Week-5

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```
#Loading the libraries
library(ggplot2)
library(ggthemes)
```

```
## Warning: package 'ggthemes' was built under R version 3.5.2
```

```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 3.5.2
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(gridExtra)
```

```
## Warning: package 'gridExtra' was built under R version 3.5.2
```

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

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

```
library(corrplot)
```

```
## Warning: package 'corrplot' was built under R version 3.5.2
```

```
## corrplot 0.84 loaded
```

```
library(GGally)
```

```
## Warning: package 'GGally' was built under R version 3.5.2
```

```
##
## Attaching package: 'GGally'
```

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

```
library(data.table)
```

```
## Warning: package 'data.table' was built under R version 3.5.2
```

```
##
## Attaching package: 'data.table'
```

```
## The following objects are masked from 'package:dplyr':
##
##     between, first, last
```

```
library(scales)
library(MVA)
```

```
## Warning: package 'MVA' was built under R version 3.5.2
```

```
## Loading required package: HSAUR2
```

```
## Warning: package 'HSAUR2' was built under R version 3.5.2
```

```
## Loading required package: tools
```

```
library(Rmisc)
```

```
## Warning: package 'Rmisc' was built under R version 3.5.2
```

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

```
## Warning: package 'lattice' was built under R version 3.5.2
```

```
## Loading required package: plyr
```

```
## ------------------------------------------------------------------------------
```

```
## You have loaded plyr after dplyr - this is likely to cause problems.
## If you need functions from both plyr and dplyr, please load plyr first,
then dplyr:
## library(plyr); library(dplyr)
```

```
## ------------------------------------------------------------------------------
```

```
##
## Attaching package: 'plyr'
```

```
## The following objects are masked from 'package:dplyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize
```

```r
# loading the dataset
training <- read.csv("D:/MultiAnalysis/Project/house-prices-advanced-regression-techniques/Data.csv.csv")
View(training)
```

UNDERSTANDING THE DATA

```r
dim(training) # checking the dimensions
```

```
## [1] 1460   81
```

```r
str(training)# checking the structure of dataset
```

```
## 'data.frame':    1460 obs. of  81 variables:
##  $ Id           : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ MSSubClass   : int  60 20 60 70 60 50 20 60 50 190 ...
##  $ MSZoning     : Factor w/ 5 levels "C (all)","FV",..: 4 4 4 4 4 4 4 4 5
4 ...
##  $ LotFrontage  : int  65 80 68 60 84 85 75 NA 51 50 ...
##  $ LotArea      : int  8450 9600 11250 9550 14260 14115 10084 10382 6120
7420 ...
##  $ Street       : Factor w/ 2 levels "Grvl","Pave": 2 2 2 2 2 2 2 2 2 2
...
##  $ Alley        : Factor w/ 2 levels "Grvl","Pave": NA NA NA NA NA NA NA
NA NA NA ...
##  $ LotShape     : Factor w/ 4 levels "IR1","IR2","IR3",..: 4 4 1 1 1 1 4 1
4 4 ...
##  $ LandContour  : Factor w/ 4 levels "Bnk","HLS","Low",..: 4 4 4 4 4 4 4 4
4 4 ...
##  $ Utilities    : Factor w/ 2 levels "AllPub","NoSeWa": 1 1 1 1 1 1 1 1
1 ...
##  $ LotConfig    : Factor w/ 5 levels "Corner","CulDSac",..: 5 3 5 1 3 5 5
1 5 1 ...
##  $ LandSlope    : Factor w/ 3 levels "Gtl","Mod","Sev": 1 1 1 1 1 1 1 1 1
1 ...
##  $ Neighborhood : Factor w/ 25 levels "Blmngtn","Blueste",..: 6 25 6 7 14
12 21 17 18 4 ...
##  $ Condition1   : Factor w/ 9 levels "Artery","Feedr",..: 3 2 3 3 3 3 3 5
1 1 ...
##  $ Condition2   : Factor w/ 8 levels "Artery","Feedr",..: 3 3 3 3 3 3 3 3
3 1 ...
##  $ BldgType     : Factor w/ 5 levels "1Fam","2fmCon",..: 1 1 1 1 1 1 1 1 1
2 ...
##  $ HouseStyle   : Factor w/ 8 levels "1.5Fin","1.5Unf",..: 6 3 6 6 6 1 3 6
1 2 ...
##  $ OverallQual  : int  7 6 7 7 8 5 8 7 7 5 ...
##  $ OverallCond  : int  5 8 5 5 5 5 5 6 5 6 ...
##  $ YearBuilt    : int  2003 1976 2001 1915 2000 1993 2004 1973 1931 1939
...
##  $ YearRemodAdd : int  2003 1976 2002 1970 2000 1995 2005 1973 1950 1950
...
```

```
##  $ RoofStyle    : Factor w/ 6 levels "Flat","Gable",..: 2 2 2 2 2 2 2 2 2
2 ...
##  $ RoofMatl     : Factor w/ 8 levels "ClyTile","CompShg",..: 2 2 2 2 2 2 2
2 2 2 ...
##  $ Exterior1st  : Factor w/ 15 levels "AsbShng","AsphShn",..: 13 9 13 14
13 13 13 7 4 9 ...
##  $ Exterior2nd  : Factor w/ 16 levels "AsbShng","AsphShn",..: 14 9 14 16
14 14 14 7 16 9 ...
##  $ MasVnrType   : Factor w/ 4 levels "BrkCmn","BrkFace",..: 2 3 2 3 2 3 4
4 3 3 ...
##  $ MasVnrArea   : int  196 0 162 0 350 0 186 240 0 0 ...
##  $ ExterQual    : Factor w/ 4 levels "Ex","Fa","Gd",..: 3 4 3 4 3 4 3 4 4
4 ...
##  $ ExterCond    : Factor w/ 5 levels "Ex","Fa","Gd",..: 5 5 5 5 5 5 5 5 5
5 ...
##  $ Foundation   : Factor w/ 6 levels "BrkTil","CBlock",..: 3 2 3 1 3 6 3 2
1 1 ...
##  $ BsmtQual     : Factor w/ 4 levels "Ex","Fa","Gd",..: 3 3 3 4 3 3 1 3 4
4 ...
##  $ BsmtCond     : Factor w/ 4 levels "Fa","Gd","Po",..: 4 4 4 2 4 4 4 4 4
4 ...
##  $ BsmtExposure : Factor w/ 4 levels "Av","Gd","Mn",..: 4 2 3 4 1 4 1 3 4
4 ...
##  $ BsmtFinType1 : Factor w/ 6 levels "ALQ","BLQ","GLQ",..: 3 1 3 1 3 3 3 1
6 3 ...
##  $ BsmtFinSF1   : int  706 978 486 216 655 732 1369 859 0 851 ...
##  $ BsmtFinType2 : Factor w/ 6 levels "ALQ","BLQ","GLQ",..: 6 6 6 6 6 6 6 2
6 6 ...
##  $ BsmtFinSF2   : int  0 0 0 0 0 0 0 32 0 0 ...
##  $ BsmtUnfSF    : int  150 284 434 540 490 64 317 216 952 140 ...
##  $ TotalBsmtSF  : int  856 1262 920 756 1145 796 1686 1107 952 991 ...
##  $ Heating      : Factor w/ 6 levels "Floor","GasA",..: 2 2 2 2 2 2 2 2 2
2 ...
##  $ HeatingQC    : Factor w/ 5 levels "Ex","Fa","Gd",..: 1 1 1 3 1 1 1 1 3
1 ...
##  $ CentralAir   : Factor w/ 2 levels "N","Y": 2 2 2 2 2 2 2 2 2 2 ...
##  $ Electrical   : Factor w/ 5 levels "FuseA","FuseF",..: 5 5 5 5 5 5 5 5 2
5 ...
##  $ X1stFlrSF    : int  856 1262 920 961 1145 796 1694 1107 1022 1077 ...
##  $ X2ndFlrSF    : int  854 0 866 756 1053 566 0 983 752 0 ...
##  $ LowQualFinSF : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ GrLivArea    : int  1710 1262 1786 1717 2198 1362 1694 2090 1774 1077
...
##  $ BsmtFullBath : int  1 0 1 1 1 1 1 1 0 1 ...
##  $ BsmtHalfBath : int  0 1 0 0 0 0 0 0 0 0 ...
##  $ FullBath     : int  2 2 2 1 2 1 2 2 2 1 ...
##  $ HalfBath     : int  1 0 1 0 1 1 0 1 0 0 ...
##  $ BedroomAbvGr : int  3 3 3 3 4 1 3 3 2 2 ...
##  $ KitchenAbvGr : int  1 1 1 1 1 1 1 1 2 2 ...
##  $ KitchenQual  : Factor w/ 4 levels "Ex","Fa","Gd",..: 3 4 3 3 3 4 3 4 4
```

```
4 ...
##  $ TotRmsAbvGrd : int  8 6 6 7 9 5 7 7 8 5 ...
##  $ Functional   : Factor w/ 7 levels "Maj1","Maj2",..: 7 7 7 7 7 7 7 7 3 7
...
##  $ Fireplaces   : int  0 1 1 1 1 0 1 2 2 2 ...
##  $ FireplaceQu  : Factor w/ 5 levels "Ex","Fa","Gd",..: NA 5 5 3 5 NA 3 5
5 5 ...
##  $ GarageType   : Factor w/ 6 levels "2Types","Attchd",..: 2 2 2 6 2 2 2 2
6 2 ...
##  $ GarageYrBlt  : int  2003 1976 2001 1998 2000 1993 2004 1973 1931 1939
...
##  $ GarageFinish : Factor w/ 3 levels "Fin","RFn","Unf": 2 2 2 3 2 3 2 2 3
2 ...
##  $ GarageCars   : int  2 2 2 3 3 2 2 2 2 1 ...
##  $ GarageArea   : int  548 460 608 642 836 480 636 484 468 205 ...
##  $ GarageQual   : Factor w/ 5 levels "Ex","Fa","Gd",..: 5 5 5 5 5 5 5 5 2
3 ...
##  $ GarageCond   : Factor w/ 5 levels "Ex","Fa","Gd",..: 5 5 5 5 5 5 5 5 5
5 ...
##  $ PavedDrive   : Factor w/ 3 levels "N","P","Y": 3 3 3 3 3 3 3 3 3 3 ...
##  $ WoodDeckSF   : int  0 298 0 0 192 40 255 235 90 0 ...
##  $ OpenPorchSF  : int  61 0 42 35 84 30 57 204 0 4 ...
##  $ EnclosedPorch: int  0 0 0 272 0 0 0 228 205 0 ...
##  $ X3SsnPorch   : int  0 0 0 0 0 320 0 0 0 0 ...
##  $ ScreenPorch  : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ PoolArea     : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ PoolQC       : Factor w/ 3 levels "Ex","Fa","Gd": NA NA NA NA NA NA NA
NA NA NA ...
##  $ Fence        : Factor w/ 4 levels "GdPrv","GdWo",..: NA NA NA NA NA 3
NA NA NA NA ...
##  $ MiscFeature  : Factor w/ 4 levels "Gar2","Othr",..: NA NA NA NA NA 3 NA
3 NA NA ...
##  $ MiscVal      : int  0 0 0 0 0 700 0 350 0 0 ...
##  $ MoSold       : int  2 5 9 2 12 10 8 11 4 1 ...
##  $ YrSold       : int  2008 2007 2008 2006 2008 2009 2007 2009 2008 2008
...
##  $ SaleType     : Factor w/ 9 levels "COD","Con","ConLD",..: 9 9 9 9 9 9 9
9 9 9 ...
##  $ SaleCondition: Factor w/ 6 levels "Abnorml","AdjLand",..: 5 5 5 1 5 5 5
5 1 5 ...
##  $ SalePrice    : int  208500 181500 223500 140000 250000 143000 307000
200000 129900 118000 ...

summary(training)# checking the summary of dataset

##        Id           MSSubClass       MSZoning     LotFrontage
##  Min.   :   1.0   Min.   : 20.0   C (all):  10   Min.   : 21.00
##  1st Qu.: 365.8   1st Qu.: 20.0   FV     :  65   1st Qu.: 59.00
##  Median : 730.5   Median : 50.0   RH     :  16   Median : 69.00
##  Mean   : 730.5   Mean   : 56.9   RL     :1151   Mean   : 70.05
```

```
##  3rd Qu.:1095.2   3rd Qu.: 70.0   RM     : 218   3rd Qu.: 80.00
##  Max.   :1460.0   Max.   :190.0                  Max.   :313.00
##                                                 NA's   :259
##     LotArea        Street      Alley      LotShape  LandContour
##  Min.   :  1300   Grvl:   6   Grvl:  50   IR1:484   Bnk:  63
##  1st Qu.:  7554   Pave:1454   Pave:  41   IR2: 41   HLS:  50
##  Median :  9478               NA's:1369   IR3: 10   Low:  36
##  Mean   : 10517                           Reg:925   Lvl:1311
##  3rd Qu.: 11602
##  Max.   :215245
##
##   Utilities      LotConfig    LandSlope   Neighborhood   Condition1
##  AllPub:1459   Corner : 263   Gtl:1382   NAmes  :225   Norm   :1260
##  NoSeWa:   1   CulDSac:  94   Mod:  65   CollgCr:150   Feedr  :  81
##                FR2    :  47   Sev:  13   OldTown:113   Artery :  48
##                FR3    :   4              Edwards:100   RRAn   :  26
##                Inside :1052              Somerst: 86   PosN   :  19
##                                          Gilbert: 79   RRAe   :  11
##                                          (Other):707   (Other):  15
##    Condition2     BldgType      HouseStyle   OverallQual
##  Norm   :1445   1Fam  :1220   1Story :726   Min.   : 1.000
##  Feedr  :   6   2fmCon:  31   2Story :445   1st Qu.: 5.000
##  Artery :   2   Duplex:  52   1.5Fin :154   Median : 6.000
##  PosN   :   2   Twnhs :  43   SLvl   : 65   Mean   : 6.099
##  RRNn   :   2   TwnhsE: 114   SFoyer : 37   3rd Qu.: 7.000
##  PosA   :   1                 1.5Unf : 14   Max.   :10.000
##  (Other):   2                 (Other): 19
##   OverallCond      YearBuilt     YearRemodAdd    RoofStyle
##  Min.   :1.000   Min.   :1872   Min.   :1950   Flat   :  13
##  1st Qu.:5.000   1st Qu.:1954   1st Qu.:1967   Gable  :1141
##  Median :5.000   Median :1973   Median :1994   Gambrel:  11
##  Mean   :5.575   Mean   :1971   Mean   :1985   Hip    : 286
##  3rd Qu.:6.000   3rd Qu.:2000   3rd Qu.:2004   Mansard:   7
##  Max.   :9.000   Max.   :2010   Max.   :2010   Shed   :   2
##
##     RoofMatl     Exterior1st   Exterior2nd    MasVnrType    MasVnrArea
##  CompShg:1434   VinylSd:515   VinylSd:504   BrkCmn : 15   Min.   :   0.0
##  Tar&Grv:  11   HdBoard:222   MetalSd:214   BrkFace:445   1st Qu.:   0.0
##  WdShngl:   6   MetalSd:220   HdBoard:207   None   :864   Median :   0.0
##  WdShake:   5   Wd Sdng:206   Wd Sdng:197   Stone  :128   Mean   : 103.7
##  ClyTile:   1   Plywood:108   Plywood:142   NA's   :  8   3rd Qu.: 166.0
##  Membran:   1   CemntBd: 61   CmentBd: 60                 Max.   :1600.0
##  (Other):   2   (Other):128   (Other):136                 NA's   :8
##  ExterQual ExterCond  Foundation  BsmtQual   BsmtCond    BsmtExposure
##  Ex: 52    Ex:   3   BrkTil:146   Ex  :121   Fa  :  45   Av  :221
##  Fa: 14    Fa:  28   CBlock:634   Fa  : 35   Gd  :  65   Gd  :134
##  Gd:488    Gd: 146   PConc :647   Gd  :618   Po  :   2   Mn  :114
##  TA:906    Po:   1   Slab  : 24   TA  :649   TA  :1311   No  :953
##            TA:1282   Stone :  6   NA's: 37   NA's:  37   NA's: 38
##                      Wood  :  3
```

```
##
##  BsmtFinType1   BsmtFinSF1     BsmtFinType2   BsmtFinSF2
##  ALQ :220     Min.   :   0.0   ALQ :  19    Min.   :   0.00
##  BLQ :148     1st Qu.:   0.0   BLQ :  33    1st Qu.:   0.00
##  GLQ :418     Median : 383.5   GLQ :  14    Median :   0.00
##  LwQ : 74     Mean   : 443.6   LwQ :  46    Mean   :  46.55
##  Rec :133     3rd Qu.: 712.2   Rec :  54    3rd Qu.:   0.00
##  Unf :430     Max.   :5644.0   Unf :1256    Max.   :1474.00
##  NA's: 37                      NA's:  38
##    BsmtUnfSF       TotalBsmtSF      Heating     HeatingQC CentralAir
##  Min.   :   0.0   Min.   :   0.0   Floor:   1   Ex:741    N:  95
##  1st Qu.: 223.0   1st Qu.: 795.8   GasA :1428   Fa: 49    Y:1365
##  Median : 477.5   Median : 991.5   GasW :  18   Gd:241
##  Mean   : 567.2   Mean   :1057.4   Grav :   7   Po:  1
##  3rd Qu.: 808.0   3rd Qu.:1298.2   OthW :   2   TA:428
##  Max.   :2336.0   Max.   :6110.0   Wall :   4
##
##  Electrical     X1stFlrSF      X2ndFlrSF     LowQualFinSF
##  FuseA:  94   Min.   : 334   Min.   :   0   Min.   :  0.000
##  FuseF:  27   1st Qu.: 882   1st Qu.:   0   1st Qu.:  0.000
##  FuseP:   3   Median :1087   Median :   0   Median :  0.000
##  Mix  :   1   Mean   :1163   Mean   : 347   Mean   :  5.845
##  SBrkr:1334   3rd Qu.:1391   3rd Qu.: 728   3rd Qu.:  0.000
##  NA's :   1   Max.   :4692   Max.   :2065   Max.   :572.000
##
##    GrLivArea     BsmtFullBath     BsmtHalfBath        FullBath
##  Min.   : 334   Min.   :0.0000   Min.   :0.00000   Min.   :0.000
##  1st Qu.:1130   1st Qu.:0.0000   1st Qu.:0.00000   1st Qu.:1.000
##  Median :1464   Median :0.0000   Median :0.00000   Median :2.000
##  Mean   :1515   Mean   :0.4253   Mean   :0.05753   Mean   :1.565
##  3rd Qu.:1777   3rd Qu.:1.0000   3rd Qu.:0.00000   3rd Qu.:2.000
##  Max.   :5642   Max.   :3.0000   Max.   :2.00000   Max.   :3.000
##
##     HalfBath       BedroomAbvGr    KitchenAbvGr   KitchenQual
##  Min.   :0.0000   Min.   :0.000   Min.   :0.000   Ex:100
##  1st Qu.:0.0000   1st Qu.:2.000   1st Qu.:1.000   Fa: 39
##  Median :0.0000   Median :3.000   Median :1.000   Gd:586
##  Mean   :0.3829   Mean   :2.866   Mean   :1.047   TA:735
##  3rd Qu.:1.0000   3rd Qu.:3.000   3rd Qu.:1.000
##  Max.   :2.0000   Max.   :8.000   Max.   :3.000
##
##   TotRmsAbvGrd    Functional    Fireplaces    FireplaceQu   GarageType
##  Min.   : 2.000   Maj1:  14   Min.   :0.000   Ex  : 24    2Types :  6
##  1st Qu.: 5.000   Maj2:   5   1st Qu.:0.000   Fa  : 33    Attchd :870
##  Median : 6.000   Min1:  31   Median :1.000   Gd  :380    Basment: 19
##  Mean   : 6.518   Min2:  34   Mean   :0.613   Po  : 20    BuiltIn: 88
##  3rd Qu.: 7.000   Mod :  15   3rd Qu.:1.000   TA  :313    CarPort:  9
##  Max.   :14.000   Sev :   1   Max.   :3.000   NA's:690    Detchd :387
##                   Typ :1360                               NA's   : 81
##   GarageYrBlt   GarageFinish   GarageCars      GarageArea     GarageQual
```

```
##  Min.   :1900   Fin :352     Min.   :0.000   Min.   :   0.0   Ex  :   3
##  1st Qu.:1961   RFn :422     1st Qu.:1.000   1st Qu.: 334.5   Fa  :  48
##  Median :1980   Unf :605     Median :2.000   Median : 480.0   Gd  :  14
##  Mean   :1979   NA's: 81     Mean   :1.767   Mean   : 473.0   Po  :   3
##  3rd Qu.:2002                3rd Qu.:2.000   3rd Qu.: 576.0   TA  :1311
##  Max.   :2010                Max.   :4.000   Max.   :1418.0   NA's:  81
##  NA's   :81
##  GarageCond  PavedDrive   WoodDeckSF      OpenPorchSF     EnclosedPorch
##  Ex  :   2   N:  90     Min.   :  0.00   Min.   :  0.00   Min.   :  0.00
##  Fa  :  35   P:  30     1st Qu.:  0.00   1st Qu.:  0.00   1st Qu.:  0.00
##  Gd  :   9   Y:1340     Median :  0.00   Median : 25.00   Median :  0.00
##  Po  :   7              Mean   : 94.24   Mean   : 46.66   Mean   : 21.95
##  TA  :1326              3rd Qu.:168.00   3rd Qu.: 68.00   3rd Qu.:  0.00
##  NA's:  81              Max.   :857.00   Max.   :547.00   Max.   :552.00
##
##    X3SsnPorch      ScreenPorch        PoolArea        PoolQC
##  Min.   :  0.00   Min.   :  0.00   Min.   :  0.000   Ex  :   2
##  1st Qu.:  0.00   1st Qu.:  0.00   1st Qu.:  0.000   Fa  :   2
##  Median :  0.00   Median :  0.00   Median :  0.000   Gd  :   3
##  Mean   :  3.41   Mean   : 15.06   Mean   :  2.759   NA's:1453
##  3rd Qu.:  0.00   3rd Qu.:  0.00   3rd Qu.:  0.000
##  Max.   :508.00   Max.   :480.00   Max.   :738.000
##
##    Fence      MiscFeature    MiscVal             MoSold
##  GdPrv:  59   Gar2:   2   Min.   :    0.00   Min.   : 1.000
##  GdWo :  54   Othr:   2   1st Qu.:    0.00   1st Qu.: 5.000
##  MnPrv: 157   Shed:  49   Median :    0.00   Median : 6.000
##  MnWw :  11   TenC:   1   Mean   :   43.49   Mean   : 6.322
##  NA's :1179   NA's:1406   3rd Qu.:    0.00   3rd Qu.: 8.000
##                           Max.   :15500.00   Max.   :12.000
##
##      YrSold        SaleType    SaleCondition    SalePrice
##  Min.   :2006   WD     :1267   Abnorml: 101   Min.   : 34900
##  1st Qu.:2007   New    : 122   AdjLand:   4   1st Qu.:129975
##  Median :2008   COD    :  43   Alloca :  12   Median :163000
##  Mean   :2008   ConLD  :   9   Family :  20   Mean   :180921
##  3rd Qu.:2009   ConLI  :   5   Normal :1198   3rd Qu.:214000
##  Max.   :2010   ConLw  :   5   Partial: 125   Max.   :755000
##                 (Other):   9
```

Checking for MISSING VALUES

```
#Missing data
sum(is.na(training)/(nrow(training)*nrow(training)))# printing percentage of
missing data

## [1] 0.003267499

unique(nrow(training)) # printing all the unique values

## [1] 1460
```

```r
colSums(sapply(training,is.na))# prinitng number of missing values in each
column
```

```
##            Id    MSSubClass      MSZoning   LotFrontage       LotArea
##             0             0             0           259             0
##        Street         Alley      LotShape   LandContour     Utilities
##             0          1369             0             0             0
##     LotConfig     LandSlope  Neighborhood    Condition1    Condition2
##             0             0             0             0             0
##      BldgType    HouseStyle   OverallQual   OverallCond     YearBuilt
##             0             0             0             0             0
##  YearRemodAdd     RoofStyle      RoofMatl   Exterior1st   Exterior2nd
##             0             0             0             0             0
##    MasVnrType    MasVnrArea     ExterQual     ExterCond    Foundation
##             8             8             0             0             0
##      BsmtQual      BsmtCond  BsmtExposure  BsmtFinType1    BsmtFinSF1
##            37            37            38            37             0
##  BsmtFinType2    BsmtFinSF2     BsmtUnfSF   TotalBsmtSF       Heating
##            38             0             0             0             0
##     HeatingQC    CentralAir    Electrical     X1stFlrSF     X2ndFlrSF
##             0             0             1             0             0
##  LowQualFinSF     GrLivArea  BsmtFullBath  BsmtHalfBath      FullBath
##             0             0             0             0             0
##      HalfBath  BedroomAbvGr  KitchenAbvGr   KitchenQual  TotRmsAbvGrd
##             0             0             0             0             0
##    Functional    Fireplaces   FireplaceQu    GarageType   GarageYrBlt
##             0             0           690            81            81
##  GarageFinish    GarageCars    GarageArea    GarageQual    GarageCond
##            81             0             0            81            81
##    PavedDrive    WoodDeckSF   OpenPorchSF EnclosedPorch    X3SsnPorch
##             0             0             0             0             0
##   ScreenPorch      PoolArea        PoolQC         Fence   MiscFeature
##             0             0          1453          1179          1406
##       MiscVal        MoSold        YrSold      SaleType SaleCondition
##             0             0             0             0             0
##     SalePrice
##             0
```

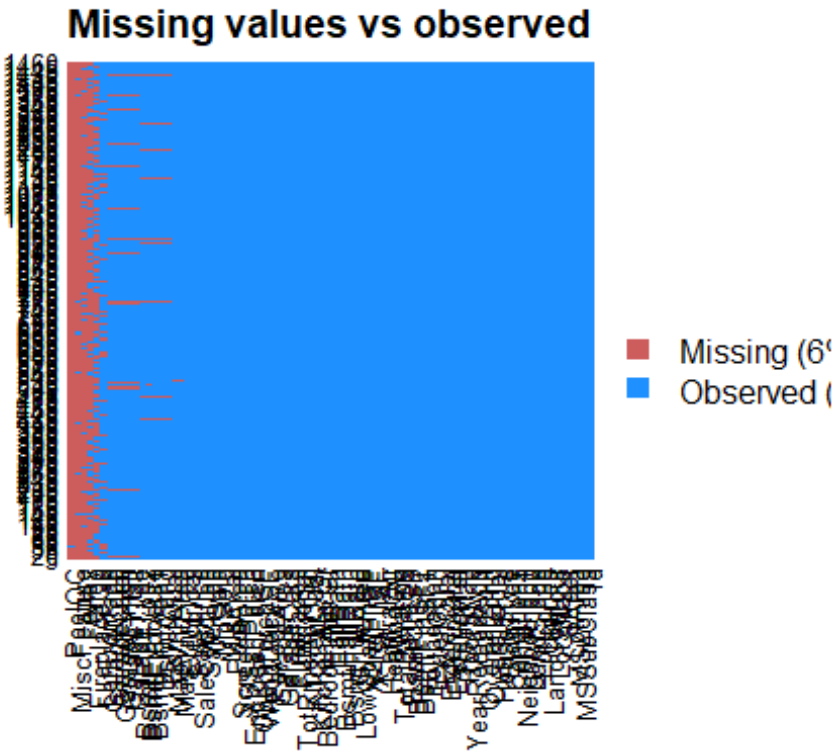
```r
library(Amelia)
```

```
## Warning: package 'Amelia' was built under R version 3.5.2
```

```
## Loading required package: Rcpp
```

```
## ##
## ## Amelia II: Multiple Imputation
## ## (Version 1.7.5, built: 2018-05-07)
## ## Copyright (C) 2005-2019 James Honaker, Gary King and Matthew Blackwell
## ## Refer to http://gking.harvard.edu/amelia/ for more information
## ##
```

```
missmap(training, main ="Missing values vs observed")
```




```
# creating dataframe of categorical and numerical variables
catvar <- c('MSZoning','Street', 'Neighborhood', 'LandContour','BldgType',
'LandSlope', 'RoofStyle',

'HouseStyle','CentralAir','PavedDrive','SaleCondition','OverallCond' )
numvar<-
c('LotArea','TotalBsmtSF','GrLivArea','BedroomAbvGr','GarageCars','GarageArea
','OpenPorchSF','EnclosedPorch','WoodDeckSF','PoolArea')

unique(nrow(training$SalePrice))

## NULL
```

Removing columns with NA values

```
training$Alley = NULL
training$LotFrontage = NULL
training$FireplaceQu = NULL
training$Fence = NULL
training$PoolQC = NULL
training$MiscFeature = NULL
training$BsmtQual = NULL
training$BsmtCond = NULL
training$BsmtExposure = NULL
training$BsmtFinType1 = NULL
training$BsmtFinType2 = NULL
```

```
training$GarageType = NULL
training$GarageYrBlt = NULL
training$MasVnrType = NULL
training$MasVnrArea = NULL
training$GarageQual = NULL
training$GarageFinish = NULL
training$GarageCond = NULL
training$Id=NULL

training[!complete.cases(training),]

##      MSSubClass MSZoning LotArea Street LotShape LandContour Utilities
## 1380         80       RL    9735   Pave      Reg         Lvl    AllPub
##      LotConfig LandSlope Neighborhood Condition1 Condition2 BldgType
## 1380    Inside       Gtl       Timber       Norm       Norm     1Fam
##      HouseStyle OverallQual OverallCond YearBuilt YearRemodAdd RoofStyle
## 1380       SLvl           5           5      2006         2007     Gable
##      RoofMatl Exterior1st Exterior2nd ExterQual ExterCond Foundation
## 1380  CompShg     VinylSd     VinylSd        TA        TA      PConc
##      BsmtFinSF1 BsmtFinSF2 BsmtUnfSF TotalBsmtSF Heating HeatingQC
## 1380          0          0       384         384    GasA        Gd
##      CentralAir Electrical X1stFlrSF X2ndFlrSF LowQualFinSF GrLivArea
## 1380          Y       <NA>       754       640            0      1394
##      BsmtFullBath BsmtHalfBath FullBath HalfBath BedroomAbvGr KitchenAbvGr
## 1380            0            0        2        1            3            1
##      KitchenQual TotRmsAbvGrd Functional Fireplaces GarageCars GarageArea
## 1380          Gd            7        Typ          0          2        400
##      PavedDrive WoodDeckSF OpenPorchSF EnclosedPorch X3SsnPorch
## 1380          Y        100           0             0          0
##      ScreenPorch PoolArea MiscVal MoSold YrSold SaleType SaleCondition
## 1380           0        0       0      5   2008       WD        Normal
##      SalePrice
## 1380    167500

head(training)

##   MSSubClass MSZoning LotArea Street LotShape LandContour Utilities
## 1         60       RL    8450   Pave      Reg         Lvl    AllPub
## 2         20       RL    9600   Pave      Reg         Lvl    AllPub
## 3         60       RL   11250   Pave      IR1         Lvl    AllPub
## 4         70       RL    9550   Pave      IR1         Lvl    AllPub
## 5         60       RL   14260   Pave      IR1         Lvl    AllPub
## 6         50       RL   14115   Pave      IR1         Lvl    AllPub
##   LotConfig LandSlope Neighborhood Condition1 Condition2 BldgType
## 1    Inside       Gtl      CollgCr       Norm       Norm     1Fam
## 2       FR2       Gtl      Veenker      Feedr       Norm     1Fam
## 3    Inside       Gtl      CollgCr       Norm       Norm     1Fam
## 4    Corner       Gtl      Crawfor       Norm       Norm     1Fam
## 5       FR2       Gtl      NoRidge       Norm       Norm     1Fam
## 6    Inside       Gtl      Mitchel       Norm       Norm     1Fam
##   HouseStyle OverallQual OverallCond YearBuilt YearRemodAdd RoofStyle
```

```
## 1     2Story           7           5      2003         2003     Gable
## 2     1Story           6           8      1976         1976     Gable
## 3     2Story           7           5      2001         2002     Gable
## 4     2Story           7           5      1915         1970     Gable
## 5     2Story           8           5      2000         2000     Gable
## 6     1.5Fin           5           5      1993         1995     Gable
##   RoofMatl Exterior1st Exterior2nd ExterQual ExterCond Foundation
## 1  CompShg     VinylSd     VinylSd        Gd        TA      PConc
## 2  CompShg     MetalSd     MetalSd        TA        TA     CBlock
## 3  CompShg     VinylSd     VinylSd        Gd        TA      PConc
## 4  CompShg     Wd Sdng     Wd Shng        TA        TA     BrkTil
## 5  CompShg     VinylSd     VinylSd        Gd        TA      PConc
## 6  CompShg     VinylSd     VinylSd        TA        TA       Wood
##   BsmtFinSF1 BsmtFinSF2 BsmtUnfSF TotalBsmtSF Heating HeatingQC CentralAir
## 1        706          0       150         856    GasA        Ex          Y
## 2        978          0       284        1262    GasA        Ex          Y
## 3        486          0       434         920    GasA        Ex          Y
## 4        216          0       540         756    GasA        Gd          Y
## 5        655          0       490        1145    GasA        Ex          Y
## 6        732          0        64         796    GasA        Ex          Y
##   Electrical X1stFlrSF X2ndFlrSF LowQualFinSF GrLivArea BsmtFullBath
## 1      SBrkr       856       854            0      1710            1
## 2      SBrkr      1262         0            0      1262            0
## 3      SBrkr       920       866            0      1786            1
## 4      SBrkr       961       756            0      1717            1
## 5      SBrkr      1145      1053            0      2198            1
## 6      SBrkr       796       566            0      1362            1
##   BsmtHalfBath FullBath HalfBath BedroomAbvGr KitchenAbvGr KitchenQual
## 1            0        2        1            3            1          Gd
## 2            1        2        0            3            1          TA
## 3            0        2        1            3            1          Gd
## 4            0        1        0            3            1          Gd
## 5            0        2        1            4            1          Gd
## 6            0        1        1            1            1          TA
##   TotRmsAbvGrd Functional Fireplaces GarageCars GarageArea PavedDrive
## 1            8        Typ          0          2        548          Y
## 2            6        Typ          1          2        460          Y
## 3            6        Typ          1          2        608          Y
## 4            7        Typ          1          3        642          Y
## 5            9        Typ          1          3        836          Y
## 6            5        Typ          0          2        480          Y
##   WoodDeckSF OpenPorchSF EnclosedPorch X3SsnPorch ScreenPorch PoolArea
## 1          0          61             0          0           0        0
## 2        298           0             0          0           0        0
## 3          0          42             0          0           0        0
## 4          0          35           272          0           0        0
## 5        192          84             0          0           0        0
## 6         40          30             0        320           0        0
##   MiscVal MoSold YrSold SaleType SaleCondition SalePrice
## 1       0      2   2008       WD        Normal    208500
```

```
## 2       0      5   2007       WD         Normal    181500
## 3       0      9   2008       WD         Normal    223500
## 4       0      2   2006       WD        Abnorml    140000
## 5       0     12   2008       WD         Normal    250000
## 6     700     10   2009       WD         Normal    143000
```

```
#Missing data
sum(is.na(training)/(nrow(training)*nrow(training)))# printing percentage of
missing data
```

```
## [1] 4.691312e-07
```

```
unique(nrow(training)) # printing all the unique values
```

```
## [1] 1460
```

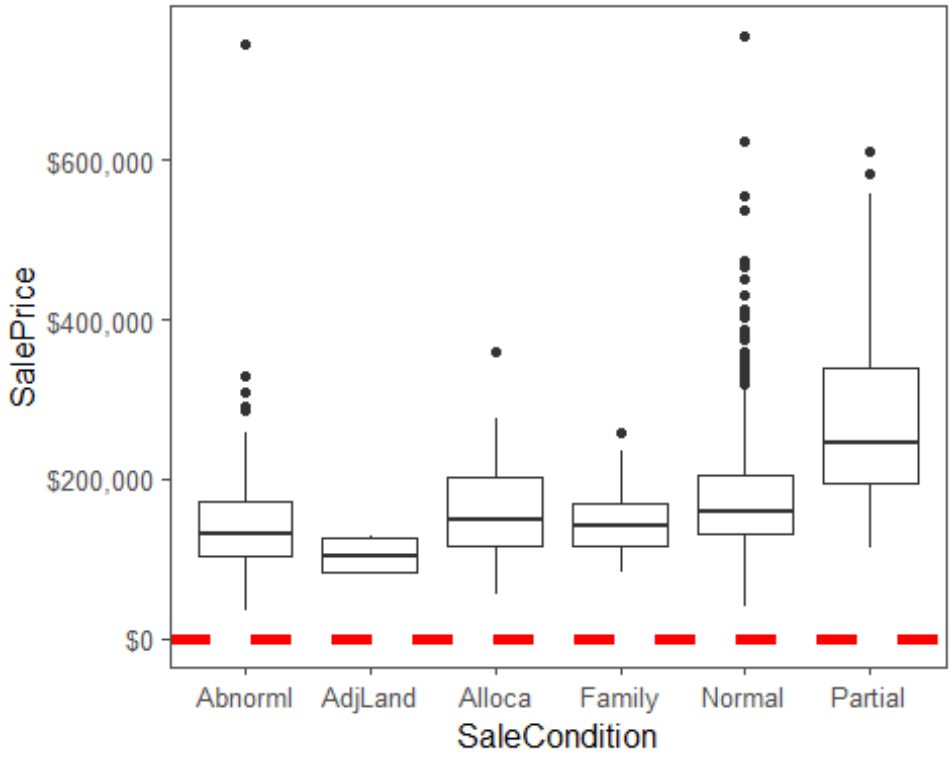
```
colSums(sapply(training,is.na))# prinitng number of missing values in each
column
```

```
##    MSSubClass      MSZoning       LotArea        Street      LotShape
##             0             0             0             0             0
##   LandContour     Utilities     LotConfig     LandSlope  Neighborhood
##             0             0             0             0             0
##    Condition1    Condition2      BldgType    HouseStyle   OverallQual
##             0             0             0             0             0
##   OverallCond     YearBuilt  YearRemodAdd     RoofStyle      RoofMatl
##             0             0             0             0             0
##   Exterior1st   Exterior2nd     ExterQual     ExterCond    Foundation
##             0             0             0             0             0
##    BsmtFinSF1    BsmtFinSF2     BsmtUnfSF   TotalBsmtSF       Heating
##             0             0             0             0             0
##     HeatingQC    CentralAir    Electrical     X1stFlrSF     X2ndFlrSF
##             0             0             1             0             0
##  LowQualFinSF     GrLivArea  BsmtFullBath  BsmtHalfBath      FullBath
##             0             0             0             0             0
##      HalfBath  BedroomAbvGr  KitchenAbvGr   KitchenQual  TotRmsAbvGrd
##             0             0             0             0             0
##    Functional    Fireplaces    GarageCars    GarageArea    PavedDrive
##             0             0             0             0             0
##    WoodDeckSF   OpenPorchSF EnclosedPorch    X3SsnPorch   ScreenPorch
##             0             0             0             0             0
##      PoolArea       MiscVal        MoSold        YrSold      SaleType
##             0             0             0             0             0
## SaleCondition     SalePrice
##             0             0
```

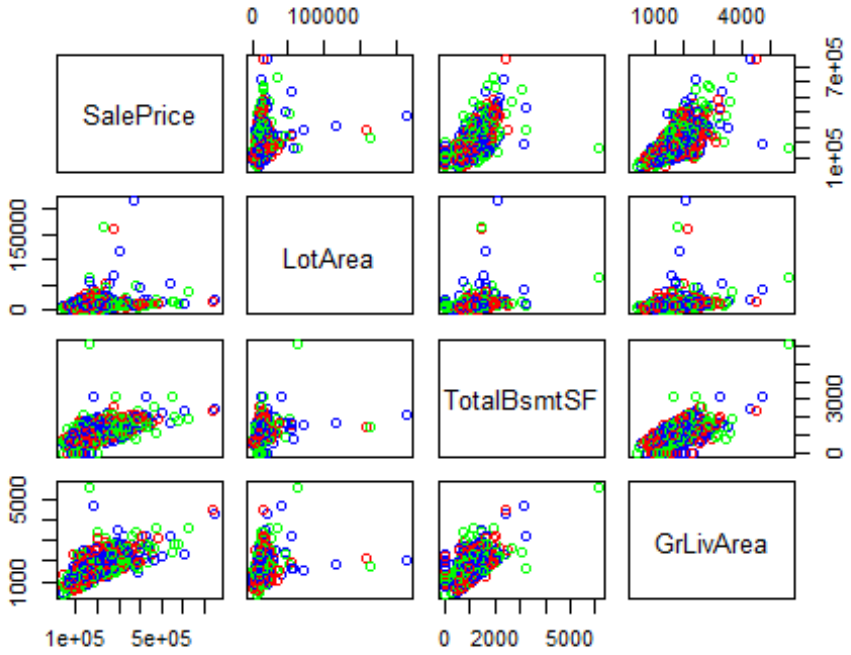
```
attach(training)
catdf<-training[,catvar]
numdf<-training[,numvar]
```

VISUALIZING THE DATA

```
ggplot(training, aes(x = SaleCondition, y = SalePrice)) +geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```




```
pairs(~SalePrice+LotArea+TotalBsmtSF+GrLivArea,
data=training,col=c('red','blue','green'))
```




```
as.factor(training$SalePrice)
```

```
##    [1] 208500 181500 223500 140000 250000 143000 307000 200000 129900
##   [10] 118000 129500 345000 144000 279500 157000 132000 149000 90000
##   [19] 159000 139000 325300 139400 230000 129900 154000 256300 134800
##   [28] 306000 207500 68500  40000  149350 179900 165500 277500 309000
##   [37] 145000 153000 109000 82000  160000 170000 144000 130250 141000
##   [46] 319900 239686 249700 113000 127000 177000 114500 110000 385000
##   [55] 130000 180500 172500 196500 438780 124900 158000 101000 202500
##   [64] 140000 219500 317000 180000 226000 80000  225000 244000 129500
##   [73] 185000 144900 107400 91000  135750 127000 136500 110000 193500
##   [82] 153500 245000 126500 168500 260000 174000 164500 85000  123600
##   [91] 109900 98600  163500 133900 204750 185000 214000 94750  83000
##  [100] 128950 205000 178000 118964 198900 169500 250000 100000 115000
##  [109] 115000 190000 136900 180000 383970 217000 259500 176000 139000
##  [118] 155000 320000 163990 180000 100000 136000 153900 181000 84500
##  [127] 128000 87000  155000 150000 226000 244000 150750 220000 180000
##  [136] 174000 143000 171000 230000 231500 115000 260000 166000 204000
##  [145] 125000 130000 105000 222500 141000 115000 122000 372402 190000
##  [154] 235000 125000 79000  109500 269500 254900 320000 162500 412500
##  [163] 220000 103200 152000 127500 190000 325624 183500 228000 128500
##  [172] 215000 239000 163000 184000 243000 211000 172500 501837 100000
##  [181] 177000 200100 120000 200000 127000 475000 173000 135000 153337
##  [190] 286000 315000 184000 192000 130000 127000 148500 311872 235000
##  [199] 104000 274900 140000 171500 112000 149000 110000 180500 143900
##  [208] 141000 277000 145000 98000  186000 252678 156000 161750 134450
##  [217] 210000 107000 311500 167240 204900 200000 179900 97000  386250
```

```
##  [226] 112000 290000 106000 125000 192500 148000 403000 94500  128200
##  [235] 216500 89500  185500 194500 318000 113000 262500 110500 79000
##  [244] 120000 205000 241500 137000 140000 180000 277000 76500  235000
##  [253] 173000 158000 145000 230000 207500 220000 231500 97000  176000
##  [262] 276000 151000 130000 73000  175500 185000 179500 120500 148000
##  [271] 266000 241500 290000 139000 124500 205000 201000 141000 415298
##  [280] 192000 228500 185000 207500 244600 179200 164700 159000 88000
##  [289] 122000 153575 233230 135900 131000 235000 167000 142500 152000
##  [298] 239000 175000 158500 157000 267000 205000 149900 295000 305900
##  [307] 225000 89500  82500  360000 165600 132000 119900 375000 178000
##  [316] 188500 260000 270000 260000 187500 342643 354000 301000 126175
##  [325] 242000 87000  324000 145250 214500 78000  119000 139000 284000
##  [334] 207000 192000 228950 377426 214000 202500 155000 202900 82000
##  [343] 87500  266000 85000  140200 151500 157500 154000 437154 318061
##  [352] 190000 95000  105900 140000 177500 173000 134000 130000 280000
##  [361] 156000 145000 198500 118000 190000 147000 159000 165000 132000
##  [370] 162000 172400 134432 125000 123000 219500 61000  148000 340000
##  [379] 394432 179000 127000 187750 213500 76000  240000 192000 81000
##  [388] 125000 191000 426000 119000 215000 106500 100000 109000 129000
##  [397] 123000 169500 67000  241000 245500 164990 108000 258000 168000
##  [406] 150000 115000 177000 280000 339750 60000  145000 222000 115000
##  [415] 228000 181134 149500 239000 126000 142000 206300 215000 113000
##  [424] 315000 139000 135000 275000 109008 195400 175000 85400  79900
##  [433] 122500 181000 81000  212000 116000 119000 90350  110000 555000
##  [442] 118000 162900 172500 210000 127500 190000 199900 119500 120000
##  [451] 110000 280000 204000 210000 188000 175500 98000  256000 161000
##  [460] 110000 263435 155000 62383  188700 124000 178740 167000 146500
##  [469] 250000 187000 212000 190000 148000 440000 251000 132500 208900
##  [478] 380000 297000 89471  326000 374000 155000 164000 132500 147000
##  [487] 156000 175000 160000 86000  115000 133000 172785 155000 91300
##  [496] 34900  430000 184000 130000 120000 113000 226700 140000 289000
##  [505] 147000 124500 215000 208300 161000 124500 164900 202665 129900
##  [514] 134000 96500  402861 158000 265000 211000 234000 106250 150000
##  [523] 159000 184750 315750 176000 132000 446261 86000  200624 175000
##  [532] 128000 107500 39300  178000 107500 188000 111250 158000 272000
##  [541] 315000 248000 213250 133000 179665 229000 210000 129500 125000
##  [550] 263000 140000 112500 255500 108000 284000 113000 141000 108000
##  [559] 175000 234000 121500 170000 108000 185000 268000 128000 325000
##  [568] 214000 316600 135960 142600 120000 224500 170000 139000 118500
##  [577] 145000 164500 146000 131500 181900 253293 118500 325000 133000
##  [586] 369900 130000 137000 143000 79500  185900 451950 138000 140000
##  [595] 110000 319000 114504 194201 217500 151000 275000 141000 220000
##  [604] 151000 221000 205000 152000 225000 359100 118500 313000 148000
##  [613] 261500 147000 75500  137500 183200 105500 314813 305000 67000
##  [622] 240000 135000 168500 165150 160000 139900 153000 135000 168500
##  [631] 124000 209500 82500  139400 144000 200000 60000  93000  85000
##  [640] 264561 274000 226000 345000 152000 370878 143250 98300  155000
##  [649] 155000 84500  205950 108000 191000 135000 350000 88000  145500
##  [658] 149000 97500  167000 197900 402000 110000 137500 423000 230500
##  [667] 129000 193500 168000 137500 173500 103600 165000 257500 140000
```

```
##  [676] 148500 87000  109500 372500 128500 143000 159434 173000 285000
##  [685] 221000 207500 227875 148800 392000 194700 141000 755000 335000
##  [694] 108480 141500 176000 89000  123500 138500 196000 312500 140000
##  [703] 361919 140000 213000 55000  302000 254000 179540 109900 52000
##  [712] 102776 189000 129000 130500 165000 159500 157000 341000 128500
##  [721] 275000 143000 124500 135000 320000 120500 222000 194500 110000
##  [730] 103000 236500 187500 222500 131400 108000 163000 93500  239900
##  [739] 179000 190000 132000 142000 179000 175000 180000 299800 236000
##  [748] 265979 260400 98000  96500  162000 217000 275500 156000 172500
##  [757] 212000 158900 179400 290000 127500 100000 215200 337000 270000
##  [766] 264132 196500 160000 216837 538000 134900 102000 107000 114500
##  [775] 395000 162000 221500 142500 144000 135000 176000 175900 187100
##  [784] 165500 128000 161500 139000 233000 107900 187500 160200 146800
##  [793] 269790 225000 194500 171000 143500 110000 485000 175000 200000
##  [802] 109900 189000 582933 118000 227680 135500 223500 159950 106000
##  [811] 181000 144500 55993  157900 116000 224900 137000 271000 155000
##  [820] 224000 183000 93000  225000 139500 232600 385000 109500 189000
##  [829] 185000 147400 166000 151000 237000 167000 139950 128000 153500
##  [838] 100000 144000 130500 140000 157500 174900 141000 153900 171000
##  [847] 213000 133500 240000 187000 131500 215000 164000 158000 170000
##  [856] 127000 147000 174000 152000 250000 189950 131500 152000 132500
##  [865] 250580 148500 248900 129000 169000 236000 109500 200500 116000
##  [874] 133000 66500  303477 132250 350000 148000 136500 157000 187500
##  [883] 178000 118500 100000 328900 145000 135500 268000 149500 122900
##  [892] 172500 154500 165000 118858 140000 106500 142953 611657 135000
##  [901] 110000 153000 180000 240000 125500 128000 255000 250000 131000
##  [910] 174000 154300 143500 88000  145000 173733 75000  35311  135000
##  [919] 238000 176500 201000 145900 169990 193000 207500 175000 285000
##  [928] 176000 236500 222000 201000 117500 320000 190000 242000 79900
##  [937] 184900 253000 239799 244400 150900 214000 150000 143000 137500
##  [946] 124900 143000 270000 192500 197500 129000 119900 133900 172000
##  [955] 127500 145000 124000 132000 185000 155000 116500 272000 155000
##  [964] 239000 214900 178900 160000 135000 37900  140000 135000 173000
##  [973] 99500  182000 167500 165000 85500  199900 110000 139000 178400
##  [982] 336000 159895 255900 126000 125000 117000 395192 195000 197000
##  [991] 348000 168000 187000 173900 337500 121600 136500 185000 91000
## [1000] 206000 82000  86000  232000 136905 181000 149900 163500 88000
## [1009] 240000 102000 135000 100000 165000 85000  119200 227000 203000
## [1018] 187500 160000 213490 176000 194000 87000  191000 287000 112500
## [1027] 167500 293077 105000 118000 160000 197000 310000 230000 119750
## [1036] 84000  315500 287000 97000  80000  155000 173000 196000 262280
## [1045] 278000 139600 556581 145000 115000 84900  176485 200141 165000
## [1054] 144500 255000 180000 185850 248000 335000 220000 213500 81000
## [1063] 90000  110500 154000 328000 178000 167900 151400 135000 135000
## [1072] 154000 91500  159500 194000 219500 170000 138800 155900 126000
## [1081] 145000 133000 192000 160000 187500 147000 83500  252000 137500
## [1090] 197000 92900  160000 136500 146000 129000 176432 127000 170000
## [1099] 128000 157000 60000  119500 135000 159500 106000 325000 179900
## [1108] 274725 181000 280000 188000 205000 129900 134500 117000 318000
## [1117] 184100 130000 140000 133700 118400 212900 112000 118000 163900
```

```
## [1126] 115000 174000 259000 215000 140000 135000 93500  117500 239500
## [1135] 169000 102000 119000 94000  196000 144000 139000 197500 424870
## [1144] 80000  80000  149000 180000 174500 116900 143000 124000 149900
## [1153] 230000 120500 201800 218000 179900 230000 235128 185000 146000
## [1162] 224000 129000 108959 194000 233170 245350 173000 235000 625000
## [1171] 171000 163000 171900 200500 239000 285000 119500 115000 154900
## [1180] 93000  250000 392500 745000 120000 186700 104900 95000  262000
## [1189] 195000 189000 168000 174000 125000 165000 158000 176000 219210
## [1198] 144000 178000 148000 116050 197900 117000 213000 153500 271900
## [1207] 107000 200000 140000 290000 189000 164000 113000 145000 134500
## [1216] 125000 112000 229456 80500  91500  115000 134000 143000 137900
## [1225] 184000 145000 214000 147000 367294 127000 190000 132500 101800
## [1234] 142000 130000 138887 175500 195000 142500 265900 224900 248328
## [1243] 170000 465000 230000 178000 186500 169900 129500 119000 244000
## [1252] 171750 130000 294000 165400 127500 301500 99900  190000 151000
## [1261] 181000 128900 161500 180500 181000 183900 122000 378500 381000
## [1270] 144000 260000 185750 137000 177000 139000 137000 162000 197900
## [1279] 237000 68400  227000 180000 150500 139000 169000 132500 143000
## [1288] 190000 278000 281000 180500 119500 107500 162900 115000 138500
## [1297] 155000 140000 160000 154000 225000 177500 290000 232000 130000
## [1306] 325000 202500 138000 147000 179200 335000 203000 302000 333168
## [1315] 119000 206900 295493 208900 275000 111000 156500 72500  190000
## [1324] 82500  147000 55000  79000  130500 256000 176500 227000 132500
## [1333] 100000 125500 125000 167900 135000 52500  200000 128500 123000
## [1342] 155000 228500 177000 155835 108500 262500 283463 215000 122000
## [1351] 200000 171000 134900 410000 235000 170000 110000 149900 177500
## [1360] 315000 189000 260000 104900 156932 144152 216000 193000 127000
## [1369] 144000 232000 105000 165500 274300 466500 250000 239000 91000
## [1378] 117000 83000  167500 58500  237500 157000 112000 105000 125500
## [1387] 250000 136000 377500 131000 235000 124000 123000 163000 246578
## [1396] 281213 160000 137500 138000 137450 120000 193000 193879 282922
## [1405] 105000 275000 133000 112000 125500 215000 230000 140000 90000
## [1414] 257000 207000 175900 122500 340000 124000 223000 179900 127500
## [1423] 136500 274970 144000 142000 271000 140000 119000 182900 192140
## [1432] 143750 64500  186500 160000 174000 120500 394617 149700 197000
## [1441] 191000 149300 310000 121000 179600 129000 157900 240000 112000
## [1450] 92000  136000 287090 145000 84500  185000 175000 210000 266500
## [1459] 142125 147500
## 663 Levels: 34900 35311 37900 39300 40000 52000 52500 55000 55993 ...
755000

hist(training$SalePrice / 1000, xlab = "Saleprice in thousands")
```

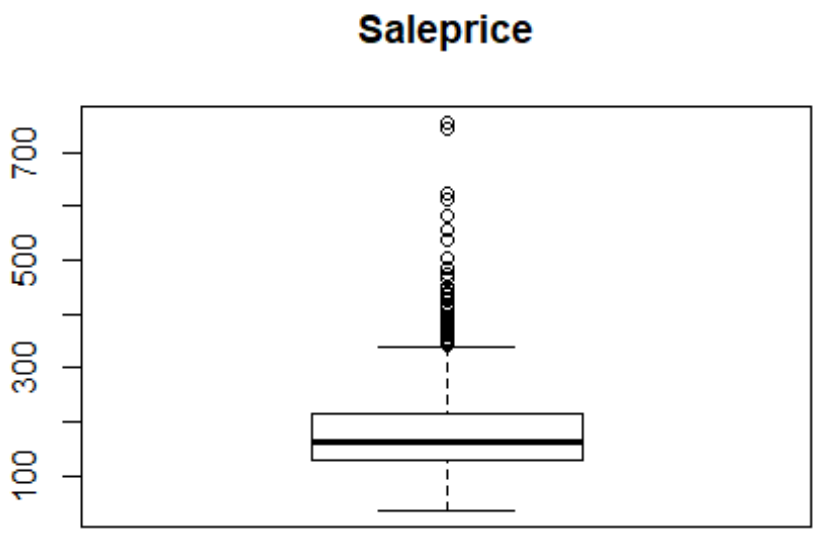

```
library(moments)
```

```
## Warning: package 'moments' was built under R version 3.5.2
```

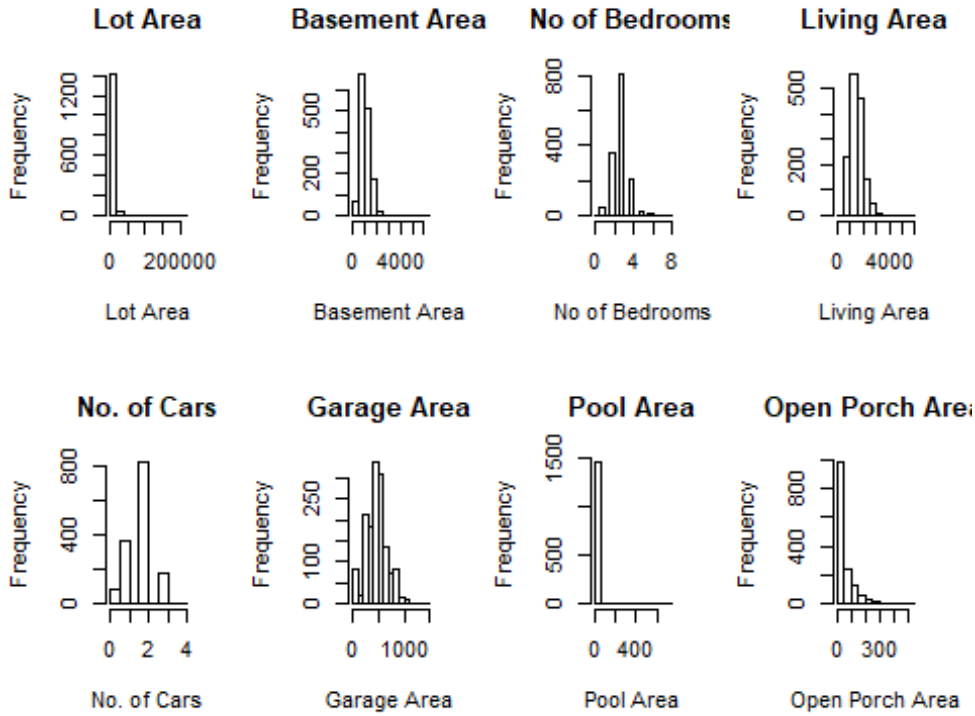
```
skewness(SalePrice)
```

```
## [1] 1.880941
```

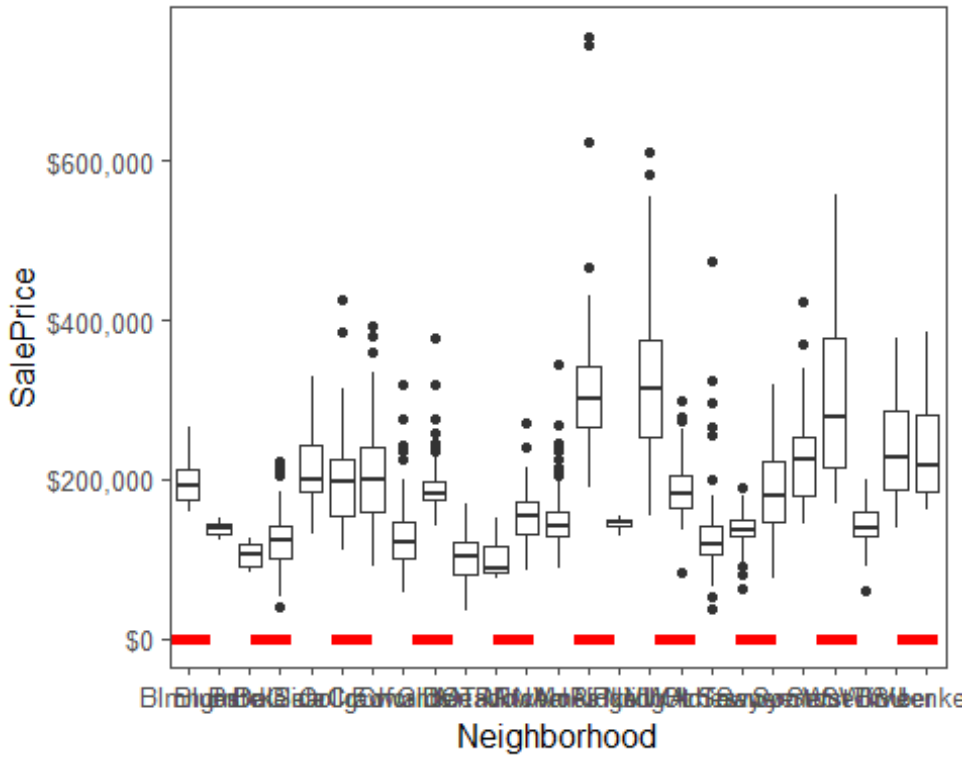
```
boxplot(training$SalePrice/ 1000, main = "Saleprice")
```



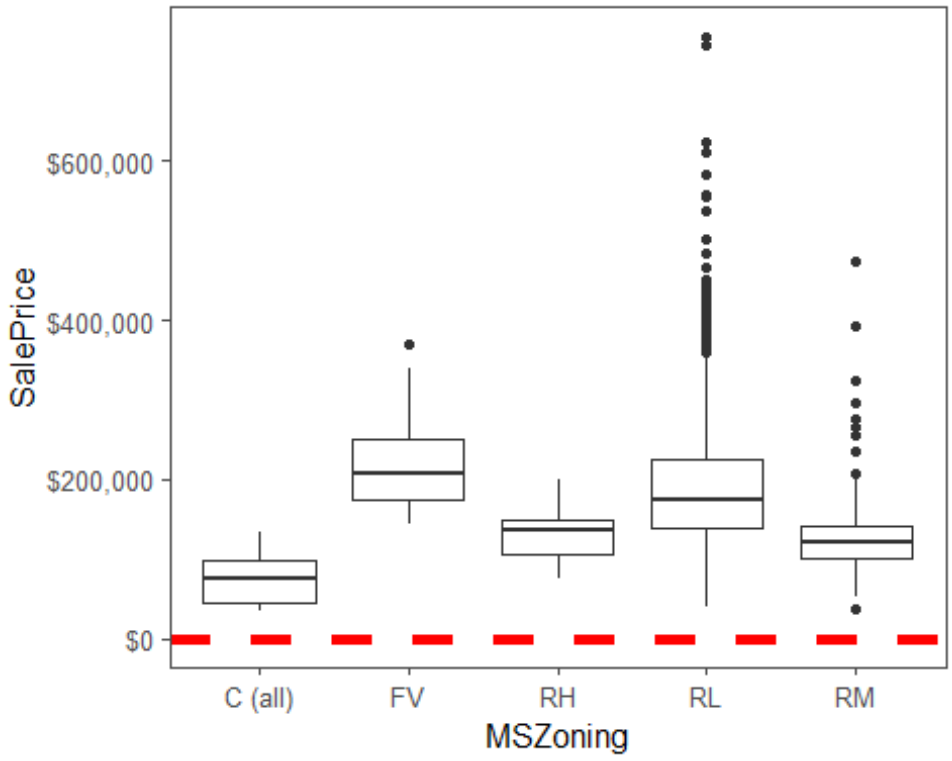

```
par(mfrow=c(2,4))
hist(training$LotArea,xlab="Lot Area", main="Lot Area")
hist(training$TotalBsmtSF, xlab="Basement Area", main="Basement Area")
hist(training$BedroomAbvGr, xlab="No of Bedrooms", main="No of Bedrooms")
hist(training$GrLivArea, xlab="Living Area",main="Living Area")
hist(training$GarageCars, xlab="No. of Cars",main="No. of Cars")
hist(training$GarageArea, xlab="Garage Area",main="Garage Area")
hist(training$PoolArea, xlab="Pool Area",main="Pool Area")
hist(training$OpenPorchSF, xlab="Open Porch Area",main="Open Porch Area")
```



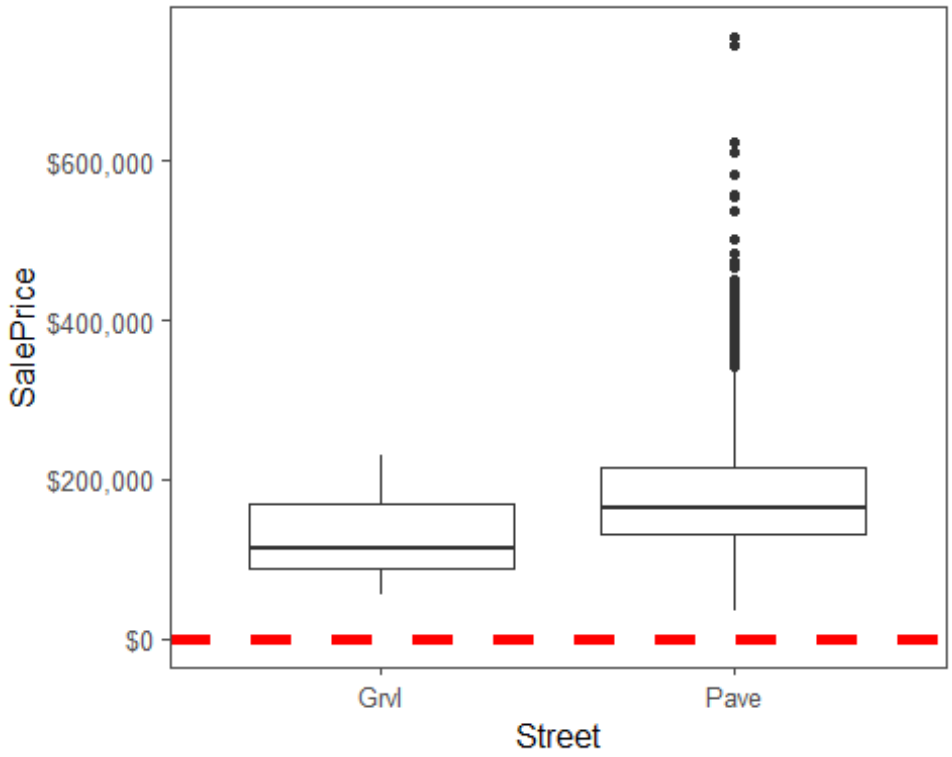

```
ggplot(training, aes(x = Neighborhood, y = SalePrice)) +
  geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```



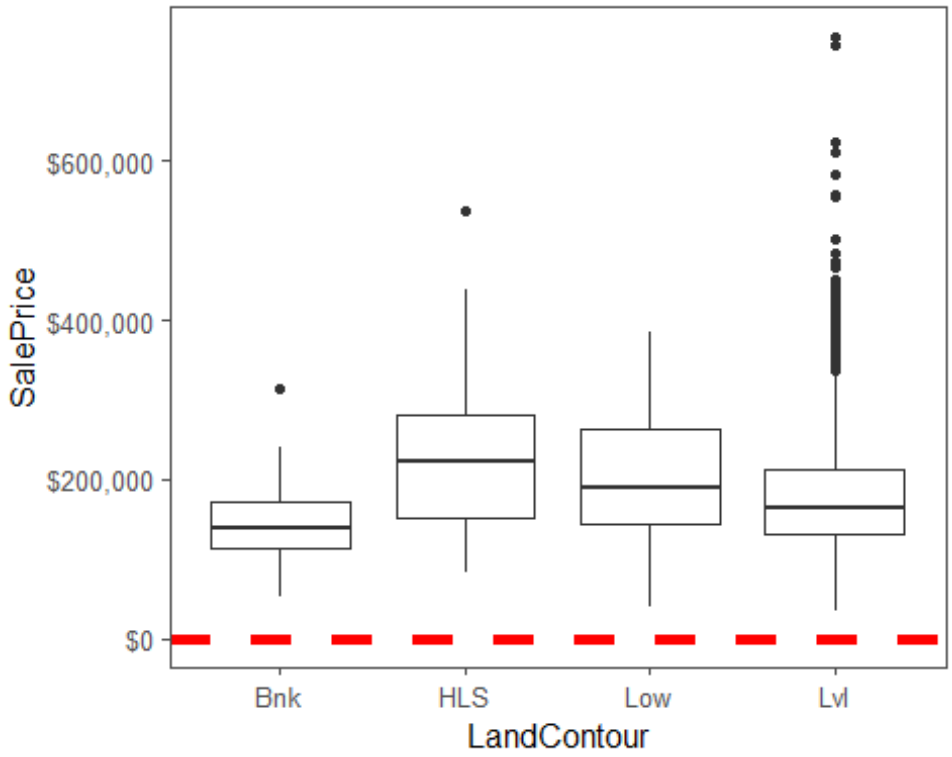

```
ggplot(training, aes(x = MSZoning, y = SalePrice)) +geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```



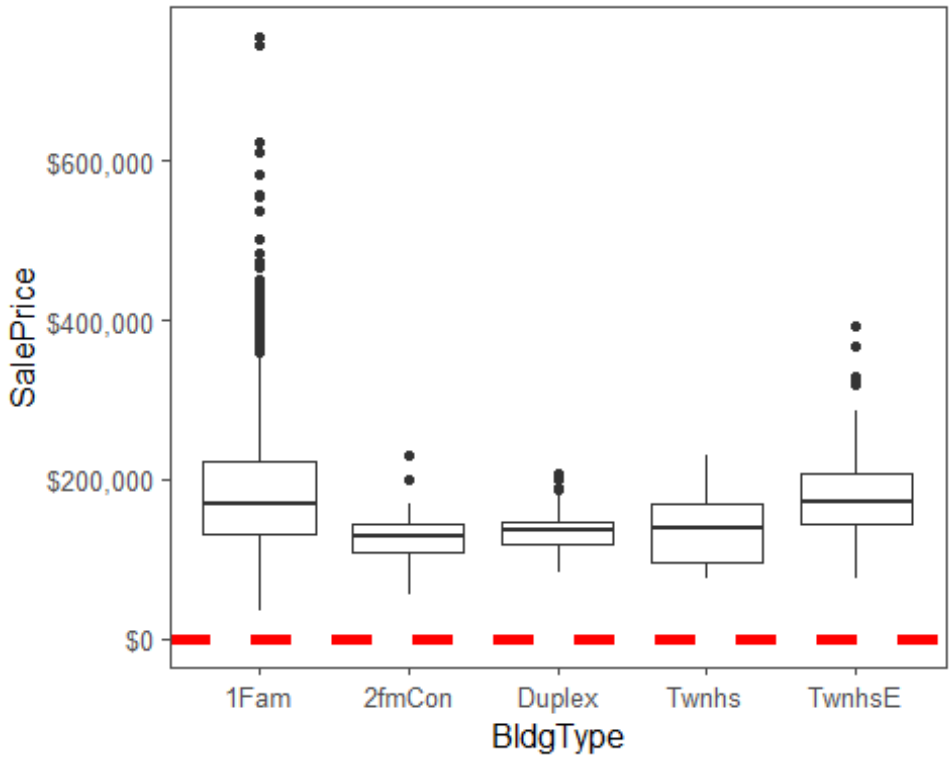

```
ggplot(training, aes(x = Street, y = SalePrice)) +geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```



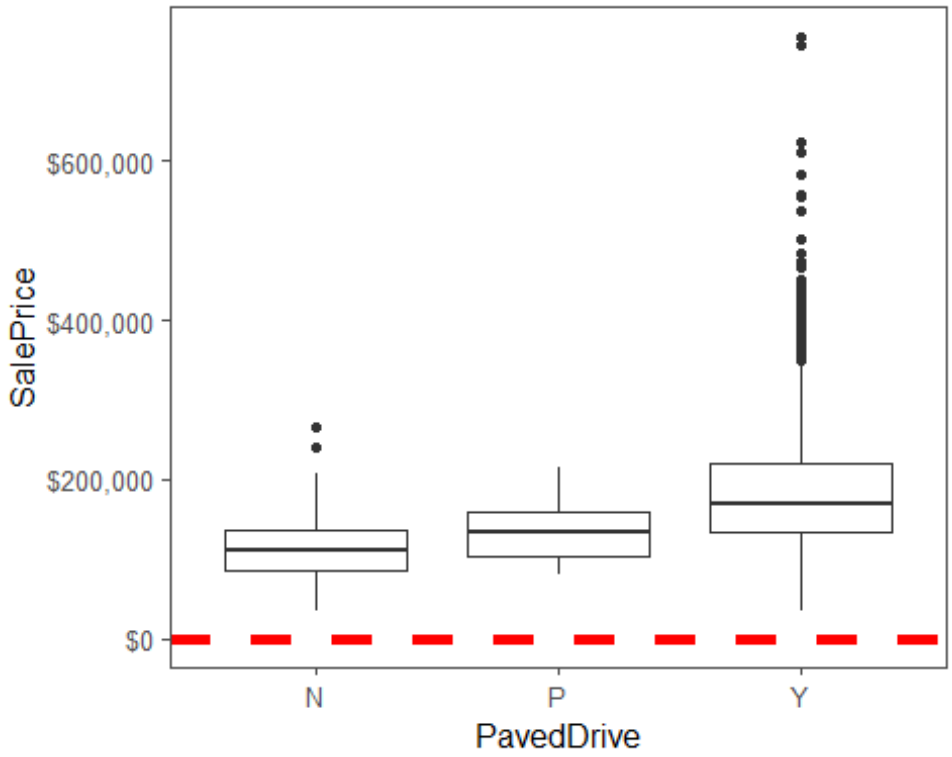

```
ggplot(training, aes(x = LandContour, y = SalePrice)) +geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```



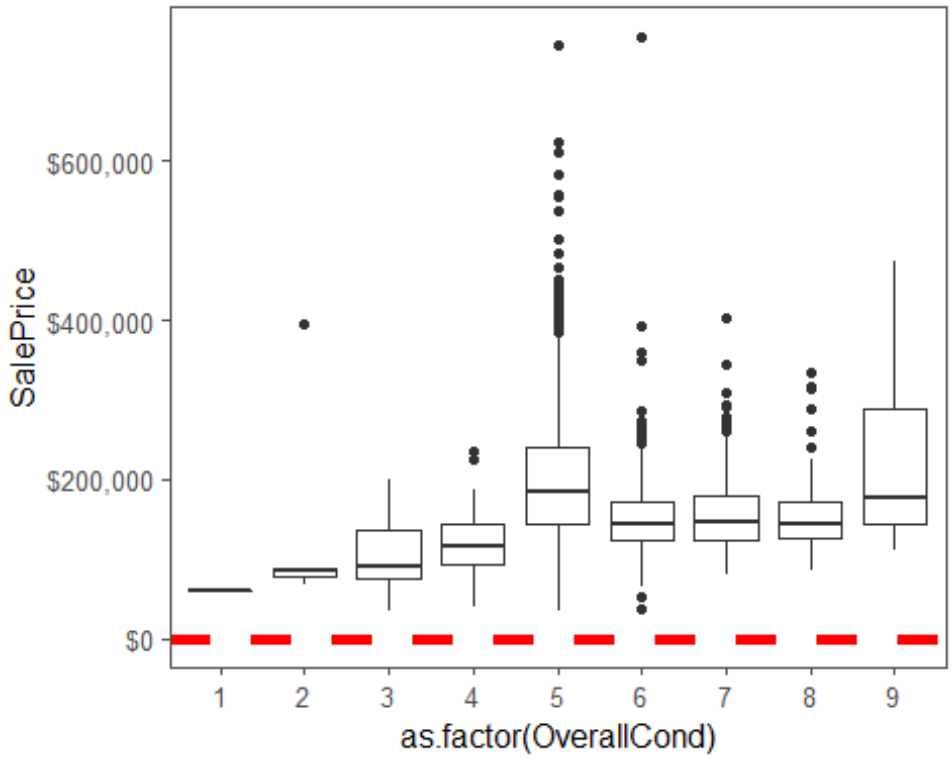

```
ggplot(training, aes(x = BldgType, y = SalePrice)) +geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```



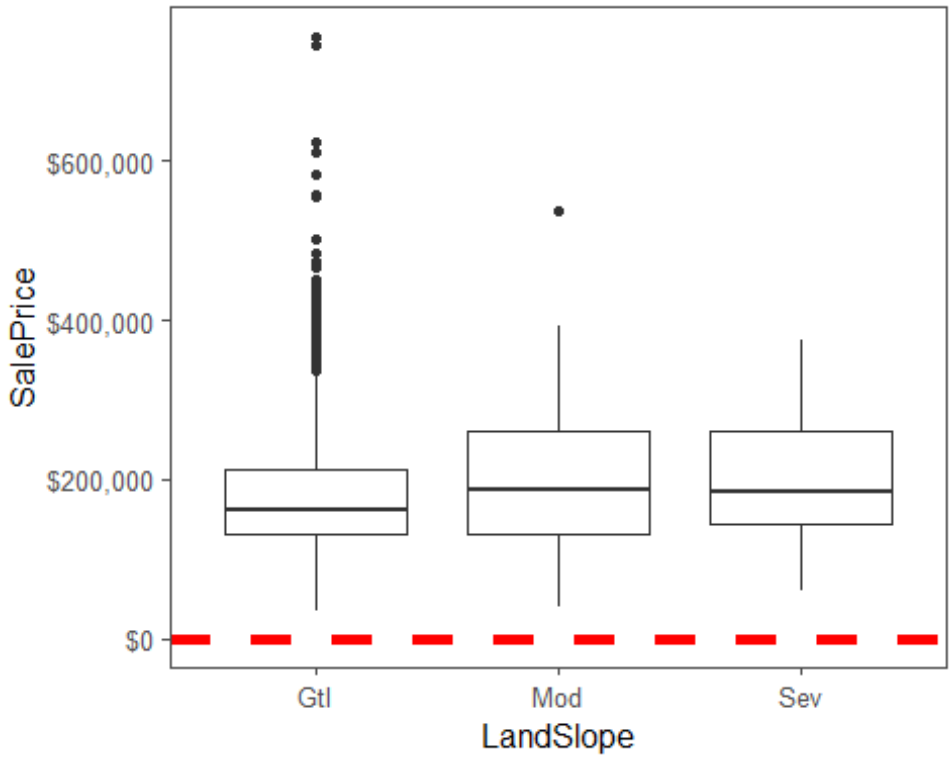

```
ggplot(training, aes(x = PavedDrive, y = SalePrice)) +geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```



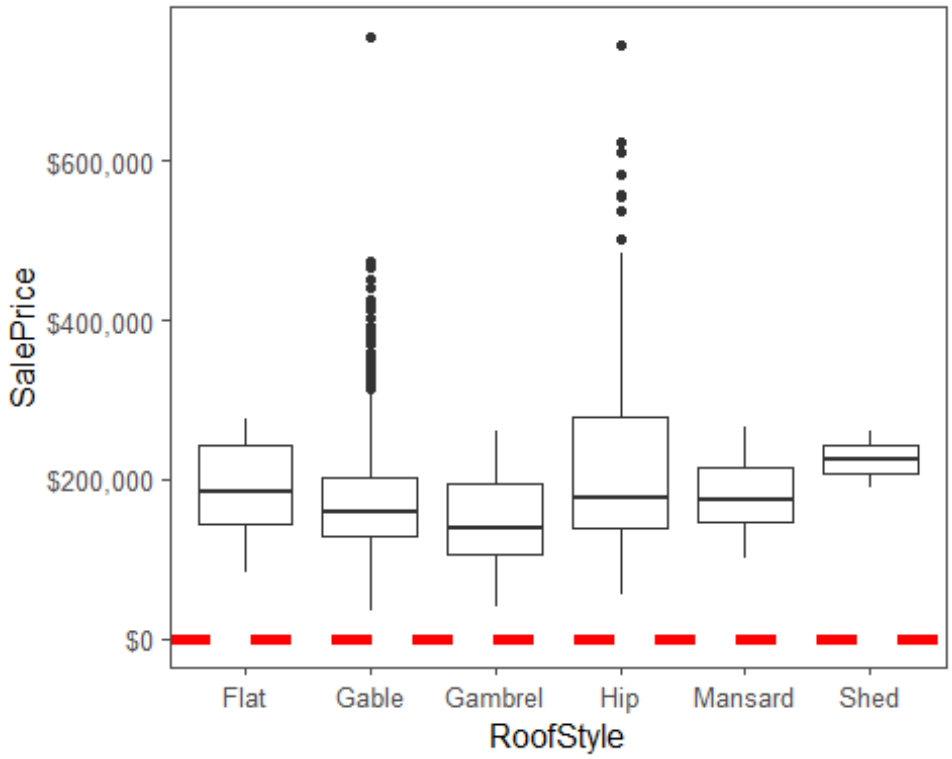

```
ggplot(training, aes(x = as.factor(OverallCond), y = SalePrice))
+geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```



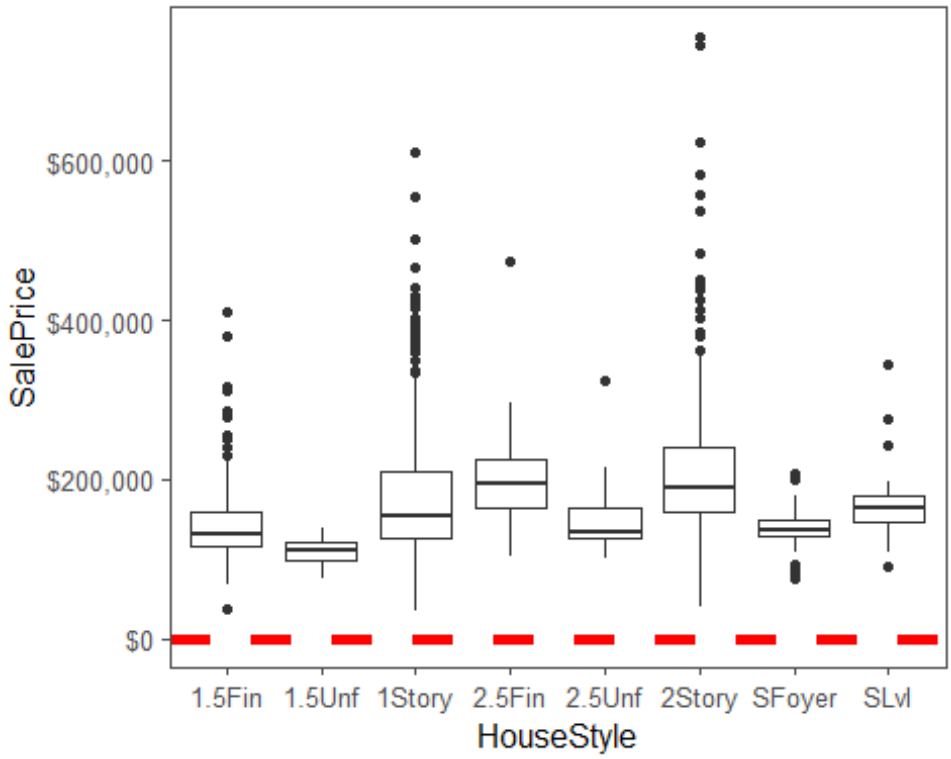

```
ggplot(training, aes(x = LandSlope, y = SalePrice)) +geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```



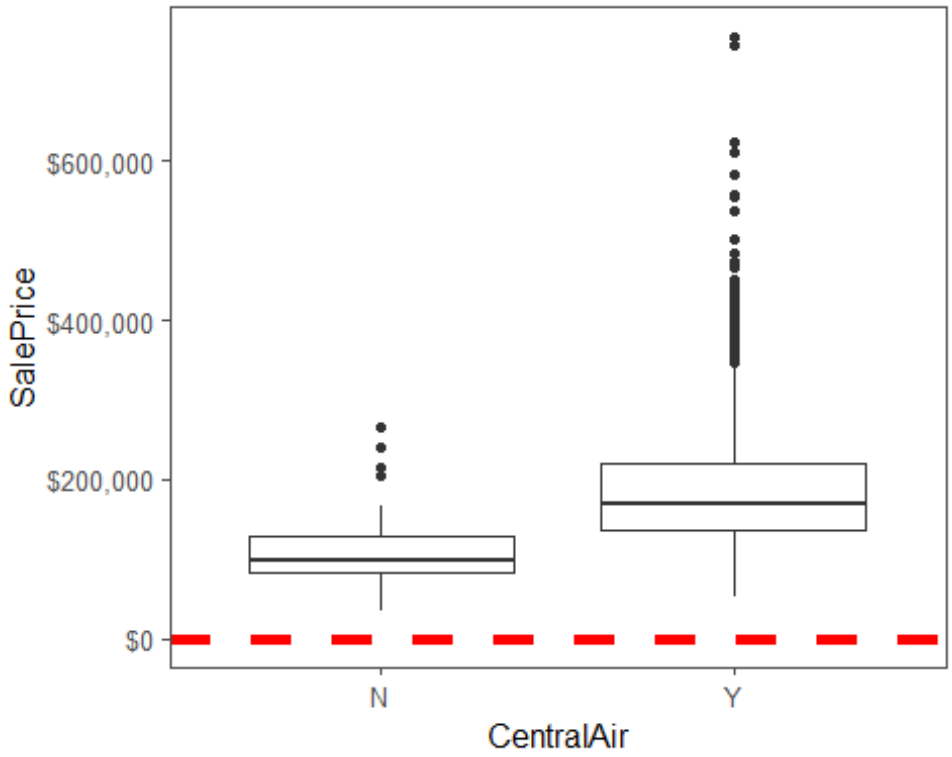

```
ggplot(training, aes(x = RoofStyle, y = SalePrice)) +geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```




```
ggplot(training, aes(x = HouseStyle, y = SalePrice)) +geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```




```
ggplot(training, aes(x = CentralAir, y = SalePrice)) +geom_boxplot() +
  geom_hline(aes(yintercept=80),
             colour='red', linetype='dashed', lwd=2) +
  scale_y_continuous(labels=dollar_format()) +
  theme_few()
```




```
library(PerformanceAnalytics)
```

```
## Warning: package 'PerformanceAnalytics' was built under R version 3.5.2
```

```
## Loading required package: xts
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
##
## Attaching package: 'xts'
```

```
## The following objects are masked from 'package:data.table':
##
##     first, last
```

```
## The following objects are masked from 'package:dplyr':
##
##     first, last
```

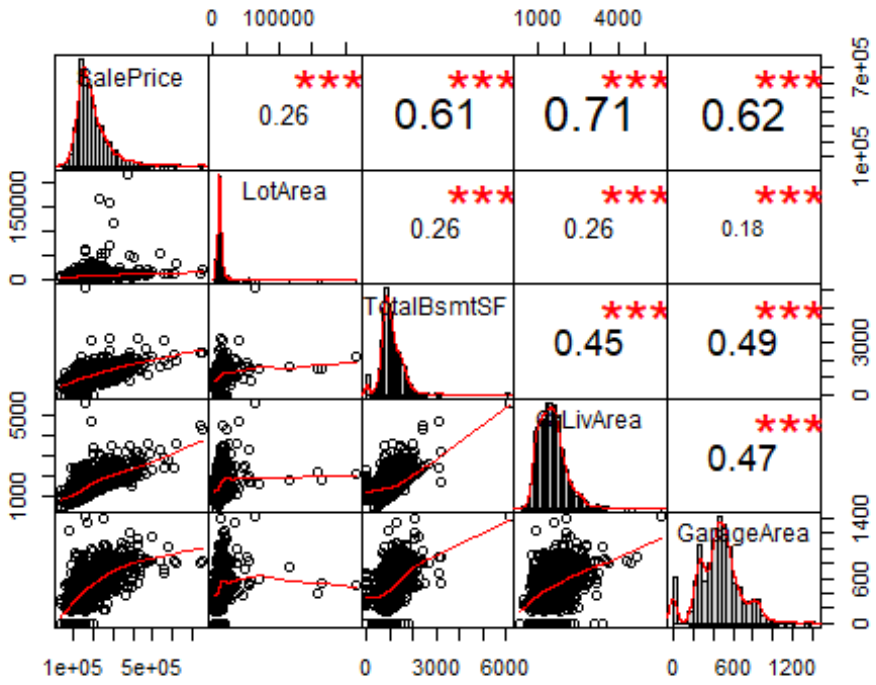
```
##
## Attaching package: 'PerformanceAnalytics'
```

```
## The following objects are masked from 'package:moments':
##
##     kurtosis, skewness

## The following object is masked from 'package:graphics':
##
##     legend

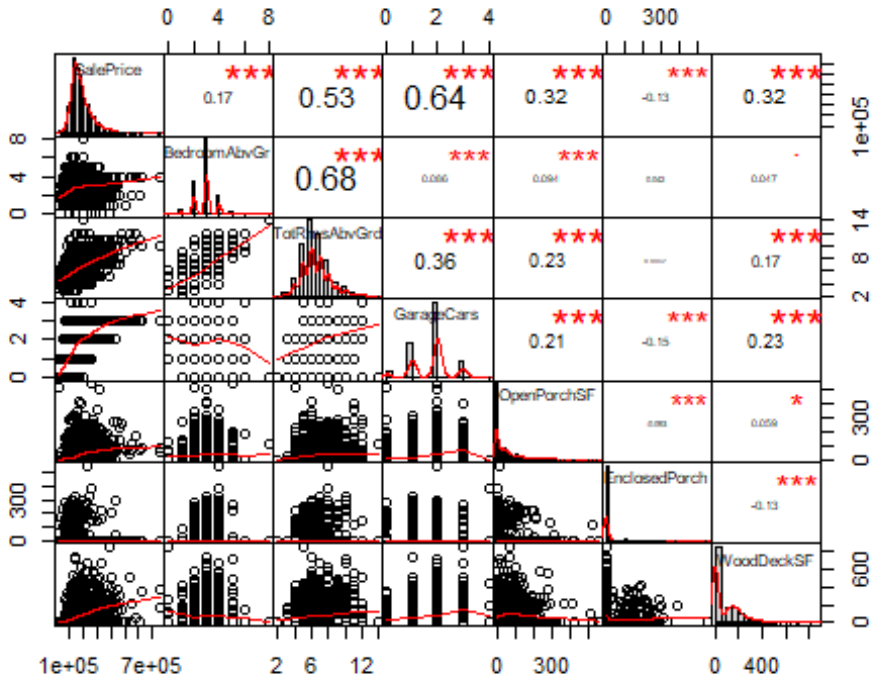
my_data <- training[,
c('SalePrice','LotArea','TotalBsmtSF','GrLivArea','GarageArea')]

chart.Correlation(my_data, histogram=TRUE, pch=19)
```




```
my_data <- training[,
c('SalePrice','BedroomAbvGr','TotRmsAbvGrd','GarageCars','OpenPorchSF','Enclo
sedPorch','WoodDeckSF')]

chart.Correlation(my_data, histogram=TRUE, pch=19)
```




```
library(forecast)
linear <- lm(SalePrice~., data=training, metric="RMSE", maximize=FALSE)

## Warning: In lm.fit(x, y, offset = offset, singular.ok = singular.ok, ...)
:
##  extra arguments 'metric', 'maximize' will be disregarded

summary(linear)

##
## Call:
## lm(formula = SalePrice ~ ., data = training, metric = "RMSE",
##     maximize = FALSE)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -174391  -10619      56    9756  174391
##
## Coefficients: (3 not defined because of singularities)
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)          -1.193e+06  1.065e+06  -1.120 0.262752
## MSSubClass           -8.938e+00  8.546e+01  -0.105 0.916718
## MSZoningFV            3.093e+04  1.224e+04   2.526 0.011645 *
## MSZoningRH            2.384e+04  1.231e+04   1.937 0.053021 .
## MSZoningRL            2.593e+04  1.050e+04   2.469 0.013689 *
## MSZoningRM            2.507e+04  9.849e+03   2.545 0.011037 *
## LotArea               6.986e-01  1.081e-01   6.460 1.48e-10 ***
```

```
## StreetPave             3.867e+04  1.228e+04   3.148 0.001680 **
## LotShapeIR2            4.576e+03  4.320e+03   1.059 0.289725
## LotShapeIR3            4.803e+03  9.043e+03   0.531 0.595398
## LotShapeReg            5.767e+02  1.666e+03   0.346 0.729302
## LandContourHLS         1.352e+04  5.305e+03   2.549 0.010916 *
## LandContourLow        -4.225e+03  6.528e+03  -0.647 0.517604
## LandContourLvl         7.058e+03  3.820e+03   1.848 0.064898 .
## UtilitiesNoSeWa       -3.031e+04  2.662e+04  -1.139 0.255026
## LotConfigCulDSac       7.679e+03  3.324e+03   2.310 0.021050 *
## LotConfigFR2          -5.773e+03  4.154e+03  -1.390 0.164864
## LotConfigFR3          -1.330e+04  1.307e+04  -1.018 0.309109
## LotConfigInside       -1.203e+03  1.808e+03  -0.665 0.505920
## LandSlopeMod           1.052e+04  4.040e+03   2.605 0.009300 **
## LandSlopeSev          -2.552e+04  1.110e+04  -2.299 0.021673 *
## NeighborhoodBlueste   -2.654e+03  1.935e+04  -0.137 0.890911
## NeighborhoodBrDale     8.375e+03  1.113e+04   0.752 0.451912
## NeighborhoodBrkSide   -2.043e+03  9.505e+03  -0.215 0.829841
## NeighborhoodClearCr   -1.275e+04  9.428e+03  -1.352 0.176510
## NeighborhoodCollgCr   -9.666e+03  7.333e+03  -1.318 0.187712
## NeighborhoodCrawfor    9.620e+03  8.671e+03   1.110 0.267404
## NeighborhoodEdwards   -1.672e+04  8.082e+03  -2.069 0.038755 *
## NeighborhoodGilbert   -1.376e+04  7.846e+03  -1.754 0.079666 .
## NeighborhoodIDOTRR    -7.858e+03  1.087e+04  -0.723 0.469721
## NeighborhoodMeadowV   -1.427e+03  1.140e+04  -0.125 0.900428
## NeighborhoodMitchel   -2.033e+04  8.277e+03  -2.456 0.014191 *
## NeighborhoodNAmes     -1.445e+04  7.902e+03  -1.828 0.067751 .
## NeighborhoodNoRidge    2.890e+04  8.397e+03   3.441 0.000598 ***
## NeighborhoodNPkVill    8.282e+03  1.433e+04   0.578 0.563421
## NeighborhoodNridgHt    2.453e+04  7.379e+03   3.324 0.000912 ***
## NeighborhoodNWAmes    -2.040e+04  8.145e+03  -2.505 0.012384 *
## NeighborhoodOldTown   -1.302e+04  9.678e+03  -1.345 0.178726
## NeighborhoodSawyer    -1.004e+04  8.233e+03  -1.220 0.222806
## NeighborhoodSawyerW   -6.130e+03  7.854e+03  -0.780 0.435278
## NeighborhoodSomerst    1.281e+02  8.973e+03   0.014 0.988611
## NeighborhoodStoneBr    3.893e+04  8.387e+03   4.642 3.81e-06 ***
## NeighborhoodSWISU     -9.528e+03  9.833e+03  -0.969 0.332740
## NeighborhoodTimber    -6.024e+03  8.413e+03  -0.716 0.474088
## NeighborhoodVeenker    3.098e+03  1.073e+04   0.289 0.772903
## Condition1Feedr        2.859e+03  5.116e+03   0.559 0.576291
## Condition1Norm         1.210e+04  4.225e+03   2.865 0.004244 **
## Condition1PosA         7.351e+03  1.031e+04   0.713 0.475886
## Condition1PosN         7.855e+03  7.632e+03   1.029 0.303568
## Condition1RRAe        -1.708e+04  9.378e+03  -1.822 0.068739 .
## Condition1RRAn         6.208e+03  7.038e+03   0.882 0.377872
## Condition1RRNe        -7.457e+03  1.838e+04  -0.406 0.684983
## Condition1RRNn         3.816e+03  1.312e+04   0.291 0.771210
## Condition2Feedr       -9.753e+03  2.306e+04  -0.423 0.672332
## Condition2Norm        -7.569e+03  1.966e+04  -0.385 0.700300
## Condition2PosA         1.989e+04  3.801e+04   0.523 0.600827
## Condition2PosN        -2.303e+05  2.763e+04  -8.333  < 2e-16 ***
```

```
## Condition2RRAe       -1.289e+05  4.686e+04  -2.751 0.006034 **
## Condition2RRAn       -1.201e+04  3.196e+04  -0.376 0.707057
## Condition2RRNn       -9.079e+03  2.710e+04  -0.335 0.737680
## BldgType2fmCon       -6.151e+03  1.287e+04  -0.478 0.632832
## BldgTypeDuplex       -8.995e+02  7.457e+03  -0.121 0.904008
## BldgTypeTwnhs        -2.544e+04  1.016e+04  -2.504 0.012405 *
## BldgTypeTwnhsE       -2.322e+04  9.198e+03  -2.525 0.011697 *
## HouseStyle1.5Unf      1.093e+04  7.917e+03   1.380 0.167750
## HouseStyle1Story      8.849e+03  4.360e+03   2.029 0.042619 *
## HouseStyle2.5Fin     -1.718e+04  1.232e+04  -1.395 0.163390
## HouseStyle2.5Unf     -1.185e+04  9.393e+03  -1.262 0.207199
## HouseStyle2Story     -6.363e+03  3.557e+03  -1.789 0.073832 .
## HouseStyleSFoyer      7.689e+03  6.201e+03   1.240 0.215225
## HouseStyleSLvl        7.301e+03  5.497e+03   1.328 0.184333
## OverallQual           8.026e+03  1.021e+03   7.861 8.11e-15 ***
## OverallCond           5.439e+03  8.756e+02   6.212 7.08e-10 ***
## YearBuilt             3.287e+02  7.381e+01   4.454 9.18e-06 ***
## YearRemodAdd          1.058e+02  5.567e+01   1.901 0.057496 .
## RoofStyleGable        1.530e+03  1.876e+04   0.082 0.934996
## RoofStyleGambrel      4.258e+03  2.051e+04   0.208 0.835583
## RoofStyleHip          3.159e+03  1.881e+04   0.168 0.866662
## RoofStyleMansard      1.714e+04  2.185e+04   0.785 0.432799
## RoofStyleShed         8.808e+04  3.551e+04   2.481 0.013242 *
## RoofMatlCompShg       6.501e+05  3.304e+04  19.674  < 2e-16 ***
## RoofMatlMembran       7.371e+05  4.778e+04  15.427  < 2e-16 ***
## RoofMatlMetal         6.971e+05  4.720e+04  14.770  < 2e-16 ***
## RoofMatlRoll          6.496e+05  4.167e+04  15.589  < 2e-16 ***
## RoofMatlTar&Grv       6.556e+05  3.799e+04  17.258  < 2e-16 ***
## RoofMatlWdShake       6.305e+05  3.680e+04  17.133  < 2e-16 ***
## RoofMatlWdShngl       7.278e+05  3.428e+04  21.233  < 2e-16 ***
## Exterior1stAsphShn   -1.233e+04  3.420e+04  -0.361 0.718455
## Exterior1stBrkComm   -1.312e+04  2.868e+04  -0.458 0.647308
## Exterior1stBrkFace    5.389e+03  1.287e+04   0.419 0.675425
## Exterior1stCBlock    -2.778e+04  2.759e+04  -1.007 0.314220
## Exterior1stCemntBd   -1.499e+04  1.946e+04  -0.770 0.441238
## Exterior1stHdBoard   -1.383e+04  1.299e+04  -1.065 0.287064
## Exterior1stImStucc   -6.889e+04  2.861e+04  -2.408 0.016182 *
## Exterior1stMetalSd   -3.066e+03  1.483e+04  -0.207 0.836187
## Exterior1stPlywood   -1.804e+04  1.287e+04  -1.401 0.161366
## Exterior1stStone     -1.496e+04  2.437e+04  -0.614 0.539296
## Exterior1stStucco    -5.054e+03  1.417e+04  -0.357 0.721436
## Exterior1stVinylSd   -1.752e+04  1.346e+04  -1.301 0.193376
## Exterior1stWd Sdng   -1.360e+04  1.243e+04  -1.095 0.273923
## Exterior1stWdShing   -6.500e+03  1.344e+04  -0.484 0.628651
## Exterior2ndAsphShn    7.872e+03  2.281e+04   0.345 0.730070
## Exterior2ndBrk Cmn    1.484e+04  2.074e+04   0.716 0.474376
## Exterior2ndBrkFace   -7.826e+02  1.330e+04  -0.059 0.953086
## Exterior2ndCBlock            NA         NA      NA       NA
## Exterior2ndCmentBd    1.311e+04  1.919e+04   0.683 0.494595
## Exterior2ndHdBoard    8.093e+03  1.251e+04   0.647 0.517684
```

```
## Exterior2ndImStucc    3.360e+04  1.447e+04   2.323 0.020359 *
## Exterior2ndMetalSd    2.714e+03  1.447e+04   0.188 0.851230
## Exterior2ndOther     -6.345e+03  2.821e+04  -0.225 0.822084
## Exterior2ndPlywood    9.203e+03  1.215e+04   0.757 0.448915
## Exterior2ndStone     -9.978e+03  1.737e+04  -0.574 0.565811
## Exterior2ndStucco     2.382e+03  1.365e+04   0.174 0.861561
## Exterior2ndVinylSd    1.630e+04  1.300e+04   1.254 0.209933
## Exterior2ndWd Sdng    1.049e+04  1.199e+04   0.875 0.381793
## Exterior2ndWd Shng    3.418e+03  1.250e+04   0.273 0.784655
## ExterQualFa          -8.686e+03  1.089e+04  -0.798 0.425052
## ExterQualGd          -3.080e+04  4.792e+03  -6.428 1.83e-10 ***
## ExterQualTA          -3.074e+04  5.362e+03  -5.734 1.23e-08 ***
## ExterCondFa          -2.825e+03  1.887e+04  -0.150 0.881022
## ExterCondGd          -8.101e+03  1.802e+04  -0.450 0.653048
## ExterCondPo           1.160e+04  3.282e+04   0.354 0.723716
## ExterCondTA          -5.453e+03  1.798e+04  -0.303 0.761747
## FoundationCBlock      1.744e+03  3.198e+03   0.545 0.585564
## FoundationPConc       4.818e+03  3.507e+03   1.374 0.169794
## FoundationSlab        8.487e+03  7.862e+03   1.080 0.280554
## FoundationStone       2.693e+03  1.116e+04   0.241 0.809459
## FoundationWood       -3.324e+04  1.512e+04  -2.198 0.028133 *
## BsmtFinSF1            3.704e+01  4.420e+00   8.380  < 2e-16 ***
## BsmtFinSF2            2.453e+01  5.797e+00   4.232 2.48e-05 ***
## BsmtUnfSF             1.492e+01  4.069e+00   3.668 0.000255 ***
## TotalBsmtSF                  NA         NA      NA       NA
## HeatingGasA          -7.328e+03  2.546e+04  -0.288 0.773499
## HeatingGasW          -1.591e+04  2.625e+04  -0.606 0.544477
## HeatingGrav          -1.550e+04  2.764e+04  -0.561 0.575086
## HeatingOthW          -4.569e+04  3.173e+04  -1.440 0.150032
## HeatingWall           8.058e+03  2.950e+04   0.273 0.784775
## HeatingQCFa          -1.588e+03  4.831e+03  -0.329 0.742432
## HeatingQCGd          -3.671e+03  2.149e+03  -1.708 0.087792 .
## HeatingQCPo           8.416e+03  2.774e+04   0.303 0.761604
## HeatingQCTA          -4.397e+03  2.122e+03  -2.072 0.038449 *
## CentralAirY          -3.634e+03  3.996e+03  -0.909 0.363285
## ElectricalFuseF      -1.244e+03  5.991e+03  -0.208 0.835574
## ElectricalFuseP      -1.038e+04  1.743e+04  -0.595 0.551653
## ElectricalMix         3.613e+03  2.892e+04   0.125 0.900595
## ElectricalSBrkr      -1.294e+03  3.025e+03  -0.428 0.668809
## X1stFlrSF             5.503e+01  5.335e+00  10.316  < 2e-16 ***
## X2ndFlrSF             6.990e+01  5.272e+00  13.257  < 2e-16 ***
## LowQualFinSF          2.482e+01  1.871e+01   1.327 0.184866
## GrLivArea                    NA         NA      NA       NA
## BsmtFullBath          1.554e+03  1.968e+03   0.789 0.430031
## BsmtHalfBath          3.207e+02  3.116e+03   0.103 0.918049
## FullBath              2.603e+03  2.246e+03   1.159 0.246760
## HalfBath             -1.328e+02  2.140e+03  -0.062 0.950553
## BedroomAbvGr         -5.495e+03  1.384e+03  -3.969 7.62e-05 ***
## KitchenAbvGr         -1.584e+04  5.771e+03  -2.745 0.006138 **
## KitchenQualFa        -2.069e+04  6.413e+03  -3.226 0.001286 **
```

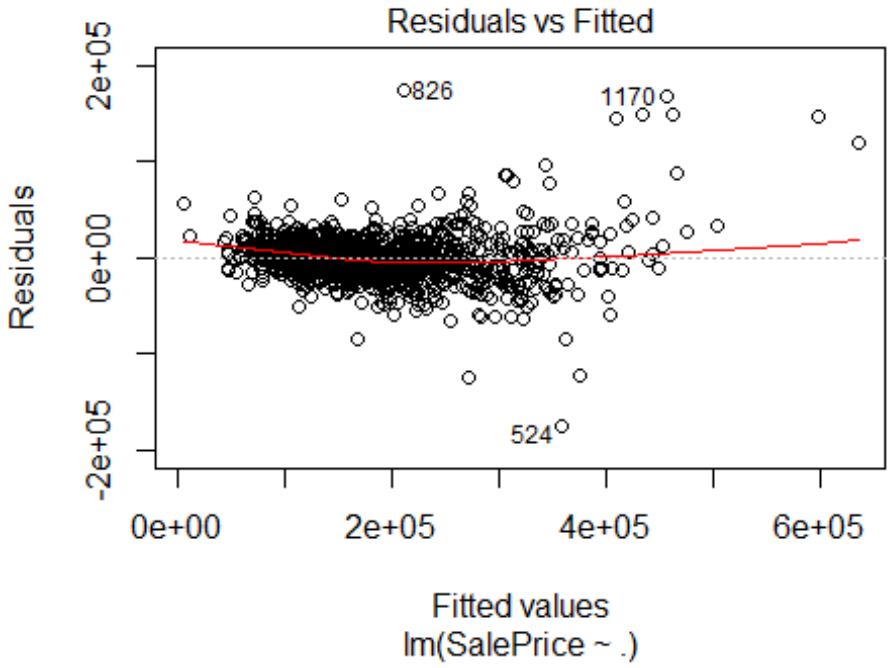
```
## KitchenQualGd        -2.779e+04  3.487e+03  -7.968 3.55e-15 ***
## KitchenQualTA        -2.530e+04  3.993e+03  -6.334 3.30e-10 ***
## TotRmsAbvGrd          1.360e+03  9.753e+02   1.394 0.163564
## FunctionalMaj2       -5.360e+02  1.480e+04  -0.036 0.971111
## FunctionalMin1        4.401e+03  8.666e+03   0.508 0.611610
## FunctionalMin2        8.577e+03  8.581e+03   1.000 0.317726
## FunctionalMod        -7.196e+03  1.056e+04  -0.681 0.495815
## FunctionalSev        -5.986e+04  2.758e+04  -2.170 0.030174 *
## FunctionalTyp         1.971e+04  7.420e+03   2.656 0.008003 **
## Fireplaces            2.806e+03  1.374e+03   2.043 0.041253 *
## GarageCars            4.257e+03  2.221e+03   1.916 0.055556 .
## GarageArea            1.347e+01  7.647e+00   1.761 0.078488 .
## PavedDriveP          -3.300e+03  5.574e+03  -0.592 0.553913
## PavedDriveY          -2.103e+03  3.458e+03  -0.608 0.543253
## WoodDeckSF            1.365e+01  5.954e+00   2.292 0.022065 *
## OpenPorchSF           1.219e+01  1.184e+01   1.029 0.303668
## EnclosedPorch         5.565e+00  1.285e+01   0.433 0.664986
## X3SsnPorch            2.380e+01  2.312e+01   1.029 0.303549
## ScreenPorch           3.714e+01  1.260e+01   2.948 0.003252 **
## PoolArea              7.168e+01  1.832e+01   3.913 9.62e-05 ***
## MiscVal              -3.293e-01  1.469e+00  -0.224 0.822608
## MoSold               -6.362e+02  2.539e+02  -2.505 0.012357 *
## YrSold               -1.753e+02  5.248e+02  -0.334 0.738462
## SaleTypeCon           3.533e+04  1.838e+04   1.922 0.054800 .
## SaleTypeConLD         1.681e+04  1.002e+04   1.678 0.093529 .
## SaleTypeConLI         9.741e+03  1.190e+04   0.818 0.413351
## SaleTypeConLw        -2.484e+03  1.243e+04  -0.200 0.841598
## SaleTypeCWD           2.333e+04  1.336e+04   1.746 0.081044 .
## SaleTypeNew           3.459e+04  1.604e+04   2.156 0.031294 *
## SaleTypeOth           1.888e+04  1.502e+04   1.257 0.208952
## SaleTypeWD            4.925e+02  4.341e+03   0.113 0.909689
## SaleConditionAdjLand  1.036e+04  1.505e+04   0.688 0.491294
## SaleConditionAlloca   4.966e+03  8.781e+03   0.566 0.571776
## SaleConditionFamily  -1.351e+03  6.328e+03  -0.213 0.830984
## SaleConditionNormal   6.627e+03  2.993e+03   2.214 0.027003 *
## SaleConditionPartial -9.293e+03  1.546e+04  -0.601 0.547944
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 24000 on 1269 degrees of freedom
##   (1 observation deleted due to missingness)
## Multiple R-squared:  0.9206, Adjusted R-squared:  0.9088
## F-statistic: 77.83 on 189 and 1269 DF,  p-value: < 2.2e-16

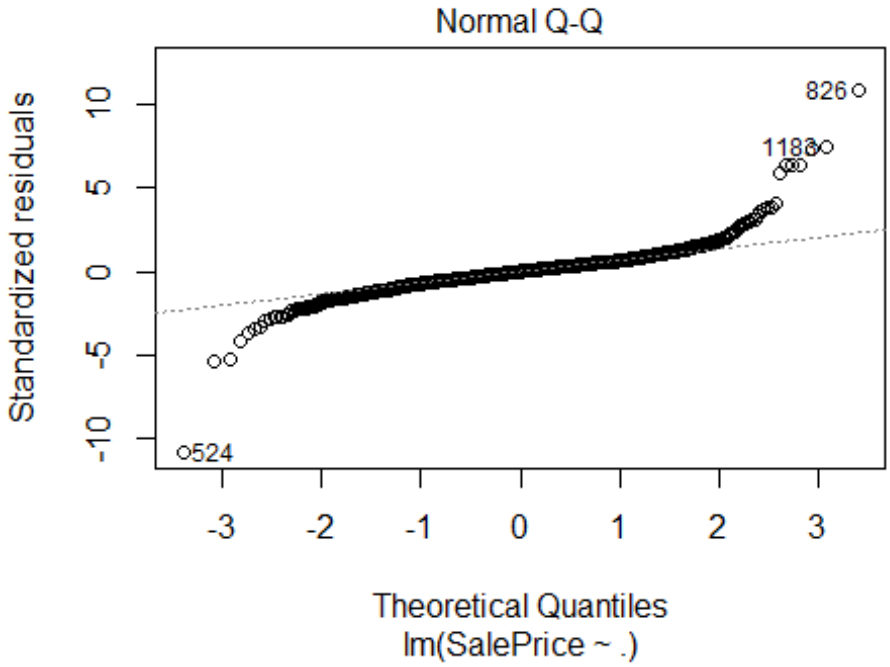
accuracy(linear)

##                        ME     RMSE      MAE        MPE     MAPE      MASE
## Training set 1.816243e-13 22387.36 14533.37 -0.5889875 8.494719 0.2528991

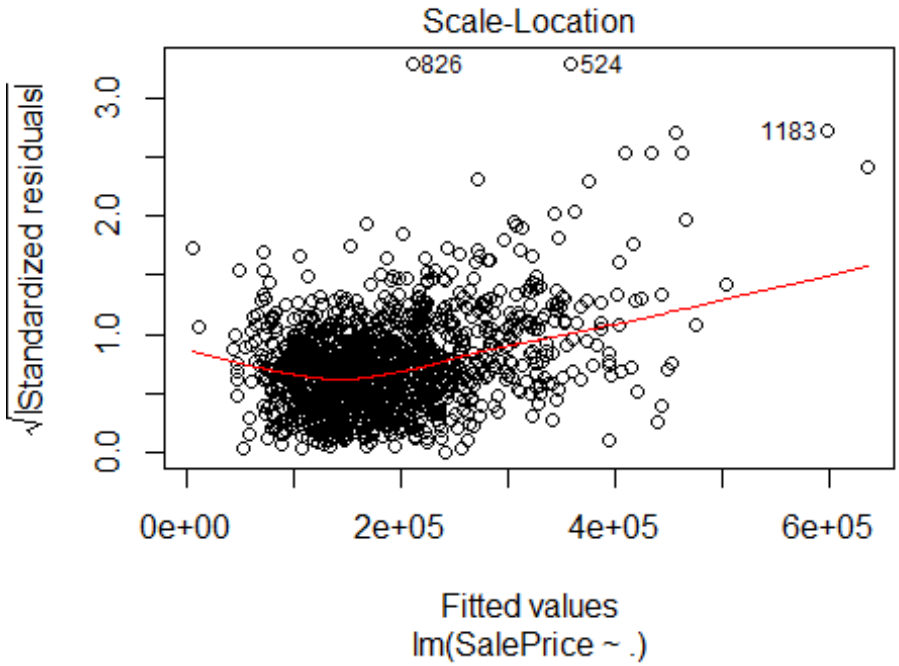
plot(linear)
```

```
## Warning: not plotting observations with leverage one:
##   121, 251, 326, 399, 584, 596, 667, 945, 1004, 1012, 1188, 1231, 1271,
1276, 1299, 1322, 1371
```



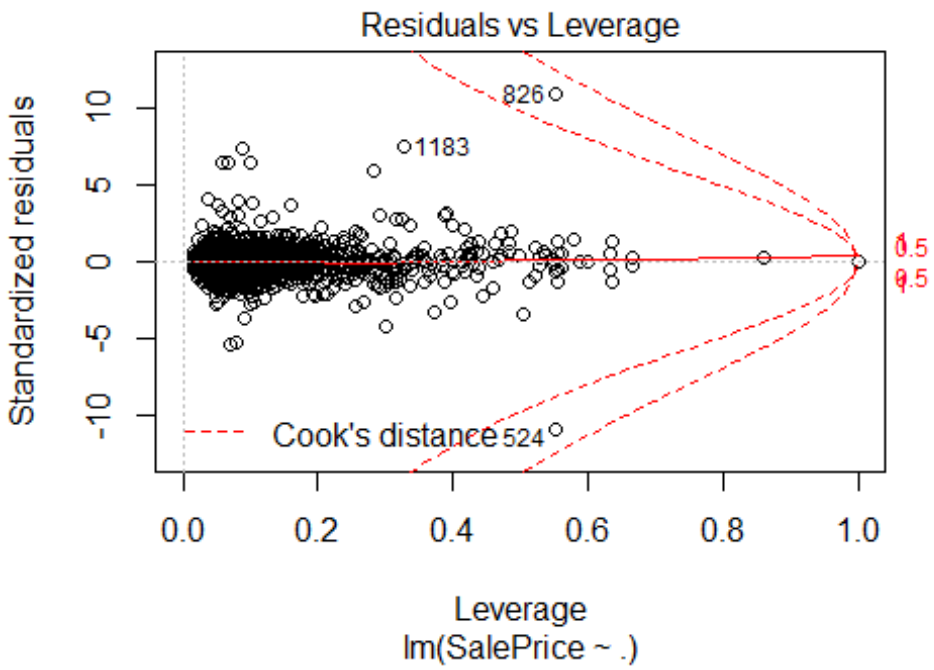


```
## Warning: not plotting observations with leverage one:
##   121, 251, 326, 399, 584, 596, 667, 945, 1004, 1012, 1188, 1231, 1271,
1276, 1299, 1322, 1371
```




```
## Warning in sqrt(crit * p * (1 - hh)/hh): NaNs produced

## Warning in sqrt(crit * p * (1 - hh)/hh): NaNs produced
```




```
library(car)
```

```
## Warning: package 'car' was built under R version 3.5.2
```

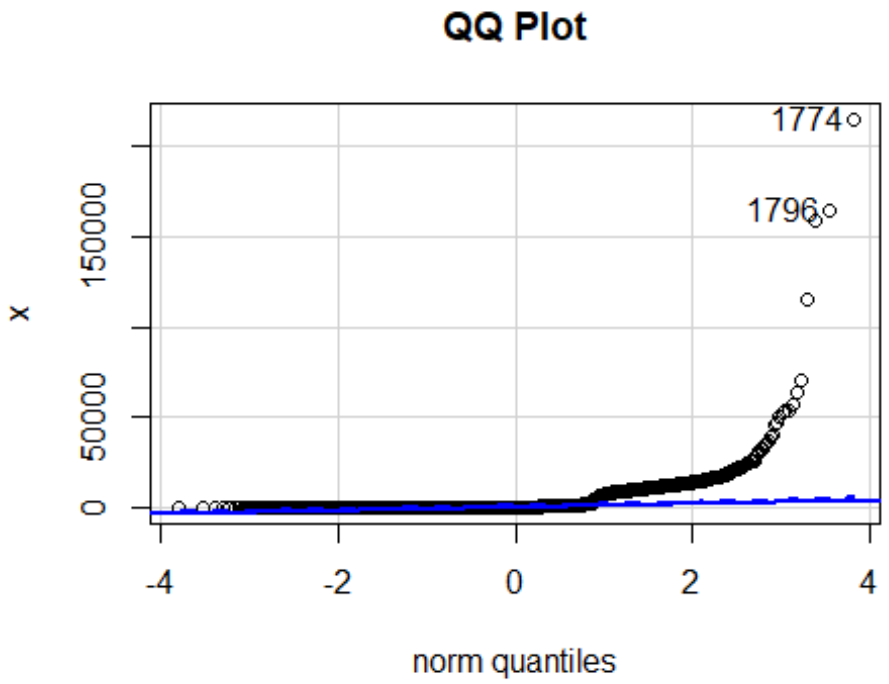
```
## Loading required package: carData
```

```
## Warning: package 'carData' was built under R version 3.5.2
```

```
##
## Attaching package: 'car'
```

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

```
x <- c( BedroomAbvGr, LotArea, PoolArea, TotalBsmtSF, TotRmsAbvGrd)
qqPlot(x , main="QQ Plot")
```




```
## [1] 1774 1796
```

```
library(ggpubr)
```

```
## Warning: package 'ggpubr' was built under R version 3.5.2
```

```
## Loading required package: magrittr
```

```
##
## Attaching package: 'ggpubr'
```

```
## The following object is masked from 'package:forecast':
##
##     gghistogram
```

```
## The following object is masked from 'package:plyr':
##
##     mutate
```

```
t.test(SalePrice, x, data = training)
```

```
##
##  Welch Two Sample t-test
##
## data:  SalePrice and x
## t = 85.854, df = 1462.4, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
```

```
##  174523.2 182684.6
## sample estimates:
## mean of x mean of y
## 180921.20   2317.28
```

```
library(Hmisc)
```

```
## Warning: package 'Hmisc' was built under R version 3.5.2
```

```
## Loading required package: survival
```

```
## Loading required package: Formula
```

```
## Warning: package 'Formula' was built under R version 3.5.2
```

```
##
## Attaching package: 'Hmisc'
```

```
## The following objects are masked from 'package:plyr':
##
##     is.discrete, summarize
```

```
## The following objects are masked from 'package:dplyr':
##
##     src, summarize
```

```
## The following objects are masked from 'package:base':
##
##     format.pval, units
```

```
describe(training)
```

```
## training
##
##  62  Variables      1460  Observations
## ---------------------------------------------------------------------------
-
## MSSubClass
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0       15     0.94     56.9    43.19       20       20
##      .25      .50      .75      .90      .95
##       20       50       70      120      160
##
## Value         20    30    40    45    50    60    70    75    80    85
## Frequency    536    69     4    12   144   299    60    16    58    20
## Proportion 0.367 0.047 0.003 0.008 0.099 0.205 0.041 0.011 0.040 0.014
##
## Value         90   120   160   180   190
## Frequency     52    87    63    10    30
## Proportion 0.036 0.060 0.043 0.007 0.021
## ---------------------------------------------------------------------------
-
```

```
## MSZoning
##        n  missing distinct
##     1460        0        5
##
## Value      C (all)      FV      RH      RL      RM
## Frequency       10      65      16    1151     218
## Proportion   0.007   0.045   0.011   0.788   0.149
## ------------------------------------------------------------------------
-
## LotArea
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0     1073        1    10517     5718     3312     5000
##      .25      .50      .75      .90      .95
##     7554     9478    11602    14382    17401
##
## lowest :   1300   1477   1491   1526   1533, highest:  70761 115149 159000
164660 215245
## ------------------------------------------------------------------------
-
## Street
##        n  missing distinct
##     1460        0        2
##
## Value       Grvl  Pave
## Frequency      6  1454
## Proportion 0.004 0.996
## ------------------------------------------------------------------------
-
## LotShape
##        n  missing distinct
##     1460        0        4
##
## Value        IR1   IR2   IR3   Reg
## Frequency    484    41    10   925
## Proportion 0.332 0.028 0.007 0.634
## ------------------------------------------------------------------------
-
## LandContour
##        n  missing distinct
##     1460        0        4
##
## Value        Bnk   HLS   Low   Lvl
## Frequency     63    50    36  1311
## Proportion 0.043 0.034 0.025 0.898
## ------------------------------------------------------------------------
-
## Utilities
##        n  missing distinct
##     1460        0        2
##
```

```
## Value      AllPub NoSeWa
## Frequency    1459      1
## Proportion  0.999  0.001
## ------------------------------------------------------------------------
-
## LotConfig
##        n  missing distinct
##     1460        0        5
##
## Value       Corner CulDSac     FR2     FR3  Inside
## Frequency      263      94      47       4    1052
## Proportion   0.180   0.064   0.032   0.003   0.721
## ------------------------------------------------------------------------
-
## LandSlope
##        n  missing distinct
##     1460        0        3
##
## Value        Gtl   Mod   Sev
## Frequency   1382    65    13
## Proportion 0.947 0.045 0.009
## ------------------------------------------------------------------------
-
## Neighborhood
##        n  missing distinct
##     1460        0       25
##
## lowest : Blmngtn Blueste BrDale  BrkSide ClearCr
## highest: Somerst StoneBr SWISU   Timber  Veenker
## ------------------------------------------------------------------------
-
## Condition1
##        n  missing distinct
##     1460        0        9
##
## Value      Artery  Feedr   Norm   PosA   PosN   RRAe   RRAn   RRNe   RRNn
## Frequency      48     81   1260      8     19     11     26      2      5
## Proportion  0.033  0.055  0.863  0.005  0.013  0.008  0.018  0.001  0.003
## ------------------------------------------------------------------------
-
## Condition2
##        n  missing distinct
##     1460        0        8
##
## Value      Artery  Feedr   Norm   PosA   PosN   RRAe   RRAn   RRNn
## Frequency       2      6   1445      1      2      1      1      2
## Proportion  0.001  0.004  0.990  0.001  0.001  0.001  0.001  0.001
## ------------------------------------------------------------------------
-
## BldgType
```

```
##        n  missing distinct
##     1460        0        5
##
## Value        1Fam 2fmCon Duplex  Twnhs TwnhsE
## Frequency    1220     31     52     43    114
## Proportion  0.836  0.021  0.036  0.029  0.078
## ------------------------------------------------------------------------
-
## HouseStyle
##        n  missing distinct
##     1460        0        8
##
## Value      1.5Fin 1.5Unf 1Story 2.5Fin 2.5Unf 2Story SFoyer   SLvl
## Frequency     154     14    726      8     11    445     37     65
## Proportion  0.105  0.010  0.497  0.005  0.008  0.305  0.025  0.045
## ------------------------------------------------------------------------
-
## OverallQual
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0       10    0.951    6.099    1.522        4        5
##      .25      .50      .75      .90      .95
##        5        6        7        8        8
##
## Value          1     2     3     4     5     6     7     8     9    10
## Frequency      2     3    20   116   397   374   319   168    43    18
## Proportion 0.001 0.002 0.014 0.079 0.272 0.256 0.218 0.115 0.029 0.012
## ------------------------------------------------------------------------
-
## OverallCond
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        9    0.814    5.575    1.111
##
## Value          1     2     3     4     5     6     7     8     9
## Frequency      1     5    25    57   821   252   205    72    22
## Proportion 0.001 0.003 0.017 0.039 0.562 0.173 0.140 0.049 0.015
## ------------------------------------------------------------------------
-
## YearBuilt
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      112        1     1971    33.88     1916     1925
##      .25      .50      .75      .90      .95
##     1954     1973     2000     2006     2007
##
## lowest : 1872 1875 1880 1882 1885, highest: 2006 2007 2008 2009 2010
## ------------------------------------------------------------------------
-
## YearRemodAdd
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0       61    0.997     1985    23.05     1950     1950
##      .25      .50      .75      .90      .95
```

```
##     1967     1994     2004     2006     2007
##
## lowest : 1950 1951 1952 1953 1954, highest: 2006 2007 2008 2009 2010
## ---------------------------------------------------------------------------
-
## RoofStyle
##        n  missing distinct
##     1460        0        6
##
## Value          Flat   Gable Gambrel     Hip Mansard    Shed
## Frequency        13    1141      11     286       7       2
## Proportion    0.009   0.782   0.008   0.196   0.005   0.001
## ---------------------------------------------------------------------------
-
## RoofMatl
##        n  missing distinct
##     1460        0        8
##
## Value      ClyTile CompShg Membran   Metal    Roll Tar&Grv WdShake WdShngl
## Frequency        1    1434       1       1       1      11       5       6
## Proportion   0.001   0.982   0.001   0.001   0.001   0.008   0.003   0.004
## ---------------------------------------------------------------------------
-
## Exterior1st
##        n  missing distinct
##     1460        0       15
##
## Value      AsbShng AsphShn BrkComm BrkFace  CBlock CemntBd HdBoard ImStucc
## Frequency       20       1       2      50       1      61     222       1
## Proportion   0.014   0.001   0.001   0.034   0.001   0.042   0.152   0.001
##
## Value      MetalSd Plywood   Stone  Stucco VinylSd Wd Sdng WdShing
## Frequency      220     108       2      25     515     206      26
## Proportion   0.151   0.074   0.001   0.017   0.353   0.141   0.018
## ---------------------------------------------------------------------------
-
## Exterior2nd
##        n  missing distinct
##     1460        0       16
##
## Value      AsbShng AsphShn Brk Cmn BrkFace  CBlock CmentBd HdBoard ImStucc
## Frequency       20       3       7      25       1      60     207      10
## Proportion   0.014   0.002   0.005   0.017   0.001   0.041   0.142   0.007
##
## Value      MetalSd   Other Plywood   Stone  Stucco VinylSd Wd Sdng Wd Shng
## Frequency      214       1     142       5      26     504     197      38
## Proportion   0.147   0.001   0.097   0.003   0.018   0.345   0.135   0.026
## ---------------------------------------------------------------------------
-
## ExterQual
```

```
##        n  missing distinct
##     1460        0        4
##
## Value         Ex    Fa    Gd    TA
## Frequency     52    14   488   906
## Proportion 0.036 0.010 0.334 0.621
## ------------------------------------------------------------------------
-
## ExterCond
##        n  missing distinct
##     1460        0        5
##
## Value         Ex    Fa    Gd    Po    TA
## Frequency      3    28   146     1  1282
## Proportion 0.002 0.019 0.100 0.001 0.878
## ------------------------------------------------------------------------
-
## Foundation
##        n  missing distinct
##     1460        0        6
##
## Value      BrkTil CBlock  PConc   Slab  Stone   Wood
## Frequency     146    634    647     24      6      3
## Proportion  0.100  0.434  0.443  0.016  0.004  0.002
## ------------------------------------------------------------------------
-
## BsmtFinSF1
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      637    0.967    443.6    484.5      0.0      0.0
##      .25      .50      .75      .90      .95
##      0.0    383.5    712.2   1065.5   1274.0
##
## lowest :    0    2   16   20   24, highest: 1904 2096 2188 2260 5644
## ------------------------------------------------------------------------
-
## BsmtFinSF2
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      144    0.305    46.55    86.58      0.0      0.0
##      .25      .50      .75      .90      .95
##      0.0      0.0      0.0    117.2    396.2
##
## lowest :    0   28   32   35   40, highest: 1080 1085 1120 1127 1474
## ------------------------------------------------------------------------
-
## BsmtUnfSF
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      780    0.999    567.2    486.6      0.0     74.9
##      .25      .50      .75      .90      .95
##    223.0    477.5    808.0   1232.0   1468.0
##
```

```
## lowest :    0   14   15   23   26, highest: 2042 2046 2121 2153 2336
## ------------------------------------------------------------------------
-
## TotalBsmtSF
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      721        1     1057    459.5    519.3    636.9
##      .25      .50      .75      .90      .95
##    795.8    991.5   1298.2   1602.2   1753.0
##
## lowest :    0  105  190  264  270, highest: 3094 3138 3200 3206 6110
## ------------------------------------------------------------------------
-
## Heating
##        n  missing distinct
##     1460        0        6
##
## Value      Floor  GasA  GasW  Grav  OthW  Wall
## Frequency      1  1428    18     7     2     4
## Proportion 0.001 0.978 0.012 0.005 0.001 0.003
## ------------------------------------------------------------------------
-
## HeatingQC
##        n  missing distinct
##     1460        0        5
##
## Value         Ex    Fa    Gd    Po    TA
## Frequency    741    49   241     1   428
## Proportion 0.508 0.034 0.165 0.001 0.293
## ------------------------------------------------------------------------
-
## CentralAir
##        n  missing distinct
##     1460        0        2
##
## Value          N     Y
## Frequency     95  1365
## Proportion 0.065 0.935
## ------------------------------------------------------------------------
-
## Electrical
##        n  missing distinct
##     1459        1        5
##
## Value      FuseA FuseF FuseP   Mix SBrkr
## Frequency     94    27     3     1  1334
## Proportion 0.064 0.019 0.002 0.001 0.914
## ------------------------------------------------------------------------
-
## X1stFlrSF
##        n  missing distinct     Info     Mean      Gmd      .05      .10
```

```
##     1460        0      753        1     1163    416.4    673.0    756.9
##      .25      .50      .75      .90      .95
##    882.0   1087.0   1391.2   1680.0   1831.2
##
## lowest :  334  372  438  480  483, highest: 2633 2898 3138 3228 4692
## ------------------------------------------------------------------------
-
## X2ndFlrSF
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      417    0.817      347    450.2      0.0      0.0
##      .25      .50      .75      .90      .95
##      0.0      0.0    728.0    954.2   1141.0
##
## lowest :    0  110  167  192  208, highest: 1611 1796 1818 1872 2065
## ------------------------------------------------------------------------
-
## LowQualFinSF
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0       24    0.052    5.845    11.55        0        0
##      .25      .50      .75      .90      .95
##        0        0        0        0        0
##
## lowest :   0  53  80 120 144, highest: 513 514 515 528 572
## ------------------------------------------------------------------------
-
## GrLivArea
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      861        1     1515    563.1      848      912
##      .25      .50      .75      .90      .95
##     1130     1464     1777     2158     2466
##
## lowest :  334  438  480  520  605, highest: 3627 4316 4476 4676 5642
## ------------------------------------------------------------------------
-
## BsmtFullBath
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        4    0.733   0.4253   0.5085
##
## Value          0     1     2     3
## Frequency    856   588    15     1
## Proportion 0.586 0.403 0.010 0.001
## ------------------------------------------------------------------------
-
## BsmtHalfBath
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        3    0.159  0.05753   0.1088
##
## Value          0     1     2
## Frequency   1378    80     2
## Proportion 0.944 0.055 0.001
```

```
## ------------------------------------------------------------------------
-
## FullBath
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        4    0.766    1.565   0.5521
##
## Value          0     1     2     3
## Frequency      9   650   768    33
## Proportion 0.006 0.445 0.526 0.023
## ------------------------------------------------------------------------
-
## HalfBath
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        3    0.706   0.3829   0.4852
##
## Value          0     1     2
## Frequency    913   535    12
## Proportion 0.625 0.366 0.008
## ------------------------------------------------------------------------
-
## BedroomAbvGr
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        8    0.815    2.866    0.818
##
## Value          0     1     2     3     4     5     6     8
## Frequency      6    50   358   804   213    21     7     1
## Proportion 0.004 0.034 0.245 0.551 0.146 0.014 0.005 0.001
## ------------------------------------------------------------------------
-
## KitchenAbvGr
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        4    0.133    1.047  0.09174
##
## Value          0     1     2     3
## Frequency      1  1392    65     2
## Proportion 0.001 0.953 0.045 0.001
## ------------------------------------------------------------------------
-
## KitchenQual
##        n  missing distinct
##     1460        0        4
##
## Value         Ex    Fa    Gd    TA
## Frequency    100    39   586   735
## Proportion 0.068 0.027 0.401 0.503
## ------------------------------------------------------------------------
-
## TotRmsAbvGrd
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0       12    0.958    6.518    1.762        4        5
```

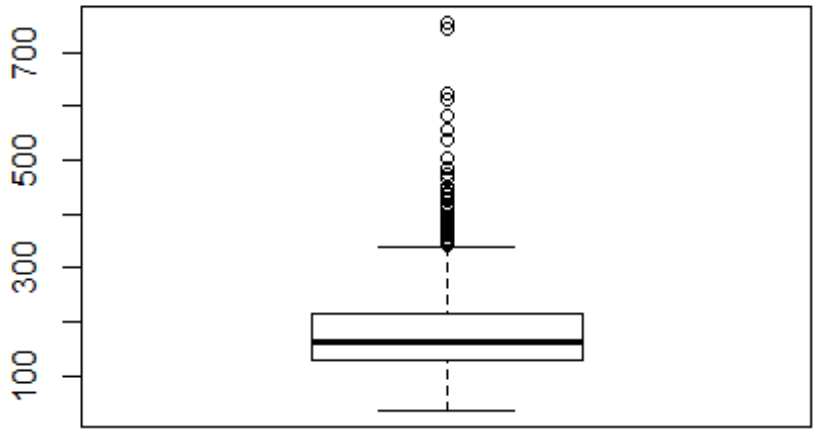
```
##      .25      .50      .75      .90      .95
##        5        6        7        9       10
##
## Value          2     3     4     5     6     7     8     9    10    11
## Frequency      1    17    97   275   402   329   187    75    47    18
## Proportion 0.001 0.012 0.066 0.188 0.275 0.225 0.128 0.051 0.032 0.012
##
## Value         12    14
## Frequency     11     1
## Proportion 0.008 0.001
## ------------------------------------------------------------------------
-
## Functional
##        n  missing distinct
##     1460        0        7
##
## Value       Maj1  Maj2  Min1  Min2   Mod   Sev   Typ
## Frequency     14     5    31    34    15     1  1360
## Proportion 0.010 0.003 0.021 0.023 0.010 0.001 0.932
## ------------------------------------------------------------------------
-
## Fireplaces
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        4    0.806    0.613   0.6566
##
## Value          0     1     2     3
## Frequency    690   650   115     5
## Proportion 0.473 0.445 0.079 0.003
## ------------------------------------------------------------------------
-
## GarageCars
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        5    0.802    1.767   0.7609
##
## Value          0     1     2     3     4
## Frequency     81   369   824   181     5
## Proportion 0.055 0.253 0.564 0.124 0.003
## ------------------------------------------------------------------------
-
## GarageArea
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      441        1      473    234.9      0.0    240.0
##      .25      .50      .75      .90      .95
##    334.5    480.0    576.0    757.1    850.1
##
## lowest :    0  160  164  180  186, highest: 1220 1248 1356 1390 1418
## ------------------------------------------------------------------------
-
## PavedDrive
##        n  missing distinct
```

```
##     1460        0        3
##
## Value          N     P     Y
## Frequency     90    30  1340
## Proportion 0.062 0.021 0.918
## ------------------------------------------------------------------------
-
## WoodDeckSF
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      274    0.858    94.24      125        0        0
##      .25      .50      .75      .90      .95
##        0        0      168      262      335
##
## lowest :   0  12  24  26  28, highest: 668 670 728 736 857
## ------------------------------------------------------------------------
-
## OpenPorchSF
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      202    0.909    46.66    62.43        0        0
##      .25      .50      .75      .90      .95
##        0       25       68      130      175
##
## lowest :   0   4   8  10  11, highest: 406 418 502 523 547
## ------------------------------------------------------------------------
-
## EnclosedPorch
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      120    0.369    21.95    39.39      0.0      0.0
##      .25      .50      .75      .90      .95
##      0.0      0.0      0.0    112.0    180.1
##
## lowest :   0  19  20  24  30, highest: 301 318 330 386 552
## ------------------------------------------------------------------------
-
## X3SsnPorch
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0       20    0.049     3.41    6.739        0        0
##      .25      .50      .75      .90      .95
##        0        0        0        0        0
##
## Value          0    23    96   130   140   144   153   162   168   180
## Frequency   1436     1     1     1     1     2     1     1     3     2
## Proportion 0.984 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.002 0.001
##
## Value        182   196   216   238   245   290   304   320   407   508
## Frequency      1     1     2     1     1     1     1     1     1     1
## Proportion 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001
## ------------------------------------------------------------------------
-
## ScreenPorch
```

```
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0       76     0.22    15.06    28.27        0        0
##      .25      .50      .75      .90      .95
##        0        0        0        0      160
##
## lowest :   0  40  53  60  63, highest: 385 396 410 440 480
## ------------------------------------------------------------------------
-
## PoolArea
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        8    0.014    2.759    5.497
##
## Value          0   480   512   519   555   576   648   738
## Frequency   1453     1     1     1     1     1     1     1
## Proportion 0.995 0.001 0.001 0.001 0.001 0.001 0.001 0.001
## ------------------------------------------------------------------------
-
## MiscVal
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0       21    0.103    43.49    85.67        0        0
##      .25      .50      .75      .90      .95
##        0        0        0        0        0
##
## Value          0    50   350   400   450   500   550   600   700   800
## Frequency   1408     1     1    11     4    10     1     5     5     1
## Proportion 0.964 0.001 0.001 0.008 0.003 0.007 0.001 0.003 0.003 0.001
##
## Value       1150  1200  1300  1400  2000  2500  3500  8300 15500
## Frequency      1     2     1     1     4     1     1     1     1
## Proportion 0.001 0.001 0.001 0.001 0.003 0.001 0.001 0.001 0.001
## ------------------------------------------------------------------------
-
## MoSold
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0       12    0.985    6.322    3.041        2        3
##      .25      .50      .75      .90      .95
##        5        6        8       10       11
##
## Value          1     2     3     4     5     6     7     8     9    10
## Frequency     58    52   106   141   204   253   234   122    63    89
## Proportion 0.040 0.036 0.073 0.097 0.140 0.173 0.160 0.084 0.043 0.061
##
## Value         11    12
## Frequency     79    59
## Proportion 0.054 0.040
## ------------------------------------------------------------------------
-
## YrSold
##        n  missing distinct     Info     Mean      Gmd
##     1460        0        5    0.955     2008    1.498
```

```
##
## Value       2006  2007  2008  2009  2010
## Frequency    314   329   304   338   175
## Proportion 0.215 0.225 0.208 0.232 0.120
## ------------------------------------------------------------------------
-
## SaleType
##        n  missing distinct
##     1460        0        9
##
## Value        COD   Con ConLD ConLI ConLw   CWD   New   Oth    WD
## Frequency     43     2     9     5     5     4   122     3  1267
## Proportion 0.029 0.001 0.006 0.003 0.003 0.003 0.084 0.002 0.868
## ------------------------------------------------------------------------
-
## SaleCondition
##        n  missing distinct
##     1460        0        6
##
## Value      Abnorml AdjLand  Alloca  Family  Normal Partial
## Frequency      101       4      12      20    1198     125
## Proportion   0.069   0.003   0.008   0.014   0.821   0.086
## ------------------------------------------------------------------------
-
## SalePrice
##        n  missing distinct     Info     Mean      Gmd      .05      .10
##     1460        0      663        1   180921    81086    88000   106475
##      .25      .50      .75      .90      .95
##   129975   163000   214000   278000   326100
##
## lowest :  34900  35311  37900  39300  40000, highest: 582933 611657 625000
745000 755000
## ------------------------------------------------------------------------
-

boxplot(training$SalePrice / 1000 )
```




```
cat_var <- names(training)[which(sapply(training, is.factor))]
cat_var
```

```
##  [1] "MSZoning"      "Street"        "LotShape"      "LandContour"
##  [5] "Utilities"     "LotConfig"     "LandSlope"     "Neighborhood"
##  [9] "Condition1"    "Condition2"    "BldgType"      "HouseStyle"
## [13] "RoofStyle"     "RoofMatl"      "Exterior1st"   "Exterior2nd"
## [17] "ExterQual"     "ExterCond"     "Foundation"    "Heating"
## [21] "HeatingQC"     "CentralAir"    "Electrical"    "KitchenQual"
## [25] "Functional"    "PavedDrive"    "SaleType"      "SaleCondition"
```

```
num_var <-
c('SalePrice','LotArea','TotalBsmtSF','GrLivArea','BsmtFinSF1','BsmtFinSF2','
X1stFlrSF','X2ndFlrSF','GarageArea','WoodDeckSF','OpenPorchSF')
training_pca<-training[,num_var]
training_pca<-training_pca[,-1]
training_pca
```

```
##      LotArea TotalBsmtSF GrLivArea BsmtFinSF1 BsmtFinSF2 X1stFlrSF
## 1       8450         856      1710        706          0       856
## 2       9600        1262      1262        978          0      1262
## 3      11250         920      1786        486          0       920
## 4       9550         756      1717        216          0       961
## 5      14260        1145      2198        655          0      1145
## 6      14115         796      1362        732          0       796
## 7      10084        1686      1694       1369          0      1694
## 8      10382        1107      2090        859         32      1107
```

```
## 9       6120         952      1774          0          0      1022
## 10      7420         991      1077        851          0      1077
## 11     11200        1040      1040        906          0      1040
## 12     11924        1175      2324        998          0      1182
## 13     12968         912       912        737          0       912
## 14     10652        1494      1494          0          0      1494
## 15     10920        1253      1253        733          0      1253
## 16      6120         832       854          0          0       854
## 17     11241        1004      1004        578          0      1004
## 18     10791           0      1296          0          0      1296
## 19     13695        1114      1114        646          0      1114
## 20      7560        1029      1339        504          0      1339
## 21     14215        1158      2376          0          0      1158
## 22      7449         637      1108          0          0      1108
## 23      9742        1777      1795          0          0      1795
## 24      4224        1040      1060        840          0      1060
## 25      8246        1060      1060        188        668      1060
## 26     14230        1566      1600          0          0      1600
## 27      7200         900       900        234        486       900
## 28     11478        1704      1704       1218          0      1704
## 29     16321        1484      1600       1277          0      1600
## 30      6324         520       520          0          0       520
## 31      8500         649      1317          0          0       649
## 32      8544        1228      1228          0          0      1228
## 33     11049        1234      1234          0          0      1234
## 34     10552        1398      1700       1018          0      1700
## 35      7313        1561      1561       1153          0      1561
## 36     13418        1117      2452          0          0      1132
## 37     10859        1097      1097          0          0      1097
## 38      8532        1297      1297       1213          0      1297
## 39      7922        1057      1057        731          0      1057
## 40      6040           0      1152          0          0      1152
## 41      8658        1088      1324        643          0      1324
## 42     16905        1350      1328        967          0      1328
## 43      9180         840       884        747         93       884
## 44      9200         938       938        280        491       938
## 45      7945        1150      1150        179        506      1150
## 46      7658        1752      1752        456          0      1752
## 47     12822        1434      2149       1351          0      1518
## 48     11096        1656      1656         24          0      1656
## 49      4456         736      1452          0          0       736
## 50      7742         955       955        763          0       955
## 51     13869         794      1470        182          0       794
## 52      6240         816      1176          0          0       816
## 53      8472         816       816        104        712       816
## 54     50271        1842      1842       1810          0      1842
## 55      7134         384      1360        384          0      1360
## 56     10175        1425      1425        490          0      1425
## 57      2645         970      1739        649          0       983
## 58     11645         860      1720          0          0       860
```

```
## 59     13682        1410       2945          0          0       1426
## 60      7200         780        780        632          0        780
## 61     13072        1158       1158        941          0       1158
## 62      7200         530       1111          0          0        581
## 63      6442        1370       1370         24          0       1370
## 64     10300         576       1710          0          0        902
## 65      9375        1057       2034        739          0       1057
## 66      9591        1143       2473          0          0       1143
## 67     19900        1947       2207        912          0       2207
## 68     10665        1453       1479       1013          0       1479
## 69      4608         747        747          0          0        747
## 70     15593        1304       2287        603          0       1304
## 71     13651        2223       2223       1880          0       2223
## 72      7599         845        845        565          0        845
## 73     10141         832       1718          0          0        885
## 74     10200        1086       1086        320        362       1086
## 75      5790         840       1605          0          0        840
## 76      1596         462        988        462          0        526
## 77      8475         952        952        228          0        952
## 78      8635         672       1285        336         41       1072
## 79     10778        1768       1768          0          0       1768
## 80     10440         440       1230          0          0        682
## 81     13000         896       2142        448          0       1182
## 82      4500        1237       1337       1201          0       1337
## 83     10206        1563       1563         33          0       1563
## 84      8892        1065       1065          0          0       1065
## 85      8530         384       1474          0          0        804
## 86     16059        1288       2417          0          0       1301
## 87     11911         684       1560          0          0        684
## 88      3951         612       1224          0          0        612
## 89      8470        1013       1526          0          0       1013
## 90      8070         990        990        588          0        990
## 91      7200           0       1040          0          0       1040
## 92      8500        1235       1235        600          0       1235
## 93     13360         876        964        713          0        964
## 94      7200        1214       2291       1046          0       1260
## 95      9337         824       1786        648          0        905
## 96      9765         680       1470        310          0        680
## 97     10264        1588       1588       1162          0       1588
## 98     10921         960        960        520          0        960
## 99     10625         458        835        108          0        835
## 100     9320         950       1225        569          0       1225
## 101    10603        1610       1610       1200          0       1610
## 102     9206         741       1732          0          0        977
## 103     7018           0       1535          0          0       1535
## 104    10402        1226       1226          0          0       1226
## 105     7758        1040       1818        224          0       1226
## 106     9375        1053       1992          0          0       1053
## 107    10800         641       1047          0          0       1047
## 108     6000         789        789        104        169        789
```

```
## 109     8500         793      1517          0          0       997
## 110    11751        1844      1844        705          0      1844
## 111     9525         994      1855        444          0      1216
## 112     7750         384      1430        250          0       774
## 113     9965        1264      2696        984          0      1282
## 114    21000        1809      2259         35        869      2259
## 115     7259        1028      2320        774        150      1436
## 116     3230         729      1458        419          0       729
## 117    11616        1092      1092        170        670      1092
## 118     8536        1125      1125          0          0      1125
## 119    12376        1673      3222       1470          0      1699
## 120     8461         728      1456          0          0       728
## 121    21453         938       988        938          0       988
## 122     6060         732      1123          0          0       772
## 123     9464        1080      1080        570          0      1080
## 124     7892        1199      1199        300          0      1199
## 125    17043        1362      1586          0          0      1586
## 126     6780         520       754        490          0       520
## 127     4928        1078       958        120          0       958
## 128     4388         672       840        116          0       840
## 129     7590         660      1348        512          0       660
## 130     8973        1008      1053        567         28      1053
## 131    14200         924      2157        445          0      1216
## 132    12224         992      2054        695          0      1022
## 133     7388        1063      1327        405          0      1327
## 134     6853        1267      1296       1005          0      1296
## 135    10335        1461      1721        570          0      1721
## 136    10400        1304      1682          0          0      1682
## 137    10355        1214      1214        695          0      1214
## 138    11070        1907      1959          0          0      1959
## 139     9066        1004      1852        668          0      1004
## 140    15426         928      1764        821          0       928
## 141    10500         864       864        432          0       864
## 142    11645        1734      1734       1300          0      1734
## 143     8520         910      1385        507          0       910
## 144    10335        1490      1501        679          0      1501
## 145     9100        1728      1728       1332          0      1728
## 146     2522         970      1709          0          0       970
## 147     6120         715       875        209          0       875
## 148     9505         884      2035          0          0       884
## 149     7500        1080      1080        680          0      1080
## 150     6240         896      1344          0          0       896
## 151    10356         969       969        716          0       969
## 152    13891        1710      1710       1400          0      1710
## 153    14803         825      1993        416          0      1097
## 154    13500        1602      1252        429       1080      1252
## 155    11340        1200      1200          0          0      1200
## 156     9600         572      1096          0          0       572
## 157     7200           0      1040          0          0      1040
## 158    12003         774      1968          0          0       774
```

```
## 159    12552         991      1947         222           0       991
## 160    19378        1392      2462          57           0      1392
## 161    11120        1232      1232         660           0      1232
## 162    13688        1572      2668        1016           0      1572
## 163    12182        1541      1541        1201           0      1541
## 164     5500         882       882           0           0       882
## 165     5400        1149      1616         370           0      1149
## 166    10106         644      1355         351         181       808
## 167    10708        1617      1867         379         768      1867
## 168    10562        1582      2161        1288           0      1610
## 169     8244         840      1720           0           0       840
## 170    16669        1686      1707           0           0      1707
## 171    12358         720      1382         360           0       854
## 172    31770        1080      1656         639           0      1656
## 173     5306        1064      1767         495         215      1064
## 174    10197        1362      1362         288         374      1362
## 175    12416        1606      1651        1398         208      1651
## 176    12615        1202      2158         477           0      2158
## 177    10029        1151      2060         831           0      1164
## 178    13650        1052      1920          57         441      1252
## 179    17423        2216      2234        1904           0      2234
## 180     8520         968       968           0           0       968
## 181     2117         756      1525         436           0       769
## 182     7588         793      1802         352           0       901
## 183     9060           0      1340           0           0      1340
## 184    11426        1362      2082           0           0      1362
## 185     7438         504      1252           0           0       936
## 186    22950        1107      3608           0           0      1518
## 187     9947        1188      1217         611           0      1217
## 188    10410         660      1656           0           0       808
## 189     7018        1086      1224        1086           0      1224
## 190     4923        1593      1593        1153           0      1593
## 191    10570         853      2727         297           0      1549
## 192     7472         725      1479         626           0       725
## 193     9017        1431      1431         560           0      1431
## 194     2522         970      1709           0           0       970
## 195     7180         864       864         390           0       864
## 196     2280         855      1456         566           0       855
## 197     9416        1726      1726        1126           0      1726
## 198    25419        1360      3112        1036         184      1360
## 199     5520         755      2229           0           0       929
## 200     9591        1713      1713        1088           0      1713
## 201     8546        1121      1121           0           0      1121
## 202    10125        1196      1279         641         279      1279
## 203     7000         617      1310         617           0       865
## 204     4438         848       848         662           0       848
## 205     3500         720      1284         312           0       720
## 206    11851        1424      1442           0           0      1442
## 207    13673        1140      1696           0           0      1696
## 208    12493        1100      1100         419         306      1100
```

```
## 209    14364        1157      2062       1065          0      1180
## 210     8250        1092      1092        787          0      1092
## 211     5604         864       864        468          0       864
## 212    10420        1212      1212         36          0      1212
## 213     8640         900      1852        822          0       932
## 214    13568         990       990        716          0       990
## 215    10900         689      1392        378          0       689
## 216    10011        1070      1236        360          0      1236
## 217     8450        1436      1436        946          0      1436
## 218     9906         686      1328          0          0       810
## 219    15660         798      1954        341          0      1137
## 220     3010        1248      1248         16          0      1248
## 221     8990        1498      1498          0          0      1498
## 222     8068        1010      2267          0          0      1010
## 223    11475         713      1552        550          0       811
## 224    10500         864       864        524        180       864
## 225    13472        2392      2392         56          0      2392
## 226     1680         630      1302          0          0       630
## 227     9950        1203      2520        565          0      1214
## 228     1869         483       987        321          0       483
## 229     8521         912       912        842          0       912
## 230     3182        1373      1555         16          0      1555
## 231     8760        1194      1194          0          0      1194
## 232    15138        1462      2794        689          0      1490
## 233     1680         483       987          0          0       483
## 234    10650         894       894        182        712       894
## 235     7851         860      1960        625          0       860
## 236     1680         483       987        358          0       483
## 237     8773        1414      1414         24          0      1414
## 238     9453         996      1744        402          0      1014
## 239    12030        1694      1694          0          0      1694
## 240     8741         735      1487         94          0       798
## 241     9000        1566      1566       1078          0      1566
## 242     3880         686       866        329          0       866
## 243     5000         540      1440          0          0       889
## 244    10762         626      1217          0          0       626
## 245     8880         948      2110        695          0      1222
## 246    10400        1845      1872        929          0      1872
## 247     9142        1020      1928          0          0       908
## 248    11310        1367      1375          0          0      1375
## 249    11317         840      1668          0          0       840
## 250   159000        1444      2144        697          0      1444
## 251     5350         728      1306          0          0      1306
## 252     4750        1573      1625       1573          0      1625
## 253     8366         798      1640          0          0       798
## 254     9350        1302      1302        270        580      1302
## 255     8400        1314      1314        922          0      1314
## 256     8738         975      2291          0          0      1005
## 257     8791         864      1728        503          0       864
## 258     8814        1604      1604       1334          0      1604
```

```
## 259    12435         963      1792         361           0       963
## 260    12702           0       882           0           0       882
## 261    19296        1362      1382         672         690      1382
## 262     9588        1482      2574           0           0      1482
## 263     8471         506      1212         506           0      1212
## 264     5500         926      1316         234         692       926
## 265     5232         680       764           0           0       764
## 266    12090        1422      1422         588         228      1422
## 267    11207         802      1511         714           0       802
## 268     8400         720      2192         378           0      1052
## 269     6900         740       778         403         125       778
## 270     7917        1143      1113         751           0      1113
## 271    10728        1095      1939           0           0      1095
## 272    39104        1385      1363         226        1063      1363
## 273    11764        1152      2270         524           0      1164
## 274     9600        1240      1632         620         620      1632
## 275     8314         816       816         546           0       816
## 276     7264         952      1548           0           0       952
## 277     9196        1560      1560           0           0      1560
## 278    19138         864       864         120           0       864
## 279    14450        2121      2121           0           0      2121
## 280    10005        1160      2022         392           0      1156
## 281    11287         807      1982         421           0      1175
## 282     7200        1262      1262         905           0      1262
## 283     5063        1314      1314         904           0      1314
## 284     9612        1468      1468           0           0      1468
## 285     8012        1575      1575         430           0      1575
## 286     4251         625      1250           0           0       625
## 287     9786         912      1734         600           0      1085
## 288     8125         858       858         614           0       858
## 289     9819         882       900         450           0       900
## 290     8730         698      1396           0           0       698
## 291    15611        1079      1919           0           0      1079
## 292     5687         780      1716         210           0       936
## 293    11409         768      1716         292           0      1148
## 294    16659         795      2263         795           0      1468
## 295     9600        1416      1644        1285           0      1644
## 296     7937        1003      1003         819           0      1003
## 297    13710         910      1558         420           0       910
## 298     7399         975      1950         649           0       975
## 299    11700         702      1743         384         175      1041
## 300    14000        1092      1152           0           0      1152
## 301    15750        1165      1336         841           0      1336
## 302    16226        1028      2452         281           0      1210
## 303    13704        1541      1541           0           0      1541
## 304     9800         894       894         894           0       894
## 305    18386        1470      3493           0           0      1675
## 306    10386        2000      2000        1464           0      2000
## 307    13474         700      2243         700           0      1122
## 308     7920         319      1406           0           0      1035
```

```
## 309    12342         861        861         262           0        861
## 310    12378        1896       1944        1274           0       1944
## 311     7685         697       1501         518           0        697
## 312     8000         972        972         680           0        972
## 313     7800         793       1118         507           0        793
## 314   215245        2136       2036        1236         820       2036
## 315     9600         728       1641          16           0        832
## 316     7795         716       1432         425           0        716
## 317    13005         845       2353         692           0       1153
## 318     9000        1088       1959           0           0       1088
## 319     9900        1347       2646         987           0       1372
## 320    14115        1372       1472        1036           0       1472
## 321    16259        1249       2596           0           0       1249
## 322    12099        1136       2468         970           0       1136
## 323    10380        1502       2730          28        1474       1553
## 324     5820        1162       1163         256           0       1163
## 325    11275         710       2978           0           0       1898
## 326     5000         720        803         116           0        803
## 327    10846        1719       1719        1619           0       1719
## 328    11600        1383       1383         565           0       1383
## 329    11888         844       2134           0           0       1445
## 330     6402         596       1192           0           0        596
## 331    10624        1728       1728          40         264       1728
## 332     8176        1056       1056         846           0       1056
## 333    10655        3206       1629        1124         479       1629
## 334     8198        1358       1358         720           0       1358
## 335     9042         943       1638         828           0        943
## 336   164660        1499       1786        1249         147       1619
## 337    14157        1922       1922        1249           0       1922
## 338     9135        1536       1536         810           0       1536
## 339    14145        1208       1621         213           0       1621
## 340    12400        1215       1215         585           0       1215
## 341    14191         967       1908           0           0        993
## 342     8400         721        841           0           0        841
## 343     8544           0       1040           0           0       1040
## 344     8849        1684       1684          28           0       1684
## 345     2592         536       1112         129         232        536
## 346     6435         972       1577           0           0        972
## 347    12772         958        958         498           0        958
## 348    17600        1478       1478        1270           0       1478
## 349     2448         764       1626         573           0        764
## 350    20431        1848       2728        1410           0       1848
## 351     7820        1869       1869           0           0       1869
## 352     5271        1453       1453        1082           0       1453
## 353     9084         616       1111         236         380        616
## 354     8520         624        720           0           0        720
## 355     8400         940       1595         388           0       1192
## 356    11249        1200       1200         334         544       1200
## 357     9248        1158       1167         560           0       1167
## 358     4224        1142       1142         874           0       1142
```

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## 359     6930        1062      1352         300         294      1352
## 360    12011        1086      1924         956           0      1086
## 361     7540         888       912         773           0       912
## 362     9144         883      1505         399           0       988
## 363     7301           0      1922           0           0       495
## 364     1680         483       987         162           0       483
## 365    18800         796      1574         712           0       790
## 366    10690         672      1344         456           0       672
## 367     9500        1394      1394         609           0      1394
## 368     9150        1099      1431         371           0      1431
## 369     7800        1268      1268         540           0      1268
## 370     9830        1063      1287          72         258      1287
## 371     8121         953      1664           0           0       953
## 372    17120           0      1588           0           0      1120
## 373     7175         744       752         623         121       752
## 374    10634         608      1319         428         180      1319
## 375     8200         847      1928           0           0       847
## 376    10020         683       904         350           0       904
## 377     8846         870       914         298           0       914
## 378    11143        1580      2466           0           0      1580
## 379    11394        1856      1856        1445           0      1856
## 380     8123         982      1800           0           0      1007
## 381     5000        1026      1691         218           0      1026
## 382     7200        1293      1301           0           0      1301
## 383     9245         939      1797           0           0       939
## 384     9000         784       784           0           0       784
## 385    53107        1580      1953         985           0      1079
## 386     3182        1256      1269          24           0      1269
## 387     8410         658      1184           0           0       658
## 388     7200        1041      1125         631           0      1125
## 389     9382        1468      1479           0           0      1479
## 390    12474        1682      2332        1280           0      1742
## 391     8405         861      1367         241         391       961
## 392    12209         804      1961         690           0       804
## 393     8339           0       882           0           0       882
## 394     7446         788       788         266           0       788
## 395    10134         735      1034           0           0       735
## 396     9571        1144      1144         739           0      1144
## 397     7200         894       894         777           0       894
## 398     7590         864      1812         540           0       876
## 399     8967         961      1077           0           0      1077
## 400     8125        1092      1550         812           0      1112
## 401    14963        1260      1288         786           0      1288
## 402     8767        1310      1310          24           0      1310
## 403    10200         672       672           0           0       672
## 404    12090        1141      2263           0           0      1165
## 405    10364         806      1572           0           0       806
## 406     9991        1281      1620        1116           0      1620
## 407    10480        1064      1639           0           0      1166
## 408    15576         840      1680           0           0       840
```

```
## 409    14154        1063      2172         0          0      1071
## 410    10800        1034      2078       789          0      1050
## 411     9571        1276      1276         0          0      1276
## 412    34650        1056      1056      1056          0      1056
## 413     4403        1470      1478       578          0      1478
## 414     8960        1008      1028         0          0      1028
## 415    11228        1080      2097        50        531      1080
## 416     8899        1340      1340        24          0      1340
## 417     7844         672      1400       209          0       672
## 418    22420        1370      2624      1128          0      1370
## 419     8160         756      1134       312          0       756
## 420     8450        1056      1056       775          0      1056
## 421     7060        1344      1344      1309          0      1344
## 422    16635        1602      1602      1246          0      1602
## 423    21750         988       988         0          0       988
## 424     9200        1470      2630       986          0      1470
## 425     9000        1196      1196       616          0      1196
## 426     3378         651      1389         0          0       707
## 427    12800        1518      1644      1518          0      1644
## 428     8593         907       907       288          0       907
## 429     6762        1208      1208       664          0      1208
## 430    11457        1392      1412      1005          0      1412
## 431     1680         483       987       387          0       483
## 432     5586         901      1198         0          0      1088
## 433     1920         765      1365       471          0       765
## 434    10839         926      1604         0          0       926
## 435     1890         630       630       495          0       630
## 436    10667         799      1661       385        344       827
## 437     4400         648      1118         0          0       734
## 438     6000         884       904         0          0       904
## 439     4280         440       694       365          0       694
## 440    12354         684      1196         0          0       684
## 441    15431        3094      2402      1767        539      2402
## 442    12108        1440      1440       133          0      1440
## 443     6240        1078      1573         0          0      1128
## 444     3922        1258      1258         0          0      1258
## 445     8750         915      1908       642          0       933
## 446     9855        1436      1689         0          0      1689
## 447    16492        1517      1888       247        713      1888
## 448    11214         930      1886         0          0       956
## 449     8600         780      1376         0          0       780
## 450     6000         649      1183       331          0       679
## 451     5684         813       813         0          0       813
## 452    70761        1533      1533       655          0      1533
## 453     9303         872      1756       742          0       888
## 454     9000         768      1590         0          0       786
## 455     9297        1728      1728      1606          0      1728
## 456     9600        1242      1242       916          0      1242
## 457     4571         624      1344         0          0       624
## 458    53227        1364      1663      1116          0      1663
```

```
## 459     5100         588      1666          0          0       833
## 460     7015         709      1203        185          0       979
## 461     8004         832      1935        544          0       832
## 462     7200         560      1135        350        210       575
## 463     8281         864       864        553        311       864
## 464    11988         715      1660        326          0       849
## 465     8430        1040      1040        616          0      1040
## 466     3072        1375      1414          0          0      1414
## 467    10628        1277      1277        778          0      1277
## 468     9480         728      1644        386          0       888
## 469    11428        1626      1634          0          0      1634
## 470     9291         832      1710        426          0       832
## 471     6820        1488      1502        368       1120      1502
## 472    11952         808      1969          0          0      1161
## 473     3675         547      1072        459          0      1072
## 474    14977        1976      1976       1350          0      1976
## 475     5330        1494      1652       1196          0      1652
## 476     8480         970       970        630          0       970
## 477    13125        1478      1493        994          0      1493
## 478    13693        2153      2643          0          0      2069
## 479    10637        1705      1718       1288          0      1718
## 480     5925         907      1131        168          0      1131
## 481    16033        1833      1850       1261          0      1850
## 482    11846        1792      1792       1567          0      1792
## 483     2500         910      1826        299          0       916
## 484     4500        1216      1216        897          0      1216
## 485     7758         999       999        588          0       999
## 486     9600        1113      1113        607          0      1113
## 487    10289        1073      1073        836          0      1073
## 488    12243        1484      1484        998          0      1484
## 489    10800         954      2414        664          0      1766
## 490     1526         630       630        515          0       630
## 491     2665         264      1304          0          0       616
## 492     9490         806      1578        403        165       958
## 493    15578         728      1456          0          0       728
## 494     7931        1269      1269        374        532      1269
## 495     5784         190       886          0          0       886
## 496     7879         720       720        495          0       720
## 497    12692        3200      3228       1231          0      3228
## 498     9120        1026      1820        329          0      1133
## 499     7800         864       899        450          0       899
## 500     7535         912       912        111        279       912
## 501     1890         672      1218        356          0       672
## 502     9803         866      1768        400          0       866
## 503     9170        1214      1214        698         96      1214
## 504    15602        1501      1801       1247          0      1801
## 505     2308         855      1322        257        495       855
## 506     7596         960      1960          0          0       960
## 507     9554         777      1911        380          0      1065
## 508     7862        1218      1218         27          0      1218
```

```
## 509     9600         689      1378         141           0       689
## 510     9600        1041      1041         991           0      1041
## 511    14559        1008      1363         650         180      1363
## 512     6792        1368      1368           0           0      1368
## 513     9100         864       864         521         174       864
## 514     9187        1084      1080         336           0      1080
## 515    10594         768       789           0           0       789
## 516    12220        2006      2020        1436           0      2020
## 517    10448         689      2119           0           0      1378
## 518    10208        1264      2344           0           0      1277
## 519     9531         794      1796         706           0       882
## 520    10918        1276      2080           0           0      1276
## 521    10800           0      1294           0           0       694
## 522    11988        1244      1244         777           0      1244
## 523     5000        1004      1664         399           0      1004
## 524    40094        3138      4676        2260           0      3138
## 525    11787        1379      2398         719           0      1383
## 526     7500        1257      1266           0           0      1266
## 527    13300         928       928         377           0       928
## 528    14948        1452      2713        1330           0      1476
## 529     9098         528       605         348           0       605
## 530    32668        2035      2515        1219           0      2515
## 531    10200        1461      1509         783           0      1509
## 532     6155         611      1362           0           0       751
## 533     7200           0       827           0           0       827
## 534     5000           0       334           0           0       334
## 535     9056         707      1414           0           0       707
## 536     7000        1117      1347         969           0       820
## 537     8924         880      1724           0           0       880
## 538    12735         864       864         600           0       864
## 539    11553        1051      1159         673           0      1159
## 540    11423        1581      1601        1358           0      1601
## 541    14601        1838      1838        1260           0      1838
## 542    11000         969      2285           0           0       997
## 543    10140        1650      1680         144        1127      1680
## 544     4058         723       767         584         139       767
## 545    17104         654      1496         554           0       664
## 546    13837        1204      2183        1002         202      1377
## 547     8737        1065      1635         300           0       915
## 548     7244         768       768         619           0       768
## 549     8235         825       825         180         645       825
## 550     9375         912      2094           0           0       912
## 551     4043        1069      1069         559           0      1069
## 552     6000         928       928         308           0       928
## 553    11146        1709      1717           0           0      1717
## 554     8777           0      1126           0           0      1126
## 555    10625         998      2046         866           0      1006
## 556     6380         993      1048           0           0      1048
## 557    14850        1092      1092         895           0      1092
## 558    11040         637      1336         637           0       897
```

```
## 559    21872         729      1446         604           0       729
## 560     3196        1374      1557           0           0      1557
## 561    11341        1392      1392        1302           0      1392
## 562    10010        1389      1389        1071         123      1389
## 563    13907         996       996         290           0       996
## 564    21780        1163      1674           0           0      1163
## 565    13346        1095      2295         728           0      1166
## 566     6858         806      1647           0           0       841
## 567    11198        1122      2504           0           0      1134
## 568    10171        1517      1535           2           0      1535
## 569    12327        1496      2132        1441           0      1496
## 570     7032         943       943         943           0       943
## 571    13101        1728      1728         231           0      1728
## 572     7332         864       864         414           0       864
## 573    13159         846      1692           0           0       846
## 574     9967         384      1430           0           0       774
## 575    10500         372      1109         349           0       576
## 576     8480         832      1216         442           0       832
## 577     6292         861      1477           0           0       877
## 578    11777        1164      1320         328         551      1320
## 579     3604         689      1392           0           0       703
## 580    12150        1050      1795           0           0      1050
## 581    14585        1144      1429         594         219      1429
## 582    12704        2042      2042           0           0      2042
## 583    11841         816       816         816           0       816
## 584    13500        1237      2775           0           0      1521
## 585     6120         884      1573           0           0       989
## 586    11443        1868      2028        1460           0      2028
## 587    10267         816       838         210         606       838
## 588     8740         840       860         672           0       860
## 589    25095        1437      1473        1324           0      1473
## 590     9100         742       935           0           0       779
## 591     8320         770      1582         490           0       770
## 592    13478        1722      2296        1338           0      1728
## 593     6600         816       816         816           0       816
## 594     4435         848       848         685           0       848
## 595     7990         924       924           0           0       924
## 596    11302        1814      1826        1422           0      1826
## 597     3600         684      1368           0           0       684
## 598     3922        1258      1402           0           0      1402
## 599    12984        1430      1647        1283         147      1647
## 600     1950         716      1556          81         612       716
## 601    10927        1058      1904         546           0      1058
## 602     9000         780      1375           0           0       780
## 603    10041         908      1915         789           0       927
## 604     3182         600      1200           0           0       600
## 605    12803        1494      1494         922           0      1494
## 606    13600         768      1986         454           0      1186
## 607    12464        1040      1040         732           0      1040
## 608     7800         896      2008         603           0      1112
```

```
## 609    12168         965      3194         428           0      1940
## 610     7943        1029      1029         903           0      1029
## 611    11050        1440      2153         904           0      1476
## 612    10395        1032      1032         605           0      1032
## 613    11885        1299      1872         990           0      1299
## 614     8402        1120      1120         206           0      1120
## 615     1491         630       630         150         480       630
## 616     8800         936      1054         763           0      1054
## 617     7861         783      1509         457           0       807
## 618     7227         832       832           0           0       832
## 619    11694        1822      1828          48           0      1828
## 620    12244        1482      2262         871           0      1482
## 621     8248         864       864          41           0       864
## 622    10800        1522      2614         956         182      1548
## 623     7064         980       980         560           0       980
## 624     2117         756      1512         420           0       756
## 625    10400         732      1790         247           0      1012
## 626    10000        1116      1116           0           0      1116
## 627    12342         978      1422           0           0      1422
## 628     9600        1156      1520         674         132      1520
## 629    11606        1040      2080         650           0      1040
## 630     9020        1248      1350         624         336      1350
## 631     9000         636      1750           0           0      1089
## 632     4590        1554      1554          24           0      1554
## 633    11900        1386      1411         822           0      1411
## 634     9250        1056      1056         480         468      1056
## 635     6979        1056      1056        1056           0      1056
## 636    10896        1440      3395         256           0      1440
## 637     6120         264       800           0           0       800
## 638     6000         811      1387           0           0       811
## 639     8777         796       796           0           0       796
## 640     3982        1520      1567        1154           0      1567
## 641    12677        1518      1518        1218           0      1518
## 642     7050        1057      1929         738           0      1057
## 643    13860        1952      2704        1410           0      2000
## 644    10793         780      1620         493         287       780
## 645     9187        1766      1766        1121           0      1766
## 646    10530         981       981         282          35       981
## 647     7200           0      1048           0           0      1048
## 648    10452        1094      1094         500           0      1094
## 649     7700         756      1839           0           0      1051
## 650     1936         630       630         131         499       630
## 651     8125         813      1665           0           0       822
## 652     9084         755      1510           0           0       755
## 653     8750         880      1716           0           0       909
## 654    10320         756      1469           0           0       756
## 655    10437        2109      2113        1696           0      2113
## 656     1680         525      1092           0           0       525
## 657    10007        1053      1053         806           0      1053
## 658     7200         776      1502           0           0       851
```

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## 659    17503         912      1458         0          0       912
## 660     9937        1486      1486       637          0      1486
## 661    12384         793      1935         0          0      1142
## 662    46589        1629      2448      1361        180      1686
## 663    13560        1392      1392         0          0      1392
## 664    10012        1138      1181       920        180      1181
## 665    20896        2077      2097      1721          0      2097
## 666    11194        1406      1936         0          0      1454
## 667    18450        1021      2380       187        723      1465
## 668     8125        1408      1679      1138          0      1679
## 669    14175        1188      1437       988          0      1437
## 670    11600         700      1180         0          0      1180
## 671     8633         738      1476       193          0       738
## 672     6629         672      1369       551          0       697
## 673    11250        1208      1208       767          0      1208
## 674    14442        1477      1839      1186          0      1839
## 675     9200        1136      1136       892          0      1136
## 676     2289         855      1441       311          0       855
## 677     9600        1095      1774         0          0      1095
## 678     9022         768       792         0          0       792
## 679    11844        2046      2046         0          0      2046
## 680     9945         988       988       827          0       988
## 681     8012         923       923       543        119       923
## 682     4500         793      1520       182          0       848
## 683     2887        1291      1291      1003          0      1291
## 684    11248        1626      1668      1059          0      1668
## 685    16770        1195      1839         0          0      1195
## 686     5062        1190      2090       828        182      1190
## 687    10207         874      1761         0          0       874
## 688     5105         551      1102       239          0       551
## 689     8089        1419      1419       945          0      1419
## 690     7577        1362      1362        20          0      1362
## 691     4426         848       848       697          0       848
## 692    21535        2444      4316      1455          0      2444
## 693    26178        1210      2519       965          0      1238
## 694     5400        1073      1073         0          0      1073
## 695     6120         927      1539         0          0      1067
## 696    13811        1112      1137       980         40      1137
## 697     6000         616       616       616          0       616
## 698     6420         980      1148       210        551      1148
## 699     8450         894       894       553        117       894
## 700     4282        1391      1391        16          0      1391
## 701    14331        1800      1800      1274          0      1800
## 702     9600        1164      1164         0          0      1164
## 703    12438        1234      2576         0          0      1264
## 704     7630         360      1812         0          0      1032
## 705     8400        1473      1484       712          0      1484
## 706     5600           0      1092         0          0       372
## 707   115149        1643      1824      1219          0      1824
## 708     6240        1324      1324       863          0      1324
```

```
## 709     9018         728      1456          0          0       728
## 710     7162         876       904          0          0       904
## 711     4130         270       729          0          0       729
## 712     8712         859      1178          0          0       859
## 713     4671        1228      1228        767          0      1228
## 714     9873         960       960        789          0       960
## 715    13517         725      1479        533          0       725
## 716    10140        1064      1350          0          0      1350
## 717    10800         718      2554          0          0      1576
## 718    10000        1176      1178       1084          0      1178
## 719    10542        1311      2418       1173          0      1325
## 720     9920         971       971        523          0       971
## 721     6563        1742      1742       1148          0      1742
## 722     4426         848       848        662          0       848
## 723     8120         864       864        191          0       864
## 724     8172         941      1470          0          0       997
## 725    13286        1698      1698       1234          0      1698
## 726     6960         864       864        375        239       864
## 727    21695         880      1680        808          0      1680
## 728     7314        1232      1232        724          0      1232
## 729    11475        1584      1776          0          0      1776
## 730     6240         780      1208        152          0       848
## 731     5389        1595      1616       1180          0      1616
## 732     9590         868      1146        786          0      1146
## 733    11404        1153      2031        252          0      1153
## 734    10000         864      1144        594          0      1144
## 735     8978         948       948          0          0       948
## 736    10800         880      1768        390          0       880
## 737     8544           0      1040          0          0      1040
## 738    10463         893      1801          0          0       901
## 739    10800        1200      1200       1200          0      1200
## 740     9313         864      1728          0          0       864
## 741     9600         264      1432          0          0       768
## 742     6768         912       912        832          0       912
## 743     8450        1349      1349          0          0      1349
## 744    12886         520      1464        444          0      1464
## 745     5395        1337      1337        733          0      1337
## 746     8963        1142      2715        575         80      1175
## 747     8795         952      2256        300          0       980
## 748    11700        1240      2640          0          0      1320
## 749    10593        1720      1720        919          0      1720
## 750     8405           0      1529          0          0      1088
## 751     8800         576      1140          0          0       792
## 752     7750         660      1320          0          0       660
## 753     9236        1479      1494       1200          0      1494
## 754    10240        1030      2098          0          0      1038
## 755     7930        1026      1026        439        472      1026
## 756     3230         729      1471        381          0       742
## 757    10769         866      1768         20          0       866
## 758    11616         672      1386        438          0       672
```

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## 759     2280         744      1501         549           0       757
## 760    12257        1318      2531          56          64      1328
## 761     9100         864       864         612           0       864
## 762     6911        1145      1301         405           0      1301
## 763     8640         756      1547          24           0       764
## 764     9430        1252      2365        1163           0      1268
## 765     9549        1494      1494         437        1057      1494
## 766    14587        1498      1506           0           0      1506
## 767    10421         980      1714         394           0       980
## 768    12508         983      1750         660           0       983
## 769     9100        1860      1836          24           0      1836
## 770    53504        1650      3279        1416           0      1690
## 771     7252         858       858         685           0       858
## 772     8877         836      1220         836           0      1220
## 773     7819        1029      1117         422         127      1117
## 774    10150         912       912         456           0       912
## 775    14226        1935      1973           0           0      1973
## 776     4500        1204      1204         866           0      1204
## 777    11210        1614      1614          20           0      1614
## 778    13350         864       894         762           0       894
## 779     8400           0      2020           0           0      2020
## 780    10530         975      1004         975           0      1004
## 781     7875        1237      1253           0           0      1253
## 782     7153         761      1603         387           0       810
## 783    16285        1413      1430           0           0      1430
## 784     9101        1097      1110        1097           0      1110
## 785     6300         742      1484           0           0       742
## 786     9790        1372      1342         251         630      1342
## 787    10800         686      1652         686           0       966
## 788    10142         956      2084         656           0       956
## 789     6000         901       901           0           0       901
## 790    12205         832      2087         568           0       976
## 791     3182        1145      1145          16           0      1145
## 792    11333        1029      1062         539           0      1062
## 793     9920        1117      2013         862           0      1127
## 794     9158        1496      1496           0           0      1496
## 795    10832         712      1895           0           0      1086
## 796     8400         650      1564           0           0       888
## 797     8197         660      1285           0           0      1285
## 798     7677         773       773         570           0       773
## 799    13518        1926      3140           0           0      1966
## 800     7200         731      1768         569           0       981
## 801    12798         616      1688         462           0       616
## 802     4800        1196      1196         197           0      1196
## 803     8199         728      1456         648           0       728
## 804    13891        1734      2822           0           0      1734
## 805     9000         936      1128         812           0      1128
## 806    12274        1417      1428           0           0      1428
## 807     9750         980       980         400         480       980
## 808    21384        1324      1576        1309           0      1072
```

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## 809    13400        1024      1086         516        128      1086
## 810     8100         849      2138           0          0      1075
## 811    10140        1040      1309         663        377      1309
## 812     4438         848       848         662          0       848
## 813     8712         540      1044           0          0      1044
## 814     9750        1442      1442         608          0      1442
## 815     8248         686      1250           0          0       686
## 816    12137        1649      1661           0          0      1661
## 817    11425        1008      1008         486          0      1008
## 818    13265        1568      1689        1218          0      1689
## 819     8816        1010      1052         504          0      1052
## 820     6371        1358      1358         733          0      1358
## 821     7226         798      1640           0          0       798
## 822     6000         936       936           0          0       936
## 823    12394         847      1733           0          0       847
## 824     9900         778      1489           0          0       944
## 825    11216        1489      1489           0          0      1489
## 826    14803        2078      2084        1636          0      2084
## 827     6130         784       784         784          0       784
## 828     8529        1454      1434          20          0      1434
## 829    28698        1013      2126         249        764      1160
## 830     2544         600      1223           0          0       520
## 831    11900        1392      1392        1040          0      1392
## 832     3180         600      1200           0          0       520
## 833     9548         941      1829         483          0       941
## 834    10004        1516      1516         196        345      1516
## 835     7875        1144      1144         572          0      1144
## 836     9600        1067      1067         442          0      1067
## 837     8100        1559      1559         338          0      1559
## 838     1680         483       987         330          0       483
## 839     9525        1099      1099           0          0      1099
## 840    11767         768      1200         352          0       768
## 841    12155         672      1482         156          0       810
## 842    10440         650      1539           0          0       958
## 843     9020        1127      1165         312        539      1165
## 844     8000        1800      1800           0          0      1800
## 845    12665         876      1416           0          0       876
## 846    16647        1390      1701        1390          0      1701
## 847     9317         740      1775         513          0      1006
## 848    15523         864       864         460          0       864
## 849    45600         907      2358           0          0      1307
## 850     9600         528      1855           0          0      1094
## 851     4435         848       848         659          0       848
## 852     3196        1273      1456           0          0      1456
## 853     7128         918      1646         364          0       918
## 854    12095        1127      1445         564          0      1445
## 855    17920        1763      1779         306       1085      1779
## 856     6897        1040      1040         659          0      1040
## 857    10970         940      1026         505        435      1026
## 858     8125         702      1481           0          0       702
```

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## 859    10400        1090      1370         0          0      1370
## 860    11029        1054      2654       619          0      1512
## 861     7642         912      1426         0          0       912
## 862    11625        1039      1039       841          0      1039
## 863     9672        1040      1097       338          0      1097
## 864     7931        1148      1148      1148          0      1148
## 865     8640        1372      1372         0          0      1372
## 866     8750        1002      1002       828          0      1002
## 867    10656        1638      1646         0          0      1646
## 868     6970        1040      1120       932          0      1120
## 869    14762           0      2320         0          0      1547
## 870     9938        1050      1949       750          0      1062
## 871     6600         894       894         0          0       894
## 872     8750         804      1682       505          0       804
## 873     8892         105       910         0          0       910
## 874    12144         832      1268       375          0      1036
## 875     5720         676      1131         0          0       676
## 876     9000        1184      2610        64          0      1184
## 877    25286        1064      1040       633          0      1040
## 878     8834        1462      2224      1170          0      1462
## 879    11782        1109      1155       899          0      1155
## 880     7000         864       864       646          0       864
## 881     7024        1090      1090       980          0      1090
## 882    13758        1156      1717       902          0      1187
## 883     9636         808      1593         0          0       808
## 884     6204         795      2230         0          0       954
## 885     7150         892       892       432          0       892
## 886     5119        1698      1709      1238          0      1709
## 887     8393        1626      1712       528          0      1712
## 888    16466         816      1393         0          0       872
## 889    15865        2217      2217       351        823      2217
## 890    12160        1505      1505      1024          0      1505
## 891     8064         672       924         0          0       672
## 892    11184         918      1683       226        500       918
## 893     8414        1059      1068       663          0      1068
## 894    13284        1383      1383      1064          0      1383
## 895     7018           0      1535         0          0      1535
## 896     7056         780      1796       400          0       983
## 897     8765         951       951       285          0       951
## 898     7018           0      2240         0          0      1120
## 899    12919        2330      2364      2188          0      2364
## 900     6993         912      1236       465          0      1236
## 901     7340         858       858       322          0       858
## 902     8712         992      1306       860          0      1306
## 903     7875         783      1509         0          0       807
## 904    14859        1670      1670         0          0      1670
## 905     6173         876       902       599          0       902
## 906     9920        1056      1063       354        290      1063
## 907    13501        1623      1636        63          0      1636
## 908    11500        1017      2057       223          0      1020
```

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## 909     8885         864        902         301         324        902
## 910    12589         742       1484           0           0        742
## 911    11600        1105       2274         443           0       1105
## 912     9286        1268       1268         196           0       1268
## 913     6120         768       1015         489           0       1015
## 914     6270        1001       2002         284           0       1001
## 915     3000         612       1224         294           0        612
## 916     2001         546       1092           0           0        546
## 917     9000         480        480          50           0        480
## 918    17140        1134       1229        1059           0       1229
## 919    13125        1104       2127          48         634        912
## 920    11029        1184       1414         528         411       1414
## 921     8462         928       1721         814           0        936
## 922     8777        1272       2200        1084           0       1272
## 923    10237        1316       1316          28           0       1316
## 924     8012        1604       1617         165         841       1617
## 925    10240        1686       1686         625        1061       1686
## 926    15611        1126       1126         767          93       1126
## 927    11999        1181       2374           0           0       1234
## 928     9900         832       1978         552           0       1098
## 929    11838        1753       1788           0           0       1788
## 930    13006         964       2236           0           0        993
## 931     8925        1466       1466          16           0       1466
## 932     9100         925        925         338         466        925
## 933    11670        1905       1905           0           0       1905
## 934     8487        1500       1500          20           0       1500
## 935    27650         585       2069         425           0       2069
## 936     5825         600        747           0           0        747
## 937    10083        1176       1200         833           0       1200
## 938     9675        1113       1971         341           0       1113
## 939     8760        1391       1962         464           0       1391
## 940    24090        1032       2403           0           0       1207
## 941    12640        1728       1728         936         396       1728
## 942     8755         992       2060         772           0       1022
## 943     7711        1440       1440        1440           0       1440
## 944    25000        1632       1632           0           0       1632
## 945    14375         819       1344         111         354       1344
## 946     8820        1088       1869        1088           0       1188
## 947     8163        1144       1144         748         294       1144
## 948    14536        1616       1629        1300           0       1629
## 949    14006         936       1776           0           0        936
## 950     9360        1161       1381         982           0       1381
## 951     7200         864        864         398         149        864
## 952     7800         828        965         641           0        965
## 953     7200         768        768         660           0        768
## 954    11075         784       1968         562         193       1168
## 955     9400         945        980         945           0        980
## 956     7136         979       1958         484           0        979
## 957     1300         561       1229         285           0        561
## 958     7420        1057       1057         417           0       1057
```

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## 959     8450        1337      1337        699          0      1337
## 960     2572         696      1416        604          0       696
## 961     7207         858       858        696          0       858
## 962    12227        1330      2872        896          0      1542
## 963     2308         804      1548        556          0       804
## 964    11923        1800      1800          0          0      1800
## 965    11316         817      1894        624          0       824
## 966    10237         783      1484          0          0       783
## 967     9600         728      1308        428          0       976
## 968     7390        1098      1098        902          0      1098
## 969     5925         600       968          0          0       600
## 970    10382         588      1095        513          0      1095
## 971    10800         720      1192          0          0       720
## 972     2268         764      1626        567          0       764
## 973     7892         918       918          0          0       918
## 974    11639        1428      1428          0          0      1428
## 975    11414         728      2019          0          0      1136
## 976     2651         673      1382        641          0       673
## 977     5900         440       869          0          0       869
## 978     4274        1241      1241       1106          0      1241
## 979     9450         894       894        552          0       894
## 980     8816        1121      1121        651          0      1121
## 981    12122         944       999        867          0       999
## 982    12203        1225      2612        854          0      1276
## 983     3182        1266      1266          0          0      1266
## 984    11250        1128      2290          0          0      1149
## 985    10125           0      1734          0          0      1302
## 986    10880        1164      1164       1040          0      1164
## 987     5310         485      1635          0          0      1001
## 988    10159        1930      1940       1646          0      1940
## 989    12046         848      2030        156          0      1118
## 990     8125         770      1576          0          0       778
## 991     9452        1396      2392       1074          0      1407
## 992    17671         916      1742        216          0       916
## 993     9760         822      1851        536        117      1020
## 994     8846         750      1500          0          0       750
## 995    12456        1700      1718       1172          0      1718
## 996     4712         747      1230        384          0       774
## 997    10659        1050      1050        915          0      1050
## 998    11717        1442      1442          0          0      1442
## 999     9786        1007      1077          0          0      1077
## 1000    6762        1187      1208        686          0      1208
## 1001   10206           0       944          0          0       944
## 1002    5400         691       691          0          0       691
## 1003   11957        1574      1574         24          0      1574
## 1004   11500        1680      1680          0          0      1680
## 1005    3182        1346      1504         16          0      1504
## 1006    8385         985       985        595          0       985
## 1007   12155        1657      1657       1237          0      1657
## 1008    2217         546      1092        273        273       546
```

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## 1009   12118        1710      1710          0          0      1710
## 1010    6000        1008      1522          0          0      1008
## 1011   21286         720      1271          0          0       720
## 1012    9825           0      1664          0          0      1664
## 1013   10592         602      1502          0          0       900
## 1014    7200        1022      1022        247        465      1022
## 1015   11664        1082      1082        336          0      1082
## 1016    8400         810      1665        643          0       810
## 1017   11883        1504      1504        690          0      1504
## 1018    5814        1220      1360       1036          0      1360
## 1019   10784         384      1472          0          0       802
## 1020    3013        1362      1506         16          0      1506
## 1021    7024        1132      1132       1024          0      1132
## 1022    7406        1199      1220        684          0      1220
## 1023    9439         912      1248        324          0       912
## 1024    3182        1346      1504         16          0      1504
## 1025   15498        1565      2898       1165        400      2898
## 1026    7700         882       882        138        468       882
## 1027    9300        1268      1264        697          0      1264
## 1028    9520        1638      1646       1513          0      1646
## 1029    9492         768      1376        368         41       968
## 1030    1680         672      1218        317          0       672
## 1031    7082         686      1928          0          0       948
## 1032   15863         824      3082        523          0      1687
## 1033   14541        1338      2520       1012          0      1352
## 1034    8125        1654      1654        986          0      1654
## 1035    6305         920       954          0          0       954
## 1036   11500           0       845          0          0       845
## 1037   12898        1620      1620       1022          0      1620
## 1038    9240        1055      2263          0          0      1055
## 1039    1533         546      1344          0          0       798
## 1040    1477         630       630        509          0       630
## 1041   13125        1134      1803        168        682      1803
## 1042    9130         800      1632        400         64       800
## 1043    5381        1306      1306        900          0      1306
## 1044   11839        1475      2329       1085          0      1532
## 1045    9600        2524      2524       1104          0      2524
## 1046   13680           0      1733          0          0      1733
## 1047   16056        1992      2868        240          0      1992
## 1048    9245         990       990        686          0       990
## 1049   21750           0      1771          0          0      1771
## 1050   11100           0       930          0          0       930
## 1051    8993        1302      1302          0          0      1302
## 1052   11175        1316      1316          0          0      1316
## 1053    9500         816      1977        442          0      1127
## 1054    8562        1216      1526        383          0      1526
## 1055   11367        1065      1989        932          0      1091
## 1056   11361        1193      1523        644          0      1523
## 1057    7052        1364      1364        659          0      1364
## 1058   29959         973      1850        595          0       979
```

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## 1059   11308        1104      2184         936          0      1130
## 1060   11275         854      1991         297        557      1096
## 1061    4920        1338      1338         616          0      1338
## 1062   18000         894       894           0          0       894
## 1063   13600         662      2337           0          0      1422
## 1064    6000        1103      1103         397          0      1103
## 1065   11000        1154      1154         740        230      1154
## 1066   14000        1306      2260        1201          0      1306
## 1067    7837         799      1571           0          0       799
## 1068    9760         780      1611         674        106       798
## 1069    3964         942      2521         837          0      1291
## 1070    9600         845       893         220          0       893
## 1071   10152        1048      1048         586          0      1048
## 1072   11700         727      1556         298          0       829
## 1073    7585         810      1456           0          0      1002
## 1074    7950         690      1426         535          0       698
## 1075    8556        1240      1240           0          0      1240
## 1076   13125         800      1740         410          0       960
## 1077   10800         796      1466         626          0      1096
## 1078   15870        1096      1096          75        791      1096
## 1079    4435         848       848         662          0       848
## 1080    8775         990       990         495          0       990
## 1081   11040        1258      1258         656          0      1258
## 1082    7500        1040      1040         824          0      1040
## 1083    8749        1459      1459           0          0      1459
## 1084    8800        1251      1251         553          0      1251
## 1085   13031         691      1498         592          0       691
## 1086    9069         936       996         747          0       996
## 1087    1974         546      1092         334          0       546
## 1088   10574        1082      1953           0          0      1082
## 1089    2522         970      1709           0          0       970
## 1090    3316        1247      1247        1039          0      1247
## 1091    8544           0      1040           0          0      1040
## 1092    2160         600      1252         510          0       624
## 1093    8400        1181      1694         423          0      1390
## 1094    9230         864      1200         661          0      1200
## 1095    5868         936       936         248        240       936
## 1096    9317        1314      1314          24          0      1314
## 1097    6882         684      1355           0          0       773
## 1098    3696        1074      1088           0          0      1088
## 1099    6000         672      1324         672          0       757
## 1100   11880        1271      1601         704          0      1601
## 1101    8400         290       438         290          0       438
## 1102    9758         950       950         412        287       950
## 1103    7000        1010      1134         588          0      1134
## 1104    8910         655      1194         655          0      1194
## 1105    2016         630      1302           0          0       630
## 1106   12256        1463      2622        1032          0      1500
## 1107   10357         910      1442         738          0      1442
## 1108   23257         868      2021           0          0       887
```

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## 1109    8063         924      1690          0          0       948
## 1110   11362        1836      1836       1039          0      1836
## 1111    8000         773      1658        219          0       773
## 1112   10480         803      1964        403          0      1098
## 1113    7100         816       816        708          0       816
## 1114    8923        1008      1008        643          0      1008
## 1115    5400         833       833        415          0       833
## 1116   12085        1734      1734       1004          0      1734
## 1117    7750         408      1419        353          0       779
## 1118    9764         894       894        702          0       894
## 1119   13825         533      1601          0          0      1021
## 1120    7560        1040      1040        369          0      1040
## 1121    8263        1012      1012          0          0      1012
## 1122   10084        1552      1552         24          0      1552
## 1123    8926         672       960          0          0       960
## 1124    9405         698       698          0          0       698
## 1125    9125         384      1482          0          0       812
## 1126   10434        1005      1005          0          0      1005
## 1127    3684        1373      1555          0          0      1555
## 1128   14572        1530      1530       1300          0      1530
## 1129   11796         847      1959          0          0       847
## 1130    7200         936       936        936          0       936
## 1131    7804        1122      1981        622          0      1328
## 1132   10712         974       974        212          0       974
## 1133    9900        1008      2210          0          0      1178
## 1134    9828        1128      2020        584          0      1142
## 1135    8773         916      1600          0          0       916
## 1136    6180         960       986          0          0       986
## 1137    9600        1032      1252        280          0      1032
## 1138    6342         780      1020          0          0       780
## 1139    9819        1567      1567       1567          0      1567
## 1140    8731         915      1167        645          0      1167
## 1141    7350         952       952        852          0       952
## 1142   10304         780      1868        381          0      1088
## 1143    9965        1466      2828       1150          0      1466
## 1144    9000        1006      1006        288          0      1006
## 1145   12180         672       924        348          0       672
## 1146    6240        1042      1576          0          0      1042
## 1147   11200        1298      1298       1258          0      1298
## 1148   12000         704      1564        275          0       860
## 1149    5700         572      1111          0          0       572
## 1150    9000         650      1482        624          0       832
## 1151    8280         932       932          0          0       932
## 1152   17755        1466      1466        176          0      1466
## 1153   14115        1073      1811        296        547      1811
## 1154    5890         816       816        538          0       816
## 1155   13700         864      1820        454          0       902
## 1156   10768        1437      1437       1157          0      1437
## 1157    9350        1219      1265        633          0      1265
## 1158    5001        1314      1314        904          0      1314
```

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## 1159   11932        1580      1580          0          0      1580
## 1160    9120         901      1876        442          0       943
## 1161    2280         855      1456        311          0       855
## 1162   14778        1296      1640        728          0      1640
## 1163    8724         894       894        492          0       894
## 1164   12900        1198      1258       1198          0      1258
## 1165   16157        1360      1432        680        391      1432
## 1166    9541        1502      1502          0          0      1502
## 1167   10475        1694      1694          0          0      1694
## 1168   10852         959      1671        786          0       959
## 1169   13728        1127      2108        626          0      1236
## 1170   35760        1930      3627       1387          0      1831
## 1171    9880        1096      1118        522          0      1118
## 1172    9120        1261      1261        662          0      1261
## 1173    4017         625      1250          0          0       625
## 1174   18030        1598      3086        152        469      1636
## 1175   16560         952      2345        503          0      1170
## 1176   10678        1683      2872        700          0      2129
## 1177    6951         876       923        658          0       923
## 1178    3950         818      1224        468          0       818
## 1179    7681         731      1343          0          0       820
## 1180    8335           0      1124          0          0      1124
## 1181   11170        1216      2514       1216          0      1298
## 1182    5587        1600      1652       1480          0      1652
## 1183   15623        2396      4476       2096          0      2411
## 1184   10800        1120      1130        821          0      1130
## 1185   35133        1572      1572       1159          0      1572
## 1186    9738         784      1221        392          0       949
## 1187   10615         978      1699        440          0      1014
## 1188   12461        1624      1624       1456          0      1624
## 1189    8935         831      1660          0          0       831
## 1190    7500         994      1804          0          0      1028
## 1191   32463        1249      1622       1159          0      1622
## 1192    2645         776      1441          0          0       764
## 1193    9600         702      1472          0          0       842
## 1194    4500        1224      1224        883          0      1224
## 1195    9364         663      1352        371          0       663
## 1196    8029         728      1456          0          0       728
## 1197   14054         879      1863          0          0       879
## 1198    8850         815      1690          0          0       815
## 1199    9100        1212      1212          0          0      1212
## 1200   11235        1051      1382        547          0      1382
## 1201    9353         864       864          0          0       864
## 1202   10400         866      1779          0          0       866
## 1203    6000         884      1348          0          0       884
## 1204    9750        1630      1630          0          0      1630
## 1205   10140        1056      1074        788          0      1074
## 1206   14684        2158      2196        485        177      2196
## 1207    8900        1056      1056       1056          0      1056
## 1208    9135        1682      1700        340          0      1700
```

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## 1209    7763         931      1283         504         108      1283
## 1210   10182        1660      1660        1220           0      1660
## 1211   11218        1055      1845           0           0      1055
## 1212   12134         559      1752         427           0      1080
## 1213    9340         672       672         344           0       672
## 1214   10246         648       960         648           0       960
## 1215   10205         925       999         784           0       999
## 1216    7094         894       894         180         374       894
## 1217    8930           0      1902           0           0      1318
## 1218    8640        1300      1314         936           0      1314
## 1219    6240           0       912           0           0       672
## 1220    1680         672      1218           0           0       672
## 1221    7800         912       912         312         600       912
## 1222    8250         952      1211         250         492      1211
## 1223   10496        1040      1846         196           0      1168
## 1224   10680        2136      2136         756           0      2136
## 1225   15384         788      1490         724           0       788
## 1226   10482         588      1138         507           0      1138
## 1227   14598         894      1933           0           0       894
## 1228    8872         912       912         595           0       912
## 1229    8769        1702      1702        1540           0      1702
## 1230    7910        1075      1507         666           0      1507
## 1231   18890        1361      2620         498         211      1361
## 1232    7728        1106      1190         803           0      1190
## 1233    9842           0      1224           0           0      1224
## 1234   12160        1188      1188        1000           0      1188
## 1235    8525         940      1964           0           0      1024
## 1236   13132         747      1784           0           0       892
## 1237    2628         764      1626           0           0       764
## 1238   12393         847      1948           0           0       847
## 1239   13072        1141      1141           0           0      1141
## 1240    9037        1476      1484         428           0      1484
## 1241    8158         884      1768         550           0       884
## 1242    9849        1689      1689           0           0      1689
## 1243   10625        1053      1173         885         168      1173
## 1244   13891        2076      2076        1386           0      2076
## 1245   11435         792      1517           0           0       792
## 1246   12090         585      1868           0           0      1140
## 1247    8125         756      1553           0           0       756
## 1248   12328        1012      1034         539           0      1034
## 1249    9600         735      2058         319           0      1134
## 1250    7200         876       988         534          96       988
## 1251   11160        2110      2110        1065           0      2110
## 1252    3136        1405      1405           0           0      1405
## 1253    9858         864       874         510           0       874
## 1254   17542        1192      2167         125        1031      1516
## 1255    6931         746      1656           0           0       760
## 1256    6240         884      1367         425           0       959
## 1257   14303        1986      1987        1314           0      1987
## 1258    4060         864       864           0           0       864
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## 1259    9587         856      1166         655           0      1166
## 1260    9750        1054      1054         602         438      1054
## 1261   24682         841      1675           0           0       892
## 1262    9600        1050      1050         504           0      1050
## 1263   11250        1104      1788           0           0      1104
## 1264   13515         764      1824           0           0      1060
## 1265    4060        1405      1337         266           0      1337
## 1266    3735         691      1452         450           0       713
## 1267   10120         925      1889           0           0       964
## 1268   13214        2002      2018           0           0      2018
## 1269   14100         728      3447         192           0      1968
## 1270   11344         874      1524         460           0       874
## 1271   23595        1332      1524        1258           0      1332
## 1272    9156        1489      1489           0           0      1489
## 1273   13526         935       935         560         375       935
## 1274   11512        1019      1357         719           0      1357
## 1275    5362         661      1250           0           0       661
## 1276   11345         928      1920         220           0       928
## 1277   12936         723      1395         593           0       735
## 1278   17871        1680      1724         528           0      1724
## 1279    9473        1128      2031         804           0      1128
## 1280    7500         698      1128           0           0       698
## 1281    9808        1573      1573         788           0      1573
## 1282    8049        1309      1339        1053           0      1339
## 1283    8800        1040      1040         532         144      1040
## 1284    9400         912      1824           0           0       912
## 1285    9638         804      2447           0           0      1699
## 1286    6000         780      1412           0           0       825
## 1287    9790        1328      1328         569          81      1328
## 1288   36500        1624      1582         812           0      1582
## 1289    5664        1501      1659        1158           0      1659
## 1290   11065        1085      1970           0           0      1120
## 1291   14112        1152      1152        1014           0      1152
## 1292    1680         630      1302         231           0       630
## 1293    6600         994      2372           0           0      1378
## 1294   10140         832      1664         194           0       832
## 1295    8172         864       864         167           0       864
## 1296    8400        1052      1052        1016           0      1052
## 1297    8700        1120      1128         776           0      1128
## 1298    3675         547      1072         547           0      1072
## 1299   63887        6110      5642        5644           0      4692
## 1300    7500        1246      1246         340         906      1246
## 1301   10762         978      1983         694           0      1005
## 1302    7500         771      1494         547           0       753
## 1303   10120        1165      2526         740           0      1203
## 1304    8688        1616      1616           0           0      1616
## 1305    3363         976      1708           0           0       976
## 1306   13173        1652      1652        1572           0      1652
## 1307    6955        1368      1368           0           0      1368
## 1308    8072         990       990         746           0       990
```

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## 1309   12000         924      1122         144         608      1122
## 1310    7153        1278      1294        1200           0      1294
## 1311   17500        1902      1902        1406           0      1902
## 1312    8814        1274      1274         925           0      1274
## 1313    9572        1453      2810         482           0      1453
## 1314   14774        1393      2599           0           0      1422
## 1315    8190         948       948         732           0       948
## 1316   11075         952      2112         500         276      1092
## 1317   10226        1622      1630           0           0      1630
## 1318    4230        1352      1352           0           0      1352
## 1319   14781        1753      1787           0           0      1787
## 1320   10215         864       948         492           0       948
## 1321    8400        1478      1478         189         661      1478
## 1322    6627           0       720           0           0       720
## 1323   10186         750      1923         674           0      1061
## 1324    5330         420       708         280           0       708
## 1325    9986        1795      1795           0           0      1795
## 1326    3636         796       796           0           0       796
## 1327    4270         544       774         544           0       774
## 1328    6600         816       816         641           0       816
## 1329   10440        1510      2792         493           0      1584
## 1330    9084         935      1632           0           0       955
## 1331   10000        1588      1588           0           0      1588
## 1332   10780         911       954         483           0       954
## 1333    8877         816       816         690           0       816
## 1334    7200         803      1360           0           0       803
## 1335    2368         765      1365         765           0       765
## 1336    9650        1350      1334         686           0      1334
## 1337    9246        1656      1656           0           0      1656
## 1338    4118         693       693           0           0       693
## 1339   13450         916      1861         700           0       920
## 1340    9560         864       864         360           0       864
## 1341    8294         858       872           0           0       872
## 1342   13695        1114      1114         814           0      1114
## 1343    9375        1284      2169           0           0      1284
## 1344    7558         896      1913           0           0      1172
## 1345   11103         728      1456           0           0       728
## 1346    6000         960       960         250           0       960
## 1347   20781        1568      2156         297          68      2156
## 1348   15306        1732      1776          80           0      1776
## 1349   16196        1482      1494        1443           0      1494
## 1350    5250         684      2358         259           0       938
## 1351   11643        1248      2634         500           0      1338
## 1352    9247         858      1716         319           0       858
## 1353    6000         698      1176           0           0       786
## 1354   14720        2033      3238         816           0      2053
## 1355   10316         992      1865         735           0       992
## 1356   10192         570      1920           0           0      1222
## 1357    9477         864       892         340           0       892
## 1358   12537        1078      1078         734           0      1078
```

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## 1359    2117         756      1573         378          0       769
## 1360   16737        1980      1980        1447          0      1980
## 1361    9842         612      2601           0          0       990
## 1362   16158        1530      1530        1274          0      1530
## 1363   12513         715      1738           0          0      1281
## 1364    8499         616      1412           0          0       616
## 1365    3180         600      1200           0          0       520
## 1366    7500         814      1674         533          0       814
## 1367    9179         873      1790         633          0       882
## 1368    2665         757      1475         548        173       925
## 1369    4435         848       848         685          0       848
## 1370   10635        1657      1668         370        972      1668
## 1371    5400         840      1374         315        105       840
## 1372    9600         992      1661         831          0      1661
## 1373    9750        1108      2097         975          0      1108
## 1374   11400        2633      2633        1282          0      2633
## 1375   10625        1026      1958           0          0      1026
## 1376   10991        1571      1571           0          0      1571
## 1377    6292         768       790         384          0       790
## 1378   10998         984      1604         408        420       984
## 1379    1953         483       987         309          0       483
## 1380    9735         384      1394           0          0       754
## 1381    8212         864       864         203          0       864
## 1382   12925        1205      2117         865          0      2117
## 1383    7200         596      1762           0          0       998
## 1384   25339         816      1416           0          0      1416
## 1385    9060         560      1258         204          0       698
## 1386    5436         796      1154         735          0       796
## 1387   16692        1392      2784         790        469      1392
## 1388    8520         714      2526         168        546      1664
## 1389   14892        1746      1746        1320          0      1746
## 1390    6000         735      1218         375          0       869
## 1391    9100        1525      1525        1400          0      1525
## 1392    8944        1584      1584           0          0      1584
## 1393    7838         864       900         769          0       900
## 1394   10800         482      1912           0          0      1221
## 1395    4045        1356      1500        1070          0      1500
## 1396   12665        1094      2482           0          0      1133
## 1397   57200         747      1687         353        334      1687
## 1398    6120         939      1513           0          0       939
## 1399    7200        1208      1904         180        352      1136
## 1400    6171         976      1608         264          0      1160
## 1401    6000         862      1158           0          0       950
## 1402    7415         839      1593         759          0       864
## 1403    6762        1286      1294           0          0      1294
## 1404   15256        1485      1464         929          0      1464
## 1405   10410         672      1214           0          0       694
## 1406    3842        1594      1646        1373          0      1646
## 1407    8445         768       768         656          0       768
## 1408    8780         833       833         625          0       833
```

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## 1409    7740         622      1363          0          0       741
## 1410   20544         791      2093          0          0      1236
## 1411   12420         944      1840        666          0       944
## 1412    9600         856      1668        120          0      1112
## 1413    7200           0      1040          0          0      1040
## 1414   10994        1844      1844        976          0      1844
## 1415   13053         833      1848          0          0      1053
## 1416    3635        1386      1569        988          0      1569
## 1417   11340         777      2290          0          0      1246
## 1418   16545        1284      2450        781          0      1310
## 1419    9204        1144      1144         25        872      1144
## 1420   16381        1844      1844       1110          0      1844
## 1421   11700         708      1416        404          0       708
## 1422    4043        1069      1069        360          0      1069
## 1423    4435         848       848        686          0       848
## 1424   19690         697      2201          0          0      1575
## 1425    9503        1024      1344        457        374      1344
## 1426   10721        1252      1252          0          0      1252
## 1427   10944        1223      2127       1000          0      1223
## 1428   10930         913      1558        580          0      1048
## 1429    7200         788       804        510          0       804
## 1430   12546        1440      1440        678          0      1440
## 1431   21930         732      1838          0          0       734
## 1432    4928         958       958        958          0       958
## 1433   10800         656       968          0          0       968
## 1434   10261         936      1792          0          0       962
## 1435   17400        1126      1126        936          0      1126
## 1436    8400        1319      1537          0          0      1537
## 1437    9000         864       864        616          0       864
## 1438   12444        1932      1932       1336          0      1932
## 1439    7407         912      1236        600          0      1236
## 1440   11584         539      1725        315        110      1040
## 1441   11526         588      2555          0          0      1423
## 1442    4426         848       848        697          0       848
## 1443   11003        1017      2007        765          0      1026
## 1444    8854         952       952          0          0       952
## 1445    8500        1422      1422          0          0      1422
## 1446    8400         814       913        187        627       913
## 1447   26142        1188      1188        593          0      1188
## 1448   10000        1220      2090       1079          0      1220
## 1449   11767         560      1346          0          0       796
## 1450    1533         630       630        553          0       630
## 1451    9000         896      1792          0          0       896
## 1452    9262        1573      1578          0          0      1578
## 1453    3675         547      1072        547          0      1072
## 1454   17217        1140      1140          0          0      1140
## 1455    7500        1221      1221        410          0      1221
## 1456    7917         953      1647          0          0       953
## 1457   13175        1542      2073        790        163      2073
## 1458    9042        1152      2340        275          0      1188
```

```
## 1459    9717        1078      1078         49       1029      1078
## 1460    9937        1256      1256        830        290      1256
##      X2ndFlrSF GarageArea WoodDeckSF OpenPorchSF
## 1          854        548          0          61
## 2            0        460        298           0
## 3          866        608          0          42
## 4          756        642          0          35
## 5         1053        836        192          84
## 6          566        480         40          30
## 7            0        636        255          57
## 8          983        484        235         204
## 9          752        468         90           0
## 10           0        205          0           4
## 11           0        384          0           0
## 12        1142        736        147          21
## 13           0        352        140           0
## 14           0        840        160          33
## 15           0        352          0         213
## 16           0        576         48         112
## 17           0        480          0           0
## 18           0        516          0           0
## 19           0        576          0         102
## 20           0        294          0           0
## 21        1218        853        240         154
## 22           0        280          0           0
## 23           0        534        171         159
## 24           0        572        100         110
## 25           0        270        406          90
## 26           0        890          0          56
## 27           0        576        222          32
## 28           0        772          0          50
## 29           0        319        288         258
## 30           0        240         49           0
## 31         668        250          0          54
## 32           0        271          0          65
## 33           0        484          0          30
## 34           0        447          0          38
## 35           0        556        203          47
## 36        1320        691        113          32
## 37           0        672        392          64
## 38           0        498          0           0
## 39           0        246          0          52
## 40           0          0          0           0
## 41           0        440          0         138
## 42           0        308          0         104
## 43           0        504        240           0
## 44           0        308        145           0
## 45           0        300          0           0
## 46           0        576        196          82
## 47         631        670        168          43
```

```
## 48           0        826          0         146
## 49         716          0          0           0
## 50           0        386          0           0
## 51         676        388          0          75
## 52           0        528        112           0
## 53           0        516        106           0
## 54           0        894        857          72
## 55           0        572          0          50
## 56           0        576          0           0
## 57         756        480        115           0
## 58         860        565          0          70
## 59        1519        641        192           0
## 60           0        352        196           0
## 61           0        576          0          50
## 62         530        288          0           0
## 63           0        484        120          49
## 64         808        480         12          11
## 65         977        645        576          36
## 66        1330        852        192         151
## 67           0        576        301           0
## 68           0        558        144          29
## 69           0        220          0           0
## 70         983        667          0          21
## 71           0        516        300           0
## 72           0        360          0           0
## 73         833        427          0          94
## 74           0        490          0           0
## 75         765        379          0           0
## 76         462        297        120         101
## 77           0        283          0           0
## 78         213        240          0           0
## 79           0          0          0           0
## 80         548        440         74           0
## 81         960        509          0          72
## 82           0        405          0         199
## 83           0        758        144          99
## 84           0        461         74           0
## 85         670        400        120          72
## 86        1116        462        127          82
## 87         876        400        100          38
## 88         612        528          0         234
## 89           0          0          0           0
## 90           0          0          0           0
## 91           0        420          0          29
## 92           0        480          0           0
## 93           0        432          0           0
## 94        1031        506          0           0
## 95         881        684          0         162
## 96         790        420        232          63
## 97           0        472        158          29
```

```
## 98           0        432        120           0
## 99           0        366          0           0
## 100          0          0        352           0
## 101          0        480        168          68
## 102        755        476        192          46
## 103          0        410          0           0
## 104          0        740          0          36
## 105        592        240          0           0
## 106        939        648        140          45
## 107          0        273          0           0
## 108          0        250          0           0
## 109        520          0          0           0
## 110          0        546          0         122
## 111        639        325        182           0
## 112        656        400        180           0
## 113       1414        792        120         184
## 114          0        450        166         120
## 115        884        180        224           0
## 116        729        440          0          32
## 117          0        288          0          20
## 118          0        430         80          64
## 119       1523        594        367           0
## 120        728        390          0          24
## 121          0        540          0         130
## 122        351        264          0           0
## 123          0        288          0           0
## 124          0        530          0          63
## 125          0        435        192           0
## 126          0          0         53           0
## 127          0        440          0         205
## 128          0          0          0           0
## 129        688        453        188         108
## 130          0        750          0          80
## 131        941        487        105          66
## 132       1032        390         24          48
## 133          0        624          0           0
## 134          0        471        192          25
## 135          0        440          0          96
## 136          0        530         98           0
## 137          0        318          0         111
## 138          0        766          0           0
## 139        848        660        224         106
## 140        836        470        276          99
## 141          0          0          0           0
## 142          0        660        160          24
## 143        475        720          0           0
## 144          0        577        144          29
## 145          0        504          0           0
## 146        739        380          0          40
## 147          0        180         48           0
```

```
## 148       1151        434        144         48
## 149          0          0          0          0
## 150        448        240        200        114
## 151          0        440          0          0
## 152          0        866          0        102
## 153        896        495          0         66
## 154          0        564        409          0
## 155          0        312          0          0
## 156        524          0          0          8
## 157          0        625          0          0
## 158       1194        680          0         75
## 159        956        678          0        136
## 160       1070        576        239        132
## 161          0        516          0          0
## 162       1096        726        400          0
## 163          0        532          0         70
## 164          0          0          0          0
## 165        467        216          0          0
## 166        547          0        140          0
## 167          0        303        476          0
## 168        551        789        178        120
## 169        880        440        100         48
## 170          0        511        574         64
## 171          0        660        237          0
## 172          0        528        210         62
## 173        703        504        441         35
## 174          0        504          0         20
## 175          0        616        192          0
## 176          0        576          0         29
## 177        896        521          0        228
## 178        668        451          0          0
## 179          0       1166          0         60
## 180          0        480          0          0
## 181        756        440          0          0
## 182        901        216          0          0
## 183          0        252        116          0
## 184        720        484        280        238
## 185        316        576        104          0
## 186       1518        840          0        260
## 187          0        497        168         27
## 188        704        180          0          0
## 189          0        528        120          0
## 190          0        682          0        120
## 191       1178        440          0         74
## 192        754        484          0         32
## 193          0        666          0         35
## 194        739        380          0         40
## 195          0        352          0          0
## 196        601        440         87          0
## 197          0        786        171        138
```

```
## 198       1360        795          0          16
## 199        929          0          0         198
## 200          0        856          0          26
## 201          0        440        132          64
## 202          0        473        238          83
## 203        445        398          0           0
## 204          0        420        149           0
## 205        564        240          0          35
## 206          0        500          0          34
## 207          0        349          0          30
## 208          0        312        355           0
## 209        882        454         60          55
## 210          0        504          0           0
## 211          0          0          0           0
## 212          0        460        100          22
## 213        920        644        168         108
## 214          0        576        224           0
## 215        703        299          0          36
## 216          0        447          0           0
## 217          0        484        139          98
## 218        518        210          0         172
## 219        817        431          0         119
## 220          0        438        108           0
## 221          0        675        351          33
## 222       1257        390        120          46
## 223        741        434        209         208
## 224          0        576        216           0
## 225          0        968        248         105
## 226        672        280          0           0
## 227       1306        721        224         114
## 228        504        280          0           0
## 229          0        336          0           0
## 230          0        430        143          20
## 231          0        312          0           0
## 232       1304        810          0         146
## 233        504        288          0           0
## 234          0        308        365           0
## 235       1100        440        288          48
## 236        504        264          0           0
## 237          0        494        132         105
## 238        730        457        370          70
## 239          0        818        168         228
## 240        689        220          0         140
## 241          0        750        144         168
## 242          0          0         58          42
## 243        551        352          0           0
## 244        591        288          0          28
## 245        888        463          0         130
## 246          0        604        197          39
## 247       1020        440          0          60
```

```
## 248          0        451          0          30
## 249        828        500        144          68
## 250        700        389          0          98
## 251          0          0        263           0
## 252          0        538        123           0
## 253        842        520        138          45
## 254          0        309        333           0
## 255          0        294        250           0
## 256       1286        429        192           0
## 257        864        673        216          56
## 258          0        660        123         110
## 259        829        564          0          96
## 260          0        308          0          45
## 261          0        884          0           0
## 262       1092        868          0         148
## 263          0        492        292          12
## 264          0        484          0           0
## 265          0        504          0           0
## 266          0        576        276           0
## 267        709        413         95          75
## 268        720        240        262          24
## 269          0        924          0          25
## 270          0        504        370          30
## 271        844       1053        192          51
## 272          0        439         81           0
## 273       1106        671        132          57
## 274          0        338        289           0
## 275          0        264        168           0
## 276        596        672         74           0
## 277          0        573        100         150
## 278          0        400          0           0
## 279          0        732        124          98
## 280        866        505        288         117
## 281        807        575          0          84
## 282          0        572          0         120
## 283          0        626        172          62
## 284          0        898        210         150
## 285          0        529          0           0
## 286        625        528          0          54
## 287        649        440          0           0
## 288          0          0          0           0
## 289          0        280          0           0
## 290        698        384          0           0
## 291        840        685          0          51
## 292        780          0          0         184
## 293        568        281          0           0
## 294        795        539          0         250
## 295          0        418        110           0
## 296          0        588        120           0
## 297        648        282        289           0
```

```
## 298        975        576          0          10
## 299        702        539        224           0
## 300          0        300          0          36
## 301          0        375          0           0
## 302       1242        683        208          50
## 303          0        843        468          81
## 304          0        552        256           0
## 305       1818        870        302           0
## 306          0        888        168           0
## 307       1121        746        127          44
## 308        371          0          0         144
## 309          0        539        158           0
## 310          0        708        208         175
## 311        804        420        190          63
## 312          0        240          0           0
## 313        325        410          0           0
## 314          0        513          0           0
## 315        809        546          0           0
## 316        716        432        100          51
## 317       1200        484        288         195
## 318        871       1025        208          46
## 319       1274        656        340          60
## 320          0        588        233          48
## 321       1347        840        240         154
## 322       1332        872        184         154
## 323       1177        576        201          96
## 324          0        220        142          98
## 325       1080        564        240           0
## 326          0        360          0           0
## 327          0        473        122          30
## 328          0        292          0          45
## 329        689        441          0          60
## 330        596        189          0           0
## 331          0        352        155           0
## 332          0        308          0           0
## 333          0        880          0           0
## 334          0        484        192          30
## 335        695        472        100          38
## 336        167        529        670           0
## 337          0        676        178          51
## 338          0        532        192          74
## 339          0        440        108          45
## 340          0        297          0           0
## 341        915        431        135           0
## 342          0        294        250           0
## 343          0        400          0           0
## 344          0        564        495          72
## 345        576        336        182           0
## 346        605        312          0           0
## 347          0        301          0           0
```

```
## 348          0        498          0          40
## 349        862        474          0          27
## 350        880        706          0           0
## 351          0        617        210          54
## 352          0        445          0          80
## 353        495        200         48           0
## 354          0        484        106           0
## 355        403        240          0           0
## 356          0        521          0          26
## 357          0        400        120          26
## 358          0        528        536          90
## 359          0        288        168           0
## 360        838        592        208          75
## 361          0        470          0           0
## 362        517        240          0           0
## 363       1427        672          0           0
## 364        504        264        250           0
## 365        784        566        306         111
## 366        672        468          0         128
## 367          0        514          0          76
## 368          0        296         64         110
## 369          0        244          0          98
## 370          0        576        364          17
## 371        711        460        100          40
## 372        468        680          0          59
## 373          0        264        353           0
## 374          0        270         66           0
## 375       1081        434        100          48
## 376          0          0          0           0
## 377          0        576          0           0
## 378        886        610        159         214
## 379          0        834        113           0
## 380        793        463        100          63
## 381        665        308          0           0
## 382          0        572        216         121
## 383        858        639        144          53
## 384          0        360          0           0
## 385        874        501        216         231
## 386          0        430        146          20
## 387        526          0          0         151
## 388          0        352        296           0
## 389          0        577        120          25
## 390        590        846        196         134
## 391        406        384          0         130
## 392       1157        560        125         192
## 393          0        294          0           0
## 394          0          0          0           0
## 395        299        240          0          39
## 396          0        596         44           0
## 397          0        600        215           0
```

```
## 398        936        264          0         168
## 399          0        338          0           0
## 400        438        438          0         168
## 401          0        500        120          30
## 402          0        400          0           0
## 403          0        240        168           0
## 404       1098        420        144         123
## 405        766        373          0          40
## 406          0        490        120          78
## 407          0        240          0           0
## 408        840        308          0           0
## 409       1101        947        192          62
## 410       1028        836          0         102
## 411          0        350          0           0
## 412          0        572        264           0
## 413          0        484          0         144
## 414          0        360          0           0
## 415       1017        678        196         187
## 416          0        396        100          30
## 417        728        440          0           0
## 418       1254        864          0           0
## 419        378        240          0           0
## 420          0        304          0          85
## 421          0        784          0           0
## 422          0        529        240           0
## 423          0        520          0           0
## 424       1160        696          0          66
## 425          0        297          0          44
## 426        682        240          0           0
## 427          0        569         80           0
## 428          0        352          0           0
## 429          0        628        105          54
## 430          0        576          0           0
## 431        504        264          0           0
## 432        110          0          0          98
## 433        600        440        240          36
## 434        678        470          0          36
## 435          0          0         88           0
## 436        834        550        158          61
## 437        384        440          0           0
## 438          0        180          0           0
## 439          0        352          0           0
## 440        512        528          0          46
## 441          0        672          0          72
## 442          0          0          0           0
## 443        445        360          0           0
## 444          0        648        144          16
## 445        975        493        144         133
## 446          0        480          0           0
## 447          0        578          0           0
```

```
## 448        930        431         89          0
## 449        596        198          0          0
## 450        504        308          0        176
## 451          0        270          0        113
## 452          0        576        200         54
## 453        868        422        144        122
## 454        804        676          0         30
## 455          0        560          0          0
## 456          0        528          0          0
## 457        720        513          0          0
## 458          0        529        224        137
## 459        833        228        192         63
## 460        224        352          0          0
## 461       1103        552          0        150
## 462        560        576        256          0
## 463          0        360          0          0
## 464        811        240          0          0
## 465          0          0          0          0
## 466          0        398        144         20
## 467          0        526          0          0
## 468        756        312        168          0
## 469          0        866          0         44
## 470        878        506        144         70
## 471          0        528          0         54
## 472        808        534          0          0
## 473          0        525          0         28
## 474          0        908        250         63
## 475          0        499         96         48
## 476          0        624          0         24
## 477          0        508        140         39
## 478        574        694        414         84
## 479          0        826        208         44
## 480          0        672          0         72
## 481          0        772        519        112
## 482          0        874        206         49
## 483        910        164          0          0
## 484          0        402          0        125
## 485          0        264          0        132
## 486          0        264          0         80
## 487          0        515          0          0
## 488          0        487        224          0
## 489        648        520        142          0
## 490          0        286          0          0
## 491        688        336        141         24
## 492        620        240          0          0
## 493        728        429          0          0
## 494          0        308          0          0
## 495          0        273        144         20
## 496          0          0          0        523
## 497          0        546        264         75
```

```
## 498        687        240          0          100
## 499          0        288         64            0
## 500          0        297         12          285
## 501        546        264        144           28
## 502        902        603          0          108
## 503          0        461          0            0
## 504          0        484          0           54
## 505        467        440        260            0
## 506       1000        400          0            0
## 507        846        471        182           81
## 508          0        676          0          102
## 509        689        360          0            0
## 510          0        270        224           88
## 511          0        288        324           42
## 512          0        474        132           35
## 513          0        624          0            0
## 514          0        484        120            0
## 515          0        200          0            0
## 516          0        900        156           54
## 517        741        583          0          104
## 518       1067        889        220            0
## 519        914        546          0           36
## 520        804        282          0            0
## 521        600          0        220          114
## 522          0        336          0           40
## 523        660        420          0           24
## 524       1538        884        208          406
## 525       1015        834        239           60
## 526          0        453         38          144
## 527          0        252        261            0
## 528       1237        858        126           66
## 529          0          0          0            0
## 530          0        484          0            0
## 531          0        600        224            0
## 532        611        502          0            0
## 533          0        392          0            0
## 534          0          0          0            0
## 535        707        403        100           35
## 536        527          0         85            0
## 537        844        527        120          155
## 538          0        576        216            0
## 539          0        336        466            0
## 540          0        670        180            0
## 541          0        765        270           68
## 542       1288        648          0           56
## 543          0        583         78           73
## 544          0        367        120           40
## 545        832        426        100           24
## 546        806        786          0            0
## 547        720        440          0           38
```

```
## 548          0        624        104          0
## 549          0        720        140         50
## 550       1182        615        182        182
## 551          0        440          0         55
## 552          0        288          0          0
## 553          0        908        169         39
## 554          0        520          0         96
## 555       1040        871        320         62
## 556          0        280          0          0
## 557          0        299        268          0
## 558        439        570          0         47
## 559        717        406        264         22
## 560          0        420        143         20
## 561          0        528          0          0
## 562          0        418        240         38
## 563          0          0        144          0
## 564        511        396         72         36
## 565       1129        590          0         40
## 566        806        216          0         66
## 567       1370        656        144         39
## 568          0        532          0          0
## 569        636        612        349         40
## 570          0        600         42          0
## 571          0        576          0          0
## 572          0        288        168          0
## 573        846        650        208        114
## 574        656        400        100          0
## 575        533        288         35          0
## 576        384        336        158          0
## 577        600        216          0         50
## 578          0        564        160         68
## 579        689        540          0        102
## 580        745        352          0          0
## 581          0        572        216        110
## 582          0       1390          0         90
## 583          0          0          0         32
## 584       1254        880        105        502
## 585        584        240          0          0
## 586          0        880        326         66
## 587          0        275          0          0
## 588          0        528          0          0
## 589          0        452          0         48
## 590          0        308          0          0
## 591        812        520          0         45
## 592        568        842        382        274
## 593          0        816          0          0
## 594          0        420        140          0
## 595          0        280          0          0
## 596          0        758        180         75
## 597        684        216          0        158
```

```
## 598          0        648        120          16
## 599          0        621          0           0
## 600        840        452        161           0
## 601        846        736        179          60
## 602        595        544          0         162
## 603        988        506        120         150
## 604        600        480          0         172
## 605          0        530        192          36
## 606        800        486          0          42
## 607          0        576        168           0
## 608        896        230        103           0
## 609       1254        380          0           0
## 610          0        261         64           0
## 611        677        736        253         142
## 612          0        564          0           0
## 613        573        531        160         122
## 614          0          0          0          30
## 615          0          0         96          24
## 616          0        480        120           0
## 617        702        393        100          75
## 618          0        528          0           0
## 619          0        774          0         108
## 620        780        749        168           0
## 621          0          0          0           0
## 622       1066        624         38         243
## 623          0        484        192           0
## 624        756        440          0          32
## 625        778        484        148           0
## 626          0        440          0           0
## 627          0        286          0           0
## 628          0        364          0           0
## 629       1040        504        335           0
## 630          0        520        176           0
## 631        661        240          0           0
## 632          0        627        156          73
## 633          0        544        192           0
## 634          0        260        390           0
## 635          0        576        264          56
## 636       1440          0          0         110
## 637          0          0          0           0
## 638        576        256          0           0
## 639          0          0        328           0
## 640          0        648        312           0
## 641          0        588        185         140
## 642        872        650          0         235
## 643        704        538        269         111
## 644        840        462        208           0
## 645          0        478        195         130
## 646          0        576          0         312
## 647          0        420          0          27
```

```
## 648          0        495          0          0
## 649        788        442          0        124
## 650          0          0          0          0
## 651        843        562          0          0
## 652        755        296        120          0
## 653        807        512          0        120
## 654        713        216         57          0
## 655          0        839        236         46
## 656        567        264          0          0
## 657          0        312          0          0
## 658        651        270          0          0
## 659        546        330        192          0
## 660          0        480          0          0
## 661        793        550          0        113
## 662        762        711        517         76
## 663          0        576          0          0
## 664          0        588          0          0
## 665          0       1134        192        267
## 666        482        504        188        124
## 667        915        596          0        265
## 668          0        575        224         42
## 669          0        576        304          0
## 670          0        252          0          0
## 671        738        540        100         35
## 672        672        300        147          0
## 673          0        546        198         42
## 674          0        416          0         87
## 675          0        384        426          0
## 676        586        440         28          0
## 677        679        779          0          0
## 678          0        240        316          0
## 679          0        834        322         82
## 680          0        572          0          0
## 681          0        264         80          0
## 682        672        281          0          0
## 683          0        431        307          0
## 684          0        702        257         45
## 685        644        486          0         81
## 686        900        577        219          0
## 687        887        578        144        105
## 688        551        480          0         60
## 689          0        567        140          0
## 690          0        460        192         28
## 691          0        420        149          0
## 692       1872        832        382         50
## 693       1281        628        320         27
## 694          0        326          0          0
## 695        472        576        112          0
## 696          0        551        125          0
## 697          0        205          0          0
```

```
## 698          0        308          0          0
## 699          0        336        416        144
## 700          0        530        156        158
## 701          0        765        270         78
## 702          0        528          0          0
## 703       1312        666        324        100
## 704        780        672        344          0
## 705          0        606          0         35
## 706        720          0          0          0
## 707          0        739        380         48
## 708          0        550        192         38
## 709        728        400        100         24
## 710          0        408          0          0
## 711          0          0          0          0
## 712        319        384         68          0
## 713          0        472        168        120
## 714          0        576          0        288
## 715        754        475          0         44
## 716          0        478          0          0
## 717        978        704          0         48
## 718          0        439        224          0
## 719       1093        983        250        154
## 720          0        300          0          0
## 721          0        564        114         28
## 722          0        420        160          0
## 723          0        463          0          0
## 724        473        548          0          0
## 725          0        768        327         64
## 726          0        660         96          0
## 727          0        540        292         44
## 728          0        632        132          0
## 729          0        888          0         25
## 730          0        539          0         23
## 731          0        608        237        152
## 732          0        438        160         22
## 733        878        541        192         84
## 734          0        264        165          0
## 735          0        300        147          0
## 736        888        320          0        341
## 737          0        400          0          0
## 738        900        800          0        116
## 739          0          0        120          0
## 740        864        572        187         56
## 741        664        360        270          0
## 742          0        288        168          0
## 743          0        539        120         55
## 744          0        480        302          0
## 745          0        462         96          0
## 746       1540        831          0        204
## 747       1276        554        224         54
```

```
## 748       1320        864        181           0
## 749          0        527        240          56
## 750        441        240         92           0
## 751        348          0          0         160
## 752        660        400          0          48
## 753          0        576        168          27
## 754       1060        878        192          52
## 755          0        440        171          48
## 756        729        440          0          24
## 757        902        578        144         105
## 758        714        440        335           0
## 759        744        440          0           0
## 760       1203        752        222          98
## 761          0        300          0           0
## 762          0        440          0           0
## 763        783        614        169          45
## 764       1097        856          0         128
## 765          0        481          0          30
## 766          0        592          0         174
## 767        734        496        228          66
## 768        767        423        245           0
## 769          0        484        120          33
## 770       1589        841        503          36
## 771          0        576        120           0
## 772          0        396          0           0
## 773          0        672        144           0
## 774          0        275          0           0
## 775          0        895        315          45
## 776          0        412          0         247
## 777          0        865        144          59
## 778          0        440        241           0
## 779          0        630          0           0
## 780          0        504          0           0
## 781          0        402        220          21
## 782        793        484          0         124
## 783          0        605          0          33
## 784          0        602        303          30
## 785        742          0          0         291
## 786          0        457          0           0
## 787        686        416          0           0
## 788       1128        618          0          45
## 789          0        281          0           0
## 790       1111        444        133         168
## 791          0        397        100          16
## 792          0        539        120           0
## 793        886        455        180         130
## 794          0        474        168         130
## 795        809        409        143          46
## 796        676        476          0          50
## 797          0        528        138           0
```

```
## 798          0        240          0          0
## 799       1174        820        144         78
## 800        787        240          0          0
## 801       1072        603        403        114
## 802          0        440          0          0
## 803        728        410         36         18
## 804       1088       1020         52        170
## 805          0        286          0          0
## 806          0        554          0         60
## 807          0        384         68          0
## 808        504        528          0        312
## 809          0        484          0          0
## 810       1063        360         40        156
## 811          0        484        265          0
## 812          0        420        140          0
## 813          0        504          0          0
## 814          0        301          0          0
## 815        564        280        207          0
## 816          0        598          0         34
## 817          0        275          0          0
## 818          0        857        150         59
## 819          0        440          0          0
## 820          0        484        192         35
## 821        842        595          0         45
## 822          0        576          0         32
## 823        886        433        100         48
## 824        545        240        335          0
## 825          0        776          0        140
## 826          0       1220        188         45
## 827          0          0          0          0
## 828          0        527        290         39
## 829        966        538        486          0
## 830        623        480          0        166
## 831          0        458          0          0
## 832        600        480          0        166
## 833        888        613        192         39
## 834          0        472          0          0
## 835          0        456          0          0
## 836          0        436        290          0
## 837          0        812          0        116
## 838        504        264          0          0
## 839          0        352        278          0
## 840        432        240          0          0
## 841        672        400          0          0
## 842        581        686         70         78
## 843          0        490          0        129
## 844          0          0          0          0
## 845        540        720        418          0
## 846          0        611          0          0
## 847        769        425        234         72
```

```
## 848          0        338          0           0
## 849       1051        360        486          40
## 850        761        512        113         100
## 851          0        420        140           0
## 852          0        400        143          20
## 853        728        240          0           0
## 854          0        645        180           0
## 855          0        454          0         418
## 856          0        260          0         104
## 857          0        576          0           0
## 858        779        343          0          36
## 859          0        479          0           0
## 860       1142        619          0          65
## 861        514        216          0         240
## 862          0        504          0           0
## 863          0        480          0           0
## 864          0        672          0           0
## 865          0        529          0         140
## 866          0        902          0           0
## 867          0        870        192          80
## 868          0        544        168           0
## 869        720        672        120         144
## 870        887        574        156          90
## 871          0        308          0           0
## 872        878        523          0          77
## 873          0        414        196           0
## 874          0        288          0          28
## 875        455        200         26           0
## 876       1426        550        208         364
## 877          0        648          0           0
## 878        762        738        184           0
## 879          0        576        192           0
## 880          0        336          0           0
## 881          0        450          0          49
## 882        530        400        168          36
## 883        785        389        342          40
## 884        795        440          0         188
## 885          0        288          0           0
## 886          0        506         97          65
## 887          0        588        272          54
## 888        521        300        121           0
## 889          0        621         81         207
## 890          0        505          0           0
## 891        252        576          0           0
## 892        765        440        243           0
## 893          0        264        192           0
## 894          0        354        511         116
## 895          0        400          0           0
## 896        813        483          0          50
## 897          0        327          0          28
```

```
## 898       1120        528        154           0
## 899          0        820          0          67
## 900          0        288          0           0
## 901          0        684          0           0
## 902          0        756          0           0
## 903        702        393          0          75
## 904          0        690        144          60
## 905          0        288          0           0
## 906          0        280          0           0
## 907          0        865          0          60
## 908       1037        180          0           0
## 909          0        484        164           0
## 910        742        390         36          24
## 911       1169        480          0           0
## 912          0        252        173           0
## 913          0        450          0           0
## 914       1001        871          0           0
## 915        612        528          0         234
## 916        546        286          0           0
## 917          0        308          0           0
## 918          0        284          0           0
## 919       1215        833         72         192
## 920          0        601          0          51
## 921        785        471        300          87
## 922        928          0          0          70
## 923          0        397        100           0
## 924          0        533          0          69
## 925          0        612        384         131
## 926          0        540        180           0
## 927       1140        656        104         100
## 928        880        486          0          43
## 929          0        522        202         151
## 930       1243        642          0           0
## 931          0        610        100          18
## 932          0        429          0           0
## 933          0        788          0         191
## 934          0        570        192          36
## 935          0        505          0           0
## 936          0        528          0           0
## 937          0        555          0          41
## 938        858        689          0          48
## 939        571        868          0          90
## 940       1196        349         56           0
## 941          0        574         40           0
## 942       1038        390          0           0
## 943          0          0        321           0
## 944          0        576          0           0
## 945          0        525          0         118
## 946        561        456         48           0
## 947          0        796         86           0
```

```
## 948          0        808          0         252
## 949        840        474        144          96
## 950          0        676          0           0
## 951          0        720        194           0
## 952          0        300        421           0
## 953          0        396        192           0
## 954        800        530        305         189
## 955          0          0          0           0
## 956        979        492          0           0
## 957        668        462        150           0
## 958          0        576          0           0
## 959          0        531          0          39
## 960        720        484          0          44
## 961          0          0        117           0
## 962       1330        619        550         282
## 963        744        440         48           0
## 964          0        702        288         136
## 965       1070        510          0          40
## 966        701        393          0          72
## 967        332        256          0          70
## 968          0        260          0           0
## 969        368          0          0           0
## 970          0        264          0           0
## 971        472          0          0           0
## 972        862        474          0          27
## 973          0        264         28           0
## 974          0        480          0         120
## 975        883        532        509         135
## 976        709        490        153          50
## 977          0          0          0           0
## 978          0        569          0         116
## 979          0        400          0           0
## 980          0        480          0          80
## 981          0        588        144          76
## 982       1336        676        250           0
## 983          0        388        100          16
## 984       1141        779          0           0
## 985        432        539          0           0
## 986          0        240          0          48
## 987        634        255        394           0
## 988          0        606        168          95
## 989        912        551          0         224
## 990        798        614          0          50
## 991        985        870          0          70
## 992        826        424          0         169
## 993        831        440        239          42
## 994        750        564          0          35
## 995          0        786        216          48
## 996        456        305          0          57
## 997          0        368          0         319
```

```
## 998          0        615        371          0
## 999          0        210          0        100
## 1000         0        632        105         61
## 1001         0        528          0          0
## 1002         0        216          0         20
## 1003         0        824        144        104
## 1004         0        528          0          0
## 1005         0        457        156          0
## 1006         0        328        210          0
## 1007         0        484          0          0
## 1008       546        286        238          0
## 1009         0        550        100         48
## 1010         0          0          0          0
## 1011       551        312          0          0
## 1012         0          0          0          0
## 1013       602        180         96          0
## 1014         0        280          0         30
## 1015         0        240          0        130
## 1016       855        528          0         45
## 1017         0        478        115         66
## 1018         0        565         63          0
## 1019       670        402        164          0
## 1020         0        440        142         20
## 1021         0        451        252         64
## 1022         0        632        105         54
## 1023       336        160          0          0
## 1024         0        437        156         20
## 1025         0        665          0         72
## 1026         0        461         96          0
## 1027         0        461          0          0
## 1028         0        800        192         44
## 1029       408        240          0          0
## 1030       546        264          0         28
## 1031       980          0          0          0
## 1032       998        672        136         63
## 1033      1168        796        209         55
## 1034         0        900          0        136
## 1035         0        240          0          0
## 1036         0        290        186          0
## 1037         0        912        228          0
## 1038      1208        905          0         45
## 1039       546          0          0          0
## 1040         0        286          0          0
## 1041         0        484          0          0
## 1042       832        484          0         40
## 1043         0        624        170         63
## 1044       797        514        192        121
## 1045         0        542        474        120
## 1046         0        452          0          0
## 1047       876        716        214        108
```

```
## 1048         0        672          0           0
## 1049         0        336          0           0
## 1050         0        308          0           0
## 1051         0        436          0          22
## 1052         0        440          0          20
## 1053       850        540          0          52
## 1054         0        364        116          78
## 1055       898        586        199          60
## 1056         0        478          0           0
## 1057         0        484        192          36
## 1058       871        467        168          98
## 1059      1054        836          0         102
## 1060       895        432          0           0
## 1061         0        582          0           0
## 1062         0       1248          0          20
## 1063       915        560          0          57
## 1064         0        440        166         120
## 1065         0        480          0          58
## 1066       954        533        296          44
## 1067       772        380          0          40
## 1068       813        442        328         128
## 1069      1230        576        728          20
## 1070         0        576          0           0
## 1071         0        286          0          20
## 1072       727        441          0           0
## 1073       454        280          0           0
## 1074       728        440        252           0
## 1075         0        826        140          93
## 1076       780        240          0           0
## 1077       370        566        436          21
## 1078         0        299        240          32
## 1079         0        420        140           0
## 1080         0        299          0          64
## 1081         0        528         55           0
## 1082         0        308          0           0
## 1083         0        527        192          39
## 1084         0        461          0         116
## 1085       807        409        315          44
## 1086         0        564        120           0
## 1087       546        286        120          96
## 1088       871       1043        160          50
## 1089       739        380          0          40
## 1090         0        550          0          84
## 1091         0        400          0           0
## 1092       628        462          0          48
## 1093       304        576        342           0
## 1094         0        884          0          64
## 1095         0        308          0           0
## 1096         0        440          0          22
## 1097       582          0        136           0
```

```
## 1098         0        461          0          74
## 1099       567        240          0           0
## 1100         0        478          0           0
## 1101         0        246          0           0
## 1102         0        280          0           0
## 1103         0        254          0          16
## 1104         0        539          0           0
## 1105       672        440          0           0
## 1106      1122        712        186          32
## 1107         0        719          0         244
## 1108      1134        422          0         100
## 1109       742        463        100          48
## 1110         0        862        125         185
## 1111       885        431        224          84
## 1112       866        483          0          69
## 1113         0        308          0           0
## 1114         0        240          0          18
## 1115         0        326          0           0
## 1116         0        928          0           0
## 1117       640        527        120           0
## 1118         0        450          0           0
## 1119       580        300        280          34
## 1120         0        286        140           0
## 1121         0        308          0          22
## 1122         0        782        144          20
## 1123         0        288         64           0
## 1124         0          0          0         200
## 1125       670        392        100          25
## 1126         0        672          0           0
## 1127         0        660        143          20
## 1128         0        630        144          36
## 1129      1112        434        100          48
## 1130         0        672         49           0
## 1131       653        576        431          44
## 1132         0          0          0          28
## 1133      1032        205          0          48
## 1134       878        466          0         155
## 1135       684        460        100          38
## 1136         0        180          0         128
## 1137       220        288          0           0
## 1138       240          0          0           0
## 1139         0        714        264          32
## 1140         0        495          0           0
## 1141         0        840          0           0
## 1142       780        484        448          96
## 1143      1362       1052        125         144
## 1144         0          0          0          24
## 1145       252        280          0           0
## 1146       534        225          0           0
## 1147         0        403        165          26
```

```
## 1148       704        234          0           0
## 1149       539        288          0           0
## 1150       650        324          0           0
## 1151         0        306          0           0
## 1152         0        528          0         140
## 1153         0        470          0           0
## 1154         0        432          0           0
## 1155       918        492         60          84
## 1156         0        528          0          21
## 1157         0        502          0          92
## 1158         0        626        172          62
## 1159         0        830          0          24
## 1160       933        540          0          69
## 1161       601        440         26           0
## 1162         0        924        108           0
## 1163         0        450          0           0
## 1164         0        400        120           0
## 1165         0        588        168         180
## 1166         0        644          0         114
## 1167         0        776        160          33
## 1168       712        472          0          38
## 1169       872        540          0           0
## 1170      1796        807        361          76
## 1171         0        358        203           0
## 1172         0        433          0           0
## 1173       625        625          0          54
## 1174       971          0        122           0
## 1175      1175        360          0           0
## 1176       743        541          0          33
## 1177         0        264        362           0
## 1178       406        210          0           0
## 1179       523        186        192           0
## 1180         0          0          0          36
## 1181      1216        693          0           0
## 1182         0        482        162          53
## 1183      2065        813        171          78
## 1184         0        720        229           0
## 1185         0        995          0         263
## 1186       272        392          0           0
## 1187       685        420          0          74
## 1188         0        757          0         114
## 1189       829        493        144          68
## 1190       776        442        140          60
## 1191         0       1356        439           0
## 1192       677        492        206           0
## 1193       630        250          0           0
## 1194         0        402          0         304
## 1195       689        299        379          36
## 1196       728        400        100          24
## 1197       984        660        100          17
```

```
## 1198       875        225          0           0
## 1199         0        573        356           0
## 1200         0        459          0          82
## 1201         0        280          0           0
## 1202       913        546        198          36
## 1203       464        216          0           0
## 1204         0        451         74         234
## 1205         0        495          0          88
## 1206         0        701         84          70
## 1207         0        384          0          42
## 1208         0        544        192          23
## 1209         0        506          0           0
## 1210         0        500        322          50
## 1211       790        462        635         104
## 1212       672        492        325          12
## 1213         0        234          0         113
## 1214         0        364         88           0
## 1215         0        300        150          72
## 1216         0        384          0           0
## 1217       584        539          0           0
## 1218         0        552        135         112
## 1219       240          0          0           0
## 1220       546          0        201           0
## 1221         0        288          0           0
## 1222         0        322          0          63
## 1223       678        315          0           0
## 1224         0        528          0          30
## 1225       702        388        100          75
## 1226         0        264        224           0
## 1227      1039        668        100          18
## 1228         0        576          0         240
## 1229         0       1052          0          72
## 1230         0        404          0           0
## 1231      1259        600        155          24
## 1232         0        540          0          18
## 1233         0        462          0           0
## 1234         0        531          0           0
## 1235       940          0          0         192
## 1236       892        180        203          40
## 1237       862        474          0          27
## 1238      1101        434        100          48
## 1239         0        484          0           0
## 1240         0        472        120          33
## 1241       884        543          0          63
## 1242         0        954          0          56
## 1243         0        528          0         120
## 1244         0        850        216         229
## 1245       725        400          0           0
## 1246       728        477        268         112
## 1247       797        615          0          45
```

```
## 1248         0        888          0           0
## 1249       924        396          0           0
## 1250         0        276          0          80
## 1251         0        522          0           0
## 1252         0        478        148          36
## 1253         0        288         33           0
## 1254       651        518        220          47
## 1255       896        397        178         128
## 1256       408        560          0           0
## 1257         0        691        262          36
## 1258         0          0          0          96
## 1259         0        400        212           0
## 1260         0        460        180           0
## 1261       783        502          0         103
## 1262         0        338          0           0
## 1263       684        304        120           0
## 1264       764        520          0           0
## 1265         0        511        144          68
## 1266       739        506          0          34
## 1267       925        308          0           0
## 1268         0        746        144          76
## 1269      1479       1014        314          12
## 1270       650        315          0           0
## 1271       192        586        268           0
## 1272         0        462          0           0
## 1273         0        288        180           0
## 1274         0        312          0           0
## 1275       589        552        242           0
## 1276       992        400          0           0
## 1277       660        497        294         116
## 1278         0        480          0           0
## 1279       903        577          0         211
## 1280       430        528         30           0
## 1281         0        544          0          72
## 1282         0        484          0          58
## 1283         0        484          0           0
## 1284       912          0        128           0
## 1285       748        336        272           0
## 1286       587        280         45           0
## 1287         0        528          0          26
## 1288         0        390        168         198
## 1289         0        499        212          59
## 1290       850        753        177          74
## 1291         0        484        227           0
## 1292       672        264        185           0
## 1293       994        432          0         287
## 1294       832        528          0          28
## 1295         0        572          0           0
## 1296         0        288        356           0
## 1297         0        525        192          20
```

```
## 1298         0        525          0          44
## 1299       950       1418        214         292
## 1300         0        305        218           0
## 1301       978        490          0           0
## 1302       741        213          0           0
## 1303      1323        844        309          78
## 1304         0        834        208          59
## 1305       732        380          0          40
## 1306         0        840        404         102
## 1307         0        474        132          35
## 1308         0        480          0          64
## 1309         0        528          0          36
## 1310         0        496        112          51
## 1311         0        567          0         207
## 1312         0        508        264          98
## 1313      1357        750        500           0
## 1314      1177        779        668          30
## 1315         0        280          0          36
## 1316      1020        576        280           0
## 1317         0        860        172          42
## 1318         0        466          0         241
## 1319         0        748        198         150
## 1320         0        248          0           0
## 1321         0        442        114           0
## 1322         0        287          0           0
## 1323       862        564        240          39
## 1324         0          0        164           0
## 1325         0        895          0          49
## 1326         0          0          0           0
## 1327         0          0          0           0
## 1328         0        264          0           0
## 1329      1208        520          0         547
## 1330       677        462          0          28
## 1331         0        825        144          45
## 1332         0        576          0           0
## 1333         0        288          0           0
## 1334       557        297          0          65
## 1335       600        440          0          36
## 1336         0        630          0          16
## 1337         0        506          0         211
## 1338         0          0          0          20
## 1339       941        492        146          91
## 1340         0        288          0           0
## 1341         0        480          0           0
## 1342         0        576          0          78
## 1343       885        647        192          87
## 1344       741        342          0           0
## 1345       728        440          0           0
## 1346         0        308          0           0
## 1347         0        508          0          80
```

```
## 1348         0        712          0           0
## 1349         0        514        402          25
## 1350      1215          0          0          54
## 1351      1296        968          0           0
## 1352       858        490          0          84
## 1353       390        624        210           0
## 1354      1185        666        283          86
## 1355       873        839          0         184
## 1356       698        487          0          98
## 1357         0        264          0           0
## 1358         0        500          0           0
## 1359       804        440          0          32
## 1360         0        770        194          45
## 1361      1611        621        183           0
## 1362         0        430        168          36
## 1363       457        368         55           0
## 1364       796        432          0          36
## 1365       600        480          0         166
## 1366       860        663          0          96
## 1367       908        588          0          88
## 1368       550        336        104          26
## 1369         0        420        140           0
## 1370         0        502          0         262
## 1371       534        338          0           0
## 1372         0        377          0          28
## 1373       989        583        253         170
## 1374         0        804        314         140
## 1375       932        936        154         210
## 1376         0        722        100          36
## 1377         0        160          0         141
## 1378       620        660          0          68
## 1379       504        264         72           0
## 1380       640        400        100           0
## 1381         0        200          0           0
## 1382         0        550          0          42
## 1383       764        576         36           0
## 1384         0        576          0           0
## 1385       560        280          0           0
## 1386       358        240          0          96
## 1387      1392        564          0         112
## 1388       862        216         88          15
## 1389         0        758        201          39
## 1390       349        440          0           0
## 1391         0        541        219          36
## 1392         0        792          0         152
## 1393         0        288        175         144
## 1394       691        672          0          25
## 1395         0        648        161          20
## 1396      1349        642        144          39
## 1397         0        572          0           0
```

```
## 1398       574        180         24          0
## 1399       768        240          0          0
## 1400       448        216        147         16
## 1401       208        208          0          0
## 1402       729        398        100         75
## 1403         0        662        168         55
## 1404         0        754        168        160
## 1405       520        936        216          0
## 1406         0        482        128         53
## 1407         0        396         58          0
## 1408         0          0          0          0
## 1409       622        528          0          0
## 1410       857        542        364         63
## 1411       896        622          0         45
## 1412       556        271          0          0
## 1413         0        420          0          0
## 1414         0        620        165         44
## 1415       795        370          0          0
## 1416         0        660        143         20
## 1417      1044        560          0          0
## 1418      1140       1069          0        126
## 1419         0        336          0         88
## 1420         0        540          0         73
## 1421       708        776          0        169
## 1422         0        440          0         55
## 1423         0        420        140          0
## 1424       626        432        586        236
## 1425         0        484        316         28
## 1426         0        528          0         39
## 1427       904        525        171        132
## 1428       510        288          0          0
## 1429         0        240          0          0
## 1430         0        467          0          0
## 1431      1104        372        100         40
## 1432         0        440          0         60
## 1433         0        216          0          0
## 1434       830        451          0          0
## 1435         0        484        295         41
## 1436         0        462          0         36
## 1437         0        528          0          0
## 1438         0        774          0         66
## 1439         0        923          0        158
## 1440       685        550          0         88
## 1441       748        672        431          0
## 1442         0        420        149          0
## 1443       981        812        168         52
## 1444         0        192          0         98
## 1445         0        626        192         60
## 1446         0        240          0          0
## 1447         0        312        261         39
```

```
## 1448       870        556          0          65
## 1449       550        384        168          24
## 1450         0          0          0           0
## 1451       896          0         32          45
## 1452         0        840          0          36
## 1453         0        525          0          28
## 1454         0          0         36          56
## 1455         0        400          0         113
## 1456       694        460          0          40
## 1457         0        500        349           0
## 1458      1152        252          0          60
## 1459         0        240        366           0
## 1460         0        276        736          68
```

```
library(stats)
library(factoextra)
```

```
## Warning: package 'factoextra' was built under R version 3.5.2
```

```
## Welcome! Related Books: `Practical Guide To Cluster Analysis in R` at
https://goo.gl/13EFCZ
```

```
pca <- prcomp(training_pca, scale. = T, center = T)
pca
```

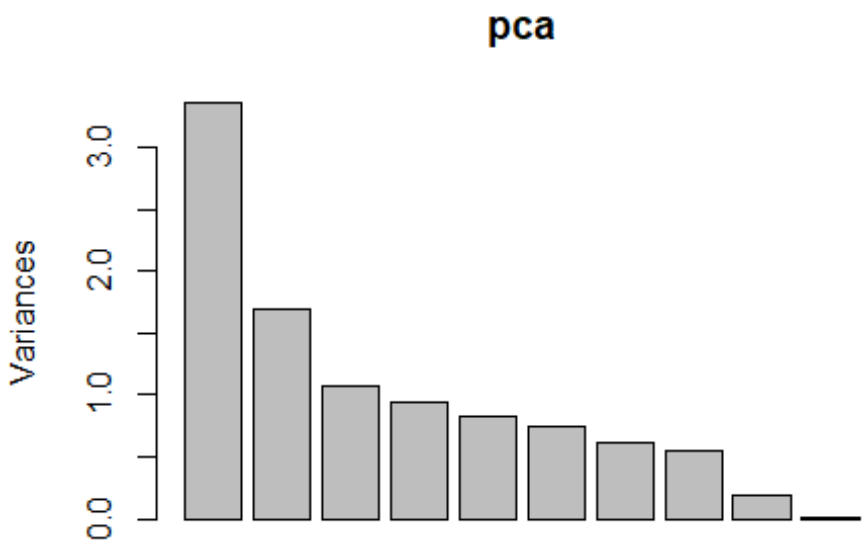
```
## Standard deviations (1, .., p=10):
##  [1] 1.83243422 1.30429534 1.03548877 0.97248759 0.90793164 0.86649566
##  [7] 0.77941503 0.73794318 0.43830438 0.06096042
##
## Rotation (n x k) = (10 x 10):
##                    PC1         PC2         PC3         PC4         PC5
## LotArea     0.24082621 -0.03031059 -0.40321015  0.23822964  0.77267425
## TotalBsmtSF 0.45634490 -0.25721946  0.08271935 -0.13355898 -0.04317210
## GrLivArea   0.40759887  0.43900569 -0.03989019 -0.01123075  0.03799954
## BsmtFinSF1  0.31864938 -0.26991749  0.24502299  0.21866216  0.08778484
## BsmtFinSF2  0.04272502 -0.16236957 -0.79944538 -0.39689989 -0.21229754
## X1stFlrSF   0.46316944 -0.23031329  0.04318594 -0.11537263  0.00025177
## X2ndFlrSF   0.08073359  0.72388109 -0.08170676  0.09248418  0.04172027
## GarageArea  0.37860907  0.07132877  0.14820597 -0.02714632 -0.16463297
## WoodDeckSF  0.22506337  0.02882402 -0.28991205  0.61195709 -0.55929762
## OpenPorchSF 0.22183369  0.24084730  0.12362708 -0.56819651 -0.07233113
##                    PC6         PC7         PC8          PC9          PC10
## LotArea      0.2458665 -0.24325647  0.05908480  0.040144360 -0.0003067372
## TotalBsmtSF -0.1173180  0.03307807 -0.23823061  0.792089692 -0.0050582128
## GrLivArea   -0.2699258  0.16012622 -0.23801319 -0.210405689 -0.6622346195
## BsmtFinSF1   0.1946590  0.70572976  0.39400253 -0.137325978 -0.0029135324
## BsmtFinSF2  -0.1266822  0.24663944  0.22835668 -0.032725184  0.0009599222
## X1stFlrSF   -0.2162628 -0.09485291 -0.39200004 -0.508365329  0.4993875181
## X2ndFlrSF   -0.1288099  0.27091579  0.07695150  0.211276857  0.5585351789
## GarageArea  -0.2348152 -0.49980027  0.70433203 -0.026111169 -0.0075857437
```

```
## WoodDeckSF   0.3733019 -0.13413661 -0.14074732  0.001222033 -0.0017692250
## OpenPorchSF  0.7356165 -0.07085779 -0.01552828 -0.055008452  0.0003257185

eigenvalues <- get_eigenvalue(pca)
eigenvalues <- pca$sdev^2
sum(eigenvalues)

## [1] 10

plot(pca)
```




```
summary(pca)

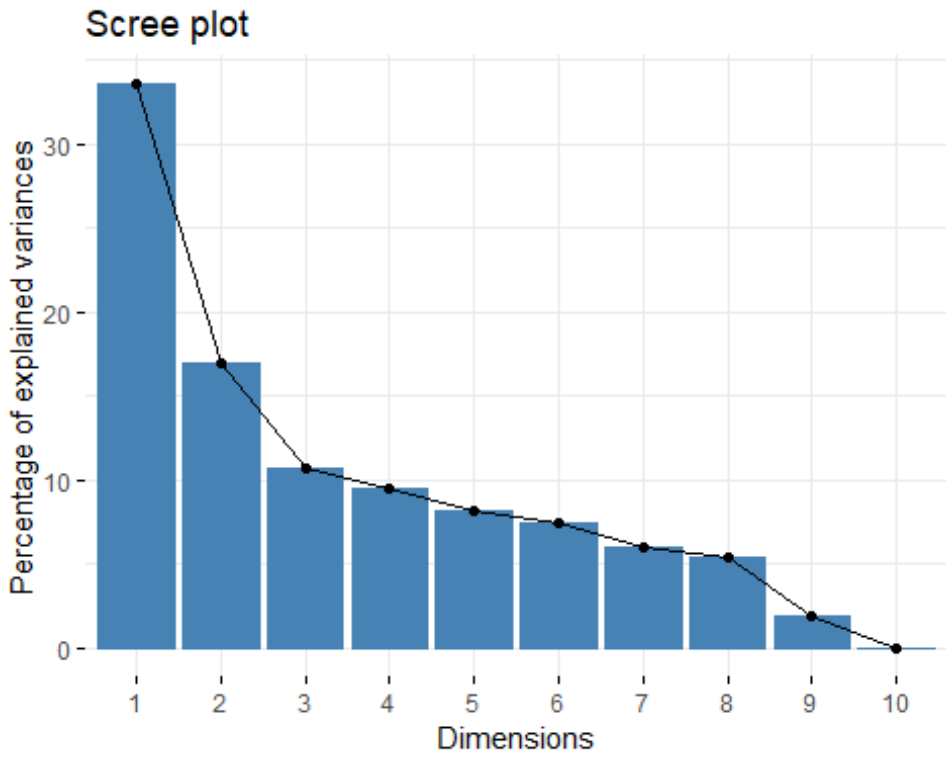
## Importance of components:
##                           PC1    PC2    PC3     PC4     PC5     PC6
## Standard deviation     1.8324 1.3043 1.0355 0.97249 0.90793 0.86650
## Proportion of Variance 0.3358 0.1701 0.1072 0.09457 0.08243 0.07508
## Cumulative Proportion  0.3358 0.5059 0.6131 0.70770 0.79013 0.86521
##                           PC7     PC8     PC9    PC10
## Standard deviation     0.77942 0.73794 0.43830 0.06096
## Proportion of Variance 0.06075 0.05446 0.01921 0.00037
## Cumulative Proportion  0.92596 0.98042 0.99963 1.00000

head(pca$x)

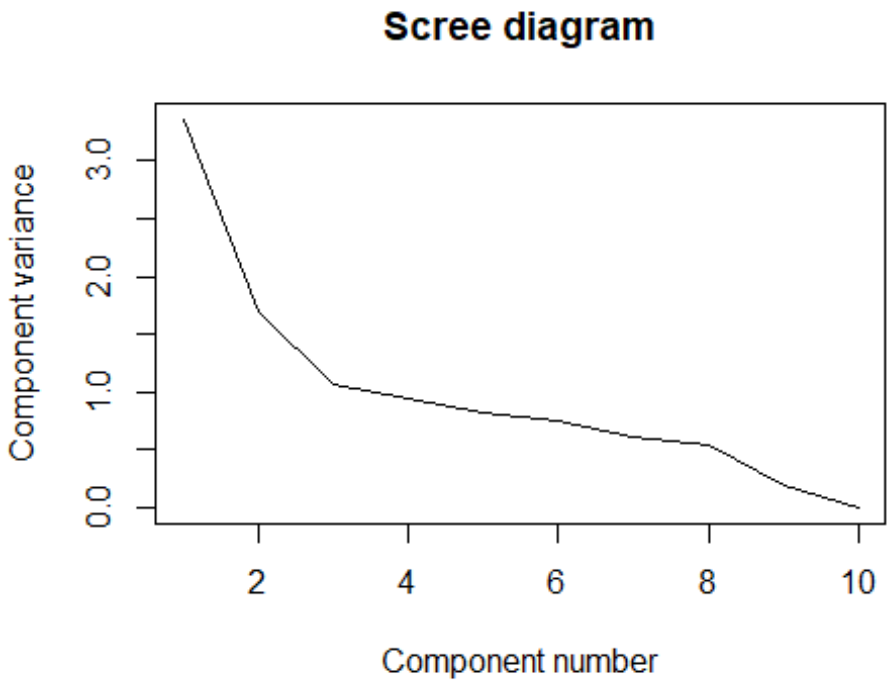
##              PC1        PC2       PC3         PC4        PC5         PC6
## [1,] -0.19950507  1.2573996 0.5699695 -0.14557326  0.3810288 -0.13039710
## [2,]  0.59661501 -1.3599887 0.1212960  1.58540971 -0.8267072  0.46737933
```

```
## [3,] -0.03859223  1.3377818 0.3560117 -0.06656048  0.5303680 -0.52766323
## [4,] -0.42680935  1.3203016 0.2896293 -0.16500343  0.3289244 -0.71100966
## [5,]  1.89901231  1.8898496 0.1188016  0.52976295 -0.2565965 -0.04649434
## [6,] -0.65453329  0.4012457 0.2198969  0.45447540  0.6854618  0.18322966
##             PC7         PC8         PC9         PC10
## [1,]  0.7292940  0.91968255  0.10717694  0.006626031
## [2,]  0.3386459 -0.02855527  0.05940217 -0.004845053
## [3,]  0.2204336  0.81636043  0.19989466  0.007234564
## [4,] -0.3396242  0.74604766 -0.09962054  0.008837563
## [5,] -0.1714445  1.00183713  0.13617801  0.003570218
## [6,]  0.5061831  0.91429199  0.12708586  0.001237862

library(factoextra)
fviz_screeplot(pca, ncp = 35)
```




```
#plot(pca, type = "l", main = "Scree diagram")
plot(eigenvalues, xlab = "Component number", ylab = "Component variance",
type = "l", main ="Scree diagram")
```

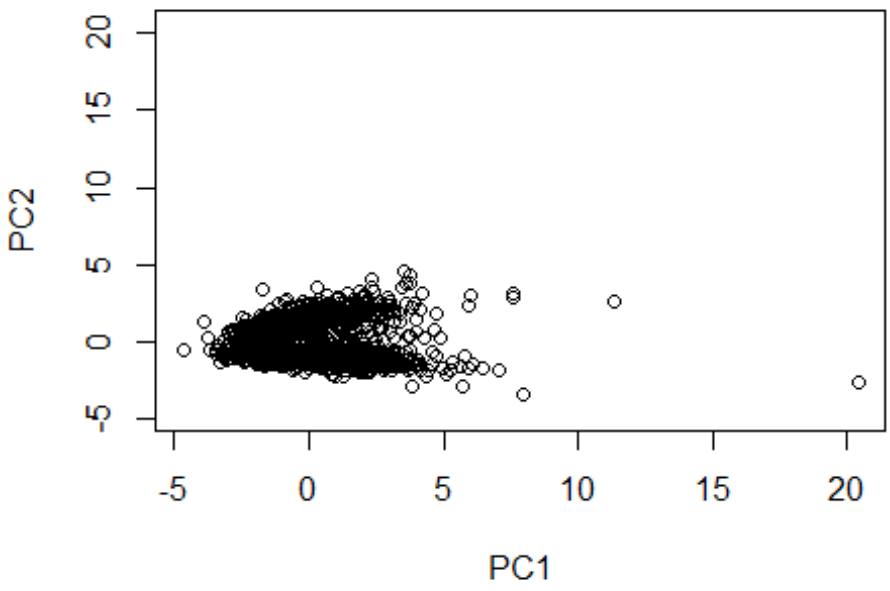



```
diag(cov(pca$x))
```

```
##         PC1         PC2         PC3         PC4         PC5         PC6
## 3.357815156 1.701186327 1.072236997 0.945732115 0.824339863 0.750814721
##         PC7         PC8         PC9        PC10
## 0.607487793 0.544560130 0.192110725 0.003716173
```

```
xlim <- range(pca$x[,1])
```

```
plot(pca$x,xlim=xlim,ylim=xlim)
```




```
pca$rotation[,1]

##     LotArea TotalBsmtSF   GrLivArea  BsmtFinSF1  BsmtFinSF2   X1stFlrSF
##  0.24082621  0.45634490  0.40759887  0.31864938  0.04272502  0.46316944
##   X2ndFlrSF  GarageArea  WoodDeckSF OpenPorchSF
##  0.08073359  0.37860907  0.22506337  0.22183369

pca$rotation[,2]

##     LotArea TotalBsmtSF   GrLivArea  BsmtFinSF1  BsmtFinSF2   X1stFlrSF
## -0.03031059 -0.25721946  0.43900569 -0.26991749 -0.16236957 -0.23031329
##   X2ndFlrSF  GarageArea  WoodDeckSF OpenPorchSF
##  0.72388109  0.07132877  0.02882402  0.24084730

pca$rotation[,3]

##     LotArea TotalBsmtSF   GrLivArea  BsmtFinSF1  BsmtFinSF2   X1stFlrSF
## -0.40321015  0.08271935 -0.03989019  0.24502299 -0.79944538  0.04318594
##   X2ndFlrSF  GarageArea  WoodDeckSF OpenPorchSF
## -0.08170676  0.14820597 -0.28991205  0.12362708

pca$rotation[,4]

##     LotArea TotalBsmtSF   GrLivArea  BsmtFinSF1  BsmtFinSF2   X1stFlrSF
##  0.23822964 -0.13355898 -0.01123075  0.21866216 -0.39689989 -0.11537263
##   X2ndFlrSF  GarageArea  WoodDeckSF OpenPorchSF
##  0.09248418 -0.02714632  0.61195709 -0.56819651
```

```
pca$rotation[,5]
```

```
##     LotArea TotalBsmtSF   GrLivArea  BsmtFinSF1  BsmtFinSF2   X1stFlrSF
##  0.77267425 -0.04317210  0.03799954  0.08778484 -0.21229754  0.00025177
##   X2ndFlrSF  GarageArea  WoodDeckSF OpenPorchSF
##  0.04172027 -0.16463297 -0.55929762 -0.07233113
```