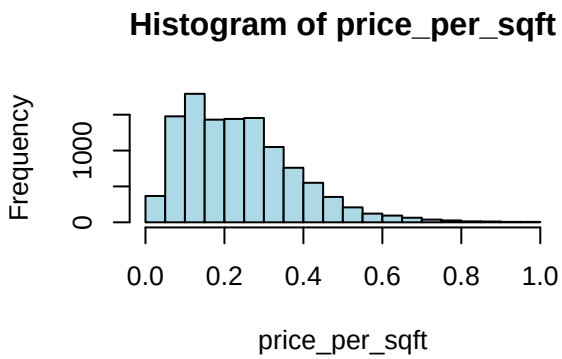

Histogram of decade_built
Frequency
0
1000
1900
1940
1980
decade_built


Histogram of age
Frequency
0
600
0.0
0.2
0.4
0.6
0.8
1.0
age


Histogram of bed_bath_ratio
Frequency
0
2000
0.0
0.2
0.4
0.6
0.8
1.0
bed_bath_ratio


Histogram of total_sqft
Frequency
0
1000
0.0
0.2
0.4
0.6
0.8
1.0
total_sqft






```
correlation_matrix <- cor(house_data_clean[, sapply(house_data_clean, is.numeric)])
```

```
## Warning in cor(house_data_clean[, sapply(house_data_clean, is.numeric)]): the
## standard deviation is zero
```

```
library(caret)
nearZeroVarCols <- nearZeroVar(house_data_clean, saveMetrics = TRUE)
```

```
library(caret)


nearZeroVarCols <- nearZeroVar(house_data_clean, saveMetrics = TRUE)

# Extract the names of near-zero variance columns
nearZeroVarNames <- names(house_data_clean)[nearZeroVarCols$nzv]

# Exclude near-zero variance variables from the dataset
filtered_data <- house_data_clean[, !names(house_data_clean) %in% nearZeroVarNames]
```

```
# Select numeric variables for correlation analysis
numeric_variables <- filtered_data[, sapply(filtered_data, is.numeric)]

# Compute the correlation matrix for numeric variables
correlation_matrix_filtered <- cor(numeric_variables)
```

```
# Visualize the correlation matrix using a heatmap
library(corrplot)
```

```
## corrplot 0.92 loaded
```

```
corrplot(correlation_matrix_filtered, method = "color")
```