Senior Project: Real Estate Listings Price Prediction

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January 26, 2021

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# Introduction

Motivation: There is a lot of variation in the prices of real estate, and it is often difficult to know whether or not you are paying a fair price for a house. It is often difficult for people to know if the real estate price listed online truly reflects the value of the house, especially for people who do not know much about real estate. This uncertainty is even more frustrating in a pandemic. I am interested in uncovering the factors that contribute most to the price of a house and how that price is determined. I aim to help inform people more about what contributes to the prices of real estate.

Goal: Implement a Multiple Linear Regression Model to predict price and determine which factors are most significant in deciding the price of a house.

# Data

Real Estate Data:

* Pre-processed data found on Kaggle’s website
* Scraped from Trulia, a subsidiary of Zillow, in 2019
* Contains various real estate listings from multiple cities/states in the United States
* 68 attributes including price, size, location, style, year built, features, years listed on Trulia, and more.
* Includes 30,000 records of real estate listings.

Crime Data:

* Obtained from the FBI Uniform Crime Reporting (UCR) Program
* Includes the total number of known violent crimes and property crimes for each city in 2019

# Exploratory Analysis of the Data

# Note: This data was cleaned in Python. This report is a continuation of the project which I began in Python Jupyter Notebook.  
  
# Read in the data  
housing2 <- read.csv("~/Luther College Year 4/Senior Project/Zscoredf.csv")  
  
View(housing2)  
head (housing2)

## Price Sqr.Ft Bedrooms Bathrooms Year.Built Days.On.Trulia Lot.Size.sqft.  
## 1 895900 3447 4 4.5 2019 110 7895.00  
## 2 300825 2537 3 4.0 2005 126 5400.00  
## 3 1050000 2443 4 2.0 1962 3 14810.40  
## 4 490990 2005 2 2.5 1975 180 92933.22  
## 5 190000 1732 4 2.0 1983 29 9165.00  
## 6 239999 2423 4 2.0 1969 65 6747.00  
## Price.per.Sqft Population Violent.Crime.Rate Property.Crime.Rate City  
## 1 259.91 1688722 0.006989309 0.03314578 Phoenix  
## 2 118.58 1688722 0.006989309 0.03314578 Phoenix  
## 3 429.80 1688722 0.006989309 0.03314578 Phoenix  
## 4 244.88 1688722 0.006989309 0.03314578 Phoenix  
## 5 109.70 1688722 0.006989309 0.03314578 Phoenix  
## 6 99.05 1688722 0.006989309 0.03314578 Phoenix  
## State  
## 1 AZ  
## 2 AZ  
## 3 AZ  
## 4 AZ  
## 5 AZ  
## 6 AZ

## Rename columns:

#Rename columns  
colnames(housing2)[1] <- "Price"  
colnames(housing2)[2] <- "Size" #in square feet  
colnames(housing2)[3] <- "Bedrooms"  
colnames(housing2)[4] <- "Bathrooms"  
colnames(housing2)[5] <- "Year\_Built"  
colnames(housing2)[6] <- "Days\_On\_Trulia"  
colnames(housing2)[7] <- "Lot\_Size" #in square feet  
colnames(housing2)[8] <- "Price\_per\_sqft"  
colnames(housing2)[9] <- "Population"  
colnames(housing2)[10] <- "Violent\_Crime\_Rate"  
colnames(housing2)[11] <- "Property\_Crime\_Rate"  
colnames(housing2)[12] <- "City"  
colnames(housing2)[13] <- "State"  
  
head(housing2)

## Price Size Bedrooms Bathrooms Year\_Built Days\_On\_Trulia Lot\_Size  
## 1 895900 3447 4 4.5 2019 110 7895.00  
## 2 300825 2537 3 4.0 2005 126 5400.00  
## 3 1050000 2443 4 2.0 1962 3 14810.40  
## 4 490990 2005 2 2.5 1975 180 92933.22  
## 5 190000 1732 4 2.0 1983 29 9165.00  
## 6 239999 2423 4 2.0 1969 65 6747.00  
## Price\_per\_sqft Population Violent\_Crime\_Rate Property\_Crime\_Rate City  
## 1 259.91 1688722 0.006989309 0.03314578 Phoenix  
## 2 118.58 1688722 0.006989309 0.03314578 Phoenix  
## 3 429.80 1688722 0.006989309 0.03314578 Phoenix  
## 4 244.88 1688722 0.006989309 0.03314578 Phoenix  
## 5 109.70 1688722 0.006989309 0.03314578 Phoenix  
## 6 99.05 1688722 0.006989309 0.03314578 Phoenix  
## State  
## 1 AZ  
## 2 AZ  
## 3 AZ  
## 4 AZ  
## 5 AZ  
## 6 AZ

dim(housing2) #Shows data dimension

## [1] 21912 13

There are 21,912 rows and 13 columns in the dataset.

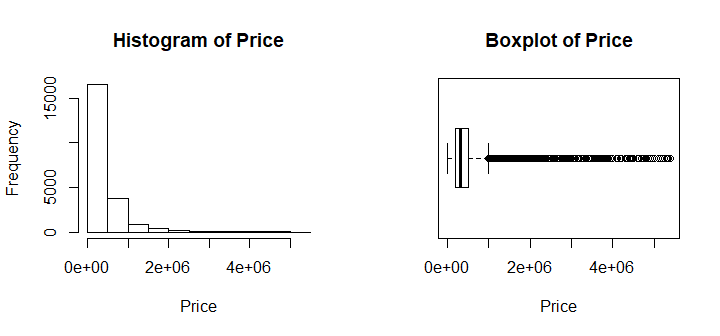
#Check for missing values  
any(is.na(housing2))

## [1] FALSE

No missing values.

## Check for Skewness and Outliers in ‘Price’

par (mfrow = c(1, 2))  
  
hist (housing2$Price, xlab="Price", main="Histogram of Price")  
boxplot (housing2$Price, horizontal = T, xlab="Price", main="Boxplot of Price")



The price data is very right skewed. It would probably be beneficial to use a log transformation.

## Check distributions of the quantitative predictor variables:

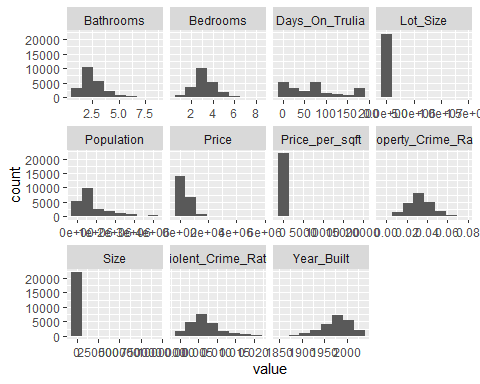
library (tidyr)

## Warning: package 'tidyr' was built under R version 3.6.3

library (ggplot2)

## Warning: package 'ggplot2' was built under R version 3.6.3

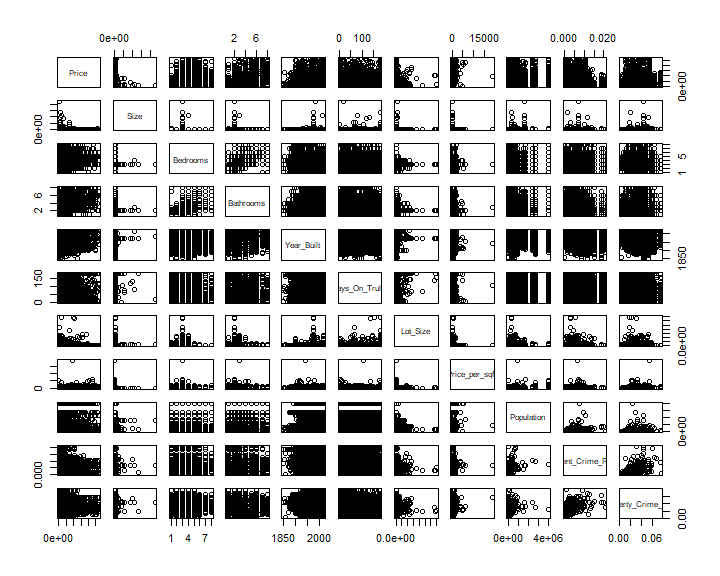
#Histograms  
ggplot(gather(housing2 [, 1:11]), aes(value)) +   
 geom\_histogram(bins = 8) +   
 facet\_wrap(~key, scales = 'free\_x')



It looks like price, lot size, population, size, and price per sqft are all skewed right. Number of bathrooms and violent crime rate are slightly skewed right as well. Year Built is slightly skewed left.

## Scatterplots and correlation between predictor variables

#scatterplot between some variables  
plot (housing2[ ,1:11]) #Color shows



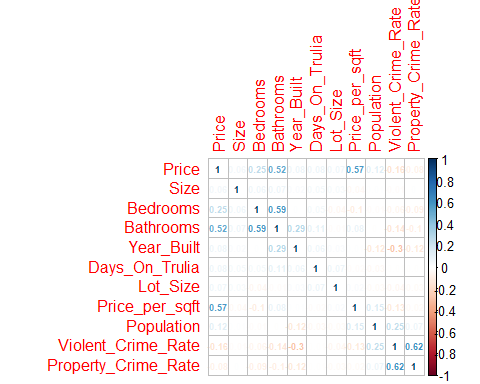
#### Heat Map for Correlation

transcorr = cor(housing2 [, 1:11], use= "complete.obs")  
# c(1, 4:5, 8, 10)  
library("corrplot")

## Warning: package 'corrplot' was built under R version 3.6.3

## corrplot 0.84 loaded

## corrplot 0.84 loaded  
corrplot (transcorr, method = "number", number.cex=0.55)



#### Categorical variables:

* City
* State

#### Correlation:

#Correlation for quantitative predictor variables  
cormat = cor (housing2 [, 1:11], use = "complete.obs")  
round (cormat, 2)

## Price Size Bedrooms Bathrooms Year\_Built Days\_On\_Trulia  
## Price 1.00 0.06 0.25 0.52 0.08 0.08  
## Size 0.06 1.00 0.06 0.07 0.02 0.05  
## Bedrooms 0.25 0.06 1.00 0.59 0.00 0.05  
## Bathrooms 0.52 0.07 0.59 1.00 0.29 0.11  
## Year\_Built 0.08 0.02 0.00 0.29 1.00 0.06  
## Days\_On\_Trulia 0.08 0.05 0.05 0.11 0.06 1.00  
## Lot\_Size 0.07 0.03 -0.04 -0.01 0.03 0.07  
## Price\_per\_sqft 0.57 -0.04 -0.10 0.08 0.01 -0.02  
## Population 0.12 0.01 -0.01 0.00 -0.12 -0.03  
## Violent\_Crime\_Rate -0.16 -0.01 -0.06 -0.14 -0.30 -0.01  
## Property\_Crime\_Rate -0.08 0.00 -0.09 -0.10 -0.12 -0.01  
## Lot\_Size Price\_per\_sqft Population Violent\_Crime\_Rate  
## Price 0.07 0.57 0.12 -0.16  
## Size 0.03 -0.04 0.01 -0.01  
## Bedrooms -0.04 -0.10 -0.01 -0.06  
## Bathrooms -0.01 0.08 0.00 -0.14  
## Year\_Built 0.03 0.01 -0.12 -0.30  
## Days\_On\_Trulia 0.07 -0.02 -0.03 -0.01  
## Lot\_Size 1.00 0.02 -0.03 -0.04  
## Price\_per\_sqft 0.02 1.00 0.15 -0.13  
## Population -0.03 0.15 1.00 0.25  
## Violent\_Crime\_Rate -0.04 -0.13 0.25 1.00  
## Property\_Crime\_Rate -0.03 -0.02 0.07 0.62  
## Property\_Crime\_Rate  
## Price -0.08  
## Size 0.00  
## Bedrooms -0.09  
## Bathrooms -0.10  
## Year\_Built -0.12  
## Days\_On\_Trulia -0.01  
## Lot\_Size -0.03  
## Price\_per\_sqft -0.02  
## Population 0.07  
## Violent\_Crime\_Rate 0.62  
## Property\_Crime\_Rate 1.00

High correlations with the response variable, price: - price per sqft (0.57) - bathrooms (0.52) - bedrooms (0.25) - violent crime rate (-0.16)

High correlations between predictor variables: - bedrooms and bathrooms (0.59) - bathrooms and year built (0.29) - violent crime rate and year built (-0.30) - property crime rate and violent crime rate (0.62) - violent crime rate and population (0.25)

Note: Crime rates are based on the population. Price per square foot should not be used becuase it takes into account the price.

Variables to most likely use in model: Size, Bedrooms, Bathrooms, Year\_Built, Lot\_Size, Violent Crime Rate, City

# Simple Linear Regression with one Predictor Variable (Bathrooms)

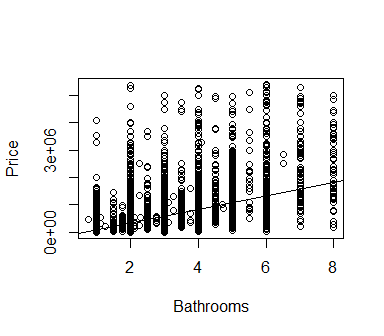
plot (Price ~ Bathrooms, data=housing2)  
#fit the model  
fit0 = lm (Price ~ Bathrooms, data=housing2)  
  
summary (fit0)

##   
## Call:  
## lm(formula = Price ~ Bathrooms, data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1648135 -219940 -83597 80160 5027619   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -172538 7458 -23.14 <2e-16 \*\*\*  
## Bathrooms 247459 2754 89.84 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 440600 on 21910 degrees of freedom  
## Multiple R-squared: 0.2692, Adjusted R-squared: 0.2692   
## F-statistic: 8072 on 1 and 21910 DF, p-value: < 2.2e-16

confint (fit0) #confidence interval

## 2.5 % 97.5 %  
## (Intercept) -187154.7 -157920.3  
## Bathrooms 242060.4 252857.8

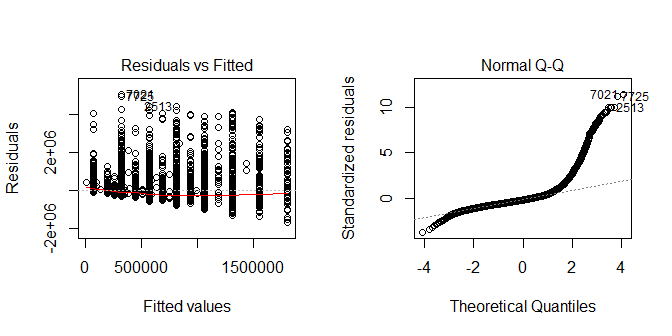
abline (fit0)



The R-squared is 0.269. This means that the number of bathrooms explains about 27% of the variation in the price of the real estate. The residual standard error is $440,600.

### Residual Analysis

par (mfrow = c(1,2))  
plot (fit0, which=1:2)



The Normal Q-Q plot shows that the data is not Normal. It is very much skewed to the right.

# First Order Multiple Linear Regression Model

Next, we fit a first-order linear model with all quantitative predictors.

fit1 = lm ((Price) ~ Size + Bedrooms + Bathrooms + Year\_Built + Lot\_Size + Price\_per\_sqft + Population + Violent\_Crime\_Rate + Property\_Crime\_Rate, data=housing2)  
summary (fit1)

##   
## Call:  
## lm(formula = (Price) ~ Size + Bedrooms + Bathrooms + Year\_Built +   
## Lot\_Size + Price\_per\_sqft + Population + Violent\_Crime\_Rate +   
## Property\_Crime\_Rate, data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -19594210 -127390 -35832 73426 4876817   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 2.221e+06 1.653e+05 13.434 < 2e-16 \*\*\*  
## Size 2.343e+00 2.498e-01 9.379 < 2e-16 \*\*\*  
## Bedrooms 8.691e+03 2.846e+03 3.054 0.00226 \*\*   
## Bathrooms 2.274e+05 2.877e+03 79.055 < 2e-16 \*\*\*  
## Year\_Built -1.316e+03 8.322e+01 -15.819 < 2e-16 \*\*\*  
## Lot\_Size 1.224e-01 9.068e-03 13.492 < 2e-16 \*\*\*  
## Price\_per\_sqft 1.113e+03 1.008e+01 110.368 < 2e-16 \*\*\*  
## Population 3.226e-02 2.910e-03 11.085 < 2e-16 \*\*\*  
## Violent\_Crime\_Rate -8.291e+06 7.505e+05 -11.047 < 2e-16 \*\*\*  
## Property\_Crime\_Rate 4.702e+05 2.434e+05 1.932 0.05339 .   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 339700 on 21902 degrees of freedom  
## Multiple R-squared: 0.5656, Adjusted R-squared: 0.5655   
## F-statistic: 3169 on 9 and 21902 DF, p-value: < 2.2e-16

anova (fit1)

## Analysis of Variance Table  
##   
## Response: (Price)  
## Df Sum Sq Mean Sq F value Pr(>F)   
## Size 1 2.0429e+13 2.0429e+13 176.9917 < 2.2e-16 \*\*\*  
## Bedrooms 1 3.5525e+14 3.5525e+14 3077.7835 < 2.2e-16 \*\*\*  
## Bathrooms 1 1.2241e+15 1.2241e+15 10605.1022 < 2.2e-16 \*\*\*  
## Year\_Built 1 5.0220e+13 5.0220e+13 435.0937 < 2.2e-16 \*\*\*  
## Lot\_Size 1 2.8738e+13 2.8738e+13 248.9819 < 2.2e-16 \*\*\*  
## Price\_per\_sqft 1 1.5872e+15 1.5872e+15 13751.3482 < 2.2e-16 \*\*\*  
## Population 1 7.5123e+12 7.5123e+12 65.0847 7.54e-16 \*\*\*  
## Violent\_Crime\_Rate 1 1.8121e+13 1.8121e+13 156.9962 < 2.2e-16 \*\*\*  
## Property\_Crime\_Rate 1 4.3077e+11 4.3077e+11 3.7321 0.05339 .   
## Residuals 21902 2.5280e+15 1.1542e+11   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Adjusted R-squared: 0.565. All variables are significant. Property Crime Rate is the least significant in this model.

#### Variance Inflation Factors

car::vif(fit1)

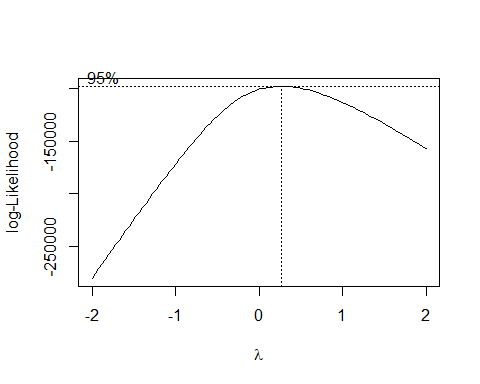
## Size Bedrooms Bathrooms Year\_Built   
## 1.009538 1.695412 1.834415 1.254716   
## Lot\_Size Price\_per\_sqft Population Violent\_Crime\_Rate   
## 1.005690 1.113660 1.125694 1.937196   
## Property\_Crime\_Rate   
## 1.663129

Since all of the variance inflation factors are less than 5, we do not need to worry about multicollinearity.

Box-Cox Analysis:

Box-Cox analysis is one way to choose a response variable transformation from the set of power transformations. It can also just help choose between log, square root, and squaring.

library ("MASS")  
boxcox (fit1)



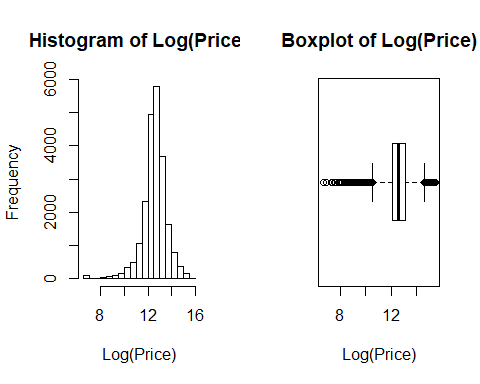
Since the peak is close to 1/2, this suggests a log transformation of the response variable, Price.

### Log Transfomation of Price

#Define LogPrice variable  
housing2$LogPrice = log(housing2$Price)

Plot the distribution of Log(Price)

par (mfrow = c(1, 2))  
# histogram and boxplot for log of price  
hist (housing2$LogPrice, xlab="Log(Price)", main="Histogram of Log(Price)")  
boxplot (housing2$LogPrice, horizontal = T, xlab="Log(Price)", main="Boxplot of Log(Price)")



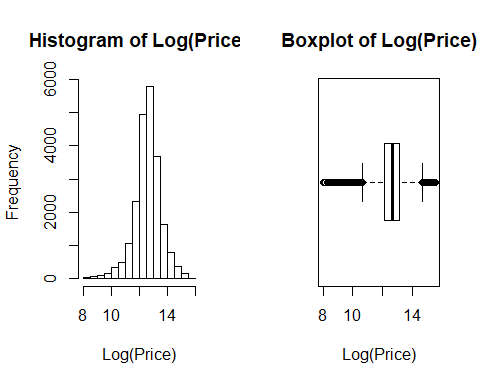
The data has more of a Normal distribution. There are still a few outliers at the lower end of the data.

Get rid of outliers where Log of Price is less than 8.

housing2 = housing2[housing2$LogPrice >= 8, ]  
  
#Check data dimension  
dim(housing2)

## [1] 21818 14

par (mfrow = c(1, 2))  
# histogram and boxplot for log of price  
hist (housing2$LogPrice, xlab="Log(Price)", main="Histogram of Log(Price)")  
boxplot (housing2$LogPrice, horizontal = T, xlab="Log(Price)", main="Boxplot of Log(Price)")



#### Fit a Model with Log(Price):

fit2 = lm ((LogPrice) ~ Size + Bedrooms + Bathrooms + Year\_Built + Lot\_Size + Price\_per\_sqft + Population + Violent\_Crime\_Rate + Property\_Crime\_Rate, data=housing2)  
summary (fit2)

##   
## Call:  
## lm(formula = (LogPrice) ~ Size + Bedrooms + Bathrooms + Year\_Built +   
## Lot\_Size + Price\_per\_sqft + Population + Violent\_Crime\_Rate +   
## Property\_Crime\_Rate, data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -31.6024 -0.2523 0.0469 0.3330 2.9652   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 8.449e+00 3.029e-01 27.896 < 2e-16 \*\*\*  
## Size 1.720e-06 4.570e-07 3.763 0.000168 \*\*\*  
## Bedrooms 4.535e-02 5.219e-03 8.690 < 2e-16 \*\*\*  
## Bathrooms 3.706e-01 5.271e-03 70.315 < 2e-16 \*\*\*  
## Year\_Built 1.409e-03 1.524e-04 9.241 < 2e-16 \*\*\*  
## Lot\_Size 1.265e-07 1.659e-08 7.626 2.53e-14 \*\*\*  
## Price\_per\_sqft 1.770e-03 1.845e-05 95.919 < 2e-16 \*\*\*  
## Population 1.177e-07 5.341e-09 22.048 < 2e-16 \*\*\*  
## Violent\_Crime\_Rate -5.251e+01 1.398e+00 -37.553 < 2e-16 \*\*\*  
## Property\_Crime\_Rate 5.206e+00 4.476e-01 11.630 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.6216 on 21808 degrees of freedom  
## Multiple R-squared: 0.5621, Adjusted R-squared: 0.5619   
## F-statistic: 3110 on 9 and 21808 DF, p-value: < 2.2e-16

anova (fit2)

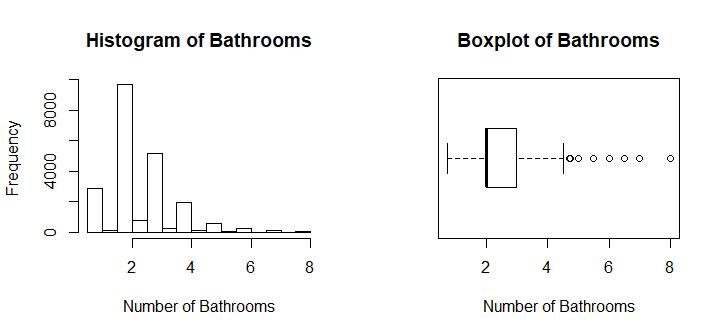
## Analysis of Variance Table  
##   
## Response: (LogPrice)  
## Df Sum Sq Mean Sq F value Pr(>F)   
## Size 1 29.6 29.6 76.679 < 2.2e-16 \*\*\*  
## Bedrooms 1 1326.8 1326.8 3434.190 < 2.2e-16 \*\*\*  
## Bathrooms 1 4164.3 4164.3 10778.599 < 2.2e-16 \*\*\*  
## Year\_Built 1 58.7 58.7 152.038 < 2.2e-16 \*\*\*  
## Lot\_Size 1 41.3 41.3 106.938 < 2.2e-16 \*\*\*  
## Price\_per\_sqft 1 4514.1 4514.1 11683.984 < 2.2e-16 \*\*\*  
## Population 1 49.2 49.2 127.272 < 2.2e-16 \*\*\*  
## Violent\_Crime\_Rate 1 579.0 579.0 1498.612 < 2.2e-16 \*\*\*  
## Property\_Crime\_Rate 1 52.3 52.3 135.267 < 2.2e-16 \*\*\*  
## Residuals 21808 8425.4 0.4   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Adjusted R-squared: 0.562. This is a little bit of a decrease from the previous model. All variables are significant.

## Check for Outliers in Predictor Variables

Bathrooms:

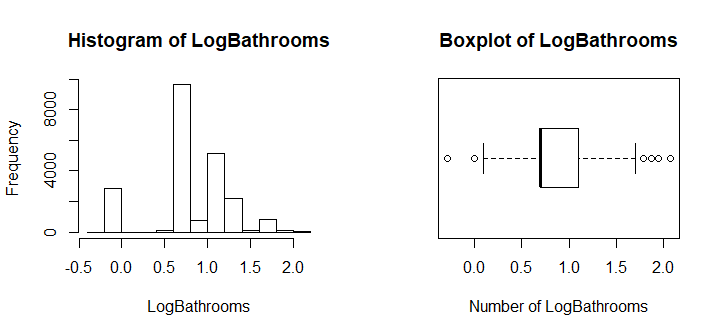
par (mfrow = c(1, 2))  
  
hist (housing2$Bathrooms, xlab="Number of Bathrooms", main="Histogram of Bathrooms")  
boxplot (housing2$Bathrooms, horizontal = T, xlab="Number of Bathrooms", main="Boxplot of Bathrooms")



Skewed Right - do log transformation

Log Transformation of Bathrooms

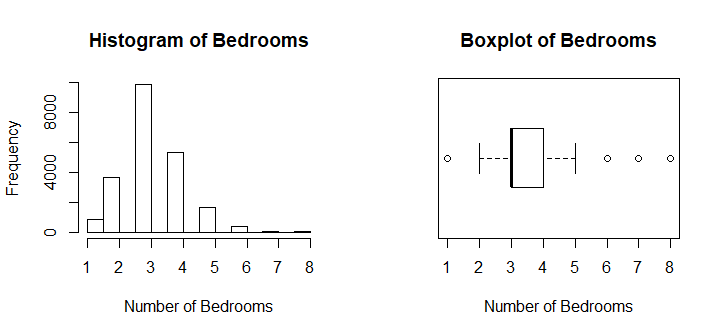
housing2$LogBathrooms = log(housing2$Bathrooms)  
  
par (mfrow = c(1, 2))  
  
hist (housing2$LogBathrooms, xlab="LogBathrooms", main="Histogram of LogBathrooms")  
boxplot (housing2$LogBathrooms, horizontal = T, xlab="Number of LogBathrooms", main="Boxplot of LogBathrooms")



The distribution is more Normal looking with only a few outliers in the boxplot.

Bedrooms:

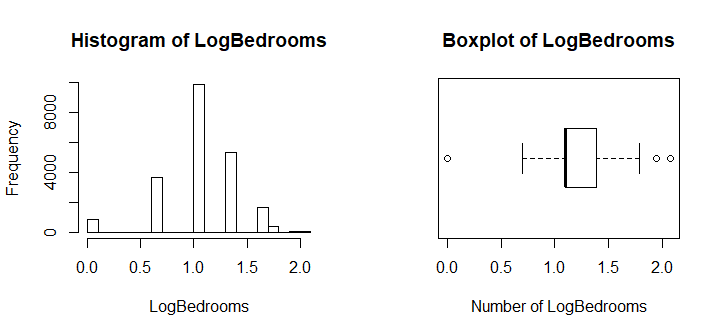
par (mfrow = c(1, 2))  
  
hist (housing2$Bedrooms, xlab="Number of Bedrooms", main="Histogram of Bedrooms")  
boxplot (housing2$Bedrooms, horizontal = T, xlab="Number of Bedrooms", main="Boxplot of Bedrooms")



Slightly skewed right. Try log transformation.

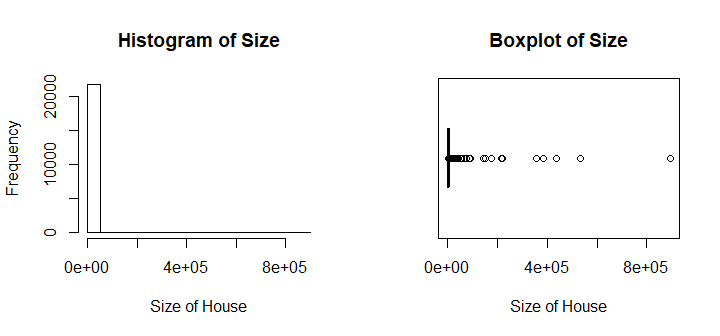
Log Transformation of Bedrooms

housing2$LogBedrooms = log(housing2$Bedrooms)  
  
par (mfrow = c(1, 2))  
  
hist (housing2$LogBedrooms, xlab="LogBedrooms", main="Histogram of LogBedrooms")  
boxplot (housing2$LogBedrooms, horizontal = T, xlab="Number of LogBedrooms", main="Boxplot of LogBedrooms")

 Looks better. Note: a natural log value equal to 0 means the original value is 1 (1 bedroom).

Size:

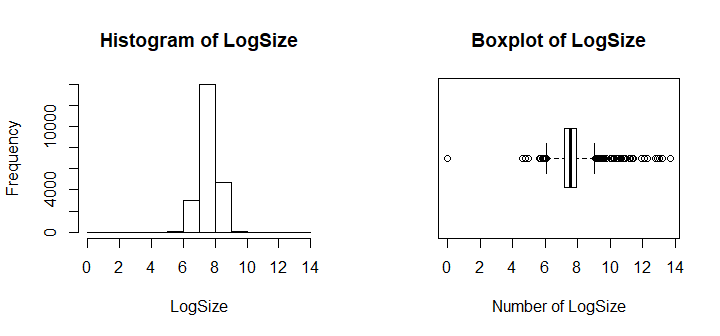
par (mfrow = c(1, 2))  
  
hist (housing2$Size, xlab="Size of House", main="Histogram of Size")  
boxplot (housing2$Size, horizontal = T, xlab="Size of House", main="Boxplot of Size")



Very skewed to the right. Do log transformation.

Log Transformation of Size

housing2$LogSize = log(housing2$Size)  
  
par (mfrow = c(1, 2))  
  
hist (housing2$LogSize, xlab="LogSize", main="Histogram of LogSize")  
boxplot (housing2$LogSize, horizontal = T, xlab="Number of LogSize", main="Boxplot of LogSize")



Get rid of outlier where log(size)=0.

dim(housing2)

## [1] 21818 17

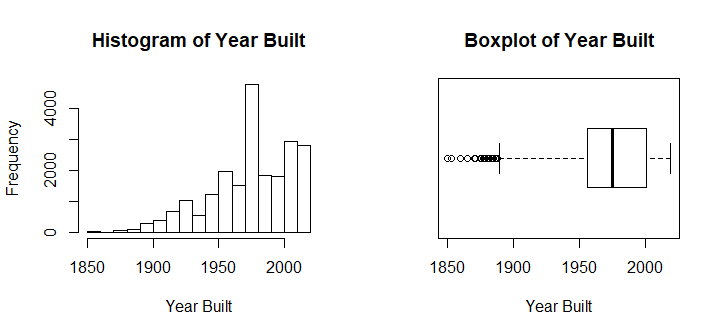
housing2 = housing2[housing2$LogSize > 0, ]  
  
#Check data dimension  
dim(housing2)

## [1] 21817 17

Got rid of one value.

Year Built:

par (mfrow = c(1, 2))  
  
hist (housing2$Year\_Built, xlab="Year Built", main="Histogram of Year Built")  
boxplot (housing2$Year\_Built, horizontal = T, xlab="Year Built", main="Boxplot of Year Built")



Slightly skewed left, but not too bad. We will leave this as is.

# Model with Categorical Predictors

housing2$Citycat = as.factor(housing2$City)  
housing2$Statecat = as.factor(housing2$State)  
  
  
fit3 = lm ((LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built + Lot\_Size + Price\_per\_sqft + Population + Violent\_Crime\_Rate + Property\_Crime\_Rate + Citycat + Statecat, data=housing2)  
summary (fit3)

##   
## Call:  
## lm(formula = (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built +   
## Lot\_Size + Price\_per\_sqft + Population + Violent\_Crime\_Rate +   
## Property\_Crime\_Rate + Citycat + Statecat, data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -26.1848 -0.1783 0.0502 0.2696 2.5644   
##   
## Coefficients: (31 not defined because of singularities)  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 7.381e+00 4.719e-01 15.641 < 2e-16 \*\*\*  
## LogSize 2.175e-01 9.137e-03 23.808 < 2e-16 \*\*\*  
## Bedrooms 3.692e-02 5.050e-03 7.311 2.74e-13 \*\*\*  
## Bathrooms 3.054e-01 5.345e-03 57.126 < 2e-16 \*\*\*  
## Year\_Built 1.507e-03 1.524e-04 9.889 < 2e-16 \*\*\*  
## Lot\_Size 1.057e-07 1.530e-08 6.907 5.10e-12 \*\*\*  
## Price\_per\_sqft 1.503e-03 2.083e-05 72.139 < 2e-16 \*\*\*  
## Population -9.105e-07 9.488e-07 -0.960 0.337256   
## Violent\_Crime\_Rate -8.641e+01 3.389e+01 -2.550 0.010783 \*   
## Property\_Crime\_Rate -1.156e+01 1.289e+01 -0.897 0.369772   
## CitycatAlbuquerque 1.287e+00 5.586e-01 2.304 0.021251 \*   
## CitycatAnaheim 6.248e-01 4.317e-01 1.447 0.147831   
## CitycatAnchorage 1.143e+00 4.714e-01 2.424 0.015352 \*   
## CitycatApple Valley -3.498e-01 3.082e-01 -1.135 0.256425   
## CitycatArlington 4.243e-01 4.664e-01 0.910 0.363014   
## CitycatAtlantic Beach 1.355e-01 3.401e-01 0.398 0.690381   
## CitycatAurora 8.777e-01 4.397e-01 1.996 0.045931 \*   
## CitycatAustin 1.303e+00 1.035e+00 1.259 0.208127   
## CitycatAventura 3.242e-01 4.761e-01 0.681 0.495960   
## CitycatBainbridge Island 8.735e-02 3.233e-01 0.270 0.787047   
## CitycatBaker -7.627e-01 6.332e-01 -1.205 0.228365   
## CitycatBakersfield 6.250e-01 5.664e-01 1.104 0.269801   
## CitycatBaltimore 1.644e+00 6.389e-01 2.573 0.010086 \*   
## CitycatBaton Rouge 7.728e-01 5.269e-01 1.467 0.142419   
## CitycatBay Harbor Islands -3.883e-01 3.937e-01 -0.986 0.323947   
## CitycatBay Village -4.052e-01 3.598e-01 -1.126 0.260037   
## CitycatBayside -4.620e-01 4.641e-01 -0.995 0.319524   
## CitycatBeachwood -7.650e-01 4.187e-01 -1.827 0.067686 .   
## CitycatBedford -1.040e+00 3.259e-01 -3.190 0.001426 \*\*   
## CitycatBee Cave 1.481e-01 6.285e-01 0.236 0.813763   
## CitycatBel Aire -8.097e-01 4.306e-01 -1.880 0.060061 .   
## CitycatBelle Isle -5.514e-02 6.296e-01 -0.088 0.930208   
## CitycatBellevue -7.155e-02 3.779e-01 -0.189 0.849831   
## CitycatBenbrook -1.524e-01 3.541e-01 -0.430 0.666944   
## CitycatBerkeley 1.540e+00 7.507e-01 2.051 0.040246 \*   
## CitycatBeverly Hills 5.698e-01 4.687e-01 1.216 0.224117   
## CitycatBexley -1.215e-01 4.878e-01 -0.249 0.803310   
## CitycatBiscayne Park -7.127e-02 6.409e-01 -0.111 0.911463   
## CitycatBixby -3.015e-01 4.876e-01 -0.618 0.536416   
## CitycatBlaine -4.215e-02 3.218e-01 -0.131 0.895810   
## CitycatBloomington 2.270e-01 3.892e-01 0.583 0.559861   
## CitycatBlue Ash -3.363e-03 4.286e-01 -0.008 0.993740   
## CitycatBoise 2.074e-01 3.323e-01 0.624 0.532565   
## CitycatBrentwood -2.725e-01 3.413e-01 -0.798 0.424688   
## CitycatBroken Arrow -4.216e-01 6.328e-01 -0.666 0.505261   
## CitycatBrookhaven 2.195e-01 3.113e-01 0.705 0.480780   
## CitycatBrooklyn Center 1.308e-01 4.141e-01 0.316 0.752072   
## CitycatBrooklyn Park 6.475e-02 3.624e-01 0.179 0.858211   
## CitycatBrown Deer -7.188e-02 5.350e-01 -0.134 0.893114   
## CitycatBuffalo 4.707e-01 3.955e-01 1.190 0.233990   
## CitycatBurbank 3.258e-01 4.495e-01 0.725 0.468581   
## CitycatBurien 4.399e-01 3.621e-01 1.215 0.224412   
## CitycatBurleson -3.207e-01 3.814e-01 -0.841 0.400412   
## CitycatCampbell 3.646e-01 5.157e-01 0.707 0.479549   
## CitycatCarson 6.074e-01 3.584e-01 1.695 0.090132 .   
## CitycatCary 2.519e-01 6.433e-01 0.392 0.695422   
## CitycatCastroville -2.541e-01 4.885e-01 -0.520 0.602953   
## CitycatCeres 3.401e-01 6.333e-01 0.537 0.591280   
## CitycatChandler 1.932e-01 6.671e-01 0.290 0.772140   
## CitycatChesapeake 1.699e-01 3.473e-01 0.489 0.624710   
## CitycatChicago 3.131e+00 2.482e+00 1.261 0.207162   
## CitycatChoctaw -3.132e-01 6.290e-01 -0.498 0.618533   
## CitycatChula Vista 3.939e-01 3.535e-01 1.114 0.265208   
## CitycatCincinnati 6.248e-01 4.836e-01 1.292 0.196411   
## CitycatCleveland 9.172e-01 5.313e-01 1.726 0.084339 .   
## CitycatCleveland Heights -6.666e-01 3.012e-01 -2.213 0.026895 \*   
## CitycatClive -4.600e-01 3.391e-01 -1.357 0.174871   
## CitycatColerain Township -3.347e-01 4.057e-01 -0.825 0.409312   
## CitycatCollege Park 7.157e-01 6.211e-01 1.152 0.249201   
## CitycatColorado Springs 8.074e-01 5.738e-01 1.407 0.159374   
## CitycatColumbia Heights -1.686e-01 3.437e-01 -0.491 0.623747   
## CitycatColumbus 8.043e-01 9.160e-01 0.878 0.379922   
## CitycatCommerce City 3.522e-01 3.328e-01 1.058 0.289911   
## CitycatConverse -2.759e-01 4.555e-01 -0.606 0.544809   
## CitycatCoral Gables 3.312e-01 3.204e-01 1.034 0.301340   
## CitycatCoronado 1.874e-01 3.129e-01 0.599 0.549292   
## CitycatCorpus Christi 5.506e-01 4.382e-01 1.257 0.208897   
## CitycatCrafton -6.618e-01 6.352e-01 -1.042 0.297418   
## CitycatCrowley -1.390e-01 3.396e-01 -0.409 0.682244   
## CitycatCrystal 5.357e-02 3.628e-01 0.148 0.882594   
## CitycatCulver City 7.035e-01 4.441e-01 1.584 0.113172   
## CitycatCutler Bay 1.966e-02 3.377e-01 0.058 0.953560   
## CitycatDallas 1.877e+00 1.268e+00 1.481 0.138699   
## CitycatDel City -2.677e-01 4.614e-01 -0.580 0.561745   
## CitycatDel Mar 3.717e-01 3.660e-01 1.016 0.309788   
## CitycatDenton 9.334e-02 6.358e-01 0.147 0.883284   
## CitycatDenver 1.545e+00 7.553e-01 2.046 0.040803 \*   
## CitycatDerby -2.449e+00 6.591e-01 -3.715 0.000204 \*\*\*  
## CitycatDes Moines 3.985e-01 4.218e-01 0.945 0.344755   
## CitycatDetroit 1.101e+00 6.789e-01 1.622 0.104792   
## CitycatDoral -3.746e-02 3.159e-01 -0.119 0.905616   
## CitycatDouglas -3.750e+00 6.790e-01 -5.523 3.38e-08 \*\*\*  
## CitycatDublin -5.223e-01 3.473e-01 -1.504 0.132609   
## CitycatDunwoody 9.213e-02 4.172e-01 0.221 0.825222   
## CitycatDurham 6.957e-01 4.404e-01 1.580 0.114216   
## CitycatEagan -9.853e-02 3.180e-01 -0.310 0.756646   
## CitycatEast Cleveland -1.342e+00 5.055e-01 -2.655 0.007945 \*\*   
## CitycatEast Orange 1.391e-01 6.393e-01 0.218 0.827745   
## CitycatEastvale -1.437e-01 6.289e-01 -0.229 0.819201   
## CitycatEcorse 5.268e-01 6.549e-01 0.804 0.421215   
## CitycatEdgewood -3.492e-01 4.304e-01 -0.812 0.417069   
## CitycatEdina 1.969e-01 3.023e-01 0.651 0.514791   
## CitycatEdmond -1.589e-01 4.020e-01 -0.395 0.692564   
## CitycatEl Paso 8.314e-02 6.444e-01 0.129 0.897342   
## CitycatEl Portal 2.707e-01 4.962e-01 0.546 0.585410   
## CitycatElmwood Park -3.042e-01 6.391e-01 -0.476 0.634062   
## CitycatEnglewood 4.140e-01 7.616e-01 0.544 0.586775   
## CitycatEuclid -4.892e-01 3.287e-01 -1.488 0.136663   
## CitycatEuless -6.670e-01 6.288e-01 -1.061 0.288774   
## CitycatEvendale -2.645e-01 7.435e-01 -0.356 0.721998   
## CitycatFairview Park -5.918e-01 3.537e-01 -1.673 0.094298 .   
## CitycatFarmers Branch -1.198e-01 3.494e-01 -0.343 0.731755   
## CitycatFerndale -8.515e-02 3.142e-01 -0.271 0.786397   
## CitycatFitchburg -3.264e-01 3.310e-01 -0.986 0.324178   
## CitycatForest Hill -3.953e-01 5.091e-01 -0.776 0.437528   
## CitycatFort Wayne -3.099e-01 3.923e-01 -0.790 0.429603   
## CitycatFort Worth 8.372e-01 8.924e-01 0.938 0.348163   
## CitycatFountain Valley 1.238e-01 3.384e-01 0.366 0.714470   
## CitycatFremont 6.201e-01 3.594e-01 1.725 0.084483 .   
## CitycatFridley 1.557e-01 4.372e-01 0.356 0.721764   
## CitycatGahanna -3.215e-01 3.453e-01 -0.931 0.351830   
## CitycatGarden City 2.053e-01 3.517e-01 0.584 0.559451   
## CitycatGarden Ridge -5.126e-01 4.104e-01 -1.249 0.211662   
## CitycatGarland 1.747e-01 3.765e-01 0.464 0.642714   
## CitycatGeorgetown -4.342e-01 4.022e-01 -1.080 0.280316   
## CitycatGermantown -3.174e-01 3.175e-01 -1.000 0.317491   
## CitycatGilbert 6.782e-02 3.522e-01 0.193 0.847299   
## CitycatGlendale 3.449e-01 4.152e-01 0.831 0.406194   
## CitycatGlenn Heights 3.780e-03 6.316e-01 0.006 0.995225   
## CitycatGolden Beach 3.644e-01 6.280e-01 0.580 0.561739   
## CitycatGolden Valley -8.560e-02 4.308e-01 -0.199 0.842506   
## CitycatGoodlettsville -8.497e-02 4.006e-01 -0.212 0.832031   
## CitycatGrand Prairie -2.487e-01 6.504e-01 -0.382 0.702143   
## CitycatGranite Shoals -1.077e-01 6.455e-01 -0.167 0.867481   
## CitycatGreenfield -4.911e-01 3.640e-01 -1.349 0.177253   
## CitycatGreensboro 4.773e-01 4.374e-01 1.091 0.275124   
## CitycatGrosse Pointe -2.975e-01 3.966e-01 -0.750 0.453149   
## CitycatGrosse Pointe Farms -2.564e-01 3.948e-01 -0.650 0.516015   
## CitycatGrosse Pointe Park -1.705e-01 3.544e-01 -0.481 0.630463   
## CitycatGrosse Pointe Shores -5.191e-01 6.341e-01 -0.819 0.413000   
## CitycatGrosse Pointe Woods -1.383e-01 3.716e-01 -0.372 0.709684   
## CitycatGroveport -8.049e-01 4.864e-01 -1.655 0.097990 .   
## CitycatHaltom City -9.296e-02 3.653e-01 -0.254 0.799150   
## CitycatHamtramck 1.127e-01 4.131e-01 0.273 0.784981   
## CitycatHarahan -5.838e-01 5.018e-01 -1.163 0.244684   
## CitycatHarper Woods 2.075e-01 4.337e-01 0.478 0.632375   
## CitycatHelotes -6.144e-01 4.985e-01 -1.232 0.217830   
## CitycatHenderson 1.974e-01 3.937e-01 0.501 0.616073   
## CitycatHialeah 1.942e-01 3.564e-01 0.545 0.585921   
## CitycatHialeah Gardens -6.087e-01 4.397e-01 -1.384 0.166286   
## CitycatHighland Park 1.876e-02 6.200e-01 0.030 0.975865   
## CitycatHilliard -6.473e-01 3.995e-01 -1.620 0.105178   
## CitycatHillsborough 4.917e-01 7.424e-01 0.662 0.507768   
## CitycatHollywood Park 1.867e-02 5.006e-01 0.037 0.970256   
## CitycatHoover -2.793e-01 3.185e-01 -0.877 0.380621   
## CitycatHorizon City -1.061e+00 3.344e-01 -3.174 0.001508 \*\*   
## CitycatHouston 2.903e+00 2.214e+00 1.311 0.189824   
## CitycatHurst 4.008e-02 6.650e-01 0.060 0.951939   
## CitycatIndian Hills -1.328e-01 4.394e-01 -0.302 0.762461   
## CitycatIrvine 3.800e-01 3.796e-01 1.001 0.316812   
## CitycatIrving 1.128e-01 3.760e-01 0.300 0.764104   
## CitycatJacksonville 9.295e-01 8.942e-01 1.039 0.298622   
## CitycatJacksonville Beach 5.831e-01 3.691e-01 1.580 0.114183   
## CitycatJeffersontown -3.064e-01 3.651e-01 -0.839 0.401342   
## CitycatJersey City 1.673e+00 6.576e-01 2.544 0.010965 \*   
## CitycatJones 1.316e-01 6.303e-01 0.209 0.834587   
## CitycatJurupa Valley 3.393e-01 3.396e-01 0.999 0.317819   
## CitycatKeller -5.944e-01 3.399e-01 -1.749 0.080349 .   
## CitycatKey Biscayne 2.692e-01 3.176e-01 0.847 0.396757   
## CitycatKirby -4.657e-01 6.292e-01 -0.740 0.459224   
## CitycatKnightdale -2.627e-01 4.876e-01 -0.539 0.589955   
## CitycatLa Vergne -1.574e-01 4.940e-01 -0.319 0.749965   
## CitycatLackawanna -3.235e-01 3.530e-01 -0.916 0.359432   
## CitycatLake Forest Park 1.375e-01 4.297e-01 0.320 0.748992   
## CitycatLakeway -2.944e-01 3.408e-01 -0.864 0.387620   
## CitycatLakewood -4.038e-01 3.099e-01 -1.303 0.192670   
## CitycatLancaster -1.043e-01 6.336e-01 -0.165 0.869276   
## CitycatLaredo -2.562e-01 3.541e-01 -0.724 0.469375   
## CitycatLauderdale -1.120e-01 4.858e-01 -0.230 0.817719   
## CitycatLeon Valley -1.854e-01 5.359e-01 -0.346 0.729357   
## CitycatLexington 2.517e-01 4.531e-01 0.556 0.578505   
## CitycatLincoln 1.090e-02 4.025e-01 0.027 0.978392   
## CitycatLittleton 5.558e-02 3.347e-01 0.166 0.868102   
## CitycatLive Oak -7.421e-02 4.757e-01 -0.156 0.876044   
## CitycatLong Beach 1.080e+00 4.948e-01 2.182 0.029111 \*   
## CitycatLos Angeles 4.403e+00 3.719e+00 1.184 0.236482   
## CitycatLubbock 7.166e-01 4.820e-01 1.487 0.137086   
## CitycatLuther -5.326e-01 6.556e-01 -0.812 0.416582   
## CitycatLyndhurst -7.089e-01 3.384e-01 -2.095 0.036220 \*   
## CitycatMadison 2.703e-01 3.734e-01 0.724 0.469078   
## CitycatManor -1.165e-01 3.865e-01 -0.301 0.763105   
## CitycatMaplewood 3.017e-01 5.002e-01 0.603 0.546423   
## CitycatMatthews -1.393e-01 4.107e-01 -0.339 0.734427   
## CitycatMayfield Heights -5.826e-01 3.814e-01 -1.528 0.126619   
## CitycatMemphis 1.574e+00 7.917e-01 1.988 0.046776 \*   
## CitycatMendota Heights 3.450e-02 3.678e-01 0.094 0.925287   
## CitycatMeridian 1.095e-01 3.465e-01 0.316 0.752075   
## CitycatMesa 5.052e-01 5.190e-01 0.973 0.330393   
## CitycatMiami 1.060e+00 5.727e-01 1.850 0.064266 .   
## CitycatMiami Beach 1.522e+00 7.210e-01 2.111 0.034806 \*   
## CitycatMiami Gardens 5.584e-01 4.370e-01 1.278 0.201252   
## CitycatMiami Lakes 5.766e-02 3.188e-01 0.181 0.856448   
## CitycatMiami Shores 4.868e-01 6.579e-01 0.740 0.459417   
## CitycatMiami Springs 2.083e-01 6.337e-01 0.329 0.742379   
## CitycatMiddleton -3.568e-01 3.794e-01 -0.940 0.346982   
## CitycatMiddletown -3.897e-01 6.266e-01 -0.622 0.533954   
## CitycatMidwest City -3.308e-01 3.656e-01 -0.905 0.365589   
## CitycatMilwaukee 8.797e-01 5.467e-01 1.609 0.107583   
## CitycatMinneapolis 1.370e+00 5.718e-01 2.395 0.016631 \*   
## CitycatMint Hill -4.090e-01 3.151e-01 -1.298 0.194369   
## CitycatMissouri City -6.119e-01 3.866e-01 -1.583 0.113546   
## CitycatModesto 9.213e-01 3.821e-01 2.411 0.015901 \*   
## CitycatMonona 5.979e-01 8.537e-01 0.700 0.483733   
## CitycatMontgomery -3.032e-01 3.908e-01 -0.776 0.437820   
## CitycatMoore -2.988e-01 3.104e-01 -0.963 0.335719   
## CitycatMorrisville -2.476e-01 4.311e-01 -0.574 0.565695   
## CitycatMounds View 1.528e-02 4.000e-01 0.038 0.969527   
## CitycatMurphy -5.113e-01 3.656e-01 -1.398 0.162031   
## CitycatNeptune Beach 5.175e-02 4.001e-01 0.129 0.897084   
## CitycatNew Brighton -2.028e-01 4.285e-01 -0.473 0.636100   
## CitycatNew Hope -7.818e-02 3.660e-01 -0.214 0.830881   
## CitycatNew Orleans 1.092e+00 6.017e-01 1.815 0.069533 .   
## CitycatNewark 3.466e-01 3.572e-01 0.970 0.331926   
## CitycatNewtown -2.753e-01 6.386e-01 -0.431 0.666397   
## CitycatNichols Hills 4.892e-02 3.530e-01 0.139 0.889794   
## CitycatNolensville -2.781e-01 5.002e-01 -0.556 0.578243   
## CitycatNorfolk 3.717e-01 4.087e-01 0.909 0.363153   
## CitycatNormandy Park 2.434e-01 6.273e-01 0.388 0.697991   
## CitycatNorth Bay Village -8.688e-02 3.388e-01 -0.256 0.797601   
## CitycatNorth Las Vegas 5.071e-01 3.602e-01 1.408 0.159142   
## CitycatNorth Miami 7.914e-01 3.853e-01 2.054 0.039962 \*   
## CitycatNorth Miami Beach 5.102e-01 3.526e-01 1.447 0.147940   
## CitycatNorth Richland Hills -1.312e-01 2.997e-01 -0.438 0.661658   
## CitycatNorth Royalton -7.234e-01 3.506e-01 -2.063 0.039091 \*   
## CitycatNorthfield -1.691e-01 6.409e-01 -0.264 0.791937   
## CitycatNorthglenn 3.618e-01 3.823e-01 0.946 0.343921   
## CitycatOak Park -2.989e-01 3.794e-01 -0.788 0.430774   
## CitycatOakdale -1.516e-01 3.654e-01 -0.415 0.678160   
## CitycatOakland 2.197e+00 7.244e-01 3.033 0.002428 \*\*   
## CitycatOklahoma City 8.470e-01 7.282e-01 1.163 0.244766   
## CitycatOlmos Park 1.274e-01 3.815e-01 0.334 0.738525   
## CitycatOlmsted Falls -9.172e-01 3.959e-01 -2.317 0.020534 \*   
## CitycatOlmsted Township -9.176e-01 4.199e-01 -2.185 0.028877 \*   
## CitycatOmaha 5.004e-01 5.618e-01 0.891 0.373110   
## CitycatOrlando 8.160e-01 5.322e-01 1.533 0.125229   
## CitycatOro Valley -2.187e-01 2.990e-01 -0.731 0.464524   
## CitycatOttawa Hills -8.229e-01 6.381e-01 -1.290 0.197201   
## CitycatPalmetto Bay 2.940e-01 3.333e-01 0.882 0.377776   
## CitycatPantego 8.286e-02 7.387e-01 0.112 0.910692   
## CitycatPapillion -7.142e-02 4.869e-01 -0.147 0.883390   
## CitycatParadise Valley 4.076e-01 3.058e-01 1.333 0.182684   
## CitycatPark City -8.199e-01 3.993e-01 -2.053 0.040074 \*   
## CitycatParma -7.111e-01 3.193e-01 -2.227 0.025956 \*   
## CitycatPeoria 1.401e-02 4.003e-01 0.035 0.972072   
## CitycatPepper Pike -2.724e-01 4.328e-01 -0.629 0.529053   
## CitycatPflugerville -2.858e-01 6.302e-01 -0.454 0.650170   
## CitycatPhoenix 2.061e+00 1.595e+00 1.292 0.196291   
## CitycatPickerington -7.715e-03 4.408e-01 -0.018 0.986036   
## CitycatPiedmont 1.780e-01 4.863e-01 0.366 0.714285   
## CitycatPlano 9.939e-02 3.795e-01 0.262 0.793411   
## CitycatPlymouth -2.083e-01 3.079e-01 -0.677 0.498716   
## CitycatPortland 1.501e+00 8.591e-01 1.747 0.080720 .   
## CitycatPowell -7.757e-01 6.415e-01 -1.209 0.226615   
## CitycatRaleigh 2.862e-01 5.000e-01 0.572 0.567041   
## CitycatRalston -9.381e-01 4.014e-01 -2.337 0.019442 \*   
## CitycatRed Oak -1.459e-01 6.294e-01 -0.232 0.816634   
## CitycatReno 3.856e-01 3.447e-01 1.119 0.263343   
## CitycatReynoldsburg -4.201e-01 3.884e-01 -1.082 0.279420   
## CitycatRichfield 1.112e-01 3.390e-01 0.328 0.742960   
## CitycatRichland Hills -9.165e-03 4.397e-01 -0.021 0.983369   
## CitycatRichmond 4.858e-01 4.120e-01 1.179 0.238376   
## CitycatRichmond Heights -6.115e-01 4.064e-01 -1.505 0.132393   
## CitycatRio Rancho -1.310e+00 2.996e-01 -4.372 1.24e-05 \*\*\*  
## CitycatRiver Hills -3.270e-01 6.479e-01 -0.505 0.613808   
## CitycatRiver Rouge -1.282e-01 5.812e-01 -0.221 0.825400   
## CitycatRiverside 7.794e-01 4.290e-01 1.817 0.069280 .   
## CitycatRoanoke -1.857e-01 3.720e-01 -0.499 0.617692   
## CitycatRobbinsdale -1.630e-02 4.157e-01 -0.039 0.968720   
## CitycatRoseville 5.328e-01 6.104e-01 0.873 0.382716   
## CitycatSachse -3.105e-01 3.357e-01 -0.925 0.355028   
## CitycatSaginaw -2.998e-01 3.155e-01 -0.950 0.341996   
## CitycatSan Antonio 1.767e+00 1.544e+00 1.145 0.252391   
## CitycatSan Diego 1.701e+00 1.341e+00 1.269 0.204368   
## CitycatSan Fernando 2.676e-01 5.096e-01 0.525 0.599486   
## CitycatSan Francisco 1.802e+00 1.050e+00 1.715 0.086285 .   
## CitycatSan Jose 1.592e+00 9.898e-01 1.608 0.107861   
## CitycatSand Springs -7.913e-01 7.105e-01 -1.114 0.265420   
## CitycatSandy Springs -3.180e-02 3.018e-01 -0.105 0.916105   
## CitycatSanta Ana 9.212e-01 3.985e-01 2.312 0.020786 \*   
## CitycatSantee 1.071e-01 6.295e-01 0.170 0.864883   
## CitycatScottsdale 4.410e-01 3.666e-01 1.203 0.229076   
## CitycatSeattle 1.678e+00 8.715e-01 1.925 0.054193 .   
## CitycatSeven Hills -6.823e-01 3.966e-01 -1.720 0.085365 .   
## CitycatShavano Park -3.773e-01 4.284e-01 -0.881 0.378530   
## CitycatShively -7.638e-02 4.006e-01 -0.191 0.848797   
## CitycatShoreline 4.379e-01 3.184e-01 1.375 0.169145   
## CitycatShorewood -1.529e-01 4.871e-01 -0.314 0.753654   
## CitycatSignal Hill 1.427e+00 7.647e-01 1.865 0.062127 .   
## CitycatSocorro -8.337e-01 3.367e-01 -2.476 0.013286 \*   
## CitycatSolon -8.490e-01 3.378e-01 -2.513 0.011969 \*   
## CitycatSouth Euclid -7.392e-01 3.449e-01 -2.143 0.032125 \*   
## CitycatSouth Miami 3.119e-01 4.884e-01 0.638 0.523158   
## CitycatSpeedway -2.363e+00 6.747e-01 -3.502 0.000463 \*\*\*  
## CitycatSpencer -3.045e+00 6.300e-01 -4.833 1.35e-06 \*\*\*  
## CitycatSpokane 8.879e-01 6.121e-01 1.451 0.146871   
## CitycatSpokane Valley 2.897e-01 4.640e-01 0.624 0.532406   
## CitycatSpring Lake Park -1.774e-01 4.973e-01 -0.357 0.721355   
## CitycatStafford -2.549e-01 6.492e-01 -0.393 0.694597   
## CitycatStockton 1.509e+00 4.754e-01 3.174 0.001508 \*\*   
## CitycatStrongsville -6.259e-01 3.474e-01 -1.802 0.071581 .   
## CitycatSuffolk 1.647e-01 4.975e-01 0.331 0.740671   
## CitycatSunny Isles Beach 6.113e-02 3.042e-01 0.201 0.840724   
## CitycatSurfside -2.146e-02 4.882e-01 -0.044 0.964945   
## CitycatSweetwater -5.995e-01 6.329e-01 -0.947 0.343547   
## CitycatSwissvale -1.492e-01 6.282e-01 -0.237 0.812301   
## CitycatTampa 3.139e-01 4.206e-01 0.746 0.455527   
## CitycatTemple Terrace -2.250e-01 3.469e-01 -0.649 0.516578   
## CitycatTerrell Hills 1.333e-01 4.292e-01 0.311 0.756143   
## CitycatThornton 1.057e-01 3.650e-01 0.290 0.772159   
## CitycatTigard 2.294e-01 3.198e-01 0.717 0.473188   
## CitycatToledo 1.120e-01 4.110e-01 0.273 0.785184   
## CitycatTorrance 5.734e-01 4.144e-01 1.384 0.166457   
## CitycatTucson 7.065e-01 5.836e-01 1.211 0.226070   
## CitycatTulsa 7.990e-01 6.197e-01 1.289 0.197283   
## CitycatUniversity Heights -7.155e-01 3.623e-01 -1.975 0.048277 \*   
## CitycatUpper Arlington -1.324e-01 3.342e-01 -0.396 0.692000   
## CitycatUrbandale -7.487e-01 3.085e-01 -2.427 0.015242 \*   
## CitycatVerona -2.938e-01 3.326e-01 -0.884 0.376926   
## CitycatVirginia Beach 1.378e-01 4.954e-01 0.278 0.780942   
## CitycatVirginia Gardens 4.887e-01 6.294e-01 0.776 0.437492   
## CitycatWarr Acres 1.262e-01 5.220e-01 0.242 0.808986   
## CitycatWatauga -3.768e-01 3.986e-01 -0.945 0.344566   
## CitycatWauwatosa 3.106e-02 3.587e-01 0.087 0.930998   
## CitycatWest Allis -9.128e-02 3.337e-01 -0.274 0.784405   
## CitycatWest Hollywood 1.290e+00 4.784e-01 2.696 0.007020 \*\*   
## CitycatWest Lake Hills 4.967e-01 6.325e-01 0.785 0.432348   
## CitycatWesterville -5.117e-01 3.329e-01 -1.537 0.124371   
## CitycatWestminster 2.545e-01 4.040e-01 0.630 0.528671   
## CitycatWhite Bear Lake -1.317e-01 3.580e-01 -0.368 0.712931   
## CitycatWhite Settlement 8.937e-01 6.272e-01 1.425 0.154179   
## CitycatWhitefish Bay -3.319e-01 4.925e-01 -0.674 0.500387   
## CitycatWhitehall -4.549e-02 5.732e-01 -0.079 0.936747   
## CitycatWichita 9.164e-01 6.026e-01 1.521 0.128339   
## CitycatWindsor Heights 2.219e-02 7.627e-01 0.029 0.976794   
## CitycatWinter Park 3.787e-01 4.343e-01 0.872 0.383299   
## CitycatWolfforth -5.583e-01 4.958e-01 -1.126 0.260188   
## CitycatWoodbury -2.686e-01 3.036e-01 -0.884 0.376443   
## CitycatWorthington -4.598e-01 4.859e-01 -0.946 0.343954   
## CitycatYukon -4.169e-02 4.301e-01 -0.097 0.922780   
## StatecatAL NA NA NA NA   
## StatecatAZ NA NA NA NA   
## StatecatCA NA NA NA NA   
## StatecatCO NA NA NA NA   
## StatecatFL NA NA NA NA   
## StatecatGA NA NA NA NA   
## StatecatIA NA NA NA NA   
## StatecatID NA NA NA NA   
## StatecatIL NA NA NA NA   
## StatecatIN NA NA NA NA   
## StatecatKS NA NA NA NA   
## StatecatKY NA NA NA NA   
## StatecatLA NA NA NA NA   
## StatecatMD NA NA NA NA   
## StatecatMI NA NA NA NA   
## StatecatMN NA NA NA NA   
## StatecatNC NA NA NA NA   
## StatecatNE NA NA NA NA   
## StatecatNJ NA NA NA NA   
## StatecatNM NA NA NA NA   
## StatecatNV NA NA NA NA   
## StatecatNY NA NA NA NA   
## StatecatOH NA NA NA NA   
## StatecatOK NA NA NA NA   
## StatecatOR NA NA NA NA   
## StatecatPA NA NA NA NA   
## StatecatTN NA NA NA NA   
## StatecatTX NA NA NA NA   
## StatecatVA NA NA NA NA   
## StatecatWA NA NA NA NA   
## StatecatWI NA NA NA NA   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.5604 on 21468 degrees of freedom  
## Multiple R-squared: 0.6493, Adjusted R-squared: 0.6436   
## F-statistic: 114.2 on 348 and 21468 DF, p-value: < 2.2e-16

anova (fit3)

## Analysis of Variance Table  
##   
## Response: (LogPrice)  
## Df Sum Sq Mean Sq F value Pr(>F)   
## LogSize 1 1774.3 1774.3 5649.513 < 2.2e-16 \*\*\*  
## Bedrooms 1 280.3 280.3 892.509 < 2.2e-16 \*\*\*  
## Bathrooms 1 3470.0 3470.0 11048.778 < 2.2e-16 \*\*\*  
## Year\_Built 1 56.9 56.9 181.060 < 2.2e-16 \*\*\*  
## Lot\_Size 1 39.2 39.2 124.806 < 2.2e-16 \*\*\*  
## Price\_per\_sqft 1 4946.4 4946.4 15749.899 < 2.2e-16 \*\*\*  
## Population 1 38.4 38.4 122.130 < 2.2e-16 \*\*\*  
## Violent\_Crime\_Rate 1 533.1 533.1 1697.614 < 2.2e-16 \*\*\*  
## Property\_Crime\_Rate 1 44.2 44.2 140.599 < 2.2e-16 \*\*\*  
## Citycat 339 1299.2 3.8 12.203 < 2.2e-16 \*\*\*  
## Residuals 21468 6742.2 0.3   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Adjusted R-squared: 0.644

### Stepwise Regression

Next, we apply stepwise regression to the full model (fit3) using the AIC criterion.

fit3aic = step (fit3, direction='both')

## Start: AIC=-24921.79  
## (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built + Lot\_Size +   
## Price\_per\_sqft + Population + Violent\_Crime\_Rate + Property\_Crime\_Rate +   
## Citycat + Statecat  
##   
##   
## Step: AIC=-24921.79  
## (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built + Lot\_Size +   
## Price\_per\_sqft + Population + Violent\_Crime\_Rate + Property\_Crime\_Rate +   
## Citycat  
##   
## Df Sum of Sq RSS AIC  
## - Property\_Crime\_Rate 1 0.25 6742.4 -24923  
## - Population 1 0.29 6742.5 -24923  
## <none> 6742.2 -24922  
## - Violent\_Crime\_Rate 1 2.04 6744.2 -24917  
## - Lot\_Size 1 14.98 6757.2 -24875  
## - Bedrooms 1 16.79 6759.0 -24870  
## - Year\_Built 1 30.71 6772.9 -24825  
## - LogSize 1 178.01 6920.2 -24355  
## - Bathrooms 1 1024.87 7767.1 -21837  
## - Citycat 339 1299.21 8041.4 -21755  
## - Price\_per\_sqft 1 1634.38 8376.6 -20188  
##   
## Step: AIC=-24922.97  
## (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built + Lot\_Size +   
## Price\_per\_sqft + Population + Violent\_Crime\_Rate + Citycat  
##   
## Df Sum of Sq RSS AIC  
## - Population 1 0.12 6742.6 -24925  
## <none> 6742.4 -24923  
## + Statecat 1 0.25 6742.2 -24922  
## + Property\_Crime\_Rate 1 0.25 6742.2 -24922  
## - Violent\_Crime\_Rate 1 4.16 6746.6 -24912  
## - Lot\_Size 1 14.98 6757.4 -24877  
## - Bedrooms 1 16.80 6759.3 -24871  
## - Year\_Built 1 30.84 6773.3 -24825  
## - LogSize 1 178.19 6920.6 -24356  
## - Bathrooms 1 1024.66 7767.1 -21838  
## - Citycat 339 1343.11 8085.6 -21638  
## - Price\_per\_sqft 1 1635.16 8377.6 -20188  
##   
## Step: AIC=-24924.58  
## (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built + Lot\_Size +   
## Price\_per\_sqft + Violent\_Crime\_Rate + Citycat  
##   
## Df Sum of Sq RSS AIC  
## <none> 6742.6 -24925  
## + Population 1 0.12 6742.4 -24923  
## + Property\_Crime\_Rate 1 0.08 6742.5 -24923  
## + Statecat 2 0.37 6742.2 -24922  
## - Violent\_Crime\_Rate 1 6.20 6748.8 -24907  
## - Lot\_Size 1 14.97 6757.5 -24878  
## - Bedrooms 1 16.82 6759.4 -24872  
## - Year\_Built 1 30.84 6773.4 -24827  
## - LogSize 1 178.23 6920.8 -24357  
## - Bathrooms 1 1024.55 7767.1 -21840  
## - Citycat 339 1484.98 8227.6 -21260  
## - Price\_per\_sqft 1 1635.50 8378.1 -20188

summary(fit3aic)

##   
## Call:  
## lm(formula = (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built +   
## Lot\_Size + Price\_per\_sqft + Violent\_Crime\_Rate + Citycat,   
## data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -26.1904 -0.1783 0.0502 0.2696 2.5641   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 7.180e+00 4.144e-01 17.324 < 2e-16 \*\*\*  
## LogSize 2.176e-01 9.136e-03 23.823 < 2e-16 \*\*\*  
## Bedrooms 3.695e-02 5.050e-03 7.318 2.61e-13 \*\*\*  
## Bathrooms 3.053e-01 5.345e-03 57.117 < 2e-16 \*\*\*  
## Year\_Built 1.510e-03 1.523e-04 9.910 < 2e-16 \*\*\*  
## Lot\_Size 1.056e-07 1.530e-08 6.905 5.16e-12 \*\*\*  
## Price\_per\_sqft 1.503e-03 2.083e-05 72.165 < 2e-16 \*\*\*  
## Violent\_Crime\_Rate -1.113e+02 2.505e+01 -4.442 8.95e-06 \*\*\*  
## CitycatAlbuquerque 9.198e-01 4.259e-01 2.160 0.03081 \*   
## CitycatAnaheim 3.058e-01 2.961e-01 1.033 0.30171   
## CitycatAnchorage 8.920e-01 4.072e-01 2.191 0.02850 \*   
## CitycatApple Valley -4.064e-01 3.037e-01 -1.338 0.18087   
## CitycatArlington 5.490e-02 3.043e-01 0.180 0.85681   
## CitycatAtlantic Beach 2.182e-01 3.303e-01 0.661 0.50889   
## CitycatAurora 5.711e-01 3.278e-01 1.742 0.08149 .   
## CitycatAustin 2.704e-01 2.929e-01 0.923 0.35588   
## CitycatAventura -1.989e-02 2.924e-01 -0.068 0.94576   
## CitycatBainbridge Island 1.644e-01 3.072e-01 0.535 0.59245   
## CitycatBaker -7.692e-01 6.312e-01 -1.219 0.22303   
## CitycatBakersfield 1.003e-01 2.987e-01 0.336 0.73692   
## CitycatBaltimore 1.259e+00 5.270e-01 2.388 0.01693 \*   
## CitycatBaton Rouge 3.876e-01 3.548e-01 1.093 0.27458   
## CitycatBay Harbor Islands -2.851e-01 3.761e-01 -0.758 0.44855   
## CitycatBay Village -2.729e-01 3.238e-01 -0.843 0.39947   
## CitycatBayside -2.997e-01 4.280e-01 -0.700 0.48381   
## CitycatBeachwood -1.002e+00 3.273e-01 -3.062 0.00220 \*\*   
## CitycatBedford -9.641e-01 3.159e-01 -3.051 0.00228 \*\*   
## CitycatBee Cave 1.047e-01 6.266e-01 0.167 0.86728   
## CitycatBel Aire -7.664e-01 4.284e-01 -1.789 0.07360 .   
## CitycatBelle Isle -1.024e-03 6.275e-01 -0.002 0.99870   
## CitycatBellevue -8.174e-02 3.773e-01 -0.217 0.82848   
## CitycatBenbrook -1.185e-01 3.519e-01 -0.337 0.73627   
## CitycatBerkeley 1.158e+00 6.356e-01 1.823 0.06838 .   
## CitycatBeverly Hills 3.012e-01 3.560e-01 0.846 0.39747   
## CitycatBexley -1.669e-01 4.854e-01 -0.344 0.73101   
## CitycatBiscayne Park 5.786e-02 6.272e-01 0.092 0.92649   
## CitycatBixby -2.701e-01 4.854e-01 -0.556 0.57793   
## CitycatBlaine -1.621e-01 3.019e-01 -0.537 0.59136   
## CitycatBloomington -1.250e-02 3.062e-01 -0.041 0.96743   
## CitycatBlue Ash 1.642e-02 4.281e-01 0.038 0.96941   
## CitycatBoise 7.824e-02 2.886e-01 0.271 0.78628   
## CitycatBrentwood -1.958e-01 3.236e-01 -0.605 0.54519   
## CitycatBroken Arrow -5.037e-01 6.267e-01 -0.804 0.42155   
## CitycatBrookhaven 1.777e-01 3.076e-01 0.578 0.56342   
## CitycatBrooklyn Center -7.244e-02 3.384e-01 -0.214 0.83048   
## CitycatBrooklyn Park -1.162e-01 3.104e-01 -0.374 0.70819   
## CitycatBrown Deer -2.437e-01 4.896e-01 -0.498 0.61865   
## CitycatBuffalo 3.036e-01 3.646e-01 0.833 0.40502   
## CitycatBurbank 1.794e-01 4.288e-01 0.418 0.67571   
## CitycatBurien 2.871e-01 3.202e-01 0.897 0.36999   
## CitycatBurleson -2.854e-01 3.780e-01 -0.755 0.45020   
## CitycatCampbell 2.044e-01 4.865e-01 0.420 0.67445   
## CitycatCarson 5.861e-01 3.578e-01 1.638 0.10139   
## CitycatCary 2.009e-01 6.266e-01 0.321 0.74849   
## CitycatCastroville -2.201e-01 4.874e-01 -0.452 0.65159   
## CitycatCeres 3.229e-01 6.326e-01 0.510 0.60976   
## CitycatChandler -3.191e-02 6.277e-01 -0.051 0.95946   
## CitycatChesapeake -7.056e-03 2.993e-01 -0.024 0.98119   
## CitycatChicago 7.499e-01 3.545e-01 2.116 0.03439 \*   
## CitycatChoctaw -2.649e-01 6.267e-01 -0.423 0.67252   
## CitycatChula Vista 2.590e-01 2.961e-01 0.875 0.38176   
## CitycatCincinnati 2.557e-01 3.412e-01 0.750 0.45352   
## CitycatCleveland 6.248e-01 4.576e-01 1.366 0.17210   
## CitycatCleveland Heights -6.412e-01 2.987e-01 -2.146 0.03185 \*   
## CitycatClive -3.523e-01 3.135e-01 -1.124 0.26104   
## CitycatColerain Township -4.274e-01 3.965e-01 -1.078 0.28103   
## CitycatCollege Park 3.991e-01 4.081e-01 0.978 0.32812   
## CitycatColorado Springs 2.866e-01 3.095e-01 0.926 0.35441   
## CitycatColumbia Heights -1.930e-01 3.409e-01 -0.566 0.57126   
## CitycatColumbus -8.355e-02 3.018e-01 -0.277 0.78192   
## CitycatCommerce City 2.498e-01 3.111e-01 0.803 0.42201   
## CitycatConverse -1.614e-01 4.428e-01 -0.364 0.71551   
## CitycatCoral Gables 2.014e-01 2.946e-01 0.684 0.49427   
## CitycatCoronado 1.954e-01 3.119e-01 0.626 0.53103   
## CitycatCorpus Christi 2.444e-01 3.357e-01 0.728 0.46661   
## CitycatCrafton -7.391e-01 6.273e-01 -1.178 0.23874   
## CitycatCrowley -2.019e-01 3.296e-01 -0.612 0.54022   
## CitycatCrystal -8.989e-03 3.542e-01 -0.025 0.97975   
## CitycatCulver City 4.923e-01 3.643e-01 1.351 0.17664   
## CitycatCutler Bay -1.137e-01 3.074e-01 -0.370 0.71140   
## CitycatDallas 6.609e-01 3.429e-01 1.927 0.05395 .   
## CitycatDel City -3.782e-01 4.115e-01 -0.919 0.35804   
## CitycatDel Mar 4.245e-01 3.624e-01 1.171 0.24148   
## CitycatDenton -7.518e-04 6.278e-01 -0.001 0.99904   
## CitycatDenver 8.292e-01 3.277e-01 2.530 0.01141 \*   
## CitycatDerby -2.638e+00 6.267e-01 -4.210 2.56e-05 \*\*\*  
## CitycatDes Moines 1.136e-01 3.220e-01 0.353 0.72428   
## CitycatDetroit 6.831e-01 5.502e-01 1.241 0.21445   
## CitycatDoral -1.433e-01 3.003e-01 -0.477 0.63321   
## CitycatDouglas -3.989e+00 6.267e-01 -6.366 1.98e-10 \*\*\*  
## CitycatDublin -4.601e-01 3.317e-01 -1.387 0.16536   
## CitycatDunwoody -1.709e-01 3.135e-01 -0.545 0.58562   
## CitycatDurham 3.762e-01 3.276e-01 1.148 0.25086   
## CitycatEagan -1.745e-01 3.099e-01 -0.563 0.57340   
## CitycatEast Cleveland -1.272e+00 5.007e-01 -2.540 0.01109 \*   
## CitycatEast Orange 2.207e-01 6.327e-01 0.349 0.72725   
## CitycatEastvale -1.433e-01 6.267e-01 -0.229 0.81907   
## CitycatEcorse 8.879e-01 5.630e-01 1.577 0.11483   
## CitycatEdgewood -3.838e-01 4.281e-01 -0.897 0.36989   
## CitycatEdina 1.508e-01 2.989e-01 0.504 0.61396   
## CitycatEdmond -2.099e-01 3.967e-01 -0.529 0.59670   
## CitycatEl Paso -4.349e-01 2.902e-01 -1.499 0.13394   
## CitycatEl Portal 3.662e-01 4.854e-01 0.754 0.45057   
## CitycatElmwood Park -1.931e-01 6.284e-01 -0.307 0.75867   
## CitycatEnglewood 2.298e-02 6.273e-01 0.037 0.97077   
## CitycatEuclid -5.261e-01 3.222e-01 -1.633 0.10255   
## CitycatEuless -7.157e-01 6.271e-01 -1.141 0.25380   
## CitycatEvendale -6.113e-01 6.271e-01 -0.975 0.32966   
## CitycatFairview Park -5.027e-01 3.369e-01 -1.492 0.13569   
## CitycatFarmers Branch -1.854e-01 3.437e-01 -0.540 0.58953   
## CitycatFerndale -1.020e-01 3.127e-01 -0.326 0.74427   
## CitycatFitchburg -2.835e-01 3.284e-01 -0.863 0.38800   
## CitycatForest Hill -5.104e-01 4.879e-01 -1.046 0.29547   
## CitycatFort Wayne -5.901e-01 2.931e-01 -2.013 0.04409 \*   
## CitycatFort Worth -2.036e-03 2.961e-01 -0.007 0.99451   
## CitycatFountain Valley 5.009e-02 3.316e-01 0.151 0.87994   
## CitycatFremont 4.192e-01 2.928e-01 1.432 0.15228   
## CitycatFridley -2.730e-02 3.806e-01 -0.072 0.94283   
## CitycatGahanna -3.612e-01 3.434e-01 -1.052 0.29281   
## CitycatGarden City 2.407e-01 3.487e-01 0.690 0.49011   
## CitycatGarden Ridge -4.230e-01 3.968e-01 -1.066 0.28652   
## CitycatGarland -7.695e-02 2.938e-01 -0.262 0.79340   
## CitycatGeorgetown -5.717e-01 3.761e-01 -1.520 0.12848   
## CitycatGermantown -2.812e-01 3.115e-01 -0.903 0.36658   
## CitycatGilbert -8.391e-02 2.852e-01 -0.294 0.76862   
## CitycatGlendale 2.323e-02 2.921e-01 0.080 0.93663   
## CitycatGlenn Heights 5.564e-02 6.298e-01 0.088 0.92960   
## CitycatGolden Beach 4.036e-01 6.268e-01 0.644 0.51964   
## CitycatGolden Valley -1.348e-01 4.280e-01 -0.315 0.75280   
## CitycatGoodlettsville -1.805e-01 3.805e-01 -0.474 0.63517   
## CitycatGrand Prairie -4.228e-01 6.275e-01 -0.674 0.50051   
## CitycatGranite Shoals 3.690e-02 6.268e-01 0.059 0.95306   
## CitycatGreenfield -5.807e-01 3.521e-01 -1.650 0.09905 .   
## CitycatGreensboro 1.775e-01 3.399e-01 0.522 0.60149   
## CitycatGrosse Pointe -2.835e-01 3.964e-01 -0.715 0.47458   
## CitycatGrosse Pointe Farms -1.472e-01 3.760e-01 -0.391 0.69544   
## CitycatGrosse Pointe Park -1.273e-01 3.515e-01 -0.362 0.71714   
## CitycatGrosse Pointe Shores -4.328e-01 6.267e-01 -0.691 0.48980   
## CitycatGrosse Pointe Woods -6.130e-02 3.624e-01 -0.169 0.86566   
## CitycatGroveport -7.837e-01 4.860e-01 -1.612 0.10688   
## CitycatHaltom City -1.726e-01 3.550e-01 -0.486 0.62684   
## CitycatHamtramck 2.663e-01 3.883e-01 0.686 0.49281   
## CitycatHarahan -4.678e-01 4.859e-01 -0.963 0.33574   
## CitycatHarper Woods 7.887e-02 3.705e-01 0.213 0.83145   
## CitycatHelotes -5.189e-01 4.856e-01 -1.069 0.28529   
## CitycatHenderson -5.722e-02 2.837e-01 -0.202 0.84015   
## CitycatHialeah -1.372e-02 2.887e-01 -0.048 0.96209   
## CitycatHialeah Gardens -7.023e-01 4.283e-01 -1.640 0.10104   
## CitycatHighland Park 3.095e-01 5.528e-01 0.560 0.57558   
## CitycatHilliard -5.445e-01 3.760e-01 -1.448 0.14763   
## CitycatHillsborough 1.896e-01 6.363e-01 0.298 0.76572   
## CitycatHollywood Park 1.338e-01 4.855e-01 0.276 0.78280   
## CitycatHoover -3.892e-01 3.021e-01 -1.288 0.19766   
## CitycatHorizon City -9.347e-01 2.975e-01 -3.141 0.00168 \*\*   
## CitycatHouston 7.204e-01 3.751e-01 1.921 0.05478 .   
## CitycatHurst -1.628e-01 6.274e-01 -0.259 0.79526   
## CitycatIndian Hills -4.917e-02 4.285e-01 -0.115 0.90864   
## CitycatIrvine 1.726e-01 2.853e-01 0.605 0.54515   
## CitycatIrving -1.356e-01 2.934e-01 -0.462 0.64408   
## CitycatJacksonville 7.448e-02 3.153e-01 0.236 0.81325   
## CitycatJacksonville Beach 4.600e-01 3.283e-01 1.401 0.16118   
## CitycatJeffersontown -3.560e-01 3.619e-01 -0.984 0.32523   
## CitycatJersey City 1.534e+00 6.364e-01 2.411 0.01592 \*   
## CitycatJones 8.340e-02 6.269e-01 0.133 0.89416   
## CitycatJurupa Valley 2.430e-01 3.278e-01 0.741 0.45849   
## CitycatKeller -5.148e-01 3.179e-01 -1.619 0.10538   
## CitycatKey Biscayne 3.080e-01 3.136e-01 0.982 0.32600   
## CitycatKirby -4.241e-01 6.280e-01 -0.675 0.49949   
## CitycatKnightdale -2.336e-01 4.868e-01 -0.480 0.63129   
## CitycatLa Vergne -1.061e-01 4.917e-01 -0.216 0.82909   
## CitycatLackawanna -2.781e-01 3.498e-01 -0.795 0.42657   
## CitycatLake Forest Park 1.592e-01 4.283e-01 0.372 0.71004   
## CitycatLakeway -2.051e-01 3.237e-01 -0.634 0.52630   
## CitycatLakewood -3.735e-01 3.038e-01 -1.229 0.21896   
## CitycatLancaster -1.489e-01 6.308e-01 -0.236 0.81342   
## CitycatLaredo -4.294e-01 2.946e-01 -1.458 0.14497   
## CitycatLauderdale -1.175e-01 4.855e-01 -0.242 0.80883   
## CitycatLeon Valley -5.069e-01 3.965e-01 -1.279 0.20104   
## CitycatLexington -1.236e-01 2.897e-01 -0.427 0.66958   
## CitycatLincoln -2.826e-01 2.940e-01 -0.961 0.33648   
## CitycatLittleton -9.751e-02 2.983e-01 -0.327 0.74380   
## CitycatLive Oak -3.023e-01 3.975e-01 -0.761 0.44695   
## CitycatLong Beach 6.947e-01 3.077e-01 2.257 0.02399 \*   
## CitycatLos Angeles 8.478e-01 3.257e-01 2.603 0.00924 \*\*   
## CitycatLubbock 3.932e-01 3.674e-01 1.070 0.28452   
## CitycatLuther -3.489e-01 6.276e-01 -0.556 0.57829   
## CitycatLyndhurst -6.206e-01 3.237e-01 -1.917 0.05520 .   
## CitycatMadison 3.026e-02 2.951e-01 0.103 0.91831   
## CitycatManor -6.954e-02 3.838e-01 -0.181 0.85621   
## CitycatMaplewood -2.814e-02 3.293e-01 -0.085 0.93190   
## CitycatMatthews -3.174e-01 3.625e-01 -0.875 0.38135   
## CitycatMayfield Heights -5.325e-01 3.760e-01 -1.416 0.15670   
## CitycatMemphis 9.411e-01 5.370e-01 1.752 0.07971 .   
## CitycatMendota Heights 9.566e-02 3.620e-01 0.264 0.79161   
## CitycatMeridian 1.185e-01 3.322e-01 0.357 0.72137   
## CitycatMesa 1.054e-01 2.924e-01 0.360 0.71856   
## CitycatMiami 5.401e-01 3.090e-01 1.748 0.08055 .   
## CitycatMiami Beach 9.874e-01 3.584e-01 2.755 0.00587 \*\*   
## CitycatMiami Gardens 3.951e-01 3.977e-01 0.993 0.32054   
## CitycatMiami Lakes 3.122e-02 3.178e-01 0.098 0.92175   
## CitycatMiami Shores 1.002e-01 4.866e-01 0.206 0.83679   
## CitycatMiami Springs 1.455e-01 6.280e-01 0.232 0.81681   
## CitycatMiddleton -3.203e-01 3.760e-01 -0.852 0.39431   
## CitycatMiddletown -3.859e-01 6.266e-01 -0.616 0.53800   
## CitycatMidwest City -5.035e-01 3.170e-01 -1.588 0.11221   
## CitycatMilwaukee 5.723e-01 4.224e-01 1.355 0.17550   
## CitycatMinneapolis 8.796e-01 3.534e-01 2.489 0.01283 \*   
## CitycatMint Hill -3.466e-01 3.076e-01 -1.127 0.25983   
## CitycatMissouri City -5.752e-01 3.763e-01 -1.529 0.12640   
## CitycatModesto 7.369e-01 3.420e-01 2.155 0.03118 \*   
## CitycatMonona -7.735e-02 3.964e-01 -0.195 0.84528   
## CitycatMontgomery -2.128e-01 3.761e-01 -0.566 0.57148   
## CitycatMoore -3.796e-01 3.012e-01 -1.260 0.20765   
## CitycatMorrisville -2.215e-01 4.282e-01 -0.517 0.60504   
## CitycatMounds View -1.532e-02 3.975e-01 -0.039 0.96925   
## CitycatMurphy -3.834e-01 3.317e-01 -1.156 0.24782   
## CitycatNeptune Beach 1.035e-01 3.968e-01 0.261 0.79427   
## CitycatNew Brighton -2.176e-01 4.283e-01 -0.508 0.61138   
## CitycatNew Hope -1.972e-01 3.432e-01 -0.575 0.56555   
## CitycatNew Orleans 6.003e-01 3.887e-01 1.544 0.12252   
## CitycatNewark 2.490e-01 3.197e-01 0.779 0.43618   
## CitycatNewtown -1.704e-01 6.270e-01 -0.272 0.78581   
## CitycatNichols Hills 2.125e-02 3.514e-01 0.060 0.95178   
## CitycatNolensville -1.651e-01 4.859e-01 -0.340 0.73406   
## CitycatNorfolk 8.059e-02 3.089e-01 0.261 0.79417   
## CitycatNormandy Park 2.213e-01 6.269e-01 0.353 0.72406   
## CitycatNorth Bay Village -4.581e-03 3.278e-01 -0.014 0.98885   
## CitycatNorth Las Vegas 4.534e-01 3.458e-01 1.311 0.18979   
## CitycatNorth Miami 6.853e-01 3.507e-01 1.954 0.05072 .   
## CitycatNorth Miami Beach 4.213e-01 3.276e-01 1.286 0.19847   
## CitycatNorth Richland Hills -1.587e-01 2.973e-01 -0.534 0.59362   
## CitycatNorth Royalton -5.881e-01 3.084e-01 -1.907 0.05652 .   
## CitycatNorthfield -5.214e-02 6.269e-01 -0.083 0.93372   
## CitycatNorthglenn 2.734e-01 3.637e-01 0.752 0.45229   
## CitycatOak Park -2.700e-01 3.782e-01 -0.714 0.47533   
## CitycatOakdale -2.469e-01 3.515e-01 -0.702 0.48251   
## CitycatOakland 1.570e+00 4.141e-01 3.792 0.00015 \*\*\*  
## CitycatOklahoma City 1.490e-01 3.251e-01 0.458 0.64669   
## CitycatOlmos Park 1.848e-01 3.761e-01 0.491 0.62317   
## CitycatOlmsted Falls -7.433e-01 3.433e-01 -2.165 0.03041 \*   
## CitycatOlmsted Township -7.595e-01 3.764e-01 -2.018 0.04363 \*   
## CitycatOmaha -2.438e-03 3.131e-01 -0.008 0.99379   
## CitycatOrlando 3.700e-01 3.263e-01 1.134 0.25682   
## CitycatOro Valley -2.023e-01 2.937e-01 -0.689 0.49103   
## CitycatOttawa Hills -7.206e-01 6.269e-01 -1.149 0.25038   
## CitycatPalmetto Bay 2.056e-01 3.186e-01 0.645 0.51873   
## CitycatPantego -2.241e-01 6.327e-01 -0.354 0.72325   
## CitycatPapillion -9.080e-02 4.862e-01 -0.187 0.85185   
## CitycatParadise Valley 4.789e-01 2.940e-01 1.629 0.10334   
## CitycatPark City -7.936e-01 3.985e-01 -1.991 0.04644 \*   
## CitycatParma -6.646e-01 3.031e-01 -2.192 0.02836 \*   
## CitycatPeoria -1.094e-01 3.779e-01 -0.290 0.77217   
## CitycatPepper Pike -1.153e-01 3.963e-01 -0.291 0.77113   
## CitycatPflugerville -2.720e-01 6.266e-01 -0.434 0.66425   
## CitycatPhoenix 5.085e-01 3.212e-01 1.583 0.11342   
## CitycatPickerington 8.137e-02 4.289e-01 0.190 0.84953   
## CitycatPiedmont 1.609e-01 4.857e-01 0.331 0.74053   
## CitycatPlano -1.297e-01 2.860e-01 -0.453 0.65031   
## CitycatPlymouth -2.106e-01 2.979e-01 -0.707 0.47969   
## CitycatPortland 6.260e-01 3.048e-01 2.054 0.04003 \*   
## CitycatPowell -6.617e-01 6.268e-01 -1.056 0.29116   
## CitycatRaleigh -9.706e-02 2.864e-01 -0.339 0.73474   
## CitycatRalston -8.778e-01 3.968e-01 -2.212 0.02697 \*   
## CitycatRed Oak -1.967e-01 6.267e-01 -0.314 0.75366   
## CitycatReno 2.442e-01 3.076e-01 0.794 0.42735   
## CitycatReynoldsburg -5.099e-01 3.770e-01 -1.353 0.17621   
## CitycatRichfield 5.070e-02 3.330e-01 0.152 0.87901   
## CitycatRichland Hills -1.120e-01 4.090e-01 -0.274 0.78430   
## CitycatRichmond 1.807e-01 3.012e-01 0.600 0.54859   
## CitycatRichmond Heights -5.373e-01 4.005e-01 -1.342 0.17967   
## CitycatRio Rancho -1.330e+00 2.924e-01 -4.549 5.42e-06 \*\*\*  
## CitycatRiver Hills -1.768e-01 6.266e-01 -0.282 0.77778   
## CitycatRiver Rouge 8.629e-02 5.463e-01 0.158 0.87449   
## CitycatRiverside 4.565e-01 3.045e-01 1.499 0.13382   
## CitycatRoanoke -1.056e-01 3.620e-01 -0.292 0.77055   
## CitycatRobbinsdale -7.783e-02 4.036e-01 -0.193 0.84711   
## CitycatRoseville 6.918e-02 3.293e-01 0.210 0.83360   
## CitycatSachse -2.082e-01 3.099e-01 -0.672 0.50176   
## CitycatSaginaw -2.758e-01 3.144e-01 -0.877 0.38044   
## CitycatSan Antonio 2.177e-01 3.220e-01 0.676 0.49900   
## CitycatSan Diego 4.553e-01 2.907e-01 1.566 0.11734   
## CitycatSan Fernando 4.062e-01 4.892e-01 0.830 0.40639   
## CitycatSan Francisco 7.193e-01 3.209e-01 2.242 0.02500 \*   
## CitycatSan Jose 6.681e-01 2.978e-01 2.244 0.02487 \*   
## CitycatSand Springs -1.095e+00 6.267e-01 -1.747 0.08067 .   
## CitycatSandy Springs -1.120e-01 2.891e-01 -0.388 0.69839   
## CitycatSanta Ana 6.841e-01 3.090e-01 2.214 0.02683 \*   
## CitycatSantee 1.308e-01 6.269e-01 0.209 0.83475   
## CitycatScottsdale 2.114e-01 2.829e-01 0.747 0.45493   
## CitycatSeattle 8.029e-01 3.094e-01 2.595 0.00948 \*\*   
## CitycatSeven Hills -5.204e-01 3.513e-01 -1.481 0.13855   
## CitycatShavano Park -2.315e-01 3.964e-01 -0.584 0.55922   
## CitycatShively -1.991e-01 3.677e-01 -0.541 0.58820   
## CitycatShoreline 3.982e-01 3.162e-01 1.260 0.20784   
## CitycatShorewood -1.166e-01 4.857e-01 -0.240 0.81034   
## CitycatSignal Hill 1.139e+00 6.533e-01 1.744 0.08119 .   
## CitycatSocorro -7.398e-01 3.157e-01 -2.344 0.01911 \*   
## CitycatSolon -7.734e-01 3.237e-01 -2.389 0.01688 \*   
## CitycatSouth Euclid -8.484e-01 3.238e-01 -2.620 0.00880 \*\*   
## CitycatSouth Miami 1.270e-01 4.322e-01 0.294 0.76884   
## CitycatSpeedway -2.562e+00 6.293e-01 -4.072 4.69e-05 \*\*\*  
## CitycatSpencer -3.023e+00 6.291e-01 -4.805 1.56e-06 \*\*\*  
## CitycatSpokane 3.688e-01 3.226e-01 1.143 0.25297   
## CitycatSpokane Valley -4.244e-02 3.151e-01 -0.135 0.89285   
## CitycatSpring Lake Park -2.441e-01 4.877e-01 -0.501 0.61669   
## CitycatStafford -3.021e-01 6.396e-01 -0.472 0.63670   
## CitycatStockton 1.309e+00 4.380e-01 2.989 0.00281 \*\*   
## CitycatStrongsville -6.133e-01 3.433e-01 -1.786 0.07406 .   
## CitycatSuffolk 6.263e-02 4.884e-01 0.128 0.89795   
## CitycatSunny Isles Beach 8.881e-02 3.024e-01 0.294 0.76898   
## CitycatSurfside -6.463e-02 4.854e-01 -0.133 0.89408   
## CitycatSweetwater -5.278e-01 6.266e-01 -0.842 0.39960   
## CitycatSwissvale -1.131e-01 6.274e-01 -0.180 0.85695   
## CitycatTampa 5.598e-02 2.934e-01 0.191 0.84867   
## CitycatTemple Terrace -2.333e-01 3.464e-01 -0.674 0.50055   
## CitycatTerrell Hills 1.571e-01 4.282e-01 0.367 0.71376   
## CitycatThornton -1.114e-01 3.042e-01 -0.366 0.71412   
## CitycatTigard 1.332e-01 3.055e-01 0.436 0.66281   
## CitycatToledo -1.060e-01 3.591e-01 -0.295 0.76788   
## CitycatTorrance 4.562e-01 3.973e-01 1.148 0.25095   
## CitycatTucson 1.945e-01 3.203e-01 0.607 0.54372   
## CitycatTulsa 2.592e-01 3.630e-01 0.714 0.47532   
## CitycatUniversity Heights -7.092e-01 3.622e-01 -1.958 0.05023 .   
## CitycatUpper Arlington -8.062e-02 3.238e-01 -0.249 0.80336   
## CitycatUrbandale -6.974e-01 2.963e-01 -2.354 0.01859 \*   
## CitycatVerona -2.405e-01 3.276e-01 -0.734 0.46278   
## CitycatVirginia Beach -2.482e-01 2.832e-01 -0.876 0.38096   
## CitycatVirginia Gardens 5.433e-01 6.274e-01 0.866 0.38648   
## CitycatWarr Acres 9.722e-02 5.086e-01 0.191 0.84842   
## CitycatWatauga -3.450e-01 3.968e-01 -0.869 0.38460   
## CitycatWauwatosa -1.064e-01 3.317e-01 -0.321 0.74833   
## CitycatWest Allis -1.910e-01 3.160e-01 -0.605 0.54551   
## CitycatWest Hollywood 1.057e+00 3.592e-01 2.942 0.00326 \*\*   
## CitycatWest Lake Hills 4.236e-01 6.267e-01 0.676 0.49910   
## CitycatWesterville -5.263e-01 3.326e-01 -1.583 0.11353   
## CitycatWestminster 3.819e-02 3.467e-01 0.110 0.91229   
## CitycatWhite Bear Lake -1.969e-01 3.515e-01 -0.560 0.57540   
## CitycatWhite Settlement 8.781e-01 6.269e-01 1.401 0.16133   
## CitycatWhitefish Bay -2.660e-01 4.856e-01 -0.548 0.58385   
## CitycatWhitehall -3.864e-01 3.842e-01 -1.006 0.31457   
## CitycatWichita 4.243e-01 3.889e-01 1.091 0.27526   
## CitycatWindsor Heights -3.475e-01 6.283e-01 -0.553 0.58022   
## CitycatWinter Park 3.210e-01 4.296e-01 0.747 0.45493   
## CitycatWolfforth -4.678e-01 4.854e-01 -0.964 0.33517   
## CitycatWoodbury -3.264e-01 2.973e-01 -1.098 0.27226   
## CitycatWorthington -4.458e-01 4.854e-01 -0.918 0.35843   
## CitycatYukon -1.312e-02 4.286e-01 -0.031 0.97559   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.5604 on 21470 degrees of freedom  
## Multiple R-squared: 0.6493, Adjusted R-squared: 0.6436   
## F-statistic: 114.9 on 346 and 21470 DF, p-value: < 2.2e-16

Population, Property Crime Rate, and State are removed. We are left with Size, Violent Crime Rate, Lot Size, Year Built, Bedrooms, Bathrooms, Price per sqft, and City.

Check the VIF factors:

car::vif (fit3aic)

## GVIF Df GVIF^(1/(2\*Df))  
## LogSize 1.874798 1 1.369233  
## Bedrooms 1.955380 1 1.398349  
## Bathrooms 2.316696 1 1.522070  
## Year\_Built 1.530358 1 1.237076  
## Lot\_Size 1.051712 1 1.025530  
## Price\_per\_sqft 1.710281 1 1.307777  
## Violent\_Crime\_Rate 767.164089 1 27.697727  
## Citycat 1926.143803 339 1.011218

All of the VIF factors are less than 5 except for violent crime rate. This suggests multicolinearity.

Summary of AIC model:

summary(fit3aic)

##   
## Call:  
## lm(formula = (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built +   
## Lot\_Size + Price\_per\_sqft + Violent\_Crime\_Rate + Citycat,   
## data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -26.1904 -0.1783 0.0502 0.2696 2.5641   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 7.180e+00 4.144e-01 17.324 < 2e-16 \*\*\*  
## LogSize 2.176e-01 9.136e-03 23.823 < 2e-16 \*\*\*  
## Bedrooms 3.695e-02 5.050e-03 7.318 2.61e-13 \*\*\*  
## Bathrooms 3.053e-01 5.345e-03 57.117 < 2e-16 \*\*\*  
## Year\_Built 1.510e-03 1.523e-04 9.910 < 2e-16 \*\*\*  
## Lot\_Size 1.056e-07 1.530e-08 6.905 5.16e-12 \*\*\*  
## Price\_per\_sqft 1.503e-03 2.083e-05 72.165 < 2e-16 \*\*\*  
## Violent\_Crime\_Rate -1.113e+02 2.505e+01 -4.442 8.95e-06 \*\*\*  
## CitycatAlbuquerque 9.198e-01 4.259e-01 2.160 0.03081 \*   
## CitycatAnaheim 3.058e-01 2.961e-01 1.033 0.30171   
## CitycatAnchorage 8.920e-01 4.072e-01 2.191 0.02850 \*   
## CitycatApple Valley -4.064e-01 3.037e-01 -1.338 0.18087   
## CitycatArlington 5.490e-02 3.043e-01 0.180 0.85681   
## CitycatAtlantic Beach 2.182e-01 3.303e-01 0.661 0.50889   
## CitycatAurora 5.711e-01 3.278e-01 1.742 0.08149 .   
## CitycatAustin 2.704e-01 2.929e-01 0.923 0.35588   
## CitycatAventura -1.989e-02 2.924e-01 -0.068 0.94576   
## CitycatBainbridge Island 1.644e-01 3.072e-01 0.535 0.59245   
## CitycatBaker -7.692e-01 6.312e-01 -1.219 0.22303   
## CitycatBakersfield 1.003e-01 2.987e-01 0.336 0.73692   
## CitycatBaltimore 1.259e+00 5.270e-01 2.388 0.01693 \*   
## CitycatBaton Rouge 3.876e-01 3.548e-01 1.093 0.27458   
## CitycatBay Harbor Islands -2.851e-01 3.761e-01 -0.758 0.44855   
## CitycatBay Village -2.729e-01 3.238e-01 -0.843 0.39947   
## CitycatBayside -2.997e-01 4.280e-01 -0.700 0.48381   
## CitycatBeachwood -1.002e+00 3.273e-01 -3.062 0.00220 \*\*   
## CitycatBedford -9.641e-01 3.159e-01 -3.051 0.00228 \*\*   
## CitycatBee Cave 1.047e-01 6.266e-01 0.167 0.86728   
## CitycatBel Aire -7.664e-01 4.284e-01 -1.789 0.07360 .   
## CitycatBelle Isle -1.024e-03 6.275e-01 -0.002 0.99870   
## CitycatBellevue -8.174e-02 3.773e-01 -0.217 0.82848   
## CitycatBenbrook -1.185e-01 3.519e-01 -0.337 0.73627   
## CitycatBerkeley 1.158e+00 6.356e-01 1.823 0.06838 .   
## CitycatBeverly Hills 3.012e-01 3.560e-01 0.846 0.39747   
## CitycatBexley -1.669e-01 4.854e-01 -0.344 0.73101   
## CitycatBiscayne Park 5.786e-02 6.272e-01 0.092 0.92649   
## CitycatBixby -2.701e-01 4.854e-01 -0.556 0.57793   
## CitycatBlaine -1.621e-01 3.019e-01 -0.537 0.59136   
## CitycatBloomington -1.250e-02 3.062e-01 -0.041 0.96743   
## CitycatBlue Ash 1.642e-02 4.281e-01 0.038 0.96941   
## CitycatBoise 7.824e-02 2.886e-01 0.271 0.78628   
## CitycatBrentwood -1.958e-01 3.236e-01 -0.605 0.54519   
## CitycatBroken Arrow -5.037e-01 6.267e-01 -0.804 0.42155   
## CitycatBrookhaven 1.777e-01 3.076e-01 0.578 0.56342   
## CitycatBrooklyn Center -7.244e-02 3.384e-01 -0.214 0.83048   
## CitycatBrooklyn Park -1.162e-01 3.104e-01 -0.374 0.70819   
## CitycatBrown Deer -2.437e-01 4.896e-01 -0.498 0.61865   
## CitycatBuffalo 3.036e-01 3.646e-01 0.833 0.40502   
## CitycatBurbank 1.794e-01 4.288e-01 0.418 0.67571   
## CitycatBurien 2.871e-01 3.202e-01 0.897 0.36999   
## CitycatBurleson -2.854e-01 3.780e-01 -0.755 0.45020   
## CitycatCampbell 2.044e-01 4.865e-01 0.420 0.67445   
## CitycatCarson 5.861e-01 3.578e-01 1.638 0.10139   
## CitycatCary 2.009e-01 6.266e-01 0.321 0.74849   
## CitycatCastroville -2.201e-01 4.874e-01 -0.452 0.65159   
## CitycatCeres 3.229e-01 6.326e-01 0.510 0.60976   
## CitycatChandler -3.191e-02 6.277e-01 -0.051 0.95946   
## CitycatChesapeake -7.056e-03 2.993e-01 -0.024 0.98119   
## CitycatChicago 7.499e-01 3.545e-01 2.116 0.03439 \*   
## CitycatChoctaw -2.649e-01 6.267e-01 -0.423 0.67252   
## CitycatChula Vista 2.590e-01 2.961e-01 0.875 0.38176   
## CitycatCincinnati 2.557e-01 3.412e-01 0.750 0.45352   
## CitycatCleveland 6.248e-01 4.576e-01 1.366 0.17210   
## CitycatCleveland Heights -6.412e-01 2.987e-01 -2.146 0.03185 \*   
## CitycatClive -3.523e-01 3.135e-01 -1.124 0.26104   
## CitycatColerain Township -4.274e-01 3.965e-01 -1.078 0.28103   
## CitycatCollege Park 3.991e-01 4.081e-01 0.978 0.32812   
## CitycatColorado Springs 2.866e-01 3.095e-01 0.926 0.35441   
## CitycatColumbia Heights -1.930e-01 3.409e-01 -0.566 0.57126   
## CitycatColumbus -8.355e-02 3.018e-01 -0.277 0.78192   
## CitycatCommerce City 2.498e-01 3.111e-01 0.803 0.42201   
## CitycatConverse -1.614e-01 4.428e-01 -0.364 0.71551   
## CitycatCoral Gables 2.014e-01 2.946e-01 0.684 0.49427   
## CitycatCoronado 1.954e-01 3.119e-01 0.626 0.53103   
## CitycatCorpus Christi 2.444e-01 3.357e-01 0.728 0.46661   
## CitycatCrafton -7.391e-01 6.273e-01 -1.178 0.23874   
## CitycatCrowley -2.019e-01 3.296e-01 -0.612 0.54022   
## CitycatCrystal -8.989e-03 3.542e-01 -0.025 0.97975   
## CitycatCulver City 4.923e-01 3.643e-01 1.351 0.17664   
## CitycatCutler Bay -1.137e-01 3.074e-01 -0.370 0.71140   
## CitycatDallas 6.609e-01 3.429e-01 1.927 0.05395 .   
## CitycatDel City -3.782e-01 4.115e-01 -0.919 0.35804   
## CitycatDel Mar 4.245e-01 3.624e-01 1.171 0.24148   
## CitycatDenton -7.518e-04 6.278e-01 -0.001 0.99904   
## CitycatDenver 8.292e-01 3.277e-01 2.530 0.01141 \*   
## CitycatDerby -2.638e+00 6.267e-01 -4.210 2.56e-05 \*\*\*  
## CitycatDes Moines 1.136e-01 3.220e-01 0.353 0.72428   
## CitycatDetroit 6.831e-01 5.502e-01 1.241 0.21445   
## CitycatDoral -1.433e-01 3.003e-01 -0.477 0.63321   
## CitycatDouglas -3.989e+00 6.267e-01 -6.366 1.98e-10 \*\*\*  
## CitycatDublin -4.601e-01 3.317e-01 -1.387 0.16536   
## CitycatDunwoody -1.709e-01 3.135e-01 -0.545 0.58562   
## CitycatDurham 3.762e-01 3.276e-01 1.148 0.25086   
## CitycatEagan -1.745e-01 3.099e-01 -0.563 0.57340   
## CitycatEast Cleveland -1.272e+00 5.007e-01 -2.540 0.01109 \*   
## CitycatEast Orange 2.207e-01 6.327e-01 0.349 0.72725   
## CitycatEastvale -1.433e-01 6.267e-01 -0.229 0.81907   
## CitycatEcorse 8.879e-01 5.630e-01 1.577 0.11483   
## CitycatEdgewood -3.838e-01 4.281e-01 -0.897 0.36989   
## CitycatEdina 1.508e-01 2.989e-01 0.504 0.61396   
## CitycatEdmond -2.099e-01 3.967e-01 -0.529 0.59670   
## CitycatEl Paso -4.349e-01 2.902e-01 -1.499 0.13394   
## CitycatEl Portal 3.662e-01 4.854e-01 0.754 0.45057   
## CitycatElmwood Park -1.931e-01 6.284e-01 -0.307 0.75867   
## CitycatEnglewood 2.298e-02 6.273e-01 0.037 0.97077   
## CitycatEuclid -5.261e-01 3.222e-01 -1.633 0.10255   
## CitycatEuless -7.157e-01 6.271e-01 -1.141 0.25380   
## CitycatEvendale -6.113e-01 6.271e-01 -0.975 0.32966   
## CitycatFairview Park -5.027e-01 3.369e-01 -1.492 0.13569   
## CitycatFarmers Branch -1.854e-01 3.437e-01 -0.540 0.58953   
## CitycatFerndale -1.020e-01 3.127e-01 -0.326 0.74427   
## CitycatFitchburg -2.835e-01 3.284e-01 -0.863 0.38800   
## CitycatForest Hill -5.104e-01 4.879e-01 -1.046 0.29547   
## CitycatFort Wayne -5.901e-01 2.931e-01 -2.013 0.04409 \*   
## CitycatFort Worth -2.036e-03 2.961e-01 -0.007 0.99451   
## CitycatFountain Valley 5.009e-02 3.316e-01 0.151 0.87994   
## CitycatFremont 4.192e-01 2.928e-01 1.432 0.15228   
## CitycatFridley -2.730e-02 3.806e-01 -0.072 0.94283   
## CitycatGahanna -3.612e-01 3.434e-01 -1.052 0.29281   
## CitycatGarden City 2.407e-01 3.487e-01 0.690 0.49011   
## CitycatGarden Ridge -4.230e-01 3.968e-01 -1.066 0.28652   
## CitycatGarland -7.695e-02 2.938e-01 -0.262 0.79340   
## CitycatGeorgetown -5.717e-01 3.761e-01 -1.520 0.12848   
## CitycatGermantown -2.812e-01 3.115e-01 -0.903 0.36658   
## CitycatGilbert -8.391e-02 2.852e-01 -0.294 0.76862   
## CitycatGlendale 2.323e-02 2.921e-01 0.080 0.93663   
## CitycatGlenn Heights 5.564e-02 6.298e-01 0.088 0.92960   
## CitycatGolden Beach 4.036e-01 6.268e-01 0.644 0.51964   
## CitycatGolden Valley -1.348e-01 4.280e-01 -0.315 0.75280   
## CitycatGoodlettsville -1.805e-01 3.805e-01 -0.474 0.63517   
## CitycatGrand Prairie -4.228e-01 6.275e-01 -0.674 0.50051   
## CitycatGranite Shoals 3.690e-02 6.268e-01 0.059 0.95306   
## CitycatGreenfield -5.807e-01 3.521e-01 -1.650 0.09905 .   
## CitycatGreensboro 1.775e-01 3.399e-01 0.522 0.60149   
## CitycatGrosse Pointe -2.835e-01 3.964e-01 -0.715 0.47458   
## CitycatGrosse Pointe Farms -1.472e-01 3.760e-01 -0.391 0.69544   
## CitycatGrosse Pointe Park -1.273e-01 3.515e-01 -0.362 0.71714   
## CitycatGrosse Pointe Shores -4.328e-01 6.267e-01 -0.691 0.48980   
## CitycatGrosse Pointe Woods -6.130e-02 3.624e-01 -0.169 0.86566   
## CitycatGroveport -7.837e-01 4.860e-01 -1.612 0.10688   
## CitycatHaltom City -1.726e-01 3.550e-01 -0.486 0.62684   
## CitycatHamtramck 2.663e-01 3.883e-01 0.686 0.49281   
## CitycatHarahan -4.678e-01 4.859e-01 -0.963 0.33574   
## CitycatHarper Woods 7.887e-02 3.705e-01 0.213 0.83145   
## CitycatHelotes -5.189e-01 4.856e-01 -1.069 0.28529   
## CitycatHenderson -5.722e-02 2.837e-01 -0.202 0.84015   
## CitycatHialeah -1.372e-02 2.887e-01 -0.048 0.96209   
## CitycatHialeah Gardens -7.023e-01 4.283e-01 -1.640 0.10104   
## CitycatHighland Park 3.095e-01 5.528e-01 0.560 0.57558   
## CitycatHilliard -5.445e-01 3.760e-01 -1.448 0.14763   
## CitycatHillsborough 1.896e-01 6.363e-01 0.298 0.76572   
## CitycatHollywood Park 1.338e-01 4.855e-01 0.276 0.78280   
## CitycatHoover -3.892e-01 3.021e-01 -1.288 0.19766   
## CitycatHorizon City -9.347e-01 2.975e-01 -3.141 0.00168 \*\*   
## CitycatHouston 7.204e-01 3.751e-01 1.921 0.05478 .   
## CitycatHurst -1.628e-01 6.274e-01 -0.259 0.79526   
## CitycatIndian Hills -4.917e-02 4.285e-01 -0.115 0.90864   
## CitycatIrvine 1.726e-01 2.853e-01 0.605 0.54515   
## CitycatIrving -1.356e-01 2.934e-01 -0.462 0.64408   
## CitycatJacksonville 7.448e-02 3.153e-01 0.236 0.81325   
## CitycatJacksonville Beach 4.600e-01 3.283e-01 1.401 0.16118   
## CitycatJeffersontown -3.560e-01 3.619e-01 -0.984 0.32523   
## CitycatJersey City 1.534e+00 6.364e-01 2.411 0.01592 \*   
## CitycatJones 8.340e-02 6.269e-01 0.133 0.89416   
## CitycatJurupa Valley 2.430e-01 3.278e-01 0.741 0.45849   
## CitycatKeller -5.148e-01 3.179e-01 -1.619 0.10538   
## CitycatKey Biscayne 3.080e-01 3.136e-01 0.982 0.32600   
## CitycatKirby -4.241e-01 6.280e-01 -0.675 0.49949   
## CitycatKnightdale -2.336e-01 4.868e-01 -0.480 0.63129   
## CitycatLa Vergne -1.061e-01 4.917e-01 -0.216 0.82909   
## CitycatLackawanna -2.781e-01 3.498e-01 -0.795 0.42657   
## CitycatLake Forest Park 1.592e-01 4.283e-01 0.372 0.71004   
## CitycatLakeway -2.051e-01 3.237e-01 -0.634 0.52630   
## CitycatLakewood -3.735e-01 3.038e-01 -1.229 0.21896   
## CitycatLancaster -1.489e-01 6.308e-01 -0.236 0.81342   
## CitycatLaredo -4.294e-01 2.946e-01 -1.458 0.14497   
## CitycatLauderdale -1.175e-01 4.855e-01 -0.242 0.80883   
## CitycatLeon Valley -5.069e-01 3.965e-01 -1.279 0.20104   
## CitycatLexington -1.236e-01 2.897e-01 -0.427 0.66958   
## CitycatLincoln -2.826e-01 2.940e-01 -0.961 0.33648   
## CitycatLittleton -9.751e-02 2.983e-01 -0.327 0.74380   
## CitycatLive Oak -3.023e-01 3.975e-01 -0.761 0.44695   
## CitycatLong Beach 6.947e-01 3.077e-01 2.257 0.02399 \*   
## CitycatLos Angeles 8.478e-01 3.257e-01 2.603 0.00924 \*\*   
## CitycatLubbock 3.932e-01 3.674e-01 1.070 0.28452   
## CitycatLuther -3.489e-01 6.276e-01 -0.556 0.57829   
## CitycatLyndhurst -6.206e-01 3.237e-01 -1.917 0.05520 .   
## CitycatMadison 3.026e-02 2.951e-01 0.103 0.91831   
## CitycatManor -6.954e-02 3.838e-01 -0.181 0.85621   
## CitycatMaplewood -2.814e-02 3.293e-01 -0.085 0.93190   
## CitycatMatthews -3.174e-01 3.625e-01 -0.875 0.38135   
## CitycatMayfield Heights -5.325e-01 3.760e-01 -1.416 0.15670   
## CitycatMemphis 9.411e-01 5.370e-01 1.752 0.07971 .   
## CitycatMendota Heights 9.566e-02 3.620e-01 0.264 0.79161   
## CitycatMeridian 1.185e-01 3.322e-01 0.357 0.72137   
## CitycatMesa 1.054e-01 2.924e-01 0.360 0.71856   
## CitycatMiami 5.401e-01 3.090e-01 1.748 0.08055 .   
## CitycatMiami Beach 9.874e-01 3.584e-01 2.755 0.00587 \*\*   
## CitycatMiami Gardens 3.951e-01 3.977e-01 0.993 0.32054   
## CitycatMiami Lakes 3.122e-02 3.178e-01 0.098 0.92175   
## CitycatMiami Shores 1.002e-01 4.866e-01 0.206 0.83679   
## CitycatMiami Springs 1.455e-01 6.280e-01 0.232 0.81681   
## CitycatMiddleton -3.203e-01 3.760e-01 -0.852 0.39431   
## CitycatMiddletown -3.859e-01 6.266e-01 -0.616 0.53800   
## CitycatMidwest City -5.035e-01 3.170e-01 -1.588 0.11221   
## CitycatMilwaukee 5.723e-01 4.224e-01 1.355 0.17550   
## CitycatMinneapolis 8.796e-01 3.534e-01 2.489 0.01283 \*   
## CitycatMint Hill -3.466e-01 3.076e-01 -1.127 0.25983   
## CitycatMissouri City -5.752e-01 3.763e-01 -1.529 0.12640   
## CitycatModesto 7.369e-01 3.420e-01 2.155 0.03118 \*   
## CitycatMonona -7.735e-02 3.964e-01 -0.195 0.84528   
## CitycatMontgomery -2.128e-01 3.761e-01 -0.566 0.57148   
## CitycatMoore -3.796e-01 3.012e-01 -1.260 0.20765   
## CitycatMorrisville -2.215e-01 4.282e-01 -0.517 0.60504   
## CitycatMounds View -1.532e-02 3.975e-01 -0.039 0.96925   
## CitycatMurphy -3.834e-01 3.317e-01 -1.156 0.24782   
## CitycatNeptune Beach 1.035e-01 3.968e-01 0.261 0.79427   
## CitycatNew Brighton -2.176e-01 4.283e-01 -0.508 0.61138   
## CitycatNew Hope -1.972e-01 3.432e-01 -0.575 0.56555   
## CitycatNew Orleans 6.003e-01 3.887e-01 1.544 0.12252   
## CitycatNewark 2.490e-01 3.197e-01 0.779 0.43618   
## CitycatNewtown -1.704e-01 6.270e-01 -0.272 0.78581   
## CitycatNichols Hills 2.125e-02 3.514e-01 0.060 0.95178   
## CitycatNolensville -1.651e-01 4.859e-01 -0.340 0.73406   
## CitycatNorfolk 8.059e-02 3.089e-01 0.261 0.79417   
## CitycatNormandy Park 2.213e-01 6.269e-01 0.353 0.72406   
## CitycatNorth Bay Village -4.581e-03 3.278e-01 -0.014 0.98885   
## CitycatNorth Las Vegas 4.534e-01 3.458e-01 1.311 0.18979   
## CitycatNorth Miami 6.853e-01 3.507e-01 1.954 0.05072 .   
## CitycatNorth Miami Beach 4.213e-01 3.276e-01 1.286 0.19847   
## CitycatNorth Richland Hills -1.587e-01 2.973e-01 -0.534 0.59362   
## CitycatNorth Royalton -5.881e-01 3.084e-01 -1.907 0.05652 .   
## CitycatNorthfield -5.214e-02 6.269e-01 -0.083 0.93372   
## CitycatNorthglenn 2.734e-01 3.637e-01 0.752 0.45229   
## CitycatOak Park -2.700e-01 3.782e-01 -0.714 0.47533   
## CitycatOakdale -2.469e-01 3.515e-01 -0.702 0.48251   
## CitycatOakland 1.570e+00 4.141e-01 3.792 0.00015 \*\*\*  
## CitycatOklahoma City 1.490e-01 3.251e-01 0.458 0.64669   
## CitycatOlmos Park 1.848e-01 3.761e-01 0.491 0.62317   
## CitycatOlmsted Falls -7.433e-01 3.433e-01 -2.165 0.03041 \*   
## CitycatOlmsted Township -7.595e-01 3.764e-01 -2.018 0.04363 \*   
## CitycatOmaha -2.438e-03 3.131e-01 -0.008 0.99379   
## CitycatOrlando 3.700e-01 3.263e-01 1.134 0.25682   
## CitycatOro Valley -2.023e-01 2.937e-01 -0.689 0.49103   
## CitycatOttawa Hills -7.206e-01 6.269e-01 -1.149 0.25038   
## CitycatPalmetto Bay 2.056e-01 3.186e-01 0.645 0.51873   
## CitycatPantego -2.241e-01 6.327e-01 -0.354 0.72325   
## CitycatPapillion -9.080e-02 4.862e-01 -0.187 0.85185   
## CitycatParadise Valley 4.789e-01 2.940e-01 1.629 0.10334   
## CitycatPark City -7.936e-01 3.985e-01 -1.991 0.04644 \*   
## CitycatParma -6.646e-01 3.031e-01 -2.192 0.02836 \*   
## CitycatPeoria -1.094e-01 3.779e-01 -0.290 0.77217   
## CitycatPepper Pike -1.153e-01 3.963e-01 -0.291 0.77113   
## CitycatPflugerville -2.720e-01 6.266e-01 -0.434 0.66425   
## CitycatPhoenix 5.085e-01 3.212e-01 1.583 0.11342   
## CitycatPickerington 8.137e-02 4.289e-01 0.190 0.84953   
## CitycatPiedmont 1.609e-01 4.857e-01 0.331 0.74053   
## CitycatPlano -1.297e-01 2.860e-01 -0.453 0.65031   
## CitycatPlymouth -2.106e-01 2.979e-01 -0.707 0.47969   
## CitycatPortland 6.260e-01 3.048e-01 2.054 0.04003 \*   
## CitycatPowell -6.617e-01 6.268e-01 -1.056 0.29116   
## CitycatRaleigh -9.706e-02 2.864e-01 -0.339 0.73474   
## CitycatRalston -8.778e-01 3.968e-01 -2.212 0.02697 \*   
## CitycatRed Oak -1.967e-01 6.267e-01 -0.314 0.75366   
## CitycatReno 2.442e-01 3.076e-01 0.794 0.42735   
## CitycatReynoldsburg -5.099e-01 3.770e-01 -1.353 0.17621   
## CitycatRichfield 5.070e-02 3.330e-01 0.152 0.87901   
## CitycatRichland Hills -1.120e-01 4.090e-01 -0.274 0.78430   
## CitycatRichmond 1.807e-01 3.012e-01 0.600 0.54859   
## CitycatRichmond Heights -5.373e-01 4.005e-01 -1.342 0.17967   
## CitycatRio Rancho -1.330e+00 2.924e-01 -4.549 5.42e-06 \*\*\*  
## CitycatRiver Hills -1.768e-01 6.266e-01 -0.282 0.77778   
## CitycatRiver Rouge 8.629e-02 5.463e-01 0.158 0.87449   
## CitycatRiverside 4.565e-01 3.045e-01 1.499 0.13382   
## CitycatRoanoke -1.056e-01 3.620e-01 -0.292 0.77055   
## CitycatRobbinsdale -7.783e-02 4.036e-01 -0.193 0.84711   
## CitycatRoseville 6.918e-02 3.293e-01 0.210 0.83360   
## CitycatSachse -2.082e-01 3.099e-01 -0.672 0.50176   
## CitycatSaginaw -2.758e-01 3.144e-01 -0.877 0.38044   
## CitycatSan Antonio 2.177e-01 3.220e-01 0.676 0.49900   
## CitycatSan Diego 4.553e-01 2.907e-01 1.566 0.11734   
## CitycatSan Fernando 4.062e-01 4.892e-01 0.830 0.40639   
## CitycatSan Francisco 7.193e-01 3.209e-01 2.242 0.02500 \*   
## CitycatSan Jose 6.681e-01 2.978e-01 2.244 0.02487 \*   
## CitycatSand Springs -1.095e+00 6.267e-01 -1.747 0.08067 .   
## CitycatSandy Springs -1.120e-01 2.891e-01 -0.388 0.69839   
## CitycatSanta Ana 6.841e-01 3.090e-01 2.214 0.02683 \*   
## CitycatSantee 1.308e-01 6.269e-01 0.209 0.83475   
## CitycatScottsdale 2.114e-01 2.829e-01 0.747 0.45493   
## CitycatSeattle 8.029e-01 3.094e-01 2.595 0.00948 \*\*   
## CitycatSeven Hills -5.204e-01 3.513e-01 -1.481 0.13855   
## CitycatShavano Park -2.315e-01 3.964e-01 -0.584 0.55922   
## CitycatShively -1.991e-01 3.677e-01 -0.541 0.58820   
## CitycatShoreline 3.982e-01 3.162e-01 1.260 0.20784   
## CitycatShorewood -1.166e-01 4.857e-01 -0.240 0.81034   
## CitycatSignal Hill 1.139e+00 6.533e-01 1.744 0.08119 .   
## CitycatSocorro -7.398e-01 3.157e-01 -2.344 0.01911 \*   
## CitycatSolon -7.734e-01 3.237e-01 -2.389 0.01688 \*   
## CitycatSouth Euclid -8.484e-01 3.238e-01 -2.620 0.00880 \*\*   
## CitycatSouth Miami 1.270e-01 4.322e-01 0.294 0.76884   
## CitycatSpeedway -2.562e+00 6.293e-01 -4.072 4.69e-05 \*\*\*  
## CitycatSpencer -3.023e+00 6.291e-01 -4.805 1.56e-06 \*\*\*  
## CitycatSpokane 3.688e-01 3.226e-01 1.143 0.25297   
## CitycatSpokane Valley -4.244e-02 3.151e-01 -0.135 0.89285   
## CitycatSpring Lake Park -2.441e-01 4.877e-01 -0.501 0.61669   
## CitycatStafford -3.021e-01 6.396e-01 -0.472 0.63670   
## CitycatStockton 1.309e+00 4.380e-01 2.989 0.00281 \*\*   
## CitycatStrongsville -6.133e-01 3.433e-01 -1.786 0.07406 .   
## CitycatSuffolk 6.263e-02 4.884e-01 0.128 0.89795   
## CitycatSunny Isles Beach 8.881e-02 3.024e-01 0.294 0.76898   
## CitycatSurfside -6.463e-02 4.854e-01 -0.133 0.89408   
## CitycatSweetwater -5.278e-01 6.266e-01 -0.842 0.39960   
## CitycatSwissvale -1.131e-01 6.274e-01 -0.180 0.85695   
## CitycatTampa 5.598e-02 2.934e-01 0.191 0.84867   
## CitycatTemple Terrace -2.333e-01 3.464e-01 -0.674 0.50055   
## CitycatTerrell Hills 1.571e-01 4.282e-01 0.367 0.71376   
## CitycatThornton -1.114e-01 3.042e-01 -0.366 0.71412   
## CitycatTigard 1.332e-01 3.055e-01 0.436 0.66281   
## CitycatToledo -1.060e-01 3.591e-01 -0.295 0.76788   
## CitycatTorrance 4.562e-01 3.973e-01 1.148 0.25095   
## CitycatTucson 1.945e-01 3.203e-01 0.607 0.54372   
## CitycatTulsa 2.592e-01 3.630e-01 0.714 0.47532   
## CitycatUniversity Heights -7.092e-01 3.622e-01 -1.958 0.05023 .   
## CitycatUpper Arlington -8.062e-02 3.238e-01 -0.249 0.80336   
## CitycatUrbandale -6.974e-01 2.963e-01 -2.354 0.01859 \*   
## CitycatVerona -2.405e-01 3.276e-01 -0.734 0.46278   
## CitycatVirginia Beach -2.482e-01 2.832e-01 -0.876 0.38096   
## CitycatVirginia Gardens 5.433e-01 6.274e-01 0.866 0.38648   
## CitycatWarr Acres 9.722e-02 5.086e-01 0.191 0.84842   
## CitycatWatauga -3.450e-01 3.968e-01 -0.869 0.38460   
## CitycatWauwatosa -1.064e-01 3.317e-01 -0.321 0.74833   
## CitycatWest Allis -1.910e-01 3.160e-01 -0.605 0.54551   
## CitycatWest Hollywood 1.057e+00 3.592e-01 2.942 0.00326 \*\*   
## CitycatWest Lake Hills 4.236e-01 6.267e-01 0.676 0.49910   
## CitycatWesterville -5.263e-01 3.326e-01 -1.583 0.11353   
## CitycatWestminster 3.819e-02 3.467e-01 0.110 0.91229   
## CitycatWhite Bear Lake -1.969e-01 3.515e-01 -0.560 0.57540   
## CitycatWhite Settlement 8.781e-01 6.269e-01 1.401 0.16133   
## CitycatWhitefish Bay -2.660e-01 4.856e-01 -0.548 0.58385   
## CitycatWhitehall -3.864e-01 3.842e-01 -1.006 0.31457   
## CitycatWichita 4.243e-01 3.889e-01 1.091 0.27526   
## CitycatWindsor Heights -3.475e-01 6.283e-01 -0.553 0.58022   
## CitycatWinter Park 3.210e-01 4.296e-01 0.747 0.45493   
## CitycatWolfforth -4.678e-01 4.854e-01 -0.964 0.33517   
## CitycatWoodbury -3.264e-01 2.973e-01 -1.098 0.27226   
## CitycatWorthington -4.458e-01 4.854e-01 -0.918 0.35843   
## CitycatYukon -1.312e-02 4.286e-01 -0.031 0.97559   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.5604 on 21470 degrees of freedom  
## Multiple R-squared: 0.6493, Adjusted R-squared: 0.6436   
## F-statistic: 114.9 on 346 and 21470 DF, p-value: < 2.2e-16

The R-squared is 0.6436 and the residual standard error is 0.5604.

Next we will apply stepwise regression with the BIC criterion.

fit3BIC = step (fit3, direction="both",   
 k = log (fit3$rank + fit3$df.residual))

## Start: AIC=-22133.12  
## (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built + Lot\_Size +   
## Price\_per\_sqft + Population + Violent\_Crime\_Rate + Property\_Crime\_Rate +   
## Citycat + Statecat  
##   
##   
## Step: AIC=-22133.12  
## (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built + Lot\_Size +   
## Price\_per\_sqft + Population + Violent\_Crime\_Rate + Property\_Crime\_Rate +   
## Citycat  
##   
## Df Sum of Sq RSS AIC  
## - Property\_Crime\_Rate 1 0.25 6742.4 -22142  
## - Population 1 0.29 6742.5 -22142  
## - Violent\_Crime\_Rate 1 2.04 6744.2 -22137  
## <none> 6742.2 -22133  
## - Lot\_Size 1 14.98 6757.2 -22095  
## - Bedrooms 1 16.79 6759.0 -22089  
## - Year\_Built 1 30.71 6772.9 -22044  
## - Citycat 339 1299.21 8041.4 -21675  
## - LogSize 1 178.01 6920.2 -21575  
## - Bathrooms 1 1024.87 7767.1 -19056  
## - Price\_per\_sqft 1 1634.38 8376.6 -17408  
##   
## Step: AIC=-22142.29  
## (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built + Lot\_Size +   
## Price\_per\_sqft + Population + Violent\_Crime\_Rate + Citycat  
##   
## Df Sum of Sq RSS AIC  
## - Population 1 0.12 6742.6 -22152  
## <none> 6742.4 -22142  
## - Violent\_Crime\_Rate 1 4.16 6746.6 -22139  
## + Statecat 1 0.25 6742.2 -22133  
## + Property\_Crime\_Rate 1 0.25 6742.2 -22133  
## - Lot\_Size 1 14.98 6757.4 -22104  
## - Bedrooms 1 16.80 6759.3 -22098  
## - Year\_Built 1 30.84 6773.3 -22053  
## - LogSize 1 178.19 6920.6 -21583  
## - Citycat 339 1343.11 8085.6 -21566  
## - Bathrooms 1 1024.66 7767.1 -19066  
## - Price\_per\_sqft 1 1635.16 8377.6 -17415  
##   
## Step: AIC=-22151.89  
## (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built + Lot\_Size +   
## Price\_per\_sqft + Violent\_Crime\_Rate + Citycat  
##   
## Df Sum of Sq RSS AIC  
## <none> 6742.6 -22152  
## + Population 1 0.12 6742.4 -22142  
## + Property\_Crime\_Rate 1 0.08 6742.5 -22142  
## - Violent\_Crime\_Rate 1 6.20 6748.8 -22142  
## + Statecat 2 0.37 6742.2 -22133  
## - Lot\_Size 1 14.97 6757.5 -22114  
## - Bedrooms 1 16.82 6759.4 -22108  
## - Year\_Built 1 30.84 6773.4 -22062  
## - LogSize 1 178.23 6920.8 -21593  
## - Citycat 339 1484.98 8227.6 -21196  
## - Bathrooms 1 1024.55 7767.1 -19076  
## - Price\_per\_sqft 1 1635.50 8378.1 -17424

summary (fit3BIC)

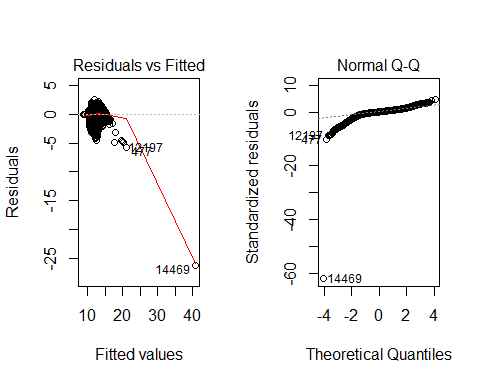
##   
## Call:  
## lm(formula = (LogPrice) ~ LogSize + Bedrooms + Bathrooms + Year\_Built +   
## Lot\_Size + Price\_per\_sqft + Violent\_Crime\_Rate + Citycat,   
## data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -26.1904 -0.1783 0.0502 0.2696 2.5641   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 7.180e+00 4.144e-01 17.324 < 2e-16 \*\*\*  
## LogSize 2.176e-01 9.136e-03 23.823 < 2e-16 \*\*\*  
## Bedrooms 3.695e-02 5.050e-03 7.318 2.61e-13 \*\*\*  
## Bathrooms 3.053e-01 5.345e-03 57.117 < 2e-16 \*\*\*  
## Year\_Built 1.510e-03 1.523e-04 9.910 < 2e-16 \*\*\*  
## Lot\_Size 1.056e-07 1.530e-08 6.905 5.16e-12 \*\*\*  
## Price\_per\_sqft 1.503e-03 2.083e-05 72.165 < 2e-16 \*\*\*  
## Violent\_Crime\_Rate -1.113e+02 2.505e+01 -4.442 8.95e-06 \*\*\*  
## CitycatAlbuquerque 9.198e-01 4.259e-01 2.160 0.03081 \*   
## CitycatAnaheim 3.058e-01 2.961e-01 1.033 0.30171   
## CitycatAnchorage 8.920e-01 4.072e-01 2.191 0.02850 \*   
## CitycatApple Valley -4.064e-01 3.037e-01 -1.338 0.18087   
## CitycatArlington 5.490e-02 3.043e-01 0.180 0.85681   
## CitycatAtlantic Beach 2.182e-01 3.303e-01 0.661 0.50889   
## CitycatAurora 5.711e-01 3.278e-01 1.742 0.08149 .   
## CitycatAustin 2.704e-01 2.929e-01 0.923 0.35588   
## CitycatAventura -1.989e-02 2.924e-01 -0.068 0.94576   
## CitycatBainbridge Island 1.644e-01 3.072e-01 0.535 0.59245   
## CitycatBaker -7.692e-01 6.312e-01 -1.219 0.22303   
## CitycatBakersfield 1.003e-01 2.987e-01 0.336 0.73692   
## CitycatBaltimore 1.259e+00 5.270e-01 2.388 0.01693 \*   
## CitycatBaton Rouge 3.876e-01 3.548e-01 1.093 0.27458   
## CitycatBay Harbor Islands -2.851e-01 3.761e-01 -0.758 0.44855   
## CitycatBay Village -2.729e-01 3.238e-01 -0.843 0.39947   
## CitycatBayside -2.997e-01 4.280e-01 -0.700 0.48381   
## CitycatBeachwood -1.002e+00 3.273e-01 -3.062 0.00220 \*\*   
## CitycatBedford -9.641e-01 3.159e-01 -3.051 0.00228 \*\*   
## CitycatBee Cave 1.047e-01 6.266e-01 0.167 0.86728   
## CitycatBel Aire -7.664e-01 4.284e-01 -1.789 0.07360 .   
## CitycatBelle Isle -1.024e-03 6.275e-01 -0.002 0.99870   
## CitycatBellevue -8.174e-02 3.773e-01 -0.217 0.82848   
## CitycatBenbrook -1.185e-01 3.519e-01 -0.337 0.73627   
## CitycatBerkeley 1.158e+00 6.356e-01 1.823 0.06838 .   
## CitycatBeverly Hills 3.012e-01 3.560e-01 0.846 0.39747   
## CitycatBexley -1.669e-01 4.854e-01 -0.344 0.73101   
## CitycatBiscayne Park 5.786e-02 6.272e-01 0.092 0.92649   
## CitycatBixby -2.701e-01 4.854e-01 -0.556 0.57793   
## CitycatBlaine -1.621e-01 3.019e-01 -0.537 0.59136   
## CitycatBloomington -1.250e-02 3.062e-01 -0.041 0.96743   
## CitycatBlue Ash 1.642e-02 4.281e-01 0.038 0.96941   
## CitycatBoise 7.824e-02 2.886e-01 0.271 0.78628   
## CitycatBrentwood -1.958e-01 3.236e-01 -0.605 0.54519   
## CitycatBroken Arrow -5.037e-01 6.267e-01 -0.804 0.42155   
## CitycatBrookhaven 1.777e-01 3.076e-01 0.578 0.56342   
## CitycatBrooklyn Center -7.244e-02 3.384e-01 -0.214 0.83048   
## CitycatBrooklyn Park -1.162e-01 3.104e-01 -0.374 0.70819   
## CitycatBrown Deer -2.437e-01 4.896e-01 -0.498 0.61865   
## CitycatBuffalo 3.036e-01 3.646e-01 0.833 0.40502   
## CitycatBurbank 1.794e-01 4.288e-01 0.418 0.67571   
## CitycatBurien 2.871e-01 3.202e-01 0.897 0.36999   
## CitycatBurleson -2.854e-01 3.780e-01 -0.755 0.45020   
## CitycatCampbell 2.044e-01 4.865e-01 0.420 0.67445   
## CitycatCarson 5.861e-01 3.578e-01 1.638 0.10139   
## CitycatCary 2.009e-01 6.266e-01 0.321 0.74849   
## CitycatCastroville -2.201e-01 4.874e-01 -0.452 0.65159   
## CitycatCeres 3.229e-01 6.326e-01 0.510 0.60976   
## CitycatChandler -3.191e-02 6.277e-01 -0.051 0.95946   
## CitycatChesapeake -7.056e-03 2.993e-01 -0.024 0.98119   
## CitycatChicago 7.499e-01 3.545e-01 2.116 0.03439 \*   
## CitycatChoctaw -2.649e-01 6.267e-01 -0.423 0.67252   
## CitycatChula Vista 2.590e-01 2.961e-01 0.875 0.38176   
## CitycatCincinnati 2.557e-01 3.412e-01 0.750 0.45352   
## CitycatCleveland 6.248e-01 4.576e-01 1.366 0.17210   
## CitycatCleveland Heights -6.412e-01 2.987e-01 -2.146 0.03185 \*   
## CitycatClive -3.523e-01 3.135e-01 -1.124 0.26104   
## CitycatColerain Township -4.274e-01 3.965e-01 -1.078 0.28103   
## CitycatCollege Park 3.991e-01 4.081e-01 0.978 0.32812   
## CitycatColorado Springs 2.866e-01 3.095e-01 0.926 0.35441   
## CitycatColumbia Heights -1.930e-01 3.409e-01 -0.566 0.57126   
## CitycatColumbus -8.355e-02 3.018e-01 -0.277 0.78192   
## CitycatCommerce City 2.498e-01 3.111e-01 0.803 0.42201   
## CitycatConverse -1.614e-01 4.428e-01 -0.364 0.71551   
## CitycatCoral Gables 2.014e-01 2.946e-01 0.684 0.49427   
## CitycatCoronado 1.954e-01 3.119e-01 0.626 0.53103   
## CitycatCorpus Christi 2.444e-01 3.357e-01 0.728 0.46661   
## CitycatCrafton -7.391e-01 6.273e-01 -1.178 0.23874   
## CitycatCrowley -2.019e-01 3.296e-01 -0.612 0.54022   
## CitycatCrystal -8.989e-03 3.542e-01 -0.025 0.97975   
## CitycatCulver City 4.923e-01 3.643e-01 1.351 0.17664   
## CitycatCutler Bay -1.137e-01 3.074e-01 -0.370 0.71140   
## CitycatDallas 6.609e-01 3.429e-01 1.927 0.05395 .   
## CitycatDel City -3.782e-01 4.115e-01 -0.919 0.35804   
## CitycatDel Mar 4.245e-01 3.624e-01 1.171 0.24148   
## CitycatDenton -7.518e-04 6.278e-01 -0.001 0.99904   
## CitycatDenver 8.292e-01 3.277e-01 2.530 0.01141 \*   
## CitycatDerby -2.638e+00 6.267e-01 -4.210 2.56e-05 \*\*\*  
## CitycatDes Moines 1.136e-01 3.220e-01 0.353 0.72428   
## CitycatDetroit 6.831e-01 5.502e-01 1.241 0.21445   
## CitycatDoral -1.433e-01 3.003e-01 -0.477 0.63321   
## CitycatDouglas -3.989e+00 6.267e-01 -6.366 1.98e-10 \*\*\*  
## CitycatDublin -4.601e-01 3.317e-01 -1.387 0.16536   
## CitycatDunwoody -1.709e-01 3.135e-01 -0.545 0.58562   
## CitycatDurham 3.762e-01 3.276e-01 1.148 0.25086   
## CitycatEagan -1.745e-01 3.099e-01 -0.563 0.57340   
## CitycatEast Cleveland -1.272e+00 5.007e-01 -2.540 0.01109 \*   
## CitycatEast Orange 2.207e-01 6.327e-01 0.349 0.72725   
## CitycatEastvale -1.433e-01 6.267e-01 -0.229 0.81907   
## CitycatEcorse 8.879e-01 5.630e-01 1.577 0.11483   
## CitycatEdgewood -3.838e-01 4.281e-01 -0.897 0.36989   
## CitycatEdina 1.508e-01 2.989e-01 0.504 0.61396   
## CitycatEdmond -2.099e-01 3.967e-01 -0.529 0.59670   
## CitycatEl Paso -4.349e-01 2.902e-01 -1.499 0.13394   
## CitycatEl Portal 3.662e-01 4.854e-01 0.754 0.45057   
## CitycatElmwood Park -1.931e-01 6.284e-01 -0.307 0.75867   
## CitycatEnglewood 2.298e-02 6.273e-01 0.037 0.97077   
## CitycatEuclid -5.261e-01 3.222e-01 -1.633 0.10255   
## CitycatEuless -7.157e-01 6.271e-01 -1.141 0.25380   
## CitycatEvendale -6.113e-01 6.271e-01 -0.975 0.32966   
## CitycatFairview Park -5.027e-01 3.369e-01 -1.492 0.13569   
## CitycatFarmers Branch -1.854e-01 3.437e-01 -0.540 0.58953   
## CitycatFerndale -1.020e-01 3.127e-01 -0.326 0.74427   
## CitycatFitchburg -2.835e-01 3.284e-01 -0.863 0.38800   
## CitycatForest Hill -5.104e-01 4.879e-01 -1.046 0.29547   
## CitycatFort Wayne -5.901e-01 2.931e-01 -2.013 0.04409 \*   
## CitycatFort Worth -2.036e-03 2.961e-01 -0.007 0.99451   
## CitycatFountain Valley 5.009e-02 3.316e-01 0.151 0.87994   
## CitycatFremont 4.192e-01 2.928e-01 1.432 0.15228   
## CitycatFridley -2.730e-02 3.806e-01 -0.072 0.94283   
## CitycatGahanna -3.612e-01 3.434e-01 -1.052 0.29281   
## CitycatGarden City 2.407e-01 3.487e-01 0.690 0.49011   
## CitycatGarden Ridge -4.230e-01 3.968e-01 -1.066 0.28652   
## CitycatGarland -7.695e-02 2.938e-01 -0.262 0.79340   
## CitycatGeorgetown -5.717e-01 3.761e-01 -1.520 0.12848   
## CitycatGermantown -2.812e-01 3.115e-01 -0.903 0.36658   
## CitycatGilbert -8.391e-02 2.852e-01 -0.294 0.76862   
## CitycatGlendale 2.323e-02 2.921e-01 0.080 0.93663   
## CitycatGlenn Heights 5.564e-02 6.298e-01 0.088 0.92960   
## CitycatGolden Beach 4.036e-01 6.268e-01 0.644 0.51964   
## CitycatGolden Valley -1.348e-01 4.280e-01 -0.315 0.75280   
## CitycatGoodlettsville -1.805e-01 3.805e-01 -0.474 0.63517   
## CitycatGrand Prairie -4.228e-01 6.275e-01 -0.674 0.50051   
## CitycatGranite Shoals 3.690e-02 6.268e-01 0.059 0.95306   
## CitycatGreenfield -5.807e-01 3.521e-01 -1.650 0.09905 .   
## CitycatGreensboro 1.775e-01 3.399e-01 0.522 0.60149   
## CitycatGrosse Pointe -2.835e-01 3.964e-01 -0.715 0.47458   
## CitycatGrosse Pointe Farms -1.472e-01 3.760e-01 -0.391 0.69544   
## CitycatGrosse Pointe Park -1.273e-01 3.515e-01 -0.362 0.71714   
## CitycatGrosse Pointe Shores -4.328e-01 6.267e-01 -0.691 0.48980   
## CitycatGrosse Pointe Woods -6.130e-02 3.624e-01 -0.169 0.86566   
## CitycatGroveport -7.837e-01 4.860e-01 -1.612 0.10688   
## CitycatHaltom City -1.726e-01 3.550e-01 -0.486 0.62684   
## CitycatHamtramck 2.663e-01 3.883e-01 0.686 0.49281   
## CitycatHarahan -4.678e-01 4.859e-01 -0.963 0.33574   
## CitycatHarper Woods 7.887e-02 3.705e-01 0.213 0.83145   
## CitycatHelotes -5.189e-01 4.856e-01 -1.069 0.28529   
## CitycatHenderson -5.722e-02 2.837e-01 -0.202 0.84015   
## CitycatHialeah -1.372e-02 2.887e-01 -0.048 0.96209   
## CitycatHialeah Gardens -7.023e-01 4.283e-01 -1.640 0.10104   
## CitycatHighland Park 3.095e-01 5.528e-01 0.560 0.57558   
## CitycatHilliard -5.445e-01 3.760e-01 -1.448 0.14763   
## CitycatHillsborough 1.896e-01 6.363e-01 0.298 0.76572   
## CitycatHollywood Park 1.338e-01 4.855e-01 0.276 0.78280   
## CitycatHoover -3.892e-01 3.021e-01 -1.288 0.19766   
## CitycatHorizon City -9.347e-01 2.975e-01 -3.141 0.00168 \*\*   
## CitycatHouston 7.204e-01 3.751e-01 1.921 0.05478 .   
## CitycatHurst -1.628e-01 6.274e-01 -0.259 0.79526   
## CitycatIndian Hills -4.917e-02 4.285e-01 -0.115 0.90864   
## CitycatIrvine 1.726e-01 2.853e-01 0.605 0.54515   
## CitycatIrving -1.356e-01 2.934e-01 -0.462 0.64408   
## CitycatJacksonville 7.448e-02 3.153e-01 0.236 0.81325   
## CitycatJacksonville Beach 4.600e-01 3.283e-01 1.401 0.16118   
## CitycatJeffersontown -3.560e-01 3.619e-01 -0.984 0.32523   
## CitycatJersey City 1.534e+00 6.364e-01 2.411 0.01592 \*   
## CitycatJones 8.340e-02 6.269e-01 0.133 0.89416   
## CitycatJurupa Valley 2.430e-01 3.278e-01 0.741 0.45849   
## CitycatKeller -5.148e-01 3.179e-01 -1.619 0.10538   
## CitycatKey Biscayne 3.080e-01 3.136e-01 0.982 0.32600   
## CitycatKirby -4.241e-01 6.280e-01 -0.675 0.49949   
## CitycatKnightdale -2.336e-01 4.868e-01 -0.480 0.63129   
## CitycatLa Vergne -1.061e-01 4.917e-01 -0.216 0.82909   
## CitycatLackawanna -2.781e-01 3.498e-01 -0.795 0.42657   
## CitycatLake Forest Park 1.592e-01 4.283e-01 0.372 0.71004   
## CitycatLakeway -2.051e-01 3.237e-01 -0.634 0.52630   
## CitycatLakewood -3.735e-01 3.038e-01 -1.229 0.21896   
## CitycatLancaster -1.489e-01 6.308e-01 -0.236 0.81342   
## CitycatLaredo -4.294e-01 2.946e-01 -1.458 0.14497   
## CitycatLauderdale -1.175e-01 4.855e-01 -0.242 0.80883   
## CitycatLeon Valley -5.069e-01 3.965e-01 -1.279 0.20104   
## CitycatLexington -1.236e-01 2.897e-01 -0.427 0.66958   
## CitycatLincoln -2.826e-01 2.940e-01 -0.961 0.33648   
## CitycatLittleton -9.751e-02 2.983e-01 -0.327 0.74380   
## CitycatLive Oak -3.023e-01 3.975e-01 -0.761 0.44695   
## CitycatLong Beach 6.947e-01 3.077e-01 2.257 0.02399 \*   
## CitycatLos Angeles 8.478e-01 3.257e-01 2.603 0.00924 \*\*   
## CitycatLubbock 3.932e-01 3.674e-01 1.070 0.28452   
## CitycatLuther -3.489e-01 6.276e-01 -0.556 0.57829   
## CitycatLyndhurst -6.206e-01 3.237e-01 -1.917 0.05520 .   
## CitycatMadison 3.026e-02 2.951e-01 0.103 0.91831   
## CitycatManor -6.954e-02 3.838e-01 -0.181 0.85621   
## CitycatMaplewood -2.814e-02 3.293e-01 -0.085 0.93190   
## CitycatMatthews -3.174e-01 3.625e-01 -0.875 0.38135   
## CitycatMayfield Heights -5.325e-01 3.760e-01 -1.416 0.15670   
## CitycatMemphis 9.411e-01 5.370e-01 1.752 0.07971 .   
## CitycatMendota Heights 9.566e-02 3.620e-01 0.264 0.79161   
## CitycatMeridian 1.185e-01 3.322e-01 0.357 0.72137   
## CitycatMesa 1.054e-01 2.924e-01 0.360 0.71856   
## CitycatMiami 5.401e-01 3.090e-01 1.748 0.08055 .   
## CitycatMiami Beach 9.874e-01 3.584e-01 2.755 0.00587 \*\*   
## CitycatMiami Gardens 3.951e-01 3.977e-01 0.993 0.32054   
## CitycatMiami Lakes 3.122e-02 3.178e-01 0.098 0.92175   
## CitycatMiami Shores 1.002e-01 4.866e-01 0.206 0.83679   
## CitycatMiami Springs 1.455e-01 6.280e-01 0.232 0.81681   
## CitycatMiddleton -3.203e-01 3.760e-01 -0.852 0.39431   
## CitycatMiddletown -3.859e-01 6.266e-01 -0.616 0.53800   
## CitycatMidwest City -5.035e-01 3.170e-01 -1.588 0.11221   
## CitycatMilwaukee 5.723e-01 4.224e-01 1.355 0.17550   
## CitycatMinneapolis 8.796e-01 3.534e-01 2.489 0.01283 \*   
## CitycatMint Hill -3.466e-01 3.076e-01 -1.127 0.25983   
## CitycatMissouri City -5.752e-01 3.763e-01 -1.529 0.12640   
## CitycatModesto 7.369e-01 3.420e-01 2.155 0.03118 \*   
## CitycatMonona -7.735e-02 3.964e-01 -0.195 0.84528   
## CitycatMontgomery -2.128e-01 3.761e-01 -0.566 0.57148   
## CitycatMoore -3.796e-01 3.012e-01 -1.260 0.20765   
## CitycatMorrisville -2.215e-01 4.282e-01 -0.517 0.60504   
## CitycatMounds View -1.532e-02 3.975e-01 -0.039 0.96925   
## CitycatMurphy -3.834e-01 3.317e-01 -1.156 0.24782   
## CitycatNeptune Beach 1.035e-01 3.968e-01 0.261 0.79427   
## CitycatNew Brighton -2.176e-01 4.283e-01 -0.508 0.61138   
## CitycatNew Hope -1.972e-01 3.432e-01 -0.575 0.56555   
## CitycatNew Orleans 6.003e-01 3.887e-01 1.544 0.12252   
## CitycatNewark 2.490e-01 3.197e-01 0.779 0.43618   
## CitycatNewtown -1.704e-01 6.270e-01 -0.272 0.78581   
## CitycatNichols Hills 2.125e-02 3.514e-01 0.060 0.95178   
## CitycatNolensville -1.651e-01 4.859e-01 -0.340 0.73406   
## CitycatNorfolk 8.059e-02 3.089e-01 0.261 0.79417   
## CitycatNormandy Park 2.213e-01 6.269e-01 0.353 0.72406   
## CitycatNorth Bay Village -4.581e-03 3.278e-01 -0.014 0.98885   
## CitycatNorth Las Vegas 4.534e-01 3.458e-01 1.311 0.18979   
## CitycatNorth Miami 6.853e-01 3.507e-01 1.954 0.05072 .   
## CitycatNorth Miami Beach 4.213e-01 3.276e-01 1.286 0.19847   
## CitycatNorth Richland Hills -1.587e-01 2.973e-01 -0.534 0.59362   
## CitycatNorth Royalton -5.881e-01 3.084e-01 -1.907 0.05652 .   
## CitycatNorthfield -5.214e-02 6.269e-01 -0.083 0.93372   
## CitycatNorthglenn 2.734e-01 3.637e-01 0.752 0.45229   
## CitycatOak Park -2.700e-01 3.782e-01 -0.714 0.47533   
## CitycatOakdale -2.469e-01 3.515e-01 -0.702 0.48251   
## CitycatOakland 1.570e+00 4.141e-01 3.792 0.00015 \*\*\*  
## CitycatOklahoma City 1.490e-01 3.251e-01 0.458 0.64669   
## CitycatOlmos Park 1.848e-01 3.761e-01 0.491 0.62317   
## CitycatOlmsted Falls -7.433e-01 3.433e-01 -2.165 0.03041 \*   
## CitycatOlmsted Township -7.595e-01 3.764e-01 -2.018 0.04363 \*   
## CitycatOmaha -2.438e-03 3.131e-01 -0.008 0.99379   
## CitycatOrlando 3.700e-01 3.263e-01 1.134 0.25682   
## CitycatOro Valley -2.023e-01 2.937e-01 -0.689 0.49103   
## CitycatOttawa Hills -7.206e-01 6.269e-01 -1.149 0.25038   
## CitycatPalmetto Bay 2.056e-01 3.186e-01 0.645 0.51873   
## CitycatPantego -2.241e-01 6.327e-01 -0.354 0.72325   
## CitycatPapillion -9.080e-02 4.862e-01 -0.187 0.85185   
## CitycatParadise Valley 4.789e-01 2.940e-01 1.629 0.10334   
## CitycatPark City -7.936e-01 3.985e-01 -1.991 0.04644 \*   
## CitycatParma -6.646e-01 3.031e-01 -2.192 0.02836 \*   
## CitycatPeoria -1.094e-01 3.779e-01 -0.290 0.77217   
## CitycatPepper Pike -1.153e-01 3.963e-01 -0.291 0.77113   
## CitycatPflugerville -2.720e-01 6.266e-01 -0.434 0.66425   
## CitycatPhoenix 5.085e-01 3.212e-01 1.583 0.11342   
## CitycatPickerington 8.137e-02 4.289e-01 0.190 0.84953   
## CitycatPiedmont 1.609e-01 4.857e-01 0.331 0.74053   
## CitycatPlano -1.297e-01 2.860e-01 -0.453 0.65031   
## CitycatPlymouth -2.106e-01 2.979e-01 -0.707 0.47969   
## CitycatPortland 6.260e-01 3.048e-01 2.054 0.04003 \*   
## CitycatPowell -6.617e-01 6.268e-01 -1.056 0.29116   
## CitycatRaleigh -9.706e-02 2.864e-01 -0.339 0.73474   
## CitycatRalston -8.778e-01 3.968e-01 -2.212 0.02697 \*   
## CitycatRed Oak -1.967e-01 6.267e-01 -0.314 0.75366   
## CitycatReno 2.442e-01 3.076e-01 0.794 0.42735   
## CitycatReynoldsburg -5.099e-01 3.770e-01 -1.353 0.17621   
## CitycatRichfield 5.070e-02 3.330e-01 0.152 0.87901   
## CitycatRichland Hills -1.120e-01 4.090e-01 -0.274 0.78430   
## CitycatRichmond 1.807e-01 3.012e-01 0.600 0.54859   
## CitycatRichmond Heights -5.373e-01 4.005e-01 -1.342 0.17967   
## CitycatRio Rancho -1.330e+00 2.924e-01 -4.549 5.42e-06 \*\*\*  
## CitycatRiver Hills -1.768e-01 6.266e-01 -0.282 0.77778   
## CitycatRiver Rouge 8.629e-02 5.463e-01 0.158 0.87449   
## CitycatRiverside 4.565e-01 3.045e-01 1.499 0.13382   
## CitycatRoanoke -1.056e-01 3.620e-01 -0.292 0.77055   
## CitycatRobbinsdale -7.783e-02 4.036e-01 -0.193 0.84711   
## CitycatRoseville 6.918e-02 3.293e-01 0.210 0.83360   
## CitycatSachse -2.082e-01 3.099e-01 -0.672 0.50176   
## CitycatSaginaw -2.758e-01 3.144e-01 -0.877 0.38044   
## CitycatSan Antonio 2.177e-01 3.220e-01 0.676 0.49900   
## CitycatSan Diego 4.553e-01 2.907e-01 1.566 0.11734   
## CitycatSan Fernando 4.062e-01 4.892e-01 0.830 0.40639   
## CitycatSan Francisco 7.193e-01 3.209e-01 2.242 0.02500 \*   
## CitycatSan Jose 6.681e-01 2.978e-01 2.244 0.02487 \*   
## CitycatSand Springs -1.095e+00 6.267e-01 -1.747 0.08067 .   
## CitycatSandy Springs -1.120e-01 2.891e-01 -0.388 0.69839   
## CitycatSanta Ana 6.841e-01 3.090e-01 2.214 0.02683 \*   
## CitycatSantee 1.308e-01 6.269e-01 0.209 0.83475   
## CitycatScottsdale 2.114e-01 2.829e-01 0.747 0.45493   
## CitycatSeattle 8.029e-01 3.094e-01 2.595 0.00948 \*\*   
## CitycatSeven Hills -5.204e-01 3.513e-01 -1.481 0.13855   
## CitycatShavano Park -2.315e-01 3.964e-01 -0.584 0.55922   
## CitycatShively -1.991e-01 3.677e-01 -0.541 0.58820   
## CitycatShoreline 3.982e-01 3.162e-01 1.260 0.20784   
## CitycatShorewood -1.166e-01 4.857e-01 -0.240 0.81034   
## CitycatSignal Hill 1.139e+00 6.533e-01 1.744 0.08119 .   
## CitycatSocorro -7.398e-01 3.157e-01 -2.344 0.01911 \*   
## CitycatSolon -7.734e-01 3.237e-01 -2.389 0.01688 \*   
## CitycatSouth Euclid -8.484e-01 3.238e-01 -2.620 0.00880 \*\*   
## CitycatSouth Miami 1.270e-01 4.322e-01 0.294 0.76884   
## CitycatSpeedway -2.562e+00 6.293e-01 -4.072 4.69e-05 \*\*\*  
## CitycatSpencer -3.023e+00 6.291e-01 -4.805 1.56e-06 \*\*\*  
## CitycatSpokane 3.688e-01 3.226e-01 1.143 0.25297   
## CitycatSpokane Valley -4.244e-02 3.151e-01 -0.135 0.89285   
## CitycatSpring Lake Park -2.441e-01 4.877e-01 -0.501 0.61669   
## CitycatStafford -3.021e-01 6.396e-01 -0.472 0.63670   
## CitycatStockton 1.309e+00 4.380e-01 2.989 0.00281 \*\*   
## CitycatStrongsville -6.133e-01 3.433e-01 -1.786 0.07406 .   
## CitycatSuffolk 6.263e-02 4.884e-01 0.128 0.89795   
## CitycatSunny Isles Beach 8.881e-02 3.024e-01 0.294 0.76898   
## CitycatSurfside -6.463e-02 4.854e-01 -0.133 0.89408   
## CitycatSweetwater -5.278e-01 6.266e-01 -0.842 0.39960   
## CitycatSwissvale -1.131e-01 6.274e-01 -0.180 0.85695   
## CitycatTampa 5.598e-02 2.934e-01 0.191 0.84867   
## CitycatTemple Terrace -2.333e-01 3.464e-01 -0.674 0.50055   
## CitycatTerrell Hills 1.571e-01 4.282e-01 0.367 0.71376   
## CitycatThornton -1.114e-01 3.042e-01 -0.366 0.71412   
## CitycatTigard 1.332e-01 3.055e-01 0.436 0.66281   
## CitycatToledo -1.060e-01 3.591e-01 -0.295 0.76788   
## CitycatTorrance 4.562e-01 3.973e-01 1.148 0.25095   
## CitycatTucson 1.945e-01 3.203e-01 0.607 0.54372   
## CitycatTulsa 2.592e-01 3.630e-01 0.714 0.47532   
## CitycatUniversity Heights -7.092e-01 3.622e-01 -1.958 0.05023 .   
## CitycatUpper Arlington -8.062e-02 3.238e-01 -0.249 0.80336   
## CitycatUrbandale -6.974e-01 2.963e-01 -2.354 0.01859 \*   
## CitycatVerona -2.405e-01 3.276e-01 -0.734 0.46278   
## CitycatVirginia Beach -2.482e-01 2.832e-01 -0.876 0.38096   
## CitycatVirginia Gardens 5.433e-01 6.274e-01 0.866 0.38648   
## CitycatWarr Acres 9.722e-02 5.086e-01 0.191 0.84842   
## CitycatWatauga -3.450e-01 3.968e-01 -0.869 0.38460   
## CitycatWauwatosa -1.064e-01 3.317e-01 -0.321 0.74833   
## CitycatWest Allis -1.910e-01 3.160e-01 -0.605 0.54551   
## CitycatWest Hollywood 1.057e+00 3.592e-01 2.942 0.00326 \*\*   
## CitycatWest Lake Hills 4.236e-01 6.267e-01 0.676 0.49910   
## CitycatWesterville -5.263e-01 3.326e-01 -1.583 0.11353   
## CitycatWestminster 3.819e-02 3.467e-01 0.110 0.91229   
## CitycatWhite Bear Lake -1.969e-01 3.515e-01 -0.560 0.57540   
## CitycatWhite Settlement 8.781e-01 6.269e-01 1.401 0.16133   
## CitycatWhitefish Bay -2.660e-01 4.856e-01 -0.548 0.58385   
## CitycatWhitehall -3.864e-01 3.842e-01 -1.006 0.31457   
## CitycatWichita 4.243e-01 3.889e-01 1.091 0.27526   
## CitycatWindsor Heights -3.475e-01 6.283e-01 -0.553 0.58022   
## CitycatWinter Park 3.210e-01 4.296e-01 0.747 0.45493   
## CitycatWolfforth -4.678e-01 4.854e-01 -0.964 0.33517   
## CitycatWoodbury -3.264e-01 2.973e-01 -1.098 0.27226   
## CitycatWorthington -4.458e-01 4.854e-01 -0.918 0.35843   
## CitycatYukon -1.312e-02 4.286e-01 -0.031 0.97559   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.5604 on 21470 degrees of freedom  
## Multiple R-squared: 0.6493, Adjusted R-squared: 0.6436   
## F-statistic: 114.9 on 346 and 21470 DF, p-value: < 2.2e-16

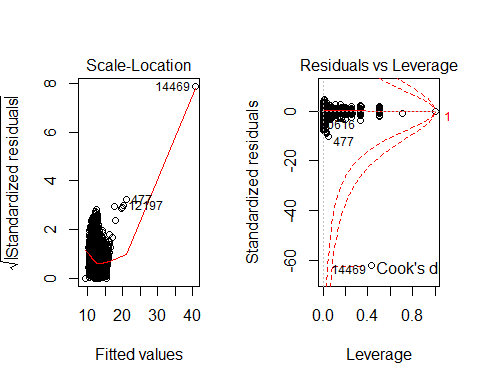
The BIC criterion removed the same 3 variables as the AIC criterion. The R-squared and residual standard error are the same as well.

### Residual Analysis of Model

par (mfrow = c(1, 2))  
plot (fit3aic)

## Warning: not plotting observations with leverage one:  
## 15997, 19480, 20658, 20754, 20839, 20977, 21006, 21135, 21157, 21262, 21378, 21476, 21484, 21485, 21601, 21613, 21665, 21669, 21672, 21690, 21715, 21720, 21757, 21761, 21762, 21763, 21768, 21777, 21782, 21783, 21784, 21787, 21790, 21791, 21792, 21793, 21794, 21795, 21797, 21798, 21799, 21800, 21806, 21807, 21808, 21811, 21814, 21815, 21816, 21817





Residual analysis shows problems with linearity, constant variance, and a Normal distribution.

# Model 4 (Reduced):

# Take out predictor variables that are correlated with another predictor  
# Used logged varibles  
housing2$LogLot\_Size = log(housing2$Lot\_Size)  
  
fit4 = lm (LogPrice ~   
 (LogSize + LogBedrooms + LogBathrooms + Year\_Built + LogLot\_Size + Citycat), data=housing2)  
  
summary (fit4)

##   
## Call:  
## lm(formula = LogPrice ~ (LogSize + LogBedrooms + LogBathrooms +   
## Year\_Built + LogLot\_Size + Citycat), data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.7368 -0.2623 0.0231 0.3286 2.9883   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 9.1053893 0.4740207 19.209 < 2e-16 \*\*\*  
## LogSize 0.0669704 0.0104809 6.390 1.70e-10 \*\*\*  
## LogBedrooms 0.0595462 0.0170377 3.495 0.000475 \*\*\*  
## LogBathrooms 0.9229442 0.0150557 61.302 < 2e-16 \*\*\*  
## Year\_Built 0.0011246 0.0001755 6.406 1.52e-10 \*\*\*  
## LogLot\_Size 0.0373346 0.0029957 12.463 < 2e-16 \*\*\*  
## CitycatAlbuquerque -0.7259330 0.3208256 -2.263 0.023664 \*   
## CitycatAnaheim 0.0985560 0.3294487 0.299 0.764825   
## CitycatAnchorage -0.5819318 0.3225153 -1.804 0.071190 .   
## CitycatApple Valley -0.6784637 0.3448620 -1.967 0.049156 \*   
## CitycatArlington -0.6469123 0.3230217 -2.003 0.045223 \*   
## CitycatAtlantic Beach 0.0382804 0.3716483 0.103 0.917963   
## CitycatAurora -0.2621069 0.3221289 -0.814 0.415843   
## CitycatAustin -0.1043112 0.3198001 -0.326 0.744294   
## CitycatAventura -0.1825563 0.3308472 -0.552 0.581102   
## CitycatBainbridge Island 0.2145308 0.3486856 0.615 0.538392   
## CitycatBaker -1.1782660 0.7120766 -1.655 0.098002 .   
## CitycatBakersfield -0.4742046 0.3219273 -1.473 0.140761   
## CitycatBaltimore -0.8747711 0.3194777 -2.738 0.006184 \*\*   
## CitycatBaton Rouge -0.5570071 0.3212907 -1.734 0.082994 .   
## CitycatBay Harbor Islands -0.3904456 0.4271846 -0.914 0.360729   
## CitycatBay Village -0.3171361 0.3674874 -0.863 0.388155   
## CitycatBayside -0.5447818 0.4861176 -1.121 0.262437   
## CitycatBeachwood -1.2784151 0.3716353 -3.440 0.000583 \*\*\*  
## CitycatBedford -1.3083151 0.3582301 -3.652 0.000261 \*\*\*  
## CitycatBee Cave 0.3601154 0.7116213 0.506 0.612827   
## CitycatBel Aire -1.0409058 0.4862398 -2.141 0.032307 \*   
## CitycatBelle Isle -0.3468344 0.7115887 -0.487 0.625974   
## CitycatBellevue -0.4308467 0.4269832 -1.009 0.312963   
## CitycatBenbrook -0.3707987 0.3989769 -0.929 0.352706   
## CitycatBerkeley 1.3491010 0.7116212 1.896 0.057998 .   
## CitycatBeverly Hills 1.2064851 0.3989644 3.024 0.002497 \*\*   
## CitycatBexley -0.3126048 0.5512184 -0.567 0.570641   
## CitycatBiscayne Park -0.1530289 0.7115884 -0.215 0.829728   
## CitycatBixby -0.6081493 0.5512982 -1.103 0.269986   
## CitycatBlaine -0.2717907 0.3428213 -0.793 0.427900   
## CitycatBloomington -0.3445695 0.3448288 -0.999 0.317686   
## CitycatBlue Ash -0.1345119 0.4861258 -0.277 0.782012   
## CitycatBoise -0.2771712 0.3226826 -0.859 0.390373   
## CitycatBrentwood -0.3852079 0.3674873 -1.048 0.294549   
## CitycatBroken Arrow -0.9425122 0.7116386 -1.324 0.185376   
## CitycatBrookhaven -0.2215035 0.3381729 -0.655 0.512474   
## CitycatBrooklyn Center -0.6222286 0.3765793 -1.652 0.098484 .   
## CitycatBrooklyn Park -0.6683732 0.3427805 -1.950 0.051206 .   
## CitycatBrown Deer -0.8477215 0.5512140 -1.538 0.124084   
## CitycatBuffalo -0.8940762 0.3229572 -2.768 0.005638 \*\*   
## CitycatBurbank 0.1085341 0.4861801 0.223 0.823352   
## CitycatBurien 0.0232046 0.3558843 0.065 0.948013   
## CitycatBurleson -0.6974490 0.4270565 -1.633 0.102451   
## CitycatCampbell 0.6888926 0.5512812 1.250 0.211452   
## CitycatCarson 0.2410552 0.3897730 0.618 0.536285   
## CitycatCary 0.0259298 0.7116312 0.036 0.970934   
## CitycatCastroville -0.5766054 0.5512527 -1.046 0.295577   
## CitycatCeres -0.3171713 0.7117056 -0.446 0.655855   
## CitycatChandler -0.3910647 0.7116229 -0.550 0.582641   
## CitycatChesapeake -0.6570312 0.3225264 -2.037 0.041648 \*   
## CitycatChicago -0.2432456 0.3189510 -0.763 0.445685   
## CitycatChoctaw -0.6250020 0.7117154 -0.878 0.379865   
## CitycatChula Vista -0.0370842 0.3287026 -0.113 0.910174   
## CitycatCincinnati -0.7938952 0.3206003 -2.476 0.013284 \*   
## CitycatCleveland -1.2022559 0.3208918 -3.747 0.000180 \*\*\*  
## CitycatCleveland Heights -1.0155368 0.3370367 -3.013 0.002589 \*\*   
## CitycatClive -0.5020866 0.3558375 -1.411 0.158259   
## CitycatColerain Township -0.6460103 0.4502066 -1.435 0.151325   
## CitycatCollege Park -1.0721402 0.3472339 -3.088 0.002020 \*\*   
## CitycatColorado Springs -0.4352564 0.3207492 -1.357 0.174796   
## CitycatColumbia Heights -0.7048053 0.3824972 -1.843 0.065395 .   
## CitycatColumbus -0.7420593 0.3209102 -2.312 0.020767 \*   
## CitycatCommerce City -0.3255351 0.3370139 -0.966 0.334085   
## CitycatConverse -0.9112242 0.4861546 -1.874 0.060896 .   
## CitycatCoral Gables 0.5116423 0.3345762 1.529 0.126223   
## CitycatCoronado 1.2662283 0.3537383 3.580 0.000345 \*\*\*  
## CitycatCorpus Christi -0.7568630 0.3224612 -2.347 0.018927 \*   
## CitycatCrafton -1.1264658 0.7116804 -1.583 0.113476   
## CitycatCrowley -0.6427059 0.3716834 -1.729 0.083792 .   
## CitycatCrystal -0.3642633 0.3989943 -0.913 0.361277   
## CitycatCulver City 0.3878007 0.3989733 0.972 0.331063   
## CitycatCutler Bay -0.3914313 0.3472680 -1.127 0.259682   
## CitycatDallas -0.2986700 0.3193550 -0.935 0.349681   
## CitycatDel City -1.5597748 0.4109091 -3.796 0.000148 \*\*\*  
## CitycatDel Mar 0.7367231 0.4108739 1.793 0.072977 .   
## CitycatDenton -0.4773427 0.7116361 -0.671 0.502376   
## CitycatDenver 0.1800187 0.3197573 0.563 0.573451   
## CitycatDerby -2.9606068 0.7116976 -4.160 3.20e-05 \*\*\*  
## CitycatDes Moines -0.7655261 0.3244066 -2.360 0.018295 \*   
## CitycatDetroit -1.6300534 0.3205493 -5.085 3.70e-07 \*\*\*  
## CitycatDoral -0.1584057 0.3410665 -0.464 0.642336   
## CitycatDouglas -4.2332710 0.7117088 -5.948 2.76e-09 \*\*\*  
## CitycatDublin -0.7097908 0.3765933 -1.885 0.059475 .   
## CitycatDunwoody -0.4026021 0.3558255 -1.131 0.257874   
## CitycatDurham -0.5549567 0.3228089 -1.719 0.085602 .   
## CitycatEagan -0.3240171 0.3518724 -0.921 0.357146   
## CitycatEast Cleveland -2.0806413 0.5512889 -3.774 0.000161 \*\*\*  
## CitycatEast Orange -0.3583017 0.7116572 -0.503 0.614635   
## CitycatEastvale -0.2773750 0.7116234 -0.390 0.696705   
## CitycatEcorse -0.1446651 0.5513647 -0.262 0.793034   
## CitycatEdgewood -0.5747039 0.4861080 -1.182 0.237117   
## CitycatEdina 0.1869177 0.3394877 0.551 0.581922   
## CitycatEdmond -0.5621033 0.4501232 -1.249 0.211760   
## CitycatEl Paso -0.9923828 0.3202481 -3.099 0.001946 \*\*   
## CitycatEl Portal 0.4716903 0.5512332 0.856 0.392173   
## CitycatElmwood Park -0.6476609 0.7116407 -0.910 0.362782   
## CitycatEnglewood -0.3343281 0.7115813 -0.470 0.638475   
## CitycatEuclid -1.3501637 0.3438059 -3.927 8.62e-05 \*\*\*  
## CitycatEuless -1.0562571 0.7116153 -1.484 0.137742   
## CitycatEvendale -0.9966957 0.7116982 -1.400 0.161394   
## CitycatFairview Park -0.6799103 0.3825048 -1.778 0.075497 .   
## CitycatFarmers Branch -0.4902277 0.3897757 -1.258 0.208508   
## CitycatFerndale -0.3953602 0.3519271 -1.123 0.261274   
## CitycatFitchburg -0.7806380 0.3675520 -2.124 0.033691 \*   
## CitycatForest Hill -1.0207925 0.5512363 -1.852 0.064065 .   
## CitycatFort Wayne -1.1627937 0.3230232 -3.600 0.000319 \*\*\*  
## CitycatFort Worth -0.6087515 0.3198115 -1.903 0.056993 .   
## CitycatFountain Valley 0.1177824 0.3765574 0.313 0.754445   
## CitycatFremont 0.8531255 0.3315402 2.573 0.010082 \*   
## CitycatFridley -0.5067937 0.4269979 -1.187 0.235290   
## CitycatGahanna -0.6540094 0.3897831 -1.678 0.093385 .   
## CitycatGarden City -0.3233717 0.3825101 -0.845 0.397900   
## CitycatGarden Ridge -0.3435017 0.4501157 -0.763 0.445388   
## CitycatGarland -0.5382876 0.3276274 -1.643 0.100400   
## CitycatGeorgetown -0.9012539 0.4269615 -2.111 0.034796 \*   
## CitycatGermantown -0.3563213 0.3537313 -1.007 0.313792   
## CitycatGilbert -0.2391713 0.3238813 -0.738 0.460247   
## CitycatGlendale -0.4380546 0.3236434 -1.354 0.175907   
## CitycatGlenn Heights -0.5498854 0.7116369 -0.773 0.439705   
## CitycatGolden Beach 1.5055616 0.7116177 2.116 0.034383 \*   
## CitycatGolden Valley -0.3164424 0.4861278 -0.651 0.515089   
## CitycatGoodlettsville -0.7482437 0.4270791 -1.752 0.079788 .   
## CitycatGrand Prairie -0.8311685 0.7116093 -1.168 0.242815   
## CitycatGranite Shoals 0.6486447 0.7116196 0.912 0.362040   
## CitycatGreenfield -0.9015196 0.3989838 -2.260 0.023860 \*   
## CitycatGreensboro -0.8752474 0.3237483 -2.703 0.006867 \*\*   
## CitycatGrosse Pointe -0.5727503 0.4500640 -1.273 0.203175   
## CitycatGrosse Pointe Farms -0.2325499 0.4269942 -0.545 0.586020   
## CitycatGrosse Pointe Park -0.3105596 0.3989619 -0.778 0.436330   
## CitycatGrosse Pointe Shores -0.5938715 0.7115955 -0.835 0.403973   
## CitycatGrosse Pointe Woods -0.2879921 0.4108689 -0.701 0.483352   
## CitycatGroveport -1.3502639 0.5513021 -2.449 0.014324 \*   
## CitycatHaltom City -0.6667335 0.3989541 -1.671 0.094696 .   
## CitycatHamtramck -0.7747093 0.3898540 -1.987 0.046915 \*   
## CitycatHarahan -0.8081114 0.5513406 -1.466 0.142739   
## CitycatHarper Woods -0.9584627 0.3675632 -2.608 0.009124 \*\*   
## CitycatHelotes -0.7112733 0.5512119 -1.290 0.196932   
## CitycatHenderson -0.2591933 0.3211008 -0.807 0.419559   
## CitycatHialeah -0.3110095 0.3257702 -0.955 0.339745   
## CitycatHialeah Gardens -1.0611833 0.4862575 -2.182 0.029095 \*   
## CitycatHighland Park -1.8817438 0.3989946 -4.716 2.42e-06 \*\*\*  
## CitycatHilliard -0.7940196 0.4270391 -1.859 0.062990 .   
## CitycatHillsborough -0.3271606 0.7116945 -0.460 0.645742   
## CitycatHollywood Park -0.1274910 0.5512338 -0.231 0.817097   
## CitycatHoover -0.6620327 0.3427785 -1.931 0.053450 .   
## CitycatHorizon City -1.1681766 0.3376601 -3.460 0.000542 \*\*\*  
## CitycatHouston -0.5279323 0.3188504 -1.656 0.097790 .   
## CitycatHurst -0.5275010 0.7116269 -0.741 0.458544   
## CitycatIndian Hills 0.0392382 0.4861518 0.081 0.935672   
## CitycatIrvine 0.5128400 0.3239939 1.583 0.113466   
## CitycatIrving -0.4856773 0.3296243 -1.473 0.140651   
## CitycatJacksonville -0.7770389 0.3195609 -2.432 0.015041 \*   
## CitycatJacksonville Beach 0.0213545 0.3558115 0.060 0.952143   
## CitycatJeffersontown -0.6351268 0.4108612 -1.546 0.122157   
## CitycatJersey City 1.1826267 0.7117201 1.662 0.096598 .   
## CitycatJones -0.2301725 0.7116147 -0.323 0.746357   
## CitycatJurupa Valley -0.0837327 0.3675213 -0.228 0.819780   
## CitycatKeller -0.6830656 0.3609060 -1.893 0.058419 .   
## CitycatKey Biscayne 0.6758941 0.3559113 1.899 0.057571 .   
## CitycatKirby -0.9332140 0.7115972 -1.311 0.189725   
## CitycatKnightdale -0.6957804 0.5512111 -1.262 0.206863   
## CitycatLa Vergne -0.7014427 0.5512603 -1.272 0.203233   
## CitycatLackawanna -0.8748402 0.3825533 -2.287 0.022215 \*   
## CitycatLake Forest Park 0.1230902 0.4861305 0.253 0.800113   
## CitycatLakeway -0.2686719 0.3675379 -0.731 0.464784   
## CitycatLakewood -0.5863316 0.3448646 -1.700 0.089112 .   
## CitycatLancaster -0.8112749 0.7116738 -1.140 0.254318   
## CitycatLaredo -0.8970625 0.3276647 -2.738 0.006191 \*\*   
## CitycatLauderdale -0.4131595 0.5512279 -0.750 0.453549   
## CitycatLeon Valley -0.7069198 0.4501456 -1.570 0.116331   
## CitycatLexington -0.5157472 0.3231859 -1.596 0.110543   
## CitycatLincoln -0.8390684 0.3225491 -2.601 0.009292 \*\*   
## CitycatLittleton -0.1756123 0.3388236 -0.518 0.604254   
## CitycatLive Oak -0.7090119 0.4500806 -1.575 0.115202   
## CitycatLong Beach 0.5727622 0.3276691 1.748 0.080480 .   
## CitycatLos Angeles 0.6228894 0.3197355 1.948 0.051411 .   
## CitycatLubbock -0.8837129 0.3230012 -2.736 0.006225 \*\*   
## CitycatLuther -0.8551302 0.7117067 -1.202 0.229563   
## CitycatLyndhurst -0.9555165 0.3675084 -2.600 0.009329 \*\*   
## CitycatMadison -0.4348243 0.3255058 -1.336 0.181615   
## CitycatManor -0.7424672 0.4269919 -1.739 0.082079 .   
## CitycatMaplewood -0.5797402 0.3639454 -1.593 0.111190   
## CitycatMatthews -0.6481825 0.4108511 -1.578 0.114659   
## CitycatMayfield Heights -0.7872603 0.4269838 -1.844 0.065230 .   
## CitycatMemphis -1.3211817 0.3214918 -4.110 3.98e-05 \*\*\*  
## CitycatMendota Heights -0.1540270 0.4108909 -0.375 0.707768   
## CitycatMeridian -0.1428837 0.3766313 -0.379 0.704415   
## CitycatMesa -0.3866378 0.3211663 -1.204 0.228659   
## CitycatMiami 0.0687158 0.3190903 0.215 0.829497   
## CitycatMiami Beach 0.2049756 0.3284742 0.624 0.532619   
## CitycatMiami Gardens -0.4983608 0.4108874 -1.213 0.225186   
## CitycatMiami Lakes -0.0980818 0.3608682 -0.272 0.785783   
## CitycatMiami Shores 0.0615581 0.5512141 0.112 0.911080   
## CitycatMiami Springs -0.2561565 0.7115899 -0.360 0.718867   
## CitycatMiddleton -0.5694517 0.4270240 -1.334 0.182370   
## CitycatMiddletown -0.6499312 0.7115985 -0.913 0.361074   
## CitycatMidwest City -1.0089433 0.3558469 -2.835 0.004582 \*\*   
## CitycatMilwaukee -1.0232454 0.3211558 -3.186 0.001444 \*\*   
## CitycatMinneapolis -0.1459354 0.3212267 -0.454 0.649613   
## CitycatMint Hill -0.7229941 0.3472768 -2.082 0.037364 \*   
## CitycatMissouri City -0.9592827 0.4269774 -2.247 0.024670 \*   
## CitycatModesto -0.1680319 0.3277819 -0.513 0.608213   
## CitycatMonona -0.2780724 0.4500494 -0.618 0.536667   
## CitycatMontgomery -0.3496493 0.4269629 -0.819 0.412840   
## CitycatMoore -0.7626723 0.3410424 -2.236 0.025343 \*   
## CitycatMorrisville -0.3820280 0.4862042 -0.786 0.432031   
## CitycatMounds View -0.3640715 0.4501078 -0.809 0.418608   
## CitycatMurphy -0.5594114 0.3765958 -1.485 0.137441   
## CitycatNeptune Beach -0.0215389 0.4500413 -0.048 0.961828   
## CitycatNew Brighton -0.5158975 0.4861188 -1.061 0.288584   
## CitycatNew Hope -0.4396777 0.3897964 -1.128 0.259346   
## CitycatNew Orleans -0.6971143 0.3209257 -2.172 0.029852 \*   
## CitycatNewark -0.4748993 0.3290830 -1.443 0.149007   
## CitycatNewtown -0.3518342 0.7118030 -0.494 0.621109   
## CitycatNichols Hills 0.0255644 0.3989728 0.064 0.948911   
## CitycatNolensville -0.5141041 0.5512181 -0.933 0.351001   
## CitycatNorfolk -0.6332511 0.3248229 -1.950 0.051245 .   
## CitycatNormandy Park 0.7098671 0.7117116 0.997 0.318578   
## CitycatNorth Bay Village -0.0565029 0.3717266 -0.152 0.879187   
## CitycatNorth Las Vegas -0.6260386 0.3231876 -1.937 0.052749 .   
## CitycatNorth Miami -0.2191514 0.3419204 -0.641 0.521567   
## CitycatNorth Miami Beach -0.2081189 0.3410652 -0.610 0.541734   
## CitycatNorth Richland Hills -0.4948761 0.3359661 -1.473 0.140767   
## CitycatNorth Royalton -0.8844672 0.3501991 -2.526 0.011557 \*   
## CitycatNorthfield -0.1577963 0.7116166 -0.222 0.824516   
## CitycatNorthglenn -0.2949656 0.3989321 -0.739 0.459679   
## CitycatOak Park -0.6716831 0.4269947 -1.573 0.115722   
## CitycatOakdale -0.4976612 0.3989925 -1.247 0.212303   
## CitycatOakland 0.5921933 0.3256236 1.819 0.068980 .   
## CitycatOklahoma City -0.7972453 0.3207930 -2.485 0.012954 \*   
## CitycatOlmos Park 0.4037544 0.4269894 0.946 0.344371   
## CitycatOlmsted Falls -0.9735220 0.3897944 -2.498 0.012514 \*   
## CitycatOlmsted Township -0.9739697 0.4270113 -2.281 0.022564 \*   
## CitycatOmaha -0.7768339 0.3216204 -2.415 0.015727 \*   
## CitycatOrlando -0.5337110 0.3197019 -1.669 0.095052 .   
## CitycatOro Valley -0.3734128 0.3334570 -1.120 0.262802   
## CitycatOttawa Hills -0.9390332 0.7115952 -1.320 0.186977   
## CitycatPalmetto Bay 0.0174104 0.3608592 0.048 0.961520   
## CitycatPantego -0.9295999 0.7115937 -1.306 0.191443   
## CitycatPapillion -0.4370789 0.5512149 -0.793 0.427823   
## CitycatParadise Valley 0.9484193 0.3338536 2.841 0.004504 \*\*   
## CitycatPark City -1.1945843 0.4501176 -2.654 0.007962 \*\*   
## CitycatParma -1.0033084 0.3437839 -2.918 0.003522 \*\*   
## CitycatPeoria -0.5320797 0.4269867 -1.246 0.212731   
## CitycatPepper Pike -0.2776116 0.4501181 -0.617 0.537404   
## CitycatPflugerville -0.6010075 0.7116613 -0.845 0.398392   
## CitycatPhoenix -0.2704227 0.3194242 -0.847 0.397231   
## CitycatPickerington 0.0881152 0.4862047 0.181 0.856188   
## CitycatPiedmont 1.1677831 0.5513149 2.118 0.034171 \*   
## CitycatPlano -0.2916661 0.3242670 -0.899 0.368416   
## CitycatPlymouth -0.2914136 0.3381932 -0.862 0.388874   
## CitycatPortland 0.1462577 0.3199194 0.457 0.647553   
## CitycatPowell -0.9925490 0.7116645 -1.395 0.163125   
## CitycatRaleigh -0.4600006 0.3214231 -1.431 0.152405   
## CitycatRalston -1.2660355 0.4500862 -2.813 0.004915 \*\*   
## CitycatRed Oak -0.5748524 0.7116361 -0.808 0.419221   
## CitycatReno -0.3980253 0.3217241 -1.237 0.216040   
## CitycatReynoldsburg -0.9333784 0.4269867 -2.186 0.028829 \*   
## CitycatRichfield -0.1581416 0.3766656 -0.420 0.674602   
## CitycatRichland Hills -0.8338636 0.4500696 -1.853 0.063933 .   
## CitycatRichmond -0.3886971 0.3242228 -1.199 0.230596   
## CitycatRichmond Heights -1.0964942 0.4500763 -2.436 0.014849 \*   
## CitycatRio Rancho -1.7248346 0.3305955 -5.217 1.83e-07 \*\*\*  
## CitycatRiver Hills -0.3785147 0.7116601 -0.532 0.594818   
## CitycatRiver Rouge -1.2387387 0.5513062 -2.247 0.024656 \*   
## CitycatRiverside -0.0917958 0.3238119 -0.283 0.776808   
## CitycatRoanoke -0.3866671 0.4109047 -0.941 0.346708   
## CitycatRobbinsdale -0.4727794 0.4501930 -1.050 0.293652   
## CitycatRoseville -0.2168460 0.3716505 -0.583 0.559585   
## CitycatSachse -0.2684172 0.3518543 -0.763 0.445552   
## CitycatSaginaw -0.6673663 0.3558443 -1.875 0.060745 .   
## CitycatSan Antonio -0.7080445 0.3189457 -2.220 0.026432 \*   
## CitycatSan Diego 0.3998458 0.3202407 1.249 0.211833   
## CitycatSan Fernando 0.1442590 0.5512163 0.262 0.793547   
## CitycatSan Francisco 1.4112024 0.3225788 4.375 1.22e-05 \*\*\*  
## CitycatSan Jose 0.7685309 0.3222878 2.385 0.017106 \*   
## CitycatSand Springs -1.4575426 0.7117102 -2.048 0.040578 \*   
## CitycatSandy Springs -0.2007722 0.3280506 -0.612 0.540534   
## CitycatSanta Ana 0.5114983 0.3359699 1.522 0.127910   
## CitycatSantee 0.0685444 0.7115750 0.096 0.923261   
## CitycatScottsdale 0.1308790 0.3204636 0.408 0.682980   
## CitycatSeattle 0.5890710 0.3205357 1.838 0.066110 .   
## CitycatSeven Hills -0.7732469 0.3989451 -1.938 0.052608 .   
## CitycatShavano Park -0.0279126 0.4501411 -0.062 0.950557   
## CitycatShively -0.6142784 0.4109783 -1.495 0.135014   
## CitycatShoreline 0.5777569 0.3582179 1.613 0.106789   
## CitycatShorewood -0.2235768 0.5513123 -0.406 0.685088   
## CitycatSignal Hill 0.3174818 0.7116359 0.446 0.655508   
## CitycatSocorro -1.0529995 0.3582600 -2.939 0.003294 \*\*   
## CitycatSolon -1.0097918 0.3675045 -2.748 0.006007 \*\*   
## CitycatSouth Euclid -1.2183654 0.3674947 -3.315 0.000917 \*\*\*  
## CitycatSouth Miami -0.1611029 0.4861403 -0.331 0.740352   
## CitycatSpeedway -3.0128144 0.7117151 -4.233 2.31e-05 \*\*\*  
## CitycatSpencer -3.6210363 0.7117076 -5.088 3.65e-07 \*\*\*  
## CitycatSpokane -0.4790134 0.3227472 -1.484 0.137777   
## CitycatSpokane Valley -0.4704145 0.3518901 -1.337 0.181295   
## CitycatSpring Lake Park -0.7022586 0.5512124 -1.274 0.202668   
## CitycatStafford -1.2025202 0.7115768 -1.690 0.091054 .   
## CitycatStockton -0.2454571 0.3271309 -0.750 0.453062   
## CitycatStrongsville -0.8512735 0.3897697 -2.184 0.028970 \*   
## CitycatSuffolk -0.4221678 0.5512923 -0.766 0.443817   
## CitycatSunny Isles Beach 0.2673144 0.3428685 0.780 0.435611   
## CitycatSurfside -0.1013373 0.5512363 -0.184 0.854144   
## CitycatSweetwater -0.8480537 0.7116928 -1.192 0.233431   
## CitycatSwissvale -0.4281145 0.7117090 -0.602 0.547493   
## CitycatTampa -0.4481137 0.3200469 -1.400 0.161483   
## CitycatTemple Terrace -0.6830460 0.3897879 -1.752 0.079727 .   
## CitycatTerrell Hills 0.1050895 0.4861298 0.216 0.828853   
## CitycatThornton -0.4610773 0.3410172 -1.352 0.176369   
## CitycatTigard -0.0952626 0.3448165 -0.276 0.782343   
## CitycatToledo -1.3363237 0.3236168 -4.129 3.65e-05 \*\*\*  
## CitycatTorrance 0.5678170 0.4501058 1.262 0.207136   
## CitycatTucson -0.6846571 0.3198572 -2.141 0.032325 \*   
## CitycatTulsa -0.9571984 0.3215261 -2.977 0.002914 \*\*   
## CitycatUniversity Heights -1.1251245 0.4108666 -2.738 0.006179 \*\*   
## CitycatUpper Arlington -0.0215338 0.3674750 -0.059 0.953272   
## CitycatUrbandale -0.9087864 0.3364769 -2.701 0.006921 \*\*   
## CitycatVerona -0.4858170 0.3716813 -1.307 0.191200   
## CitycatVirginia Beach -0.4873395 0.3213717 -1.516 0.129424   
## CitycatVirginia Gardens 0.6847804 0.7117007 0.962 0.335973   
## CitycatWarr Acres -0.9215375 0.5512040 -1.672 0.094566 .   
## CitycatWatauga -0.6944862 0.4500926 -1.543 0.122849   
## CitycatWauwatosa -0.2887178 0.3766132 -0.767 0.443318   
## CitycatWest Allis -0.6795247 0.3502030 -1.940 0.052347 .   
## CitycatWest Hollywood 1.1294394 0.3537163 3.193 0.001410 \*\*   
## CitycatWest Lake Hills 1.2568970 0.7116711 1.766 0.077390 .   
## CitycatWesterville -0.9849201 0.3766134 -2.615 0.008924 \*\*   
## CitycatWestminster -0.3624620 0.3897837 -0.930 0.352430   
## CitycatWhite Bear Lake -0.4045147 0.3989304 -1.014 0.310595   
## CitycatWhite Settlement 0.7048309 0.7117617 0.990 0.322057   
## CitycatWhitefish Bay -0.3151297 0.5512183 -0.572 0.567533   
## CitycatWhitehall -1.1893117 0.4109123 -2.894 0.003804 \*\*   
## CitycatWichita -0.9606685 0.3222688 -2.981 0.002877 \*\*   
## CitycatWindsor Heights -0.6184586 0.7117152 -0.869 0.384874   
## CitycatWinter Park 0.2275362 0.4862252 0.468 0.639815   
## CitycatWolfforth -0.6967430 0.5512017 -1.264 0.206228   
## CitycatWoodbury -0.4895341 0.3375846 -1.450 0.147043   
## CitycatWorthington -0.6250895 0.5512577 -1.134 0.256835   
## CitycatYukon -0.3425779 0.4862110 -0.705 0.481075   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.6364 on 21472 degrees of freedom  
## Multiple R-squared: 0.5476, Adjusted R-squared: 0.5403   
## F-statistic: 75.54 on 344 and 21472 DF, p-value: < 2.2e-16

#VIFs  
car::vif (fit4)

## GVIF Df GVIF^(1/(2\*Df))  
## LogSize 1.913058 1 1.383133  
## LogBedrooms 2.008030 1 1.417050  
## LogBathrooms 2.256131 1 1.502042  
## Year\_Built 1.575353 1 1.255131  
## LogLot\_Size 1.369588 1 1.170294  
## Citycat 2.269587 339 1.001210

### Stepwise

Stepwise Regression for model 4 (AIC):

# AIC  
fit4AIC = step (fit4, direction='both')

## Start: AIC=-19373.94  
## LogPrice ~ (LogSize + LogBedrooms + LogBathrooms + Year\_Built +   
## LogLot\_Size + Citycat)  
##   
## Df Sum of Sq RSS AIC  
## <none> 8697.6 -19373.9  
## - LogBedrooms 1 4.9 8702.5 -19363.5  
## - LogSize 1 16.5 8714.1 -19334.5  
## - Year\_Built 1 16.6 8714.2 -19334.3  
## - LogLot\_Size 1 62.9 8760.5 -19218.7  
## - LogBathrooms 1 1522.2 10219.8 -15857.3  
## - Citycat 339 5197.8 13895.4 -9830.3

summary(fit4AIC)

##   
## Call:  
## lm(formula = LogPrice ~ (LogSize + LogBedrooms + LogBathrooms +   
## Year\_Built + LogLot\_Size + Citycat), data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.7368 -0.2623 0.0231 0.3286 2.9883   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 9.1053893 0.4740207 19.209 < 2e-16 \*\*\*  
## LogSize 0.0669704 0.0104809 6.390 1.70e-10 \*\*\*  
## LogBedrooms 0.0595462 0.0170377 3.495 0.000475 \*\*\*  
## LogBathrooms 0.9229442 0.0150557 61.302 < 2e-16 \*\*\*  
## Year\_Built 0.0011246 0.0001755 6.406 1.52e-10 \*\*\*  
## LogLot\_Size 0.0373346 0.0029957 12.463 < 2e-16 \*\*\*  
## CitycatAlbuquerque -0.7259330 0.3208256 -2.263 0.023664 \*   
## CitycatAnaheim 0.0985560 0.3294487 0.299 0.764825   
## CitycatAnchorage -0.5819318 0.3225153 -1.804 0.071190 .   
## CitycatApple Valley -0.6784637 0.3448620 -1.967 0.049156 \*   
## CitycatArlington -0.6469123 0.3230217 -2.003 0.045223 \*   
## CitycatAtlantic Beach 0.0382804 0.3716483 0.103 0.917963   
## CitycatAurora -0.2621069 0.3221289 -0.814 0.415843   
## CitycatAustin -0.1043112 0.3198001 -0.326 0.744294   
## CitycatAventura -0.1825563 0.3308472 -0.552 0.581102   
## CitycatBainbridge Island 0.2145308 0.3486856 0.615 0.538392   
## CitycatBaker -1.1782660 0.7120766 -1.655 0.098002 .   
## CitycatBakersfield -0.4742046 0.3219273 -1.473 0.140761   
## CitycatBaltimore -0.8747711 0.3194777 -2.738 0.006184 \*\*   
## CitycatBaton Rouge -0.5570071 0.3212907 -1.734 0.082994 .   
## CitycatBay Harbor Islands -0.3904456 0.4271846 -0.914 0.360729   
## CitycatBay Village -0.3171361 0.3674874 -0.863 0.388155   
## CitycatBayside -0.5447818 0.4861176 -1.121 0.262437   
## CitycatBeachwood -1.2784151 0.3716353 -3.440 0.000583 \*\*\*  
## CitycatBedford -1.3083151 0.3582301 -3.652 0.000261 \*\*\*  
## CitycatBee Cave 0.3601154 0.7116213 0.506 0.612827   
## CitycatBel Aire -1.0409058 0.4862398 -2.141 0.032307 \*   
## CitycatBelle Isle -0.3468344 0.7115887 -0.487 0.625974   
## CitycatBellevue -0.4308467 0.4269832 -1.009 0.312963   
## CitycatBenbrook -0.3707987 0.3989769 -0.929 0.352706   
## CitycatBerkeley 1.3491010 0.7116212 1.896 0.057998 .   
## CitycatBeverly Hills 1.2064851 0.3989644 3.024 0.002497 \*\*   
## CitycatBexley -0.3126048 0.5512184 -0.567 0.570641   
## CitycatBiscayne Park -0.1530289 0.7115884 -0.215 0.829728   
## CitycatBixby -0.6081493 0.5512982 -1.103 0.269986   
## CitycatBlaine -0.2717907 0.3428213 -0.793 0.427900   
## CitycatBloomington -0.3445695 0.3448288 -0.999 0.317686   
## CitycatBlue Ash -0.1345119 0.4861258 -0.277 0.782012   
## CitycatBoise -0.2771712 0.3226826 -0.859 0.390373   
## CitycatBrentwood -0.3852079 0.3674873 -1.048 0.294549   
## CitycatBroken Arrow -0.9425122 0.7116386 -1.324 0.185376   
## CitycatBrookhaven -0.2215035 0.3381729 -0.655 0.512474   
## CitycatBrooklyn Center -0.6222286 0.3765793 -1.652 0.098484 .   
## CitycatBrooklyn Park -0.6683732 0.3427805 -1.950 0.051206 .   
## CitycatBrown Deer -0.8477215 0.5512140 -1.538 0.124084   
## CitycatBuffalo -0.8940762 0.3229572 -2.768 0.005638 \*\*   
## CitycatBurbank 0.1085341 0.4861801 0.223 0.823352   
## CitycatBurien 0.0232046 0.3558843 0.065 0.948013   
## CitycatBurleson -0.6974490 0.4270565 -1.633 0.102451   
## CitycatCampbell 0.6888926 0.5512812 1.250 0.211452   
## CitycatCarson 0.2410552 0.3897730 0.618 0.536285   
## CitycatCary 0.0259298 0.7116312 0.036 0.970934   
## CitycatCastroville -0.5766054 0.5512527 -1.046 0.295577   
## CitycatCeres -0.3171713 0.7117056 -0.446 0.655855   
## CitycatChandler -0.3910647 0.7116229 -0.550 0.582641   
## CitycatChesapeake -0.6570312 0.3225264 -2.037 0.041648 \*   
## CitycatChicago -0.2432456 0.3189510 -0.763 0.445685   
## CitycatChoctaw -0.6250020 0.7117154 -0.878 0.379865   
## CitycatChula Vista -0.0370842 0.3287026 -0.113 0.910174   
## CitycatCincinnati -0.7938952 0.3206003 -2.476 0.013284 \*   
## CitycatCleveland -1.2022559 0.3208918 -3.747 0.000180 \*\*\*  
## CitycatCleveland Heights -1.0155368 0.3370367 -3.013 0.002589 \*\*   
## CitycatClive -0.5020866 0.3558375 -1.411 0.158259   
## CitycatColerain Township -0.6460103 0.4502066 -1.435 0.151325   
## CitycatCollege Park -1.0721402 0.3472339 -3.088 0.002020 \*\*   
## CitycatColorado Springs -0.4352564 0.3207492 -1.357 0.174796   
## CitycatColumbia Heights -0.7048053 0.3824972 -1.843 0.065395 .   
## CitycatColumbus -0.7420593 0.3209102 -2.312 0.020767 \*   
## CitycatCommerce City -0.3255351 0.3370139 -0.966 0.334085   
## CitycatConverse -0.9112242 0.4861546 -1.874 0.060896 .   
## CitycatCoral Gables 0.5116423 0.3345762 1.529 0.126223   
## CitycatCoronado 1.2662283 0.3537383 3.580 0.000345 \*\*\*  
## CitycatCorpus Christi -0.7568630 0.3224612 -2.347 0.018927 \*   
## CitycatCrafton -1.1264658 0.7116804 -1.583 0.113476   
## CitycatCrowley -0.6427059 0.3716834 -1.729 0.083792 .   
## CitycatCrystal -0.3642633 0.3989943 -0.913 0.361277   
## CitycatCulver City 0.3878007 0.3989733 0.972 0.331063   
## CitycatCutler Bay -0.3914313 0.3472680 -1.127 0.259682   
## CitycatDallas -0.2986700 0.3193550 -0.935 0.349681   
## CitycatDel City -1.5597748 0.4109091 -3.796 0.000148 \*\*\*  
## CitycatDel Mar 0.7367231 0.4108739 1.793 0.072977 .   
## CitycatDenton -0.4773427 0.7116361 -0.671 0.502376   
## CitycatDenver 0.1800187 0.3197573 0.563 0.573451   
## CitycatDerby -2.9606068 0.7116976 -4.160 3.20e-05 \*\*\*  
## CitycatDes Moines -0.7655261 0.3244066 -2.360 0.018295 \*   
## CitycatDetroit -1.6300534 0.3205493 -5.085 3.70e-07 \*\*\*  
## CitycatDoral -0.1584057 0.3410665 -0.464 0.642336   
## CitycatDouglas -4.2332710 0.7117088 -5.948 2.76e-09 \*\*\*  
## CitycatDublin -0.7097908 0.3765933 -1.885 0.059475 .   
## CitycatDunwoody -0.4026021 0.3558255 -1.131 0.257874   
## CitycatDurham -0.5549567 0.3228089 -1.719 0.085602 .   
## CitycatEagan -0.3240171 0.3518724 -0.921 0.357146   
## CitycatEast Cleveland -2.0806413 0.5512889 -3.774 0.000161 \*\*\*  
## CitycatEast Orange -0.3583017 0.7116572 -0.503 0.614635   
## CitycatEastvale -0.2773750 0.7116234 -0.390 0.696705   
## CitycatEcorse -0.1446651 0.5513647 -0.262 0.793034   
## CitycatEdgewood -0.5747039 0.4861080 -1.182 0.237117   
## CitycatEdina 0.1869177 0.3394877 0.551 0.581922   
## CitycatEdmond -0.5621033 0.4501232 -1.249 0.211760   
## CitycatEl Paso -0.9923828 0.3202481 -3.099 0.001946 \*\*   
## CitycatEl Portal 0.4716903 0.5512332 0.856 0.392173   
## CitycatElmwood Park -0.6476609 0.7116407 -0.910 0.362782   
## CitycatEnglewood -0.3343281 0.7115813 -0.470 0.638475   
## CitycatEuclid -1.3501637 0.3438059 -3.927 8.62e-05 \*\*\*  
## CitycatEuless -1.0562571 0.7116153 -1.484 0.137742   
## CitycatEvendale -0.9966957 0.7116982 -1.400 0.161394   
## CitycatFairview Park -0.6799103 0.3825048 -1.778 0.075497 .   
## CitycatFarmers Branch -0.4902277 0.3897757 -1.258 0.208508   
## CitycatFerndale -0.3953602 0.3519271 -1.123 0.261274   
## CitycatFitchburg -0.7806380 0.3675520 -2.124 0.033691 \*   
## CitycatForest Hill -1.0207925 0.5512363 -1.852 0.064065 .   
## CitycatFort Wayne -1.1627937 0.3230232 -3.600 0.000319 \*\*\*  
## CitycatFort Worth -0.6087515 0.3198115 -1.903 0.056993 .   
## CitycatFountain Valley 0.1177824 0.3765574 0.313 0.754445   
## CitycatFremont 0.8531255 0.3315402 2.573 0.010082 \*   
## CitycatFridley -0.5067937 0.4269979 -1.187 0.235290   
## CitycatGahanna -0.6540094 0.3897831 -1.678 0.093385 .   
## CitycatGarden City -0.3233717 0.3825101 -0.845 0.397900   
## CitycatGarden Ridge -0.3435017 0.4501157 -0.763 0.445388   
## CitycatGarland -0.5382876 0.3276274 -1.643 0.100400   
## CitycatGeorgetown -0.9012539 0.4269615 -2.111 0.034796 \*   
## CitycatGermantown -0.3563213 0.3537313 -1.007 0.313792   
## CitycatGilbert -0.2391713 0.3238813 -0.738 0.460247   
## CitycatGlendale -0.4380546 0.3236434 -1.354 0.175907   
## CitycatGlenn Heights -0.5498854 0.7116369 -0.773 0.439705   
## CitycatGolden Beach 1.5055616 0.7116177 2.116 0.034383 \*   
## CitycatGolden Valley -0.3164424 0.4861278 -0.651 0.515089   
## CitycatGoodlettsville -0.7482437 0.4270791 -1.752 0.079788 .   
## CitycatGrand Prairie -0.8311685 0.7116093 -1.168 0.242815   
## CitycatGranite Shoals 0.6486447 0.7116196 0.912 0.362040   
## CitycatGreenfield -0.9015196 0.3989838 -2.260 0.023860 \*   
## CitycatGreensboro -0.8752474 0.3237483 -2.703 0.006867 \*\*   
## CitycatGrosse Pointe -0.5727503 0.4500640 -1.273 0.203175   
## CitycatGrosse Pointe Farms -0.2325499 0.4269942 -0.545 0.586020   
## CitycatGrosse Pointe Park -0.3105596 0.3989619 -0.778 0.436330   
## CitycatGrosse Pointe Shores -0.5938715 0.7115955 -0.835 0.403973   
## CitycatGrosse Pointe Woods -0.2879921 0.4108689 -0.701 0.483352   
## CitycatGroveport -1.3502639 0.5513021 -2.449 0.014324 \*   
## CitycatHaltom City -0.6667335 0.3989541 -1.671 0.094696 .   
## CitycatHamtramck -0.7747093 0.3898540 -1.987 0.046915 \*   
## CitycatHarahan -0.8081114 0.5513406 -1.466 0.142739   
## CitycatHarper Woods -0.9584627 0.3675632 -2.608 0.009124 \*\*   
## CitycatHelotes -0.7112733 0.5512119 -1.290 0.196932   
## CitycatHenderson -0.2591933 0.3211008 -0.807 0.419559   
## CitycatHialeah -0.3110095 0.3257702 -0.955 0.339745   
## CitycatHialeah Gardens -1.0611833 0.4862575 -2.182 0.029095 \*   
## CitycatHighland Park -1.8817438 0.3989946 -4.716 2.42e-06 \*\*\*  
## CitycatHilliard -0.7940196 0.4270391 -1.859 0.062990 .   
## CitycatHillsborough -0.3271606 0.7116945 -0.460 0.645742   
## CitycatHollywood Park -0.1274910 0.5512338 -0.231 0.817097   
## CitycatHoover -0.6620327 0.3427785 -1.931 0.053450 .   
## CitycatHorizon City -1.1681766 0.3376601 -3.460 0.000542 \*\*\*  
## CitycatHouston -0.5279323 0.3188504 -1.656 0.097790 .   
## CitycatHurst -0.5275010 0.7116269 -0.741 0.458544   
## CitycatIndian Hills 0.0392382 0.4861518 0.081 0.935672   
## CitycatIrvine 0.5128400 0.3239939 1.583 0.113466   
## CitycatIrving -0.4856773 0.3296243 -1.473 0.140651   
## CitycatJacksonville -0.7770389 0.3195609 -2.432 0.015041 \*   
## CitycatJacksonville Beach 0.0213545 0.3558115 0.060 0.952143   
## CitycatJeffersontown -0.6351268 0.4108612 -1.546 0.122157   
## CitycatJersey City 1.1826267 0.7117201 1.662 0.096598 .   
## CitycatJones -0.2301725 0.7116147 -0.323 0.746357   
## CitycatJurupa Valley -0.0837327 0.3675213 -0.228 0.819780   
## CitycatKeller -0.6830656 0.3609060 -1.893 0.058419 .   
## CitycatKey Biscayne 0.6758941 0.3559113 1.899 0.057571 .   
## CitycatKirby -0.9332140 0.7115972 -1.311 0.189725   
## CitycatKnightdale -0.6957804 0.5512111 -1.262 0.206863   
## CitycatLa Vergne -0.7014427 0.5512603 -1.272 0.203233   
## CitycatLackawanna -0.8748402 0.3825533 -2.287 0.022215 \*   
## CitycatLake Forest Park 0.1230902 0.4861305 0.253 0.800113   
## CitycatLakeway -0.2686719 0.3675379 -0.731 0.464784   
## CitycatLakewood -0.5863316 0.3448646 -1.700 0.089112 .   
## CitycatLancaster -0.8112749 0.7116738 -1.140 0.254318   
## CitycatLaredo -0.8970625 0.3276647 -2.738 0.006191 \*\*   
## CitycatLauderdale -0.4131595 0.5512279 -0.750 0.453549   
## CitycatLeon Valley -0.7069198 0.4501456 -1.570 0.116331   
## CitycatLexington -0.5157472 0.3231859 -1.596 0.110543   
## CitycatLincoln -0.8390684 0.3225491 -2.601 0.009292 \*\*   
## CitycatLittleton -0.1756123 0.3388236 -0.518 0.604254   
## CitycatLive Oak -0.7090119 0.4500806 -1.575 0.115202   
## CitycatLong Beach 0.5727622 0.3276691 1.748 0.080480 .   
## CitycatLos Angeles 0.6228894 0.3197355 1.948 0.051411 .   
## CitycatLubbock -0.8837129 0.3230012 -2.736 0.006225 \*\*   
## CitycatLuther -0.8551302 0.7117067 -1.202 0.229563   
## CitycatLyndhurst -0.9555165 0.3675084 -2.600 0.009329 \*\*   
## CitycatMadison -0.4348243 0.3255058 -1.336 0.181615   
## CitycatManor -0.7424672 0.4269919 -1.739 0.082079 .   
## CitycatMaplewood -0.5797402 0.3639454 -1.593 0.111190   
## CitycatMatthews -0.6481825 0.4108511 -1.578 0.114659   
## CitycatMayfield Heights -0.7872603 0.4269838 -1.844 0.065230 .   
## CitycatMemphis -1.3211817 0.3214918 -4.110 3.98e-05 \*\*\*  
## CitycatMendota Heights -0.1540270 0.4108909 -0.375 0.707768   
## CitycatMeridian -0.1428837 0.3766313 -0.379 0.704415   
## CitycatMesa -0.3866378 0.3211663 -1.204 0.228659   
## CitycatMiami 0.0687158 0.3190903 0.215 0.829497   
## CitycatMiami Beach 0.2049756 0.3284742 0.624 0.532619   
## CitycatMiami Gardens -0.4983608 0.4108874 -1.213 0.225186   
## CitycatMiami Lakes -0.0980818 0.3608682 -0.272 0.785783   
## CitycatMiami Shores 0.0615581 0.5512141 0.112 0.911080   
## CitycatMiami Springs -0.2561565 0.7115899 -0.360 0.718867   
## CitycatMiddleton -0.5694517 0.4270240 -1.334 0.182370   
## CitycatMiddletown -0.6499312 0.7115985 -0.913 0.361074   
## CitycatMidwest City -1.0089433 0.3558469 -2.835 0.004582 \*\*   
## CitycatMilwaukee -1.0232454 0.3211558 -3.186 0.001444 \*\*   
## CitycatMinneapolis -0.1459354 0.3212267 -0.454 0.649613   
## CitycatMint Hill -0.7229941 0.3472768 -2.082 0.037364 \*   
## CitycatMissouri City -0.9592827 0.4269774 -2.247 0.024670 \*   
## CitycatModesto -0.1680319 0.3277819 -0.513 0.608213   
## CitycatMonona -0.2780724 0.4500494 -0.618 0.536667   
## CitycatMontgomery -0.3496493 0.4269629 -0.819 0.412840   
## CitycatMoore -0.7626723 0.3410424 -2.236 0.025343 \*   
## CitycatMorrisville -0.3820280 0.4862042 -0.786 0.432031   
## CitycatMounds View -0.3640715 0.4501078 -0.809 0.418608   
## CitycatMurphy -0.5594114 0.3765958 -1.485 0.137441   
## CitycatNeptune Beach -0.0215389 0.4500413 -0.048 0.961828   
## CitycatNew Brighton -0.5158975 0.4861188 -1.061 0.288584   
## CitycatNew Hope -0.4396777 0.3897964 -1.128 0.259346   
## CitycatNew Orleans -0.6971143 0.3209257 -2.172 0.029852 \*   
## CitycatNewark -0.4748993 0.3290830 -1.443 0.149007   
## CitycatNewtown -0.3518342 0.7118030 -0.494 0.621109   
## CitycatNichols Hills 0.0255644 0.3989728 0.064 0.948911   
## CitycatNolensville -0.5141041 0.5512181 -0.933 0.351001   
## CitycatNorfolk -0.6332511 0.3248229 -1.950 0.051245 .   
## CitycatNormandy Park 0.7098671 0.7117116 0.997 0.318578   
## CitycatNorth Bay Village -0.0565029 0.3717266 -0.152 0.879187   
## CitycatNorth Las Vegas -0.6260386 0.3231876 -1.937 0.052749 .   
## CitycatNorth Miami -0.2191514 0.3419204 -0.641 0.521567   
## CitycatNorth Miami Beach -0.2081189 0.3410652 -0.610 0.541734   
## CitycatNorth Richland Hills -0.4948761 0.3359661 -1.473 0.140767   
## CitycatNorth Royalton -0.8844672 0.3501991 -2.526 0.011557 \*   
## CitycatNorthfield -0.1577963 0.7116166 -0.222 0.824516   
## CitycatNorthglenn -0.2949656 0.3989321 -0.739 0.459679   
## CitycatOak Park -0.6716831 0.4269947 -1.573 0.115722   
## CitycatOakdale -0.4976612 0.3989925 -1.247 0.212303   
## CitycatOakland 0.5921933 0.3256236 1.819 0.068980 .   
## CitycatOklahoma City -0.7972453 0.3207930 -2.485 0.012954 \*   
## CitycatOlmos Park 0.4037544 0.4269894 0.946 0.344371   
## CitycatOlmsted Falls -0.9735220 0.3897944 -2.498 0.012514 \*   
## CitycatOlmsted Township -0.9739697 0.4270113 -2.281 0.022564 \*   
## CitycatOmaha -0.7768339 0.3216204 -2.415 0.015727 \*   
## CitycatOrlando -0.5337110 0.3197019 -1.669 0.095052 .   
## CitycatOro Valley -0.3734128 0.3334570 -1.120 0.262802   
## CitycatOttawa Hills -0.9390332 0.7115952 -1.320 0.186977   
## CitycatPalmetto Bay 0.0174104 0.3608592 0.048 0.961520   
## CitycatPantego -0.9295999 0.7115937 -1.306 0.191443   
## CitycatPapillion -0.4370789 0.5512149 -0.793 0.427823   
## CitycatParadise Valley 0.9484193 0.3338536 2.841 0.004504 \*\*   
## CitycatPark City -1.1945843 0.4501176 -2.654 0.007962 \*\*   
## CitycatParma -1.0033084 0.3437839 -2.918 0.003522 \*\*   
## CitycatPeoria -0.5320797 0.4269867 -1.246 0.212731   
## CitycatPepper Pike -0.2776116 0.4501181 -0.617 0.537404   
## CitycatPflugerville -0.6010075 0.7116613 -0.845 0.398392   
## CitycatPhoenix -0.2704227 0.3194242 -0.847 0.397231   
## CitycatPickerington 0.0881152 0.4862047 0.181 0.856188   
## CitycatPiedmont 1.1677831 0.5513149 2.118 0.034171 \*   
## CitycatPlano -0.2916661 0.3242670 -0.899 0.368416   
## CitycatPlymouth -0.2914136 0.3381932 -0.862 0.388874   
## CitycatPortland 0.1462577 0.3199194 0.457 0.647553   
## CitycatPowell -0.9925490 0.7116645 -1.395 0.163125   
## CitycatRaleigh -0.4600006 0.3214231 -1.431 0.152405   
## CitycatRalston -1.2660355 0.4500862 -2.813 0.004915 \*\*   
## CitycatRed Oak -0.5748524 0.7116361 -0.808 0.419221   
## CitycatReno -0.3980253 0.3217241 -1.237 0.216040   
## CitycatReynoldsburg -0.9333784 0.4269867 -2.186 0.028829 \*   
## CitycatRichfield -0.1581416 0.3766656 -0.420 0.674602   
## CitycatRichland Hills -0.8338636 0.4500696 -1.853 0.063933 .   
## CitycatRichmond -0.3886971 0.3242228 -1.199 0.230596   
## CitycatRichmond Heights -1.0964942 0.4500763 -2.436 0.014849 \*   
## CitycatRio Rancho -1.7248346 0.3305955 -5.217 1.83e-07 \*\*\*  
## CitycatRiver Hills -0.3785147 0.7116601 -0.532 0.594818   
## CitycatRiver Rouge -1.2387387 0.5513062 -2.247 0.024656 \*   
## CitycatRiverside -0.0917958 0.3238119 -0.283 0.776808   
## CitycatRoanoke -0.3866671 0.4109047 -0.941 0.346708   
## CitycatRobbinsdale -0.4727794 0.4501930 -1.050 0.293652   
## CitycatRoseville -0.2168460 0.3716505 -0.583 0.559585   
## CitycatSachse -0.2684172 0.3518543 -0.763 0.445552   
## CitycatSaginaw -0.6673663 0.3558443 -1.875 0.060745 .   
## CitycatSan Antonio -0.7080445 0.3189457 -2.220 0.026432 \*   
## CitycatSan Diego 0.3998458 0.3202407 1.249 0.211833   
## CitycatSan Fernando 0.1442590 0.5512163 0.262 0.793547   
## CitycatSan Francisco 1.4112024 0.3225788 4.375 1.22e-05 \*\*\*  
## CitycatSan Jose 0.7685309 0.3222878 2.385 0.017106 \*   
## CitycatSand Springs -1.4575426 0.7117102 -2.048 0.040578 \*   
## CitycatSandy Springs -0.2007722 0.3280506 -0.612 0.540534   
## CitycatSanta Ana 0.5114983 0.3359699 1.522 0.127910   
## CitycatSantee 0.0685444 0.7115750 0.096 0.923261   
## CitycatScottsdale 0.1308790 0.3204636 0.408 0.682980   
## CitycatSeattle 0.5890710 0.3205357 1.838 0.066110 .   
## CitycatSeven Hills -0.7732469 0.3989451 -1.938 0.052608 .   
## CitycatShavano Park -0.0279126 0.4501411 -0.062 0.950557   
## CitycatShively -0.6142784 0.4109783 -1.495 0.135014   
## CitycatShoreline 0.5777569 0.3582179 1.613 0.106789   
## CitycatShorewood -0.2235768 0.5513123 -0.406 0.685088   
## CitycatSignal Hill 0.3174818 0.7116359 0.446 0.655508   
## CitycatSocorro -1.0529995 0.3582600 -2.939 0.003294 \*\*   
## CitycatSolon -1.0097918 0.3675045 -2.748 0.006007 \*\*   
## CitycatSouth Euclid -1.2183654 0.3674947 -3.315 0.000917 \*\*\*  
## CitycatSouth Miami -0.1611029 0.4861403 -0.331 0.740352   
## CitycatSpeedway -3.0128144 0.7117151 -4.233 2.31e-05 \*\*\*  
## CitycatSpencer -3.6210363 0.7117076 -5.088 3.65e-07 \*\*\*  
## CitycatSpokane -0.4790134 0.3227472 -1.484 0.137777   
## CitycatSpokane Valley -0.4704145 0.3518901 -1.337 0.181295   
## CitycatSpring Lake Park -0.7022586 0.5512124 -1.274 0.202668   
## CitycatStafford -1.2025202 0.7115768 -1.690 0.091054 .   
## CitycatStockton -0.2454571 0.3271309 -0.750 0.453062   
## CitycatStrongsville -0.8512735 0.3897697 -2.184 0.028970 \*   
## CitycatSuffolk -0.4221678 0.5512923 -0.766 0.443817   
## CitycatSunny Isles Beach 0.2673144 0.3428685 0.780 0.435611   
## CitycatSurfside -0.1013373 0.5512363 -0.184 0.854144   
## CitycatSweetwater -0.8480537 0.7116928 -1.192 0.233431   
## CitycatSwissvale -0.4281145 0.7117090 -0.602 0.547493   
## CitycatTampa -0.4481137 0.3200469 -1.400 0.161483   
## CitycatTemple Terrace -0.6830460 0.3897879 -1.752 0.079727 .   
## CitycatTerrell Hills 0.1050895 0.4861298 0.216 0.828853   
## CitycatThornton -0.4610773 0.3410172 -1.352 0.176369   
## CitycatTigard -0.0952626 0.3448165 -0.276 0.782343   
## CitycatToledo -1.3363237 0.3236168 -4.129 3.65e-05 \*\*\*  
## CitycatTorrance 0.5678170 0.4501058 1.262 0.207136   
## CitycatTucson -0.6846571 0.3198572 -2.141 0.032325 \*   
## CitycatTulsa -0.9571984 0.3215261 -2.977 0.002914 \*\*   
## CitycatUniversity Heights -1.1251245 0.4108666 -2.738 0.006179 \*\*   
## CitycatUpper Arlington -0.0215338 0.3674750 -0.059 0.953272   
## CitycatUrbandale -0.9087864 0.3364769 -2.701 0.006921 \*\*   
## CitycatVerona -0.4858170 0.3716813 -1.307 0.191200   
## CitycatVirginia Beach -0.4873395 0.3213717 -1.516 0.129424   
## CitycatVirginia Gardens 0.6847804 0.7117007 0.962 0.335973   
## CitycatWarr Acres -0.9215375 0.5512040 -1.672 0.094566 .   
## CitycatWatauga -0.6944862 0.4500926 -1.543 0.122849   
## CitycatWauwatosa -0.2887178 0.3766132 -0.767 0.443318   
## CitycatWest Allis -0.6795247 0.3502030 -1.940 0.052347 .   
## CitycatWest Hollywood 1.1294394 0.3537163 3.193 0.001410 \*\*   
## CitycatWest Lake Hills 1.2568970 0.7116711 1.766 0.077390 .   
## CitycatWesterville -0.9849201 0.3766134 -2.615 0.008924 \*\*   
## CitycatWestminster -0.3624620 0.3897837 -0.930 0.352430   
## CitycatWhite Bear Lake -0.4045147 0.3989304 -1.014 0.310595   
## CitycatWhite Settlement 0.7048309 0.7117617 0.990 0.322057   
## CitycatWhitefish Bay -0.3151297 0.5512183 -0.572 0.567533   
## CitycatWhitehall -1.1893117 0.4109123 -2.894 0.003804 \*\*   
## CitycatWichita -0.9606685 0.3222688 -2.981 0.002877 \*\*   
## CitycatWindsor Heights -0.6184586 0.7117152 -0.869 0.384874   
## CitycatWinter Park 0.2275362 0.4862252 0.468 0.639815   
## CitycatWolfforth -0.6967430 0.5512017 -1.264 0.206228   
## CitycatWoodbury -0.4895341 0.3375846 -1.450 0.147043   
## CitycatWorthington -0.6250895 0.5512577 -1.134 0.256835   
## CitycatYukon -0.3425779 0.4862110 -0.705 0.481075   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.6364 on 21472 degrees of freedom  
## Multiple R-squared: 0.5476, Adjusted R-squared: 0.5403   
## F-statistic: 75.54 on 344 and 21472 DF, p-value: < 2.2e-16

Nothing was removed. We are left with Size, Year Built, Lot Size, Bathrooms, and City. The R-squared is 0.5403.

Try BIC:

fit4BIC = step (fit4, direction="both",   
 k = log (fit4$rank + fit4$df.residual))

## Start: AIC=-16617.24  
## LogPrice ~ (LogSize + LogBedrooms + LogBathrooms + Year\_Built +   
## LogLot\_Size + Citycat)  
##   
## Df Sum of Sq RSS AIC  
## <none> 8697.6 -16617.2  
## - LogBedrooms 1 4.9 8702.5 -16614.8  
## - LogSize 1 16.5 8714.1 -16585.8  
## - Year\_Built 1 16.6 8714.2 -16585.6  
## - LogLot\_Size 1 62.9 8760.5 -16470.0  
## - LogBathrooms 1 1522.2 10219.8 -13108.6  
## - Citycat 339 5197.8 13895.4 -9782.4

summary (fit4BIC)

##   
## Call:  
## lm(formula = LogPrice ~ (LogSize + LogBedrooms + LogBathrooms +   
## Year\_Built + LogLot\_Size + Citycat), data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.7368 -0.2623 0.0231 0.3286 2.9883   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 9.1053893 0.4740207 19.209 < 2e-16 \*\*\*  
## LogSize 0.0669704 0.0104809 6.390 1.70e-10 \*\*\*  
## LogBedrooms 0.0595462 0.0170377 3.495 0.000475 \*\*\*  
## LogBathrooms 0.9229442 0.0150557 61.302 < 2e-16 \*\*\*  
## Year\_Built 0.0011246 0.0001755 6.406 1.52e-10 \*\*\*  
## LogLot\_Size 0.0373346 0.0029957 12.463 < 2e-16 \*\*\*  
## CitycatAlbuquerque -0.7259330 0.3208256 -2.263 0.023664 \*   
## CitycatAnaheim 0.0985560 0.3294487 0.299 0.764825   
## CitycatAnchorage -0.5819318 0.3225153 -1.804 0.071190 .   
## CitycatApple Valley -0.6784637 0.3448620 -1.967 0.049156 \*   
## CitycatArlington -0.6469123 0.3230217 -2.003 0.045223 \*   
## CitycatAtlantic Beach 0.0382804 0.3716483 0.103 0.917963   
## CitycatAurora -0.2621069 0.3221289 -0.814 0.415843   
## CitycatAustin -0.1043112 0.3198001 -0.326 0.744294   
## CitycatAventura -0.1825563 0.3308472 -0.552 0.581102   
## CitycatBainbridge Island 0.2145308 0.3486856 0.615 0.538392   
## CitycatBaker -1.1782660 0.7120766 -1.655 0.098002 .   
## CitycatBakersfield -0.4742046 0.3219273 -1.473 0.140761   
## CitycatBaltimore -0.8747711 0.3194777 -2.738 0.006184 \*\*   
## CitycatBaton Rouge -0.5570071 0.3212907 -1.734 0.082994 .   
## CitycatBay Harbor Islands -0.3904456 0.4271846 -0.914 0.360729   
## CitycatBay Village -0.3171361 0.3674874 -0.863 0.388155   
## CitycatBayside -0.5447818 0.4861176 -1.121 0.262437   
## CitycatBeachwood -1.2784151 0.3716353 -3.440 0.000583 \*\*\*  
## CitycatBedford -1.3083151 0.3582301 -3.652 0.000261 \*\*\*  
## CitycatBee Cave 0.3601154 0.7116213 0.506 0.612827   
## CitycatBel Aire -1.0409058 0.4862398 -2.141 0.032307 \*   
## CitycatBelle Isle -0.3468344 0.7115887 -0.487 0.625974   
## CitycatBellevue -0.4308467 0.4269832 -1.009 0.312963   
## CitycatBenbrook -0.3707987 0.3989769 -0.929 0.352706   
## CitycatBerkeley 1.3491010 0.7116212 1.896 0.057998 .   
## CitycatBeverly Hills 1.2064851 0.3989644 3.024 0.002497 \*\*   
## CitycatBexley -0.3126048 0.5512184 -0.567 0.570641   
## CitycatBiscayne Park -0.1530289 0.7115884 -0.215 0.829728   
## CitycatBixby -0.6081493 0.5512982 -1.103 0.269986   
## CitycatBlaine -0.2717907 0.3428213 -0.793 0.427900   
## CitycatBloomington -0.3445695 0.3448288 -0.999 0.317686   
## CitycatBlue Ash -0.1345119 0.4861258 -0.277 0.782012   
## CitycatBoise -0.2771712 0.3226826 -0.859 0.390373   
## CitycatBrentwood -0.3852079 0.3674873 -1.048 0.294549   
## CitycatBroken Arrow -0.9425122 0.7116386 -1.324 0.185376   
## CitycatBrookhaven -0.2215035 0.3381729 -0.655 0.512474   
## CitycatBrooklyn Center -0.6222286 0.3765793 -1.652 0.098484 .   
## CitycatBrooklyn Park -0.6683732 0.3427805 -1.950 0.051206 .   
## CitycatBrown Deer -0.8477215 0.5512140 -1.538 0.124084   
## CitycatBuffalo -0.8940762 0.3229572 -2.768 0.005638 \*\*   
## CitycatBurbank 0.1085341 0.4861801 0.223 0.823352   
## CitycatBurien 0.0232046 0.3558843 0.065 0.948013   
## CitycatBurleson -0.6974490 0.4270565 -1.633 0.102451   
## CitycatCampbell 0.6888926 0.5512812 1.250 0.211452   
## CitycatCarson 0.2410552 0.3897730 0.618 0.536285   
## CitycatCary 0.0259298 0.7116312 0.036 0.970934   
## CitycatCastroville -0.5766054 0.5512527 -1.046 0.295577   
## CitycatCeres -0.3171713 0.7117056 -0.446 0.655855   
## CitycatChandler -0.3910647 0.7116229 -0.550 0.582641   
## CitycatChesapeake -0.6570312 0.3225264 -2.037 0.041648 \*   
## CitycatChicago -0.2432456 0.3189510 -0.763 0.445685   
## CitycatChoctaw -0.6250020 0.7117154 -0.878 0.379865   
## CitycatChula Vista -0.0370842 0.3287026 -0.113 0.910174   
## CitycatCincinnati -0.7938952 0.3206003 -2.476 0.013284 \*   
## CitycatCleveland -1.2022559 0.3208918 -3.747 0.000180 \*\*\*  
## CitycatCleveland Heights -1.0155368 0.3370367 -3.013 0.002589 \*\*   
## CitycatClive -0.5020866 0.3558375 -1.411 0.158259   
## CitycatColerain Township -0.6460103 0.4502066 -1.435 0.151325   
## CitycatCollege Park -1.0721402 0.3472339 -3.088 0.002020 \*\*   
## CitycatColorado Springs -0.4352564 0.3207492 -1.357 0.174796   
## CitycatColumbia Heights -0.7048053 0.3824972 -1.843 0.065395 .   
## CitycatColumbus -0.7420593 0.3209102 -2.312 0.020767 \*   
## CitycatCommerce City -0.3255351 0.3370139 -0.966 0.334085   
## CitycatConverse -0.9112242 0.4861546 -1.874 0.060896 .   
## CitycatCoral Gables 0.5116423 0.3345762 1.529 0.126223   
## CitycatCoronado 1.2662283 0.3537383 3.580 0.000345 \*\*\*  
## CitycatCorpus Christi -0.7568630 0.3224612 -2.347 0.018927 \*   
## CitycatCrafton -1.1264658 0.7116804 -1.583 0.113476   
## CitycatCrowley -0.6427059 0.3716834 -1.729 0.083792 .   
## CitycatCrystal -0.3642633 0.3989943 -0.913 0.361277   
## CitycatCulver City 0.3878007 0.3989733 0.972 0.331063   
## CitycatCutler Bay -0.3914313 0.3472680 -1.127 0.259682   
## CitycatDallas -0.2986700 0.3193550 -0.935 0.349681   
## CitycatDel City -1.5597748 0.4109091 -3.796 0.000148 \*\*\*  
## CitycatDel Mar 0.7367231 0.4108739 1.793 0.072977 .   
## CitycatDenton -0.4773427 0.7116361 -0.671 0.502376   
## CitycatDenver 0.1800187 0.3197573 0.563 0.573451   
## CitycatDerby -2.9606068 0.7116976 -4.160 3.20e-05 \*\*\*  
## CitycatDes Moines -0.7655261 0.3244066 -2.360 0.018295 \*   
## CitycatDetroit -1.6300534 0.3205493 -5.085 3.70e-07 \*\*\*  
## CitycatDoral -0.1584057 0.3410665 -0.464 0.642336   
## CitycatDouglas -4.2332710 0.7117088 -5.948 2.76e-09 \*\*\*  
## CitycatDublin -0.7097908 0.3765933 -1.885 0.059475 .   
## CitycatDunwoody -0.4026021 0.3558255 -1.131 0.257874   
## CitycatDurham -0.5549567 0.3228089 -1.719 0.085602 .   
## CitycatEagan -0.3240171 0.3518724 -0.921 0.357146   
## CitycatEast Cleveland -2.0806413 0.5512889 -3.774 0.000161 \*\*\*  
## CitycatEast Orange -0.3583017 0.7116572 -0.503 0.614635   
## CitycatEastvale -0.2773750 0.7116234 -0.390 0.696705   
## CitycatEcorse -0.1446651 0.5513647 -0.262 0.793034   
## CitycatEdgewood -0.5747039 0.4861080 -1.182 0.237117   
## CitycatEdina 0.1869177 0.3394877 0.551 0.581922   
## CitycatEdmond -0.5621033 0.4501232 -1.249 0.211760   
## CitycatEl Paso -0.9923828 0.3202481 -3.099 0.001946 \*\*   
## CitycatEl Portal 0.4716903 0.5512332 0.856 0.392173   
## CitycatElmwood Park -0.6476609 0.7116407 -0.910 0.362782   
## CitycatEnglewood -0.3343281 0.7115813 -0.470 0.638475   
## CitycatEuclid -1.3501637 0.3438059 -3.927 8.62e-05 \*\*\*  
## CitycatEuless -1.0562571 0.7116153 -1.484 0.137742   
## CitycatEvendale -0.9966957 0.7116982 -1.400 0.161394   
## CitycatFairview Park -0.6799103 0.3825048 -1.778 0.075497 .   
## CitycatFarmers Branch -0.4902277 0.3897757 -1.258 0.208508   
## CitycatFerndale -0.3953602 0.3519271 -1.123 0.261274   
## CitycatFitchburg -0.7806380 0.3675520 -2.124 0.033691 \*   
## CitycatForest Hill -1.0207925 0.5512363 -1.852 0.064065 .   
## CitycatFort Wayne -1.1627937 0.3230232 -3.600 0.000319 \*\*\*  
## CitycatFort Worth -0.6087515 0.3198115 -1.903 0.056993 .   
## CitycatFountain Valley 0.1177824 0.3765574 0.313 0.754445   
## CitycatFremont 0.8531255 0.3315402 2.573 0.010082 \*   
## CitycatFridley -0.5067937 0.4269979 -1.187 0.235290   
## CitycatGahanna -0.6540094 0.3897831 -1.678 0.093385 .   
## CitycatGarden City -0.3233717 0.3825101 -0.845 0.397900   
## CitycatGarden Ridge -0.3435017 0.4501157 -0.763 0.445388   
## CitycatGarland -0.5382876 0.3276274 -1.643 0.100400   
## CitycatGeorgetown -0.9012539 0.4269615 -2.111 0.034796 \*   
## CitycatGermantown -0.3563213 0.3537313 -1.007 0.313792   
## CitycatGilbert -0.2391713 0.3238813 -0.738 0.460247   
## CitycatGlendale -0.4380546 0.3236434 -1.354 0.175907   
## CitycatGlenn Heights -0.5498854 0.7116369 -0.773 0.439705   
## CitycatGolden Beach 1.5055616 0.7116177 2.116 0.034383 \*   
## CitycatGolden Valley -0.3164424 0.4861278 -0.651 0.515089   
## CitycatGoodlettsville -0.7482437 0.4270791 -1.752 0.079788 .   
## CitycatGrand Prairie -0.8311685 0.7116093 -1.168 0.242815   
## CitycatGranite Shoals 0.6486447 0.7116196 0.912 0.362040   
## CitycatGreenfield -0.9015196 0.3989838 -2.260 0.023860 \*   
## CitycatGreensboro -0.8752474 0.3237483 -2.703 0.006867 \*\*   
## CitycatGrosse Pointe -0.5727503 0.4500640 -1.273 0.203175   
## CitycatGrosse Pointe Farms -0.2325499 0.4269942 -0.545 0.586020   
## CitycatGrosse Pointe Park -0.3105596 0.3989619 -0.778 0.436330   
## CitycatGrosse Pointe Shores -0.5938715 0.7115955 -0.835 0.403973   
## CitycatGrosse Pointe Woods -0.2879921 0.4108689 -0.701 0.483352   
## CitycatGroveport -1.3502639 0.5513021 -2.449 0.014324 \*   
## CitycatHaltom City -0.6667335 0.3989541 -1.671 0.094696 .   
## CitycatHamtramck -0.7747093 0.3898540 -1.987 0.046915 \*   
## CitycatHarahan -0.8081114 0.5513406 -1.466 0.142739   
## CitycatHarper Woods -0.9584627 0.3675632 -2.608 0.009124 \*\*   
## CitycatHelotes -0.7112733 0.5512119 -1.290 0.196932   
## CitycatHenderson -0.2591933 0.3211008 -0.807 0.419559   
## CitycatHialeah -0.3110095 0.3257702 -0.955 0.339745   
## CitycatHialeah Gardens -1.0611833 0.4862575 -2.182 0.029095 \*   
## CitycatHighland Park -1.8817438 0.3989946 -4.716 2.42e-06 \*\*\*  
## CitycatHilliard -0.7940196 0.4270391 -1.859 0.062990 .   
## CitycatHillsborough -0.3271606 0.7116945 -0.460 0.645742   
## CitycatHollywood Park -0.1274910 0.5512338 -0.231 0.817097   
## CitycatHoover -0.6620327 0.3427785 -1.931 0.053450 .   
## CitycatHorizon City -1.1681766 0.3376601 -3.460 0.000542 \*\*\*  
## CitycatHouston -0.5279323 0.3188504 -1.656 0.097790 .   
## CitycatHurst -0.5275010 0.7116269 -0.741 0.458544   
## CitycatIndian Hills 0.0392382 0.4861518 0.081 0.935672   
## CitycatIrvine 0.5128400 0.3239939 1.583 0.113466   
## CitycatIrving -0.4856773 0.3296243 -1.473 0.140651   
## CitycatJacksonville -0.7770389 0.3195609 -2.432 0.015041 \*   
## CitycatJacksonville Beach 0.0213545 0.3558115 0.060 0.952143   
## CitycatJeffersontown -0.6351268 0.4108612 -1.546 0.122157   
## CitycatJersey City 1.1826267 0.7117201 1.662 0.096598 .   
## CitycatJones -0.2301725 0.7116147 -0.323 0.746357   
## CitycatJurupa Valley -0.0837327 0.3675213 -0.228 0.819780   
## CitycatKeller -0.6830656 0.3609060 -1.893 0.058419 .   
## CitycatKey Biscayne 0.6758941 0.3559113 1.899 0.057571 .   
## CitycatKirby -0.9332140 0.7115972 -1.311 0.189725   
## CitycatKnightdale -0.6957804 0.5512111 -1.262 0.206863   
## CitycatLa Vergne -0.7014427 0.5512603 -1.272 0.203233   
## CitycatLackawanna -0.8748402 0.3825533 -2.287 0.022215 \*   
## CitycatLake Forest Park 0.1230902 0.4861305 0.253 0.800113   
## CitycatLakeway -0.2686719 0.3675379 -0.731 0.464784   
## CitycatLakewood -0.5863316 0.3448646 -1.700 0.089112 .   
## CitycatLancaster -0.8112749 0.7116738 -1.140 0.254318   
## CitycatLaredo -0.8970625 0.3276647 -2.738 0.006191 \*\*   
## CitycatLauderdale -0.4131595 0.5512279 -0.750 0.453549   
## CitycatLeon Valley -0.7069198 0.4501456 -1.570 0.116331   
## CitycatLexington -0.5157472 0.3231859 -1.596 0.110543   
## CitycatLincoln -0.8390684 0.3225491 -2.601 0.009292 \*\*   
## CitycatLittleton -0.1756123 0.3388236 -0.518 0.604254   
## CitycatLive Oak -0.7090119 0.4500806 -1.575 0.115202   
## CitycatLong Beach 0.5727622 0.3276691 1.748 0.080480 .   
## CitycatLos Angeles 0.6228894 0.3197355 1.948 0.051411 .   
## CitycatLubbock -0.8837129 0.3230012 -2.736 0.006225 \*\*   
## CitycatLuther -0.8551302 0.7117067 -1.202 0.229563   
## CitycatLyndhurst -0.9555165 0.3675084 -2.600 0.009329 \*\*   
## CitycatMadison -0.4348243 0.3255058 -1.336 0.181615   
## CitycatManor -0.7424672 0.4269919 -1.739 0.082079 .   
## CitycatMaplewood -0.5797402 0.3639454 -1.593 0.111190   
## CitycatMatthews -0.6481825 0.4108511 -1.578 0.114659   
## CitycatMayfield Heights -0.7872603 0.4269838 -1.844 0.065230 .   
## CitycatMemphis -1.3211817 0.3214918 -4.110 3.98e-05 \*\*\*  
## CitycatMendota Heights -0.1540270 0.4108909 -0.375 0.707768   
## CitycatMeridian -0.1428837 0.3766313 -0.379 0.704415   
## CitycatMesa -0.3866378 0.3211663 -1.204 0.228659   
## CitycatMiami 0.0687158 0.3190903 0.215 0.829497   
## CitycatMiami Beach 0.2049756 0.3284742 0.624 0.532619   
## CitycatMiami Gardens -0.4983608 0.4108874 -1.213 0.225186   
## CitycatMiami Lakes -0.0980818 0.3608682 -0.272 0.785783   
## CitycatMiami Shores 0.0615581 0.5512141 0.112 0.911080   
## CitycatMiami Springs -0.2561565 0.7115899 -0.360 0.718867   
## CitycatMiddleton -0.5694517 0.4270240 -1.334 0.182370   
## CitycatMiddletown -0.6499312 0.7115985 -0.913 0.361074   
## CitycatMidwest City -1.0089433 0.3558469 -2.835 0.004582 \*\*   
## CitycatMilwaukee -1.0232454 0.3211558 -3.186 0.001444 \*\*   
## CitycatMinneapolis -0.1459354 0.3212267 -0.454 0.649613   
## CitycatMint Hill -0.7229941 0.3472768 -2.082 0.037364 \*   
## CitycatMissouri City -0.9592827 0.4269774 -2.247 0.024670 \*   
## CitycatModesto -0.1680319 0.3277819 -0.513 0.608213   
## CitycatMonona -0.2780724 0.4500494 -0.618 0.536667   
## CitycatMontgomery -0.3496493 0.4269629 -0.819 0.412840   
## CitycatMoore -0.7626723 0.3410424 -2.236 0.025343 \*   
## CitycatMorrisville -0.3820280 0.4862042 -0.786 0.432031   
## CitycatMounds View -0.3640715 0.4501078 -0.809 0.418608   
## CitycatMurphy -0.5594114 0.3765958 -1.485 0.137441   
## CitycatNeptune Beach -0.0215389 0.4500413 -0.048 0.961828   
## CitycatNew Brighton -0.5158975 0.4861188 -1.061 0.288584   
## CitycatNew Hope -0.4396777 0.3897964 -1.128 0.259346   
## CitycatNew Orleans -0.6971143 0.3209257 -2.172 0.029852 \*   
## CitycatNewark -0.4748993 0.3290830 -1.443 0.149007   
## CitycatNewtown -0.3518342 0.7118030 -0.494 0.621109   
## CitycatNichols Hills 0.0255644 0.3989728 0.064 0.948911   
## CitycatNolensville -0.5141041 0.5512181 -0.933 0.351001   
## CitycatNorfolk -0.6332511 0.3248229 -1.950 0.051245 .   
## CitycatNormandy Park 0.7098671 0.7117116 0.997 0.318578   
## CitycatNorth Bay Village -0.0565029 0.3717266 -0.152 0.879187   
## CitycatNorth Las Vegas -0.6260386 0.3231876 -1.937 0.052749 .   
## CitycatNorth Miami -0.2191514 0.3419204 -0.641 0.521567   
## CitycatNorth Miami Beach -0.2081189 0.3410652 -0.610 0.541734   
## CitycatNorth Richland Hills -0.4948761 0.3359661 -1.473 0.140767   
## CitycatNorth Royalton -0.8844672 0.3501991 -2.526 0.011557 \*   
## CitycatNorthfield -0.1577963 0.7116166 -0.222 0.824516   
## CitycatNorthglenn -0.2949656 0.3989321 -0.739 0.459679   
## CitycatOak Park -0.6716831 0.4269947 -1.573 0.115722   
## CitycatOakdale -0.4976612 0.3989925 -1.247 0.212303   
## CitycatOakland 0.5921933 0.3256236 1.819 0.068980 .   
## CitycatOklahoma City -0.7972453 0.3207930 -2.485 0.012954 \*   
## CitycatOlmos Park 0.4037544 0.4269894 0.946 0.344371   
## CitycatOlmsted Falls -0.9735220 0.3897944 -2.498 0.012514 \*   
## CitycatOlmsted Township -0.9739697 0.4270113 -2.281 0.022564 \*   
## CitycatOmaha -0.7768339 0.3216204 -2.415 0.015727 \*   
## CitycatOrlando -0.5337110 0.3197019 -1.669 0.095052 .   
## CitycatOro Valley -0.3734128 0.3334570 -1.120 0.262802   
## CitycatOttawa Hills -0.9390332 0.7115952 -1.320 0.186977   
## CitycatPalmetto Bay 0.0174104 0.3608592 0.048 0.961520   
## CitycatPantego -0.9295999 0.7115937 -1.306 0.191443   
## CitycatPapillion -0.4370789 0.5512149 -0.793 0.427823   
## CitycatParadise Valley 0.9484193 0.3338536 2.841 0.004504 \*\*   
## CitycatPark City -1.1945843 0.4501176 -2.654 0.007962 \*\*   
## CitycatParma -1.0033084 0.3437839 -2.918 0.003522 \*\*   
## CitycatPeoria -0.5320797 0.4269867 -1.246 0.212731   
## CitycatPepper Pike -0.2776116 0.4501181 -0.617 0.537404   
## CitycatPflugerville -0.6010075 0.7116613 -0.845 0.398392   
## CitycatPhoenix -0.2704227 0.3194242 -0.847 0.397231   
## CitycatPickerington 0.0881152 0.4862047 0.181 0.856188   
## CitycatPiedmont 1.1677831 0.5513149 2.118 0.034171 \*   
## CitycatPlano -0.2916661 0.3242670 -0.899 0.368416   
## CitycatPlymouth -0.2914136 0.3381932 -0.862 0.388874   
## CitycatPortland 0.1462577 0.3199194 0.457 0.647553   
## CitycatPowell -0.9925490 0.7116645 -1.395 0.163125   
## CitycatRaleigh -0.4600006 0.3214231 -1.431 0.152405   
## CitycatRalston -1.2660355 0.4500862 -2.813 0.004915 \*\*   
## CitycatRed Oak -0.5748524 0.7116361 -0.808 0.419221   
## CitycatReno -0.3980253 0.3217241 -1.237 0.216040   
## CitycatReynoldsburg -0.9333784 0.4269867 -2.186 0.028829 \*   
## CitycatRichfield -0.1581416 0.3766656 -0.420 0.674602   
## CitycatRichland Hills -0.8338636 0.4500696 -1.853 0.063933 .   
## CitycatRichmond -0.3886971 0.3242228 -1.199 0.230596   
## CitycatRichmond Heights -1.0964942 0.4500763 -2.436 0.014849 \*   
## CitycatRio Rancho -1.7248346 0.3305955 -5.217 1.83e-07 \*\*\*  
## CitycatRiver Hills -0.3785147 0.7116601 -0.532 0.594818   
## CitycatRiver Rouge -1.2387387 0.5513062 -2.247 0.024656 \*   
## CitycatRiverside -0.0917958 0.3238119 -0.283 0.776808   
## CitycatRoanoke -0.3866671 0.4109047 -0.941 0.346708   
## CitycatRobbinsdale -0.4727794 0.4501930 -1.050 0.293652   
## CitycatRoseville -0.2168460 0.3716505 -0.583 0.559585   
## CitycatSachse -0.2684172 0.3518543 -0.763 0.445552   
## CitycatSaginaw -0.6673663 0.3558443 -1.875 0.060745 .   
## CitycatSan Antonio -0.7080445 0.3189457 -2.220 0.026432 \*   
## CitycatSan Diego 0.3998458 0.3202407 1.249 0.211833   
## CitycatSan Fernando 0.1442590 0.5512163 0.262 0.793547   
## CitycatSan Francisco 1.4112024 0.3225788 4.375 1.22e-05 \*\*\*  
## CitycatSan Jose 0.7685309 0.3222878 2.385 0.017106 \*   
## CitycatSand Springs -1.4575426 0.7117102 -2.048 0.040578 \*   
## CitycatSandy Springs -0.2007722 0.3280506 -0.612 0.540534   
## CitycatSanta Ana 0.5114983 0.3359699 1.522 0.127910   
## CitycatSantee 0.0685444 0.7115750 0.096 0.923261   
## CitycatScottsdale 0.1308790 0.3204636 0.408 0.682980   
## CitycatSeattle 0.5890710 0.3205357 1.838 0.066110 .   
## CitycatSeven Hills -0.7732469 0.3989451 -1.938 0.052608 .   
## CitycatShavano Park -0.0279126 0.4501411 -0.062 0.950557   
## CitycatShively -0.6142784 0.4109783 -1.495 0.135014   
## CitycatShoreline 0.5777569 0.3582179 1.613 0.106789   
## CitycatShorewood -0.2235768 0.5513123 -0.406 0.685088   
## CitycatSignal Hill 0.3174818 0.7116359 0.446 0.655508   
## CitycatSocorro -1.0529995 0.3582600 -2.939 0.003294 \*\*   
## CitycatSolon -1.0097918 0.3675045 -2.748 0.006007 \*\*   
## CitycatSouth Euclid -1.2183654 0.3674947 -3.315 0.000917 \*\*\*  
## CitycatSouth Miami -0.1611029 0.4861403 -0.331 0.740352   
## CitycatSpeedway -3.0128144 0.7117151 -4.233 2.31e-05 \*\*\*  
## CitycatSpencer -3.6210363 0.7117076 -5.088 3.65e-07 \*\*\*  
## CitycatSpokane -0.4790134 0.3227472 -1.484 0.137777   
## CitycatSpokane Valley -0.4704145 0.3518901 -1.337 0.181295   
## CitycatSpring Lake Park -0.7022586 0.5512124 -1.274 0.202668   
## CitycatStafford -1.2025202 0.7115768 -1.690 0.091054 .   
## CitycatStockton -0.2454571 0.3271309 -0.750 0.453062   
## CitycatStrongsville -0.8512735 0.3897697 -2.184 0.028970 \*   
## CitycatSuffolk -0.4221678 0.5512923 -0.766 0.443817   
## CitycatSunny Isles Beach 0.2673144 0.3428685 0.780 0.435611   
## CitycatSurfside -0.1013373 0.5512363 -0.184 0.854144   
## CitycatSweetwater -0.8480537 0.7116928 -1.192 0.233431   
## CitycatSwissvale -0.4281145 0.7117090 -0.602 0.547493   
## CitycatTampa -0.4481137 0.3200469 -1.400 0.161483   
## CitycatTemple Terrace -0.6830460 0.3897879 -1.752 0.079727 .   
## CitycatTerrell Hills 0.1050895 0.4861298 0.216 0.828853   
## CitycatThornton -0.4610773 0.3410172 -1.352 0.176369   
## CitycatTigard -0.0952626 0.3448165 -0.276 0.782343   
## CitycatToledo -1.3363237 0.3236168 -4.129 3.65e-05 \*\*\*  
## CitycatTorrance 0.5678170 0.4501058 1.262 0.207136   
## CitycatTucson -0.6846571 0.3198572 -2.141 0.032325 \*   
## CitycatTulsa -0.9571984 0.3215261 -2.977 0.002914 \*\*   
## CitycatUniversity Heights -1.1251245 0.4108666 -2.738 0.006179 \*\*   
## CitycatUpper Arlington -0.0215338 0.3674750 -0.059 0.953272   
## CitycatUrbandale -0.9087864 0.3364769 -2.701 0.006921 \*\*   
## CitycatVerona -0.4858170 0.3716813 -1.307 0.191200   
## CitycatVirginia Beach -0.4873395 0.3213717 -1.516 0.129424   
## CitycatVirginia Gardens 0.6847804 0.7117007 0.962 0.335973   
## CitycatWarr Acres -0.9215375 0.5512040 -1.672 0.094566 .   
## CitycatWatauga -0.6944862 0.4500926 -1.543 0.122849   
## CitycatWauwatosa -0.2887178 0.3766132 -0.767 0.443318   
## CitycatWest Allis -0.6795247 0.3502030 -1.940 0.052347 .   
## CitycatWest Hollywood 1.1294394 0.3537163 3.193 0.001410 \*\*   
## CitycatWest Lake Hills 1.2568970 0.7116711 1.766 0.077390 .   
## CitycatWesterville -0.9849201 0.3766134 -2.615 0.008924 \*\*   
## CitycatWestminster -0.3624620 0.3897837 -0.930 0.352430   
## CitycatWhite Bear Lake -0.4045147 0.3989304 -1.014 0.310595   
## CitycatWhite Settlement 0.7048309 0.7117617 0.990 0.322057   
## CitycatWhitefish Bay -0.3151297 0.5512183 -0.572 0.567533   
## CitycatWhitehall -1.1893117 0.4109123 -2.894 0.003804 \*\*   
## CitycatWichita -0.9606685 0.3222688 -2.981 0.002877 \*\*   
## CitycatWindsor Heights -0.6184586 0.7117152 -0.869 0.384874   
## CitycatWinter Park 0.2275362 0.4862252 0.468 0.639815   
## CitycatWolfforth -0.6967430 0.5512017 -1.264 0.206228   
## CitycatWoodbury -0.4895341 0.3375846 -1.450 0.147043   
## CitycatWorthington -0.6250895 0.5512577 -1.134 0.256835   
## CitycatYukon -0.3425779 0.4862110 -0.705 0.481075   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.6364 on 21472 degrees of freedom  
## Multiple R-squared: 0.5476, Adjusted R-squared: 0.5403   
## F-statistic: 75.54 on 344 and 21472 DF, p-value: < 2.2e-16

Again, no variables were removed. The R-squared is the same.

# Centered Interactions Model

Next, we will add all possible two-way interaction effects to the stepwise regression model obtained above using centered interactions.

# Define centered variables  
housing2$Bathrooms.c = housing2$LogBathrooms - mean (housing2$LogBathrooms)  
housing2$Bedrooms.c = housing2$LogBedrooms - mean (housing2$LogBedrooms)  
housing2$Year\_Built.c = housing2$Year\_Built - mean (housing2$Year\_Built)  
housing2$Lot\_Size.c = housing2$LogLot\_Size - mean (housing2$LogLot\_Size)  
housing2$Size.c = housing2$LogSize - mean (housing2$LogSize)  
  
fit5 = lm (LogPrice ~   
 (Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c + Size.c)^2, data=housing2)  
  
summary (fit5)

##   
## Call:  
## lm(formula = LogPrice ~ (Bathrooms.c + Bedrooms.c + Year\_Built.c +   
## Lot\_Size.c + Size.c)^2, data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.4964 -0.3838 0.0041 0.4239 3.7374   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 12.4988903 0.0063846 1957.647 < 2e-16 \*\*\*  
## Bathrooms.c 1.1727383 0.0187015 62.708 < 2e-16 \*\*\*  
## Bedrooms.c -0.2200419 0.0225751 -9.747 < 2e-16 \*\*\*  
## Year\_Built.c 0.0009222 0.0001973 4.673 2.98e-06 \*\*\*  
## Lot\_Size.c 0.0482379 0.0035271 13.676 < 2e-16 \*\*\*  
## Size.c 0.0569402 0.0134674 4.228 2.37e-05 \*\*\*  
## Bathrooms.c:Bedrooms.c 0.2292531 0.0482844 4.748 2.07e-06 \*\*\*  
## Bathrooms.c:Year\_Built.c 0.0012380 0.0005477 2.260 0.02383 \*   
## Bathrooms.c:Lot\_Size.c -0.0254693 0.0108857 -2.340 0.01931 \*   
## Bathrooms.c:Size.c 0.6911492 0.0300839 22.974 < 2e-16 \*\*\*  
## Bedrooms.c:Year\_Built.c -0.0010606 0.0006126 -1.731 0.08342 .   
## Bedrooms.c:Lot\_Size.c -0.0020865 0.0119389 -0.175 0.86127   
## Bedrooms.c:Size.c -0.2283805 0.0412700 -5.534 3.17e-08 \*\*\*  
## Year\_Built.c:Lot\_Size.c -0.0002140 0.0001361 -1.572 0.11588   
## Year\_Built.c:Size.c -0.0040781 0.0005003 -8.151 3.80e-16 \*\*\*  
## Lot\_Size.c:Size.c 0.0206037 0.0068995 2.986 0.00283 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.7764 on 21801 degrees of freedom  
## Multiple R-squared: 0.3163, Adjusted R-squared: 0.3158   
## F-statistic: 672.4 on 15 and 21801 DF, p-value: < 2.2e-16

### Stepwise

A stepwise regression will be used to remove the least significant predictors:

AIC:

fit5AIC = step (fit5, direction='both')

## Start: AIC=-11024.67  
## LogPrice ~ (Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c)^2  
##   
## Df Sum of Sq RSS AIC  
## - Bedrooms.c:Lot\_Size.c 1 0.02 13143 -11027  
## <none> 13143 -11025  
## - Year\_Built.c:Lot\_Size.c 1 1.49 13145 -11024  
## - Bedrooms.c:Year\_Built.c 1 1.81 13145 -11024  
## - Bathrooms.c:Year\_Built.c 1 3.08 13146 -11022  
## - Bathrooms.c:Lot\_Size.c 1 3.30 13146 -11021  
## - Lot\_Size.c:Size.c 1 5.38 13148 -11018  
## - Bathrooms.c:Bedrooms.c 1 13.59 13157 -11004  
## - Bedrooms.c:Size.c 1 18.46 13162 -10996  
## - Year\_Built.c:Size.c 1 40.05 13183 -10960  
## - Bathrooms.c:Size.c 1 318.20 13461 -10505  
##   
## Step: AIC=-11026.64  
## LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Year\_Built.c +   
## Bathrooms.c:Lot\_Size.c + Bathrooms.c:Size.c + Bedrooms.c:Year\_Built.c +   
## Bedrooms.c:Size.c + Year\_Built.c:Lot\_Size.c + Year\_Built.c:Size.c +   
## Lot\_Size.c:Size.c  
##   
## Df Sum of Sq RSS AIC  
## <none> 13143 -11027  
## - Year\_Built.c:Lot\_Size.c 1 1.47 13145 -11026  
## - Bedrooms.c:Year\_Built.c 1 1.94 13145 -11025  
## + Bedrooms.c:Lot\_Size.c 1 0.02 13143 -11025  
## - Bathrooms.c:Year\_Built.c 1 3.13 13146 -11023  
## - Bathrooms.c:Lot\_Size.c 1 4.46 13148 -11021  
## - Lot\_Size.c:Size.c 1 6.14 13149 -11018  
## - Bathrooms.c:Bedrooms.c 1 13.64 13157 -11006  
## - Bedrooms.c:Size.c 1 18.48 13162 -10998  
## - Year\_Built.c:Size.c 1 40.12 13183 -10962  
## - Bathrooms.c:Size.c 1 318.18 13461 -10507

summary (fit5AIC)

##   
## Call:  
## lm(formula = LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c +   
## Lot\_Size.c + Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Year\_Built.c +   
## Bathrooms.c:Lot\_Size.c + Bathrooms.c:Size.c + Bedrooms.c:Year\_Built.c +   
## Bedrooms.c:Size.c + Year\_Built.c:Lot\_Size.c + Year\_Built.c:Size.c +   
## Lot\_Size.c:Size.c, data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.4962 -0.3838 0.0040 0.4239 3.7372   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 12.4989964 0.0063556 1966.626 < 2e-16 \*\*\*  
## Bathrooms.c 1.1725332 0.0186642 62.823 < 2e-16 \*\*\*  
## Bedrooms.c -0.2202773 0.0225344 -9.775 < 2e-16 \*\*\*  
## Year\_Built.c 0.0009225 0.0001973 4.675 2.96e-06 \*\*\*  
## Lot\_Size.c 0.0484165 0.0033758 14.342 < 2e-16 \*\*\*  
## Size.c 0.0571037 0.0134346 4.250 2.14e-05 \*\*\*  
## Bathrooms.c:Bedrooms.c 0.2295405 0.0482553 4.757 1.98e-06 \*\*\*  
## Bathrooms.c:Year\_Built.c 0.0012445 0.0005465 2.277 0.02278 \*   
## Bathrooms.c:Lot\_Size.c -0.0263395 0.0096801 -2.721 0.00651 \*\*   
## Bathrooms.c:Size.c 0.6911001 0.0300819 22.974 < 2e-16 \*\*\*  
## Bedrooms.c:Year\_Built.c -0.0010798 0.0006026 -1.792 0.07317 .   
## Bedrooms.c:Size.c -0.2284843 0.0412648 -5.537 3.11e-08 \*\*\*  
## Year\_Built.c:Lot\_Size.c -0.0002107 0.0001348 -1.563 0.11798   
## Year\_Built.c:Size.c -0.0040722 0.0004992 -8.158 3.59e-16 \*\*\*  
## Lot\_Size.c:Size.c 0.0201131 0.0063025 3.191 0.00142 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.7764 on 21802 degrees of freedom  
## Multiple R-squared: 0.3163, Adjusted R-squared: 0.3159   
## F-statistic: 720.5 on 14 and 21802 DF, p-value: < 2.2e-16

The interaction of bedrooms with lot size was removed. The rest of the interactions are significant.

BIC:

fit5BIC = step (fit5, direction="both",   
 k = log (fit5$rank + fit5$df.residual))

## Start: AIC=-10896.82  
## LogPrice ~ (Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c)^2  
##   
## Df Sum of Sq RSS AIC  
## - Bedrooms.c:Lot\_Size.c 1 0.02 13143 -10907  
## - Year\_Built.c:Lot\_Size.c 1 1.49 13145 -10904  
## - Bedrooms.c:Year\_Built.c 1 1.81 13145 -10904  
## - Bathrooms.c:Year\_Built.c 1 3.08 13146 -10902  
## - Bathrooms.c:Lot\_Size.c 1 3.30 13146 -10901  
## - Lot\_Size.c:Size.c 1 5.38 13148 -10898  
## <none> 13143 -10897  
## - Bathrooms.c:Bedrooms.c 1 13.59 13157 -10884  
## - Bedrooms.c:Size.c 1 18.46 13162 -10876  
## - Year\_Built.c:Size.c 1 40.05 13183 -10840  
## - Bathrooms.c:Size.c 1 318.20 13461 -10385  
##   
## Step: AIC=-10906.78  
## LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Year\_Built.c +   
## Bathrooms.c:Lot\_Size.c + Bathrooms.c:Size.c + Bedrooms.c:Year\_Built.c +   
## Bedrooms.c:Size.c + Year\_Built.c:Lot\_Size.c + Year\_Built.c:Size.c +   
## Lot\_Size.c:Size.c  
##   
## Df Sum of Sq RSS AIC  
## - Year\_Built.c:Lot\_Size.c 1 1.47 13145 -10914  
## - Bedrooms.c:Year\_Built.c 1 1.94 13145 -10914  
## - Bathrooms.c:Year\_Built.c 1 3.13 13146 -10912  
## - Bathrooms.c:Lot\_Size.c 1 4.46 13148 -10909  
## <none> 13143 -10907  
## - Lot\_Size.c:Size.c 1 6.14 13149 -10907  
## + Bedrooms.c:Lot\_Size.c 1 0.02 13143 -10897  
## - Bathrooms.c:Bedrooms.c 1 13.64 13157 -10894  
## - Bedrooms.c:Size.c 1 18.48 13162 -10886  
## - Year\_Built.c:Size.c 1 40.12 13183 -10850  
## - Bathrooms.c:Size.c 1 318.18 13461 -10395  
##   
## Step: AIC=-10914.32  
## LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Year\_Built.c +   
## Bathrooms.c:Lot\_Size.c + Bathrooms.c:Size.c + Bedrooms.c:Year\_Built.c +   
## Bedrooms.c:Size.c + Year\_Built.c:Size.c + Lot\_Size.c:Size.c  
##   
## Df Sum of Sq RSS AIC  
## - Bedrooms.c:Year\_Built.c 1 1.40 13146 -10922  
## - Bathrooms.c:Year\_Built.c 1 2.99 13148 -10919  
## <none> 13145 -10914  
## - Bathrooms.c:Lot\_Size.c 1 6.46 13151 -10914  
## - Lot\_Size.c:Size.c 1 7.27 13152 -10912  
## + Year\_Built.c:Lot\_Size.c 1 1.47 13143 -10907  
## + Bedrooms.c:Lot\_Size.c 1 0.00 13145 -10904  
## - Bathrooms.c:Bedrooms.c 1 13.38 13158 -10902  
## - Bedrooms.c:Size.c 1 18.59 13163 -10894  
## - Year\_Built.c:Size.c 1 43.39 13188 -10852  
## - Bathrooms.c:Size.c 1 321.01 13466 -10398  
##   
## Step: AIC=-10922  
## LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Year\_Built.c +   
## Bathrooms.c:Lot\_Size.c + Bathrooms.c:Size.c + Bedrooms.c:Size.c +   
## Year\_Built.c:Size.c + Lot\_Size.c:Size.c  
##   
## Df Sum of Sq RSS AIC  
## - Bathrooms.c:Year\_Built.c 1 2.07 13148 -10928  
## <none> 13146 -10922  
## - Bathrooms.c:Lot\_Size.c 1 6.54 13152 -10921  
## - Lot\_Size.c:Size.c 1 7.39 13153 -10920  
## + Bedrooms.c:Year\_Built.c 1 1.40 13145 -10914  
## + Year\_Built.c:Lot\_Size.c 1 0.93 13145 -10914  
## + Bedrooms.c:Lot\_Size.c 1 0.04 13146 -10912  
## - Bathrooms.c:Bedrooms.c 1 12.34 13158 -10912  
## - Bedrooms.c:Size.c 1 17.87 13164 -10902  
## - Year\_Built.c:Size.c 1 56.82 13203 -10838  
## - Bathrooms.c:Size.c 1 327.60 13474 -10395  
##   
## Step: AIC=-10928.55  
## LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Lot\_Size.c +   
## Bathrooms.c:Size.c + Bedrooms.c:Size.c + Year\_Built.c:Size.c +   
## Lot\_Size.c:Size.c  
##   
## Df Sum of Sq RSS AIC  
## - Bathrooms.c:Lot\_Size.c 1 5.40 13154 -10930  
## <none> 13148 -10928  
## - Lot\_Size.c:Size.c 1 6.32 13154 -10928  
## + Bathrooms.c:Year\_Built.c 1 2.07 13146 -10922  
## + Year\_Built.c:Lot\_Size.c 1 1.01 13147 -10920  
## + Bedrooms.c:Year\_Built.c 1 0.48 13148 -10919  
## - Bathrooms.c:Bedrooms.c 1 11.93 13160 -10919  
## + Bedrooms.c:Lot\_Size.c 1 0.05 13148 -10919  
## - Bedrooms.c:Size.c 1 18.27 13166 -10908  
## - Year\_Built.c:Size.c 1 72.74 13221 -10818  
## - Bathrooms.c:Size.c 1 334.95 13483 -10390  
##   
## Step: AIC=-10929.58  
## LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Size.c + Bedrooms.c:Size.c +   
## Year\_Built.c:Size.c + Lot\_Size.c:Size.c  
##   
## Df Sum of Sq RSS AIC  
## - Lot\_Size.c:Size.c 1 2.13 13156 -10936  
## <none> 13154 -10930  
## + Bathrooms.c:Lot\_Size.c 1 5.40 13148 -10928  
## + Year\_Built.c:Lot\_Size.c 1 2.53 13151 -10924  
## + Bedrooms.c:Lot\_Size.c 1 1.49 13152 -10922  
## + Bathrooms.c:Year\_Built.c 1 0.93 13152 -10921  
## + Bedrooms.c:Year\_Built.c 1 0.73 13153 -10921  
## - Bathrooms.c:Bedrooms.c 1 13.93 13167 -10916  
## - Bedrooms.c:Size.c 1 18.63 13172 -10909  
## - Year\_Built.c:Size.c 1 72.27 13226 -10820  
## - Bathrooms.c:Size.c 1 329.83 13483 -10399  
##   
## Step: AIC=-10936.03  
## LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Size.c + Bedrooms.c:Size.c +   
## Year\_Built.c:Size.c  
##   
## Df Sum of Sq RSS AIC  
## <none> 13156 -10936  
## + Year\_Built.c:Lot\_Size.c 1 2.48 13153 -10930  
## + Lot\_Size.c:Size.c 1 2.13 13154 -10930  
## + Bathrooms.c:Lot\_Size.c 1 1.22 13154 -10928  
## + Bedrooms.c:Year\_Built.c 1 0.82 13155 -10927  
## + Bathrooms.c:Year\_Built.c 1 0.74 13155 -10927  
## + Bedrooms.c:Lot\_Size.c 1 0.00 13156 -10926  
## - Bathrooms.c:Bedrooms.c 1 13.60 13169 -10924  
## - Bedrooms.c:Size.c 1 19.35 13175 -10914  
## - Year\_Built.c:Size.c 1 70.22 13226 -10830  
## - Lot\_Size.c 1 122.82 13278 -10743  
## - Bathrooms.c:Size.c 1 334.02 13490 -10399

summary (fit5BIC)

##   
## Call:  
## lm(formula = LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c +   
## Lot\_Size.c + Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Size.c +   
## Bedrooms.c:Size.c + Year\_Built.c:Size.c, data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.5087 -0.3827 0.0028 0.4219 3.7535   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 12.5048818 0.0060296 2073.902 < 2e-16 \*\*\*  
## Bathrooms.c 1.1585824 0.0180290 64.262 < 2e-16 \*\*\*  
## Bedrooms.c -0.2247352 0.0223514 -10.055 < 2e-16 \*\*\*  
## Year\_Built.c 0.0010286 0.0001870 5.500 3.85e-08 \*\*\*  
## Lot\_Size.c 0.0457868 0.0032090 14.268 < 2e-16 \*\*\*  
## Size.c 0.0711661 0.0126559 5.623 1.90e-08 \*\*\*  
## Bathrooms.c:Bedrooms.c 0.2243681 0.0472582 4.748 2.07e-06 \*\*\*  
## Bathrooms.c:Size.c 0.6918399 0.0294022 23.530 < 2e-16 \*\*\*  
## Bedrooms.c:Size.c -0.2324760 0.0410488 -5.663 1.50e-08 \*\*\*  
## Year\_Built.c:Size.c -0.0038210 0.0003541 -10.789 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.7767 on 21807 degrees of freedom  
## Multiple R-squared: 0.3157, Adjusted R-squared: 0.3154   
## F-statistic: 1118 on 9 and 21807 DF, p-value: < 2.2e-16

Using the BIC criterion, more of the interaction effects are removed. We are left with interactions between bathrooms and bedrooms, bathrooms and size, bedrooms and size, and year built and size. The adjusted R-squared is 0.3154.

Check the VIF factors:

car::vif (fit5BIC)

## Bathrooms.c Bedrooms.c Year\_Built.c   
## 2.172263 2.320416 1.200667   
## Lot\_Size.c Size.c Bathrooms.c:Bedrooms.c   
## 1.055230 1.872944 3.183870   
## Bathrooms.c:Size.c Bedrooms.c:Size.c Year\_Built.c:Size.c   
## 2.594172 3.656825 1.167744

VIFs are less than 5, so good.

We will continue on by using the model obtained from the BIC criterion above (fit5BIC).

# Model with Significant Interactions

# Add in city variable  
fit6 = lm (LogPrice ~   
 (Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c + Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Size.c + Bedrooms.c:Size.c + Year\_Built.c:Size.c + Citycat), data=housing2)  
  
summary (fit6)

##   
## Call:  
## lm(formula = LogPrice ~ (Bathrooms.c + Bedrooms.c + Year\_Built.c +   
## Lot\_Size.c + Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Size.c +   
## Bedrooms.c:Size.c + Year\_Built.c:Size.c + Citycat), data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.7091 -0.2513 0.0269 0.3136 3.1145   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 12.9581888 0.3078900 42.087 < 2e-16 \*\*\*  
## Bathrooms.c 0.9518351 0.0148908 63.921 < 2e-16 \*\*\*  
## Bedrooms.c -0.0376585 0.0184184 -2.045 0.040905 \*   
## Year\_Built.c 0.0011480 0.0001701 6.750 1.51e-11 \*\*\*  
## Lot\_Size.c 0.0357067 0.0029040 12.296 < 2e-16 \*\*\*  
## Size.c 0.1136955 0.0104498 10.880 < 2e-16 \*\*\*  
## CitycatAlbuquerque -0.6925659 0.3103612 -2.231 0.025659 \*   
## CitycatAnaheim 0.0998892 0.3186985 0.313 0.753958   
## CitycatAnchorage -0.5820889 0.3119874 -1.866 0.062091 .   
## CitycatApple Valley -0.6750195 0.3336239 -2.023 0.043055 \*   
## CitycatArlington -0.6522700 0.3124926 -2.087 0.036872 \*   
## CitycatAtlantic Beach 0.0072270 0.3595224 0.020 0.983962   
## CitycatAurora -0.3036517 0.3116315 -0.974 0.329872   
## CitycatAustin -0.1276299 0.3093731 -0.413 0.679945   
## CitycatAventura -0.2174505 0.3200579 -0.679 0.496886   
## CitycatBainbridge Island 0.2322982 0.3373215 0.689 0.491048   
## CitycatBaker -1.1681936 0.6888169 -1.696 0.089911 .   
## CitycatBakersfield -0.4593498 0.3114305 -1.475 0.140236   
## CitycatBaltimore -0.8726907 0.3090666 -2.824 0.004753 \*\*   
## CitycatBaton Rouge -0.5479552 0.3108173 -1.763 0.077923 .   
## CitycatBay Harbor Islands -0.2954363 0.4133629 -0.715 0.474793   
## CitycatBay Village -0.3698912 0.3554952 -1.040 0.298121   
## CitycatBayside -0.4882486 0.4702396 -1.038 0.299143   
## CitycatBeachwood -1.3201704 0.3595144 -3.672 0.000241 \*\*\*  
## CitycatBedford -1.3503287 0.3465527 -3.896 9.79e-05 \*\*\*  
## CitycatBee Cave -0.0112493 0.6884820 -0.016 0.986964   
## CitycatBel Aire -1.0082706 0.4703706 -2.144 0.032079 \*   
## CitycatBelle Isle -0.3116155 0.6883403 -0.453 0.650765   
## CitycatBellevue -0.3956122 0.4130537 -0.958 0.338187   
## CitycatBenbrook -0.3738967 0.3859663 -0.969 0.332691   
## CitycatBerkeley 1.0965812 0.6884808 1.593 0.111230   
## CitycatBeverly Hills 1.1104178 0.3859514 2.877 0.004018 \*\*   
## CitycatBexley -0.2770312 0.5332243 -0.520 0.603390   
## CitycatBiscayne Park -0.0587829 0.6883418 -0.085 0.931946   
## CitycatBixby -0.5365375 0.5332994 -1.006 0.314392   
## CitycatBlaine -0.3170340 0.3316459 -0.956 0.339113   
## CitycatBloomington -0.3475290 0.3335765 -1.042 0.297504   
## CitycatBlue Ash -0.2916122 0.4702802 -0.620 0.535210   
## CitycatBoise -0.2644664 0.3121591 -0.847 0.396884   
## CitycatBrentwood -0.3791030 0.3554961 -1.066 0.286252   
## CitycatBroken Arrow -0.8993547 0.6883927 -1.306 0.191412   
## CitycatBrookhaven -0.3113637 0.3271510 -0.952 0.341238   
## CitycatBrooklyn Center -0.5989179 0.3642908 -1.644 0.100177   
## CitycatBrooklyn Park -0.6593635 0.3315919 -1.988 0.046771 \*   
## CitycatBrown Deer -0.7963277 0.5332186 -1.493 0.135338   
## CitycatBuffalo -0.8981008 0.3124579 -2.874 0.004053 \*\*   
## CitycatBurbank 0.2310377 0.4703327 0.491 0.623275   
## CitycatBurien 0.0143508 0.3442787 0.042 0.966751   
## CitycatBurleson -0.6538151 0.4131135 -1.583 0.113515   
## CitycatCampbell 0.8106017 0.5333087 1.520 0.128539   
## CitycatCarson 0.2641245 0.3770451 0.701 0.483615   
## CitycatCary 0.0970527 0.6883967 0.141 0.887884   
## CitycatCastroville -0.6827123 0.5333330 -1.280 0.200529   
## CitycatCeres -0.2232437 0.6884656 -0.324 0.745742   
## CitycatChandler -0.3154555 0.6883852 -0.458 0.646774   
## CitycatChesapeake -0.6240141 0.3120080 -2.000 0.045513 \*   
## CitycatChicago -0.2563849 0.3085316 -0.831 0.405992   
## CitycatChoctaw -0.5836094 0.6884669 -0.848 0.396618   
## CitycatChula Vista -0.0035125 0.3179721 -0.011 0.991187   
## CitycatCincinnati -0.8273043 0.3101490 -2.667 0.007649 \*\*   
## CitycatCleveland -1.2369627 0.3104352 -3.985 6.78e-05 \*\*\*  
## CitycatCleveland Heights -1.0194236 0.3260296 -3.127 0.001770 \*\*   
## CitycatClive -0.4455292 0.3442188 -1.294 0.195569   
## CitycatColerain Township -0.5956984 0.4355371 -1.368 0.171410   
## CitycatCollege Park -1.0392176 0.3358970 -3.094 0.001978 \*\*   
## CitycatColorado Springs -0.4518088 0.3102955 -1.456 0.145391   
## CitycatColumbia Heights -0.6553589 0.3700211 -1.771 0.076552 .   
## CitycatColumbus -0.7822809 0.3104550 -2.520 0.011750 \*   
## CitycatCommerce City -0.3134276 0.3260335 -0.961 0.336394   
## CitycatConverse -0.9019639 0.4702830 -1.918 0.055135 .   
## CitycatCoral Gables 0.4131706 0.3236738 1.277 0.201792   
## CitycatCoronado 1.2068066 0.3421937 3.527 0.000422 \*\*\*  
## CitycatCorpus Christi -0.7568549 0.3119413 -2.426 0.015263 \*   
## CitycatCrafton -1.0697277 0.6884359 -1.554 0.120234   
## CitycatCrowley -0.6006528 0.3595626 -1.671 0.094833 .   
## CitycatCrystal -0.4010905 0.3859817 -1.039 0.298750   
## CitycatCulver City 0.4652039 0.3859657 1.205 0.228101   
## CitycatCutler Bay -0.3797687 0.3359377 -1.130 0.258289   
## CitycatDallas -0.3477140 0.3089461 -1.125 0.260396   
## CitycatDel City -1.6172989 0.3975108 -4.069 4.75e-05 \*\*\*  
## CitycatDel Mar 0.7352990 0.3974779 1.850 0.064340 .   
## CitycatDenton -0.4271649 0.6883910 -0.621 0.534918   
## CitycatDenver 0.1255193 0.3093335 0.406 0.684913   
## CitycatDerby -2.8688309 0.6884578 -4.167 3.10e-05 \*\*\*  
## CitycatDes Moines -0.7596162 0.3138336 -2.420 0.015510 \*   
## CitycatDetroit -1.7290854 0.3101271 -5.575 2.50e-08 \*\*\*  
## CitycatDoral -0.2008660 0.3299403 -0.609 0.542667   
## CitycatDouglas -4.1433888 0.6884686 -6.018 1.79e-09 \*\*\*  
## CitycatDublin -0.6443197 0.3643196 -1.769 0.076982 .   
## CitycatDunwoody -0.4277655 0.3442097 -1.243 0.213975   
## CitycatDurham -0.5327300 0.3122787 -1.706 0.088033 .   
## CitycatEagan -0.2757035 0.3403925 -0.810 0.417973   
## CitycatEast Cleveland -2.1203583 0.5332916 -3.976 7.03e-05 \*\*\*  
## CitycatEast Orange -0.2941727 0.6884219 -0.427 0.669155   
## CitycatEastvale -0.2234479 0.6883695 -0.325 0.745484   
## CitycatEcorse -0.4403130 0.5334905 -0.825 0.409186   
## CitycatEdgewood -0.6669694 0.4702345 -1.418 0.156095   
## CitycatEdina 0.0492575 0.3284413 0.150 0.880787   
## CitycatEdmond -0.5002634 0.4354343 -1.149 0.250617   
## CitycatEl Paso -0.9712023 0.3097978 -3.135 0.001721 \*\*   
## CitycatEl Portal 0.5292482 0.5332452 0.993 0.320963   
## CitycatElmwood Park -0.6098991 0.6884195 -0.886 0.375659   
## CitycatEnglewood -0.3429353 0.6883418 -0.498 0.618345   
## CitycatEuclid -1.3514033 0.3326007 -4.063 4.86e-05 \*\*\*  
## CitycatEuless -1.0400899 0.6883668 -1.511 0.130815   
## CitycatEvendale -0.9040382 0.6884584 -1.313 0.189152   
## CitycatFairview Park -0.7330919 0.3700436 -1.981 0.047593 \*   
## CitycatFarmers Branch -0.4954168 0.3770544 -1.314 0.188889   
## CitycatFerndale -0.4818376 0.3404998 -1.415 0.157057   
## CitycatFitchburg -0.6973864 0.3556037 -1.961 0.049876 \*   
## CitycatForest Hill -0.9462550 0.5332266 -1.775 0.075981 .   
## CitycatFort Wayne -1.1780514 0.3124909 -3.770 0.000164 \*\*\*  
## CitycatFort Worth -0.6022786 0.3093801 -1.947 0.051580 .   
## CitycatFountain Valley 0.1719553 0.3642569 0.472 0.636881   
## CitycatFremont 0.8428982 0.3207218 2.628 0.008592 \*\*   
## CitycatFridley -0.5351023 0.4130748 -1.295 0.195192   
## CitycatGahanna -0.6572212 0.3770721 -1.743 0.081355 .   
## CitycatGarden City -0.3108483 0.3700337 -0.840 0.400887   
## CitycatGarden Ridge -0.7227660 0.4356105 -1.659 0.097090 .   
## CitycatGarland -0.5280150 0.3169430 -1.666 0.095736 .   
## CitycatGeorgetown -0.8390985 0.4130299 -2.032 0.042210 \*   
## CitycatGermantown -0.5361234 0.3422624 -1.566 0.117267   
## CitycatGilbert -0.2247941 0.3133236 -0.717 0.473104   
## CitycatGlendale -0.4104971 0.3130946 -1.311 0.189839   
## CitycatGlenn Heights -0.4945946 0.6883924 -0.718 0.472471   
## CitycatGolden Beach 1.3256473 0.6884150 1.926 0.054161 .   
## CitycatGolden Valley -0.5026972 0.4703115 -1.069 0.285145   
## CitycatGoodlettsville -0.7038727 0.4131489 -1.704 0.088456 .   
## CitycatGrand Prairie -0.7839683 0.6883588 -1.139 0.254760   
## CitycatGranite Shoals 0.4791169 0.6884026 0.696 0.486447   
## CitycatGreenfield -0.9081207 0.3859486 -2.353 0.018634 \*   
## CitycatGreensboro -0.9176962 0.3131990 -2.930 0.003392 \*\*   
## CitycatGrosse Pointe -0.5233690 0.4353932 -1.202 0.229353   
## CitycatGrosse Pointe Farms -0.2883348 0.4130519 -0.698 0.485148   
## CitycatGrosse Pointe Park -0.4352224 0.3859664 -1.128 0.259494   
## CitycatGrosse Pointe Shores -0.5171890 0.6883497 -0.751 0.452453   
## CitycatGrosse Pointe Woods -0.3388128 0.3974648 -0.852 0.393982   
## CitycatGroveport -1.2563220 0.5333331 -2.356 0.018502 \*   
## CitycatHaltom City -0.6138210 0.3859385 -1.590 0.111745   
## CitycatHamtramck -0.7675652 0.3771626 -2.035 0.041853 \*   
## CitycatHarahan -0.7704189 0.5333303 -1.445 0.148601   
## CitycatHarper Woods -1.0458649 0.3556197 -2.941 0.003275 \*\*   
## CitycatHelotes -0.6857288 0.5332069 -1.286 0.198441   
## CitycatHenderson -0.2875550 0.3106340 -0.926 0.354611   
## CitycatHialeah -0.2957951 0.3151379 -0.939 0.347936   
## CitycatHialeah Gardens -1.0369649 0.4703883 -2.204 0.027501 \*   
## CitycatHighland Park -1.9006726 0.3859874 -4.924 8.53e-07 \*\*\*  
## CitycatHilliard -0.7881200 0.4131100 -1.908 0.056434 .   
## CitycatHillsborough -0.7008964 0.6885654 -1.018 0.308733   
## CitycatHollywood Park -0.0715512 0.5332356 -0.134 0.893259   
## CitycatHoover -0.7090468 0.3316004 -2.138 0.032507 \*   
## CitycatHorizon City -1.1254541 0.3266492 -3.445 0.000571 \*\*\*  
## CitycatHouston -0.5591557 0.3084547 -1.813 0.069882 .   
## CitycatHurst -0.4940762 0.6883813 -0.718 0.472928   
## CitycatIndian Hills -0.3206876 0.4704336 -0.682 0.495445   
## CitycatIrvine 0.4608907 0.3134204 1.471 0.141436   
## CitycatIrving -0.5168665 0.3188846 -1.621 0.105063   
## CitycatJacksonville -0.7797562 0.3091386 -2.522 0.011664 \*   
## CitycatJacksonville Beach 0.0389501 0.3442029 0.113 0.909905   
## CitycatJeffersontown -0.6574802 0.3974605 -1.654 0.098101 .   
## CitycatJersey City 1.2716050 0.6884796 1.847 0.064764 .   
## CitycatJones -0.2106111 0.6883658 -0.306 0.759640   
## CitycatJurupa Valley -0.0522056 0.3555238 -0.147 0.883259   
## CitycatKeller -0.7030735 0.3491530 -2.014 0.044058 \*   
## CitycatKey Biscayne 0.7200821 0.3442984 2.091 0.036500 \*   
## CitycatKirby -0.8968462 0.6883523 -1.303 0.192627   
## CitycatKnightdale -0.6847234 0.5332117 -1.284 0.199104   
## CitycatLa Vergne -0.6440528 0.5332493 -1.208 0.227142   
## CitycatLackawanna -0.9085835 0.3700843 -2.455 0.014094 \*   
## CitycatLake Forest Park 0.1019894 0.4702598 0.217 0.828305   
## CitycatLakeway -0.3334798 0.3555942 -0.938 0.348353   
## CitycatLakewood -0.6078405 0.3336117 -1.822 0.068469 .   
## CitycatLancaster -0.7833159 0.6884238 -1.138 0.255200   
## CitycatLaredo -0.8801870 0.3169765 -2.777 0.005494 \*\*   
## CitycatLauderdale -0.3568293 0.5332349 -0.669 0.503389   
## CitycatLeon Valley -0.6802583 0.4354403 -1.562 0.118248   
## CitycatLexington -0.5698770 0.3126491 -1.823 0.068357 .   
## CitycatLincoln -0.8339272 0.3120320 -2.673 0.007533 \*\*   
## CitycatLittleton -0.2263811 0.3277881 -0.691 0.489804   
## CitycatLive Oak -0.6670533 0.4353855 -1.532 0.125513   
## CitycatLong Beach 0.5137026 0.3169903 1.621 0.105126   
## CitycatLos Angeles 0.5910996 0.3092970 1.911 0.056004 .   
## CitycatLubbock -0.8775503 0.3124665 -2.808 0.004982 \*\*   
## CitycatLuther -0.8052589 0.6884570 -1.170 0.242152   
## CitycatLyndhurst -0.9459072 0.3555243 -2.661 0.007806 \*\*   
## CitycatMadison -0.4674763 0.3148870 -1.485 0.137669   
## CitycatManor -0.6902904 0.4130481 -1.671 0.094695 .   
## CitycatMaplewood -0.5478554 0.3520727 -1.556 0.119702   
## CitycatMatthews -0.6658266 0.3974380 -1.675 0.093891 .   
## CitycatMayfield Heights -0.7880420 0.4130705 -1.908 0.056435 .   
## CitycatMemphis -1.3808011 0.3110152 -4.440 9.06e-06 \*\*\*  
## CitycatMendota Heights -0.1755479 0.3975041 -0.442 0.658765   
## CitycatMeridian -0.0933752 0.3643533 -0.256 0.797740   
## CitycatMesa -0.3778281 0.3106935 -1.216 0.223968   
## CitycatMiami 0.0562953 0.3086897 0.182 0.855295   
## CitycatMiami Beach 0.1854858 0.3178141 0.584 0.559475   
## CitycatMiami Gardens -0.5458648 0.3975174 -1.373 0.169709   
## CitycatMiami Lakes -0.0776359 0.3491104 -0.222 0.824019   
## CitycatMiami Shores 0.0026063 0.5332079 0.005 0.996100   
## CitycatMiami Springs -0.2787836 0.6883563 -0.405 0.685482   
## CitycatMiddleton -0.4960754 0.4131143 -1.201 0.229835   
## CitycatMiddletown -0.6146634 0.6883534 -0.893 0.371895   
## CitycatMidwest City -1.0485062 0.3442480 -3.046 0.002324 \*\*   
## CitycatMilwaukee -1.0508611 0.3106864 -3.382 0.000720 \*\*\*  
## CitycatMinneapolis -0.1716237 0.3107500 -0.552 0.580756   
## CitycatMint Hill -0.7290936 0.3359536 -2.170 0.030001 \*   
## CitycatMissouri City -0.8876941 0.4130427 -2.149 0.031633 \*   
## CitycatModesto -0.1810342 0.3171005 -0.571 0.568070   
## CitycatMonona -0.2832243 0.4353506 -0.651 0.515334   
## CitycatMontgomery -0.3810488 0.4130295 -0.923 0.356242   
## CitycatMoore -0.7396187 0.3299201 -2.242 0.024984 \*   
## CitycatMorrisville -0.3536764 0.4703379 -0.752 0.452082   
## CitycatMounds View -0.3152588 0.4354138 -0.724 0.469046   
## CitycatMurphy -0.5969613 0.3643111 -1.639 0.101311   
## CitycatNeptune Beach -0.0314026 0.4353359 -0.072 0.942496   
## CitycatNew Brighton -0.4434259 0.4702773 -0.943 0.345741   
## CitycatNew Hope -0.3678541 0.3770889 -0.976 0.329318   
## CitycatNew Orleans -0.6971845 0.3104607 -2.246 0.024737 \*   
## CitycatNewark -0.4036255 0.3183731 -1.268 0.204892   
## CitycatNewtown -0.1969826 0.6886910 -0.286 0.774862   
## CitycatNichols Hills -0.1279960 0.3860000 -0.332 0.740198   
## CitycatNolensville -0.4543194 0.5332107 -0.852 0.394199   
## CitycatNorfolk -0.6440148 0.3142204 -2.050 0.040419 \*   
## CitycatNormandy Park -0.0977766 0.6895356 -0.142 0.887239   
## CitycatNorth Bay Village -0.2139096 0.3596214 -0.595 0.551971   
## CitycatNorth Las Vegas -0.5899148 0.3126411 -1.887 0.059191 .   
## CitycatNorth Miami -0.2298714 0.3307732 -0.695 0.487093   
## CitycatNorth Miami Beach -0.2341082 0.3299804 -0.709 0.478046   
## CitycatNorth Richland Hills -0.4682640 0.3250149 -1.441 0.149671   
## CitycatNorth Royalton -0.8787944 0.3387821 -2.594 0.009494 \*\*   
## CitycatNorthfield -0.0571032 0.6883901 -0.083 0.933891   
## CitycatNorthglenn -0.2730242 0.3859037 -0.707 0.479268   
## CitycatOak Park -0.7355679 0.4131249 -1.780 0.075009 .   
## CitycatOakdale -0.5311261 0.3859622 -1.376 0.168802   
## CitycatOakland 0.5638000 0.3150007 1.790 0.073494 .   
## CitycatOklahoma City -0.8143522 0.3103360 -2.624 0.008694 \*\*   
## CitycatOlmos Park 0.1195578 0.4131454 0.289 0.772290   
## CitycatOlmsted Falls -0.9883919 0.3770658 -2.621 0.008766 \*\*   
## CitycatOlmsted Township -0.9776793 0.4130832 -2.367 0.017952 \*   
## CitycatOmaha -0.8269310 0.3111361 -2.658 0.007872 \*\*   
## CitycatOrlando -0.5330278 0.3092728 -1.723 0.084815 .   
## CitycatOro Valley -0.3509584 0.3225887 -1.088 0.276632   
## CitycatOttawa Hills -0.8878327 0.6883639 -1.290 0.197144   
## CitycatPalmetto Bay 0.0392463 0.3490820 0.112 0.910486   
## CitycatPantego -0.8855140 0.6883499 -1.286 0.198307   
## CitycatPapillion -0.4241502 0.5332333 -0.795 0.426372   
## CitycatParadise Valley 0.6230807 0.3231331 1.928 0.053837 .   
## CitycatPark City -1.1224599 0.4354176 -2.578 0.009947 \*\*   
## CitycatParma -0.9963530 0.3325770 -2.996 0.002740 \*\*   
## CitycatPeoria -0.4858821 0.4130499 -1.176 0.239477   
## CitycatPepper Pike -0.4199530 0.4354954 -0.964 0.334901   
## CitycatPflugerville -0.5178672 0.6884342 -0.752 0.451915   
## CitycatPhoenix -0.2763514 0.3090067 -0.894 0.371160   
## CitycatPickerington 0.1927933 0.4703586 0.410 0.681894   
## CitycatPiedmont 0.5970563 0.5336871 1.119 0.263264   
## CitycatPlano -0.3764778 0.3137181 -1.200 0.230133   
## CitycatPlymouth -0.3418505 0.3271600 -1.045 0.296080   
## CitycatPortland 0.1156799 0.3094891 0.374 0.708574   
## CitycatPowell -0.9104073 0.6884391 -1.322 0.186042   
## CitycatRaleigh -0.4902101 0.3109414 -1.577 0.114917   
## CitycatRalston -1.2200766 0.4353987 -2.802 0.005080 \*\*   
## CitycatRed Oak -0.5238223 0.6883911 -0.761 0.446703   
## CitycatReno -0.4014112 0.3112354 -1.290 0.197157   
## CitycatReynoldsburg -0.8885149 0.4130392 -2.151 0.031474 \*   
## CitycatRichfield -0.2057988 0.3643630 -0.565 0.572203   
## CitycatRichland Hills -0.7834217 0.4353789 -1.799 0.071969 .   
## CitycatRichmond -0.4291153 0.3136546 -1.368 0.171291   
## CitycatRichmond Heights -1.1045331 0.4353866 -2.537 0.011191 \*   
## CitycatRio Rancho -1.6800957 0.3198121 -5.253 1.51e-07 \*\*\*  
## CitycatRiver Hills -0.6254791 0.6884739 -0.909 0.363624   
## CitycatRiver Rouge -1.3067520 0.5333264 -2.450 0.014286 \*   
## CitycatRiverside -0.0965904 0.3132499 -0.308 0.757819   
## CitycatRoanoke -0.3575077 0.3975036 -0.899 0.368459   
## CitycatRobbinsdale -0.6095306 0.4355439 -1.399 0.161687   
## CitycatRoseville -0.1917831 0.3595172 -0.533 0.593730   
## CitycatSachse -0.3265853 0.3403906 -0.959 0.337347   
## CitycatSaginaw -0.6408403 0.3442301 -1.862 0.062664 .   
## CitycatSan Antonio -0.7025821 0.3085416 -2.277 0.022790 \*   
## CitycatSan Diego 0.3701363 0.3098007 1.195 0.232196   
## CitycatSan Fernando 0.2182005 0.5332062 0.409 0.682380   
## CitycatSan Francisco 1.3923127 0.3120525 4.462 8.17e-06 \*\*\*  
## CitycatSan Jose 0.7725914 0.3117698 2.478 0.013217 \*   
## CitycatSand Springs -1.3631568 0.6884700 -1.980 0.047719 \*   
## CitycatSandy Springs -0.3355635 0.3173740 -1.057 0.290381   
## CitycatSanta Ana 0.4793695 0.3250006 1.475 0.140232   
## CitycatSantee -0.0513432 0.6883312 -0.075 0.940541   
## CitycatScottsdale 0.0840976 0.3100344 0.271 0.786199   
## CitycatSeattle 0.5623810 0.3100807 1.814 0.069744 .   
## CitycatSeven Hills -0.7536422 0.3859182 -1.953 0.050850 .   
## CitycatShavano Park -0.4531931 0.4357344 -1.040 0.298320   
## CitycatShively -0.6272180 0.3975633 -1.578 0.114659   
## CitycatShoreline 0.5462987 0.3465484 1.576 0.114949   
## CitycatShorewood -0.2832184 0.5333464 -0.531 0.595409   
## CitycatSignal Hill 0.3548724 0.6883936 0.516 0.606203   
## CitycatSocorro -1.0428453 0.3465671 -3.009 0.002624 \*\*   
## CitycatSolon -1.0170443 0.3555213 -2.861 0.004231 \*\*   
## CitycatSouth Euclid -1.1579725 0.3555014 -3.257 0.001127 \*\*   
## CitycatSouth Miami -0.0799572 0.4702702 -0.170 0.864993   
## CitycatSpeedway -3.4318577 0.6885694 -4.984 6.28e-07 \*\*\*  
## CitycatSpencer -3.5268930 0.6884676 -5.123 3.04e-07 \*\*\*  
## CitycatSpokane -0.4691935 0.3122281 -1.503 0.132924   
## CitycatSpokane Valley -0.4682879 0.3403968 -1.376 0.168925   
## CitycatSpring Lake Park -0.6502972 0.5332120 -1.220 0.222636   
## CitycatStafford -1.1620033 0.6883251 -1.688 0.091395 .   
## CitycatStockton -0.2574628 0.3164541 -0.814 0.415891   
## CitycatStrongsville -0.8373970 0.3770469 -2.221 0.026366 \*   
## CitycatSuffolk -0.3977812 0.5332967 -0.746 0.455741   
## CitycatSunny Isles Beach 0.2489762 0.3317110 0.751 0.452913   
## CitycatSurfside 0.0713481 0.5332788 0.134 0.893569   
## CitycatSweetwater -0.7361680 0.6885069 -1.069 0.284981   
## CitycatSwissvale -0.3382488 0.6884687 -0.491 0.623215   
## CitycatTampa -0.4607792 0.3096073 -1.488 0.136694   
## CitycatTemple Terrace -0.6509959 0.3770701 -1.726 0.084279 .   
## CitycatTerrell Hills 0.1530805 0.4702613 0.326 0.744789   
## CitycatThornton -0.4667490 0.3298901 -1.415 0.157123   
## CitycatTigard -0.0887841 0.3335686 -0.266 0.790115   
## CitycatToledo -1.3628401 0.3130697 -4.353 1.35e-05 \*\*\*  
## CitycatTorrance 0.6511557 0.4354173 1.495 0.134805   
## CitycatTucson -0.6745917 0.3094260 -2.180 0.029258 \*   
## CitycatTulsa -1.0417652 0.3110508 -3.349 0.000812 \*\*\*  
## CitycatUniversity Heights -1.0641129 0.3974670 -2.677 0.007429 \*\*   
## CitycatUpper Arlington -0.2206173 0.3555256 -0.621 0.534910   
## CitycatUrbandale -0.8720002 0.3254893 -2.679 0.007389 \*\*   
## CitycatVerona -0.4463201 0.3595548 -1.241 0.214504   
## CitycatVirginia Beach -0.4743790 0.3108832 -1.526 0.127048   
## CitycatVirginia Gardens 0.5202231 0.6884608 0.756 0.449878   
## CitycatWarr Acres -0.8706877 0.5331976 -1.633 0.102493   
## CitycatWatauga -0.6661751 0.4353996 -1.530 0.126024   
## CitycatWauwatosa -0.2796026 0.3643291 -0.767 0.442825   
## CitycatWest Allis -0.6924796 0.3387794 -2.044 0.040961 \*   
## CitycatWest Hollywood 1.0809041 0.3421852 3.159 0.001586 \*\*   
## CitycatWest Lake Hills 0.5304731 0.6888749 0.770 0.441274   
## CitycatWesterville -0.8788187 0.3643573 -2.412 0.015875 \*   
## CitycatWestminster -0.3572076 0.3770658 -0.947 0.343479   
## CitycatWhite Bear Lake -0.5021801 0.3859286 -1.301 0.193195   
## CitycatWhite Settlement 0.8020991 0.6885202 1.165 0.244048   
## CitycatWhitefish Bay -0.2713180 0.5332071 -0.509 0.610868   
## CitycatWhitehall -1.2745100 0.3975191 -3.206 0.001347 \*\*   
## CitycatWichita -0.9866417 0.3117570 -3.165 0.001554 \*\*   
## CitycatWindsor Heights -0.7940776 0.6885124 -1.153 0.248790   
## CitycatWinter Park 0.1258278 0.4703620 0.268 0.789077   
## CitycatWolfforth -0.6574668 0.5331949 -1.233 0.217563   
## CitycatWoodbury -0.5341785 0.3265782 -1.636 0.101921   
## CitycatWorthington -0.7407841 0.5332537 -1.389 0.164793   
## CitycatYukon -0.2919298 0.4703314 -0.621 0.534810   
## Bathrooms.c:Bedrooms.c 0.0602287 0.0380773 1.582 0.113722   
## Bathrooms.c:Size.c 0.7569923 0.0238622 31.723 < 2e-16 \*\*\*  
## Bedrooms.c:Size.c -0.4046527 0.0330129 -12.257 < 2e-16 \*\*\*  
## Year\_Built.c:Size.c -0.0015001 0.0002862 -5.242 1.60e-07 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.6156 on 21468 degrees of freedom  
## Multiple R-squared: 0.5767, Adjusted R-squared: 0.5699   
## F-statistic: 84.06 on 348 and 21468 DF, p-value: < 2.2e-16

car::vif (fit6)

## GVIF Df GVIF^(1/(2\*Df))  
## Bathrooms.c 2.358596 1 1.535772  
## Bedrooms.c 2.507902 1 1.583636  
## Year\_Built.c 1.579964 1 1.256966  
## Lot\_Size.c 1.375531 1 1.172830  
## Size.c 2.032377 1 1.425615  
## Citycat 2.671816 339 1.001451  
## Bathrooms.c:Bedrooms.c 3.289900 1 1.813808  
## Bathrooms.c:Size.c 2.719640 1 1.649133  
## Bedrooms.c:Size.c 3.764620 1 1.940263  
## Year\_Built.c:Size.c 1.213590 1 1.101631

R-squared is 0.5699. All VIFs are less than 5.

### Stepwise

#AIC  
fit6AIC = step (fit6, direction='both')

## Start: AIC=-20819.8  
## LogPrice ~ (Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Size.c + Bedrooms.c:Size.c +   
## Year\_Built.c:Size.c + Citycat)  
##   
## Df Sum of Sq RSS AIC  
## <none> 8136.9 -20820  
## - Bathrooms.c:Bedrooms.c 1 0.9 8137.8 -20819  
## - Year\_Built.c:Size.c 1 10.4 8147.3 -20794  
## - Bedrooms.c:Size.c 1 56.9 8193.8 -20670  
## - Lot\_Size.c 1 57.3 8194.2 -20669  
## - Bathrooms.c:Size.c 1 381.4 8518.3 -19822  
## - Citycat 339 5018.8 13155.6 -11016

summary (fit6AIC)

##   
## Call:  
## lm(formula = LogPrice ~ (Bathrooms.c + Bedrooms.c + Year\_Built.c +   
## Lot\_Size.c + Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Size.c +   
## Bedrooms.c:Size.c + Year\_Built.c:Size.c + Citycat), data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.7091 -0.2513 0.0269 0.3136 3.1145   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 12.9581888 0.3078900 42.087 < 2e-16 \*\*\*  
## Bathrooms.c 0.9518351 0.0148908 63.921 < 2e-16 \*\*\*  
## Bedrooms.c -0.0376585 0.0184184 -2.045 0.040905 \*   
## Year\_Built.c 0.0011480 0.0001701 6.750 1.51e-11 \*\*\*  
## Lot\_Size.c 0.0357067 0.0029040 12.296 < 2e-16 \*\*\*  
## Size.c 0.1136955 0.0104498 10.880 < 2e-16 \*\*\*  
## CitycatAlbuquerque -0.6925659 0.3103612 -2.231 0.025659 \*   
## CitycatAnaheim 0.0998892 0.3186985 0.313 0.753958   
## CitycatAnchorage -0.5820889 0.3119874 -1.866 0.062091 .   
## CitycatApple Valley -0.6750195 0.3336239 -2.023 0.043055 \*   
## CitycatArlington -0.6522700 0.3124926 -2.087 0.036872 \*   
## CitycatAtlantic Beach 0.0072270 0.3595224 0.020 0.983962   
## CitycatAurora -0.3036517 0.3116315 -0.974 0.329872   
## CitycatAustin -0.1276299 0.3093731 -0.413 0.679945   
## CitycatAventura -0.2174505 0.3200579 -0.679 0.496886   
## CitycatBainbridge Island 0.2322982 0.3373215 0.689 0.491048   
## CitycatBaker -1.1681936 0.6888169 -1.696 0.089911 .   
## CitycatBakersfield -0.4593498 0.3114305 -1.475 0.140236   
## CitycatBaltimore -0.8726907 0.3090666 -2.824 0.004753 \*\*   
## CitycatBaton Rouge -0.5479552 0.3108173 -1.763 0.077923 .   
## CitycatBay Harbor Islands -0.2954363 0.4133629 -0.715 0.474793   
## CitycatBay Village -0.3698912 0.3554952 -1.040 0.298121   
## CitycatBayside -0.4882486 0.4702396 -1.038 0.299143   
## CitycatBeachwood -1.3201704 0.3595144 -3.672 0.000241 \*\*\*  
## CitycatBedford -1.3503287 0.3465527 -3.896 9.79e-05 \*\*\*  
## CitycatBee Cave -0.0112493 0.6884820 -0.016 0.986964   
## CitycatBel Aire -1.0082706 0.4703706 -2.144 0.032079 \*   
## CitycatBelle Isle -0.3116155 0.6883403 -0.453 0.650765   
## CitycatBellevue -0.3956122 0.4130537 -0.958 0.338187   
## CitycatBenbrook -0.3738967 0.3859663 -0.969 0.332691   
## CitycatBerkeley 1.0965812 0.6884808 1.593 0.111230   
## CitycatBeverly Hills 1.1104178 0.3859514 2.877 0.004018 \*\*   
## CitycatBexley -0.2770312 0.5332243 -0.520 0.603390   
## CitycatBiscayne Park -0.0587829 0.6883418 -0.085 0.931946   
## CitycatBixby -0.5365375 0.5332994 -1.006 0.314392   
## CitycatBlaine -0.3170340 0.3316459 -0.956 0.339113   
## CitycatBloomington -0.3475290 0.3335765 -1.042 0.297504   
## CitycatBlue Ash -0.2916122 0.4702802 -0.620 0.535210   
## CitycatBoise -0.2644664 0.3121591 -0.847 0.396884   
## CitycatBrentwood -0.3791030 0.3554961 -1.066 0.286252   
## CitycatBroken Arrow -0.8993547 0.6883927 -1.306 0.191412   
## CitycatBrookhaven -0.3113637 0.3271510 -0.952 0.341238   
## CitycatBrooklyn Center -0.5989179 0.3642908 -1.644 0.100177   
## CitycatBrooklyn Park -0.6593635 0.3315919 -1.988 0.046771 \*   
## CitycatBrown Deer -0.7963277 0.5332186 -1.493 0.135338   
## CitycatBuffalo -0.8981008 0.3124579 -2.874 0.004053 \*\*   
## CitycatBurbank 0.2310377 0.4703327 0.491 0.623275   
## CitycatBurien 0.0143508 0.3442787 0.042 0.966751   
## CitycatBurleson -0.6538151 0.4131135 -1.583 0.113515   
## CitycatCampbell 0.8106017 0.5333087 1.520 0.128539   
## CitycatCarson 0.2641245 0.3770451 0.701 0.483615   
## CitycatCary 0.0970527 0.6883967 0.141 0.887884   
## CitycatCastroville -0.6827123 0.5333330 -1.280 0.200529   
## CitycatCeres -0.2232437 0.6884656 -0.324 0.745742   
## CitycatChandler -0.3154555 0.6883852 -0.458 0.646774   
## CitycatChesapeake -0.6240141 0.3120080 -2.000 0.045513 \*   
## CitycatChicago -0.2563849 0.3085316 -0.831 0.405992   
## CitycatChoctaw -0.5836094 0.6884669 -0.848 0.396618   
## CitycatChula Vista -0.0035125 0.3179721 -0.011 0.991187   
## CitycatCincinnati -0.8273043 0.3101490 -2.667 0.007649 \*\*   
## CitycatCleveland -1.2369627 0.3104352 -3.985 6.78e-05 \*\*\*  
## CitycatCleveland Heights -1.0194236 0.3260296 -3.127 0.001770 \*\*   
## CitycatClive -0.4455292 0.3442188 -1.294 0.195569   
## CitycatColerain Township -0.5956984 0.4355371 -1.368 0.171410   
## CitycatCollege Park -1.0392176 0.3358970 -3.094 0.001978 \*\*   
## CitycatColorado Springs -0.4518088 0.3102955 -1.456 0.145391   
## CitycatColumbia Heights -0.6553589 0.3700211 -1.771 0.076552 .   
## CitycatColumbus -0.7822809 0.3104550 -2.520 0.011750 \*   
## CitycatCommerce City -0.3134276 0.3260335 -0.961 0.336394   
## CitycatConverse -0.9019639 0.4702830 -1.918 0.055135 .   
## CitycatCoral Gables 0.4131706 0.3236738 1.277 0.201792   
## CitycatCoronado 1.2068066 0.3421937 3.527 0.000422 \*\*\*  
## CitycatCorpus Christi -0.7568549 0.3119413 -2.426 0.015263 \*   
## CitycatCrafton -1.0697277 0.6884359 -1.554 0.120234   
## CitycatCrowley -0.6006528 0.3595626 -1.671 0.094833 .   
## CitycatCrystal -0.4010905 0.3859817 -1.039 0.298750   
## CitycatCulver City 0.4652039 0.3859657 1.205 0.228101   
## CitycatCutler Bay -0.3797687 0.3359377 -1.130 0.258289   
## CitycatDallas -0.3477140 0.3089461 -1.125 0.260396   
## CitycatDel City -1.6172989 0.3975108 -4.069 4.75e-05 \*\*\*  
## CitycatDel Mar 0.7352990 0.3974779 1.850 0.064340 .   
## CitycatDenton -0.4271649 0.6883910 -0.621 0.534918   
## CitycatDenver 0.1255193 0.3093335 0.406 0.684913   
## CitycatDerby -2.8688309 0.6884578 -4.167 3.10e-05 \*\*\*  
## CitycatDes Moines -0.7596162 0.3138336 -2.420 0.015510 \*   
## CitycatDetroit -1.7290854 0.3101271 -5.575 2.50e-08 \*\*\*  
## CitycatDoral -0.2008660 0.3299403 -0.609 0.542667   
## CitycatDouglas -4.1433888 0.6884686 -6.018 1.79e-09 \*\*\*  
## CitycatDublin -0.6443197 0.3643196 -1.769 0.076982 .   
## CitycatDunwoody -0.4277655 0.3442097 -1.243 0.213975   
## CitycatDurham -0.5327300 0.3122787 -1.706 0.088033 .   
## CitycatEagan -0.2757035 0.3403925 -0.810 0.417973   
## CitycatEast Cleveland -2.1203583 0.5332916 -3.976 7.03e-05 \*\*\*  
## CitycatEast Orange -0.2941727 0.6884219 -0.427 0.669155   
## CitycatEastvale -0.2234479 0.6883695 -0.325 0.745484   
## CitycatEcorse -0.4403130 0.5334905 -0.825 0.409186   
## CitycatEdgewood -0.6669694 0.4702345 -1.418 0.156095   
## CitycatEdina 0.0492575 0.3284413 0.150 0.880787   
## CitycatEdmond -0.5002634 0.4354343 -1.149 0.250617   
## CitycatEl Paso -0.9712023 0.3097978 -3.135 0.001721 \*\*   
## CitycatEl Portal 0.5292482 0.5332452 0.993 0.320963   
## CitycatElmwood Park -0.6098991 0.6884195 -0.886 0.375659   
## CitycatEnglewood -0.3429353 0.6883418 -0.498 0.618345   
## CitycatEuclid -1.3514033 0.3326007 -4.063 4.86e-05 \*\*\*  
## CitycatEuless -1.0400899 0.6883668 -1.511 0.130815   
## CitycatEvendale -0.9040382 0.6884584 -1.313 0.189152   
## CitycatFairview Park -0.7330919 0.3700436 -1.981 0.047593 \*   
## CitycatFarmers Branch -0.4954168 0.3770544 -1.314 0.188889   
## CitycatFerndale -0.4818376 0.3404998 -1.415 0.157057   
## CitycatFitchburg -0.6973864 0.3556037 -1.961 0.049876 \*   
## CitycatForest Hill -0.9462550 0.5332266 -1.775 0.075981 .   
## CitycatFort Wayne -1.1780514 0.3124909 -3.770 0.000164 \*\*\*  
## CitycatFort Worth -0.6022786 0.3093801 -1.947 0.051580 .   
## CitycatFountain Valley 0.1719553 0.3642569 0.472 0.636881   
## CitycatFremont 0.8428982 0.3207218 2.628 0.008592 \*\*   
## CitycatFridley -0.5351023 0.4130748 -1.295 0.195192   
## CitycatGahanna -0.6572212 0.3770721 -1.743 0.081355 .   
## CitycatGarden City -0.3108483 0.3700337 -0.840 0.400887   
## CitycatGarden Ridge -0.7227660 0.4356105 -1.659 0.097090 .   
## CitycatGarland -0.5280150 0.3169430 -1.666 0.095736 .   
## CitycatGeorgetown -0.8390985 0.4130299 -2.032 0.042210 \*   
## CitycatGermantown -0.5361234 0.3422624 -1.566 0.117267   
## CitycatGilbert -0.2247941 0.3133236 -0.717 0.473104   
## CitycatGlendale -0.4104971 0.3130946 -1.311 0.189839   
## CitycatGlenn Heights -0.4945946 0.6883924 -0.718 0.472471   
## CitycatGolden Beach 1.3256473 0.6884150 1.926 0.054161 .   
## CitycatGolden Valley -0.5026972 0.4703115 -1.069 0.285145   
## CitycatGoodlettsville -0.7038727 0.4131489 -1.704 0.088456 .   
## CitycatGrand Prairie -0.7839683 0.6883588 -1.139 0.254760   
## CitycatGranite Shoals 0.4791169 0.6884026 0.696 0.486447   
## CitycatGreenfield -0.9081207 0.3859486 -2.353 0.018634 \*   
## CitycatGreensboro -0.9176962 0.3131990 -2.930 0.003392 \*\*   
## CitycatGrosse Pointe -0.5233690 0.4353932 -1.202 0.229353   
## CitycatGrosse Pointe Farms -0.2883348 0.4130519 -0.698 0.485148   
## CitycatGrosse Pointe Park -0.4352224 0.3859664 -1.128 0.259494   
## CitycatGrosse Pointe Shores -0.5171890 0.6883497 -0.751 0.452453   
## CitycatGrosse Pointe Woods -0.3388128 0.3974648 -0.852 0.393982   
## CitycatGroveport -1.2563220 0.5333331 -2.356 0.018502 \*   
## CitycatHaltom City -0.6138210 0.3859385 -1.590 0.111745   
## CitycatHamtramck -0.7675652 0.3771626 -2.035 0.041853 \*   
## CitycatHarahan -0.7704189 0.5333303 -1.445 0.148601   
## CitycatHarper Woods -1.0458649 0.3556197 -2.941 0.003275 \*\*   
## CitycatHelotes -0.6857288 0.5332069 -1.286 0.198441   
## CitycatHenderson -0.2875550 0.3106340 -0.926 0.354611   
## CitycatHialeah -0.2957951 0.3151379 -0.939 0.347936   
## CitycatHialeah Gardens -1.0369649 0.4703883 -2.204 0.027501 \*   
## CitycatHighland Park -1.9006726 0.3859874 -4.924 8.53e-07 \*\*\*  
## CitycatHilliard -0.7881200 0.4131100 -1.908 0.056434 .   
## CitycatHillsborough -0.7008964 0.6885654 -1.018 0.308733   
## CitycatHollywood Park -0.0715512 0.5332356 -0.134 0.893259   
## CitycatHoover -0.7090468 0.3316004 -2.138 0.032507 \*   
## CitycatHorizon City -1.1254541 0.3266492 -3.445 0.000571 \*\*\*  
## CitycatHouston -0.5591557 0.3084547 -1.813 0.069882 .   
## CitycatHurst -0.4940762 0.6883813 -0.718 0.472928   
## CitycatIndian Hills -0.3206876 0.4704336 -0.682 0.495445   
## CitycatIrvine 0.4608907 0.3134204 1.471 0.141436   
## CitycatIrving -0.5168665 0.3188846 -1.621 0.105063   
## CitycatJacksonville -0.7797562 0.3091386 -2.522 0.011664 \*   
## CitycatJacksonville Beach 0.0389501 0.3442029 0.113 0.909905   
## CitycatJeffersontown -0.6574802 0.3974605 -1.654 0.098101 .   
## CitycatJersey City 1.2716050 0.6884796 1.847 0.064764 .   
## CitycatJones -0.2106111 0.6883658 -0.306 0.759640   
## CitycatJurupa Valley -0.0522056 0.3555238 -0.147 0.883259   
## CitycatKeller -0.7030735 0.3491530 -2.014 0.044058 \*   
## CitycatKey Biscayne 0.7200821 0.3442984 2.091 0.036500 \*   
## CitycatKirby -0.8968462 0.6883523 -1.303 0.192627   
## CitycatKnightdale -0.6847234 0.5332117 -1.284 0.199104   
## CitycatLa Vergne -0.6440528 0.5332493 -1.208 0.227142   
## CitycatLackawanna -0.9085835 0.3700843 -2.455 0.014094 \*   
## CitycatLake Forest Park 0.1019894 0.4702598 0.217 0.828305   
## CitycatLakeway -0.3334798 0.3555942 -0.938 0.348353   
## CitycatLakewood -0.6078405 0.3336117 -1.822 0.068469 .   
## CitycatLancaster -0.7833159 0.6884238 -1.138 0.255200   
## CitycatLaredo -0.8801870 0.3169765 -2.777 0.005494 \*\*   
## CitycatLauderdale -0.3568293 0.5332349 -0.669 0.503389   
## CitycatLeon Valley -0.6802583 0.4354403 -1.562 0.118248   
## CitycatLexington -0.5698770 0.3126491 -1.823 0.068357 .   
## CitycatLincoln -0.8339272 0.3120320 -2.673 0.007533 \*\*   
## CitycatLittleton -0.2263811 0.3277881 -0.691 0.489804   
## CitycatLive Oak -0.6670533 0.4353855 -1.532 0.125513   
## CitycatLong Beach 0.5137026 0.3169903 1.621 0.105126   
## CitycatLos Angeles 0.5910996 0.3092970 1.911 0.056004 .   
## CitycatLubbock -0.8775503 0.3124665 -2.808 0.004982 \*\*   
## CitycatLuther -0.8052589 0.6884570 -1.170 0.242152   
## CitycatLyndhurst -0.9459072 0.3555243 -2.661 0.007806 \*\*   
## CitycatMadison -0.4674763 0.3148870 -1.485 0.137669   
## CitycatManor -0.6902904 0.4130481 -1.671 0.094695 .   
## CitycatMaplewood -0.5478554 0.3520727 -1.556 0.119702   
## CitycatMatthews -0.6658266 0.3974380 -1.675 0.093891 .   
## CitycatMayfield Heights -0.7880420 0.4130705 -1.908 0.056435 .   
## CitycatMemphis -1.3808011 0.3110152 -4.440 9.06e-06 \*\*\*  
## CitycatMendota Heights -0.1755479 0.3975041 -0.442 0.658765   
## CitycatMeridian -0.0933752 0.3643533 -0.256 0.797740   
## CitycatMesa -0.3778281 0.3106935 -1.216 0.223968   
## CitycatMiami 0.0562953 0.3086897 0.182 0.855295   
## CitycatMiami Beach 0.1854858 0.3178141 0.584 0.559475   
## CitycatMiami Gardens -0.5458648 0.3975174 -1.373 0.169709   
## CitycatMiami Lakes -0.0776359 0.3491104 -0.222 0.824019   
## CitycatMiami Shores 0.0026063 0.5332079 0.005 0.996100   
## CitycatMiami Springs -0.2787836 0.6883563 -0.405 0.685482   
## CitycatMiddleton -0.4960754 0.4131143 -1.201 0.229835   
## CitycatMiddletown -0.6146634 0.6883534 -0.893 0.371895   
## CitycatMidwest City -1.0485062 0.3442480 -3.046 0.002324 \*\*   
## CitycatMilwaukee -1.0508611 0.3106864 -3.382 0.000720 \*\*\*  
## CitycatMinneapolis -0.1716237 0.3107500 -0.552 0.580756   
## CitycatMint Hill -0.7290936 0.3359536 -2.170 0.030001 \*   
## CitycatMissouri City -0.8876941 0.4130427 -2.149 0.031633 \*   
## CitycatModesto -0.1810342 0.3171005 -0.571 0.568070   
## CitycatMonona -0.2832243 0.4353506 -0.651 0.515334   
## CitycatMontgomery -0.3810488 0.4130295 -0.923 0.356242   
## CitycatMoore -0.7396187 0.3299201 -2.242 0.024984 \*   
## CitycatMorrisville -0.3536764 0.4703379 -0.752 0.452082   
## CitycatMounds View -0.3152588 0.4354138 -0.724 0.469046   
## CitycatMurphy -0.5969613 0.3643111 -1.639 0.101311   
## CitycatNeptune Beach -0.0314026 0.4353359 -0.072 0.942496   
## CitycatNew Brighton -0.4434259 0.4702773 -0.943 0.345741   
## CitycatNew Hope -0.3678541 0.3770889 -0.976 0.329318   
## CitycatNew Orleans -0.6971845 0.3104607 -2.246 0.024737 \*   
## CitycatNewark -0.4036255 0.3183731 -1.268 0.204892   
## CitycatNewtown -0.1969826 0.6886910 -0.286 0.774862   
## CitycatNichols Hills -0.1279960 0.3860000 -0.332 0.740198   
## CitycatNolensville -0.4543194 0.5332107 -0.852 0.394199   
## CitycatNorfolk -0.6440148 0.3142204 -2.050 0.040419 \*   
## CitycatNormandy Park -0.0977766 0.6895356 -0.142 0.887239   
## CitycatNorth Bay Village -0.2139096 0.3596214 -0.595 0.551971   
## CitycatNorth Las Vegas -0.5899148 0.3126411 -1.887 0.059191 .   
## CitycatNorth Miami -0.2298714 0.3307732 -0.695 0.487093   
## CitycatNorth Miami Beach -0.2341082 0.3299804 -0.709 0.478046   
## CitycatNorth Richland Hills -0.4682640 0.3250149 -1.441 0.149671   
## CitycatNorth Royalton -0.8787944 0.3387821 -2.594 0.009494 \*\*   
## CitycatNorthfield -0.0571032 0.6883901 -0.083 0.933891   
## CitycatNorthglenn -0.2730242 0.3859037 -0.707 0.479268   
## CitycatOak Park -0.7355679 0.4131249 -1.780 0.075009 .   
## CitycatOakdale -0.5311261 0.3859622 -1.376 0.168802   
## CitycatOakland 0.5638000 0.3150007 1.790 0.073494 .   
## CitycatOklahoma City -0.8143522 0.3103360 -2.624 0.008694 \*\*   
## CitycatOlmos Park 0.1195578 0.4131454 0.289 0.772290   
## CitycatOlmsted Falls -0.9883919 0.3770658 -2.621 0.008766 \*\*   
## CitycatOlmsted Township -0.9776793 0.4130832 -2.367 0.017952 \*   
## CitycatOmaha -0.8269310 0.3111361 -2.658 0.007872 \*\*   
## CitycatOrlando -0.5330278 0.3092728 -1.723 0.084815 .   
## CitycatOro Valley -0.3509584 0.3225887 -1.088 0.276632   
## CitycatOttawa Hills -0.8878327 0.6883639 -1.290 0.197144   
## CitycatPalmetto Bay 0.0392463 0.3490820 0.112 0.910486   
## CitycatPantego -0.8855140 0.6883499 -1.286 0.198307   
## CitycatPapillion -0.4241502 0.5332333 -0.795 0.426372   
## CitycatParadise Valley 0.6230807 0.3231331 1.928 0.053837 .   
## CitycatPark City -1.1224599 0.4354176 -2.578 0.009947 \*\*   
## CitycatParma -0.9963530 0.3325770 -2.996 0.002740 \*\*   
## CitycatPeoria -0.4858821 0.4130499 -1.176 0.239477   
## CitycatPepper Pike -0.4199530 0.4354954 -0.964 0.334901   
## CitycatPflugerville -0.5178672 0.6884342 -0.752 0.451915   
## CitycatPhoenix -0.2763514 0.3090067 -0.894 0.371160   
## CitycatPickerington 0.1927933 0.4703586 0.410 0.681894   
## CitycatPiedmont 0.5970563 0.5336871 1.119 0.263264   
## CitycatPlano -0.3764778 0.3137181 -1.200 0.230133   
## CitycatPlymouth -0.3418505 0.3271600 -1.045 0.296080   
## CitycatPortland 0.1156799 0.3094891 0.374 0.708574   
## CitycatPowell -0.9104073 0.6884391 -1.322 0.186042   
## CitycatRaleigh -0.4902101 0.3109414 -1.577 0.114917   
## CitycatRalston -1.2200766 0.4353987 -2.802 0.005080 \*\*   
## CitycatRed Oak -0.5238223 0.6883911 -0.761 0.446703   
## CitycatReno -0.4014112 0.3112354 -1.290 0.197157   
## CitycatReynoldsburg -0.8885149 0.4130392 -2.151 0.031474 \*   
## CitycatRichfield -0.2057988 0.3643630 -0.565 0.572203   
## CitycatRichland Hills -0.7834217 0.4353789 -1.799 0.071969 .   
## CitycatRichmond -0.4291153 0.3136546 -1.368 0.171291   
## CitycatRichmond Heights -1.1045331 0.4353866 -2.537 0.011191 \*   
## CitycatRio Rancho -1.6800957 0.3198121 -5.253 1.51e-07 \*\*\*  
## CitycatRiver Hills -0.6254791 0.6884739 -0.909 0.363624   
## CitycatRiver Rouge -1.3067520 0.5333264 -2.450 0.014286 \*   
## CitycatRiverside -0.0965904 0.3132499 -0.308 0.757819   
## CitycatRoanoke -0.3575077 0.3975036 -0.899 0.368459   
## CitycatRobbinsdale -0.6095306 0.4355439 -1.399 0.161687   
## CitycatRoseville -0.1917831 0.3595172 -0.533 0.593730   
## CitycatSachse -0.3265853 0.3403906 -0.959 0.337347   
## CitycatSaginaw -0.6408403 0.3442301 -1.862 0.062664 .   
## CitycatSan Antonio -0.7025821 0.3085416 -2.277 0.022790 \*   
## CitycatSan Diego 0.3701363 0.3098007 1.195 0.232196   
## CitycatSan Fernando 0.2182005 0.5332062 0.409 0.682380   
## CitycatSan Francisco 1.3923127 0.3120525 4.462 8.17e-06 \*\*\*  
## CitycatSan Jose 0.7725914 0.3117698 2.478 0.013217 \*   
## CitycatSand Springs -1.3631568 0.6884700 -1.980 0.047719 \*   
## CitycatSandy Springs -0.3355635 0.3173740 -1.057 0.290381   
## CitycatSanta Ana 0.4793695 0.3250006 1.475 0.140232   
## CitycatSantee -0.0513432 0.6883312 -0.075 0.940541   
## CitycatScottsdale 0.0840976 0.3100344 0.271 0.786199   
## CitycatSeattle 0.5623810 0.3100807 1.814 0.069744 .   
## CitycatSeven Hills -0.7536422 0.3859182 -1.953 0.050850 .   
## CitycatShavano Park -0.4531931 0.4357344 -1.040 0.298320   
## CitycatShively -0.6272180 0.3975633 -1.578 0.114659   
## CitycatShoreline 0.5462987 0.3465484 1.576 0.114949   
## CitycatShorewood -0.2832184 0.5333464 -0.531 0.595409   
## CitycatSignal Hill 0.3548724 0.6883936 0.516 0.606203   
## CitycatSocorro -1.0428453 0.3465671 -3.009 0.002624 \*\*   
## CitycatSolon -1.0170443 0.3555213 -2.861 0.004231 \*\*   
## CitycatSouth Euclid -1.1579725 0.3555014 -3.257 0.001127 \*\*   
## CitycatSouth Miami -0.0799572 0.4702702 -0.170 0.864993   
## CitycatSpeedway -3.4318577 0.6885694 -4.984 6.28e-07 \*\*\*  
## CitycatSpencer -3.5268930 0.6884676 -5.123 3.04e-07 \*\*\*  
## CitycatSpokane -0.4691935 0.3122281 -1.503 0.132924   
## CitycatSpokane Valley -0.4682879 0.3403968 -1.376 0.168925   
## CitycatSpring Lake Park -0.6502972 0.5332120 -1.220 0.222636   
## CitycatStafford -1.1620033 0.6883251 -1.688 0.091395 .   
## CitycatStockton -0.2574628 0.3164541 -0.814 0.415891   
## CitycatStrongsville -0.8373970 0.3770469 -2.221 0.026366 \*   
## CitycatSuffolk -0.3977812 0.5332967 -0.746 0.455741   
## CitycatSunny Isles Beach 0.2489762 0.3317110 0.751 0.452913   
## CitycatSurfside 0.0713481 0.5332788 0.134 0.893569   
## CitycatSweetwater -0.7361680 0.6885069 -1.069 0.284981   
## CitycatSwissvale -0.3382488 0.6884687 -0.491 0.623215   
## CitycatTampa -0.4607792 0.3096073 -1.488 0.136694   
## CitycatTemple Terrace -0.6509959 0.3770701 -1.726 0.084279 .   
## CitycatTerrell Hills 0.1530805 0.4702613 0.326 0.744789   
## CitycatThornton -0.4667490 0.3298901 -1.415 0.157123   
## CitycatTigard -0.0887841 0.3335686 -0.266 0.790115   
## CitycatToledo -1.3628401 0.3130697 -4.353 1.35e-05 \*\*\*  
## CitycatTorrance 0.6511557 0.4354173 1.495 0.134805   
## CitycatTucson -0.6745917 0.3094260 -2.180 0.029258 \*   
## CitycatTulsa -1.0417652 0.3110508 -3.349 0.000812 \*\*\*  
## CitycatUniversity Heights -1.0641129 0.3974670 -2.677 0.007429 \*\*   
## CitycatUpper Arlington -0.2206173 0.3555256 -0.621 0.534910   
## CitycatUrbandale -0.8720002 0.3254893 -2.679 0.007389 \*\*   
## CitycatVerona -0.4463201 0.3595548 -1.241 0.214504   
## CitycatVirginia Beach -0.4743790 0.3108832 -1.526 0.127048   
## CitycatVirginia Gardens 0.5202231 0.6884608 0.756 0.449878   
## CitycatWarr Acres -0.8706877 0.5331976 -1.633 0.102493   
## CitycatWatauga -0.6661751 0.4353996 -1.530 0.126024   
## CitycatWauwatosa -0.2796026 0.3643291 -0.767 0.442825   
## CitycatWest Allis -0.6924796 0.3387794 -2.044 0.040961 \*   
## CitycatWest Hollywood 1.0809041 0.3421852 3.159 0.001586 \*\*   
## CitycatWest Lake Hills 0.5304731 0.6888749 0.770 0.441274   
## CitycatWesterville -0.8788187 0.3643573 -2.412 0.015875 \*   
## CitycatWestminster -0.3572076 0.3770658 -0.947 0.343479   
## CitycatWhite Bear Lake -0.5021801 0.3859286 -1.301 0.193195   
## CitycatWhite Settlement 0.8020991 0.6885202 1.165 0.244048   
## CitycatWhitefish Bay -0.2713180 0.5332071 -0.509 0.610868   
## CitycatWhitehall -1.2745100 0.3975191 -3.206 0.001347 \*\*   
## CitycatWichita -0.9866417 0.3117570 -3.165 0.001554 \*\*   
## CitycatWindsor Heights -0.7940776 0.6885124 -1.153 0.248790   
## CitycatWinter Park 0.1258278 0.4703620 0.268 0.789077   
## CitycatWolfforth -0.6574668 0.5331949 -1.233 0.217563   
## CitycatWoodbury -0.5341785 0.3265782 -1.636 0.101921   
## CitycatWorthington -0.7407841 0.5332537 -1.389 0.164793   
## CitycatYukon -0.2919298 0.4703314 -0.621 0.534810   
## Bathrooms.c:Bedrooms.c 0.0602287 0.0380773 1.582 0.113722   
## Bathrooms.c:Size.c 0.7569923 0.0238622 31.723 < 2e-16 \*\*\*  
## Bedrooms.c:Size.c -0.4046527 0.0330129 -12.257 < 2e-16 \*\*\*  
## Year\_Built.c:Size.c -0.0015001 0.0002862 -5.242 1.60e-07 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.6156 on 21468 degrees of freedom  
## Multiple R-squared: 0.5767, Adjusted R-squared: 0.5699   
## F-statistic: 84.06 on 348 and 21468 DF, p-value: < 2.2e-16

Nothing was removed. We will try stepwise with the BIC criterion, which is stricter.

BIC:

fit6BIC = step (fit6, direction="both",   
 k = log (fit6$rank + fit6$df.residual))

## Start: AIC=-18031.14  
## LogPrice ~ (Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c + Bathrooms.c:Bedrooms.c + Bathrooms.c:Size.c + Bedrooms.c:Size.c +   
## Year\_Built.c:Size.c + Citycat)  
##   
## Df Sum of Sq RSS AIC  
## - Bathrooms.c:Bedrooms.c 1 0.9 8137.8 -18039  
## <none> 8136.9 -18031  
## - Year\_Built.c:Size.c 1 10.4 8147.3 -18013  
## - Bedrooms.c:Size.c 1 56.9 8193.8 -17889  
## - Lot\_Size.c 1 57.3 8194.2 -17888  
## - Bathrooms.c:Size.c 1 381.4 8518.3 -17042  
## - Citycat 339 5018.8 13155.6 -10936  
##   
## Step: AIC=-18038.59  
## LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c +   
## Size.c + Citycat + Bathrooms.c:Size.c + Bedrooms.c:Size.c +   
## Year\_Built.c:Size.c  
##   
## Df Sum of Sq RSS AIC  
## <none> 8137.8 -18039  
## + Bathrooms.c:Bedrooms.c 1 0.9 8136.9 -18031  
## - Year\_Built.c:Size.c 1 10.5 8148.3 -18020  
## - Lot\_Size.c 1 57.0 8194.8 -17896  
## - Bedrooms.c:Size.c 1 70.6 8208.4 -17860  
## - Bathrooms.c:Size.c 1 446.8 8584.6 -16883  
## - Citycat 339 5031.4 13169.2 -10924

summary (fit6BIC)

##   
## Call:  
## lm(formula = LogPrice ~ Bathrooms.c + Bedrooms.c + Year\_Built.c +   
## Lot\_Size.c + Size.c + Citycat + Bathrooms.c:Size.c + Bedrooms.c:Size.c +   
## Year\_Built.c:Size.c, data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.7125 -0.2513 0.0269 0.3136 3.1135   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 12.9637796 0.3078805 42.107 < 2e-16 \*\*\*  
## Bathrooms.c 0.9501550 0.0148533 63.969 < 2e-16 \*\*\*  
## Bedrooms.c -0.0398536 0.0183667 -2.170 0.030026 \*   
## Year\_Built.c 0.0011414 0.0001700 6.714 1.95e-11 \*\*\*  
## Lot\_Size.c 0.0356045 0.0029034 12.263 < 2e-16 \*\*\*  
## Size.c 0.1169996 0.0102392 11.427 < 2e-16 \*\*\*  
## CitycatAlbuquerque -0.6979076 0.3103537 -2.249 0.024539 \*   
## CitycatAnaheim 0.0949958 0.3186946 0.298 0.765647   
## CitycatAnchorage -0.5862374 0.3119873 -1.879 0.060252 .   
## CitycatApple Valley -0.6822708 0.3336041 -2.045 0.040852 \*   
## CitycatArlington -0.6582743 0.3124805 -2.107 0.035163 \*   
## CitycatAtlantic Beach 0.0020741 0.3595202 0.006 0.995397   
## CitycatAurora -0.3096636 0.3116192 -0.994 0.320368   
## CitycatAustin -0.1330679 0.3093649 -0.430 0.667103   
## CitycatAventura -0.2231015 0.3200492 -0.697 0.485757   
## CitycatBainbridge Island 0.2256635 0.3373072 0.669 0.503493   
## CitycatBaker -1.1741582 0.6888307 -1.705 0.088290 .   
## CitycatBakersfield -0.4646840 0.3114231 -1.492 0.135680   
## CitycatBaltimore -0.8782412 0.3090575 -2.842 0.004492 \*\*   
## CitycatBaton Rouge -0.5542502 0.3108027 -1.783 0.074554 .   
## CitycatBay Harbor Islands -0.3062065 0.4133213 -0.741 0.458796   
## CitycatBay Village -0.3748599 0.3554937 -1.054 0.291677   
## CitycatBayside -0.4912780 0.4702521 -1.045 0.296168   
## CitycatBeachwood -1.3263880 0.3595055 -3.689 0.000225 \*\*\*  
## CitycatBedford -1.3549973 0.3465523 -3.910 9.26e-05 \*\*\*  
## CitycatBee Cave -0.0193809 0.6884869 -0.028 0.977543   
## CitycatBel Aire -1.0122544 0.4703803 -2.152 0.031409 \*   
## CitycatBelle Isle -0.3147610 0.6883615 -0.457 0.647488   
## CitycatBellevue -0.4022698 0.4130467 -0.974 0.330113   
## CitycatBenbrook -0.3798271 0.3859616 -0.984 0.325074   
## CitycatBerkeley 1.0849041 0.6884653 1.576 0.115080   
## CitycatBeverly Hills 1.1049280 0.3859492 2.863 0.004202 \*\*   
## CitycatBexley -0.2826927 0.5332309 -0.530 0.596013   
## CitycatBiscayne Park -0.0564545 0.6883643 -0.082 0.934638   
## CitycatBixby -0.5428648 0.5333031 -1.018 0.308723   
## CitycatBlaine -0.3222784 0.3316409 -0.972 0.331176   
## CitycatBloomington -0.3527223 0.3335720 -1.057 0.290337   
## CitycatBlue Ash -0.2980693 0.4702790 -0.634 0.526209   
## CitycatBoise -0.2702161 0.3121488 -0.866 0.386684   
## CitycatBrentwood -0.3836401 0.3554970 -1.079 0.280526   
## CitycatBroken Arrow -0.9045503 0.6884090 -1.314 0.188870   
## CitycatBrookhaven -0.3163969 0.3271470 -0.967 0.333485   
## CitycatBrooklyn Center -0.6044425 0.3642868 -1.659 0.097080 .   
## CitycatBrooklyn Park -0.6634910 0.3315932 -2.001 0.045414 \*   
## CitycatBrown Deer -0.8018974 0.5332256 -1.504 0.132632   
## CitycatBuffalo -0.9072884 0.3124148 -2.904 0.003687 \*\*   
## CitycatBurbank 0.2229620 0.4703214 0.474 0.635460   
## CitycatBurien 0.0085830 0.3442715 0.025 0.980110   
## CitycatBurleson -0.6582746 0.4131183 -1.593 0.111079   
## CitycatCampbell 0.8009733 0.5332926 1.502 0.133127   
## CitycatCarson 0.2601781 0.3770500 0.690 0.490179   
## CitycatCary 0.0897577 0.6884053 0.130 0.896263   
## CitycatCastroville -0.6880550 0.5333410 -1.290 0.197035   
## CitycatCeres -0.2299264 0.6884767 -0.334 0.738410   
## CitycatChandler -0.3210993 0.6884001 -0.466 0.640903   
## CitycatChesapeake -0.6284754 0.3120061 -2.014 0.043990 \*   
## CitycatChicago -0.2584258 0.3085397 -0.838 0.402278   
## CitycatChoctaw -0.5885468 0.6884839 -0.855 0.392647   
## CitycatChula Vista -0.0071020 0.3179751 -0.022 0.982181   
## CitycatCincinnati -0.8328292 0.3101401 -2.685 0.007251 \*\*   
## CitycatCleveland -1.2431621 0.3104213 -4.005 6.23e-05 \*\*\*  
## CitycatCleveland Heights -1.0222302 0.3260361 -3.135 0.001719 \*\*   
## CitycatClive -0.4488465 0.3442244 -1.304 0.192270   
## CitycatColerain Township -0.6049971 0.4355127 -1.389 0.164798   
## CitycatCollege Park -1.0418544 0.3359046 -3.102 0.001927 \*\*   
## CitycatColorado Springs -0.4574130 0.3102861 -1.474 0.140452   
## CitycatColumbia Heights -0.6616530 0.3700126 -1.788 0.073759 .   
## CitycatColumbus -0.7888156 0.3104384 -2.541 0.011061 \*   
## CitycatCommerce City -0.3191462 0.3260249 -0.979 0.327640   
## CitycatConverse -0.9060099 0.4702925 -1.926 0.054057 .   
## CitycatCoral Gables 0.4082875 0.3236704 1.261 0.207168   
## CitycatCoronado 1.2036411 0.3421998 3.517 0.000437 \*\*\*  
## CitycatCorpus Christi -0.7620545 0.3119349 -2.443 0.014574 \*   
## CitycatCrafton -1.0761794 0.6884479 -1.563 0.118021   
## CitycatCrowley -0.6047987 0.3595657 -1.682 0.092578 .   
## CitycatCrystal -0.4072465 0.3859756 -1.055 0.291387   
## CitycatCulver City 0.4585564 0.3859563 1.188 0.234805   
## CitycatCutler Bay -0.3851955 0.3359320 -1.147 0.251540   
## CitycatDallas -0.3536762 0.3089339 -1.145 0.252293   
## CitycatDel City -1.6235873 0.3975048 -4.084 4.43e-05 \*\*\*  
## CitycatDel Mar 0.7279167 0.3974644 1.831 0.067055 .   
## CitycatDenton -0.4325544 0.6884067 -0.628 0.529787   
## CitycatDenver 0.1201715 0.3093258 0.388 0.697654   
## CitycatDerby -2.8756486 0.6884684 -4.177 2.97e-05 \*\*\*  
## CitycatDes Moines -0.7652656 0.3138242 -2.439 0.014756 \*   
## CitycatDetroit -1.7356143 0.3101104 -5.597 2.21e-08 \*\*\*  
## CitycatDoral -0.2036314 0.3299472 -0.617 0.537133   
## CitycatDouglas -4.1503253 0.6884787 -6.028 1.68e-09 \*\*\*  
## CitycatDublin -0.6512269 0.3643062 -1.788 0.073858 .   
## CitycatDunwoody -0.4310701 0.3442154 -1.252 0.210464   
## CitycatDurham -0.5378292 0.3122730 -1.722 0.085029 .   
## CitycatEagan -0.2801074 0.3403930 -0.823 0.410577   
## CitycatEast Cleveland -2.1263792 0.5332967 -3.987 6.71e-05 \*\*\*  
## CitycatEast Orange -0.2995107 0.6884377 -0.435 0.663524   
## CitycatEastvale -0.2240923 0.6883935 -0.326 0.744784   
## CitycatEcorse -0.4521293 0.5334569 -0.848 0.396700   
## CitycatEdgewood -0.6704387 0.4702458 -1.426 0.153964   
## CitycatEdina 0.0437857 0.3284346 0.133 0.893945   
## CitycatEdmond -0.5063989 0.4354323 -1.163 0.244851   
## CitycatEl Paso -0.9759864 0.3097938 -3.150 0.001632 \*\*   
## CitycatEl Portal 0.5236644 0.5332521 0.982 0.326101   
## CitycatElmwood Park -0.6126901 0.6884413 -0.890 0.373494   
## CitycatEnglewood -0.3491324 0.6883547 -0.507 0.612021   
## CitycatEuclid -1.3569413 0.3325939 -4.080 4.52e-05 \*\*\*  
## CitycatEuless -1.0365600 0.6883872 -1.506 0.132138   
## CitycatEvendale -0.9108006 0.6884692 -1.323 0.185871   
## CitycatFairview Park -0.7398561 0.3700318 -1.999 0.045573 \*   
## CitycatFarmers Branch -0.5005203 0.3770538 -1.327 0.184374   
## CitycatFerndale -0.4906389 0.3404663 -1.441 0.149577   
## CitycatFitchburg -0.7068103 0.3555662 -1.988 0.046842 \*   
## CitycatForest Hill -0.9462149 0.5332452 -1.774 0.076004 .   
## CitycatFort Wayne -1.1836013 0.3124821 -3.788 0.000152 \*\*\*  
## CitycatFort Worth -0.6073489 0.3093743 -1.963 0.049641 \*   
## CitycatFountain Valley 0.1696325 0.3642667 0.466 0.641448   
## CitycatFremont 0.8379029 0.3207175 2.613 0.008992 \*\*   
## CitycatFridley -0.5421587 0.4130651 -1.313 0.189357   
## CitycatGahanna -0.6636234 0.3770635 -1.760 0.078426 .   
## CitycatGarden City -0.3164072 0.3700299 -0.855 0.392513   
## CitycatGarden Ridge -0.7325418 0.4355819 -1.682 0.092631 .   
## CitycatGarland -0.5337001 0.3169337 -1.684 0.092206 .   
## CitycatGeorgetown -0.8445056 0.4130302 -2.045 0.040901 \*   
## CitycatGermantown -0.5425553 0.3422502 -1.585 0.112922   
## CitycatGilbert -0.2302383 0.3133156 -0.735 0.462442   
## CitycatGlendale -0.4169975 0.3130786 -1.332 0.182899   
## CitycatGlenn Heights -0.5001253 0.6884075 -0.726 0.467543   
## CitycatGolden Beach 1.3204455 0.6884313 1.918 0.055118 .   
## CitycatGolden Valley -0.5117634 0.4702930 -1.088 0.276528   
## CitycatGoodlettsville -0.7103942 0.4131428 -1.719 0.085540 .   
## CitycatGrand Prairie -0.7857934 0.6883819 -1.142 0.253671   
## CitycatGranite Shoals 0.4793288 0.6884266 0.696 0.486269   
## CitycatGreenfield -0.9091780 0.3859615 -2.356 0.018501 \*   
## CitycatGreensboro -0.9238061 0.3131861 -2.950 0.003184 \*\*   
## CitycatGrosse Pointe -0.5311742 0.4353805 -1.220 0.222470   
## CitycatGrosse Pointe Farms -0.2891285 0.4130660 -0.700 0.483962   
## CitycatGrosse Pointe Park -0.4405606 0.3859651 -1.141 0.253695   
## CitycatGrosse Pointe Shores -0.5142476 0.6883713 -0.747 0.455042   
## CitycatGrosse Pointe Woods -0.3449555 0.3974597 -0.868 0.385459   
## CitycatGroveport -1.2667979 0.5333106 -2.375 0.017541 \*   
## CitycatHaltom City -0.6198498 0.3859332 -1.606 0.108265   
## CitycatHamtramck -0.7765028 0.3771335 -2.059 0.039510 \*   
## CitycatHarahan -0.7744959 0.5333427 -1.452 0.146473   
## CitycatHarper Woods -1.0538259 0.3555965 -2.964 0.003045 \*\*   
## CitycatHelotes -0.6892635 0.5332209 -1.293 0.196149   
## CitycatHenderson -0.2935085 0.3106220 -0.945 0.344718   
## CitycatHialeah -0.3003664 0.3151357 -0.953 0.340533   
## CitycatHialeah Gardens -1.0412314 0.4703971 -2.214 0.026873 \*   
## CitycatHighland Park -1.9081755 0.3859717 -4.944 7.72e-07 \*\*\*  
## CitycatHilliard -0.7947351 0.4131033 -1.924 0.054391 .   
## CitycatHillsborough -0.7091831 0.6885696 -1.030 0.303051   
## CitycatHollywood Park -0.0775522 0.5332408 -0.145 0.884368   
## CitycatHoover -0.7131199 0.3316020 -2.151 0.031524 \*   
## CitycatHorizon City -1.1313294 0.3266395 -3.464 0.000534 \*\*\*  
## CitycatHouston -0.5647980 0.3084449 -1.831 0.067097 .   
## CitycatHurst -0.4995069 0.6883968 -0.726 0.468086   
## CitycatIndian Hills -0.3321857 0.4703939 -0.706 0.480080   
## CitycatIrvine 0.4579589 0.3134259 1.461 0.143992   
## CitycatIrving -0.5225674 0.3188754 -1.639 0.101273   
## CitycatJacksonville -0.7852408 0.3091300 -2.540 0.011087 \*   
## CitycatJacksonville Beach 0.0334171 0.3441972 0.097 0.922658   
## CitycatJeffersontown -0.6633212 0.3974573 -1.669 0.095149 .   
## CitycatJersey City 1.2646118 0.6884895 1.837 0.066254 .   
## CitycatJones -0.2150236 0.6883843 -0.312 0.754770   
## CitycatJurupa Valley -0.0522722 0.3555362 -0.147 0.883115   
## CitycatKeller -0.7080317 0.3491512 -2.028 0.042586 \*   
## CitycatKey Biscayne 0.7153535 0.3442974 2.078 0.037747 \*   
## CitycatKirby -0.9021906 0.6883681 -1.311 0.189999   
## CitycatKnightdale -0.6894098 0.5332221 -1.293 0.196055   
## CitycatLa Vergne -0.6445163 0.5332679 -1.209 0.226824   
## CitycatLackawanna -0.9147162 0.3700770 -2.472 0.013455 \*   
## CitycatLake Forest Park 0.0966923 0.4702644 0.206 0.837095   
## CitycatLakeway -0.3385475 0.3555922 -0.952 0.341074   
## CitycatLakewood -0.6122880 0.3336116 -1.835 0.066470 .   
## CitycatLancaster -0.7870528 0.6884439 -1.143 0.252954   
## CitycatLaredo -0.8854391 0.3169702 -2.793 0.005220 \*\*   
## CitycatLauderdale -0.3625157 0.5332415 -0.680 0.496617   
## CitycatLeon Valley -0.6831969 0.4354516 -1.569 0.116677   
## CitycatLexington -0.5753374 0.3126409 -1.840 0.065745 .   
## CitycatLincoln -0.8393903 0.3120238 -2.690 0.007148 \*\*   
## CitycatLittleton -0.2330654 0.3277723 -0.711 0.477056   
## CitycatLive Oak -0.6720882 0.4353891 -1.544 0.122688   
## CitycatLong Beach 0.5086697 0.3169854 1.605 0.108572   
## CitycatLos Angeles 0.5879098 0.3093013 1.901 0.057346 .   
## CitycatLubbock -0.8826698 0.3124606 -2.825 0.004734 \*\*   
## CitycatLuther -0.8073508 0.6884799 -1.173 0.240946   
## CitycatLyndhurst -0.9511159 0.3555215 -2.675 0.007473 \*\*   
## CitycatMadison -0.4725988 0.3148814 -1.501 0.133402   
## CitycatManor -0.6943050 0.4130548 -1.681 0.092796 .   
## CitycatMaplewood -0.5538177 0.3520648 -1.573 0.115721   
## CitycatMatthews -0.6695055 0.3974451 -1.685 0.092095 .   
## CitycatMayfield Heights -0.7958865 0.4130552 -1.927 0.054014 .   
## CitycatMemphis -1.3865197 0.3110051 -4.458 8.31e-06 \*\*\*  
## CitycatMendota Heights -0.1829637 0.3974904 -0.460 0.645308   
## CitycatMeridian -0.0998565 0.3643430 -0.274 0.784031   
## CitycatMesa -0.3834268 0.3106842 -1.234 0.217165   
## CitycatMiami 0.0506225 0.3086797 0.164 0.869735   
## CitycatMiami Beach 0.1766652 0.3177763 0.556 0.578256   
## CitycatMiami Gardens -0.5561627 0.3974780 -1.399 0.161759   
## CitycatMiami Lakes -0.0840891 0.3490988 -0.241 0.809654   
## CitycatMiami Shores 0.0027031 0.5332265 0.005 0.995955   
## CitycatMiami Springs -0.2857473 0.6883663 -0.415 0.678066   
## CitycatMiddleton -0.5049077 0.4130910 -1.222 0.221620   
## CitycatMiddletown -0.6199893 0.6883692 -0.901 0.367777   
## CitycatMidwest City -1.0546240 0.3442383 -3.064 0.002189 \*\*   
## CitycatMilwaukee -1.0568228 0.3106744 -3.402 0.000671 \*\*\*  
## CitycatMinneapolis -0.1769897 0.3107423 -0.570 0.568975   
## CitycatMint Hill -0.7347324 0.3359464 -2.187 0.028749 \*   
## CitycatMissouri City -0.8932673 0.4130422 -2.163 0.030579 \*   
## CitycatModesto -0.1869931 0.3170892 -0.590 0.555386   
## CitycatMonona -0.2869279 0.4353595 -0.659 0.509865   
## CitycatMontgomery -0.3863050 0.4130306 -0.935 0.349647   
## CitycatMoore -0.7454369 0.3299111 -2.260 0.023862 \*   
## CitycatMorrisville -0.3596604 0.4703391 -0.765 0.444469   
## CitycatMounds View -0.3206457 0.4354157 -0.736 0.461488   
## CitycatMurphy -0.6019528 0.3643102 -1.652 0.098486 .   
## CitycatNeptune Beach -0.0326934 0.4353504 -0.075 0.940138   
## CitycatNew Brighton -0.4533858 0.4702516 -0.964 0.334989   
## CitycatNew Hope -0.3750062 0.3770750 -0.995 0.319984   
## CitycatNew Orleans -0.7031531 0.3104486 -2.265 0.023525 \*   
## CitycatNewark -0.4051856 0.3183827 -1.273 0.203161   
## CitycatNewtown -0.2029417 0.6887048 -0.295 0.768248   
## CitycatNichols Hills -0.1359753 0.3859806 -0.352 0.724628   
## CitycatNolensville -0.4570416 0.5332266 -0.857 0.391386   
## CitycatNorfolk -0.6483456 0.3142195 -2.063 0.039091 \*   
## CitycatNormandy Park -0.1260893 0.6893273 -0.183 0.854865   
## CitycatNorth Bay Village -0.2191210 0.3596189 -0.609 0.542323   
## CitycatNorth Las Vegas -0.5941754 0.3126404 -1.901 0.057380 .   
## CitycatNorth Miami -0.2358524 0.3307632 -0.713 0.475819   
## CitycatNorth Miami Beach -0.2433011 0.3299408 -0.737 0.460882   
## CitycatNorth Richland Hills -0.4744466 0.3250027 -1.460 0.144353   
## CitycatNorth Royalton -0.8851961 0.3387697 -2.613 0.008982 \*\*   
## CitycatNorthfield -0.0658512 0.6883920 -0.096 0.923792   
## CitycatNorthglenn -0.2769605 0.3859092 -0.718 0.472961   
## CitycatOak Park -0.7450265 0.4130961 -1.804 0.071321 .   
## CitycatOakdale -0.5348178 0.3859687 -1.386 0.165868   
## CitycatOakland 0.5597276 0.3150012 1.777 0.075598 .   
## CitycatOklahoma City -0.8201715 0.3103251 -2.643 0.008225 \*\*   
## CitycatOlmos Park 0.1126122 0.4131365 0.273 0.785180   
## CitycatOlmsted Falls -0.9925424 0.3770699 -2.632 0.008488 \*\*   
## CitycatOlmsted Township -0.9849173 0.4130723 -2.384 0.017117 \*   
## CitycatOmaha -0.8322930 0.3111285 -2.675 0.007477 \*\*   
## CitycatOrlando -0.5381104 0.3092670 -1.740 0.081881 .   
## CitycatOro Valley -0.3571165 0.3225765 -1.107 0.268274   
## CitycatOttawa Hills -0.8911244 0.6883848 -1.295 0.195502   
## CitycatPalmetto Bay 0.0346258 0.3490820 0.099 0.920987   
## CitycatPantego -0.8910874 0.6883650 -1.294 0.195507   
## CitycatPapillion -0.4304421 0.5332371 -0.807 0.419546   
## CitycatParadise Valley 0.6134839 0.3230874 1.899 0.057602 .   
## CitycatPark City -1.1245064 0.4354309 -2.583 0.009815 \*\*   
## CitycatParma -1.0023937 0.3325668 -3.014 0.002580 \*\*   
## CitycatPeoria -0.4913863 0.4130497 -1.190 0.234195   
## CitycatPepper Pike -0.4291131 0.4354722 -0.985 0.324440   
## CitycatPflugerville -0.5273285 0.6884323 -0.766 0.443694   
## CitycatPhoenix -0.2819252 0.3089974 -0.912 0.361575   
## CitycatPickerington 0.1840352 0.4703425 0.391 0.695595   
## CitycatPiedmont 0.5922245 0.5336970 1.110 0.267156   
## CitycatPlano -0.3827788 0.3137037 -1.220 0.222405   
## CitycatPlymouth -0.3455699 0.3271630 -1.056 0.290860   
## CitycatPortland 0.1099846 0.3094789 0.355 0.722304   
## CitycatPowell -0.9202743 0.6884350 -1.337 0.181314   
## CitycatRaleigh -0.4955717 0.3109338 -1.594 0.110992   
## CitycatRalston -1.2262932 0.4353962 -2.816 0.004859 \*\*   
## CitycatRed Oak -0.5292354 0.6884067 -0.769 0.442031   
## CitycatReno -0.4073452 0.3112237 -1.309 0.190599   
## CitycatReynoldsburg -0.8910190 0.4130506 -2.157 0.031004 \*   
## CitycatRichfield -0.2067486 0.3643753 -0.567 0.570445   
## CitycatRichland Hills -0.7890755 0.4353794 -1.812 0.069941 .   
## CitycatRichmond -0.4350572 0.3136430 -1.387 0.165423   
## CitycatRichmond Heights -1.1105302 0.4353853 -2.551 0.010758 \*   
## CitycatRio Rancho -1.6854115 0.3198056 -5.270 1.38e-07 \*\*\*  
## CitycatRiver Hills -0.6342041 0.6884758 -0.921 0.356971   
## CitycatRiver Rouge -1.3098450 0.5333414 -2.456 0.014060 \*   
## CitycatRiverside -0.1014770 0.3132456 -0.324 0.745976   
## CitycatRoanoke -0.3638711 0.3974972 -0.915 0.359989   
## CitycatRobbinsdale -0.6193115 0.4355153 -1.422 0.155035   
## CitycatRoseville -0.1962521 0.3595187 -0.546 0.585158   
## CitycatSachse -0.3327939 0.3403798 -0.978 0.328227   
## CitycatSaginaw -0.6453185 0.3442305 -1.875 0.060852 .   
## CitycatSan Antonio -0.7074275 0.3085372 -2.293 0.021867 \*   
## CitycatSan Diego 0.3644890 0.3097910 1.177 0.239383   
## CitycatSan Fernando 0.2181792 0.5332249 0.409 0.682420   
## CitycatSan Francisco 1.3880980 0.3120520 4.448 8.70e-06 \*\*\*  
## CitycatSan Jose 0.7680279 0.3117673 2.463 0.013768 \*   
## CitycatSand Springs -1.3698108 0.6884813 -1.990 0.046646 \*   
## CitycatSandy Springs -0.3411472 0.3173654 -1.075 0.282416   
## CitycatSanta Ana 0.4756547 0.3250035 1.464 0.143335   
## CitycatSantee -0.0547017 0.6883520 -0.079 0.936661   
## CitycatScottsdale 0.0771340 0.3100140 0.249 0.803511   
## CitycatSeattle 0.5571898 0.3100742 1.797 0.072357 .   
## CitycatSeven Hills -0.7570707 0.3859256 -1.962 0.049810 \*   
## CitycatShavano Park -0.4626574 0.4357085 -1.062 0.288315   
## CitycatShively -0.6320778 0.3975653 -1.590 0.111878   
## CitycatShoreline 0.5389409 0.3465293 1.555 0.119900   
## CitycatShorewood -0.2836828 0.5333650 -0.532 0.594819   
## CitycatSignal Hill 0.3490218 0.6884077 0.507 0.612161   
## CitycatSocorro -1.0478747 0.3465647 -3.024 0.002501 \*\*   
## CitycatSolon -1.0228279 0.3555150 -2.877 0.004018 \*\*   
## CitycatSouth Euclid -1.1619081 0.3555052 -3.268 0.001084 \*\*   
## CitycatSouth Miami -0.0841010 0.4702794 -0.179 0.858071   
## CitycatSpeedway -3.4404933 0.6885718 -4.997 5.88e-07 \*\*\*  
## CitycatSpencer -3.5335621 0.6884788 -5.132 2.89e-07 \*\*\*  
## CitycatSpokane -0.4751839 0.3122160 -1.522 0.128031   
## CitycatSpokane Valley -0.4694646 0.3404078 -1.379 0.167871   
## CitycatSpring Lake Park -0.6554813 0.5332206 -1.229 0.218978   
## CitycatStafford -1.1642379 0.6883477 -1.691 0.090784 .   
## CitycatStockton -0.2614265 0.3164552 -0.826 0.408751   
## CitycatStrongsville -0.8424521 0.3770466 -2.234 0.025471 \*   
## CitycatSuffolk -0.4020911 0.5333083 -0.754 0.450884   
## CitycatSunny Isles Beach 0.2404957 0.3316792 0.725 0.468408   
## CitycatSurfside 0.0609760 0.5332572 0.114 0.908964   
## CitycatSweetwater -0.7495238 0.6884792 -1.089 0.276313   
## CitycatSwissvale -0.3451864 0.6884788 -0.501 0.616112   
## CitycatTampa -0.4660167 0.3096005 -1.505 0.132282   
## CitycatTemple Terrace -0.6565896 0.3770667 -1.741 0.081644 .   
## CitycatTerrell Hills 0.1473689 0.4702638 0.313 0.753999   
## CitycatThornton -0.4717506 0.3298865 -1.430 0.152720   
## CitycatTigard -0.0937520 0.3335655 -0.281 0.778667   
## CitycatToledo -1.3685598 0.3130598 -4.372 1.24e-05 \*\*\*  
## CitycatTorrance 0.6562935 0.4354204 1.507 0.131758   
## CitycatTucson -0.6800857 0.3094173 -2.198 0.027963 \*   
## CitycatTulsa -1.0474812 0.3110407 -3.368 0.000759 \*\*\*  
## CitycatUniversity Heights -1.0711195 0.3974562 -2.695 0.007046 \*\*   
## CitycatUpper Arlington -0.2262198 0.3555204 -0.636 0.524584   
## CitycatUrbandale -0.8744108 0.3254972 -2.686 0.007229 \*\*   
## CitycatVerona -0.4515014 0.3595524 -1.256 0.209227   
## CitycatVirginia Beach -0.4786733 0.3108822 -1.540 0.123642   
## CitycatVirginia Gardens 0.5240506 0.6884807 0.761 0.446564   
## CitycatWarr Acres -0.8742854 0.5332114 -1.640 0.101091   
## CitycatWatauga -0.6714453 0.4354021 -1.542 0.123058   
## CitycatWauwatosa -0.2855253 0.3643226 -0.784 0.433216   
## CitycatWest Allis -0.6966428 0.3387810 -2.056 0.039764 \*   
## CitycatWest Hollywood 1.0748336 0.3421756 3.141 0.001685 \*\*   
## CitycatWest Lake Hills 0.5139454 0.6888198 0.746 0.455600   
## CitycatWesterville -0.8876646 0.3643271 -2.436 0.014840 \*   
## CitycatWestminster -0.3625390 0.3770639 -0.961 0.336322   
## CitycatWhite Bear Lake -0.5086653 0.3859204 -1.318 0.187498   
## CitycatWhite Settlement 0.7956260 0.6885321 1.156 0.247882   
## CitycatWhitefish Bay -0.2727733 0.5332250 -0.512 0.608969   
## CitycatWhitehall -1.2810888 0.3975112 -3.223 0.001271 \*\*   
## CitycatWichita -0.9913915 0.3117534 -3.180 0.001475 \*\*   
## CitycatWindsor Heights -0.8040901 0.6885074 -1.168 0.242870   
## CitycatWinter Park 0.1202947 0.4703654 0.256 0.798148   
## CitycatWolfforth -0.6607872 0.5332095 -1.239 0.215261   
## CitycatWoodbury -0.5381165 0.3265801 -1.648 0.099422 .   
## CitycatWorthington -0.7419059 0.5332719 -1.391 0.164169   
## CitycatYukon -0.2962434 0.4703399 -0.630 0.528800   
## Bathrooms.c:Size.c 0.7698967 0.0224251 34.332 < 2e-16 \*\*\*  
## Bedrooms.c:Size.c -0.3758735 0.0275475 -13.645 < 2e-16 \*\*\*  
## Year\_Built.c:Size.c -0.0015072 0.0002861 -5.267 1.40e-07 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.6157 on 21469 degrees of freedom  
## Multiple R-squared: 0.5767, Adjusted R-squared: 0.5698   
## F-statistic: 84.29 on 347 and 21469 DF, p-value: < 2.2e-16

The interaction between bedrooms and bathrooms was removed. This will be the final model.

# Final Model

fit7 = lm (LogPrice ~   
 (Bathrooms.c + Bedrooms.c + Year\_Built.c + Lot\_Size.c + Size.c + Bathrooms.c:Size.c + Bedrooms.c:Size.c + Year\_Built.c:Size.c + Citycat), data=housing2)  
  
summary (fit7)

##   
## Call:  
## lm(formula = LogPrice ~ (Bathrooms.c + Bedrooms.c + Year\_Built.c +   
## Lot\_Size.c + Size.c + Bathrooms.c:Size.c + Bedrooms.c:Size.c +   
## Year\_Built.c:Size.c + Citycat), data = housing2)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -4.7125 -0.2513 0.0269 0.3136 3.1135   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 12.9637796 0.3078805 42.107 < 2e-16 \*\*\*  
## Bathrooms.c 0.9501550 0.0148533 63.969 < 2e-16 \*\*\*  
## Bedrooms.c -0.0398536 0.0183667 -2.170 0.030026 \*   
## Year\_Built.c 0.0011414 0.0001700 6.714 1.95e-11 \*\*\*  
## Lot\_Size.c 0.0356045 0.0029034 12.263 < 2e-16 \*\*\*  
## Size.c 0.1169996 0.0102392 11.427 < 2e-16 \*\*\*  
## CitycatAlbuquerque -0.6979076 0.3103537 -2.249 0.024539 \*   
## CitycatAnaheim 0.0949958 0.3186946 0.298 0.765647   
## CitycatAnchorage -0.5862374 0.3119873 -1.879 0.060252 .   
## CitycatApple Valley -0.6822708 0.3336041 -2.045 0.040852 \*   
## CitycatArlington -0.6582743 0.3124805 -2.107 0.035163 \*   
## CitycatAtlantic Beach 0.0020741 0.3595202 0.006 0.995397   
## CitycatAurora -0.3096636 0.3116192 -0.994 0.320368   
## CitycatAustin -0.1330679 0.3093649 -0.430 0.667103   
## CitycatAventura -0.2231015 0.3200492 -0.697 0.485757   
## CitycatBainbridge Island 0.2256635 0.3373072 0.669 0.503493   
## CitycatBaker -1.1741582 0.6888307 -1.705 0.088290 .   
## CitycatBakersfield -0.4646840 0.3114231 -1.492 0.135680   
## CitycatBaltimore -0.8782412 0.3090575 -2.842 0.004492 \*\*   
## CitycatBaton Rouge -0.5542502 0.3108027 -1.783 0.074554 .   
## CitycatBay Harbor Islands -0.3062065 0.4133213 -0.741 0.458796   
## CitycatBay Village -0.3748599 0.3554937 -1.054 0.291677   
## CitycatBayside -0.4912780 0.4702521 -1.045 0.296168   
## CitycatBeachwood -1.3263880 0.3595055 -3.689 0.000225 \*\*\*  
## CitycatBedford -1.3549973 0.3465523 -3.910 9.26e-05 \*\*\*  
## CitycatBee Cave -0.0193809 0.6884869 -0.028 0.977543   
## CitycatBel Aire -1.0122544 0.4703803 -2.152 0.031409 \*   
## CitycatBelle Isle -0.3147610 0.6883615 -0.457 0.647488   
## CitycatBellevue -0.4022698 0.4130467 -0.974 0.330113   
## CitycatBenbrook -0.3798271 0.3859616 -0.984 0.325074   
## CitycatBerkeley 1.0849041 0.6884653 1.576 0.115080   
## CitycatBeverly Hills 1.1049280 0.3859492 2.863 0.004202 \*\*   
## CitycatBexley -0.2826927 0.5332309 -0.530 0.596013   
## CitycatBiscayne Park -0.0564545 0.6883643 -0.082 0.934638   
## CitycatBixby -0.5428648 0.5333031 -1.018 0.308723   
## CitycatBlaine -0.3222784 0.3316409 -0.972 0.331176   
## CitycatBloomington -0.3527223 0.3335720 -1.057 0.290337   
## CitycatBlue Ash -0.2980693 0.4702790 -0.634 0.526209   
## CitycatBoise -0.2702161 0.3121488 -0.866 0.386684   
## CitycatBrentwood -0.3836401 0.3554970 -1.079 0.280526   
## CitycatBroken Arrow -0.9045503 0.6884090 -1.314 0.188870   
## CitycatBrookhaven -0.3163969 0.3271470 -0.967 0.333485   
## CitycatBrooklyn Center -0.6044425 0.3642868 -1.659 0.097080 .   
## CitycatBrooklyn Park -0.6634910 0.3315932 -2.001 0.045414 \*   
## CitycatBrown Deer -0.8018974 0.5332256 -1.504 0.132632   
## CitycatBuffalo -0.9072884 0.3124148 -2.904 0.003687 \*\*   
## CitycatBurbank 0.2229620 0.4703214 0.474 0.635460   
## CitycatBurien 0.0085830 0.3442715 0.025 0.980110   
## CitycatBurleson -0.6582746 0.4131183 -1.593 0.111079   
## CitycatCampbell 0.8009733 0.5332926 1.502 0.133127   
## CitycatCarson 0.2601781 0.3770500 0.690 0.490179   
## CitycatCary 0.0897577 0.6884053 0.130 0.896263   
## CitycatCastroville -0.6880550 0.5333410 -1.290 0.197035   
## CitycatCeres -0.2299264 0.6884767 -0.334 0.738410   
## CitycatChandler -0.3210993 0.6884001 -0.466 0.640903   
## CitycatChesapeake -0.6284754 0.3120061 -2.014 0.043990 \*   
## CitycatChicago -0.2584258 0.3085397 -0.838 0.402278   
## CitycatChoctaw -0.5885468 0.6884839 -0.855 0.392647   
## CitycatChula Vista -0.0071020 0.3179751 -0.022 0.982181   
## CitycatCincinnati -0.8328292 0.3101401 -2.685 0.007251 \*\*   
## CitycatCleveland -1.2431621 0.3104213 -4.005 6.23e-05 \*\*\*  
## CitycatCleveland Heights -1.0222302 0.3260361 -3.135 0.001719 \*\*   
## CitycatClive -0.4488465 0.3442244 -1.304 0.192270   
## CitycatColerain Township -0.6049971 0.4355127 -1.389 0.164798   
## CitycatCollege Park -1.0418544 0.3359046 -3.102 0.001927 \*\*   
## CitycatColorado Springs -0.4574130 0.3102861 -1.474 0.140452   
## CitycatColumbia Heights -0.6616530 0.3700126 -1.788 0.073759 .   
## CitycatColumbus -0.7888156 0.3104384 -2.541 0.011061 \*   
## CitycatCommerce City -0.3191462 0.3260249 -0.979 0.327640   
## CitycatConverse -0.9060099 0.4702925 -1.926 0.054057 .   
## CitycatCoral Gables 0.4082875 0.3236704 1.261 0.207168   
## CitycatCoronado 1.2036411 0.3421998 3.517 0.000437 \*\*\*  
## CitycatCorpus Christi -0.7620545 0.3119349 -2.443 0.014574 \*   
## CitycatCrafton -1.0761794 0.6884479 -1.563 0.118021   
## CitycatCrowley -0.6047987 0.3595657 -1.682 0.092578 .   
## CitycatCrystal -0.4072465 0.3859756 -1.055 0.291387   
## CitycatCulver City 0.4585564 0.3859563 1.188 0.234805   
## CitycatCutler Bay -0.3851955 0.3359320 -1.147 0.251540   
## CitycatDallas -0.3536762 0.3089339 -1.145 0.252293   
## CitycatDel City -1.6235873 0.3975048 -4.084 4.43e-05 \*\*\*  
## CitycatDel Mar 0.7279167 0.3974644 1.831 0.067055 .   
## CitycatDenton -0.4325544 0.6884067 -0.628 0.529787   
## CitycatDenver 0.1201715 0.3093258 0.388 0.697654   
## CitycatDerby -2.8756486 0.6884684 -4.177 2.97e-05 \*\*\*  
## CitycatDes Moines -0.7652656 0.3138242 -2.439 0.014756 \*   
## CitycatDetroit -1.7356143 0.3101104 -5.597 2.21e-08 \*\*\*  
## CitycatDoral -0.2036314 0.3299472 -0.617 0.537133   
## CitycatDouglas -4.1503253 0.6884787 -6.028 1.68e-09 \*\*\*  
## CitycatDublin -0.6512269 0.3643062 -1.788 0.073858 .   
## CitycatDunwoody -0.4310701 0.3442154 -1.252 0.210464   
## CitycatDurham -0.5378292 0.3122730 -1.722 0.085029 .   
## CitycatEagan -0.2801074 0.3403930 -0.823 0.410577   
## CitycatEast Cleveland -2.1263792 0.5332967 -3.987 6.71e-05 \*\*\*  
## CitycatEast Orange -0.2995107 0.6884377 -0.435 0.663524   
## CitycatEastvale -0.2240923 0.6883935 -0.326 0.744784   
## CitycatEcorse -0.4521293 0.5334569 -0.848 0.396700   
## CitycatEdgewood -0.6704387 0.4702458 -1.426 0.153964   
## CitycatEdina 0.0437857 0.3284346 0.133 0.893945   
## CitycatEdmond -0.5063989 0.4354323 -1.163 0.244851   
## CitycatEl Paso -0.9759864 0.3097938 -3.150 0.001632 \*\*   
## CitycatEl Portal 0.5236644 0.5332521 0.982 0.326101   
## CitycatElmwood Park -0.6126901 0.6884413 -0.890 0.373494   
## CitycatEnglewood -0.3491324 0.6883547 -0.507 0.612021   
## CitycatEuclid -1.3569413 0.3325939 -4.080 4.52e-05 \*\*\*  
## CitycatEuless -1.0365600 0.6883872 -1.506 0.132138   
## CitycatEvendale -0.9108006 0.6884692 -1.323 0.185871   
## CitycatFairview Park -0.7398561 0.3700318 -1.999 0.045573 \*   
## CitycatFarmers Branch -0.5005203 0.3770538 -1.327 0.184374   
## CitycatFerndale -0.4906389 0.3404663 -1.441 0.149577   
## CitycatFitchburg -0.7068103 0.3555662 -1.988 0.046842 \*   
## CitycatForest Hill -0.9462149 0.5332452 -1.774 0.076004 .   
## CitycatFort Wayne -1.1836013 0.3124821 -3.788 0.000152 \*\*\*  
## CitycatFort Worth -0.6073489 0.3093743 -1.963 0.049641 \*   
## CitycatFountain Valley 0.1696325 0.3642667 0.466 0.641448   
## CitycatFremont 0.8379029 0.3207175 2.613 0.008992 \*\*   
## CitycatFridley -0.5421587 0.4130651 -1.313 0.189357   
## CitycatGahanna -0.6636234 0.3770635 -1.760 0.078426 .   
## CitycatGarden City -0.3164072 0.3700299 -0.855 0.392513   
## CitycatGarden Ridge -0.7325418 0.4355819 -1.682 0.092631 .   
## CitycatGarland -0.5337001 0.3169337 -1.684 0.092206 .   
## CitycatGeorgetown -0.8445056 0.4130302 -2.045 0.040901 \*   
## CitycatGermantown -0.5425553 0.3422502 -1.585 0.112922   
## CitycatGilbert -0.2302383 0.3133156 -0.735 0.462442   
## CitycatGlendale -0.4169975 0.3130786 -1.332 0.182899   
## CitycatGlenn Heights -0.5001253 0.6884075 -0.726 0.467543   
## CitycatGolden Beach 1.3204455 0.6884313 1.918 0.055118 .   
## CitycatGolden Valley -0.5117634 0.4702930 -1.088 0.276528   
## CitycatGoodlettsville -0.7103942 0.4131428 -1.719 0.085540 .   
## CitycatGrand Prairie -0.7857934 0.6883819 -1.142 0.253671   
## CitycatGranite Shoals 0.4793288 0.6884266 0.696 0.486269   
## CitycatGreenfield -0.9091780 0.3859615 -2.356 0.018501 \*   
## CitycatGreensboro -0.9238061 0.3131861 -2.950 0.003184 \*\*   
## CitycatGrosse Pointe -0.5311742 0.4353805 -1.220 0.222470   
## CitycatGrosse Pointe Farms -0.2891285 0.4130660 -0.700 0.483962   
## CitycatGrosse Pointe Park -0.4405606 0.3859651 -1.141 0.253695   
## CitycatGrosse Pointe Shores -0.5142476 0.6883713 -0.747 0.455042   
## CitycatGrosse Pointe Woods -0.3449555 0.3974597 -0.868 0.385459   
## CitycatGroveport -1.2667979 0.5333106 -2.375 0.017541 \*   
## CitycatHaltom City -0.6198498 0.3859332 -1.606 0.108265   
## CitycatHamtramck -0.7765028 0.3771335 -2.059 0.039510 \*   
## CitycatHarahan -0.7744959 0.5333427 -1.452 0.146473   
## CitycatHarper Woods -1.0538259 0.3555965 -2.964 0.003045 \*\*   
## CitycatHelotes -0.6892635 0.5332209 -1.293 0.196149   
## CitycatHenderson -0.2935085 0.3106220 -0.945 0.344718   
## CitycatHialeah -0.3003664 0.3151357 -0.953 0.340533   
## CitycatHialeah Gardens -1.0412314 0.4703971 -2.214 0.026873 \*   
## CitycatHighland Park -1.9081755 0.3859717 -4.944 7.72e-07 \*\*\*  
## CitycatHilliard -0.7947351 0.4131033 -1.924 0.054391 .   
## CitycatHillsborough -0.7091831 0.6885696 -1.030 0.303051   
## CitycatHollywood Park -0.0775522 0.5332408 -0.145 0.884368   
## CitycatHoover -0.7131199 0.3316020 -2.151 0.031524 \*   
## CitycatHorizon City -1.1313294 0.3266395 -3.464 0.000534 \*\*\*  
## CitycatHouston -0.5647980 0.3084449 -1.831 0.067097 .   
## CitycatHurst -0.4995069 0.6883968 -0.726 0.468086   
## CitycatIndian Hills -0.3321857 0.4703939 -0.706 0.480080   
## CitycatIrvine 0.4579589 0.3134259 1.461 0.143992   
## CitycatIrving -0.5225674 0.3188754 -1.639 0.101273   
## CitycatJacksonville -0.7852408 0.3091300 -2.540 0.011087 \*   
## CitycatJacksonville Beach 0.0334171 0.3441972 0.097 0.922658   
## CitycatJeffersontown -0.6633212 0.3974573 -1.669 0.095149 .   
## CitycatJersey City 1.2646118 0.6884895 1.837 0.066254 .   
## CitycatJones -0.2150236 0.6883843 -0.312 0.754770   
## CitycatJurupa Valley -0.0522722 0.3555362 -0.147 0.883115   
## CitycatKeller -0.7080317 0.3491512 -2.028 0.042586 \*   
## CitycatKey Biscayne 0.7153535 0.3442974 2.078 0.037747 \*   
## CitycatKirby -0.9021906 0.6883681 -1.311 0.189999   
## CitycatKnightdale -0.6894098 0.5332221 -1.293 0.196055   
## CitycatLa Vergne -0.6445163 0.5332679 -1.209 0.226824   
## CitycatLackawanna -0.9147162 0.3700770 -2.472 0.013455 \*   
## CitycatLake Forest Park 0.0966923 0.4702644 0.206 0.837095   
## CitycatLakeway -0.3385475 0.3555922 -0.952 0.341074   
## CitycatLakewood -0.6122880 0.3336116 -1.835 0.066470 .   
## CitycatLancaster -0.7870528 0.6884439 -1.143 0.252954   
## CitycatLaredo -0.8854391 0.3169702 -2.793 0.005220 \*\*   
## CitycatLauderdale -0.3625157 0.5332415 -0.680 0.496617   
## CitycatLeon Valley -0.6831969 0.4354516 -1.569 0.116677   
## CitycatLexington -0.5753374 0.3126409 -1.840 0.065745 .   
## CitycatLincoln -0.8393903 0.3120238 -2.690 0.007148 \*\*   
## CitycatLittleton -0.2330654 0.3277723 -0.711 0.477056   
## CitycatLive Oak -0.6720882 0.4353891 -1.544 0.122688   
## CitycatLong Beach 0.5086697 0.3169854 1.605 0.108572   
## CitycatLos Angeles 0.5879098 0.3093013 1.901 0.057346 .   
## CitycatLubbock -0.8826698 0.3124606 -2.825 0.004734 \*\*   
## CitycatLuther -0.8073508 0.6884799 -1.173 0.240946   
## CitycatLyndhurst -0.9511159 0.3555215 -2.675 0.007473 \*\*   
## CitycatMadison -0.4725988 0.3148814 -1.501 0.133402   
## CitycatManor -0.6943050 0.4130548 -1.681 0.092796 .   
## CitycatMaplewood -0.5538177 0.3520648 -1.573 0.115721   
## CitycatMatthews -0.6695055 0.3974451 -1.685 0.092095 .   
## CitycatMayfield Heights -0.7958865 0.4130552 -1.927 0.054014 .   
## CitycatMemphis -1.3865197 0.3110051 -4.458 8.31e-06 \*\*\*  
## CitycatMendota Heights -0.1829637 0.3974904 -0.460 0.645308   
## CitycatMeridian -0.0998565 0.3643430 -0.274 0.784031   
## CitycatMesa -0.3834268 0.3106842 -1.234 0.217165   
## CitycatMiami 0.0506225 0.3086797 0.164 0.869735   
## CitycatMiami Beach 0.1766652 0.3177763 0.556 0.578256   
## CitycatMiami Gardens -0.5561627 0.3974780 -1.399 0.161759   
## CitycatMiami Lakes -0.0840891 0.3490988 -0.241 0.809654   
## CitycatMiami Shores 0.0027031 0.5332265 0.005 0.995955   
## CitycatMiami Springs -0.2857473 0.6883663 -0.415 0.678066   
## CitycatMiddleton -0.5049077 0.4130910 -1.222 0.221620   
## CitycatMiddletown -0.6199893 0.6883692 -0.901 0.367777   
## CitycatMidwest City -1.0546240 0.3442383 -3.064 0.002189 \*\*   
## CitycatMilwaukee -1.0568228 0.3106744 -3.402 0.000671 \*\*\*  
## CitycatMinneapolis -0.1769897 0.3107423 -0.570 0.568975   
## CitycatMint Hill -0.7347324 0.3359464 -2.187 0.028749 \*   
## CitycatMissouri City -0.8932673 0.4130422 -2.163 0.030579 \*   
## CitycatModesto -0.1869931 0.3170892 -0.590 0.555386   
## CitycatMonona -0.2869279 0.4353595 -0.659 0.509865   
## CitycatMontgomery -0.3863050 0.4130306 -0.935 0.349647   
## CitycatMoore -0.7454369 0.3299111 -2.260 0.023862 \*   
## CitycatMorrisville -0.3596604 0.4703391 -0.765 0.444469   
## CitycatMounds View -0.3206457 0.4354157 -0.736 0.461488   
## CitycatMurphy -0.6019528 0.3643102 -1.652 0.098486 .   
## CitycatNeptune Beach -0.0326934 0.4353504 -0.075 0.940138   
## CitycatNew Brighton -0.4533858 0.4702516 -0.964 0.334989   
## CitycatNew Hope -0.3750062 0.3770750 -0.995 0.319984   
## CitycatNew Orleans -0.7031531 0.3104486 -2.265 0.023525 \*   
## CitycatNewark -0.4051856 0.3183827 -1.273 0.203161   
## CitycatNewtown -0.2029417 0.6887048 -0.295 0.768248   
## CitycatNichols Hills -0.1359753 0.3859806 -0.352 0.724628   
## CitycatNolensville -0.4570416 0.5332266 -0.857 0.391386   
## CitycatNorfolk -0.6483456 0.3142195 -2.063 0.039091 \*   
## CitycatNormandy Park -0.1260893 0.6893273 -0.183 0.854865   
## CitycatNorth Bay Village -0.2191210 0.3596189 -0.609 0.542323   
## CitycatNorth Las Vegas -0.5941754 0.3126404 -1.901 0.057380 .   
## CitycatNorth Miami -0.2358524 0.3307632 -0.713 0.475819   
## CitycatNorth Miami Beach -0.2433011 0.3299408 -0.737 0.460882   
## CitycatNorth Richland Hills -0.4744466 0.3250027 -1.460 0.144353   
## CitycatNorth Royalton -0.8851961 0.3387697 -2.613 0.008982 \*\*   
## CitycatNorthfield -0.0658512 0.6883920 -0.096 0.923792   
## CitycatNorthglenn -0.2769605 0.3859092 -0.718 0.472961   
## CitycatOak Park -0.7450265 0.4130961 -1.804 0.071321 .   
## CitycatOakdale -0.5348178 0.3859687 -1.386 0.165868   
## CitycatOakland 0.5597276 0.3150012 1.777 0.075598 .   
## CitycatOklahoma City -0.8201715 0.3103251 -2.643 0.008225 \*\*   
## CitycatOlmos Park 0.1126122 0.4131365 0.273 0.785180   
## CitycatOlmsted Falls -0.9925424 0.3770699 -2.632 0.008488 \*\*   
## CitycatOlmsted Township -0.9849173 0.4130723 -2.384 0.017117 \*   
## CitycatOmaha -0.8322930 0.3111285 -2.675 0.007477 \*\*   
## CitycatOrlando -0.5381104 0.3092670 -1.740 0.081881 .   
## CitycatOro Valley -0.3571165 0.3225765 -1.107 0.268274   
## CitycatOttawa Hills -0.8911244 0.6883848 -1.295 0.195502   
## CitycatPalmetto Bay 0.0346258 0.3490820 0.099 0.920987   
## CitycatPantego -0.8910874 0.6883650 -1.294 0.195507   
## CitycatPapillion -0.4304421 0.5332371 -0.807 0.419546   
## CitycatParadise Valley 0.6134839 0.3230874 1.899 0.057602 .   
## CitycatPark City -1.1245064 0.4354309 -2.583 0.009815 \*\*   
## CitycatParma -1.0023937 0.3325668 -3.014 0.002580 \*\*   
## CitycatPeoria -0.4913863 0.4130497 -1.190 0.234195   
## CitycatPepper Pike -0.4291131 0.4354722 -0.985 0.324440   
## CitycatPflugerville -0.5273285 0.6884323 -0.766 0.443694   
## CitycatPhoenix -0.2819252 0.3089974 -0.912 0.361575   
## CitycatPickerington 0.1840352 0.4703425 0.391 0.695595   
## CitycatPiedmont 0.5922245 0.5336970 1.110 0.267156   
## CitycatPlano -0.3827788 0.3137037 -1.220 0.222405   
## CitycatPlymouth -0.3455699 0.3271630 -1.056 0.290860   
## CitycatPortland 0.1099846 0.3094789 0.355 0.722304   
## CitycatPowell -0.9202743 0.6884350 -1.337 0.181314   
## CitycatRaleigh -0.4955717 0.3109338 -1.594 0.110992   
## CitycatRalston -1.2262932 0.4353962 -2.816 0.004859 \*\*   
## CitycatRed Oak -0.5292354 0.6884067 -0.769 0.442031   
## CitycatReno -0.4073452 0.3112237 -1.309 0.190599   
## CitycatReynoldsburg -0.8910190 0.4130506 -2.157 0.031004 \*   
## CitycatRichfield -0.2067486 0.3643753 -0.567 0.570445   
## CitycatRichland Hills -0.7890755 0.4353794 -1.812 0.069941 .   
## CitycatRichmond -0.4350572 0.3136430 -1.387 0.165423   
## CitycatRichmond Heights -1.1105302 0.4353853 -2.551 0.010758 \*   
## CitycatRio Rancho -1.6854115 0.3198056 -5.270 1.38e-07 \*\*\*  
## CitycatRiver Hills -0.6342041 0.6884758 -0.921 0.356971   
## CitycatRiver Rouge -1.3098450 0.5333414 -2.456 0.014060 \*   
## CitycatRiverside -0.1014770 0.3132456 -0.324 0.745976   
## CitycatRoanoke -0.3638711 0.3974972 -0.915 0.359989   
## CitycatRobbinsdale -0.6193115 0.4355153 -1.422 0.155035   
## CitycatRoseville -0.1962521 0.3595187 -0.546 0.585158   
## CitycatSachse -0.3327939 0.3403798 -0.978 0.328227   
## CitycatSaginaw -0.6453185 0.3442305 -1.875 0.060852 .   
## CitycatSan Antonio -0.7074275 0.3085372 -2.293 0.021867 \*   
## CitycatSan Diego 0.3644890 0.3097910 1.177 0.239383   
## CitycatSan Fernando 0.2181792 0.5332249 0.409 0.682420   
## CitycatSan Francisco 1.3880980 0.3120520 4.448 8.70e-06 \*\*\*  
## CitycatSan Jose 0.7680279 0.3117673 2.463 0.013768 \*   
## CitycatSand Springs -1.3698108 0.6884813 -1.990 0.046646 \*   
## CitycatSandy Springs -0.3411472 0.3173654 -1.075 0.282416   
## CitycatSanta Ana 0.4756547 0.3250035 1.464 0.143335   
## CitycatSantee -0.0547017 0.6883520 -0.079 0.936661   
## CitycatScottsdale 0.0771340 0.3100140 0.249 0.803511   
## CitycatSeattle 0.5571898 0.3100742 1.797 0.072357 .   
## CitycatSeven Hills -0.7570707 0.3859256 -1.962 0.049810 \*   
## CitycatShavano Park -0.4626574 0.4357085 -1.062 0.288315   
## CitycatShively -0.6320778 0.3975653 -1.590 0.111878   
## CitycatShoreline 0.5389409 0.3465293 1.555 0.119900   
## CitycatShorewood -0.2836828 0.5333650 -0.532 0.594819   
## CitycatSignal Hill 0.3490218 0.6884077 0.507 0.612161   
## CitycatSocorro -1.0478747 0.3465647 -3.024 0.002501 \*\*   
## CitycatSolon -1.0228279 0.3555150 -2.877 0.004018 \*\*   
## CitycatSouth Euclid -1.1619081 0.3555052 -3.268 0.001084 \*\*   
## CitycatSouth Miami -0.0841010 0.4702794 -0.179 0.858071   
## CitycatSpeedway -3.4404933 0.6885718 -4.997 5.88e-07 \*\*\*  
## CitycatSpencer -3.5335621 0.6884788 -5.132 2.89e-07 \*\*\*  
## CitycatSpokane -0.4751839 0.3122160 -1.522 0.128031   
## CitycatSpokane Valley -0.4694646 0.3404078 -1.379 0.167871   
## CitycatSpring Lake Park -0.6554813 0.5332206 -1.229 0.218978   
## CitycatStafford -1.1642379 0.6883477 -1.691 0.090784 .   
## CitycatStockton -0.2614265 0.3164552 -0.826 0.408751   
## CitycatStrongsville -0.8424521 0.3770466 -2.234 0.025471 \*   
## CitycatSuffolk -0.4020911 0.5333083 -0.754 0.450884   
## CitycatSunny Isles Beach 0.2404957 0.3316792 0.725 0.468408   
## CitycatSurfside 0.0609760 0.5332572 0.114 0.908964   
## CitycatSweetwater -0.7495238 0.6884792 -1.089 0.276313   
## CitycatSwissvale -0.3451864 0.6884788 -0.501 0.616112   
## CitycatTampa -0.4660167 0.3096005 -1.505 0.132282   
## CitycatTemple Terrace -0.6565896 0.3770667 -1.741 0.081644 .   
## CitycatTerrell Hills 0.1473689 0.4702638 0.313 0.753999   
## CitycatThornton -0.4717506 0.3298865 -1.430 0.152720   
## CitycatTigard -0.0937520 0.3335655 -0.281 0.778667   
## CitycatToledo -1.3685598 0.3130598 -4.372 1.24e-05 \*\*\*  
## CitycatTorrance 0.6562935 0.4354204 1.507 0.131758   
## CitycatTucson -0.6800857 0.3094173 -2.198 0.027963 \*   
## CitycatTulsa -1.0474812 0.3110407 -3.368 0.000759 \*\*\*  
## CitycatUniversity Heights -1.0711195 0.3974562 -2.695 0.007046 \*\*   
## CitycatUpper Arlington -0.2262198 0.3555204 -0.636 0.524584   
## CitycatUrbandale -0.8744108 0.3254972 -2.686 0.007229 \*\*   
## CitycatVerona -0.4515014 0.3595524 -1.256 0.209227   
## CitycatVirginia Beach -0.4786733 0.3108822 -1.540 0.123642   
## CitycatVirginia Gardens 0.5240506 0.6884807 0.761 0.446564   
## CitycatWarr Acres -0.8742854 0.5332114 -1.640 0.101091   
## CitycatWatauga -0.6714453 0.4354021 -1.542 0.123058   
## CitycatWauwatosa -0.2855253 0.3643226 -0.784 0.433216   
## CitycatWest Allis -0.6966428 0.3387810 -2.056 0.039764 \*   
## CitycatWest Hollywood 1.0748336 0.3421756 3.141 0.001685 \*\*   
## CitycatWest Lake Hills 0.5139454 0.6888198 0.746 0.455600   
## CitycatWesterville -0.8876646 0.3643271 -2.436 0.014840 \*   
## CitycatWestminster -0.3625390 0.3770639 -0.961 0.336322   
## CitycatWhite Bear Lake -0.5086653 0.3859204 -1.318 0.187498   
## CitycatWhite Settlement 0.7956260 0.6885321 1.156 0.247882   
## CitycatWhitefish Bay -0.2727733 0.5332250 -0.512 0.608969   
## CitycatWhitehall -1.2810888 0.3975112 -3.223 0.001271 \*\*   
## CitycatWichita -0.9913915 0.3117534 -3.180 0.001475 \*\*   
## CitycatWindsor Heights -0.8040901 0.6885074 -1.168 0.242870   
## CitycatWinter Park 0.1202947 0.4703654 0.256 0.798148   
## CitycatWolfforth -0.6607872 0.5332095 -1.239 0.215261   
## CitycatWoodbury -0.5381165 0.3265801 -1.648 0.099422 .   
## CitycatWorthington -0.7419059 0.5332719 -1.391 0.164169   
## CitycatYukon -0.2962434 0.4703399 -0.630 0.528800   
## Bathrooms.c:Size.c 0.7698967 0.0224251 34.332 < 2e-16 \*\*\*  
## Bedrooms.c:Size.c -0.3758735 0.0275475 -13.645 < 2e-16 \*\*\*  
## Year\_Built.c:Size.c -0.0015072 0.0002861 -5.267 1.40e-07 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.6157 on 21469 degrees of freedom  
## Multiple R-squared: 0.5767, Adjusted R-squared: 0.5698   
## F-statistic: 84.29 on 347 and 21469 DF, p-value: < 2.2e-16

anova(fit7)

## Analysis of Variance Table  
##   
## Response: LogPrice  
## Df Sum Sq Mean Sq F value Pr(>F)   
## Bathrooms.c 1 4999.9 4999.9 13190.551 < 2.2e-16 \*\*\*  
## Bedrooms.c 1 142.3 142.3 375.439 < 2.2e-16 \*\*\*  
## Year\_Built.c 1 18.5 18.5 48.838 2.862e-12 \*\*\*  
## Lot\_Size.c 1 163.4 163.4 431.030 < 2.2e-16 \*\*\*  
## Size.c 1 4.6 4.6 12.061 0.000516 \*\*\*  
## Citycat 339 5197.8 15.3 40.451 < 2.2e-16 \*\*\*  
## Bathrooms.c:Size.c 1 486.6 486.6 1283.769 < 2.2e-16 \*\*\*  
## Bedrooms.c:Size.c 1 62.6 62.6 165.233 < 2.2e-16 \*\*\*  
## Year\_Built.c:Size.c 1 10.5 10.5 27.744 1.398e-07 \*\*\*  
## Residuals 21469 8137.8 0.4   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Interpret Coefficients for variables not involved in interactions:

-Lot Size: For each log square foot increase in log lot size, log price increases by 0.0356 log dollars. Or in other words, as lot size increases by 1%, price increases by about 3.56%.

R-squared: 0.5698. These variables explain about 57% of the variation in Log(Price). Note: Bedrooms is not very significant on its own, but the interaction between bedrooms and size is very significant.

Residual standard error: 0.6157.

Interpret the Residual Standard Error:

mean = mean(housing2$LogPrice)  
mean

## [1] 12.58832

#We can divide this quantity by the mean of Y to obtain the average deviation in percent (which is useful because it will be independent of the units of measure of Y).  
  
avgdev = 0.6157/mean  
avgdev

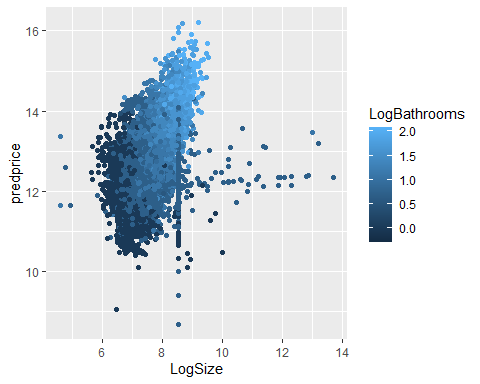
## [1] 0.04891041

The average deviation in actual vs predicted values is about 5%, which is not bad.

#### Interaction Plots

# plot the model. Note: We can use the predict function to get predicted probabilities.  
  
library (ggplot2)  
  
# Save predicted values in the data frame  
housing2$predprice = predict (fit7)  
housing2$pihat.price = predict (fit7, type='response')  
  
#Predictions vs LogSize by resting LogBathrooms  
qplot (LogSize, predprice, data=housing2, color=LogBathrooms) +   
 stat\_summary(fun=mean, geom="line", aes(group = LogBathrooms))

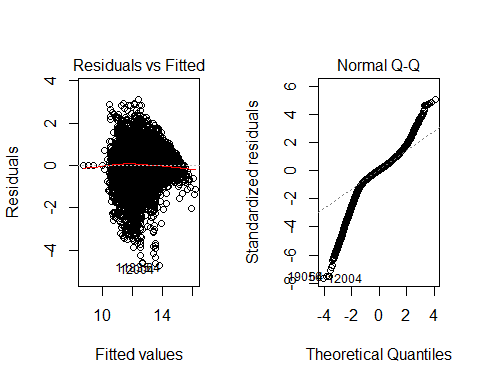
## Warning: Computation failed in `stat\_summary()`:  
## Can't convert a double vector to function



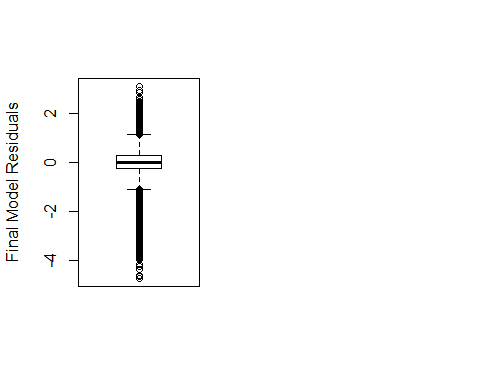
The interaction plot shows that there is a positive trend between the predicted LogPrice and LogSize. Also as LogSize increases, so does the log number of Bathrooms.

### Residual Analysis of Final Model

par (mfrow = c(1, 2))  
plot (fit7, which=c(1,2))



#boxplot  
boxplot (fit7$residuals, ylab="Final Model Residuals")



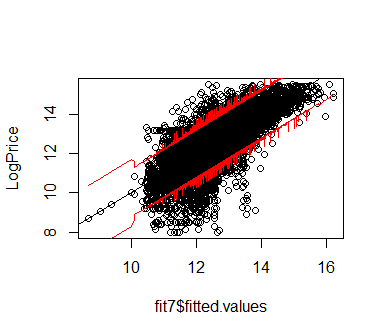
The residuals vs fitted plot show linearity, constant variance. The Normal Q-Q plot and the boxplot show that the residuals look Normal, but with some outliers.

### Outliers

# Plot max heart rate vs predicted for fit 3  
# Row 137 could be a possible outlier as shown in the plot above  
  
plot (LogPrice ~ fit7$fitted.values, data=housing2)  
abline (0, 1)  
  
# Add prediction limits to previous plot  
  
fit7.pred = as.data.frame (predict (fit7, interval="prediction"))

## Warning in predict.lm(fit7, interval = "prediction"): predictions on current data refer to \_future\_ responses

order2 = order (fit7.pred$fit)  
lines (fit7.pred$fit [order2], fit7.pred$lwr[order2], col='red')  
lines (fit7.pred$fit [order2], fit7.pred$upr[order2], col='red')



Here we can see the prediction limits over the fitted values from the final model. There seems to be some outliers on the low end of the plot.

# Compare Linear Regression Model to Tree Regression Model

For comparison to the final linear model, we fit a tree regression using log(Price).

library (rpart)  
tree1 = rpart (LogPrice ~ LogSize + LogBedrooms + LogBathrooms + Year\_Built + LogLot\_Size + Violent\_Crime\_Rate + Property\_Crime\_Rate + City, data = housing2, maxdepth=5)  
print (tree1$cptable)

## CP nsplit rel error xerror xstd  
## 1 0.20026008 0 1.0000000 1.0000724 0.013331744  
## 2 0.11833370 1 0.7997399 0.7998608 0.010779156  
## 3 0.06109785 2 0.6814062 0.6883739 0.009441135  
## 4 0.04348735 3 0.6203084 0.6317506 0.009159599  
## 5 0.02887916 4 0.5768210 0.5938455 0.008463440  
## 6 0.02069736 5 0.5479419 0.5636770 0.008339121  
## 7 0.01719501 6 0.5272445 0.5450875 0.008370723  
## 8 0.01268991 7 0.5100495 0.5273828 0.008299318  
## 9 0.01188462 8 0.4973596 0.5254014 0.008294611  
## 10 0.01000000 10 0.4735903 0.4965615 0.008067479

Find the tree with the smallest xerror:

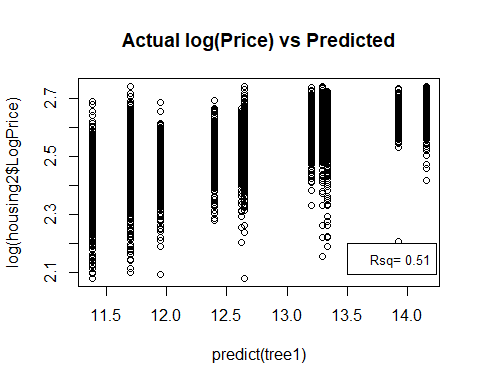
opt1 = which.min (tree1$cptable [,"xerror"])  
opt1

## 10   
## 10

The tree with the smallest xerror is Tree 10.

Plot Log (Price) vs. predicted values and interpret the plot:

plot (predict(tree1), log(housing2$LogPrice), main="Actual log(Price) vs Predicted")  
abline (0, 1, col='red')  
rsq1 = cor (predict(tree1), log(housing2$LogPrice))^2  
legend (13.5, 2.2, c(paste("Rsq=", round (rsq1, 2))), cex=0.8)



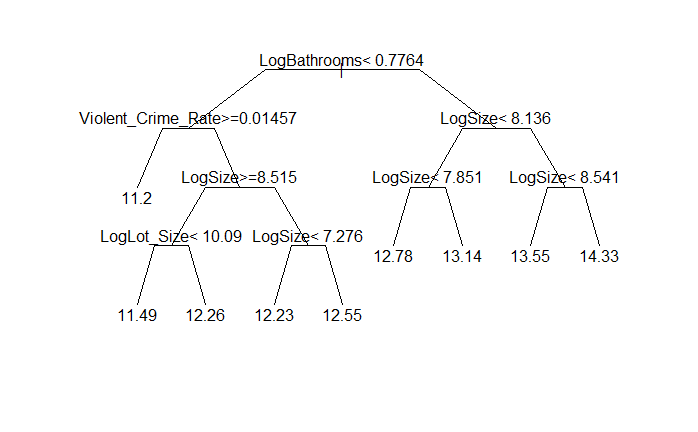
The R-squared for the tree regression model in 0.51, which is less than the R-squared for the linear regression model.

Tree Regression Model with only the numerical data for visualization purposes:

library (rpart)  
tree2 = rpart (LogPrice ~ LogSize + LogBedrooms + LogBathrooms + Year\_Built + LogLot\_Size + Violent\_Crime\_Rate + Property\_Crime\_Rate, data = housing2, maxdepth=5)

Plot and interpret the tree:

par (mfrow=c(1,1))  
  
plot(tree2, uniform = TRUE, margin = 0.08, branch = 0.5,   
 compress = TRUE)  
text(tree2)



We can see that Bathrooms is the most significant predictor.

Real Estate listings that cost the most are listings that have >= 0.7764 log bathrooms (2.17 bathrooms) and log size >= 8.541 (5,120.46 sq ft). This price is 14.33 log dollars (about 1.7 million dollars).

Real Estate listings that cost the least are listings that have < 0.7764 log bathrooms (2.17 bathrooms) and a violent crime rate of >= 0.01457.

Compare these Regression models to the models in Python. See Python Notebooks.