

# Brooklyn Rolling Sales Dataset

The aim of this project is to try to understand the relationship between the sale price of homes in Brooklyn and certain parameters. The goal is to build prediction models and verify the accuracy of these models as well as understand whether these models can be used in the real world.

source : <http://www1.nyc.gov/site/finance/taxes/property-rolling-sales-data.page>  
[\(http://www1.nyc.gov/site/finance/taxes/property-rolling-sales-data.page\)](http://www1.nyc.gov/site/finance/taxes/property-rolling-sales-data.page)

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### 1. Reading the dataset

```
In [99]: library('tidyverse')
library('ggmap')
library('readxl')
library(gridExtra)
```

```
Attaching package: 'gridExtra'
```

```
The following object is masked from 'package:dplyr':
```

```
combine
```

```
In [3]: brook <- read_excel('C:/Users/AnuragKaushik/Downloads/rollingsales_brooklyn.xls', skip = 4)
```

```
In [10]: names(brook)
```

'BOROUGH' 'NEIGHBORHOOD' 'BUILDING.CLASS.CATEGORY'  
 'TAX.CLASS.AT.PRESENT' 'BLOCK' 'LOT' 'EASE.MENT'  
 'BUILDING.CLASS.AT.PRESENT' 'ADDRESS' 'APARTMENT.NUMBER'  
 'ZIP.CODE' 'RESIDENTIAL.UNITS' 'COMMERCIAL.UNITS' 'TOTAL.UNITS'  
 'LAND.SQUARE.FEET' 'GROSS.SQUARE.FEET' 'YEAR.BUILT'  
 'TAX.CLASS.AT.TIME.OF.SALE' 'BUILDING.CLASS.AT.TIME.OF.SALE'  
 'SALE.PRICE' 'SALE.DATE'

```
In [12]: head(brook)
```

BOROUGH	NEIGHBORHOOD	BUILDING.CLASS.CATEGORY	TAX.CLASS.AT.PRESENT
3	BATH BEACH	01 ONE FAMILY DWELLINGS	1
3	BATH BEACH	01 ONE FAMILY DWELLINGS	1
3	BATH BEACH	01 ONE FAMILY DWELLINGS	1
3	BATH BEACH	01 ONE FAMILY DWELLINGS	1
3	BATH BEACH	01 ONE FAMILY DWELLINGS	1
3	BATH BEACH	01 ONE FAMILY DWELLINGS	1

## 2. Cleaning up the dataset

```
In [14]: colnames(brook)[3] <- "BUILDING.CLASS.CATEGORY"
colnames(brook)[8] <- "BUILDING.CLASS.AT.PRESENT"
colnames(brook)[10] <- "APARTMENT.NUMBER"
colnames(brook)[11] <- "ZIP.CODE"
colnames(brook)[12] <- "RESIDENTIAL.UNITS"
colnames(brook)[13] <- "COMMERCIAL.UNITS"
colnames(brook)[17] <- "YEAR.BUILT"
colnames(brook)[18] <- "TAX.CLASS.AT.TIME.OF.SALE"
colnames(brook)[19] <- "BUILDING.CLASS.AT.TIME.OF.SALE"
colnames(brook)[14] <- "TOTAL.UNITS"
colnames(brook)[4] <- "TAX.CLASS.AT.PRESENT"
colnames(brook)[7] <- "EASE.MENT"
colnames(brook)[20] <- "SALE.PRICE"
colnames(brook)[21] <- "SALE.DATE"
colnames(brook)[16] <- "GROSS.SQUARE.FEET"
colnames(brook)[15] <- "LAND.SQUARE.FEET"

brook<-brook[which(brook$GROSS.SQUARE.FEET!="0" & brook$LAND.SQUARE.FEET!="0" &
brook$SALE.PRICE!="0"),]
brook$SALE.PRICE<-sub("\\"$","",brook$SALE.PRICE)
brook$SALE.PRICE<-as.numeric(gsub(",","", brook$SALE.PRICE))
brook$GROSS.SQUARE.FEET<-as.numeric(gsub(",","", brook$GROSS.SQUARE.FEET))
brook$LAND.SQUARE.FEET<-as.numeric(gsub(",","", brook$LAND.SQUARE.FEET))

brook$SALE.PRICE<-sub("\\"$","",brook$SALE.PRICE)
brook$SALE.PRICE<-as.numeric(gsub(",","", brook$SALE.PRICE))
brook$GROSS.SQUARE.FEET<-as.numeric(gsub(",","", brook$GROSS.SQUARE.FEET))
brook$LAND.SQUARE.FEET<-as.numeric(gsub(",","", brook$LAND.SQUARE.FEET))
brook$SALE.DATE<- as.Date(gsub("[^]:digit:]", "",brook$SALE.DATE))
brook$YEAR.BUILT<- as.numeric(gsub("[^]:digit:]", "",brook$YEAR.BUILT))
brook$ZIP.CODE<- as.character(gsub("[^]:digit:]", "",brook$ZIP.CODE))
```

```
In [15]: names(brook)
```

```
'BOROUGH' 'NEIGHBORHOOD' 'BUILDING.CLASS.CATEGORY'
'TAX.CLASS.AT.PRESENT' 'BLOCK' 'LOT' 'EASE.MENT'
'BUILDING.CLASS.AT.PRESENT' 'ADDRESS' 'APARTMENT.NUMBER'
'ZIP.CODE' 'RESIDENTIAL.UNITS' 'COMMERCIAL.UNITS' 'TOTAL.UNITS'
'LAND.SQUARE.FEET' 'GROSS.SQUARE.FEET' 'YEAR.BUILT'
'TAX.CLASS.AT.TIME.OF.SALE' 'BUILDING.CLASS.AT.TIME.OF.SALE'
'SALE.PRICE' 'SALE.DATE'
```

```
In [16]: dim(brook)
```

```
8522 21
```

### 3. Exploratory Data Analysis

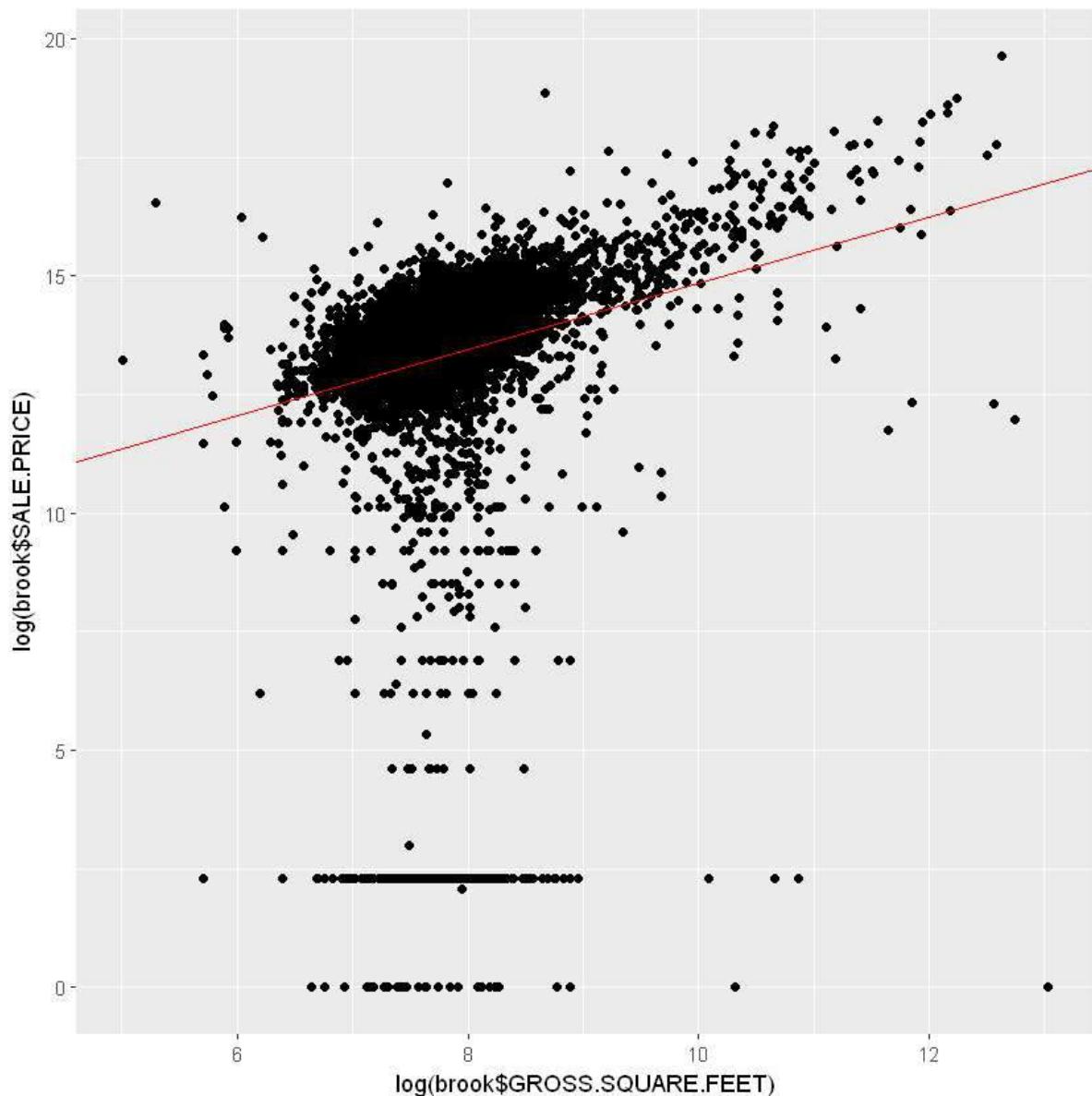
#### 3.1 Does the sale price have any effect on the Gross Square feet and total Land area occupied?

Note : Since there is a considerable difference in magnitude between the different columns, we will be using the logarithmic scale to understand the patterns in data

```
In [17]: coef(lm(log(SALE.PRICE) ~ log(GROSS.SQUARE.FEET), data = brook))
```

```
(Intercept) 7.86195814380221
log(GROSS.SQUARE.... 0.698489091488549
```

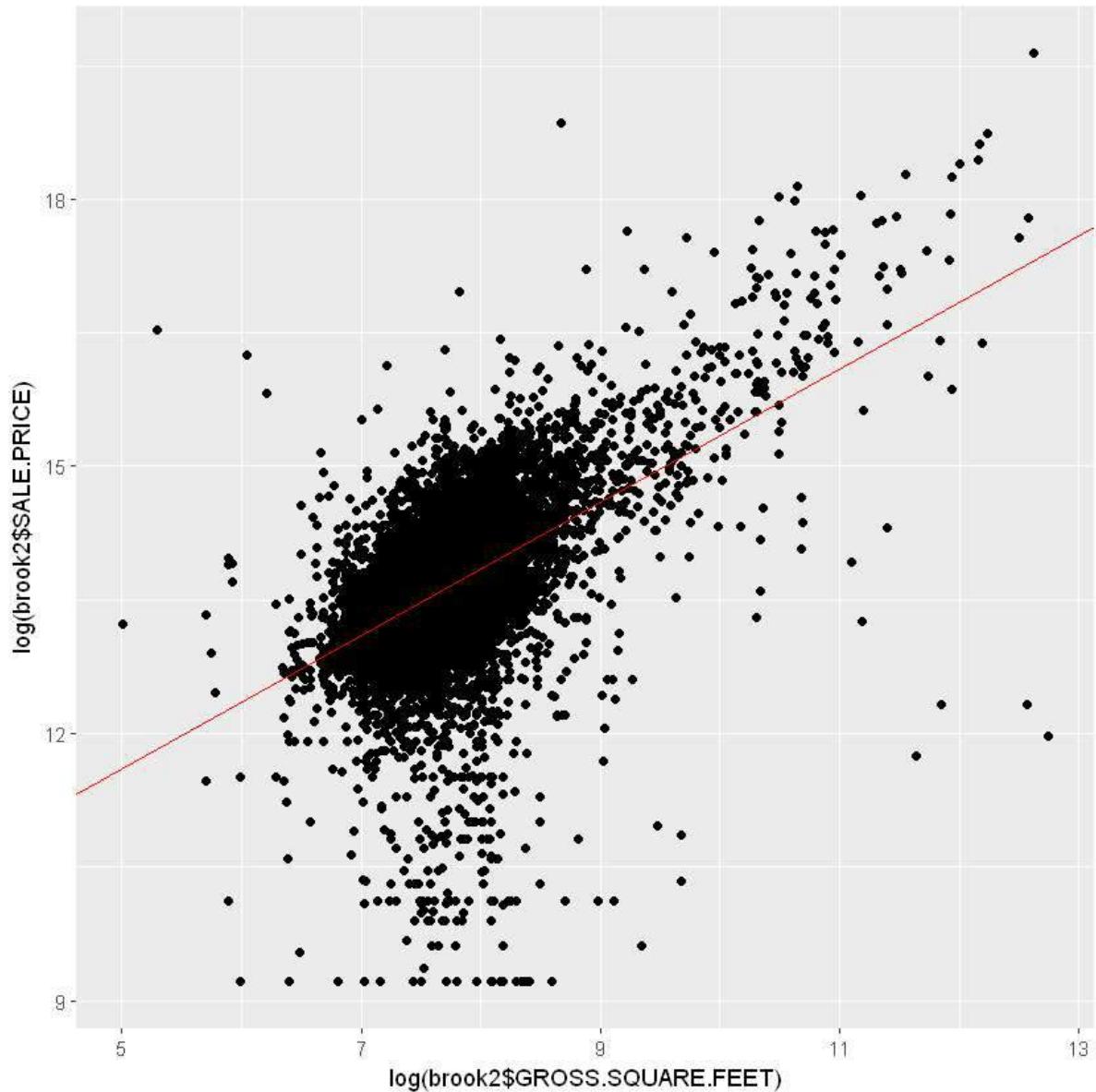
```
In [20]: p1 <- ggplot(mapping = aes(x = log(brook$GROSS.SQUARE.FEET), y = log(brook$SALE.PRICE))) + geom_point()
p1 + geom_abline(intercept = 7.86195814380221, slope = 0.698489091488549, color = "red")
```



Getting rid of the 'bad' values.. Explained below

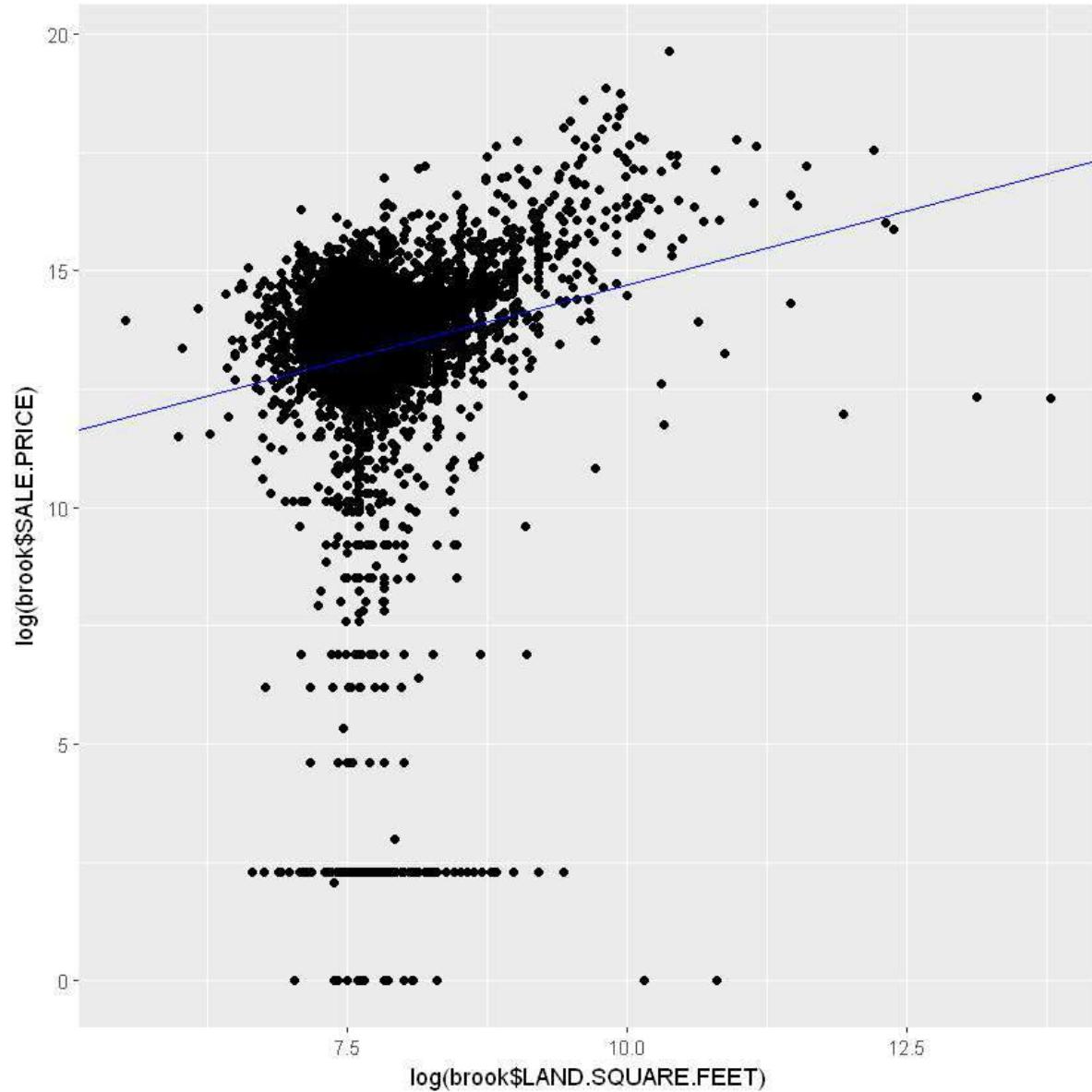
```
In [108]: coef(lm(log(SALE.PRICE) ~ log(GROSS.SQUARE.FEET), data = brook2))
ggplot(mapping = aes(log(brook2$GROSS.SQUARE.FEET), log(brook2$SALE.PRICE) ))
+ geom_point() + geom_abline(intercept = 7.85628165356758, slope = 0.748977874
063136, color = "red")
```

(Intercept) 7.85628165356758  
log(GROSS.SQUARE.... 0.748977874063136



```
In [23]: p1 <- ggplot(mapping = aes(x = log(brook$LAND.SQUARE.FEET), y = log(brook$SALE.PRICE))) + geom_point()  
coef(lm(log(SALE.PRICE) ~ log(LAND.SQUARE.FEET), data = brook))  
p1 + geom_abline(intercept = 8.4580978771284, slope = 0.624004097441551,  
color= "blue")
```

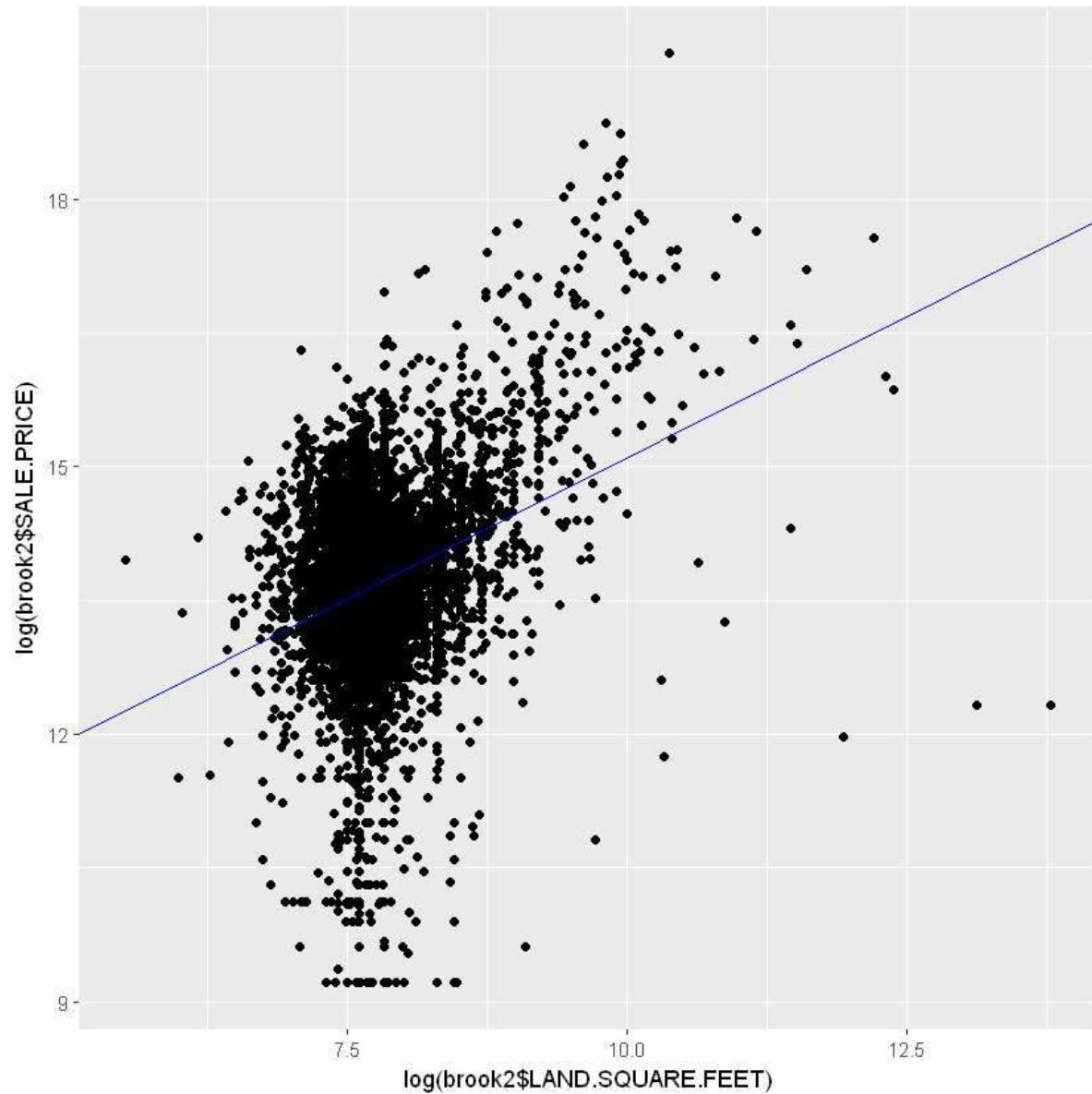
```
(Intercept) 8.4580978771284  
log(LAND.SQUARE.FEET) 0.624004097441551
```



Getting rid of the 'bad' values.. Explained below

```
In [110]: p1 <- ggplot(mapping = aes(log(brook2$LAND.SQUARE.FEET), log(brook2$SALE.PRICE))
  ) + geom_point()
coef(lm(log(SALE.PRICE) ~ log(LAND.SQUARE.FEET), data = brook2))
p1 + geom_abline(intercept = 8.76718596255152, slope = 0.633990949034109, color = "blue")
```

```
(Intercept) 8.76718596255152
log(LAND.SQUARE.FEET) 0.633990949034109
```



An almost linear relationship.

The 'bad' values : The values at zero (i.e.  $\log(1)$ ) essentially mean they are gifts or inheritance but in order to show a transaction should have occurred, the house was 'sold' for \$ 1.

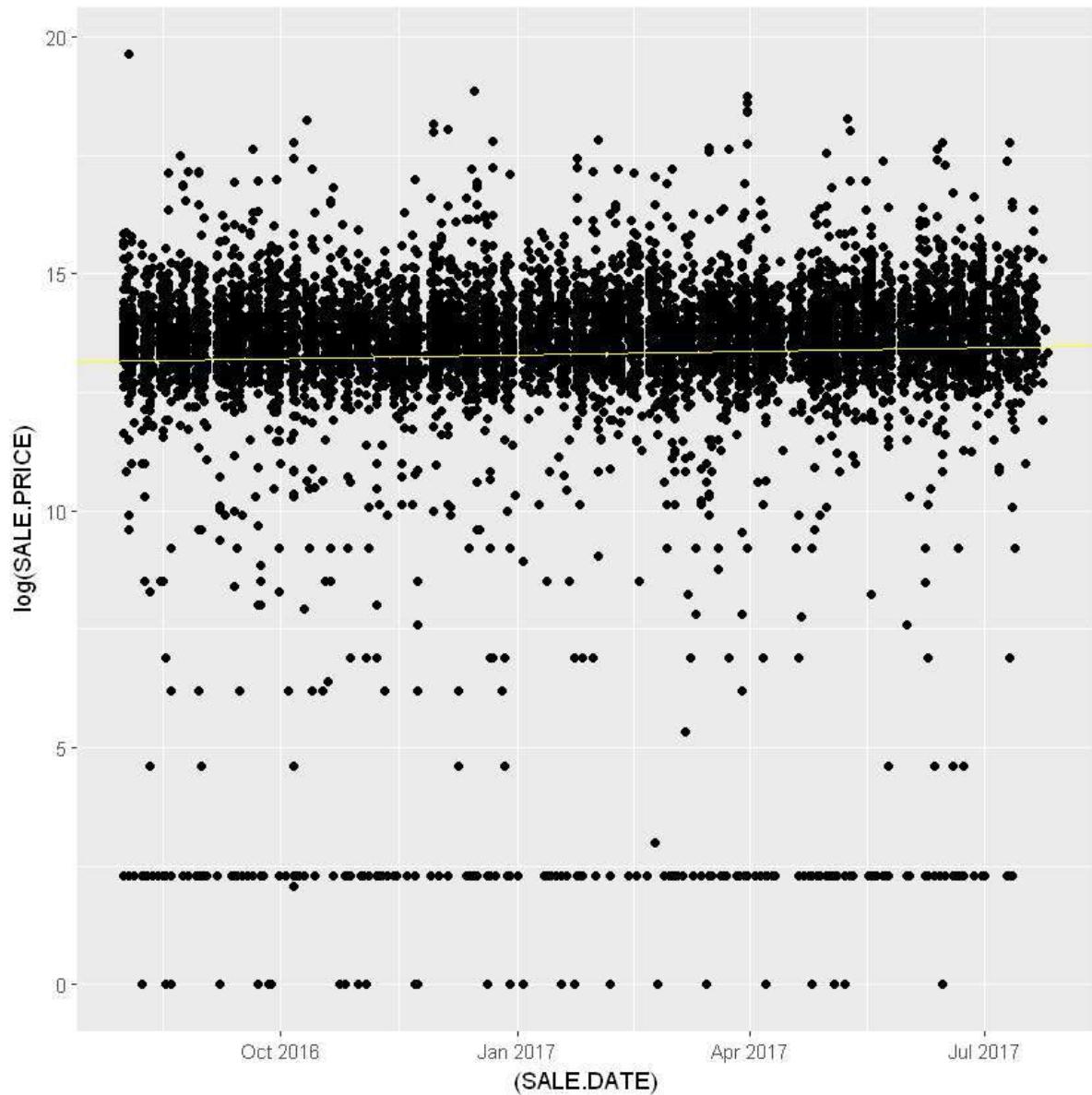
### 3.2 Does the sale date have any relationship with the sale price?

i.e Has the real estate market inflated within the span of a year?

```
In [25]: coef(lm(log(TRADE.PRICE) ~ SALE.DATE, data = brook))
```

(Intercept)	-0.860418965711823
SALE.DATE	0.000823890662193304

```
In [26]: p <- ggplot(data = brook) + geom_point(mapping = aes(x = (SALE.DATE), y = log(TRADE.PRICE)))  
p + geom_abline(intercept = -0.860418965711823, slope = 0.000823890662193304,  
color = "yellow")
```



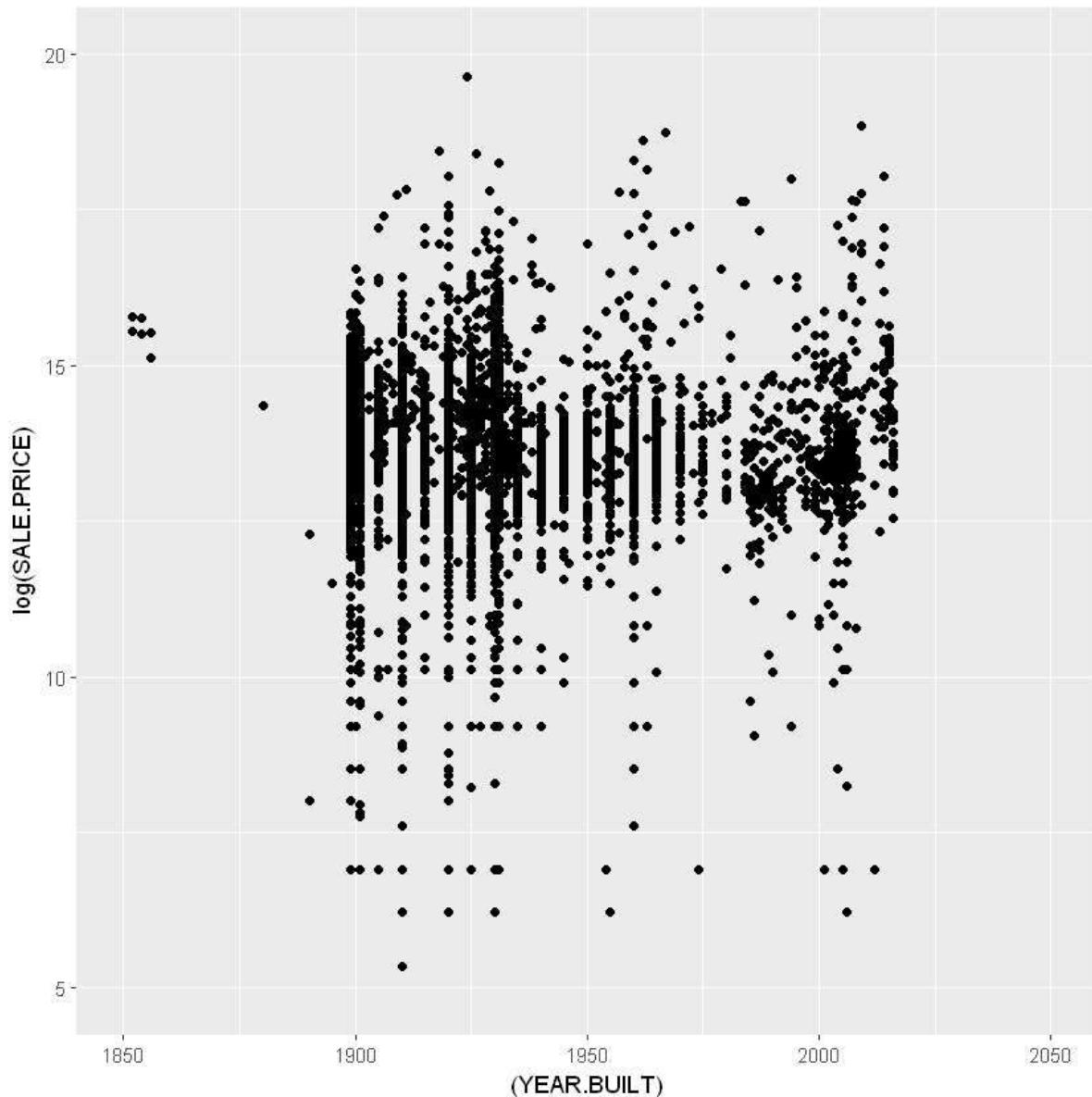
We see that the sale price is fairly constant across the sale date, i.e. the market hasn't inflated between October 2012 to July 2013. The values at zero may mean that the houses were gifted. In order to gift a house, one must show at least a \$1 transaction

### 3.3 Does the age of the house have any relevance to the sale price?

We'd assume that older houses would be more expensive and newer ones would be cheap... Lets see this for ourselves

```
In [27]: ggplot(data = brook) + geom_point(mapping = aes(x = (YEAR.BUILT), y = log(SALE.PRICE))) + xlim(c(1850,2050)) + ylim(c(5,20))
```

Warning message:  
 "Removed 265 rows containing missing values (geom\_point)."



- There seem to be a lot of houses built between 1900-1920 and these houses have a fixed range of values.
- Same could be said of houses built after the year 2000. For the years in between, there are not too many properties for sale.
- The high number beyond 2000 could mean that many buildings have been torn down and replaced by new ones (redevelopment).

### 3.4 How does it look on the map?

```
In [29]: brook$ADDRESSONLY <- 0
brook$ADDRESSONLY<- gsub("[,][[:print:]]*", "", gsub("[ ]+", "", trimws(brook$ADDRESS))) # trim has been replaced by trimws
brookadd<-
unique(data.frame(brook$ADDRESSONLY, brook$ZIP.CODE, stringsAsFactors=FALSE))
names(brookadd)<-c("ADDRESSONLY", "ZIP.CODE")
brookadd<-brookadd[order(brookadd$ADDRESSONLY),]
duplicates<-duplicated(brook$ADDRESSONLY)
```

```
In [31]: minprice<-10000 # Prices of houses only above 10,000 dollars
brook2<-brook[which(brook$SALE.PRICE>=minprice),] # we want only those values
that are higher than 10k dollars.
nval<-dim(brook2)[1]
nval
```

8210

```
In [32]: for(i in 1:nval) {
  if(duplicates[i]==FALSE)
    dupadd<-brookadd[brookadd$duplicates,1]
}
# adding the duplicates
```

```
In [ ]: nsample=450

addsample<-brookadd[sample.int(dim(brookadd), size=nsample),] #Taking a limited
sample

library(ggmap)

addrlist<-paste(addsample$ADDRESSONLY, "NY", addsample$ZIP.CODE, "US", sep="")
# Calling out addresses for NY only

querylist<-geocode(addrlist) #querying the data from google maps! So cool!!
```

```
In [40]: matched<- (querylist$lat!=0 &&querylist$lon!=0) # select lattitude and longitudes that don't have values zero
addsample<-cbind(addsample,querylist$lat,querylist$lon) #combining sample size, lattitude and longitude

names(addsample)<-c("ADDRESSONLY","ZIPCODE","Latitude","Longitude") # correct the column na

adduse<-merge(brook2,addsample) # Similar to JOIN in SQL code. No nasty business!

adduse<-adduse[!is.na(adduse$Latitude),]

mapcoord<-adduse[,c(2,3,24,25)]

table(mapcoord$NEIGHBORHOOD)
```

BAY RIDGE		BEDFORD STUYVESANT		BENSONHURST
5		26		2
BERGEN BEACH		BOERUM HILL		BOROUGH PARK
5		2		4
BRIGHTON BEACH		BROWNSVILLE		BUSH TERMINAL
5		9		1
BUSHWICK		CANARSIE		CARROLL GARDENS
17		18		4
CLINTON HILL		COBBLE HILL		COBBLE HILL-WEST
7		2		2
CROWN HEIGHTS		CYPRESS HILLS		DOWNTOWN-FULTON FERRY
13		5		2
DOWNTOWN-METROTECH		EAST NEW YORK		FLATBUSH-CENTRAL
1		26		14
FLATBUSH-EAST	FLATBUSH-LEFFERTS GARDEN			FLATBUSH-NORTH
21		4		8
FLATLANDS		FORT GREENE		GERRITSEN BEACH
8		2		3
GOWANUS		GRAVESEND		GREENPOINT
2		14		3
KENSINGTON		MADISON		MANHATTAN BEACH
2		2		3
MARINE PARK		MIDWOOD		MILL BASIN
11		11		6
NAVY YARD		OCEAN HILL		OCEAN PARKWAY-NORTH
1		14		11
OCEAN PARKWAY-SOUTH		OLD MILL BASIN		PARK SLOPE
4		4		6
PARK SLOPE SOUTH		PROSPECT HEIGHTS		RED HOOK
2		1		1
SEAGATE		SHEEPSHEAD BAY		SPRING CREEK
4		11		2
SUNSET PARK		WILLIAMSBURG-CENTRAL		WILLIAMSBURG-EAST
3		2		5
WILLIAMSBURG-NORTH		WINDSOR TERRACE		WYCKOFF HEIGHTS
1		3		3

```
In [42]: mapcoord$NEIGHBORHOOD <- as.factor(mapcoord$NEIGHBORHOOD)

map <- get_map(location = 'Brooklyn', zoom = 12) #Zoom 11 or 12

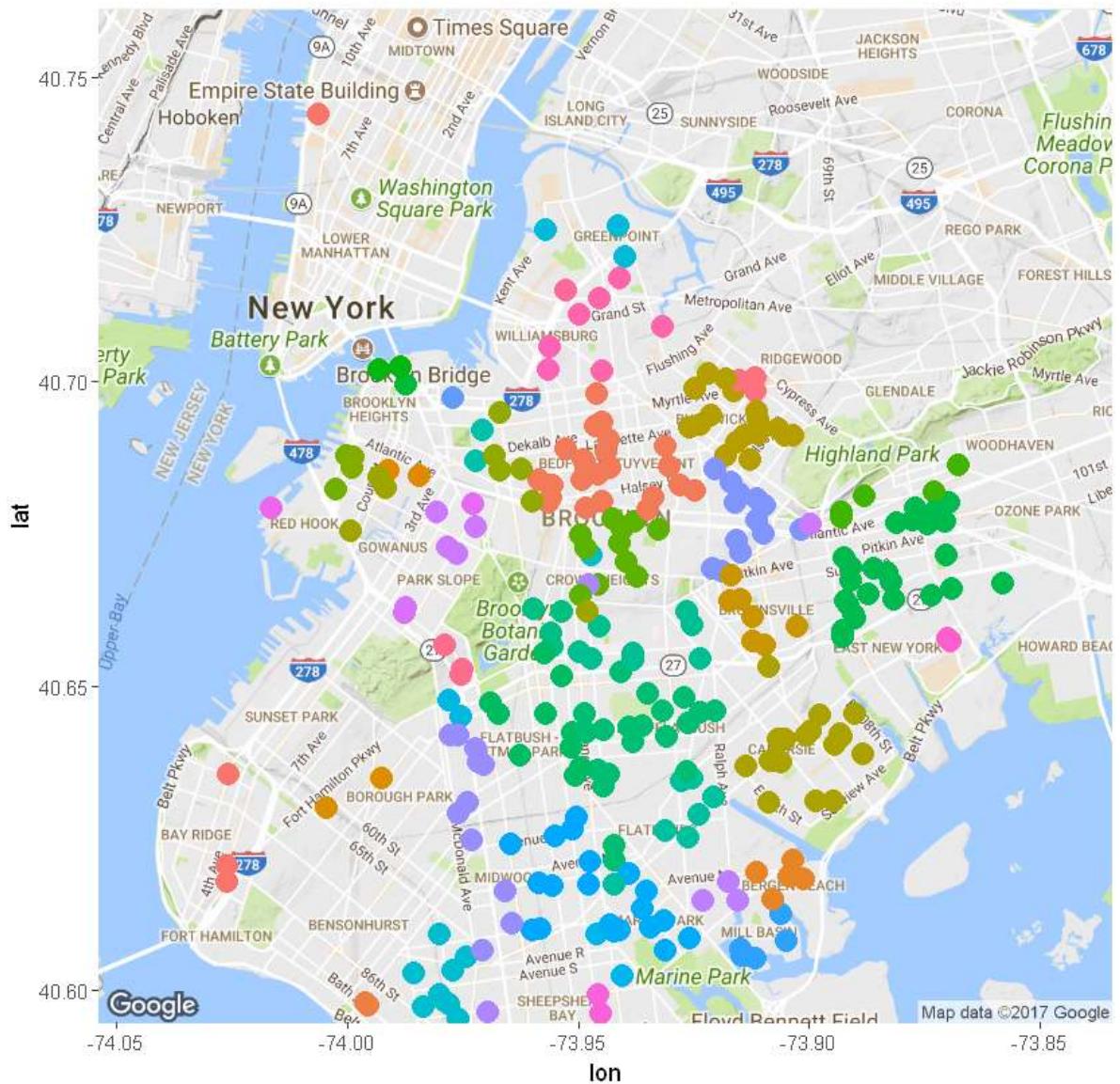
ggmap(map) + geom_point(aes(x = mapcoord$Longitude, y = mapcoord$Latitude,
                             size = 0.5, color=mapcoord$NEIGHBORHOOD),data = map
                           coord) + theme(legend.position = "none")
```

Map from URL : <http://maps.googleapis.com/maps/api/staticmap?center=Brooklyn&zoom=12&size=640x640&scale=2&maptype=terrain&language=en-EN&sensor=false>

Information from URL : <http://maps.googleapis.com/maps/api/geocode/json?address=Brooklyn&sensor=false>

Warning message:

"Removed 37 rows containing missing values (geom\_point)."

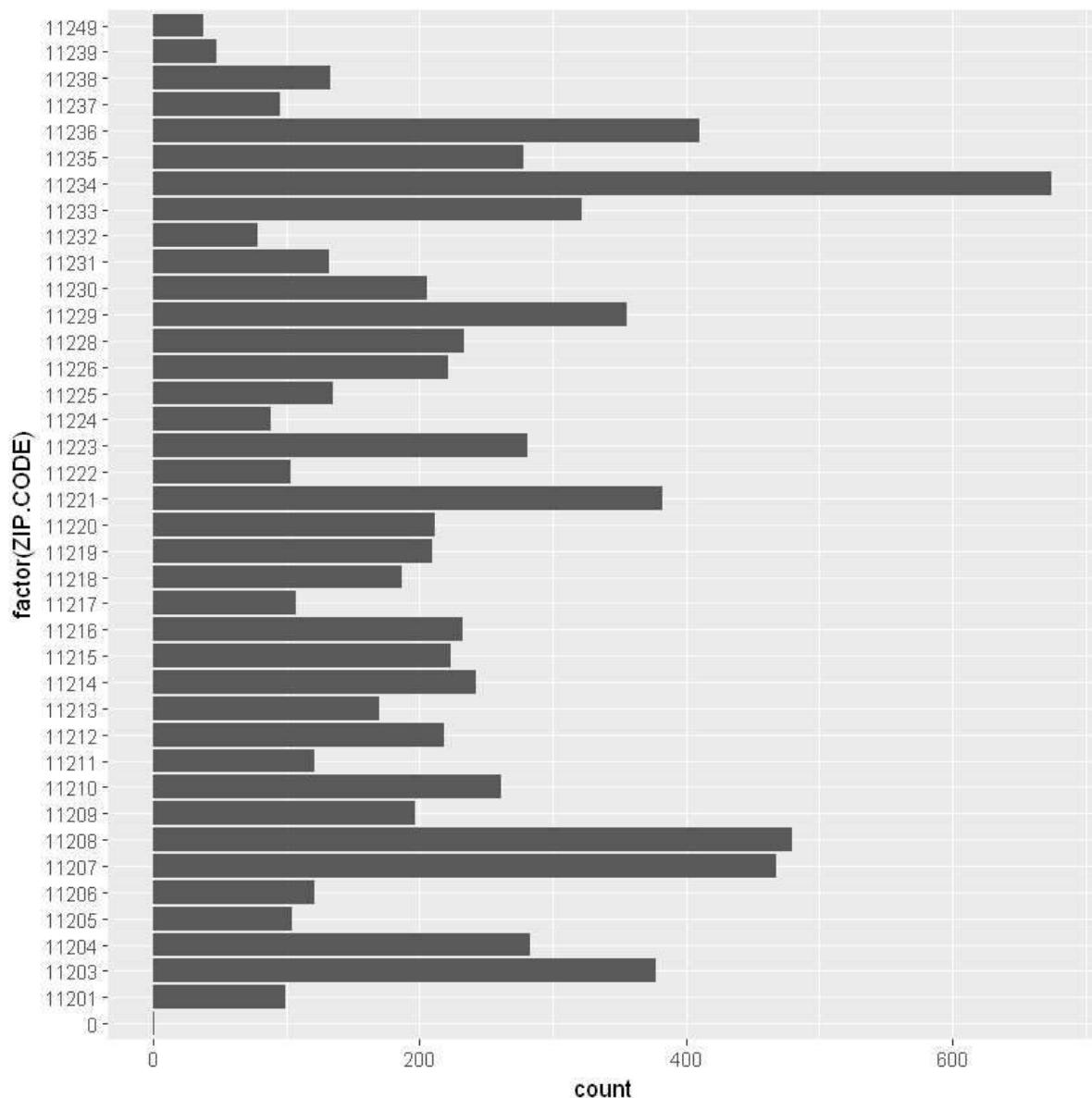


### 3.5 Where are the highest number of properties sold or listed?

```
In [43]: names(brook)
# How many houses per zip code
```

```
bar <- ggplot(brook, aes(factor(ZIP.CODE)))
bar + geom_bar() + coord_flip()
```

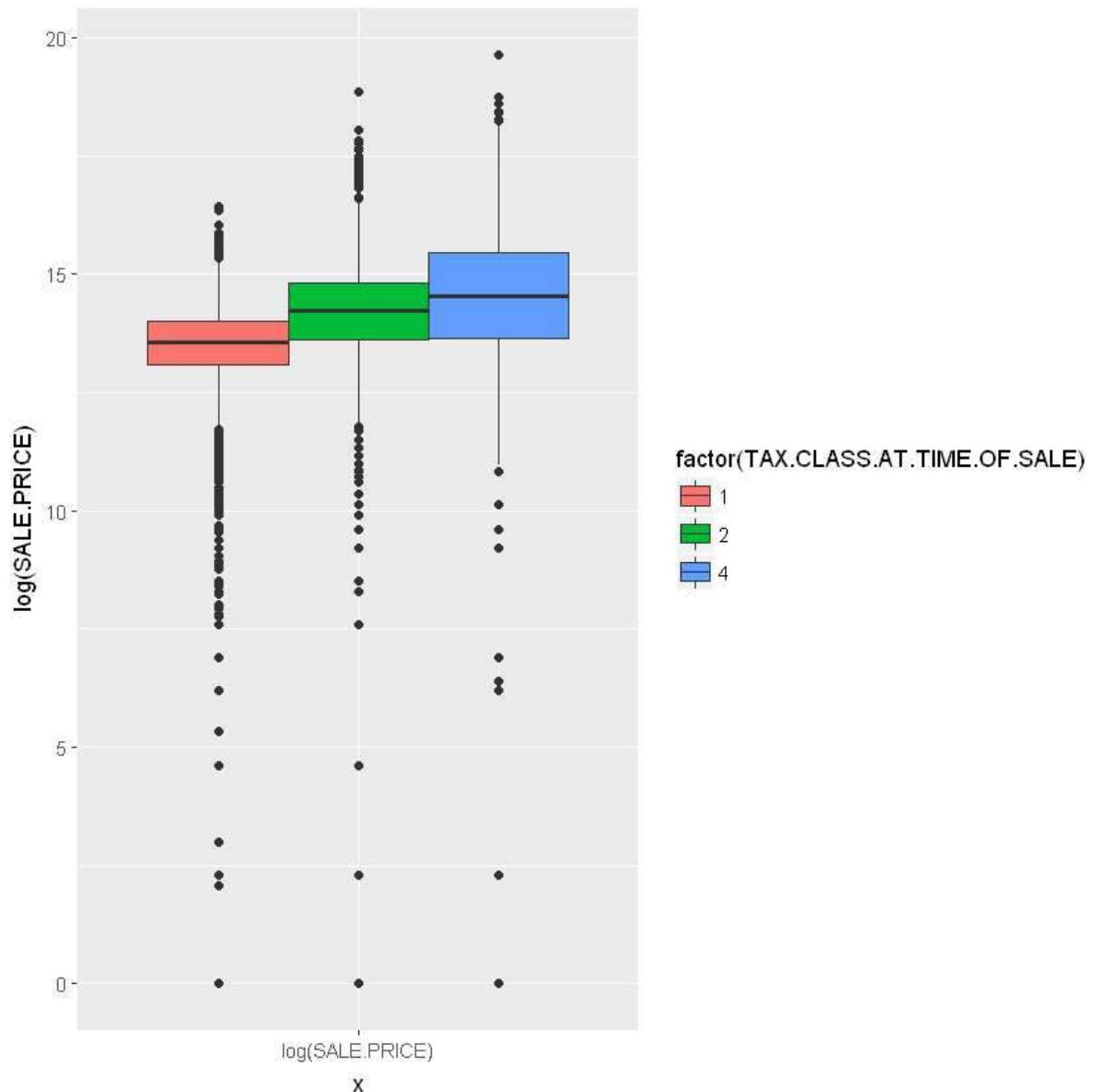
'BOROUGH' 'NEIGHBORHOOD' 'BUILDING.CLASS.CATEGORY'  
 'TAX.CLASS.AT.PRESENT' 'BLOCK' 'LOT' 'EASE.MENT'  
 'BUILDING.CLASS.AT.PRESENT' 'ADDRESS' 'APARTMENT.NUMBER'  
 'ZIP.CODE' 'RESIDENTIAL.UNITS' 'COMMERCIAL.UNITS' 'TOTAL.UNITS'  
 'LAND.SQUARE.FEET' 'GROSS.SQUARE.FEET' 'YEAR.BUILT'  
 'TAX.CLASS.AT.TIME.OF.SALE' 'BUILDING.CLASS.AT.TIME.OF.SALE'  
 'SALE.PRICE' 'SALE.DATE' 'ADDRESSONLY'



This correlates with the map that Bergen Beach (zipcode 11234 has the highest number of properties for sale), i.e. the highest density of points.

### 3.6 How does Tax Class affect the sale price?

```
In [46]: ggplot(brook, aes(x="log(SALE.PRICE)", y=log(SALE.PRICE)))+ geom_boxplot(aes(factor(TAX.CLASS.AT.TIME.OF.SALE)))
```



There is a clear difference in sales prices (especially considering that we have used natural log of the values) between the 3 taxable classes. It could be a useful factor that we can use in modeling.

## 4. Modeling using Regression

### 4.1 Model 1 : Sale Price depends on numbers only!

```
In [63]: model1 <- lm(log(SALE.PRICE) ~ 0 + RESIDENTIAL.UNITS + COMMERCIAL.UNITS
+ TOTAL.UNITS + log(LAND.SQUARE.FEET) + log(GROSS.SQUARE.FEET)
+ YEAR.BUILT+ (TAX.CLASS.AT.TIME.OF.SALE) + SALE.DATE, data = bro
ok)
summary(model1)
```

Call:

```
lm(formula = log(SALE.PRICE) ~ 0 + RESIDENTIAL.UNITS + COMMERCIAL.UNITS +
TOTAL.UNITS + log(LAND.SQUARE.FEET) + log(GROSS.SQUARE.FEET) +
YEAR.BUILT + (TAX.CLASS.AT.TIME.OF.SALE) + SALE.DATE, data = brook)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-17.0553	0.0188	0.4389	0.7942	4.8399

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
RESIDENTIAL.UNITS	0.0121593	0.2426085	0.050	0.96003
COMMERCIAL.UNITS	0.0215501	0.2378985	0.091	0.92782
TOTAL.UNITS	-0.0141110	0.2428548	-0.058	0.95367
log(LAND.SQUARE.FEET)	0.0938589	0.0599572	1.565	0.11752
log(GROSS.SQUARE.FEET)	0.6034264	0.0522792	11.542	< 2e-16 ***
YEAR.BUILT	-0.0009577	0.0004625	-2.071	0.03840 *
TAX.CLASS.AT.TIME.OF.SALE	0.1101291	0.0416770	2.642	0.00825 **
SALE.DATE	0.0005575	0.0000567	9.833	< 2e-16 ***
---				
Signif. codes:	0 **** 0.001 ** 0.01 * 0.05 . 0.1 ' ' 1			

Residual standard error: 2.185 on 8514 degrees of freedom

Multiple R-squared: 0.9738, Adjusted R-squared: 0.9738

F-statistic: 3.953e+04 on 8 and 8514 DF, p-value: < 2.2e-16

```
In [136]: # Tweaking model1 to include only the significant variables
model1 <- lm(log(SALE.PRICE) ~ 0 + log(GROSS.SQUARE.FEET) + factor(TAX.CLASS.
AT.TIME.OF.SALE) + YEAR.BUILT + SALE.DATE, data = brook)

summary(model1)

Call:
lm(formula = log(SALE.PRICE) ~ 0 + log(GROSS.SQUARE.FEET) + factor(TAX.CLASS.
AT.TIME.OF.SALE) +
YEAR.BUILT + SALE.DATE, data = brook)

Residuals:
    Min      1Q  Median      3Q     Max 
-17.0269  0.0175  0.4388  0.7999  5.0495 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)    
log(GROSS.SQUARE.FEET)          0.6422126  0.0437403 14.682 < 2e-16 ***
factor(TAX.CLASS.AT.TIME.OF.SALE)1 -3.1431809  4.0933293 -0.768  0.44258  
factor(TAX.CLASS.AT.TIME.OF.SALE)2 -3.0784217  4.0975125 -0.751  0.45250  
factor(TAX.CLASS.AT.TIME.OF.SALE)4 -2.7456076  4.0997036 -0.670  0.50306  
YEAR.BUILT                      -0.0008296  0.0004741 -1.750  0.08018 .  
SALE.DATE                        0.0007571  0.0002312  3.275  0.00106 ** 
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.185 on 8516 degrees of freedom
Multiple R-squared:  0.9738,    Adjusted R-squared:  0.9738 
F-statistic: 5.27e+04 on 6 and 8516 DF,  p-value: < 2.2e-16
```

Model performs pretty well, lets try to improve it!

```
In [84]: model_1.5 <- lm(log(SALE.PRICE) ~ 0 + log(LAND.SQUARE.FEET) +
    log(GROSS.SQUARE.FEET) + factor(TAX.CLASS.AT.TIME.OF.SALE) +
    SALE.DATE + factor(NEIGHBORHOOD) + factor(BUILDING.CLASS.CATE-
    GORY) + factor(ZIP.CODE), data = brook)

#model_1.5$call
summary(model_1.5)
```

Call:

```
lm(formula = log(SALE.PRICE) ~ 0 + log(LAND.SQUARE.FEET) + log(GROSS.SQUARE.FEET) +
  factor(TAX.CLASS.AT.TIME.OF.SALE) + SALE.DATE + factor(NEIGHBORHOOD) +
  factor(BUILDING.CLASS.CATEGORY) + factor(ZIP.CODE), data = brook)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-16.8689	0.0775	0.4277	0.7654	5.7254

Coefficients: (3 not defined because of singularities)

	Est
imate	
log(LAND.SQUARE.FEET)	0.21
79554	
log(GROSS.SQUARE.FEET)	0.46
18104	
factor(TAX.CLASS.AT.TIME.OF.SALE)1	-2.02
36401	
factor(TAX.CLASS.AT.TIME.OF.SALE)2	-2.03
29673	
factor(TAX.CLASS.AT.TIME.OF.SALE)4	-2.13
20569	
SALE.DATE	0.00
07454	
factor(NEIGHBORHOOD)BAY RIDGE	0.32
44295	
factor(NEIGHBORHOOD)BEDFORD STUYVESANT	0.31
00996	
factor(NEIGHBORHOOD)BENSONHURST	0.15
43094	
factor(NEIGHBORHOOD)BERGEN BEACH	-0.38
84179	
factor(NEIGHBORHOOD)BOERUM HILL	-0.84
74484	
factor(NEIGHBORHOOD)BOROUGH PARK	0.26
77078	
factor(NEIGHBORHOOD)BRIGHTON BEACH	0.31
96786	
factor(NEIGHBORHOOD)BROOKLYN HEIGHTS	-0.74
04788	
factor(NEIGHBORHOOD)BROWNSVILLE	-0.00
26412	
factor(NEIGHBORHOOD)BUSH TERMINAL	0.45
46431	
factor(NEIGHBORHOOD)BUSHWICK	0.08
24849	
factor(NEIGHBORHOOD)CANARSIE	-1.88
22934	
factor(NEIGHBORHOOD)CARROLL GARDENS	-0.07
77082	
factor(NEIGHBORHOOD)CLINTON HILL	0.13
00285	
factor(NEIGHBORHOOD)COBBLE HILL	0.32
50691	
factor(NEIGHBORHOOD)COBBLE HILL-WEST	-0.40
96385	

factor(NEIGHBORHOOD)CONEY ISLAND 80694	-0.08
factor(NEIGHBORHOOD)CROWN HEIGHTS 35424	0.45
factor(NEIGHBORHOOD)CYPRESS HILLS 07064	-0.11
factor(NEIGHBORHOOD)DOWNTOWN-FULTON FERRY 28731	1.43
factor(NEIGHBORHOOD)DOWNTOWN-FULTON MALL 10243	-0.11
factor(NEIGHBORHOOD)DOWNTOWN-METROTECH 88297	-1.43
factor(NEIGHBORHOOD)DYKER HEIGHTS 33386	0.01
factor(NEIGHBORHOOD)EAST NEW YORK 11822	-0.29
factor(NEIGHBORHOOD)FLATBUSH-CENTRAL 48587	0.26
factor(NEIGHBORHOOD)FLATBUSH-EAST 92792	-0.27
factor(NEIGHBORHOOD)FLATBUSH-LEFFERTS GARDEN 82747	0.26
factor(NEIGHBORHOOD)FLATBUSH-NORTH 51055	0.06
factor(NEIGHBORHOOD)FLATLANDS 72157	-0.52
factor(NEIGHBORHOOD)FORT GREENE 24870	-0.88
factor(NEIGHBORHOOD)GERRITSEN BEACH 34674	-0.48
factor(NEIGHBORHOOD)GOWANUS 48888	-0.48
factor(NEIGHBORHOOD)GRAVESEND 57298	0.04
factor(NEIGHBORHOOD)GREENPOINT 79189	0.93
factor(NEIGHBORHOOD)KENSINGTON 58723	1.26
factor(NEIGHBORHOOD)MADISON 70222	0.03
factor(NEIGHBORHOOD)MANHATTAN BEACH 46732	0.46
factor(NEIGHBORHOOD)MARINE PARK 17240	-0.07
factor(NEIGHBORHOOD)MIDWOOD 33228	0.21
factor(NEIGHBORHOOD)MILL BASIN 01747	-0.10
factor(NEIGHBORHOOD)NAVY YARD 37444	0.21
factor(NEIGHBORHOOD)OCEAN HILL 17059	0.04
factor(NEIGHBORHOOD)OCEAN PARKWAY-NORTH 68927	0.06
factor(NEIGHBORHOOD)OCEAN PARKWAY-SOUTH 41271	-0.04
factor(NEIGHBORHOOD)OLD MILL BASIN	-0.71

64275		
factor(NEIGHBORHOOD)PARK SLOPE		-0.22
36462		
factor(NEIGHBORHOOD)PARK SLOPE SOUTH		0.32
12021		
factor(NEIGHBORHOOD)PROSPECT HEIGHTS		1.20
23718		
factor(NEIGHBORHOOD)RED HOOK		-0.45
21141		
factor(NEIGHBORHOOD)SEAGATE		-0.21
57135		
factor(NEIGHBORHOOD)SHEEPSHEAD BAY		-0.15
75170		
factor(NEIGHBORHOOD)SPRING CREEK		-2.95
81802		
factor(NEIGHBORHOOD)SUNSET PARK		0.18
12798		
factor(NEIGHBORHOOD)WILLIAMSBURG-CENTRAL		-0.16
15314		
factor(NEIGHBORHOOD)WILLIAMSBURG-EAST		0.87
53098		
factor(NEIGHBORHOOD)WILLIAMSBURG-NORTH		1.27
91259		
factor(NEIGHBORHOOD)WILLIAMSBURG-SOUTH		1.39
82429		
factor(NEIGHBORHOOD)WINDSOR TERRACE		1.15
65425		
factor(NEIGHBORHOOD)WYCKOFF HEIGHTS		-0.84
57224		
factor(BUILDING.CLASS.CATEGORY)02 TWO FAMILY DWELLINGS		-0.04
14048		
factor(BUILDING.CLASS.CATEGORY)03 THREE FAMILY DWELLINGS		-0.14
85315		
factor(BUILDING.CLASS.CATEGORY)05 TAX CLASS 1 VACANT LAND		0.54
49965		
factor(BUILDING.CLASS.CATEGORY)06 TAX CLASS 1 - OTHER		-1.37
96458		
factor(BUILDING.CLASS.CATEGORY)07 RENTALS - WALKUP APARTMENTS		-0.01
35473		
factor(BUILDING.CLASS.CATEGORY)08 RENTALS - ELEVATOR APARTMENTS		-0.08
92599		
factor(BUILDING.CLASS.CATEGORY)09 COOPS - WALKUP APARTMENTS		-1.00
40429		
factor(BUILDING.CLASS.CATEGORY)10 COOPS - ELEVATOR APARTMENTS		-2.50
44400		
factor(BUILDING.CLASS.CATEGORY)11 SPECIAL CONDO BILLING LOTS		-1.35
54902		
factor(BUILDING.CLASS.CATEGORY)11A CONDO-RENTALS		3.09
10249		
factor(BUILDING.CLASS.CATEGORY)14 RENTALS - 4-10 UNIT NA		
factor(BUILDING.CLASS.CATEGORY)21 OFFICE BUILDINGS		0.23
15332		
factor(BUILDING.CLASS.CATEGORY)22 STORE BUILDINGS		0.12
06423		
factor(BUILDING.CLASS.CATEGORY)23 LOFT BUILDINGS		1.10
22567		

factor(BUILDING.CLASS.CATEGORY)26 OTHER HOTELS	0.97
09928	
factor(BUILDING.CLASS.CATEGORY)27 FACTORIES	0.40
25562	
factor(BUILDING.CLASS.CATEGORY)29 COMMERCIAL GARAGES	0.80
53754	
factor(BUILDING.CLASS.CATEGORY)30 WAREHOUSES	0.45
41628	
factor(BUILDING.CLASS.CATEGORY)31 COMMERCIAL VACANT LAND	0.81
79621	
factor(BUILDING.CLASS.CATEGORY)32 HOSPITAL AND HEALTH FACILITIES	0.52
72455	
factor(BUILDING.CLASS.CATEGORY)33 EDUCATIONAL FACILITIES	0.31
81019	
factor(BUILDING.CLASS.CATEGORY)34 THEATRES	2.06
00602	
factor(BUILDING.CLASS.CATEGORY)35 INDOOR PUBLIC AND CULTURAL FACILITIES	-3.96
71970	
factor(BUILDING.CLASS.CATEGORY)37 RELIGIOUS FACILITIES	0.55
28339	
factor(BUILDING.CLASS.CATEGORY)38 ASYLUMS AND HOMES	0.58
40186	
factor(BUILDING.CLASS.CATEGORY)41 TAX CLASS 4 - OTHER	
NA	
factor(ZIP.CODE)11201	-1.01
58010	
factor(ZIP.CODE)11203	-3.31
40269	
factor(ZIP.CODE)11204	-2.39
60056	
factor(ZIP.CODE)11205	-2.19
13372	
factor(ZIP.CODE)11206	-3.06
64780	
factor(ZIP.CODE)11207	-3.10
35826	
factor(ZIP.CODE)11208	-3.27
50747	
factor(ZIP.CODE)11209	-2.69
59456	
factor(ZIP.CODE)11210	-2.74
32541	
factor(ZIP.CODE)11211	-2.84
18989	
factor(ZIP.CODE)11212	-3.54
19525	
factor(ZIP.CODE)11213	-3.52
34341	
factor(ZIP.CODE)11214	-3.05
02422	
factor(ZIP.CODE)11215	-2.03
12875	
factor(ZIP.CODE)11216	-2.82
70022	
factor(ZIP.CODE)11217	-1.55
45425	
factor(ZIP.CODE)11218	-3.19

88839	
factor(ZIP.CODE)11219	-2.72
50490	-2.69
factor(ZIP.CODE)11220	
03090	-2.99
factor(ZIP.CODE)11221	
20072	-3.28
factor(ZIP.CODE)11222	
36373	-2.42
factor(ZIP.CODE)11223	
92966	-2.90
factor(ZIP.CODE)11224	
68322	-2.80
factor(ZIP.CODE)11225	
08404	-2.91
factor(ZIP.CODE)11226	
12545	-2.36
factor(ZIP.CODE)11228	
23978	-2.27
factor(ZIP.CODE)11229	
66419	-2.25
factor(ZIP.CODE)11230	
72936	-1.92
factor(ZIP.CODE)11231	
93726	-2.30
factor(ZIP.CODE)11232	
47466	-2.91
factor(ZIP.CODE)11233	
51137	-2.59
factor(ZIP.CODE)11234	
04310	-2.75
factor(ZIP.CODE)11235	
73888	-1.53
factor(ZIP.CODE)11236	
65569	-2.26
factor(ZIP.CODE)11237	
47271	-2.87
factor(ZIP.CODE)11238	
88969	
factor(ZIP.CODE)11239	
NA	
factor(ZIP.CODE)11249	-2.77
19657	Std.
Error	
log(LAND.SQUARE.FEET)	0.07
09279	
log(GROSS.SQUARE.FEET)	0.06
58547	
factor(TAX.CLASS.AT.TIME.OF.SALE)1	4.57
13001	
factor(TAX.CLASS.AT.TIME.OF.SALE)2	4.57
70083	
factor(TAX.CLASS.AT.TIME.OF.SALE)4	4.68
23149	
SALE.DATE	0.00
02279	

factor(NEIGHBORHOOD)BAY RIDGE	0.43
10107	
factor(NEIGHBORHOOD)BEDFORD STUYVESANT	0.60
43228	
factor(NEIGHBORHOOD)BENSONHURST	0.25
99221	
factor(NEIGHBORHOOD)BERGEN BEACH	0.57
96390	
factor(NEIGHBORHOOD)BOERUM HILL	0.63
45968	
factor(NEIGHBORHOOD)BOROUGH PARK	0.30
59658	
factor(NEIGHBORHOOD)BRIGHTON BEACH	0.55
44739	
factor(NEIGHBORHOOD)BROOKLYN HEIGHTS	0.78
31282	
factor(NEIGHBORHOOD)BROWNSVILLE	0.56
70246	
factor(NEIGHBORHOOD)BUSH TERMINAL	0.59
15547	
factor(NEIGHBORHOOD)BUSHWICK	0.63
54670	
factor(NEIGHBORHOOD)CANARSIE	0.80
96676	
factor(NEIGHBORHOOD)CARROLL GARDENS	0.76
08484	
factor(NEIGHBORHOOD)CLINTON HILL	0.65
45563	
factor(NEIGHBORHOOD)COBBLE HILL	0.80
89239	
factor(NEIGHBORHOOD)COBBLE HILL-WEST	0.83
38531	
factor(NEIGHBORHOOD)CONEY ISLAND	2.17
48996	
factor(NEIGHBORHOOD)CROWN HEIGHTS	0.59
56883	
factor(NEIGHBORHOOD)CYPRESS HILLS	0.68
90757	
factor(NEIGHBORHOOD)DOWNTOWN-FULTON FERRY	1.44
45787	
factor(NEIGHBORHOOD)DOWNTOWN-FULTON MALL	1.07
02368	
factor(NEIGHBORHOOD)DOWNTOWN-METROTECH	0.96
62646	
factor(NEIGHBORHOOD)DYKER HEIGHTS	0.31
08726	
factor(NEIGHBORHOOD)EAST NEW YORK	0.67
53376	
factor(NEIGHBORHOOD)FLATBUSH-CENTRAL	0.44
36799	
factor(NEIGHBORHOOD)FLATBUSH-EAST	0.43
95160	
factor(NEIGHBORHOOD)FLATBUSH-LEFFERTS GARDEN	0.62
77383	
factor(NEIGHBORHOOD)FLATBUSH-NORTH	0.48
44660	
factor(NEIGHBORHOOD)FLATLANDS	0.55

56018	
factor(NEIGHBORHOOD)FORT GREENE	0.62
89771	
factor(NEIGHBORHOOD)GERRITSEN BEACH	0.52
45863	
factor(NEIGHBORHOOD)GOWANUS	0.57
67250	
factor(NEIGHBORHOOD)GRAVESEND	0.30
03799	
factor(NEIGHBORHOOD)GREENPOINT	1.43
34667	
factor(NEIGHBORHOOD)KENSINGTON	0.52
07127	
factor(NEIGHBORHOOD)MADISON	0.48
93259	
factor(NEIGHBORHOOD)MANHATTAN BEACH	0.57
16173	
factor(NEIGHBORHOOD)MARINE PARK	0.52
30922	
factor(NEIGHBORHOOD)MIDWOOD	0.42
51105	
factor(NEIGHBORHOOD)MILL BASIN	0.56
91847	
factor(NEIGHBORHOOD)NAVY YARD	0.78
19281	
factor(NEIGHBORHOOD)OCEAN HILL	0.62
83865	
factor(NEIGHBORHOOD)OCEAN PARKWAY-NORTH	0.39
22316	
factor(NEIGHBORHOOD)OCEAN PARKWAY-SOUTH	0.38
61441	
factor(NEIGHBORHOOD)OLD MILL BASIN	0.54
71291	
factor(NEIGHBORHOOD)PARK SLOPE	0.52
25388	
factor(NEIGHBORHOOD)PARK SLOPE SOUTH	0.54
65737	
factor(NEIGHBORHOOD)PROSPECT HEIGHTS	0.71
39590	
factor(NEIGHBORHOOD)RED HOOK	0.80
24417	
factor(NEIGHBORHOOD)SEAGATE	2.17
99335	
factor(NEIGHBORHOOD)SHEEPSHEAD BAY	0.46
60855	
factor(NEIGHBORHOOD)SPRING CREEK	2.30
70028	
factor(NEIGHBORHOOD)SUNSET PARK	0.42
91635	
factor(NEIGHBORHOOD)WILLIAMSBURG-CENTRAL	0.84
32079	
factor(NEIGHBORHOOD)WILLIAMSBURG-EAST	0.71
26063	
factor(NEIGHBORHOOD)WILLIAMSBURG-NORTH	0.87
03502	
factor(NEIGHBORHOOD)WILLIAMSBURG-SOUTH	0.85
09503	

factor(NEIGHBORHOOD)WINDSOR TERRACE	0.47
62298	0.77
factor(NEIGHBORHOOD)WYCKOFF HEIGHTS	0.77
31171	0.06
factor(BUILDING.CLASS.CATEGORY)02 TWO FAMILY DWELLINGS	0.06
56259	0.09
factor(BUILDING.CLASS.CATEGORY)03 THREE FAMILY DWELLINGS	0.09
20264	0.96
factor(BUILDING.CLASS.CATEGORY)05 TAX CLASS 1 VACANT LAND	0.96
19183	0.81
factor(BUILDING.CLASS.CATEGORY)06 TAX CLASS 1 - OTHER	0.81
73845	0.17
factor(BUILDING.CLASS.CATEGORY)07 RENTALS - WALKUP APARTMENTS	0.17
63724	0.33
factor(BUILDING.CLASS.CATEGORY)08 RENTALS - ELEVATOR APARTMENTS	0.33
31925	1.52
factor(BUILDING.CLASS.CATEGORY)09 COOPS - WALKUP APARTMENTS	1.52
60902	1.26
factor(BUILDING.CLASS.CATEGORY)10 COOPS - ELEVATOR APARTMENTS	1.26
71098	2.14
factor(BUILDING.CLASS.CATEGORY)11 SPECIAL CONDO BILLING LOTS	2.14
47457	2.31
factor(BUILDING.CLASS.CATEGORY)11A CONDO-RENTALS	2.31
73400	
factor(BUILDING.CLASS.CATEGORY)14 RENTALS - 4-10 UNIT NA	
factor(BUILDING.CLASS.CATEGORY)21 OFFICE BUILDINGS	1.00
67346	0.97
factor(BUILDING.CLASS.CATEGORY)22 STORE BUILDINGS	0.97
83452	1.81
factor(BUILDING.CLASS.CATEGORY)23 LOFT BUILDINGS	1.81
04703	1.31
factor(BUILDING.CLASS.CATEGORY)26 OTHER HOTELS	1.31
01718	1.02
factor(BUILDING.CLASS.CATEGORY)27 FACTORIES	1.02
61167	1.00
factor(BUILDING.CLASS.CATEGORY)29 COMMERCIAL GARAGES	1.00
12615	1.00
factor(BUILDING.CLASS.CATEGORY)30 WAREHOUSES	1.00
47066	2.34
factor(BUILDING.CLASS.CATEGORY)31 COMMERCIAL VACANT LAND	2.34
44824	1.23
factor(BUILDING.CLASS.CATEGORY)32 HOSPITAL AND HEALTH FACILITIES	1.23
19383	1.11
factor(BUILDING.CLASS.CATEGORY)33 EDUCATIONAL FACILITIES	1.11
45871	2.35
factor(BUILDING.CLASS.CATEGORY)34 THEATRES	2.35
55888	1.28
factor(BUILDING.CLASS.CATEGORY)35 INDOOR PUBLIC AND CULTURAL FACILITIES	1.28
28279	1.04
factor(BUILDING.CLASS.CATEGORY)37 RELIGIOUS FACILITIES	1.04
22920	1.26
factor(BUILDING.CLASS.CATEGORY)38 ASYLUMS AND HOMES	1.26
42231	NA
factor(BUILDING.CLASS.CATEGORY)41 TAX CLASS 4 - OTHER	2.34
factor(ZIP.CODE)11201	

15329	
factor(ZIP.CODE)11203	2.25
88939	
factor(ZIP.CODE)11204	2.27
32554	
factor(ZIP.CODE)11205	2.31
48143	
factor(ZIP.CODE)11206	2.31
69516	
factor(ZIP.CODE)11207	2.32
22121	
factor(ZIP.CODE)11208	2.32
73134	
factor(ZIP.CODE)11209	2.30
08599	
factor(ZIP.CODE)11210	2.26
17543	
factor(ZIP.CODE)11211	2.34
70716	
factor(ZIP.CODE)11212	2.27
02161	
factor(ZIP.CODE)11213	2.30
67765	
factor(ZIP.CODE)11214	2.27
70715	
factor(ZIP.CODE)11215	2.29
41916	
factor(ZIP.CODE)11216	2.30
65855	
factor(ZIP.CODE)11217	2.30
53907	
factor(ZIP.CODE)11218	2.27
12017	
factor(ZIP.CODE)11219	2.27
72520	
factor(ZIP.CODE)11220	2.28
82589	
factor(ZIP.CODE)11221	2.30
95916	
factor(ZIP.CODE)11222	2.64
97278	
factor(ZIP.CODE)11223	2.27
58973	
factor(ZIP.CODE)11224	3.11
95229	
factor(ZIP.CODE)11225	2.30
05976	
factor(ZIP.CODE)11226	2.26
74965	
factor(ZIP.CODE)11228	2.28
16494	
factor(ZIP.CODE)11229	2.28
28286	
factor(ZIP.CODE)11230	2.26
97064	
factor(ZIP.CODE)11231	2.34
89661	

factor(ZIP.CODE)11232	2.30
05058	2.30
factor(ZIP.CODE)11233	2.30
83523	2.28
factor(ZIP.CODE)11234	2.28
43828	2.28
factor(ZIP.CODE)11235	2.14
84605	2.14
factor(ZIP.CODE)11236	2.33
05985	2.33
factor(ZIP.CODE)11237	2.30
08949	2.30
factor(ZIP.CODE)11238	2.39
83069	2.39
factor(ZIP.CODE)11239	t val
NA	
factor(ZIP.CODE)11249	
41144	
ue	
log(LAND.SQUARE.FEET)	3.0
73	
log(GROSS.SQUARE.FEET)	7.0
13	
factor(TAX.CLASS.AT.TIME.OF.SALE)1	-0.4
43	
factor(TAX.CLASS.AT.TIME.OF.SALE)2	-0.4
44	
factor(TAX.CLASS.AT.TIME.OF.SALE)4	-0.4
55	
SALE.DATE	3.2
70	
factor(NEIGHBORHOOD)BAY RIDGE	0.7
53	
factor(NEIGHBORHOOD)BEDFORD STUYVESANT	0.5
13	
factor(NEIGHBORHOOD)BENSONHURST	0.5
94	
factor(NEIGHBORHOOD)BERGEN BEACH	-0.6
70	
factor(NEIGHBORHOOD)BOERUM HILL	-1.3
35	
factor(NEIGHBORHOOD)BOROUGH PARK	0.8
75	
factor(NEIGHBORHOOD)BRIGHTON BEACH	0.5
77	
factor(NEIGHBORHOOD)BROOKLYN HEIGHTS	-0.9
46	
factor(NEIGHBORHOOD)BROWNSVILLE	-0.0
05	
factor(NEIGHBORHOOD)BUSH TERMINAL	0.7
69	
factor(NEIGHBORHOOD)BUSHWICK	0.1
30	
factor(NEIGHBORHOOD)CANARSIE	-2.3
25	
factor(NEIGHBORHOOD)CARROLL GARDENS	-0.1

02		
factor(NEIGHBORHOOD)CLINTON HILL		0.1
99		
factor(NEIGHBORHOOD)COBBLE HILL		0.4
02		
factor(NEIGHBORHOOD)COBBLE HILL-WEST		-0.4
91		
factor(NEIGHBORHOOD)CONEY ISLAND		-0.0
40		
factor(NEIGHBORHOOD)CROWN HEIGHTS		0.7
61		
factor(NEIGHBORHOOD)CYPRESS HILLS		-0.1
61		
factor(NEIGHBORHOOD)DOWNTOWN-FULTON FERRY		0.9
92		
factor(NEIGHBORHOOD)DOWNTOWN-FULTON MALL		-0.1
04		
factor(NEIGHBORHOOD)DOWNTOWN-METROTECH		-1.4
89		
factor(NEIGHBORHOOD)DYKER HEIGHTS		0.0
43		
factor(NEIGHBORHOOD)EAST NEW YORK		-0.4
31		
factor(NEIGHBORHOOD)FLATBUSH-CENTRAL		0.5
97		
factor(NEIGHBORHOOD)FLATBUSH-EAST		-0.6
35		
factor(NEIGHBORHOOD)FLATBUSH-LEFFERTS GARDEN		0.4
27		
factor(NEIGHBORHOOD)FLATBUSH-NORTH		0.1
34		
factor(NEIGHBORHOOD)FLATLANDS		-0.9
49		
factor(NEIGHBORHOOD)FORT GREENE		-1.4
03		
factor(NEIGHBORHOOD)GERRITSEN BEACH		-0.9
22		
factor(NEIGHBORHOOD)GOWANUS		-0.8
41		
factor(NEIGHBORHOOD)GRAVESEND		0.1
52		
factor(NEIGHBORHOOD)GREENPOINT		0.6
54		
factor(NEIGHBORHOOD)KENSINGTON		2.4
31		
factor(NEIGHBORHOOD)MADISON		0.0
76		
factor(NEIGHBORHOOD)MANHATTAN BEACH		0.8
13		
factor(NEIGHBORHOOD)MARINE PARK		-0.1
37		
factor(NEIGHBORHOOD)MIDWOOD		0.5
02		
factor(NEIGHBORHOOD)MILL BASIN		-0.1
76		
factor(NEIGHBORHOOD)NAVY YARD		0.2
73		

factor(NEIGHBORHOOD)OCEAN HILL	0.0
66	0.1
factor(NEIGHBORHOOD)OCEAN PARKWAY-NORTH	0.1
71	-0.1
factor(NEIGHBORHOOD)OCEAN PARKWAY-SOUTH	-1.3
14	-0.4
factor(NEIGHBORHOOD)OLD MILL BASIN	0.5
09	1.6
factor(NEIGHBORHOOD)PARK SLOPE	-0.4
28	0.5
factor(NEIGHBORHOOD)PARK SLOPE SOUTH	-0.3
88	-0.0
factor(NEIGHBORHOOD)PROSPECT HEIGHTS	-0.5
84	-0.5
factor(NEIGHBORHOOD)RED HOOK	0.0
63	-0.3
factor(NEIGHBORHOOD)SEAGATE	-1.2
99	-1.2
factor(NEIGHBORHOOD)SHEEPSHEAD BAY	0.4
38	-0.1
factor(NEIGHBORHOOD)SPRING CREEK	1.2
82	1.4
factor(NEIGHBORHOOD)SUNSET PARK	-0.1
22	1.6
factor(NEIGHBORHOOD)WILLIAMSBURG-CENTRAL	-0.6
92	-1.0
factor(NEIGHBORHOOD)WILLIAMSBURG-EAST	0.5
28	-0.6
factor(NEIGHBORHOOD)WILLIAMSBURG-NORTH	0.5
70	-0.6
factor(NEIGHBORHOOD)WILLIAMSBURG-SOUTH	0.5
43	-0.6
factor(NEIGHBORHOOD)WINDSOR TERRACE	0.0
29	0.5
factor(NEIGHBORHOOD)WYCKOFF HEIGHTS	-1.6
94	-1.6
factor(BUILDING.CLASS.CATEGORY)02 TWO FAMILY DWELLINGS	0.0
31	-0.2
factor(BUILDING.CLASS.CATEGORY)03 THREE FAMILY DWELLINGS	0.0
14	-0.2
factor(BUILDING.CLASS.CATEGORY)05 TAX CLASS 1 VACANT LAND	0.5
67	-0.5
factor(BUILDING.CLASS.CATEGORY)06 TAX CLASS 1 - OTHER	0.5
88	-0.6
factor(BUILDING.CLASS.CATEGORY)07 RENTALS - WALKUP APARTMENTS	0.0
77	-0.2
factor(BUILDING.CLASS.CATEGORY)08 RENTALS - ELEVATOR APARTMENTS	0.0
68	-0.6
factor(BUILDING.CLASS.CATEGORY)09 COOPS - WALKUP APARTMENTS	0.0
58	-0.6
factor(BUILDING.CLASS.CATEGORY)10 COOPS - ELEVATOR APARTMENTS	0.0
76	-0.6
factor(BUILDING.CLASS.CATEGORY)11 SPECIAL CONDO BILLING LOTS	0.0
32	0.0
factor(BUILDING.CLASS.CATEGORY)11A CONDO-RENTALS	1.3
34	-0.6
factor(BUILDING.CLASS.CATEGORY)14 RENTALS - 4-10 UNIT	0.0

NA	
factor(BUILDING.CLASS.CATEGORY)21 OFFICE BUILDINGS	0.2
30	
factor(BUILDING.CLASS.CATEGORY)22 STORE BUILDINGS	0.1
23	
factor(BUILDING.CLASS.CATEGORY)23 LOFT BUILDINGS	0.6
09	
factor(BUILDING.CLASS.CATEGORY)26 OTHER HOTELS	0.7
41	
factor(BUILDING.CLASS.CATEGORY)27 FACTORIES	0.3
92	
factor(BUILDING.CLASS.CATEGORY)29 COMMERCIAL GARAGES	0.8
04	
factor(BUILDING.CLASS.CATEGORY)30 WAREHOUSES	0.4
52	
factor(BUILDING.CLASS.CATEGORY)31 COMMERCIAL VACANT LAND	0.3
49	
factor(BUILDING.CLASS.CATEGORY)32 HOSPITAL AND HEALTH FACILITIES	0.4
28	
factor(BUILDING.CLASS.CATEGORY)33 EDUCATIONAL FACILITIES	0.2
85	
factor(BUILDING.CLASS.CATEGORY)34 THEATRES	0.8
75	
factor(BUILDING.CLASS.CATEGORY)35 INDOOR PUBLIC AND CULTURAL FACILITIES	-3.0
93	
factor(BUILDING.CLASS.CATEGORY)37 RELIGIOUS FACILITIES	0.5
30	
factor(BUILDING.CLASS.CATEGORY)38 ASYLUMS AND HOMES	0.4
62	
factor(BUILDING.CLASS.CATEGORY)41 TAX CLASS 4 - OTHER	
NA	
factor(ZIP.CODE)11201	-0.4
34	
factor(ZIP.CODE)11203	-1.4
67	
factor(ZIP.CODE)11204	-1.0
54	
factor(ZIP.CODE)11205	-0.9
47	
factor(ZIP.CODE)11206	-1.3
23	
factor(ZIP.CODE)11207	-1.3
36	
factor(ZIP.CODE)11208	-1.4
07	
factor(ZIP.CODE)11209	-1.1
72	
factor(ZIP.CODE)11210	-1.2
13	
factor(ZIP.CODE)11211	-1.2
11	
factor(ZIP.CODE)11212	-1.5
60	
factor(ZIP.CODE)11213	-1.5
27	
factor(ZIP.CODE)11214	-1.3
40	

factor(ZIP.CODE)11215	-0.8
85	-1.2
factor(ZIP.CODE)11216	-0.6
26	-1.4
factor(ZIP.CODE)11217	-1.1
74	-1.1
factor(ZIP.CODE)11218	-1.2
08	-1.2
factor(ZIP.CODE)11219	-1.2
97	-1.1
factor(ZIP.CODE)11220	-1.2
76	-1.2
factor(ZIP.CODE)11221	-1.2
95	-1.2
factor(ZIP.CODE)11222	-1.0
39	-1.0
factor(ZIP.CODE)11223	-0.9
67	-0.9
factor(ZIP.CODE)11224	-0.9
32	-1.2
factor(ZIP.CODE)11225	-1.2
17	-1.2
factor(ZIP.CODE)11226	-1.2
84	-1.0
factor(ZIP.CODE)11228	-0.9
35	-0.9
factor(ZIP.CODE)11229	-0.9
97	-0.9
factor(ZIP.CODE)11230	-0.9
95	-0.8
factor(ZIP.CODE)11231	-1.0
21	-1.2
factor(ZIP.CODE)11232	-1.1
02	-1.2
factor(ZIP.CODE)11233	-0.7
63	-1.2
factor(ZIP.CODE)11234	-1.2
34	-1.2
factor(ZIP.CODE)11235	-0.7
05	-1.2
factor(ZIP.CODE)11236	-0.7
18	-0.9
factor(ZIP.CODE)11237	-1.2
72	-0.9
factor(ZIP.CODE)11238	-1.2
47	-1.2
factor(ZIP.CODE)11239	NA
factor(ZIP.CODE)11249	-1.1
58	Pr(>
t )	0.00
log(LAND.SQUARE.FEET)	2.52e
213	0.65
log(GROSS.SQUARE.FEET)	
-12	
factor(TAX.CLASS.AT.TIME.OF.SALE)1	

801		
factor(TAX.CLASS.AT.TIME.OF.SALE)2		0.65
693		
factor(TAX.CLASS.AT.TIME.OF.SALE)4		0.64
887		
SALE.DATE		0.00
108		
factor(NEIGHBORHOOD)BAY RIDGE		0.45
164		
factor(NEIGHBORHOOD)BEDFORD STUYVESANT		0.60
787		
factor(NEIGHBORHOOD)BENSONHURST		0.55
274		
factor(NEIGHBORHOOD)BERGEN BEACH		0.50
281		
factor(NEIGHBORHOOD)BOERUM HILL		0.18
178		
factor(NEIGHBORHOOD)BOROUGH PARK		0.38
162		
factor(NEIGHBORHOOD)BRIGHTON BEACH		0.56
426		
factor(NEIGHBORHOOD)BROOKLYN HEIGHTS		0.34
441		
factor(NEIGHBORHOOD)BROWNSVILLE		0.99
628		
factor(NEIGHBORHOOD)BUSH TERMINAL		0.44
218		
factor(NEIGHBORHOOD)BUSHWICK		0.89
673		
factor(NEIGHBORHOOD)CANARSIE		0.02
011		
factor(NEIGHBORHOOD)CARROLL GARDENS		0.91
865		
factor(NEIGHBORHOOD)CLINTON HILL		0.84
254		
factor(NEIGHBORHOOD)COBBLE HILL		0.68
780		
factor(NEIGHBORHOOD)COBBLE HILL-WEST		0.62
326		
factor(NEIGHBORHOOD)CONEY ISLAND		0.96
770		
factor(NEIGHBORHOOD)CROWN HEIGHTS		0.44
645		
factor(NEIGHBORHOOD)CYPRESS HILLS		0.87
237		
factor(NEIGHBORHOOD)DOWNTOWN-FULTON FERRY		0.32
128		
factor(NEIGHBORHOOD)DOWNTOWN-FULTON MALL		0.91
738		
factor(NEIGHBORHOOD)DOWNTOWN-METROTECH		0.13
651		
factor(NEIGHBORHOOD)DYKER HEIGHTS		0.96
578		
factor(NEIGHBORHOOD)EAST NEW YORK		0.66
636		
factor(NEIGHBORHOOD)FLATBUSH-CENTRAL		0.55
055		

factor(NEIGHBORHOOD)FLATBUSH-EAST	0.52
517	
factor(NEIGHBORHOOD)FLATBUSH-LEFFERTS GARDEN	0.66
912	
factor(NEIGHBORHOOD)FLATBUSH-NORTH	0.89
310	
factor(NEIGHBORHOOD)FLATLANDS	0.34
269	
factor(NEIGHBORHOOD)FORT GREENE	0.16
064	
factor(NEIGHBORHOOD)GERRITSEN BEACH	0.35
676	
factor(NEIGHBORHOOD)GOWANUS	0.40
050	
factor(NEIGHBORHOOD)GRAVESEND	0.87
900	
factor(NEIGHBORHOOD)GREENPOINT	0.51
294	
factor(NEIGHBORHOOD)KENSINGTON	0.01
508	
factor(NEIGHBORHOOD)MADISON	0.93
969	
factor(NEIGHBORHOOD)MANHATTAN BEACH	0.41
629	
factor(NEIGHBORHOOD)MARINE PARK	0.89
094	
factor(NEIGHBORHOOD)MIDWOOD	0.61
582	
factor(NEIGHBORHOOD)MILL BASIN	0.86
030	
factor(NEIGHBORHOOD)NAVY YARD	0.78
459	
factor(NEIGHBORHOOD)OCEAN HILL	0.94
708	
factor(NEIGHBORHOOD)OCEAN PARKWAY-NORTH	0.86
459	
factor(NEIGHBORHOOD)OCEAN PARKWAY-SOUTH	0.90
902	
factor(NEIGHBORHOOD)OLD MILL BASIN	0.19
042	
factor(NEIGHBORHOOD)PARK SLOPE	0.66
866	
factor(NEIGHBORHOOD)PARK SLOPE SOUTH	0.55
677	
factor(NEIGHBORHOOD)PROSPECT HEIGHTS	0.09
220	
factor(NEIGHBORHOOD)RED HOOK	0.57
316	
factor(NEIGHBORHOOD)SEAGATE	0.92
118	
factor(NEIGHBORHOOD)SHEEPSHEAD BAY	0.73
540	
factor(NEIGHBORHOOD)SPRING CREEK	0.19
979	
factor(NEIGHBORHOOD)SUNSET PARK	0.67
274	
factor(NEIGHBORHOOD)WILLIAMSBURG-CENTRAL	0.84

809		
factor(NEIGHBORHOOD)WILLIAMSBURG-EAST		0.21
936		
factor(NEIGHBORHOOD)WILLIAMSBURG-NORTH		0.14
169		
factor(NEIGHBORHOOD)WILLIAMSBURG-SOUTH		0.10
039		
factor(NEIGHBORHOOD)WINDSOR TERRACE		0.01
518		
factor(NEIGHBORHOOD)WYCKOFF HEIGHTS		0.27
402		
factor(BUILDING.CLASS.CATEGORY)02 TWO FAMILY DWELLINGS		0.52
811		
factor(BUILDING.CLASS.CATEGORY)03 THREE FAMILY DWELLINGS		0.10
656		
factor(BUILDING.CLASS.CATEGORY)05 TAX CLASS 1 VACANT LAND		0.57
102		
factor(BUILDING.CLASS.CATEGORY)06 TAX CLASS 1 - OTHER		0.09
147		
factor(BUILDING.CLASS.CATEGORY)07 RENTALS - WALKUP APARTMENTS		0.93
878		
factor(BUILDING.CLASS.CATEGORY)08 RENTALS - ELEVATOR APARTMENTS		0.78
879		
factor(BUILDING.CLASS.CATEGORY)09 COOPS - WALKUP APARTMENTS		0.51
061		
factor(BUILDING.CLASS.CATEGORY)10 COOPS - ELEVATOR APARTMENTS		0.04
813		
factor(BUILDING.CLASS.CATEGORY)11 SPECIAL CONDO BILLING LOTS		0.52
740		
factor(BUILDING.CLASS.CATEGORY)11A CONDO-RENTALS		0.18
228		
factor(BUILDING.CLASS.CATEGORY)14 RENTALS - 4-10 UNIT		
NA		
factor(BUILDING.CLASS.CATEGORY)21 OFFICE BUILDINGS		0.81
811		
factor(BUILDING.CLASS.CATEGORY)22 STORE BUILDINGS		0.90
186		
factor(BUILDING.CLASS.CATEGORY)23 LOFT BUILDINGS		0.54
266		
factor(BUILDING.CLASS.CATEGORY)26 OTHER HOTELS		0.45
864		
factor(BUILDING.CLASS.CATEGORY)27 FACTORIES		0.69
484		
factor(BUILDING.CLASS.CATEGORY)29 COMMERCIAL GARAGES		0.42
121		
factor(BUILDING.CLASS.CATEGORY)30 WAREHOUSES		0.65
126		
factor(BUILDING.CLASS.CATEGORY)31 COMMERCIAL VACANT LAND		0.72
718		
factor(BUILDING.CLASS.CATEGORY)32 HOSPITAL AND HEALTH FACILITIES		0.66
868		
factor(BUILDING.CLASS.CATEGORY)33 EDUCATIONAL FACILITIES		0.77
535		
factor(BUILDING.CLASS.CATEGORY)34 THEATRES		0.38
185		
factor(BUILDING.CLASS.CATEGORY)35 INDOOR PUBLIC AND CULTURAL FACILITIES	0.00	
199		

factor(BUILDING.CLASS.CATEGORY)37 RELIGIOUS FACILITIES	0.59
585	
factor(BUILDING.CLASS.CATEGORY)38 ASYLUMS AND HOMES	0.64
412	
factor(BUILDING.CLASS.CATEGORY)41 TAX CLASS 4 - OTHER	
NA	
factor(ZIP.CODE)11201	0.66
443	
factor(ZIP.CODE)11203	0.14
239	
factor(ZIP.CODE)11204	0.29
191	
factor(ZIP.CODE)11205	0.34
384	
factor(ZIP.CODE)11206	0.18
571	
factor(ZIP.CODE)11207	0.18
143	
factor(ZIP.CODE)11208	0.15
940	
factor(ZIP.CODE)11209	0.24
135	
factor(ZIP.CODE)11210	0.22
521	
factor(ZIP.CODE)11211	0.22
600	
factor(ZIP.CODE)11212	0.11
875	
factor(ZIP.CODE)11213	0.12
669	
factor(ZIP.CODE)11214	0.18
043	
factor(ZIP.CODE)11215	0.37
596	
factor(ZIP.CODE)11216	0.22
038	
factor(ZIP.CODE)11217	0.50
013	
factor(ZIP.CODE)11218	0.15
903	
factor(ZIP.CODE)11219	0.23
148	
factor(ZIP.CODE)11220	0.23
975	
factor(ZIP.CODE)11221	0.19
519	
factor(ZIP.CODE)11222	0.21
529	
factor(ZIP.CODE)11223	0.28
582	
factor(ZIP.CODE)11224	0.35
146	
factor(ZIP.CODE)11225	0.22
347	
factor(ZIP.CODE)11226	0.19
921	
factor(ZIP.CODE)11228	0.30

052	
factor(ZIP.CODE)11229	0.31
865	
factor(ZIP.CODE)11230	0.31
999	
factor(ZIP.CODE)11231	0.41
146	
factor(ZIP.CODE)11232	0.31
645	
factor(ZIP.CODE)11233	0.20
668	
factor(ZIP.CODE)11234	0.25
684	
factor(ZIP.CODE)11235	0.22
827	
factor(ZIP.CODE)11236	0.47
289	
factor(ZIP.CODE)11237	0.33
127	
factor(ZIP.CODE)11238	0.21
236	
factor(ZIP.CODE)11239	
NA	
factor(ZIP.CODE)11249	0.24
697	
log(LAND.SQUARE.FEET)	**
log(GROSS.SQUARE.FEET)	***
factor(TAX.CLASS.AT.TIME.OF.SALE)1	
factor(TAX.CLASS.AT.TIME.OF.SALE)2	
factor(TAX.CLASS.AT.TIME.OF.SALE)4	
SALE.DATE	**
factor(NEIGHBORHOOD)BAY RIDGE	
factor(NEIGHBORHOOD)BEDFORD STUYVESANT	
factor(NEIGHBORHOOD)BENSONHURST	
factor(NEIGHBORHOOD)BERGEN BEACH	
factor(NEIGHBORHOOD)BOERUM HILL	
factor(NEIGHBORHOOD)BOROUGH PARK	
factor(NEIGHBORHOOD)BRIGHTON BEACH	
factor(NEIGHBORHOOD)BROOKLYN HEIGHTS	
factor(NEIGHBORHOOD)BROWNSVILLE	
factor(NEIGHBORHOOD)BUSH TERMINAL	
factor(NEIGHBORHOOD)BUSHWICK	*
factor(NEIGHBORHOOD)CANARSIE	
factor(NEIGHBORHOOD)CARROLL GARDENS	
factor(NEIGHBORHOOD)CLINTON HILL	
factor(NEIGHBORHOOD)COBBLE HILL	
factor(NEIGHBORHOOD)COBBLE HILL-WEST	
factor(NEIGHBORHOOD)CONEY ISLAND	
factor(NEIGHBORHOOD)CROWN HEIGHTS	
factor(NEIGHBORHOOD)CYPRESS HILLS	
factor(NEIGHBORHOOD)DOWNTOWN-FULTON FERRY	
factor(NEIGHBORHOOD)DOWNTOWN-FULTON MALL	
factor(NEIGHBORHOOD)DOWNTOWN-METROTECH	
factor(NEIGHBORHOOD)DYKER HEIGHTS	
factor(NEIGHBORHOOD)EAST NEW YORK	
factor(NEIGHBORHOOD)FLATBUSH-CENTRAL	

```
factor(NEIGHBORHOOD)FLATBUSH-EAST
factor(NEIGHBORHOOD)FLATBUSH-LEFFERTS GARDEN
factor(NEIGHBORHOOD)FLATBUSH-NORTH
factor(NEIGHBORHOOD)FLATLANDS
factor(NEIGHBORHOOD)FORT GREENE
factor(NEIGHBORHOOD)GERRITSEN BEACH
factor(NEIGHBORHOOD)GOWANUS
factor(NEIGHBORHOOD)GRAVESEND
factor(NEIGHBORHOOD)GREENPOINT
factor(NEIGHBORHOOD)KENSINGTON
factor(NEIGHBORHOOD)MADISON
factor(NEIGHBORHOOD)MANHATTAN BEACH
factor(NEIGHBORHOOD)MARINE PARK
factor(NEIGHBORHOOD)MIDWOOD
factor(NEIGHBORHOOD)MILL BASIN
factor(NEIGHBORHOOD)NAVY YARD
factor(NEIGHBORHOOD)OCEAN HILL
factor(NEIGHBORHOOD)OCEAN PARKWAY-NORTH
factor(NEIGHBORHOOD)OCEAN PARKWAY-SOUTH
factor(NEIGHBORHOOD)OLD MILL BASIN
factor(NEIGHBORHOOD)PARK SLOPE
factor(NEIGHBORHOOD)PARK SLOPE SOUTH
factor(NEIGHBORHOOD)PROSPECT HEIGHTS
factor(NEIGHBORHOOD)RED HOOK
factor(NEIGHBORHOOD)SEAGATE
factor(NEIGHBORHOOD)SHEEPSHEAD BAY
factor(NEIGHBORHOOD)SPRING CREEK
factor(NEIGHBORHOOD)SUNSET PARK
factor(NEIGHBORHOOD)WILLIAMSBURG-CENTRAL
factor(NEIGHBORHOOD)WILLIAMSBURG-EAST
factor(NEIGHBORHOOD)WILLIAMSBURG-NORTH
factor(NEIGHBORHOOD)WILLIAMSBURG-SOUTH
factor(NEIGHBORHOOD)WINDSOR TERRACE
factor(NEIGHBORHOOD)WYCKOFF HEIGHTS
factor(BUILDING.CLASS.CATEGORY)02 TWO FAMILY DWELLINGS
factor(BUILDING.CLASS.CATEGORY)03 THREE FAMILY DWELLINGS
factor(BUILDING.CLASS.CATEGORY)05 TAX CLASS 1 VACANT LAND
factor(BUILDING.CLASS.CATEGORY)06 TAX CLASS 1 - OTHER
factor(BUILDING.CLASS.CATEGORY)07 RENTALS - WALKUP APARTMENTS
factor(BUILDING.CLASS.CATEGORY)08 RENTALS - ELEVATOR APARTMENTS
factor(BUILDING.CLASS.CATEGORY)09 COOPS - WALKUP APARTMENTS
factor(BUILDING.CLASS.CATEGORY)10 COOPS - ELEVATOR APARTMENTS
factor(BUILDING.CLASS.CATEGORY)11 SPECIAL CONDO BILLING LOTS
factor(BUILDING.CLASS.CATEGORY)11A CONDO-RENTALS
factor(BUILDING.CLASS.CATEGORY)14 RENTALS - 4-10 UNIT
factor(BUILDING.CLASS.CATEGORY)21 OFFICE BUILDINGS
factor(BUILDING.CLASS.CATEGORY)22 STORE BUILDINGS
factor(BUILDING.CLASS.CATEGORY)23 LOFT BUILDINGS
factor(BUILDING.CLASS.CATEGORY)26 OTHER HOTELS
factor(BUILDING.CLASS.CATEGORY)27 FACTORIES
factor(BUILDING.CLASS.CATEGORY)29 COMMERCIAL GARAGES
factor(BUILDING.CLASS.CATEGORY)30 WAREHOUSES
factor(BUILDING.CLASS.CATEGORY)31 COMMERCIAL VACANT LAND
factor(BUILDING.CLASS.CATEGORY)32 HOSPITAL AND HEALTH FACILITIES
factor(BUILDING.CLASS.CATEGORY)33 EDUCATIONAL FACILITIES
factor(BUILDING.CLASS.CATEGORY)34 THEATRES
factor(BUILDING.CLASS.CATEGORY)35 INDOOR PUBLIC AND CULTURAL FACILITIES **
```

```

factor(BUILDING.CLASS.CATEGORY)37 RELIGIOUS FACILITIES
factor(BUILDING.CLASS.CATEGORY)38 ASYLUMS AND HOMES
factor(BUILDING.CLASS.CATEGORY)41 TAX CLASS 4 - OTHER
factor(ZIP.CODE)11201
factor(ZIP.CODE)11203
factor(ZIP.CODE)11204
factor(ZIP.CODE)11205
factor(ZIP.CODE)11206
factor(ZIP.CODE)11207
factor(ZIP.CODE)11208
factor(ZIP.CODE)11209
factor(ZIP.CODE)11210
factor(ZIP.CODE)11211
factor(ZIP.CODE)11212
factor(ZIP.CODE)11213
factor(ZIP.CODE)11214
factor(ZIP.CODE)11215
factor(ZIP.CODE)11216
factor(ZIP.CODE)11217
factor(ZIP.CODE)11218
factor(ZIP.CODE)11219
factor(ZIP.CODE)11220
factor(ZIP.CODE)11221
factor(ZIP.CODE)11222
factor(ZIP.CODE)11223
factor(ZIP.CODE)11224
factor(ZIP.CODE)11225
factor(ZIP.CODE)11226
factor(ZIP.CODE)11228
factor(ZIP.CODE)11229
factor(ZIP.CODE)11230
factor(ZIP.CODE)11231
factor(ZIP.CODE)11232
factor(ZIP.CODE)11233
factor(ZIP.CODE)11234
factor(ZIP.CODE)11235
factor(ZIP.CODE)11236
factor(ZIP.CODE)11237
factor(ZIP.CODE)11238
factor(ZIP.CODE)11239
factor(ZIP.CODE)11249
---
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.132 on 8396 degrees of freedom
Multiple R-squared:  0.9754,    Adjusted R-squared:  0.975
F-statistic: 2641 on 126 and 8396 DF,  p-value: < 2.2e-16

```

## 4.2 Model 2 : Human element of Superstition

Human societies have evolved around superstitions such as lucky and unlucky numbers depending upon the different cultures and beliefs, Lets see whether these things affect the sales data...

```
In [89]: # getting rid of NA's
brook$APARTMENT.NUMBER<-as.numeric(gsub("", "", brook$APARTMENT.NUMBER))
brook$APARTMENT.NUMBER[is.na(brook$APARTMENT.NUMBER)] <- 0

unique(brook$APARTMENT.NUMBER) # these are character strings with some apartme
nt numbers and they have special values simply need to be cut down
```

Warning message in eval(expr, envir, enclos):  
"NAs introduced by coercion"

```
0   6   3   4   5   16  53   2   8   39   28   104  15   14   35   7   9   1   43   23
20  19  18  38  12  11  32  13  24  34  54  42  36  30  40  113  100  60
48  31  21  63  10  49  135 189  45  41
```

```
In [92]: model3<-lm(log(brook$SALE.PRICE)~ 0 + log(brook$GROSS.SQUARE.FEET) +
log(brook$LAND.SQUARE.FEET) + factor(brook$NEIGHBORHOOD) + factor(brook$BUILDING.CLASS.CATEGORY) +
factor(brook$SALE.DATE) +factor(brook$TAX.CLASS.AT.TIME.OF.SALE) +
factor(brook$APARTMENT.NUMBER) )
summary(model3)
```

Call:

```
lm(formula = log(brook$SALE.PRICE) ~ 0 + log(brook$GROSS.SQUARE.FEET) +
  log(brook$LAND.SQUARE.FEET) + factor(brook$NEIGHBORHOOD) +
  factor(brook$BUILDING.CLASS.CATEGORY) + factor(brook$SALE.DATE) +
  factor(brook$TAX.CLASS.AT.TIME.OF.SALE) + factor(brook$APARTMENT.NUMBER))
```

Residuals:

Min	1Q	Median	3Q	Max
-16.4561	-0.0597	0.3371	0.7503	7.4230

Coefficients: (2 not defined because of singularities)

	Estimate
log(brook\$GROSS.SQUARE.FEET)	4.627e-01
log(brook\$LAND.SQUARE.FEET)	2.165e-01
factor(brook\$NEIGHBORHOOD)BATH BEACH	8.196e+00
factor(brook\$NEIGHBORHOOD)BAY RIDGE	8.483e+00
factor(brook\$NEIGHBORHOOD)BEDFORD STUYVESANT	8.213e+00
factor(brook\$NEIGHBORHOOD)BENSONHURST	8.411e+00
factor(brook\$NEIGHBORHOOD)BERGEN BEACH	7.749e+00
factor(brook\$NEIGHBORHOOD)BOERUM HILL	8.589e+00
factor(brook\$NEIGHBORHOOD)BOROUGH PARK	8.452e+00
factor(brook\$NEIGHBORHOOD)BRIGHTON BEACH	8.255e+00
factor(brook\$NEIGHBORHOOD)BROOKLYN HEIGHTS	9.097e+00
factor(brook\$NEIGHBORHOOD)BROWNSVILLE	7.255e+00
factor(brook\$NEIGHBORHOOD)BUSH TERMINAL	8.586e+00
factor(brook\$NEIGHBORHOOD)BUSHWICK	7.941e+00
factor(brook\$NEIGHBORHOOD)CANARSIE	7.429e+00
factor(brook\$NEIGHBORHOOD)CARROLL GARDENS	8.768e+00
factor(brook\$NEIGHBORHOOD)CLINTON HILL	8.339e+00
factor(brook\$NEIGHBORHOOD)COBBLE HILL	9.713e+00
factor(brook\$NEIGHBORHOOD)COBBLE HILL-WEST	8.861e+00
factor(brook\$NEIGHBORHOOD)CONEY ISLAND	7.946e+00
factor(brook\$NEIGHBORHOOD)CROWN HEIGHTS	8.111e+00
factor(brook\$NEIGHBORHOOD)CYPRESS HILLS	7.524e+00

```
factor(brook$NEIGHBORHOOD)DOWNTOWN-FULTON FERRY  
1.095e+01  
factor(brook$NEIGHBORHOOD)DOWNTOWN-FULTON MALL  
9.659e+00  
factor(brook$NEIGHBORHOOD)DOWNTOWN-METROTECH  
8.322e+00  
factor(brook$NEIGHBORHOOD)DYKER HEIGHTS  
8.428e+00  
factor(brook$NEIGHBORHOOD)EAST NEW YORK  
7.320e+00  
factor(brook$NEIGHBORHOOD)FLATBUSH-CENTRAL  
8.224e+00  
factor(brook$NEIGHBORHOOD)FLATBUSH-EAST  
7.493e+00  
factor(brook$NEIGHBORHOOD)FLATBUSH-LEFFERTS GARDEN  
8.193e+00  
factor(brook$NEIGHBORHOOD)FLATBUSH-NORTH  
7.519e+00  
factor(brook$NEIGHBORHOOD)FLATLANDS  
7.744e+00  
factor(brook$NEIGHBORHOOD)FORT GREENE  
7.754e+00  
factor(brook$NEIGHBORHOOD)GERRITSEN BEACH  
7.985e+00  
factor(brook$NEIGHBORHOOD)GOWANUS  
8.248e+00  
factor(brook$NEIGHBORHOOD)GRAVESEND  
8.254e+00  
factor(brook$NEIGHBORHOOD)GREENPOINT  
8.445e+00  
factor(brook$NEIGHBORHOOD)KENSINGTON  
8.768e+00  
factor(brook$NEIGHBORHOOD)MADISON  
8.497e+00  
factor(brook$NEIGHBORHOOD)MANHATTAN BEACH  
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7.787e+00  
factor(brook\$NEIGHBORHOOD)SUNSET PARK  
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factor(brook\$NEIGHBORHOOD)WILLIAMSBURG-CENTRAL  
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factor(brook\$BUILDING.CLASS.CATEGORY)07 RENTALS - WALKUP APARTMENTS  
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factor(brook\$BUILDING.CLASS.CATEGORY)08 RENTALS - ELEVATOR APARTMENTS  
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factor(brook\$BUILDING.CLASS.CATEGORY)09 COOPS - WALKUP APARTMENTS  
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factor(brook\$BUILDING.CLASS.CATEGORY)10 COOPS - ELEVATOR APARTMENTS  
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factor(brook\$BUILDING.CLASS.CATEGORY)11 SPECIAL CONDO BILLING LOTS  
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factor(brook\$BUILDING.CLASS.CATEGORY)11A CONDO-RENTALS  
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factor(brook\$BUILDING.CLASS.CATEGORY)14 RENTALS - 4-10 UNIT  
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factor(brook\$BUILDING.CLASS.CATEGORY)21 OFFICE BUILDINGS  
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factor(brook\$BUILDING.CLASS.CATEGORY)22 STORE BUILDINGS  
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factor(brook\$BUILDING.CLASS.CATEGORY)29 COMMERCIAL GARAGES  
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factor(brook$NEIGHBORHOOD)CANARSIE
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factor(brook$NEIGHBORHOOD)CROWN HEIGHTS
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factor(brook$NEIGHBORHOOD)CYPRESS HILLS
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factor(brook$NEIGHBORHOOD)WILLIAMSBURG-NORTH
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< 2e-16
factor(brook$NEIGHBORHOOD)WINDSOR TERRACE
< 2e-16
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factor(brook$BUILDING.CLASS.CATEGORY)02 TWO FAMILY DWELLINGS  
  0.282213  
factor(brook$BUILDING.CLASS.CATEGORY)03 THREE FAMILY DWELLINGS  
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factor(brook$BUILDING.CLASS.CATEGORY)05 TAX CLASS 1 VACANT LAND  
  0.548529  
factor(brook$BUILDING.CLASS.CATEGORY)06 TAX CLASS 1 - OTHER  
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factor(brook$BUILDING.CLASS.CATEGORY)07 RENTALS - WALKUP APARTMENTS  
  0.624665  
factor(brook$BUILDING.CLASS.CATEGORY)08 RENTALS - ELEVATOR APARTMENTS  
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factor(brook$BUILDING.CLASS.CATEGORY)09 COOPS - WALKUP APARTMENTS  
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factor(brook$BUILDING.CLASS.CATEGORY)10 COOPS - ELEVATOR APARTMENTS  
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factor(brook$BUILDING.CLASS.CATEGORY)11 SPECIAL CONDO BILLING LOTS  
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factor(brook$BUILDING.CLASS.CATEGORY)11A CONDO-RENTALS  
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factor(brook$BUILDING.CLASS.CATEGORY)14 RENTALS - 4-10 UNIT  
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factor(brook$BUILDING.CLASS.CATEGORY)21 OFFICE BUILDINGS  
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factor(brook$BUILDING.CLASS.CATEGORY)22 STORE BUILDINGS  
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factor(brook$BUILDING.CLASS.CATEGORY)23 LOFT BUILDINGS  
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factor(brook$BUILDING.CLASS.CATEGORY)26 OTHER HOTELS  
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factor(brook$BUILDING.CLASS.CATEGORY)27 FACTORIES  
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factor(brook$BUILDING.CLASS.CATEGORY)29 COMMERCIAL GARAGES  
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factor(brook$BUILDING.CLASS.CATEGORY)30 WAREHOUSES  
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factor(brook$BUILDING.CLASS.CATEGORY)31 COMMERCIAL VACANT LAND  
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factor(brook$BUILDING.CLASS.CATEGORY)33 EDUCATIONAL FACILITIES  
  0.741596  
factor(brook$BUILDING.CLASS.CATEGORY)34 THEATRES  
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factor(brook$BUILDING.CLASS.CATEGORY)35 INDOOR PUBLIC AND CULTURAL FACILITIES  
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factor(brook$BUILDING.CLASS.CATEGORY)37 RELIGIOUS FACILITIES  
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factor(brook$BUILDING.CLASS.CATEGORY)38 ASYLUMS AND HOMES  
  0.737552  
factor(brook$BUILDING.CLASS.CATEGORY)41 TAX CLASS 4 - OTHER  
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factor(brook$APARTMENT.NUMBER)11  
  
factor(brook$APARTMENT.NUMBER)12  
  
factor(brook$APARTMENT.NUMBER)13  
  
factor(brook$APARTMENT.NUMBER)14  
  
factor(brook$APARTMENT.NUMBER)15  
  
factor(brook$APARTMENT.NUMBER)16  
  
factor(brook$APARTMENT.NUMBER)18  
  
factor(brook$APARTMENT.NUMBER)19  
  
factor(brook$APARTMENT.NUMBER)20  
  
factor(brook$APARTMENT.NUMBER)21  
  
factor(brook$APARTMENT.NUMBER)23  
  
factor(brook$APARTMENT.NUMBER)24  
  
factor(brook$APARTMENT.NUMBER)28  
  
factor(brook$APARTMENT.NUMBER)30  
  
factor(brook$APARTMENT.NUMBER)31  
  
factor(brook$APARTMENT.NUMBER)32  
  
factor(brook$APARTMENT.NUMBER)34  
  
factor(brook$APARTMENT.NUMBER)35  
***  
factor(brook$APARTMENT.NUMBER)36  
  
factor(brook$APARTMENT.NUMBER)38  
  
factor(brook$APARTMENT.NUMBER)39
```

```

factor(brook$APARTMENT.NUMBER)40

factor(brook$APARTMENT.NUMBER)41

factor(brook$APARTMENT.NUMBER)42

factor(brook$APARTMENT.NUMBER)43
  ***
factor(brook$APARTMENT.NUMBER)45

factor(brook$APARTMENT.NUMBER)48

factor(brook$APARTMENT.NUMBER)49

factor(brook$APARTMENT.NUMBER)53
  ***
factor(brook$APARTMENT.NUMBER)54

factor(brook$APARTMENT.NUMBER)60
  *
factor(brook$APARTMENT.NUMBER)63

factor(brook$APARTMENT.NUMBER)100

factor(brook$APARTMENT.NUMBER)104

factor(brook$APARTMENT.NUMBER)113

factor(brook$APARTMENT.NUMBER)135

factor(brook$APARTMENT.NUMBER)189

---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.064 on 8101 degrees of freedom
Multiple R-squared:  0.9777,    Adjusted R-squared:  0.9766
F-statistic: 844.9 on 421 and 8101 DF,  p-value: < 2.2e-16

```

The model R squared actually improves when we take into account the apartment number factor and we can see that some apartment numbers are statistically significant.

Conclusion :

- Thus we can see that some variables are useful while others are not.
- The Address variable (with a lot of data munging/ transformation) can be used to further improve the model.
- Same could be said of the Building Class variables, Block and Lots.

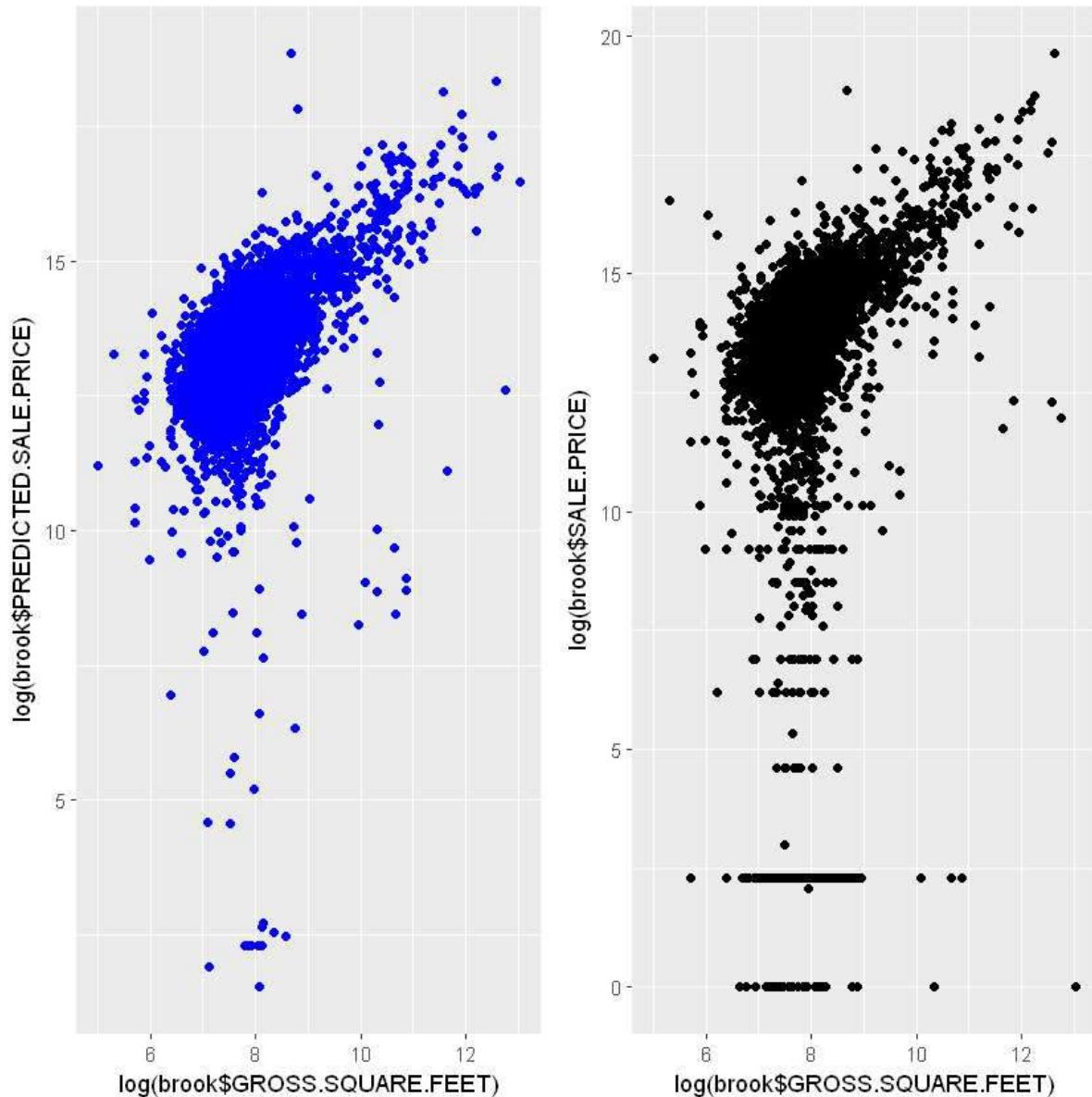
But one must stop at a certain point and beg the question : How high of an R squared do we really need?

## 5. Predictions

```
In [95]: # running the regression on the existing dataframe
brook$log_results <- predict(model3, brook)
brook$PREDICTED.SALE.PRICE <- exp(brook$log_results)
```

Warning message in `predict.lm(model3, brook)`:  
 "prediction from a rank-deficient fit may be misleading"

```
In [100]: p1 <- ggplot(mapping = aes(log(brook$GROSS.SQUARE.FEET), log(brook$PREDICTED.SALE.PRICE) )) + geom_point(color = "blue")
p2 <- ggplot(mapping = aes(log(brook$GROSS.SQUARE.FEET),
log(brook$SALE.PRICE))) + geom_point()
library(grid)
library(gridExtra)
grid.arrange(p1,p2, ncol = 2)
```



Because the prediction is made on the same data, there is a great chance that many points will overlap.

So I've decided to plot the predicted vs actual values side by side for better understanding.

Retained the original color of the observed values.

It can be seen that the predicted values closely follow the observed values at many points especially in the central cluster.

## 6. Significance of the Variables

The R squared and Adjusted RSquared for the model (model3) are very high (of the order of 0.95) which is an indication of a good fit. The model can certainly be improved but it really depends on how much accuracy is needed from the model

```
In [101]: # We perform the non parametric Kolmogorov-Smirnov test to check if the variables are significant to each other
library(stats)
ks.test(brook$GROSS.SQUARE.FEET, brook$TAX.CLASS.AT.TIME.OF.SALE)
```

Warning message in ks.test(brook\$GROSS.SQUARE.FEET, brook\$TAX.CLASS.AT.TIME.OF.SALE):  
"p-value will be approximate in the presence of ties"

Two-sample Kolmogorov-Smirnov test

```
data: brook$GROSS.SQUARE.FEET and brook$TAX.CLASS.AT.TIME.OF.SALE
D = 1, p-value < 2.2e-16
alternative hypothesis: two-sided
```

The pvalue of the KS test is very low, which means the null hypothesis is rejected and the alternate hypothesis that the two variables are correlated holds true!

## 7. Observations

- A lot of data transformation is still left such as transforming the date variable.
- Recoding different variables such as neighborhood, building class, etc. and feeding it back to the algorithm will produce better output.
- The exercise, in my opinion, is far from over and given a greater length of time, more algorithms and different models can be tested. I used Linear regression as that was the only one that made sense.
- Binning the Lots and Block variables accordingly and adding them to the regressor should improve the R Squared value.

## 8. Conclusions and Sustainability of the model

- The model is based on the assumption that the Sales price only depends on certain factors such as gross square feet, the size of the land, the neighborhood, type of tax that the owner needs to pay, building class, sale date etc.
- There are serious deficiencies in this model especially when applied to NYC. In the real world, real estate markets are swayed by many other factors such as reputation, vicinity to famous landmarks, inflation, etc. and many other measurable and non measurable characteristics.
- This model will fit better to a smaller city with not many famous landmarks. The model will also help to understand prices solely from raw measurable data.
- There is a lot to be improved and has been mentioned above such as binning the blocks and landmarks, clustering Zip Codes, taking into account the 'year built' variable which should provide better results.
- In conclusion, like every model, this model cannot predict the real world with 100% accuracy but it does a good job by helping us (and real estate brokers, customers, etc.) estimate the cost of buying property in Brooklyn just by looking at these measurable variables. However, due to the above mentioned tangible and intangible characteristics of cities, it is seriously wanting in predicting the results accurately.