

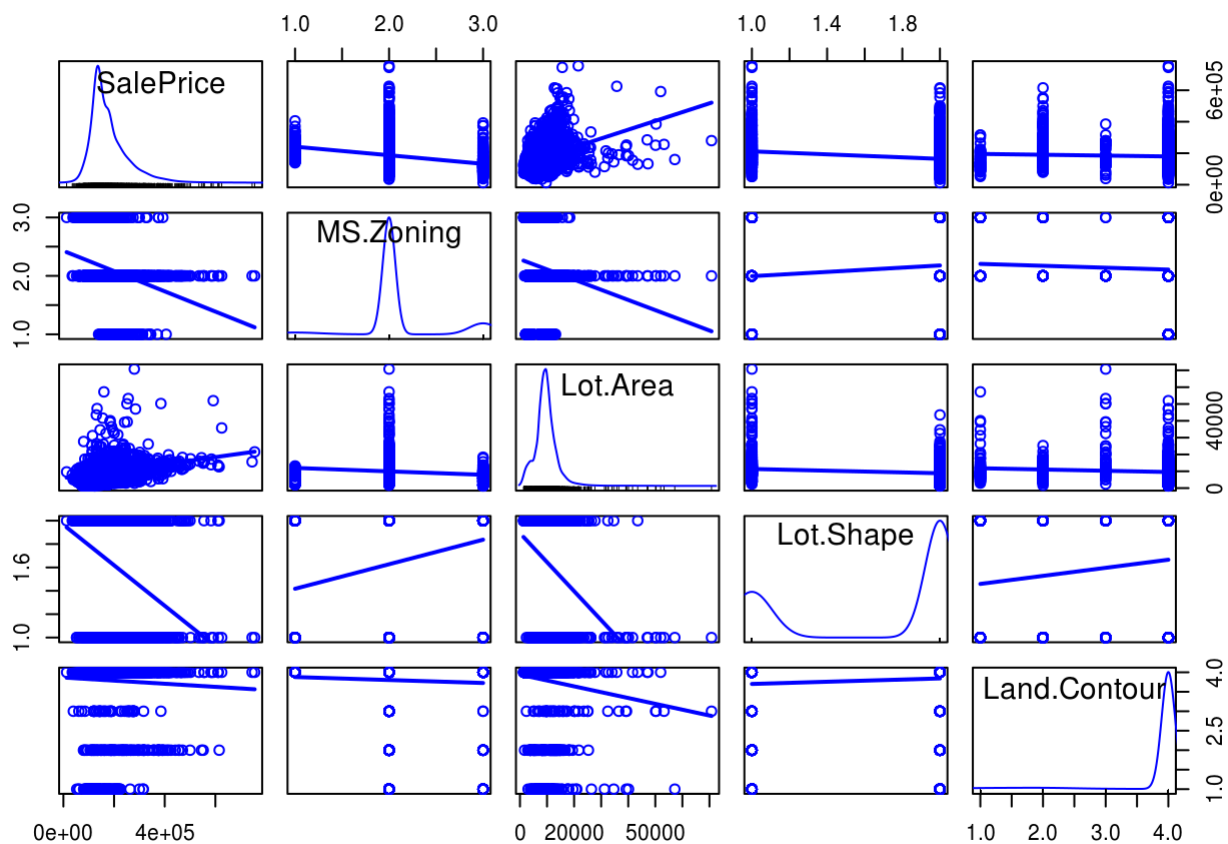
HW5

Chong Zhang

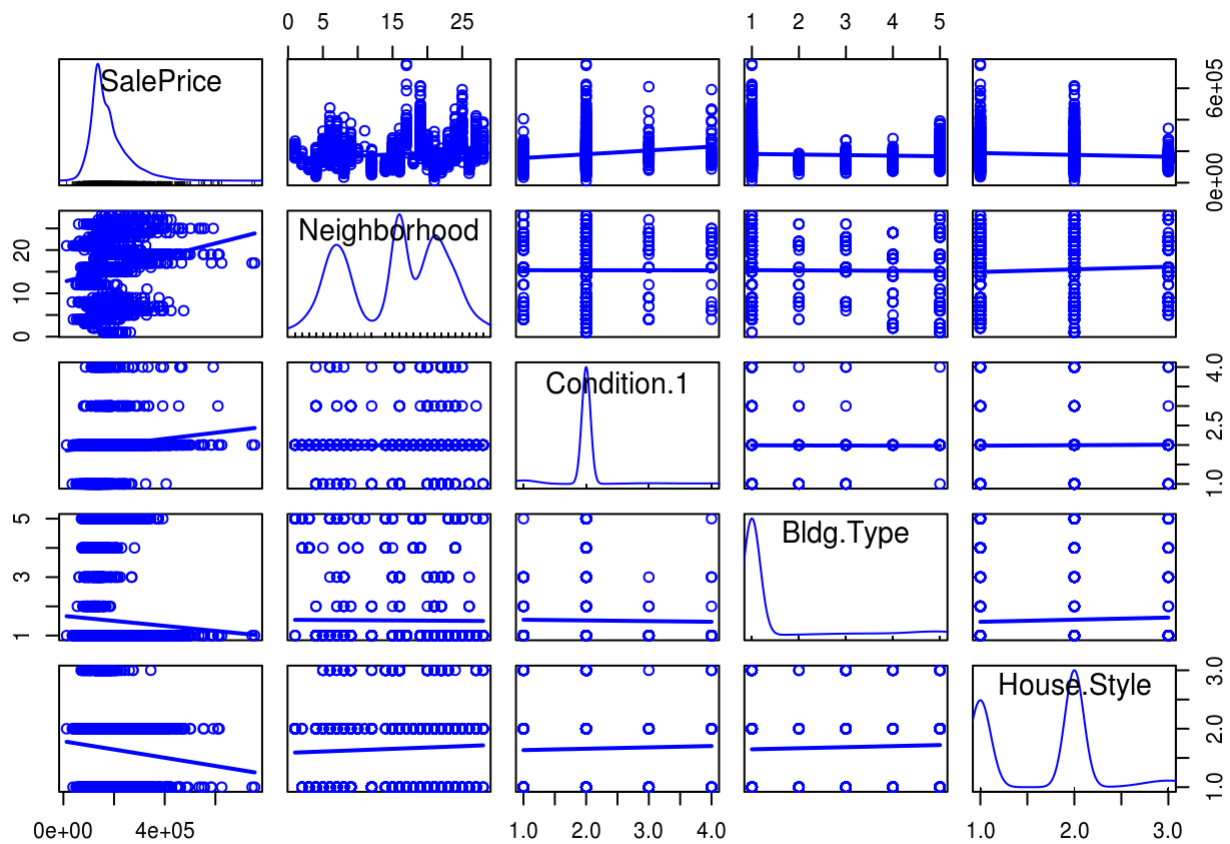
November 26, 2018

```
library(dplyr)
library(ggplot2)
library(glmnet)
library(MASS)
library(corrplot)
```

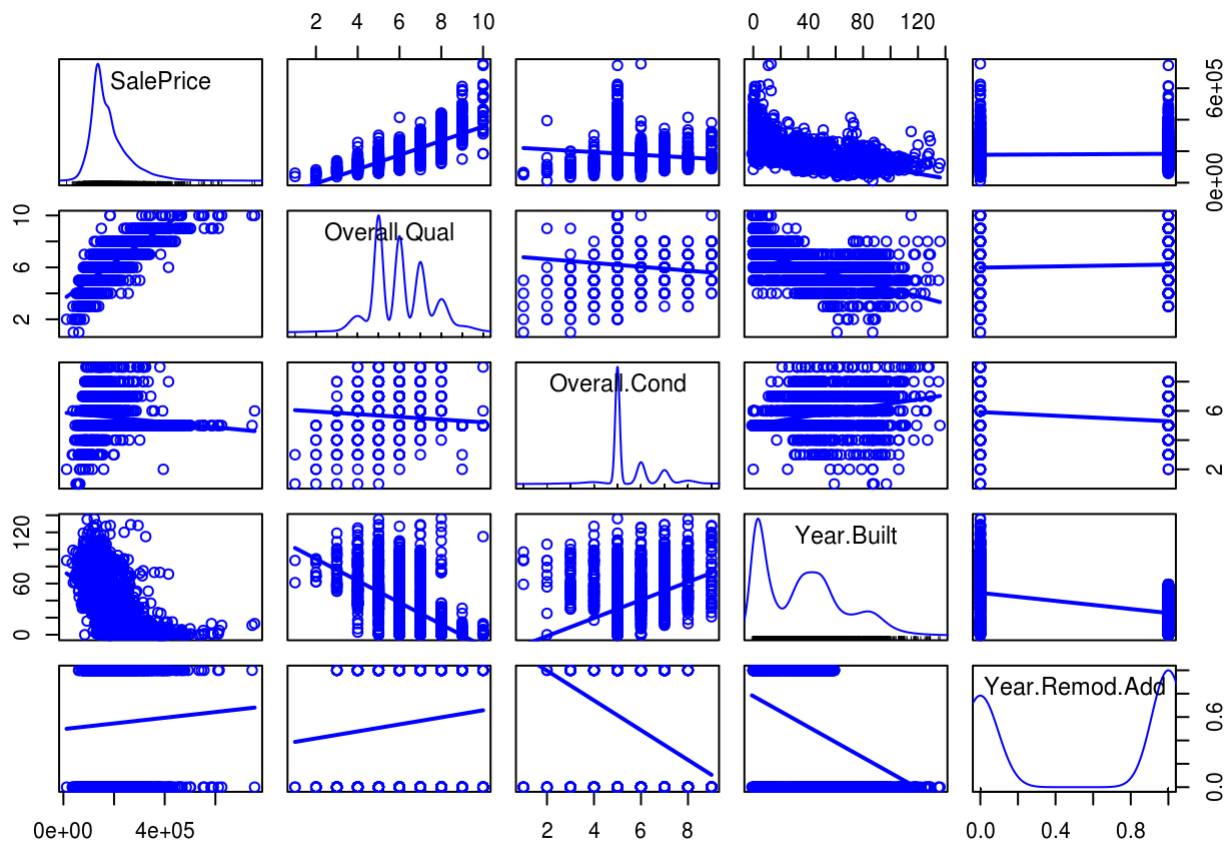
```
load(file = 'AmesHousing.RData')
attach(house)
scatterplotMatrix(~SalePrice+MS.Zoning+Lot.Area+Lot.Shape+Land.Contour,data = house, smooth=FALSE)
```



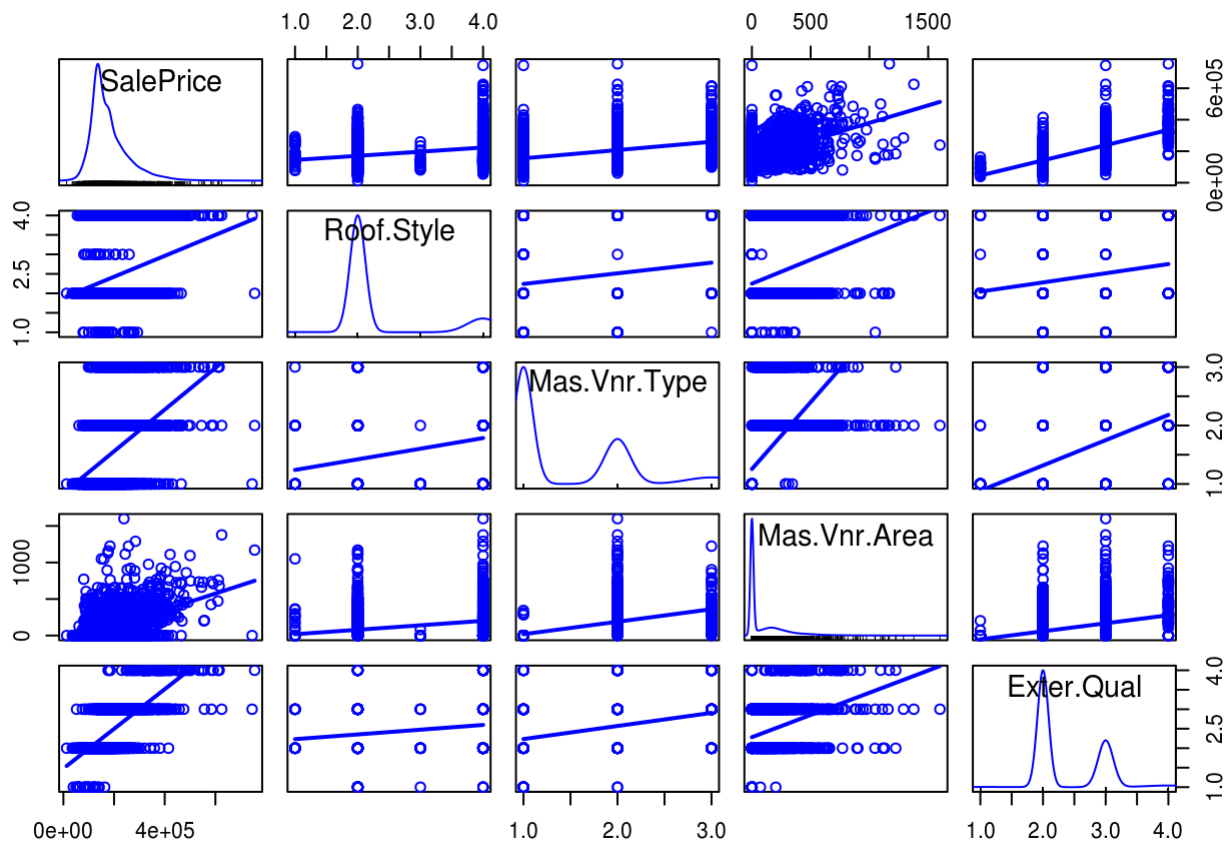
```
scatterplotMatrix(~SalePrice+Neighborhood+Condition.1+Bldg.Type+House.Style,data = house, smooth=FALSE)
```



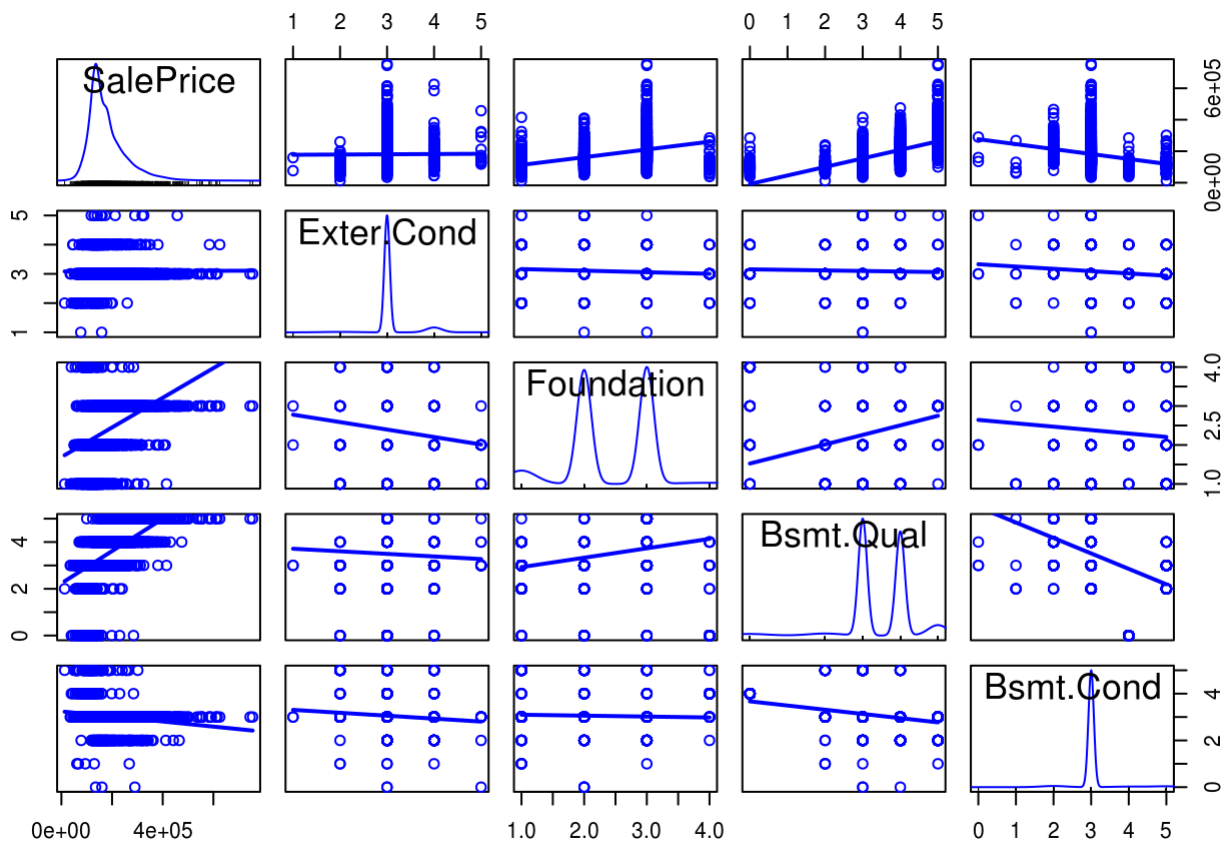
```
scatterplotMatrix(~SalePrice+Overall.Qual+Overall.Cond+Year.Built+Year.Remod.Add, smooth=FALSE)
```



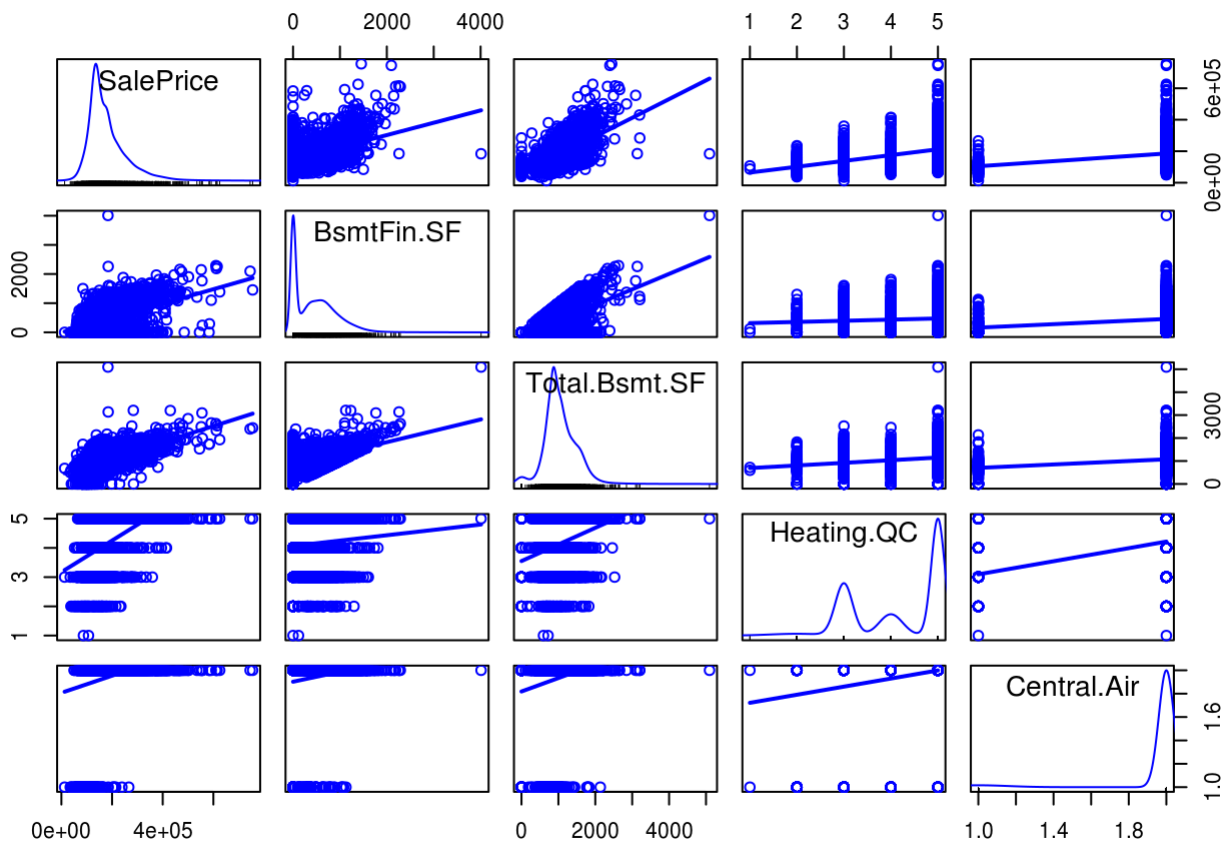
```
scatterplotMatrix(~SalePrice+Roof.Style++Mas.Vnr.Type+Mas.Vnr.Area+Exter.Qual,data = house, smooth=FALSE)
```



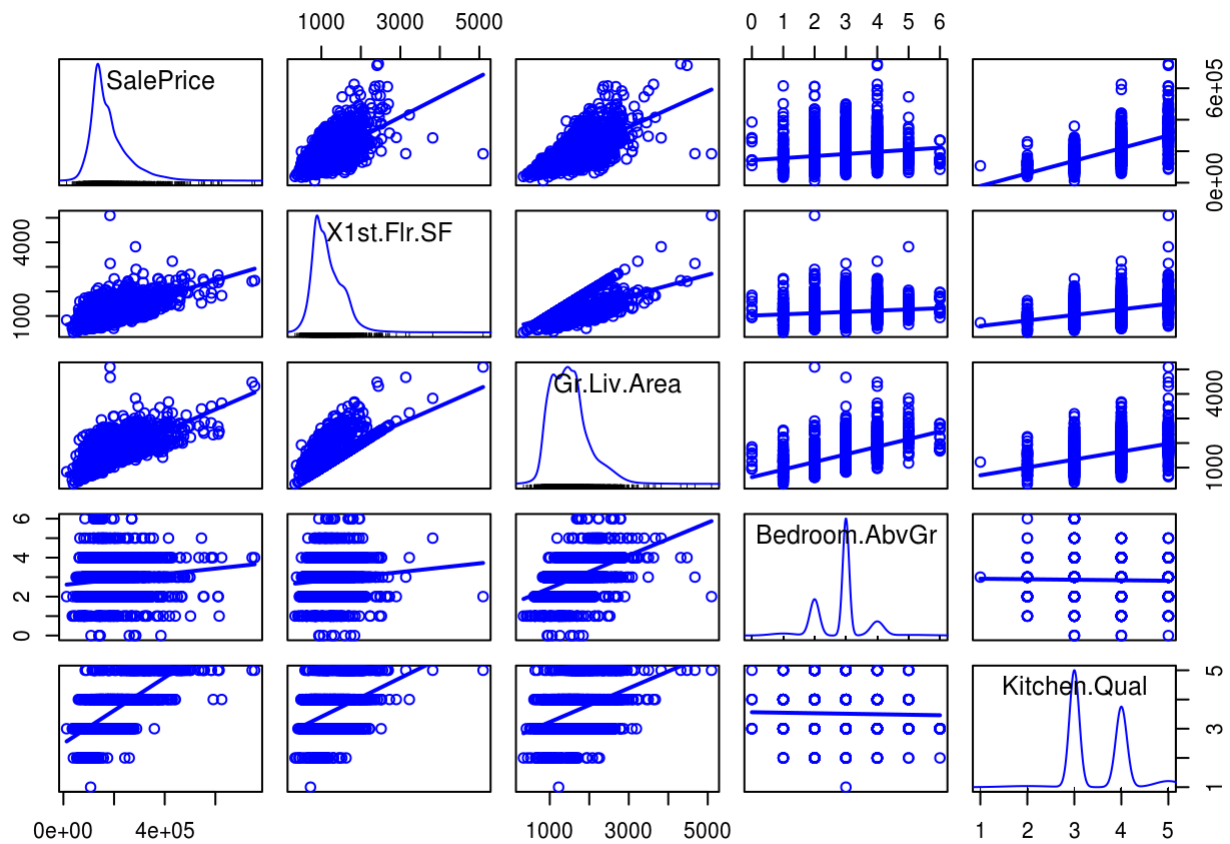
```
scatterplotMatrix(~SalePrice+Exter.Cond+Foundation+Bsmr.Qual+Bsmr.Cond,data = house, smo
oth=FALSE)
```



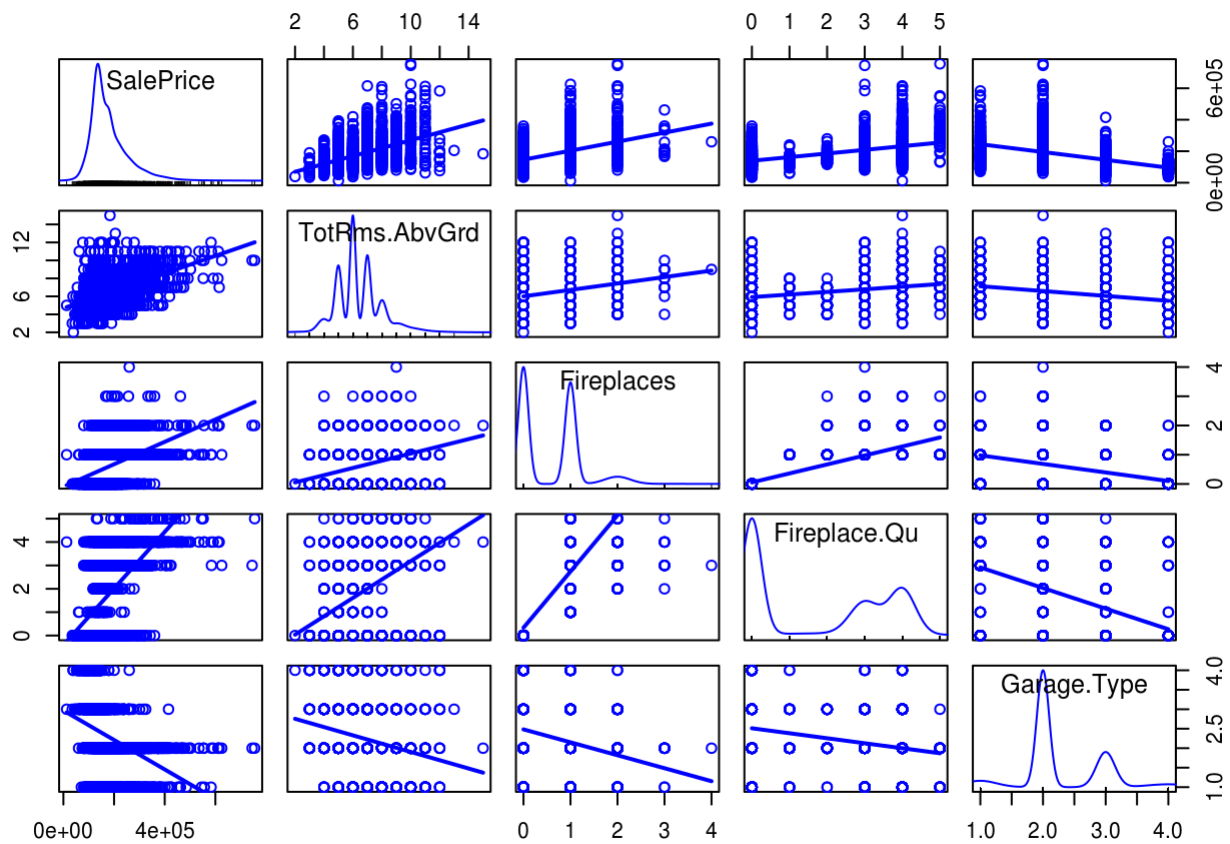
```
scatterplotMatrix(~SalePrice+BsmFin.SF+Total.Bsmt.SF+Heating.QC+Central.Air, data = house, smooth=FALSE)
```



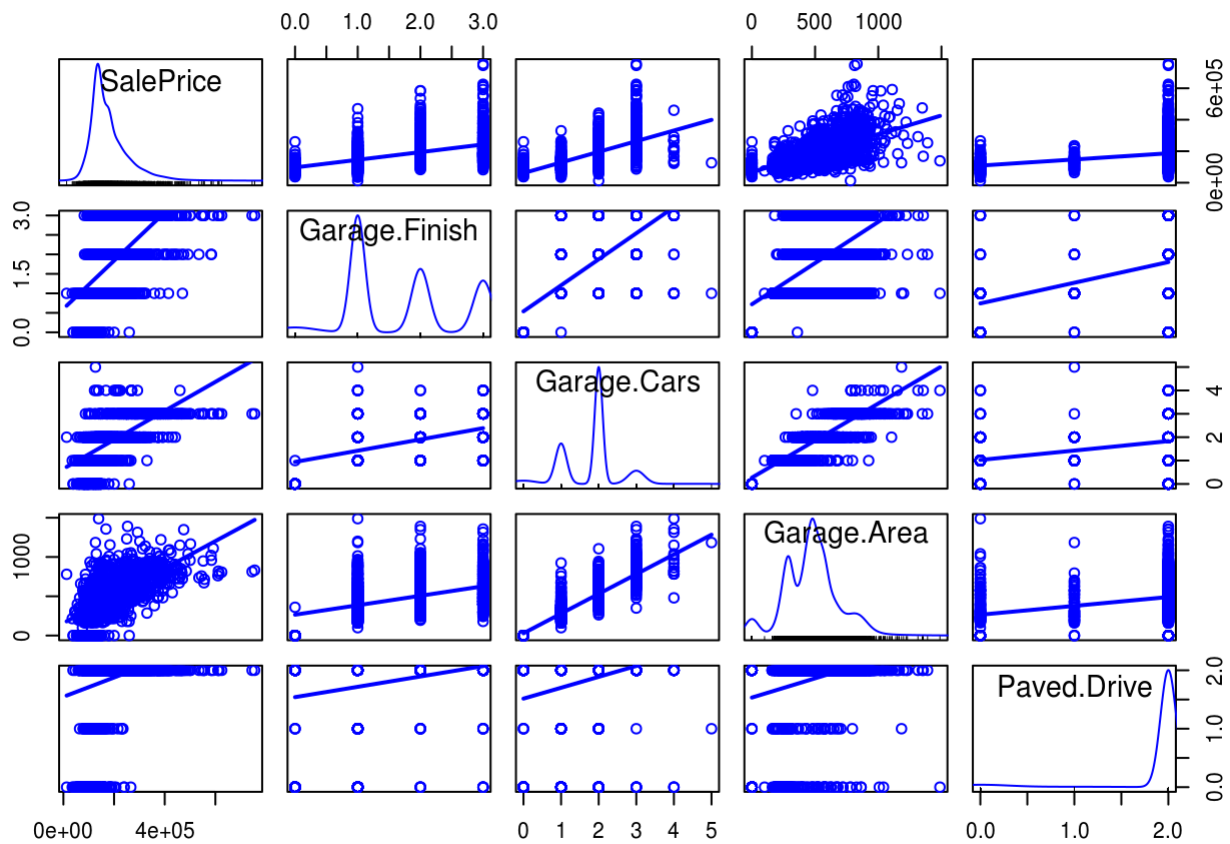
```
scatterplotMatrix(~SalePrice+X1st.Flr.SF+Gr.Liv.Area+Bedroom.AbvGr+Kitchen.Qual,data = h
ouse, smooth=FALSE)
```



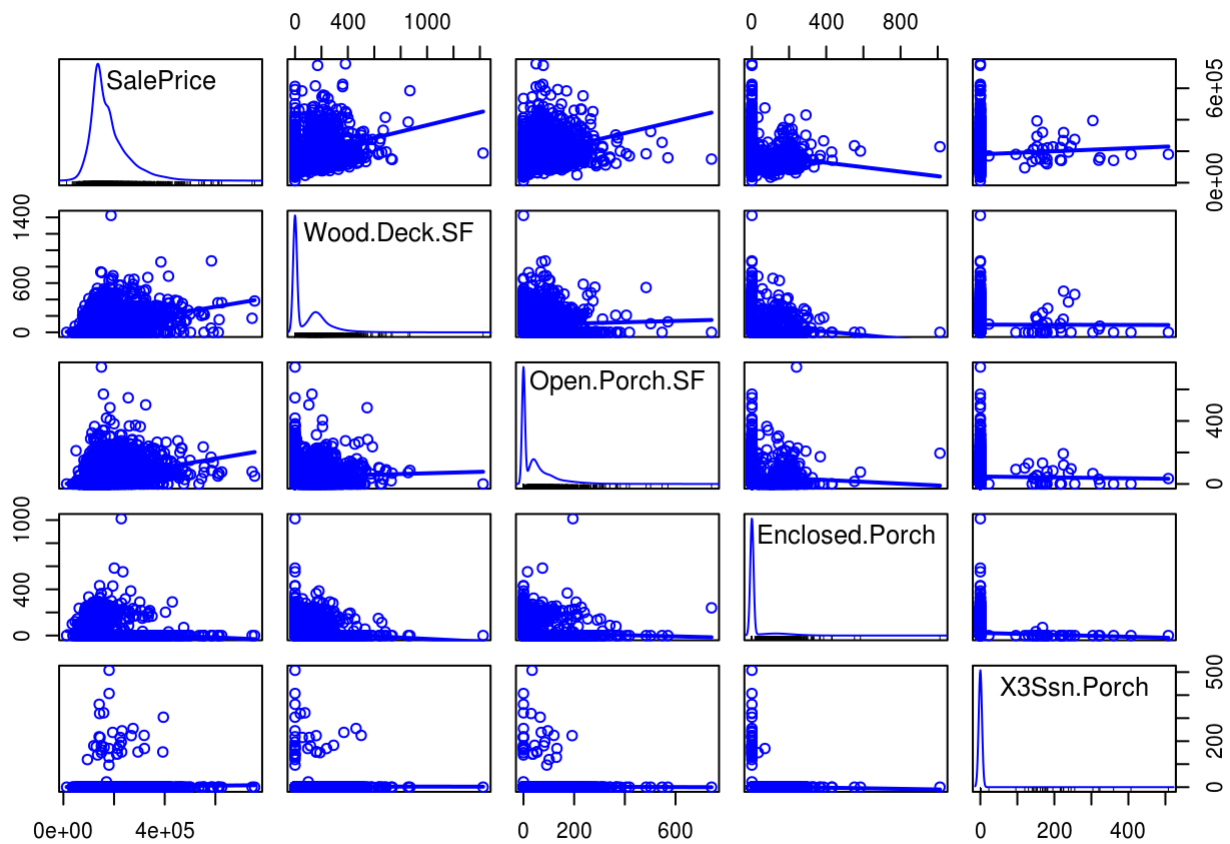
```
scatterplotMatrix(~SalePrice+TotRms.AbvGrd+Fireplaces+Fireplace.Qu+Garage.Type,data = ho
use, smooth=FALSE)
```



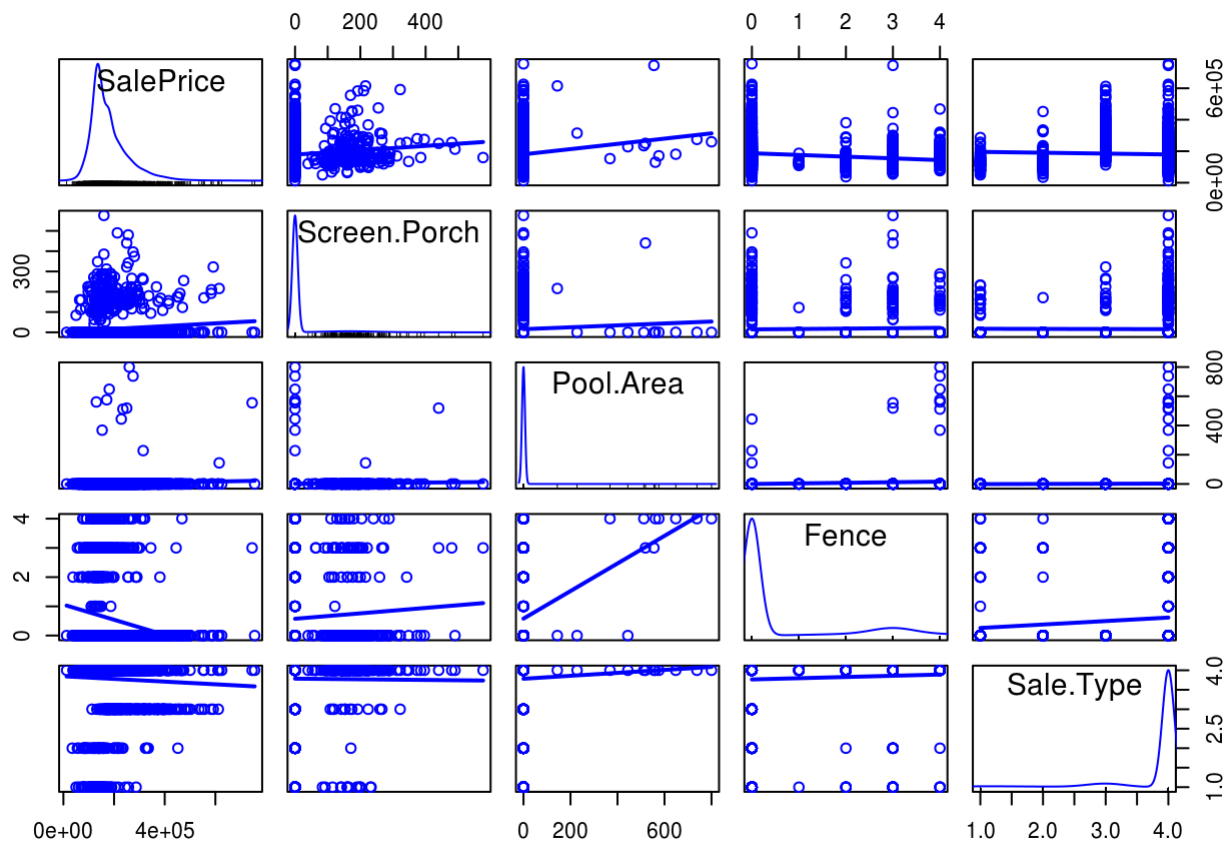
```
scatterplotMatrix(~SalePrice+Garage.Finish+Garage.Cars+Garage.Area+Paved.Drive,data = ho
use, smooth=FALSE)
```

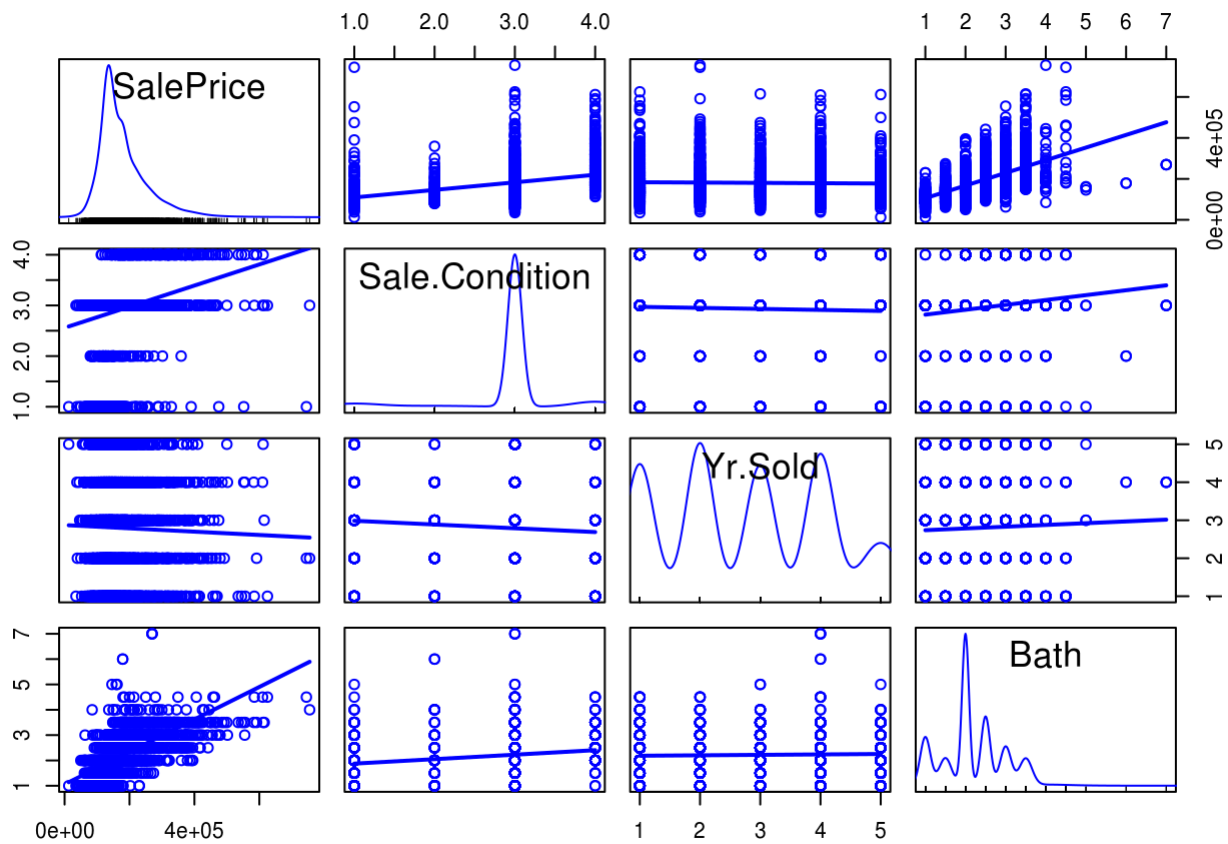
```
scatterplotMatrix(~SalePrice+Wood.Deck.SF+Open.Porch.SF+Enclosed.Porch+X3Ssn.Porch,data
= house, smooth=FALSE)
```



```
scatterplotMatrix(~SalePrice+Screen.Porch+Pool.Area+Fence+Sale.Type,data = house, smooth
=FALSE)
```



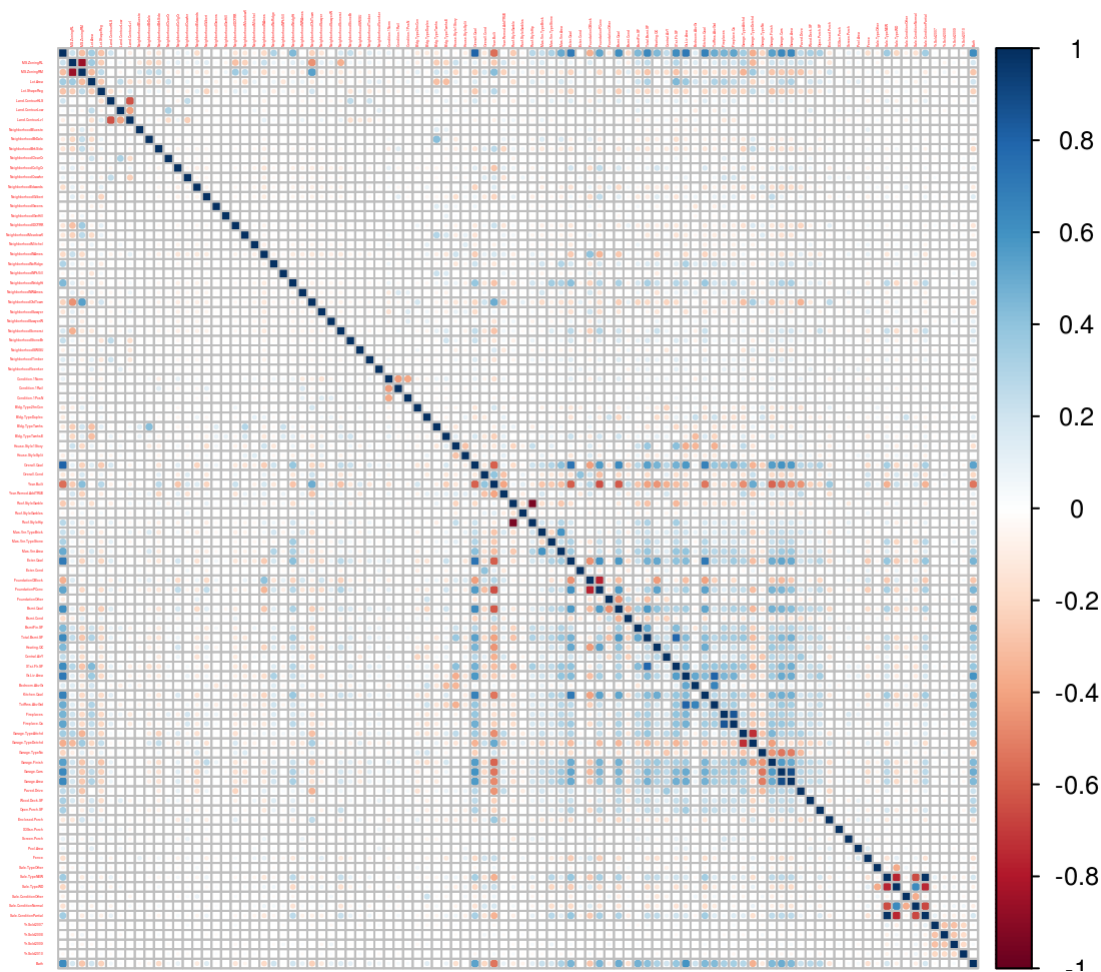
```
scatterplotMatrix(~SalePrice+Sale.Condition+Yr.Sold+Bath,data = house, smooth=FALSE)
```



The distribution of SalePrice is highly skewed. There are couple of predicting variables shows high level of linearity with SalePrice. Some do not show significant level of linearity.

b.

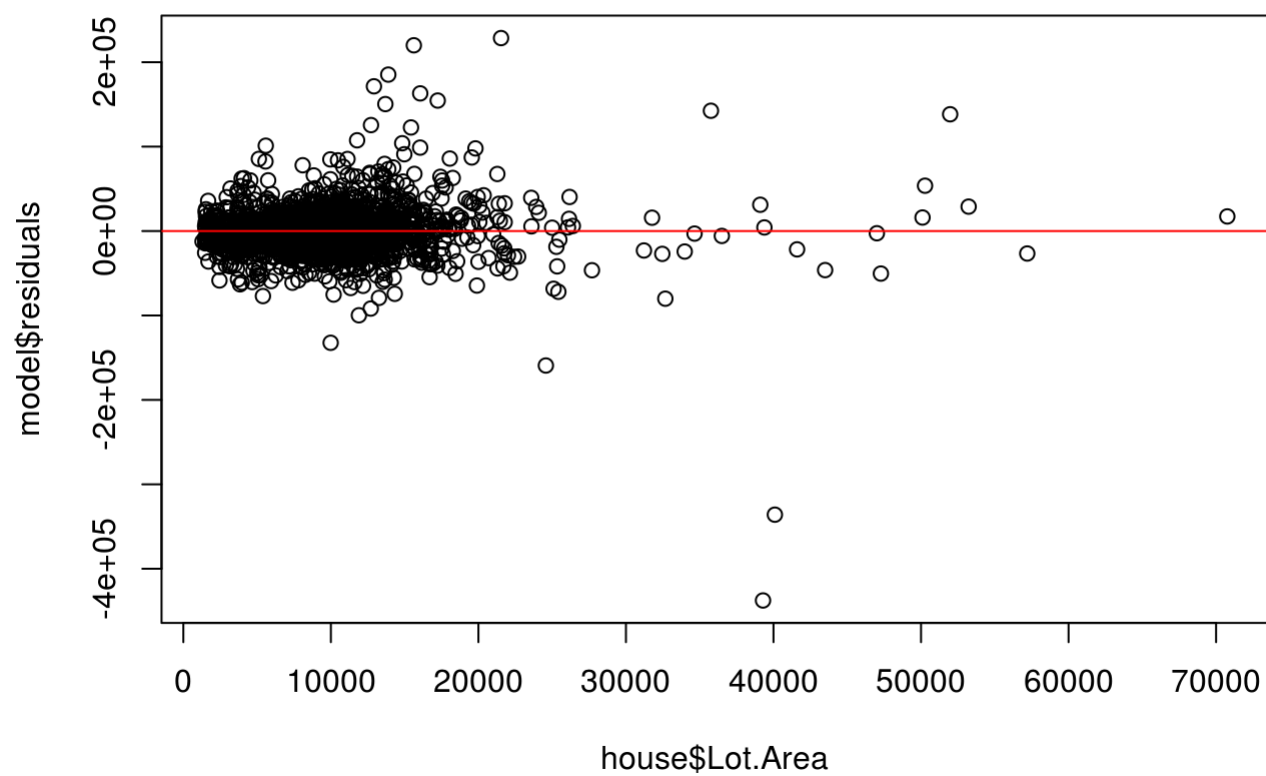
```
X = model.matrix(lm(house$SalePrice~., data = house))[, -1]
X = cbind(house$SalePrice, X)
corrplot(cor(X), tl.cex = 0.1)
```



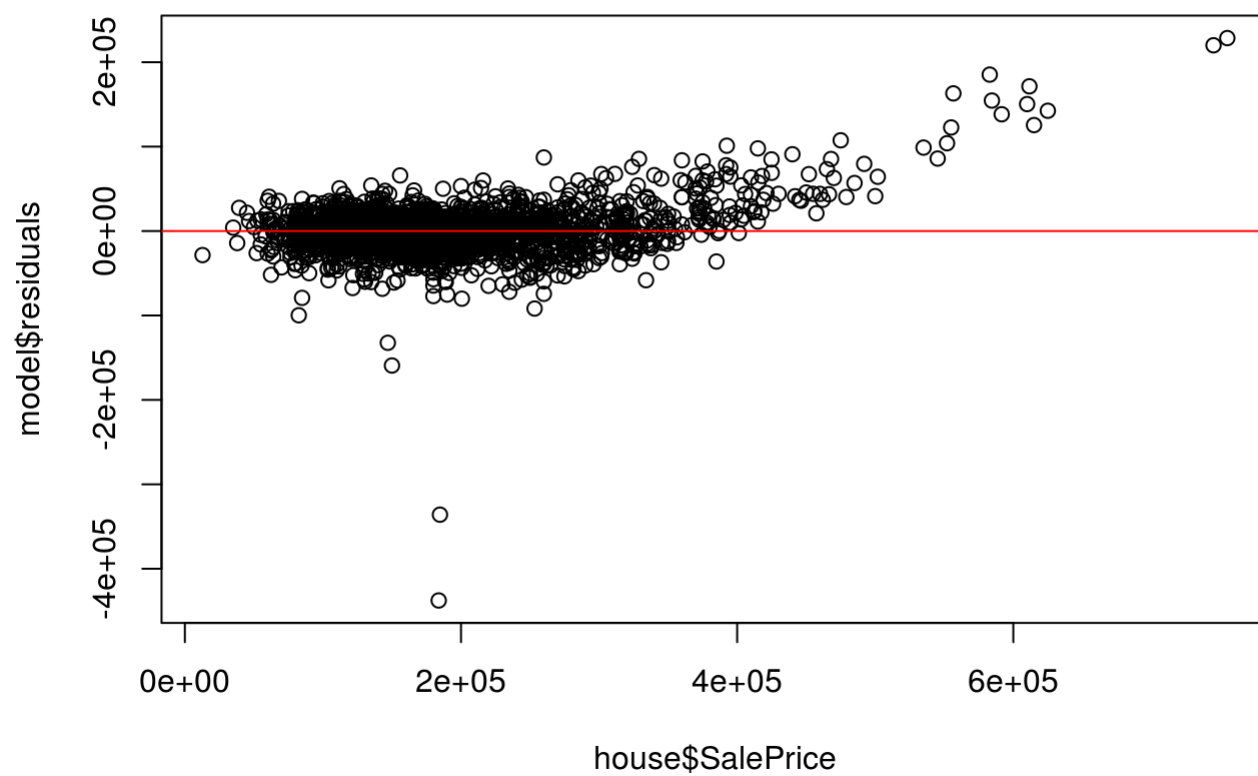
There are 18 predictors that correlate strongly with SalePrice. Yes, there is evidence showing multicollinearity based on the graph. For example, Garage.Cars tend to correlated strongly with Garage.Area. Because the larger the size of the garage, the more cars you can put in the garage.

Question 2:

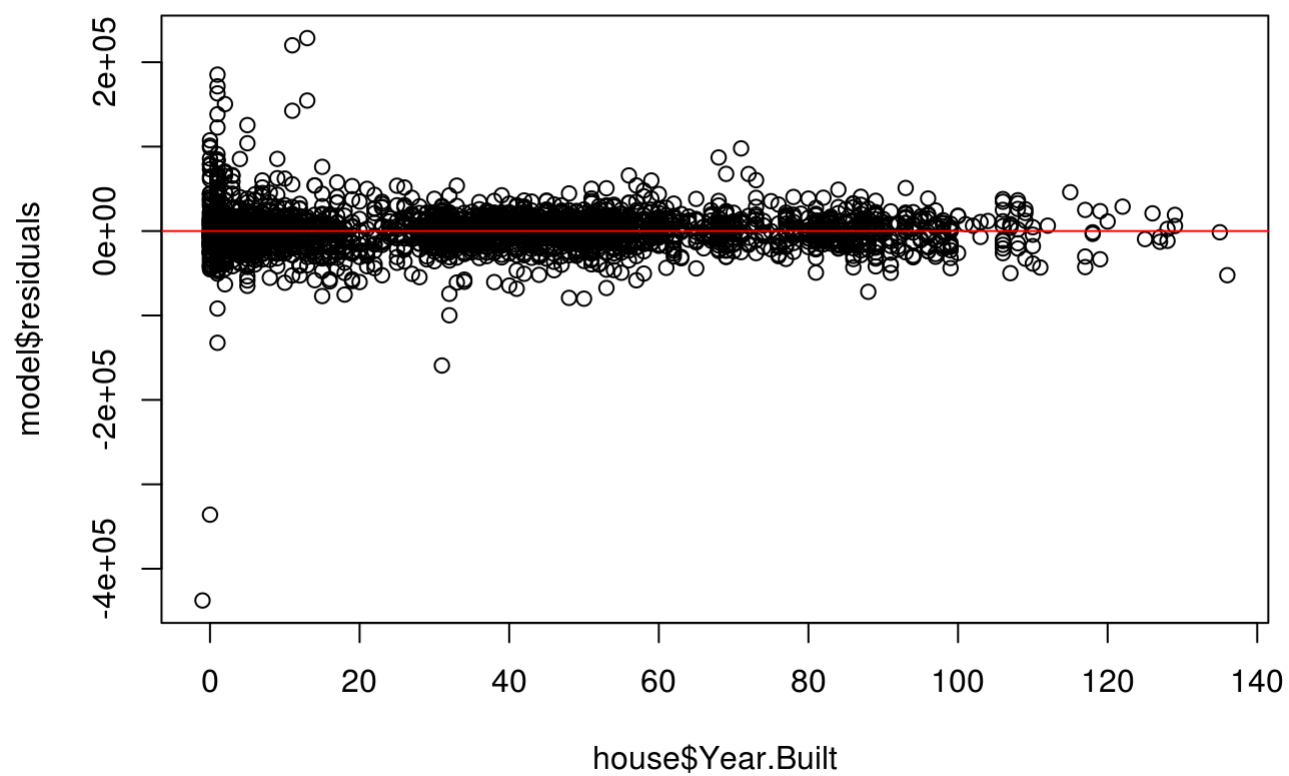
```
model = lm(SalePrice~., data = house)
plot(house$Lot.Area,model$residuals)
abline(h=0,col='red')
```



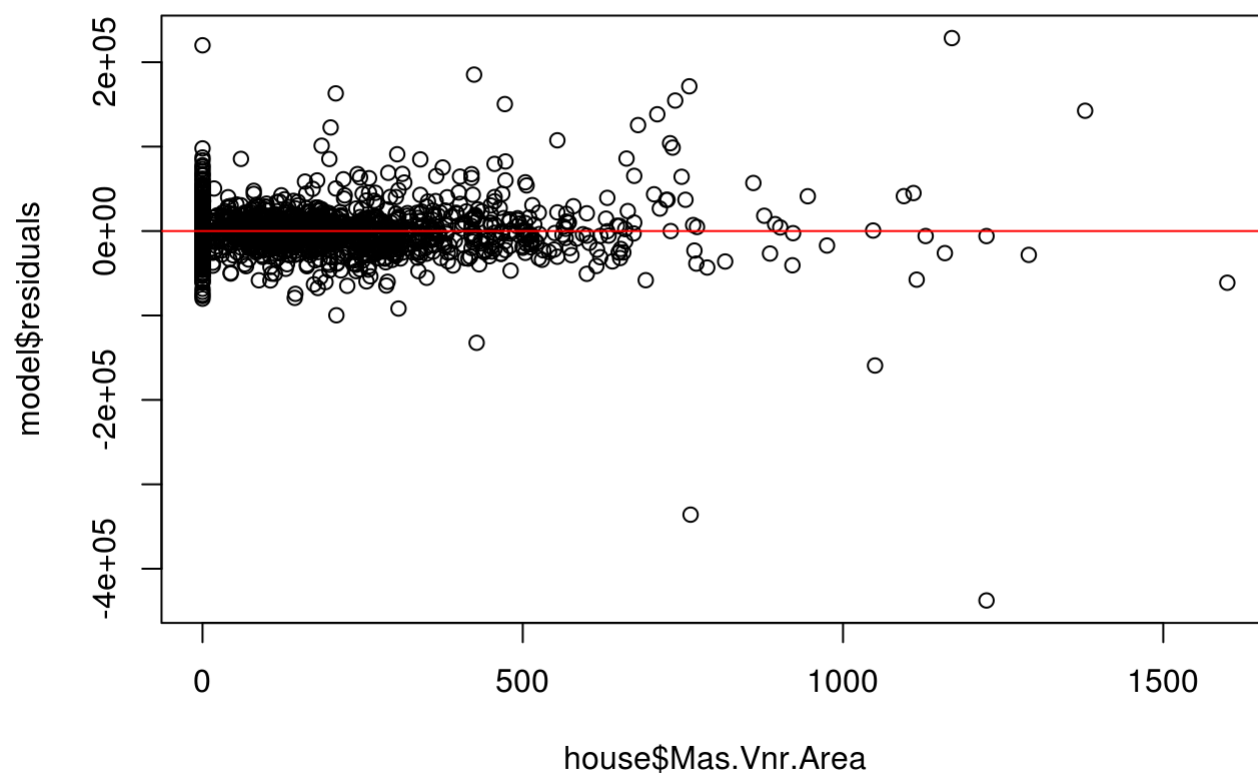
```
plot(house$SalePrice, model$residuals)
abline(h=0,col='red')
```



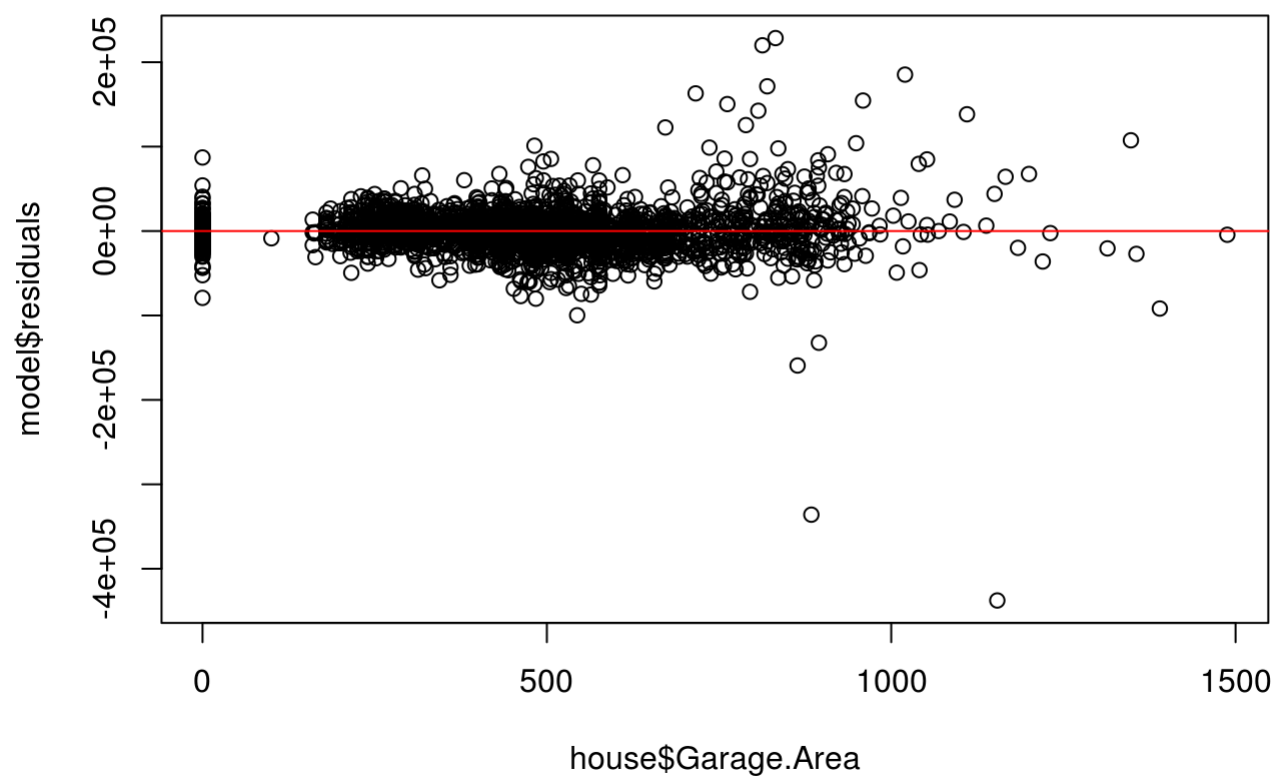
```
plot(house$Year.Built, model$residuals)
abline(h=0,col='red')
```



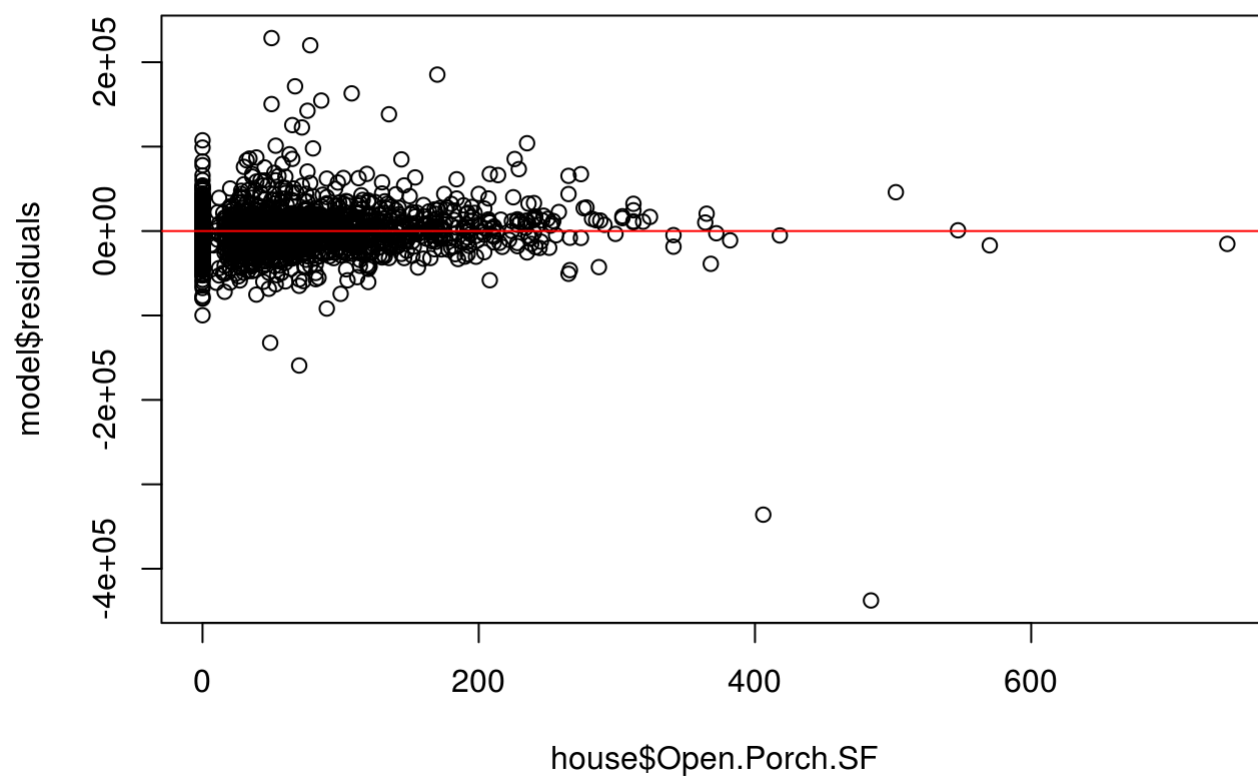
```
plot(house$Mas.Vnr.Area, model$residuals)
abline(h=0,col='red')
```

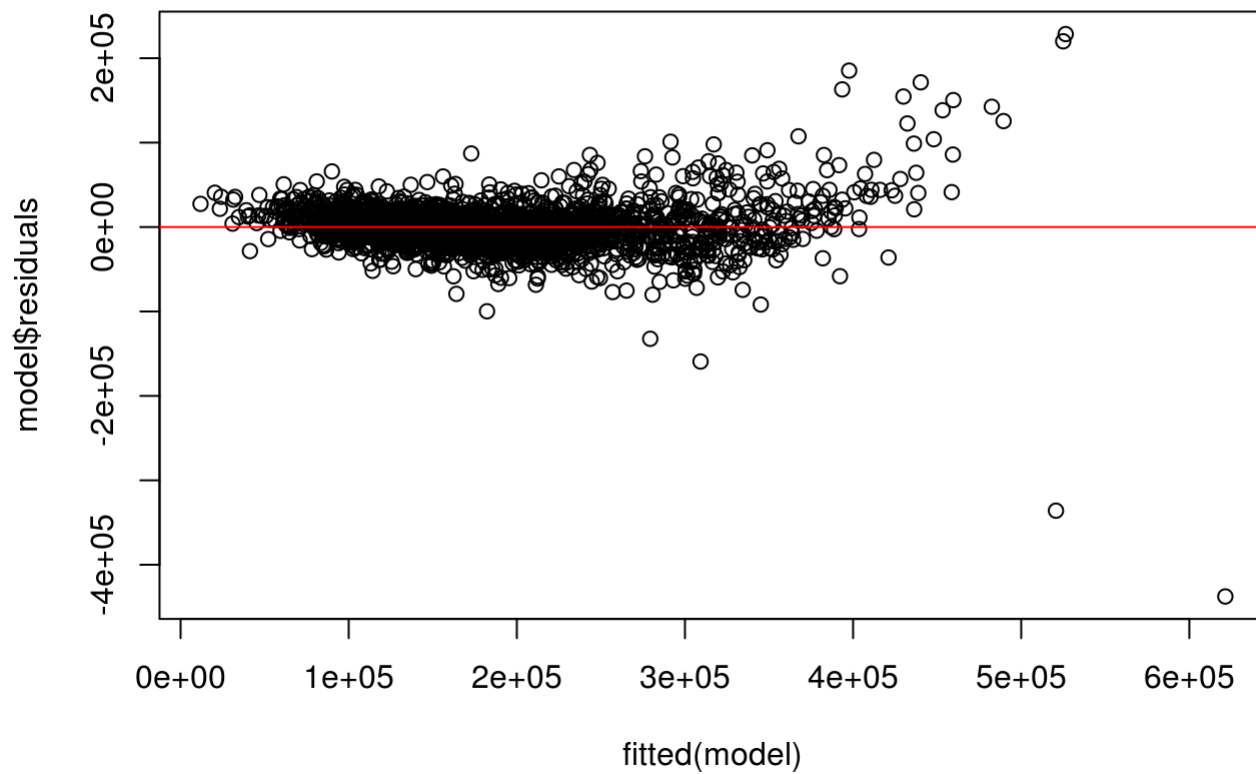
```
plot(house$Garage.Area, model$residuals)
abline(h=0,col='red')
```



```
plot(house$open.Porch.SF, model$residuals)
abline(h=0,col='red')
```



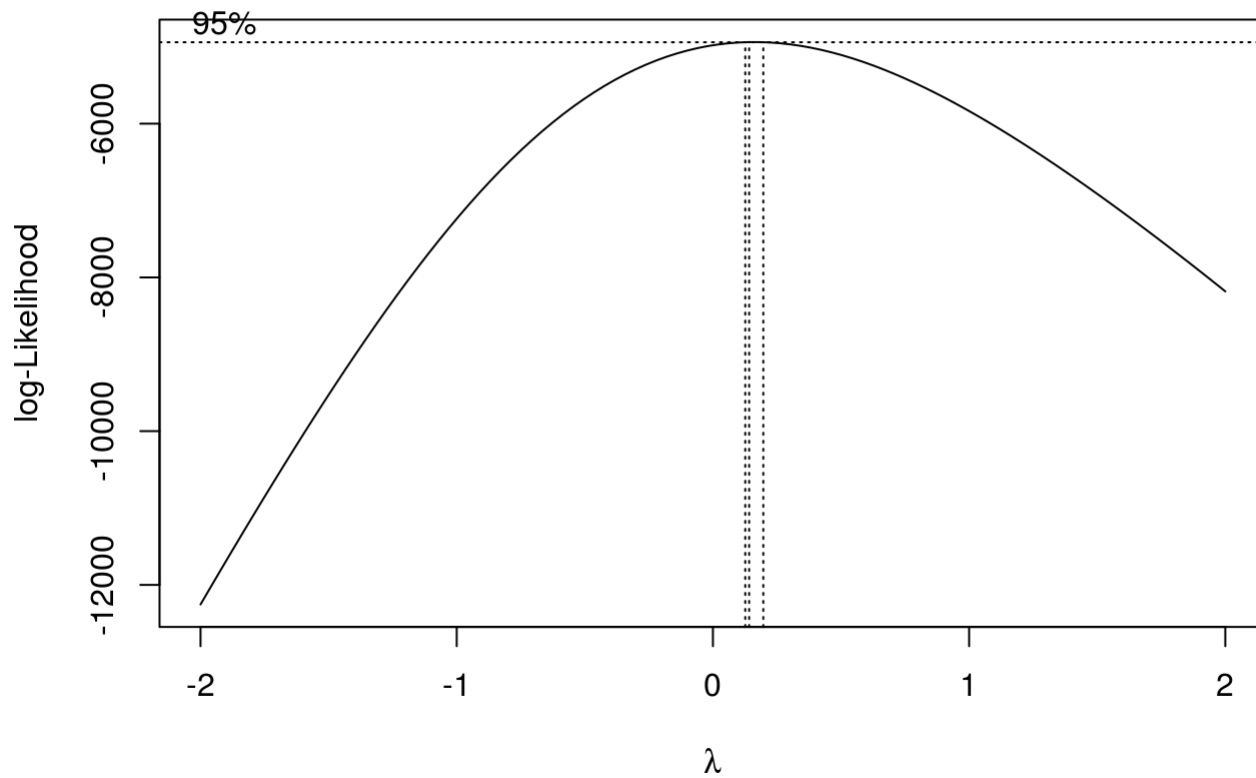
```
plot(fitted(model), model$residuals)
abline(h=0,col='red')
```



I have plotted couple of predicting variables against the residues of the model. It seems that overall, the variance is constant for different values of the predicting variables. However when I plot SalePrice against the residuals, I found that there was a departure at the right tail of the graph.

b.

```
bc = boxcox(model)
```

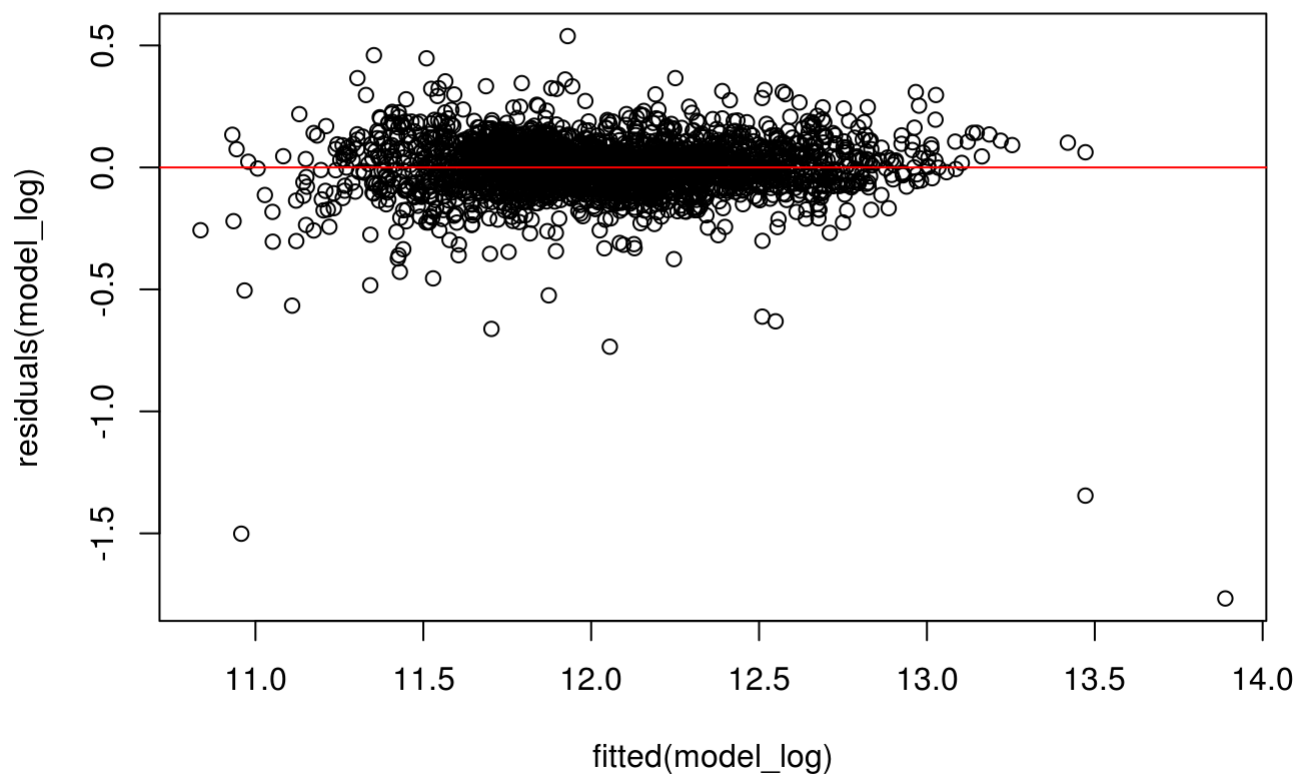


```
best.lam = bc$x[which(bc$y==max(bc$y))]
```

best lambda is 0.141414141

c.

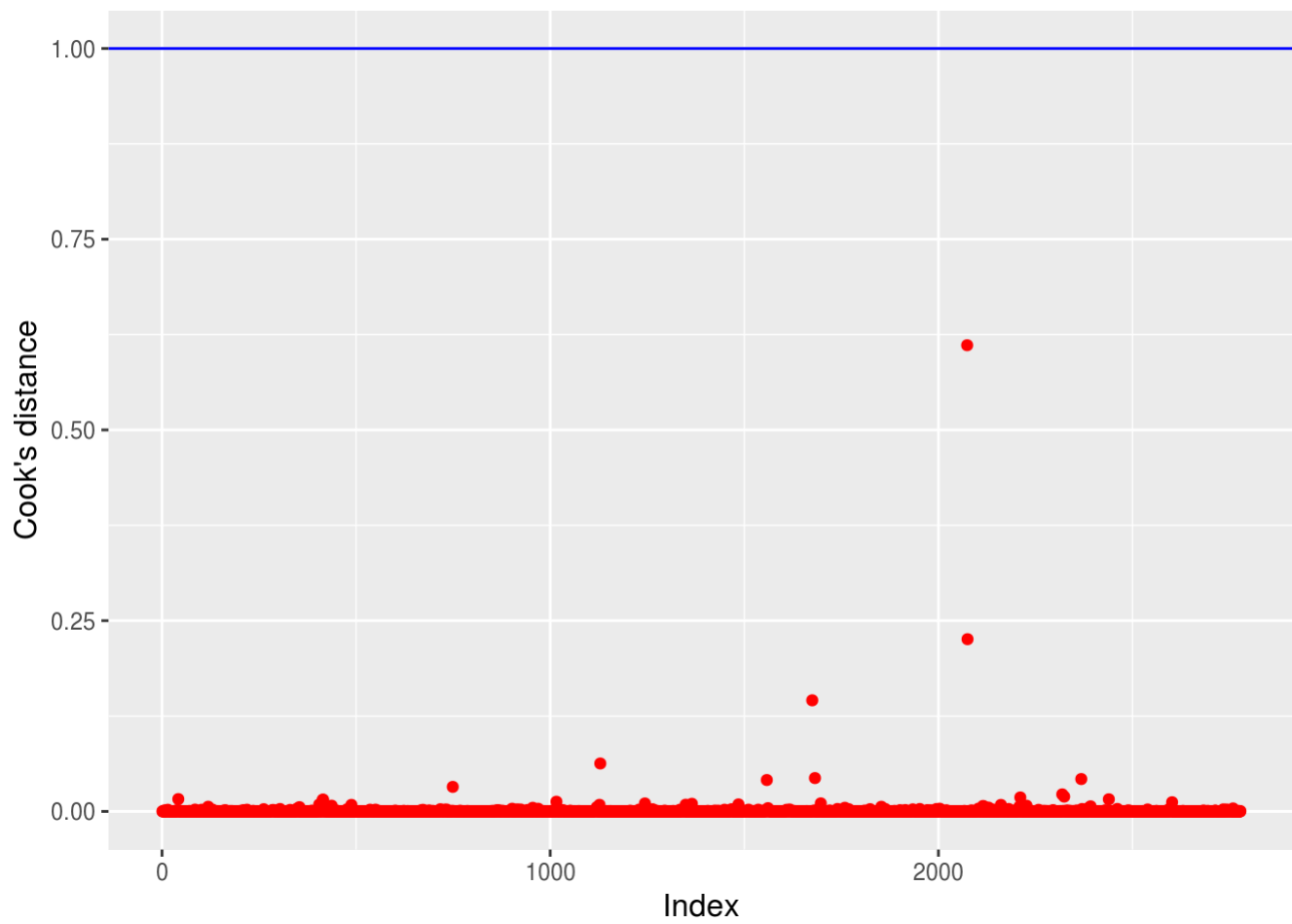
```
model_log = lm(log(SalePrice)~., data = house)
plot(x=fitted(model_log),y=residuals(model_log))
abline(h=0, col='red')
```



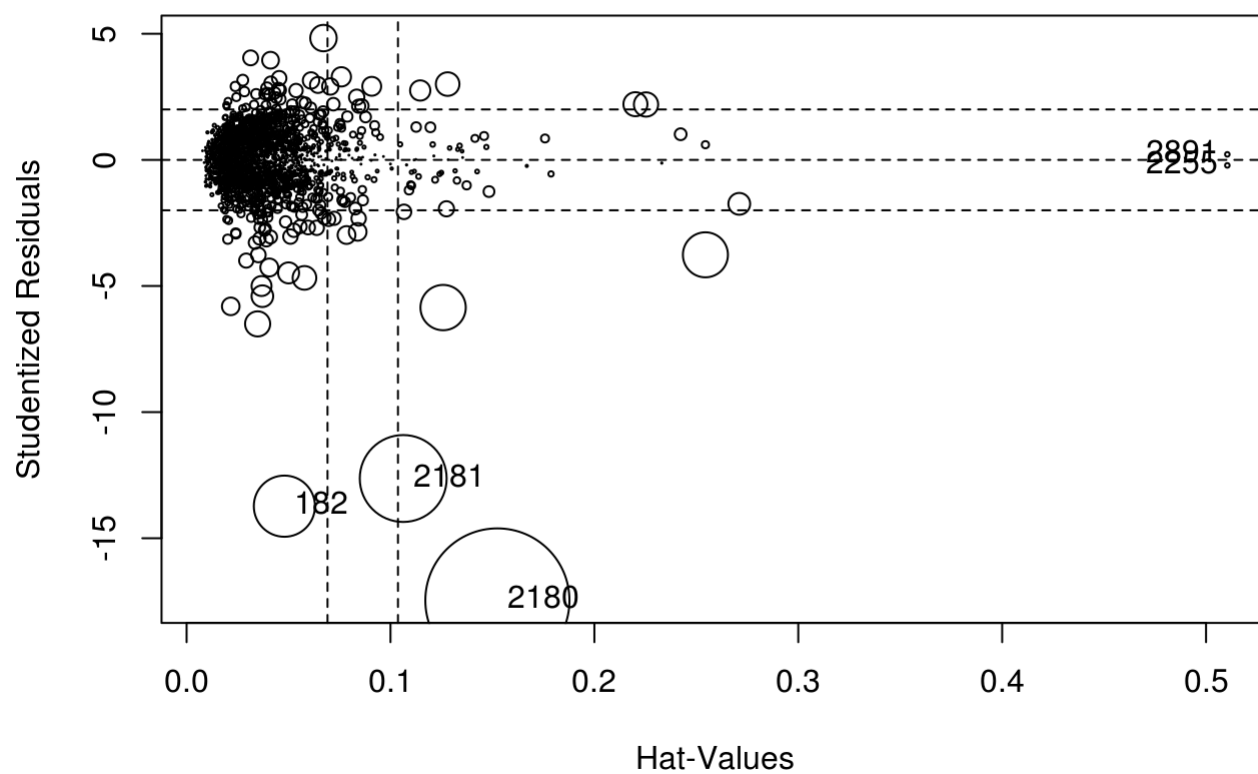
Yes, it seems there is at least 3 outliers.

d.

```
library(car)
cook = cooks.distance(model)
cook = as.data.frame(cbind(index=1:length(house$SalePrice), cooks = cook))
p = ggplot(data = cook, aes(x=index, y = cooks)) + geom_point(col='red')+xlab('Index')+y
lab('Cook\'s distance')+theme(axis.title = element_text(size=12))
p = p + geom_hline(yintercept = 1, col='blue')
p = p + geom_text(aes(label = ifelse(cooks>1, index,'')),hjust=-0.1, vjust=0.01)
p
```

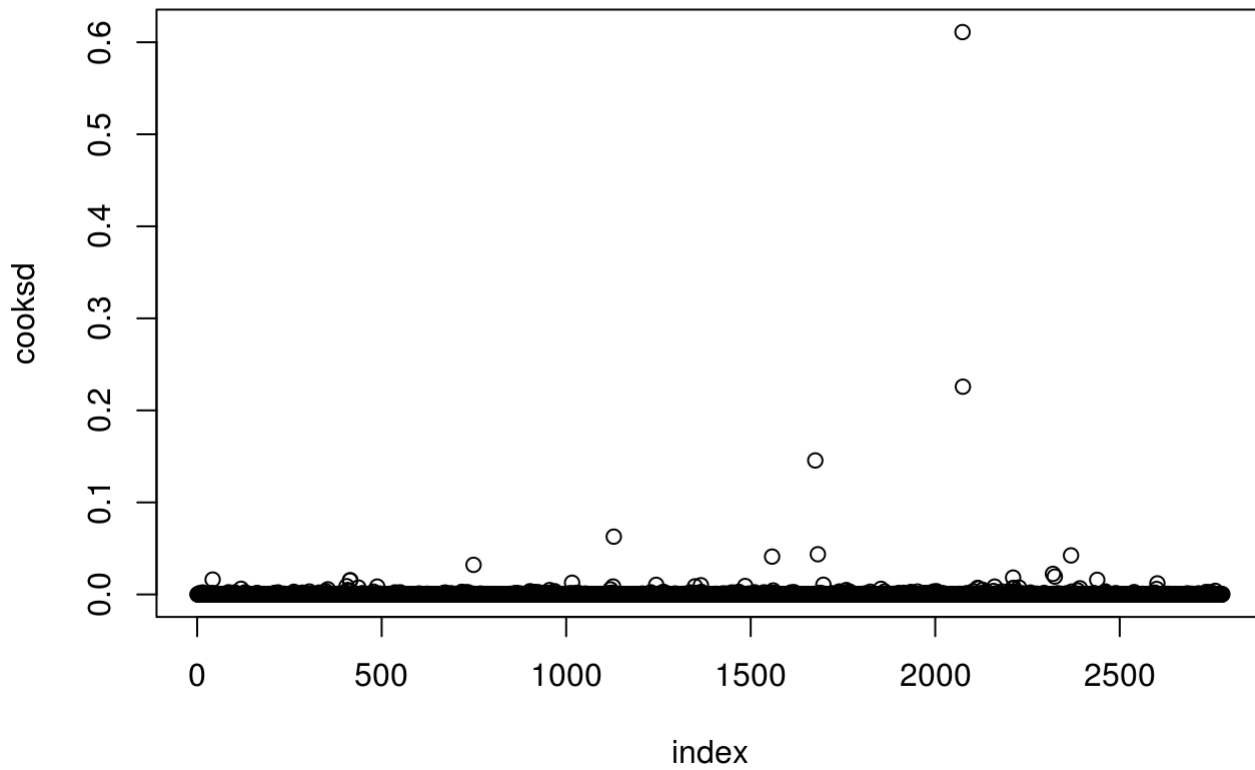


```
influencePlot(model_log)
```



##	StudRes	Hat	CookD
## 182	-13.729752	0.04796947	0.0924740277
## 2180	-17.468250	0.15243291	0.5134295982
## 2181	-12.632607	0.10624383	0.1865738428
## 2255	-0.218762	0.51043051	0.0005199348
## 2891	0.218762	0.51043051	0.0005199348

```
plot(cook)
```

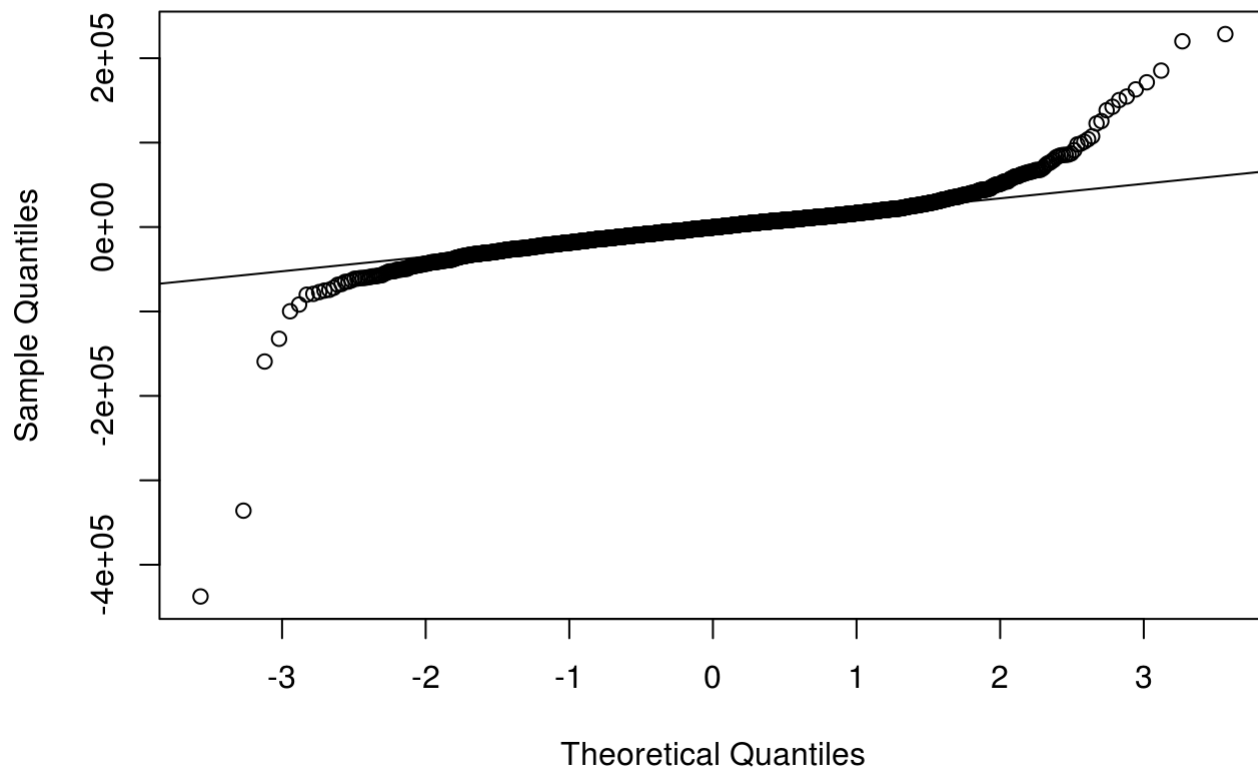



After compute the cook's distance, I found that there is no points whose cook's distance is larger than 1. So no observation was removed.

e.

```
qqnorm(model$residuals)
qqline(model$residuals)
```

Normal Q-Q Plot



There are departures at both ends of the QQ plot, indicating that the normality assumption may not hold. Thus the estimation of and inference on the regression coefficients might not be reliable.

Question 3: Variable Selection via Stepwise Regression (a)

```
summary(model)
```

```
##
## Call:
## lm(formula = SalePrice ~ ., data = house)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -437556  -12182    -376    11122   228555
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -1.123e+05  1.537e+04  -7.306 3.60e-13 ***
## MS.ZoningRL    -2.399e+03  5.030e+03  -0.477 0.633521
## MS.ZoningRM    -5.438e+03  5.653e+03  -0.962 0.336178
## Lot.Area       7.007e-01  1.535e-01   4.565 5.21e-06 ***
## Lot.ShapeReg   1.705e+03  1.216e+03   1.402 0.161178
## Land.ContourHLS 2.769e+04  3.940e+03   7.030 2.62e-12 ***
## Land.ContourLow 9.958e+03  5.108e+03   1.950 0.051331 .
## Land.ContourLvl 9.998e+03  2.835e+03   3.527 0.000428 ***
## NeighborhoodBlueste 5.110e+03  1.076e+04   0.475 0.635005
## NeighborhoodBrDale 1.078e+04  8.716e+03   1.237 0.216263
## NeighborhoodBrkSide -1.092e+04  7.396e+03  -1.477 0.139840
## NeighborhoodClearCr -9.498e+03  7.586e+03  -1.252 0.210619
## NeighborhoodCollgCr -1.622e+04  5.995e+03  -2.705 0.006867 **
## NeighborhoodCrawfor -3.018e+02  6.804e+03  -0.044 0.964626
## NeighborhoodEdwards -2.264e+04  6.437e+03  -3.518 0.000442 ***
## NeighborhoodGilbert -2.205e+04  6.264e+03  -3.520 0.000439 ***
## NeighborhoodGreens  5.838e+03  1.134e+04   0.515 0.606869
## NeighborhoodGrnHill 1.141e+05  1.979e+04   5.764 9.17e-09 ***
## NeighborhoodIDOTRR -1.715e+04  8.158e+03  -2.102 0.035642 *
## NeighborhoodMeadowV 6.532e+03  8.180e+03   0.799 0.424649
## NeighborhoodMitchel -1.945e+04  6.484e+03  -3.000 0.002727 **
## NeighborhoodNAMES -1.971e+04  6.293e+03  -3.133 0.001752 **
## NeighborhoodNoRidge 2.088e+04  6.854e+03   3.047 0.002337 **
## NeighborhoodNPkVill 6.226e+03  8.221e+03   0.757 0.448917
## NeighborhoodNridgHt 2.851e+04  6.031e+03   4.727 2.40e-06 ***
## NeighborhoodNWAmes -2.567e+04  6.437e+03  -3.988 6.84e-05 ***
## NeighborhoodOldTown -2.091e+04  7.479e+03  -2.796 0.005209 **
## NeighborhoodSawyer -1.624e+04  6.539e+03  -2.484 0.013063 *
## NeighborhoodSawyerW -2.068e+04  6.273e+03  -3.297 0.000991 ***
## NeighborhoodSomerst -8.378e+02  7.135e+03  -0.117 0.906538
## NeighborhoodStoneBr 3.628e+04  6.761e+03   5.367 8.71e-08 ***
## NeighborhoodSWISU -2.359e+04  7.830e+03  -3.013 0.002608 **
## NeighborhoodTimber -1.288e+04  6.612e+03  -1.948 0.051483 .
## NeighborhoodVeenker -1.734e+04  8.323e+03  -2.084 0.037292 *
## Condition.1Norm    7.159e+03  1.940e+03   3.689 0.000229 ***
## Condition.1Rail     6.078e+03  3.664e+03   1.659 0.097241 .
## Condition.1PosN     3.954e+03  3.896e+03   1.015 0.310271
## Bldg.Type2fmCon    -1.045e+04  3.959e+03  -2.639 0.008362 **
## Bldg.TypeDuplex    -1.324e+04  3.392e+03  -3.903 9.74e-05 ***
## Bldg.TypeTwnhs     -4.236e+04  4.146e+03 -10.219 < 2e-16 ***
## Bldg.TypeTwnhsE    -3.195e+04  2.828e+03 -11.298 < 2e-16 ***
## House.Style1Story   9.034e+03  2.591e+03   3.486 0.000498 ***
## House.StyleSplit    8.195e+03  2.982e+03   2.748 0.006033 **
```

## Overall.Qual	9.430e+03	7.499e+02	12.576	< 2e-16	***
## Overall.Cond	5.658e+03	6.258e+02	9.042	< 2e-16	***
## Year.Built	-2.407e+02	5.196e+01	-4.632	3.79e-06	***
## Year.Remod.AddTRUE	3.763e+02	1.265e+03	0.298	0.766097	
## Roof.StyleGarble	7.200e+03	5.086e+03	1.416	0.156937	
## Roof.StyleGarbles	1.210e+04	8.068e+03	1.500	0.133741	
## Roof.StyleHip	1.191e+04	5.199e+03	2.292	0.022003	*
## Mas.Vnr.TypeBrick	-7.425e+03	1.688e+03	-4.398	1.14e-05	***
## Mas.Vnr.TypeStone	-9.881e+02	2.367e+03	-0.417	0.676374	
## Mas.Vnr.Area	2.908e+01	4.581e+00	6.349	2.54e-10	***
## Exter.Qual	8.497e+03	1.639e+03	5.184	2.33e-07	***
## Exter.Cond	6.735e+02	1.541e+03	0.437	0.662141	
## FoundationCBlock	8.038e+02	2.324e+03	0.346	0.729500	
## FoundationPConc	1.911e+03	2.572e+03	0.743	0.457489	
## FoundationOther	1.649e+04	4.960e+03	3.324	0.000898	***
## Bsmt.Qual	4.185e+03	1.130e+03	3.705	0.000216	***
## Bsmt.Cond	2.773e+02	1.210e+03	0.229	0.818776	
## BsmtFin.SF	1.869e+01	1.647e+00	11.350	< 2e-16	***
## Total.Bsmt.SF	1.246e+01	2.878e+00	4.327	1.57e-05	***
## Heating.QC	1.275e+03	7.153e+02	1.783	0.074746	.
## Central.AirY	-6.096e+03	2.602e+03	-2.343	0.019210	*
## X1st.Flr.SF	-6.882e+00	4.214e+00	-1.633	0.102564	
## Gr.Liv.Area	5.590e+01	3.624e+00	15.424	< 2e-16	***
## Bedroom.AbvGr	-3.202e+03	9.932e+02	-3.224	0.001279	**
## Kitchen.Qual	6.920e+03	1.224e+03	5.654	1.73e-08	***
## TotRms.AbvGrd	-9.923e+02	6.893e+02	-1.440	0.150087	
## Fireplaces	5.754e+03	1.684e+03	3.416	0.000644	***
## Fireplace.Qu	-3.099e+02	6.139e+02	-0.505	0.613745	
## Garage.TypeAttchd	6.416e+02	2.116e+03	0.303	0.761775	
## Garage.TypeDetchd	3.232e+03	2.527e+03	1.279	0.201004	
## Garage.TypeNo	1.460e+04	4.040e+03	3.614	0.000307	***
## Garage.Finish	2.127e+03	9.147e+02	2.325	0.020137	*
## Garage.Cars	4.810e+03	1.756e+03	2.738	0.006216	**
## Garage.Area	1.335e+01	5.918e+00	2.256	0.024150	*
## Paved.Drive	1.636e+02	1.244e+03	0.132	0.895349	
## Wood.Deck.SF	7.836e+00	4.537e+00	1.727	0.084249	.
## Open.Porch.SF	-1.831e+01	8.609e+00	-2.127	0.033476	*
## Enclosed.Porch	5.761e+00	8.813e+00	0.654	0.513368	
## X3Ssn.Porch	-3.924e+00	2.025e+01	-0.194	0.846358	
## Screen.Porch	4.768e+01	9.542e+00	4.997	6.20e-07	***
## Pool.Area	4.858e+01	1.495e+01	3.250	0.001167	**
## Fence	1.402e+02	4.519e+02	0.310	0.756367	
## Sale.TypeOther	9.380e+03	4.632e+03	2.025	0.042942	*
## Sale.TypeNEW	3.197e+04	1.265e+04	2.527	0.011571	*
## Sale.TypeWD	4.180e+03	3.234e+03	1.293	0.196227	
## Sale.ConditionOther	9.326e+03	3.846e+03	2.425	0.015377	*
## Sale.ConditionNormal	1.038e+04	2.291e+03	4.532	6.11e-06	***
## Sale.ConditionPartial	-6.294e+03	1.226e+04	-0.513	0.607681	
## Yr.Sold2007	-1.221e+03	1.527e+03	-0.800	0.424040	
## Yr.Sold2008	2.126e+02	1.578e+03	0.135	0.892841	
## Yr.Sold2009	-2.275e+03	1.582e+03	-1.438	0.150436	
## Yr.Sold2010	-5.663e+01	1.873e+03	-0.030	0.975885	
## Bath	4.232e+03	1.100e+03	3.846	0.000123	***
## - - -					

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 26320 on 2682 degrees of freedom
## Multiple R-squared:  0.8928, Adjusted R-squared:  0.889
## F-statistic: 235.1 on 95 and 2682 DF,  p-value: < 2.2e-16
```

```
drop_result = drop1(model)
a = which(drop_result$AIC==max(drop_result$AIC))
b = which(drop_result$AIC==min(drop_result$AIC))
drop_result[a,]
```

```
## Single term deletions
##
## Model:
## SalePrice ~ MS.Zoning + Lot.Area + Lot.Shape + Land.Contour +
##   Neighborhood + Condition.1 + Bldg.Type + House.Style + Overall.Qual +
##   Overall.Cond + Year.Built + Year.Remod.Add + Roof.Style +
##   Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation +
##   Bsmt.Qual + Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
##   Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
##   Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
##   Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
##   Paved.Drive + Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch +
##   X3Ssn.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
##   Sale.Condition + Yr.Sold + Bath
##           Df Sum of Sq      RSS   AIC
## Neighborhood 26 3.4788e+11 2.2053e+12 57068
```

```
drop_result[b,]
```

```
## Single term deletions
##
## Model:
## SalePrice ~ MS.Zoning + Lot.Area + Lot.Shape + Land.Contour +
##   Neighborhood + Condition.1 + Bldg.Type + House.Style + Overall.Qual +
##   Overall.Cond + Year.Built + Year.Remod.Add + Roof.Style +
##   Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation +
##   Bsmt.Qual + Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
##   Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
##   Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
##   Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
##   Paved.Drive + Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch +
##   X3Ssn.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
##   Sale.Condition + Yr.Sold + Bath
##           Df Sum of Sq      RSS   AIC
## Yr.Sold    4 2487326959 1.8599e+12 56639
```

It seems that by dropping Yr.sold can improve AIC the most. Dropping Neighborhood affect the AIC the most.

b.

```
final_model = stepAIC(model)
```

```

## Start: AIC=56643
## SalePrice ~ MS.Zoning + Lot.Area + Lot.Shape + Land.Contour +
## Neighborhood + Condition.1 + Bldg.Type + House.Style + Overall.Qual +
## Overall.Cond + Year.Built + Year.Remod.Add + Roof.Style +
## Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation +
## Bsmt.Qual + Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
## Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
## Paved.Drive + Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch +
## X3Ssn.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
## Sale.Condition + Yr.Sold + Bath
##
##
##      Df Sum of Sq      RSS   AIC
## - Yr.Sold      4 2.4873e+09 1.8599e+12 56639
## - MS.Zoning      2 9.8095e+08 1.8584e+12 56640
## - Paved.Drive      1 1.1985e+07 1.8575e+12 56641
## - X3Ssn.Porch      1 2.6008e+07 1.8575e+12 56641
## - Bsmt.Cond      1 3.6363e+07 1.8575e+12 56641
## - Year.Remod.Add      1 6.1302e+07 1.8575e+12 56641
## - Fence      1 6.6678e+07 1.8575e+12 56641
## - Exter.Cond      1 1.3226e+08 1.8576e+12 56641
## - Fireplace.Qu      1 1.7648e+08 1.8576e+12 56641
## - Enclosed.Porch      1 2.9594e+08 1.8577e+12 56641
## <none>                                1.8574e+12 56643
## - Lot.Shape      1 1.3603e+09 1.8588e+12 56643
## - TotRms.AbvGrd      1 1.4354e+09 1.8589e+12 56643
## - X1st.Flr.SF      1 1.8471e+09 1.8593e+12 56644
## - Wood.Deck.SF      1 2.0660e+09 1.8595e+12 56644
## - Heating.QC      1 2.2010e+09 1.8596e+12 56644
## - Open.Porch.SF      1 3.1345e+09 1.8606e+12 56646
## - Sale.Type      3 6.1291e+09 1.8636e+12 56646
## - Garage.Area      1 3.5249e+09 1.8610e+12 56646
## - Garage.Finish      1 3.7443e+09 1.8612e+12 56647
## - Central.Air      1 3.8014e+09 1.8612e+12 56647
## - Garage.Cars      1 5.1932e+09 1.8626e+12 56649
## - Foundation      3 8.5447e+09 1.8660e+12 56650
## - Roof.Style      3 9.4320e+09 1.8669e+12 56651
## - Condition.1      3 9.7473e+09 1.8672e+12 56652
## - Bedroom.AbvGr      1 7.1991e+09 1.8646e+12 56652
## - House.Style      2 8.6174e+09 1.8661e+12 56652
## - Pool.Area      1 7.3169e+09 1.8648e+12 56652
## - Fireplaces      1 8.0824e+09 1.8655e+12 56653
## - Garage.Type      3 1.1111e+10 1.8686e+12 56654
## - Bsmt.Qual      1 9.5061e+09 1.8670e+12 56655
## - Bath      1 1.0244e+10 1.8677e+12 56656
## - Sale.Condition      3 1.5345e+10 1.8728e+12 56660
## - Total.Bsmt.SF      1 1.2968e+10 1.8704e+12 56660
## - Lot.Area      1 1.4434e+10 1.8719e+12 56663
## - Mas.Vnr.Type      2 1.5798e+10 1.8732e+12 56663
## - Year.Built      1 1.4861e+10 1.8723e+12 56663
## - Screen.Porch      1 1.7292e+10 1.8747e+12 56667
## - Exter.Qual      1 1.8614e+10 1.8761e+12 56669

```

```

## - Kitchen.Qual      1 2.2143e+10 1.8796e+12 56674
## - Mas.Vnr.Area      1 2.7918e+10 1.8854e+12 56682
## - Land.Contour      3 3.5888e+10 1.8933e+12 56690
## - Overall.Cond      1 5.6622e+10 1.9141e+12 56724
## - BsmtFin.SF        1 8.9223e+10 1.9467e+12 56771
## - Overall.Qual      1 1.0952e+11 1.9670e+12 56800
## - Bldg.Type         4 1.2661e+11 1.9841e+12 56818
## - Gr.Liv.Area       1 1.6475e+11 2.0222e+12 56877
## - Neighborhood     26 3.4788e+11 2.2053e+12 57068
##
## Step:  AIC=56638.72
## SalePrice ~ MS.Zoning + Lot.Area + Lot.Shape + Land.Contour +
##      Neighborhood + Condition.1 + Bldg.Type + House.Style + Overall.Qual +
##      Overall.Cond + Year.Built + Year.Remod.Add + Roof.Style +
##      Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation +
##      Bsmt.Qual + Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
##      Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
##      Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
##      Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
##      Paved.Drive + Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch +
##      X3Ssn.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
##      Sale.Condition + Bath
##
##              Df  Sum of Sq      RSS    AIC
## - MS.Zoning      2 8.3971e+08 1.8608e+12 56636
## - Paved.Drive     1 1.1921e+07 1.8599e+12 56637
## - X3Ssn.Porch     1 3.2096e+07 1.8600e+12 56637
## - Bsmt.Cond       1 3.6644e+07 1.8600e+12 56637
## - Fence           1 5.5417e+07 1.8600e+12 56637
## - Year.Remod.Add  1 6.6667e+07 1.8600e+12 56637
## - Exter.Cond      1 1.0978e+08 1.8600e+12 56637
## - Fireplace.Qu    1 1.8369e+08 1.8601e+12 56637
## - Enclosed.Porch  1 2.9785e+08 1.8602e+12 56637
## - TotRms.AbvGrd   1 1.3175e+09 1.8612e+12 56639
## <none>                                1.8599e+12 56639
## - Lot.Shape       1 1.3423e+09 1.8613e+12 56639
## - X1st.Flr.SF     1 1.8353e+09 1.8618e+12 56639
## - Wood.Deck.SF    1 2.1352e+09 1.8621e+12 56640
## - Heating.QC      1 2.2323e+09 1.8622e+12 56640
## - Open.Porch.SF   1 3.1022e+09 1.8630e+12 56641
## - Garage.Area     1 3.4201e+09 1.8634e+12 56642
## - Sale.Type       3 6.2418e+09 1.8662e+12 56642
## - Garage.Finish   1 3.6747e+09 1.8636e+12 56642
## - Central.Air     1 3.9065e+09 1.8638e+12 56643
## - Garage.Cars     1 5.3198e+09 1.8653e+12 56645
## - Foundation      3 8.2465e+09 1.8682e+12 56645
## - Roof.Style      3 9.1551e+09 1.8691e+12 56646
## - House.Style     2 8.2746e+09 1.8682e+12 56647
## - Bedroom.AbvGr   1 7.0509e+09 1.8670e+12 56647
## - Condition.1     3 9.8883e+09 1.8698e+12 56647
## - Pool.Area       1 7.5928e+09 1.8675e+12 56648
## - Fireplaces      1 7.9870e+09 1.8679e+12 56649
## - Garage.Type     3 1.1240e+10 1.8712e+12 56649
## - Bsmt.Qual       1 9.3357e+09 1.8693e+12 56651

```



```

## - Bath          1 1.0177e+10 1.8701e+12 56652
## - Sale.Condition 3 1.4859e+10 1.8748e+12 56655
## - Total.Bsmt.SF  1 1.3032e+10 1.8730e+12 56656
## - Mas.Vnr.Type   2 1.5564e+10 1.8755e+12 56658
## - Lot.Area       1 1.5308e+10 1.8752e+12 56659
## - Year.Built     1 1.5532e+10 1.8755e+12 56660
## - Screen.Porch   1 1.7358e+10 1.8773e+12 56663
## - Exter.Qual      1 1.8324e+10 1.8783e+12 56664
## - Kitchen.Qual    1 2.1874e+10 1.8818e+12 56669
## - Mas.Vnr.Area    1 2.8203e+10 1.8881e+12 56679
## - Land.Contour    3 3.6298e+10 1.8962e+12 56686
## - Overall.Cond    1 5.7312e+10 1.9172e+12 56721
## - BsmtFin.SF      1 9.0021e+10 1.9500e+12 56768
## - Overall.Qual    1 1.1140e+11 1.9713e+12 56798
## - Bldg.Type       4 1.2494e+11 1.9849e+12 56811
## - Gr.Liv.Area     1 1.6334e+11 2.0233e+12 56871
## - Neighborhood   26 3.4807e+11 2.2080e+12 57063
##
## Step:  AIC=56635.98
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
##      Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
##      Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
##      Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
##      Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
##      X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
##      TotRms.AbvGrd + Fireplaces + Fireplace.Qu + Garage.Type +
##      Garage.Finish + Garage.Cars + Garage.Area + Paved.Drive +
##      Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch + X3Ssn.Porch +
##      Screen.Porch + Pool.Area + Fence + Sale.Type + Sale.Condition +
##      Bath
##
##              Df  Sum of Sq      RSS   AIC
## - Paved.Drive    1 7.0633e+06 1.8608e+12 56634
## - Bsmt.Cond       1 2.5234e+07 1.8608e+12 56634
## - X3Ssn.Porch     1 3.1156e+07 1.8608e+12 56634
## - Fence           1 6.1154e+07 1.8608e+12 56634
## - Year.Remod.Add  1 6.8319e+07 1.8608e+12 56634
## - Exter.Cond      1 1.0199e+08 1.8609e+12 56634
## - Fireplace.Qu    1 1.9707e+08 1.8610e+12 56634
## - Enclosed.Porch  1 2.8073e+08 1.8611e+12 56634
## - Lot.Shape       1 1.2207e+09 1.8620e+12 56636
## <none>                                1.8608e+12 56636
## - TotRms.AbvGrd   1 1.3806e+09 1.8622e+12 56636
## - X1st.Flr.SF     1 1.9761e+09 1.8627e+12 56637
## - Wood.Deck.SF    1 2.2256e+09 1.8630e+12 56637
## - Heating.QC      1 2.2345e+09 1.8630e+12 56637
## - Open.Porch.SF   1 3.0206e+09 1.8638e+12 56638
## - Sale.Type       3 6.3140e+09 1.8671e+12 56639
## - Garage.Finish   1 3.6521e+09 1.8644e+12 56639
## - Garage.Area     1 3.7891e+09 1.8646e+12 56640
## - Central.Air     1 3.8911e+09 1.8647e+12 56640
## - Garage.Cars     1 4.9354e+09 1.8657e+12 56641
## - Foundation      3 8.1066e+09 1.8689e+12 56642
## - Roof.Style      3 9.0446e+09 1.8698e+12 56643

```

```

## - Bedroom.AbvGr 1 7.0404e+09 1.8678e+12 56644
## - House.Style 2 8.4337e+09 1.8692e+12 56645
## - Pool.Area 1 7.5481e+09 1.8683e+12 56645
## - Condition.1 3 1.0289e+10 1.8711e+12 56645
## - Fireplaces 1 8.2047e+09 1.8690e+12 56646
## - Garage.Type 3 1.1362e+10 1.8721e+12 56647
## - Bsmt.Qual 1 9.0486e+09 1.8698e+12 56647
## - Bath 1 1.0486e+10 1.8713e+12 56650
## - Sale.Condition 3 1.4975e+10 1.8757e+12 56652
## - Total.Bsmt.SF 1 1.3229e+10 1.8740e+12 56654
## - Mas.Vnr.Type 2 1.5761e+10 1.8765e+12 56655
## - Year.Built 1 1.5071e+10 1.8758e+12 56656
## - Lot.Area 1 1.5480e+10 1.8763e+12 56657
## - Screen.Porch 1 1.7414e+10 1.8782e+12 56660
## - Exter.Qual 1 1.8378e+10 1.8791e+12 56661
## - Kitchen.Qual 1 2.2403e+10 1.8832e+12 56667
## - Mas.Vnr.Area 1 2.8478e+10 1.8892e+12 56676
## - Land.Contour 3 3.5827e+10 1.8966e+12 56683
## - Overall.Cond 1 5.7026e+10 1.9178e+12 56718
## - BsmtFin.SF 1 8.9776e+10 1.9505e+12 56765
## - Overall.Qual 1 1.1068e+11 1.9715e+12 56794
## - Bldg.Type 4 1.3954e+11 2.0003e+12 56829
## - Gr.Liv.Area 1 1.6445e+11 2.0252e+12 56869
## - Neighborhood 26 3.5144e+11 2.2122e+12 57065
##
## Step: AIC=56633.99
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
## X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
## TotRms.AbvGrd + Fireplaces + Fireplace.Qu + Garage.Type +
## Garage.Finish + Garage.Cars + Garage.Area + Wood.Deck.SF +
## Open.Porch.SF + Enclosed.Porch + X3Ssn.Porch + Screen.Porch +
## Pool.Area + Fence + Sale.Type + Sale.Condition + Bath
##
##
## Df Sum of Sq RSS AIC
## - Bsmt.Cond 1 2.4606e+07 1.8608e+12 56632
## - X3Ssn.Porch 1 3.1495e+07 1.8608e+12 56632
## - Fence 1 6.2392e+07 1.8608e+12 56632
## - Year.Remod.Add 1 6.8398e+07 1.8608e+12 56632
## - Exter.Cond 1 1.0468e+08 1.8609e+12 56632
## - Fireplace.Qu 1 1.9745e+08 1.8610e+12 56632
## - Enclosed.Porch 1 2.8019e+08 1.8611e+12 56632
## - Lot.Shape 1 1.2188e+09 1.8620e+12 56634
## <none> 1.8608e+12 56634
## - TotRms.AbvGrd 1 1.3859e+09 1.8622e+12 56634
## - X1st.Flr.SF 1 1.9744e+09 1.8628e+12 56635
## - Wood.Deck.SF 1 2.2224e+09 1.8630e+12 56635
## - Heating.QC 1 2.2397e+09 1.8630e+12 56635
## - Open.Porch.SF 1 3.0184e+09 1.8638e+12 56636
## - Sale.Type 3 6.3072e+09 1.8671e+12 56637
## - Garage.Finish 1 3.6451e+09 1.8644e+12 56637

```

```

## - Garage.Area      1 3.8108e+09 1.8646e+12 56638
## - Central.Air      1 3.8989e+09 1.8647e+12 56638
## - Garage.Cars      1 4.9290e+09 1.8657e+12 56639
## - Foundation       3 8.1023e+09 1.8689e+12 56640
## - Roof.Style       3 9.0477e+09 1.8698e+12 56641
## - Bedroom.AbvGr    1 7.0348e+09 1.8678e+12 56642
## - House.Style      2 8.4292e+09 1.8692e+12 56643
## - Pool.Area        1 7.5411e+09 1.8683e+12 56643
## - Condition.1      3 1.0336e+10 1.8711e+12 56643
## - Fireplaces       1 8.2153e+09 1.8690e+12 56644
## - Garage.Type      3 1.1674e+10 1.8725e+12 56645
## - Bsmt.Qual        1 9.0597e+09 1.8698e+12 56645
## - Bath            1 1.0488e+10 1.8713e+12 56648
## - Sale.Condition   3 1.4992e+10 1.8758e+12 56650
## - Total.Bsmt.SF    1 1.3245e+10 1.8740e+12 56652
## - Mas.Vnr.Type     2 1.5759e+10 1.8765e+12 56653
## - Lot.Area         1 1.5599e+10 1.8764e+12 56655
## - Year.Built       1 1.5768e+10 1.8765e+12 56655
## - Screen.Porch     1 1.7414e+10 1.8782e+12 56658
## - Exter.Qual       1 1.8375e+10 1.8792e+12 56659
## - Kitchen.Qual     1 2.2403e+10 1.8832e+12 56665
## - Mas.Vnr.Area     1 2.8474e+10 1.8893e+12 56674
## - Land.Contour     3 3.5821e+10 1.8966e+12 56681
## - Overall.Cond     1 5.7150e+10 1.9179e+12 56716
## - BsmtFin.SF       1 8.9988e+10 1.9508e+12 56763
## - Overall.Qual     1 1.1087e+11 1.9716e+12 56793
## - Bldg.Type        4 1.3954e+11 2.0003e+12 56827
## - Gr.Liv.Area      1 1.6466e+11 2.0254e+12 56868
## - Neighborhood    26 3.5151e+11 2.2123e+12 57063
##
## Step:  AIC=56632.02
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air + X1st.Flr.SF +
## Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual + TotRms.AbvGrd +
## Fireplaces + Fireplace.Qu + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Enclosed.Porch + X3Ssn.Porch + Screen.Porch + Pool.Area +
## Fence + Sale.Type + Sale.Condition + Bath
##
##
##      Df  Sum of Sq      RSS    AIC
## - X3Ssn.Porch    1 3.2553e+07 1.8608e+12 56630
## - Fence          1 6.2629e+07 1.8609e+12 56630
## - Year.Remod.Add  1 6.4516e+07 1.8609e+12 56630
## - Exter.Cond     1 1.0062e+08 1.8609e+12 56630
## - Fireplace.Qu   1 1.9734e+08 1.8610e+12 56630
## - Enclosed.Porch  1 2.7926e+08 1.8611e+12 56630
## - Lot.Shape      1 1.2178e+09 1.8620e+12 56632
## <none>                                1.8608e+12 56632
## - TotRms.AbvGrd  1 1.3938e+09 1.8622e+12 56632
## - X1st.Flr.SF    1 1.9639e+09 1.8628e+12 56633
## - Wood.Deck.SF   1 2.2205e+09 1.8630e+12 56633

```

```

## - Heating.QC      1 2.2345e+09 1.8630e+12 56633
## - Open.Porch.SF   1 3.0229e+09 1.8638e+12 56635
## - Sale.Type       3 6.2909e+09 1.8671e+12 56635
## - Garage.Finish   1 3.6657e+09 1.8645e+12 56635
## - Garage.Area     1 3.8115e+09 1.8646e+12 56636
## - Central.Air     1 3.9447e+09 1.8647e+12 56636
## - Garage.Cars     1 4.9326e+09 1.8657e+12 56637
## - Foundation      3 8.2228e+09 1.8690e+12 56638
## - Roof.Style      3 9.1036e+09 1.8699e+12 56640
## - Bedroom.AbvGr   1 7.0446e+09 1.8678e+12 56641
## - House.Style     2 8.4208e+09 1.8692e+12 56641
## - Pool.Area       1 7.5480e+09 1.8684e+12 56641
## - Condition.1     3 1.0322e+10 1.8711e+12 56641
## - Fireplaces      1 8.2019e+09 1.8690e+12 56642
## - Garage.Type     3 1.1668e+10 1.8725e+12 56643
## - Bsmt.Qual       1 9.1069e+09 1.8699e+12 56644
## - Bath            1 1.0463e+10 1.8713e+12 56646
## - Sale.Condition  3 1.4982e+10 1.8758e+12 56648
## - Total.Bsmt.SF   1 1.3223e+10 1.8740e+12 56650
## - Mas.Vnr.Type    2 1.5787e+10 1.8766e+12 56651
## - Lot.Area        1 1.5584e+10 1.8764e+12 56653
## - Year.Built      1 1.5753e+10 1.8766e+12 56653
## - Screen.Porch    1 1.7482e+10 1.8783e+12 56656
## - Exter.Qual      1 1.8380e+10 1.8792e+12 56657
## - Kitchen.Qual    1 2.2441e+10 1.8832e+12 56663
## - Mas.Vnr.Area    1 2.8490e+10 1.8893e+12 56672
## - Land.Contour    3 3.5866e+10 1.8967e+12 56679
## - Overall.Cond    1 5.7871e+10 1.9187e+12 56715
## - BsmtFin.SF      1 9.0141e+10 1.9509e+12 56761
## - Overall.Qual    1 1.1086e+11 1.9717e+12 56791
## - Bldg.Type       4 1.3955e+11 2.0004e+12 56825
## - Gr.Liv.Area     1 1.6491e+11 2.0257e+12 56866
## - Neighborhood    26 3.5178e+11 2.2126e+12 57061
##
## Step:  AIC=56630.07
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air + X1st.Flr.SF +
## Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual + TotRms.AbvGrd +
## Fireplaces + Fireplace.Qu + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Enclosed.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
## Sale.Condition + Bath
##
##           Df Sum of Sq      RSS   AIC
## - Fence      1 6.0777e+07 1.8609e+12 56628
## - Year.Remod.Add 1 6.5085e+07 1.8609e+12 56628
## - Exter.Cond  1 9.9922e+07 1.8609e+12 56628
## - Fireplace.Qu 1 2.0058e+08 1.8610e+12 56628
## - Enclosed.Porch 1 2.8660e+08 1.8611e+12 56628
## - Lot.Shape   1 1.2181e+09 1.8621e+12 56630
## <none>                1.8608e+12 56630

```

```
## - TotRms.AbvGrd    1 1.3827e+09 1.8622e+12 56630
## - X1st.Flr.SF      1 1.9645e+09 1.8628e+12 56631
## - Heating.QC       1 2.2200e+09 1.8631e+12 56631
## - Wood.Deck.SF     1 2.2415e+09 1.8631e+12 56631
## - Open.Porch.SF    1 3.0097e+09 1.8638e+12 56633
## - Sale.Type        3 6.2886e+09 1.8671e+12 56633
## - Garage.Finish    1 3.6742e+09 1.8645e+12 56634
## - Garage.Area      1 3.7960e+09 1.8646e+12 56634
## - Central.Air      1 3.9441e+09 1.8648e+12 56634
## - Garage.Cars      1 4.9350e+09 1.8658e+12 56635
## - Foundation       3 8.1975e+09 1.8690e+12 56636
## - Roof.Style       3 9.0938e+09 1.8699e+12 56638
## - Bedroom.AbvGr    1 7.0252e+09 1.8679e+12 56639
## - House.Style      2 8.4292e+09 1.8693e+12 56639
## - Pool.Area        1 7.5543e+09 1.8684e+12 56639
## - Condition.1      3 1.0329e+10 1.8712e+12 56639
## - Fireplaces       1 8.2277e+09 1.8691e+12 56640
## - Garage.Type      3 1.1664e+10 1.8725e+12 56641
## - Bsmt.Qual        1 9.0986e+09 1.8699e+12 56642
## - Bath             1 1.0445e+10 1.8713e+12 56644
## - Sale.Condition   3 1.4983e+10 1.8758e+12 56646
## - Total.Bsmt.SF    1 1.3206e+10 1.8740e+12 56648
## - Mas.Vnr.Type     2 1.5845e+10 1.8767e+12 56650
## - Lot.Area         1 1.5587e+10 1.8764e+12 56651
## - Year.Built       1 1.5757e+10 1.8766e+12 56651
## - Screen.Porch     1 1.7630e+10 1.8785e+12 56654
## - Exter.Qual       1 1.8349e+10 1.8792e+12 56655
## - Kitchen.Qual     1 2.2439e+10 1.8833e+12 56661
## - Mas.Vnr.Area     1 2.8509e+10 1.8893e+12 56670
## - Land.Contour     3 3.5836e+10 1.8967e+12 56677
## - Overall.Cond     1 5.7839e+10 1.9187e+12 56713
## - BsmtFin.SF       1 9.0109e+10 1.9509e+12 56759
## - Overall.Qual     1 1.1099e+11 1.9718e+12 56789
## - Bldg.Type        4 1.3954e+11 2.0004e+12 56823
## - Gr.Liv.Area      1 1.6488e+11 2.0257e+12 56864
## - Neighborhood    26 3.5262e+11 2.2135e+12 57060
##
```

```
## Step: AIC=56628.16
```

```
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air + X1st.Flr.SF +
## Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual + TotRms.AbvGrd +
## Fireplaces + Fireplace.Qu + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Enclosed.Porch + Screen.Porch + Pool.Area + Sale.Type + Sale.Condition +
## Bath
```

```
##           Df Sum of Sq      RSS   AIC
## - Year.Remod.Add 1 6.5434e+07 1.8610e+12 56626
## - Exter.Cond     1 1.0213e+08 1.8610e+12 56626
## - Fireplace.Qu   1 2.0177e+08 1.8611e+12 56626
## - Enclosed.Porch 1 2.8860e+08 1.8612e+12 56627
```

```

## - Lot.Shape      1 1.2141e+09 1.8621e+12 56628
## <none>           1.8609e+12 56628
## - TotRms.AbvGrd  1 1.3798e+09 1.8623e+12 56628
## - X1st.Flr.SF    1 1.9596e+09 1.8629e+12 56629
## - Heating.QC     1 2.2025e+09 1.8631e+12 56629
## - Wood.Deck.SF   1 2.3253e+09 1.8632e+12 56630
## - Open.Porch.SF  1 2.9978e+09 1.8639e+12 56631
## - Sale.Type      3 6.2644e+09 1.8672e+12 56631
## - Garage.Finish  1 3.6811e+09 1.8646e+12 56632
## - Garage.Area    1 3.8029e+09 1.8647e+12 56632
## - Central.Air    1 3.9258e+09 1.8648e+12 56632
## - Garage.Cars    1 4.9113e+09 1.8658e+12 56633
## - Foundation     3 8.1930e+09 1.8691e+12 56634
## - Roof.Style     3 9.1332e+09 1.8700e+12 56636
## - Bedroom.AbvGr  1 7.0104e+09 1.8679e+12 56637
## - House.Style    2 8.4237e+09 1.8693e+12 56637
## - Condition.1    3 1.0294e+10 1.8712e+12 56637
## - Pool.Area      1 7.8608e+09 1.8688e+12 56638
## - Fireplaces     1 8.2429e+09 1.8691e+12 56638
## - Garage.Type    3 1.1624e+10 1.8725e+12 56639
## - Bsmt.Qual      1 9.0868e+09 1.8700e+12 56640
## - Bath           1 1.0459e+10 1.8714e+12 56642
## - Sale.Condition 3 1.4941e+10 1.8758e+12 56644
## - Total.Bsmt.SF  1 1.3200e+10 1.8741e+12 56646
## - Mas.Vnr.Type   2 1.5821e+10 1.8767e+12 56648
## - Lot.Area       1 1.5526e+10 1.8764e+12 56649
## - Year.Built     1 1.5704e+10 1.8766e+12 56650
## - Screen.Porch   1 1.7676e+10 1.8786e+12 56652
## - Exter.Qual     1 1.8293e+10 1.8792e+12 56653
## - Kitchen.Qual   1 2.2512e+10 1.8834e+12 56660
## - Mas.Vnr.Area   1 2.8528e+10 1.8894e+12 56668
## - Land.Contour   3 3.5776e+10 1.8967e+12 56675
## - Overall.Cond   1 5.8075e+10 1.9190e+12 56712
## - BsmtFin.SF     1 9.0208e+10 1.9511e+12 56758
## - Overall.Qual   1 1.1114e+11 1.9720e+12 56787
## - Bldg.Type      4 1.4064e+11 2.0015e+12 56823
## - Gr.Liv.Area    1 1.6482e+11 2.0257e+12 56862
## - Neighborhood   26 3.5261e+11 2.2135e+12 57058
##
## Step:  AIC=56626.26
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Exter.Cond + Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF +
## Heating.QC + Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
## Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
## Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch + Screen.Porch +
## Pool.Area + Sale.Type + Sale.Condition + Bath
##
##           Df Sum of Sq      RSS   AIC
## - Exter.Cond      1 9.8749e+07 1.8611e+12 56624
## - Fireplace.Qu    1 2.1015e+08 1.8612e+12 56625
## - Enclosed.Porch  1 2.9433e+08 1.8613e+12 56625

```

```

## - Lot.Shape      1 1.2109e+09 1.8622e+12 56626
## <none>           1.8610e+12 56626
## - TotRms.AbvGrd  1 1.3998e+09 1.8624e+12 56626
## - X1st.Flr.SF    1 2.0172e+09 1.8630e+12 56627
## - Heating.QC     1 2.1679e+09 1.8631e+12 56627
## - Wood.Deck.SF   1 2.3156e+09 1.8633e+12 56628
## - Open.Porch.SF  1 2.9951e+09 1.8640e+12 56629
## - Sale.Type      3 6.2447e+09 1.8672e+12 56630
## - Garage.Finish  1 3.6557e+09 1.8646e+12 56630
## - Garage.Area    1 3.8293e+09 1.8648e+12 56630
## - Central.Air    1 3.8784e+09 1.8648e+12 56630
## - Garage.Cars    1 4.9202e+09 1.8659e+12 56632
## - Foundation     3 8.1501e+09 1.8691e+12 56632
## - Roof.Style     3 9.1461e+09 1.8701e+12 56634
## - Bedroom.AbvGr  1 6.9524e+09 1.8679e+12 56635
## - House.Style    2 8.5148e+09 1.8695e+12 56635
## - Condition.1    3 1.0347e+10 1.8713e+12 56636
## - Pool.Area      1 7.9164e+09 1.8689e+12 56636
## - Fireplaces     1 8.2296e+09 1.8692e+12 56637
## - Garage.Type    3 1.1584e+10 1.8725e+12 56637
## - Bsmt.Qual      1 9.0240e+09 1.8700e+12 56638
## - Bath           1 1.0394e+10 1.8714e+12 56640
## - Sale.Condition 3 1.4963e+10 1.8759e+12 56643
## - Total.Bsmt.SF  1 1.3271e+10 1.8742e+12 56644
## - Mas.Vnr.Type   2 1.5798e+10 1.8768e+12 56646
## - Lot.Area       1 1.5501e+10 1.8765e+12 56647
## - Year.Built     1 1.6578e+10 1.8775e+12 56649
## - Screen.Porch   1 1.7662e+10 1.8786e+12 56651
## - Exter.Qual     1 1.8298e+10 1.8793e+12 56651
## - Kitchen.Qual   1 2.2447e+10 1.8834e+12 56658
## - Mas.Vnr.Area   1 2.8544e+10 1.8895e+12 56667
## - Land.Contour   3 3.5724e+10 1.8967e+12 56673
## - Overall.Cond   1 5.8773e+10 1.9197e+12 56711
## - BsmtFin.SF     1 9.0386e+10 1.9513e+12 56756
## - Overall.Qual   1 1.1163e+11 1.9726e+12 56786
## - Bldg.Type      4 1.4057e+11 2.0015e+12 56821
## - Gr.Liv.Area    1 1.6503e+11 2.0260e+12 56860
## - Neighborhood   26 3.5256e+11 2.2135e+12 57056
##
## Step:  AIC=56624.41
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
## Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
## Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch + Screen.Porch +
## Pool.Area + Sale.Type + Sale.Condition + Bath
##
##           Df Sum of Sq      RSS   AIC
## - Fireplace.Qu  1 2.0862e+08 1.8613e+12 56623
## - Enclosed.Porch 1 3.0345e+08 1.8614e+12 56623
## - Lot.Shape     1 1.2123e+09 1.8623e+12 56624

```

```

## <none> 1.8611e+12 56624
## - TotRms.AbvGrd 1 1.4087e+09 1.8625e+12 56625
## - X1st.Flr.SF 1 2.0294e+09 1.8631e+12 56625
## - Heating.QC 1 2.2501e+09 1.8633e+12 56626
## - Wood.Deck.SF 1 2.3229e+09 1.8634e+12 56626
## - Open.Porch.SF 1 2.9839e+09 1.8640e+12 56627
## - Sale.Type 3 6.1925e+09 1.8673e+12 56628
## - Garage.Finish 1 3.6601e+09 1.8647e+12 56628
## - Garage.Area 1 3.8756e+09 1.8649e+12 56628
## - Central.Air 1 3.8780e+09 1.8649e+12 56628
## - Garage.Cars 1 4.8666e+09 1.8659e+12 56630
## - Foundation 3 8.0802e+09 1.8691e+12 56630
## - Roof.Style 3 9.0902e+09 1.8702e+12 56632
## - Bedroom.AbvGr 1 6.9151e+09 1.8680e+12 56633
## - House.Style 2 8.5816e+09 1.8696e+12 56633
## - Condition.1 3 1.0327e+10 1.8714e+12 56634
## - Pool.Area 1 7.8865e+09 1.8689e+12 56634
## - Fireplaces 1 8.2226e+09 1.8693e+12 56635
## - Garage.Type 3 1.1535e+10 1.8726e+12 56636
## - Bsmt.Qual 1 9.0089e+09 1.8701e+12 56636
## - Bath 1 1.0542e+10 1.8716e+12 56638
## - Sale.Condition 3 1.4916e+10 1.8760e+12 56641
## - Total.Bsmt.SF 1 1.3199e+10 1.8743e+12 56642
## - Mas.Vnr.Type 2 1.5832e+10 1.8769e+12 56644
## - Lot.Area 1 1.5627e+10 1.8767e+12 56646
## - Year.Built 1 1.6643e+10 1.8777e+12 56647
## - Screen.Porch 1 1.7712e+10 1.8788e+12 56649
## - Exter.Qual 1 1.8634e+10 1.8797e+12 56650
## - Kitchen.Qual 1 2.2442e+10 1.8835e+12 56656
## - Mas.Vnr.Area 1 2.8714e+10 1.8898e+12 56665
## - Land.Contour 3 3.5647e+10 1.8967e+12 56671
## - Overall.Cond 1 6.7630e+10 1.9287e+12 56722
## - BsmtFin.SF 1 9.0493e+10 1.9516e+12 56754
## - Overall.Qual 1 1.1154e+11 1.9726e+12 56784
## - Bldg.Type 4 1.4062e+11 2.0017e+12 56819
## - Gr.Liv.Area 1 1.6523e+11 2.0263e+12 56859
## - Neighborhood 26 3.5247e+11 2.2135e+12 57054
##
## Step: AIC=56622.72
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Garage.Type +
## Garage.Finish + Garage.Cars + Garage.Area + Wood.Deck.SF +
## Open.Porch.SF + Enclosed.Porch + Screen.Porch + Pool.Area +
## Sale.Type + Sale.Condition + Bath
##
## Df Sum of Sq RSS AIC
## - Enclosed.Porch 1 3.1391e+08 1.8616e+12 56621
## - Lot.Shape 1 1.2153e+09 1.8625e+12 56623
## <none> 1.8613e+12 56623
## - TotRms.AbvGrd 1 1.4690e+09 1.8627e+12 56623

```



```
## - X1st.Flr.SF      1 2.0291e+09 1.8633e+12 56624
## - Heating.QC       1 2.2766e+09 1.8635e+12 56624
## - Wood.Deck.SF     1 2.2920e+09 1.8636e+12 56624
## - Open.Porch.SF    1 3.0002e+09 1.8643e+12 56625
## - Sale.Type        3 6.2039e+09 1.8675e+12 56626
## - Garage.Finish    1 3.5998e+09 1.8649e+12 56626
## - Garage.Area      1 3.8719e+09 1.8651e+12 56626
## - Central.Air      1 3.8950e+09 1.8652e+12 56627
## - Garage.Cars      1 4.8403e+09 1.8661e+12 56628
## - Foundation       3 8.0885e+09 1.8694e+12 56629
## - Roof.Style       3 9.0879e+09 1.8704e+12 56630
## - Bedroom.AbvGr    1 6.8304e+09 1.8681e+12 56631
## - House.Style      2 8.5555e+09 1.8698e+12 56631
## - Condition.1      3 1.0441e+10 1.8717e+12 56632
## - Pool.Area        1 8.1873e+09 1.8695e+12 56633
## - Garage.Type      3 1.1505e+10 1.8728e+12 56634
## - Bsmt.Qual        1 9.0381e+09 1.8703e+12 56634
## - Bath             1 1.0683e+10 1.8720e+12 56637
## - Sale.Condition   3 1.4872e+10 1.8761e+12 56639
## - Total.Bsmt.SF    1 1.3241e+10 1.8745e+12 56640
## - Mas.Vnr.Type     2 1.5911e+10 1.8772e+12 56642
## - Lot.Area         1 1.5818e+10 1.8771e+12 56644
## - Year.Built       1 1.6717e+10 1.8780e+12 56646
## - Fireplaces       1 1.7489e+10 1.8788e+12 56647
## - Screen.Porch     1 1.7756e+10 1.8790e+12 56647
## - Exter.Qual       1 1.8541e+10 1.8798e+12 56648
## - Kitchen.Qual     1 2.2269e+10 1.8835e+12 56654
## - Mas.Vnr.Area     1 2.8700e+10 1.8900e+12 56663
## - Land.Contour     3 3.5585e+10 1.8969e+12 56669
## - Overall.Cond     1 6.8014e+10 1.9293e+12 56720
## - BsmtFin.SF       1 9.1178e+10 1.9524e+12 56754
## - Overall.Qual     1 1.1138e+11 1.9726e+12 56782
## - Bldg.Type        4 1.4042e+11 2.0017e+12 56817
## - Gr.Liv.Area      1 1.6504e+11 2.0263e+12 56857
## - Neighborhood    26 3.5311e+11 2.2144e+12 57053
```

```
##
```

```
## Step: AIC=56621.19
```

```
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Garage.Type +
## Garage.Finish + Garage.Cars + Garage.Area + Wood.Deck.SF +
## Open.Porch.SF + Screen.Porch + Pool.Area + Sale.Type + Sale.Condition +
## Bath
```

```
##
```

```
##           Df Sum of Sq      RSS   AIC
## - Lot.Shape      1 1.2112e+09 1.8628e+12 56621
## <none>                1.8616e+12 56621
## - TotRms.AbvGrd  1 1.5045e+09 1.8631e+12 56621
## - X1st.Flr.SF    1 2.1129e+09 1.8637e+12 56622
## - Wood.Deck.SF   1 2.1621e+09 1.8637e+12 56622
## - Heating.QC     1 2.3058e+09 1.8639e+12 56623
```

```
## - Open.Porch.SF      1 3.1010e+09 1.8647e+12 56624
## - Sale.Type          3 6.1734e+09 1.8678e+12 56624
## - Garage.Finish      1 3.5861e+09 1.8652e+12 56625
## - Central.Air        1 3.9026e+09 1.8655e+12 56625
## - Garage.Area        1 3.9504e+09 1.8655e+12 56625
## - Garage.Cars        1 4.8173e+09 1.8664e+12 56626
## - Foundation         3 8.2875e+09 1.8699e+12 56628
## - Roof.Style         3 9.0401e+09 1.8706e+12 56629
## - Bedroom.AbvGr      1 6.7931e+09 1.8684e+12 56629
## - House.Style        2 8.5651e+09 1.8701e+12 56630
## - Condition.1        3 1.0358e+10 1.8719e+12 56631
## - Pool.Area          1 8.6430e+09 1.8702e+12 56632
## - Garage.Type        3 1.1431e+10 1.8730e+12 56632
## - Bsmt.Qual          1 8.9808e+09 1.8706e+12 56633
## - Bath               1 1.0717e+10 1.8723e+12 56635
## - Sale.Condition     3 1.4791e+10 1.8764e+12 56637
## - Total.Bsmt.SF      1 1.3655e+10 1.8752e+12 56639
## - Mas.Vnr.Type       2 1.5918e+10 1.8775e+12 56641
## - Lot.Area           1 1.6081e+10 1.8777e+12 56643
## - Year.Built         1 1.6426e+10 1.8780e+12 56644
## - Screen.Porch       1 1.7454e+10 1.8790e+12 56645
## - Fireplaces         1 1.7735e+10 1.8793e+12 56646
## - Exter.Qual         1 1.8432e+10 1.8800e+12 56647
## - Kitchen.Qual       1 2.2401e+10 1.8840e+12 56652
## - Mas.Vnr.Area       1 2.8542e+10 1.8901e+12 56661
## - Land.Contour       3 3.5558e+10 1.8971e+12 56668
## - Overall.Cond       1 6.7701e+10 1.9293e+12 56718
## - BsmtFin.SF         1 9.1055e+10 1.9526e+12 56752
## - Overall.Qual       1 1.1217e+11 1.9737e+12 56782
## - Bldg.Type          4 1.4023e+11 2.0018e+12 56815
## - Gr.Liv.Area        1 1.6544e+11 2.0270e+12 56856
## - Neighborhood      26 3.5303e+11 2.2146e+12 57052
##
```

```
## Step: AIC=56620.99
```

```
## SalePrice ~ Lot.Area + Land.Contour + Neighborhood + Condition.1 +
## Bldg.Type + House.Style + Overall.Qual + Overall.Cond + Year.Built +
## Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Foundation +
## Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
## X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
## TotRms.AbvGrd + Fireplaces + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Screen.Porch + Pool.Area + Sale.Type + Sale.Condition + Bath
##
```

```
##           Df Sum of Sq      RSS   AIC
## <none>                1.8628e+12 56621
## - TotRms.AbvGrd      1 1.4973e+09 1.8643e+12 56621
## - Wood.Deck.SF       1 2.0104e+09 1.8648e+12 56622
## - X1st.Flr.SF        1 2.0487e+09 1.8648e+12 56622
## - Heating.QC         1 2.3753e+09 1.8652e+12 56623
## - Open.Porch.SF      1 3.1609e+09 1.8660e+12 56624
## - Garage.Finish      1 3.4505e+09 1.8662e+12 56624
## - Sale.Type          3 6.2293e+09 1.8690e+12 56624
## - Central.Air        1 3.8118e+09 1.8666e+12 56625
## - Garage.Area        1 3.9154e+09 1.8667e+12 56625
```

```
## - Garage.Cars      1 4.8336e+09 1.8676e+12 56626
## - Foundation      3 8.3158e+09 1.8711e+12 56627
## - Roof.Style      3 9.5014e+09 1.8723e+12 56629
## - Bedroom.AbvGr   1 6.8155e+09 1.8696e+12 56629
## - House.Style     2 8.4041e+09 1.8712e+12 56629
## - Condition.1     3 9.9905e+09 1.8728e+12 56630
## - Garage.Type     3 1.1247e+10 1.8740e+12 56632
## - Pool.Area       1 8.7532e+09 1.8715e+12 56632
## - Bsmt.Qual       1 8.8887e+09 1.8717e+12 56632
## - Bath            1 1.0763e+10 1.8736e+12 56635
## - Sale.Condition  3 1.4670e+10 1.8775e+12 56637
## - Total.Bsmt.SF   1 1.3609e+10 1.8764e+12 56639
## - Mas.Vnr.Type    2 1.6037e+10 1.8788e+12 56641
## - Lot.Area        1 1.5252e+10 1.8780e+12 56642
## - Year.Built      1 1.5996e+10 1.8788e+12 56643
## - Screen.Porch    1 1.7332e+10 1.8801e+12 56645
## - Fireplaces      1 1.7725e+10 1.8805e+12 56645
## - Exter.Qual      1 1.8399e+10 1.8812e+12 56646
## - Kitchen.Qual    1 2.2461e+10 1.8853e+12 56652
## - Mas.Vnr.Area    1 2.8876e+10 1.8917e+12 56662
## - Land.Contour    3 3.4948e+10 1.8977e+12 56667
## - Overall.Cond    1 6.7235e+10 1.9300e+12 56717
## - BsmtFin.SF      1 9.0582e+10 1.9534e+12 56751
## - Overall.Qual    1 1.1180e+11 1.9746e+12 56781
## - Bldg.Type       4 1.4006e+11 2.0029e+12 56814
## - Gr.Liv.Area     1 1.6498e+11 2.0278e+12 56855
## - Neighborhood    26 3.5183e+11 2.2146e+12 57050
```

```
length(final_model$coefficients)
```

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

There are 81 coefficients in the final model. The final AIC is 56620.99.

c.

```
forward_model = step(model,direction = 'forward')
```

```
## Start:  AIC=56643
## SalePrice ~ MS.Zoning + Lot.Area + Lot.Shape + Land.Contour +
##   Neighborhood + Condition.1 + Bldg.Type + House.Style + Overall.Qual +
##   Overall.Cond + Year.Built + Year.Remod.Add + Roof.Style +
##   Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation +
##   Bsmt.Qual + Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
##   Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
##   Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
##   Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
##   Paved.Drive + Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch +
##   X3Ssn.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
##   Sale.Condition + Yr.Sold + Bath
```

```
length(forward_model$coefficients)
```

```
## [1] 96
```

```
backward_model = step(model, direction = 'backward')
```

```
## Start: AIC=56643
## SalePrice ~ MS.Zoning + Lot.Area + Lot.Shape + Land.Contour +
## Neighborhood + Condition.1 + Bldg.Type + House.Style + Overall.Qual +
## Overall.Cond + Year.Built + Year.Remod.Add + Roof.Style +
## Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation +
## Bsmt.Qual + Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
## Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
## Paved.Drive + Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch +
## X3Ssn.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
## Sale.Condition + Yr.Sold + Bath
```

```
##
##          Df Sum of Sq      RSS   AIC
## - Yr.Sold      4 2.4873e+09 1.8599e+12 56639
## - MS.Zoning      2 9.8095e+08 1.8584e+12 56640
## - Paved.Drive      1 1.1985e+07 1.8575e+12 56641
## - X3Ssn.Porch      1 2.6008e+07 1.8575e+12 56641
## - Bsmt.Cond      1 3.6363e+07 1.8575e+12 56641
## - Year.Remod.Add      1 6.1302e+07 1.8575e+12 56641
## - Fence      1 6.6678e+07 1.8575e+12 56641
## - Exter.Cond      1 1.3226e+08 1.8576e+12 56641
## - Fireplace.Qu      1 1.7648e+08 1.8576e+12 56641
## - Enclosed.Porch      1 2.9594e+08 1.8577e+12 56641
## <none>                                1.8574e+12 56643
## - Lot.Shape      1 1.3603e+09 1.8588e+12 56643
## - TotRms.AbvGrd      1 1.4354e+09 1.8589e+12 56643
## - X1st.Flr.SF      1 1.8471e+09 1.8593e+12 56644
## - Wood.Deck.SF      1 2.0660e+09 1.8595e+12 56644
## - Heating.QC      1 2.2010e+09 1.8596e+12 56644
## - Open.Porch.SF      1 3.1345e+09 1.8606e+12 56646
## - Sale.Type      3 6.1291e+09 1.8636e+12 56646
## - Garage.Area      1 3.5249e+09 1.8610e+12 56646
## - Garage.Finish      1 3.7443e+09 1.8612e+12 56647
## - Central.Air      1 3.8014e+09 1.8612e+12 56647
## - Garage.Cars      1 5.1932e+09 1.8626e+12 56649
## - Foundation      3 8.5447e+09 1.8660e+12 56650
## - Roof.Style      3 9.4320e+09 1.8669e+12 56651
## - Condition.1      3 9.7473e+09 1.8672e+12 56652
## - Bedroom.AbvGr      1 7.1991e+09 1.8646e+12 56652
## - House.Style      2 8.6174e+09 1.8661e+12 56652
## - Pool.Area      1 7.3169e+09 1.8648e+12 56652
## - Fireplaces      1 8.0824e+09 1.8655e+12 56653
## - Garage.Type      3 1.1111e+10 1.8686e+12 56654
## - Bsmt.Qual      1 9.5061e+09 1.8670e+12 56655
## - Bath      1 1.0244e+10 1.8677e+12 56656
## - Sale.Condition      3 1.5345e+10 1.8728e+12 56660
## - Total.Bsmt.SF      1 1.2968e+10 1.8704e+12 56660
## - Lot.Area      1 1.4434e+10 1.8719e+12 56663
## - Mas.Vnr.Type      2 1.5798e+10 1.8732e+12 56663
## - Year.Built      1 1.4861e+10 1.8723e+12 56663
## - Screen.Porch      1 1.7292e+10 1.8747e+12 56667
## - Exter.Qual      1 1.8614e+10 1.8761e+12 56669
```

```

## - Kitchen.Qual      1 2.2143e+10 1.8796e+12 56674
## - Mas.Vnr.Area      1 2.7918e+10 1.8854e+12 56682
## - Land.Contour      3 3.5888e+10 1.8933e+12 56690
## - Overall.Cond      1 5.6622e+10 1.9141e+12 56724
## - BsmtFin.SF        1 8.9223e+10 1.9467e+12 56771
## - Overall.Qual      1 1.0952e+11 1.9670e+12 56800
## - Bldg.Type         4 1.2661e+11 1.9841e+12 56818
## - Gr.Liv.Area       1 1.6475e+11 2.0222e+12 56877
## - Neighborhood     26 3.4788e+11 2.2053e+12 57068
##
## Step:  AIC=56638.72
## SalePrice ~ MS.Zoning + Lot.Area + Lot.Shape + Land.Contour +
##      Neighborhood + Condition.1 + Bldg.Type + House.Style + Overall.Qual +
##      Overall.Cond + Year.Built + Year.Remod.Add + Roof.Style +
##      Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation +
##      Bsmt.Qual + Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
##      Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
##      Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
##      Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
##      Paved.Drive + Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch +
##      X3Ssn.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
##      Sale.Condition + Bath
##
##              Df  Sum of Sq      RSS   AIC
## - MS.Zoning      2 8.3971e+08 1.8608e+12 56636
## - Paved.Drive    1 1.1921e+07 1.8599e+12 56637
## - X3Ssn.Porch    1 3.2096e+07 1.8600e+12 56637
## - Bsmt.Cond      1 3.6644e+07 1.8600e+12 56637
## - Fence          1 5.5417e+07 1.8600e+12 56637
## - Year.Remod.Add  1 6.6667e+07 1.8600e+12 56637
## - Exter.Cond     1 1.0978e+08 1.8600e+12 56637
## - Fireplace.Qu   1 1.8369e+08 1.8601e+12 56637
## - Enclosed.Porch 1 2.9785e+08 1.8602e+12 56637
## - TotRms.AbvGrd  1 1.3175e+09 1.8612e+12 56639
## <none>                                1.8599e+12 56639
## - Lot.Shape      1 1.3423e+09 1.8613e+12 56639
## - X1st.Flr.SF    1 1.8353e+09 1.8618e+12 56639
## - Wood.Deck.SF   1 2.1352e+09 1.8621e+12 56640
## - Heating.QC     1 2.2323e+09 1.8622e+12 56640
## - Open.Porch.SF  1 3.1022e+09 1.8630e+12 56641
## - Garage.Area    1 3.4201e+09 1.8634e+12 56642
## - Sale.Type      3 6.2418e+09 1.8662e+12 56642
## - Garage.Finish  1 3.6747e+09 1.8636e+12 56642
## - Central.Air    1 3.9065e+09 1.8638e+12 56643
## - Garage.Cars    1 5.3198e+09 1.8653e+12 56645
## - Foundation     3 8.2465e+09 1.8682e+12 56645
## - Roof.Style     3 9.1551e+09 1.8691e+12 56646
## - House.Style    2 8.2746e+09 1.8682e+12 56647
## - Bedroom.AbvGr  1 7.0509e+09 1.8670e+12 56647
## - Condition.1    3 9.8883e+09 1.8698e+12 56647
## - Pool.Area      1 7.5928e+09 1.8675e+12 56648
## - Fireplaces     1 7.9870e+09 1.8679e+12 56649
## - Garage.Type    3 1.1240e+10 1.8712e+12 56649
## - Bsmt.Qual      1 9.3357e+09 1.8693e+12 56651

```

```

## - Bath                1 1.0177e+10 1.8701e+12 56652
## - Sale.Condition      3 1.4859e+10 1.8748e+12 56655
## - Total.Bsmt.SF       1 1.3032e+10 1.8730e+12 56656
## - Mas.Vnr.Type        2 1.5564e+10 1.8755e+12 56658
## - Lot.Area            1 1.5308e+10 1.8752e+12 56659
## - Year.Built          1 1.5532e+10 1.8755e+12 56660
## - Screen.Porch        1 1.7358e+10 1.8773e+12 56663
## - Exter.Qual          1 1.8324e+10 1.8783e+12 56664
## - Kitchen.Qual        1 2.1874e+10 1.8818e+12 56669
## - Mas.Vnr.Area        1 2.8203e+10 1.8881e+12 56679
## - Land.Contour        3 3.6298e+10 1.8962e+12 56686
## - Overall.Cond        1 5.7312e+10 1.9172e+12 56721
## - BsmtFin.SF          1 9.0021e+10 1.9500e+12 56768
## - Overall.Qual        1 1.1140e+11 1.9713e+12 56798
## - Bldg.Type           4 1.2494e+11 1.9849e+12 56811
## - Gr.Liv.Area         1 1.6334e+11 2.0233e+12 56871
## - Neighborhood       26 3.4807e+11 2.2080e+12 57063
##
## Step:  AIC=56635.98
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
##      Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
##      Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
##      Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
##      Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
##      X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
##      TotRms.AbvGrd + Fireplaces + Fireplace.Qu + Garage.Type +
##      Garage.Finish + Garage.Cars + Garage.Area + Paved.Drive +
##      Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch + X3Ssn.Porch +
##      Screen.Porch + Pool.Area + Fence + Sale.Type + Sale.Condition +
##      Bath
##
##              Df  Sum of Sq      RSS   AIC
## - Paved.Drive    1 7.0633e+06 1.8608e+12 56634
## - Bsmt.Cond       1 2.5234e+07 1.8608e+12 56634
## - X3Ssn.Porch     1 3.1156e+07 1.8608e+12 56634
## - Fence           1 6.1154e+07 1.8608e+12 56634
## - Year.Remod.Add  1 6.8319e+07 1.8608e+12 56634
## - Exter.Cond      1 1.0199e+08 1.8609e+12 56634
## - Fireplace.Qu    1 1.9707e+08 1.8610e+12 56634
## - Enclosed.Porch  1 2.8073e+08 1.8611e+12 56634
## - Lot.Shape       1 1.2207e+09 1.8620e+12 56636
## <none>                                1.8608e+12 56636
## - TotRms.AbvGrd   1 1.3806e+09 1.8622e+12 56636
## - X1st.Flr.SF     1 1.9761e+09 1.8627e+12 56637
## - Wood.Deck.SF    1 2.2256e+09 1.8630e+12 56637
## - Heating.QC      1 2.2345e+09 1.8630e+12 56637
## - Open.Porch.SF   1 3.0206e+09 1.8638e+12 56638
## - Sale.Type       3 6.3140e+09 1.8671e+12 56639
## - Garage.Finish   1 3.6521e+09 1.8644e+12 56639
## - Garage.Area     1 3.7891e+09 1.8646e+12 56640
## - Central.Air     1 3.8911e+09 1.8647e+12 56640
## - Garage.Cars     1 4.9354e+09 1.8657e+12 56641
## - Foundation      3 8.1066e+09 1.8689e+12 56642
## - Roof.Style      3 9.0446e+09 1.8698e+12 56643

```

```

## - Bedroom.AbvGr 1 7.0404e+09 1.8678e+12 56644
## - House.Style 2 8.4337e+09 1.8692e+12 56645
## - Pool.Area 1 7.5481e+09 1.8683e+12 56645
## - Condition.1 3 1.0289e+10 1.8711e+12 56645
## - Fireplaces 1 8.2047e+09 1.8690e+12 56646
## - Garage.Type 3 1.1362e+10 1.8721e+12 56647
## - Bsmt.Qual 1 9.0486e+09 1.8698e+12 56647
## - Bath 1 1.0486e+10 1.8713e+12 56650
## - Sale.Condition 3 1.4975e+10 1.8757e+12 56652
## - Total.Bsmt.SF 1 1.3229e+10 1.8740e+12 56654
## - Mas.Vnr.Type 2 1.5761e+10 1.8765e+12 56655
## - Year.Built 1 1.5071e+10 1.8758e+12 56656
## - Lot.Area 1 1.5480e+10 1.8763e+12 56657
## - Screen.Porch 1 1.7414e+10 1.8782e+12 56660
## - Exter.Qual 1 1.8378e+10 1.8791e+12 56661
## - Kitchen.Qual 1 2.2403e+10 1.8832e+12 56667
## - Mas.Vnr.Area 1 2.8478e+10 1.8892e+12 56676
## - Land.Contour 3 3.5827e+10 1.8966e+12 56683
## - Overall.Cond 1 5.7026e+10 1.9178e+12 56718
## - BsmtFin.SF 1 8.9776e+10 1.9505e+12 56765
## - Overall.Qual 1 1.1068e+11 1.9715e+12 56794
## - Bldg.Type 4 1.3954e+11 2.0003e+12 56829
## - Gr.Liv.Area 1 1.6445e+11 2.0252e+12 56869
## - Neighborhood 26 3.5144e+11 2.2122e+12 57065
##
## Step: AIC=56633.99
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
## X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
## TotRms.AbvGrd + Fireplaces + Fireplace.Qu + Garage.Type +
## Garage.Finish + Garage.Cars + Garage.Area + Wood.Deck.SF +
## Open.Porch.SF + Enclosed.Porch + X3Ssn.Porch + Screen.Porch +
## Pool.Area + Fence + Sale.Type + Sale.Condition + Bath
##
##
## Df Sum of Sq RSS AIC
## - Bsmt.Cond 1 2.4606e+07 1.8608e+12 56632
## - X3Ssn.Porch 1 3.1495e+07 1.8608e+12 56632
## - Fence 1 6.2392e+07 1.8608e+12 56632
## - Year.Remod.Add 1 6.8398e+07 1.8608e+12 56632
## - Exter.Cond 1 1.0468e+08 1.8609e+12 56632
## - Fireplace.Qu 1 1.9745e+08 1.8610e+12 56632
## - Enclosed.Porch 1 2.8019e+08 1.8611e+12 56632
## - Lot.Shape 1 1.2188e+09 1.8620e+12 56634
## <none> 1.8608e+12 56634
## - TotRms.AbvGrd 1 1.3859e+09 1.8622e+12 56634
## - X1st.Flr.SF 1 1.9744e+09 1.8628e+12 56635
## - Wood.Deck.SF 1 2.2224e+09 1.8630e+12 56635
## - Heating.QC 1 2.2397e+09 1.8630e+12 56635
## - Open.Porch.SF 1 3.0184e+09 1.8638e+12 56636
## - Sale.Type 3 6.3072e+09 1.8671e+12 56637
## - Garage.Finish 1 3.6451e+09 1.8644e+12 56637

```



```

## - Garage.Area      1 3.8108e+09 1.8646e+12 56638
## - Central.Air      1 3.8989e+09 1.8647e+12 56638
## - Garage.Cars      1 4.9290e+09 1.8657e+12 56639
## - Foundation       3 8.1023e+09 1.8689e+12 56640
## - Roof.Style       3 9.0477e+09 1.8698e+12 56641
## - Bedroom.AbvGr    1 7.0348e+09 1.8678e+12 56642
## - House.Style      2 8.4292e+09 1.8692e+12 56643
## - Pool.Area        1 7.5411e+09 1.8683e+12 56643
## - Condition.1      3 1.0336e+10 1.8711e+12 56643
## - Fireplaces       1 8.2153e+09 1.8690e+12 56644
## - Garage.Type      3 1.1674e+10 1.8725e+12 56645
## - Bsmt.Qual        1 9.0597e+09 1.8698e+12 56645
## - Bath             1 1.0488e+10 1.8713e+12 56648
## - Sale.Condition   3 1.4992e+10 1.8758e+12 56650
## - Total.Bsmt.SF    1 1.3245e+10 1.8740e+12 56652
## - Mas.Vnr.Type     2 1.5759e+10 1.8765e+12 56653
## - Lot.Area         1 1.5599e+10 1.8764e+12 56655
## - Year.Built       1 1.5768e+10 1.8765e+12 56655
## - Screen.Porch     1 1.7414e+10 1.8782e+12 56658
## - Exter.Qual       1 1.8375e+10 1.8792e+12 56659
## - Kitchen.Qual     1 2.2403e+10 1.8832e+12 56665
## - Mas.Vnr.Area     1 2.8474e+10 1.8893e+12 56674
## - Land.Contour     3 3.5821e+10 1.8966e+12 56681
## - Overall.Cond     1 5.7150e+10 1.9179e+12 56716
## - BsmtFin.SF       1 8.9988e+10 1.9508e+12 56763
## - Overall.Qual     1 1.1087e+11 1.9716e+12 56793
## - Bldg.Type        4 1.3954e+11 2.0003e+12 56827
## - Gr.Liv.Area      1 1.6466e+11 2.0254e+12 56868
## - Neighborhood    26 3.5151e+11 2.2123e+12 57063
##
## Step:  AIC=56632.02
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air + X1st.Flr.SF +
## Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual + TotRms.AbvGrd +
## Fireplaces + Fireplace.Qu + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Enclosed.Porch + X3Ssn.Porch + Screen.Porch + Pool.Area +
## Fence + Sale.Type + Sale.Condition + Bath
##
##
##      Df Sum of Sq      RSS      AIC
## - X3Ssn.Porch    1 3.2553e+07 1.8608e+12 56630
## - Fence          1 6.2629e+07 1.8609e+12 56630
## - Year.Remod.Add  1 6.4516e+07 1.8609e+12 56630
## - Exter.Cond     1 1.0062e+08 1.8609e+12 56630
## - Fireplace.Qu   1 1.9734e+08 1.8610e+12 56630
## - Enclosed.Porch 1 2.7926e+08 1.8611e+12 56630
## - Lot.Shape      1 1.2178e+09 1.8620e+12 56632
## <none>                                1.8608e+12 56632
## - TotRms.AbvGrd  1 1.3938e+09 1.8622e+12 56632
## - X1st.Flr.SF    1 1.9639e+09 1.8628e+12 56633
## - Wood.Deck.SF   1 2.2205e+09 1.8630e+12 56633

```

```

## - Heating.QC      1 2.2345e+09 1.8630e+12 56633
## - Open.Porch.SF   1 3.0229e+09 1.8638e+12 56635
## - Sale.Type       3 6.2909e+09 1.8671e+12 56635
## - Garage.Finish   1 3.6657e+09 1.8645e+12 56635
## - Garage.Area     1 3.8115e+09 1.8646e+12 56636
## - Central.Air     1 3.9447e+09 1.8647e+12 56636
## - Garage.Cars     1 4.9326e+09 1.8657e+12 56637
## - Foundation      3 8.2228e+09 1.8690e+12 56638
## - Roof.Style      3 9.1036e+09 1.8699e+12 56640
## - Bedroom.AbvGr   1 7.0446e+09 1.8678e+12 56641
## - House.Style     2 8.4208e+09 1.8692e+12 56641
## - Pool.Area       1 7.5480e+09 1.8684e+12 56641
## - Condition.1     3 1.0322e+10 1.8711e+12 56641
## - Fireplaces      1 8.2019e+09 1.8690e+12 56642
## - Garage.Type     3 1.1668e+10 1.8725e+12 56643
## - Bsmt.Qual       1 9.1069e+09 1.8699e+12 56644
## - Bath            1 1.0463e+10 1.8713e+12 56646
## - Sale.Condition  3 1.4982e+10 1.8758e+12 56648
## - Total.Bsmt.SF   1 1.3223e+10 1.8740e+12 56650
## - Mas.Vnr.Type    2 1.5787e+10 1.8766e+12 56651
## - Lot.Area        1 1.5584e+10 1.8764e+12 56653
## - Year.Built      1 1.5753e+10 1.8766e+12 56653
## - Screen.Porch    1 1.7482e+10 1.8783e+12 56656
## - Exter.Qual      1 1.8380e+10 1.8792e+12 56657
## - Kitchen.Qual    1 2.2441e+10 1.8832e+12 56663
## - Mas.Vnr.Area    1 2.8490e+10 1.8893e+12 56672
## - Land.Contour    3 3.5866e+10 1.8967e+12 56679
## - Overall.Cond    1 5.7871e+10 1.9187e+12 56715
## - BsmtFin.SF      1 9.0141e+10 1.9509e+12 56761
## - Overall.Qual    1 1.1086e+11 1.9717e+12 56791
## - Bldg.Type       4 1.3955e+11 2.0004e+12 56825
## - Gr.Liv.Area     1 1.6491e+11 2.0257e+12 56866
## - Neighborhood    26 3.5178e+11 2.2126e+12 57061
##
## Step:  AIC=56630.07
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air + X1st.Flr.SF +
## Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual + TotRms.AbvGrd +
## Fireplaces + Fireplace.Qu + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Enclosed.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
## Sale.Condition + Bath
##
##
##      Df Sum of Sq      RSS      AIC
## - Fence      1 6.0777e+07 1.8609e+12 56628
## - Year.Remod.Add 1 6.5085e+07 1.8609e+12 56628
## - Exter.Cond  1 9.9922e+07 1.8609e+12 56628
## - Fireplace.Qu 1 2.0058e+08 1.8610e+12 56628
## - Enclosed.Porch 1 2.8660e+08 1.8611e+12 56628
## - Lot.Shape   1 1.2181e+09 1.8621e+12 56630
## <none>                1.8608e+12 56630

```

```
## - TotRms.AbvGrd    1 1.3827e+09 1.8622e+12 56630
## - X1st.Flr.SF      1 1.9645e+09 1.8628e+12 56631
## - Heating.QC       1 2.2200e+09 1.8631e+12 56631
## - Wood.Deck.SF     1 2.2415e+09 1.8631e+12 56631
## - Open.Porch.SF    1 3.0097e+09 1.8638e+12 56633
## - Sale.Type        3 6.2886e+09 1.8671e+12 56633
## - Garage.Finish    1 3.6742e+09 1.8645e+12 56634
## - Garage.Area      1 3.7960e+09 1.8646e+12 56634
## - Central.Air      1 3.9441e+09 1.8648e+12 56634
## - Garage.Cars      1 4.9350e+09 1.8658e+12 56635
## - Foundation       3 8.1975e+09 1.8690e+12 56636
## - Roof.Style       3 9.0938e+09 1.8699e+12 56638
## - Bedroom.AbvGr    1 7.0252e+09 1.8679e+12 56639
## - House.Style      2 8.4292e+09 1.8693e+12 56639
## - Pool.Area        1 7.5543e+09 1.8684e+12 56639
## - Condition.1      3 1.0329e+10 1.8712e+12 56639
## - Fireplaces       1 8.2277e+09 1.8691e+12 56640
## - Garage.Type      3 1.1664e+10 1.8725e+12 56641
## - Bsmt.Qual        1 9.0986e+09 1.8699e+12 56642
## - Bath             1 1.0445e+10 1.8713e+12 56644
## - Sale.Condition   3 1.4983e+10 1.8758e+12 56646
## - Total.Bsmt.SF    1 1.3206e+10 1.8740e+12 56648
## - Mas.Vnr.Type     2 1.5845e+10 1.8767e+12 56650
## - Lot.Area         1 1.5587e+10 1.8764e+12 56651
## - Year.Built       1 1.5757e+10 1.8766e+12 56651
## - Screen.Porch     1 1.7630e+10 1.8785e+12 56654
## - Exter.Qual       1 1.8349e+10 1.8792e+12 56655
## - Kitchen.Qual     1 2.2439e+10 1.8833e+12 56661
## - Mas.Vnr.Area     1 2.8509e+10 1.8893e+12 56670
## - Land.Contour     3 3.5836e+10 1.8967e+12 56677
## - Overall.Cond     1 5.7839e+10 1.9187e+12 56713
## - BsmtFin.SF       1 9.0109e+10 1.9509e+12 56759
## - Overall.Qual     1 1.1099e+11 1.9718e+12 56789
## - Bldg.Type        4 1.3954e+11 2.0004e+12 56823
## - Gr.Liv.Area      1 1.6488e+11 2.0257e+12 56864
## - Neighborhood    26 3.5262e+11 2.2135e+12 57060
##
```

```
## Step: AIC=56628.16
```

```
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air + X1st.Flr.SF +
## Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual + TotRms.AbvGrd +
## Fireplaces + Fireplace.Qu + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Enclosed.Porch + Screen.Porch + Pool.Area + Sale.Type + Sale.Condition +
## Bath
##
```

```
##           Df Sum of Sq      RSS   AIC
## - Year.Remod.Add 1 6.5434e+07 1.8610e+12 56626
## - Exter.Cond      1 1.0213e+08 1.8610e+12 56626
## - Fireplace.Qu    1 2.0177e+08 1.8611e+12 56626
## - Enclosed.Porch 1 2.8860e+08 1.8612e+12 56627
```

```

## - Lot.Shape      1 1.2141e+09 1.8621e+12 56628
## <none>           1.8609e+12 56628
## - TotRms.AbvGrd  1 1.3798e+09 1.8623e+12 56628
## - X1st.Flr.SF    1 1.9596e+09 1.8629e+12 56629
## - Heating.QC     1 2.2025e+09 1.8631e+12 56629
## - Wood.Deck.SF   1 2.3253e+09 1.8632e+12 56630
## - Open.Porch.SF  1 2.9978e+09 1.8639e+12 56631
## - Sale.Type      3 6.2644e+09 1.8672e+12 56631
## - Garage.Finish  1 3.6811e+09 1.8646e+12 56632
## - Garage.Area    1 3.8029e+09 1.8647e+12 56632
## - Central.Air    1 3.9258e+09 1.8648e+12 56632
## - Garage.Cars    1 4.9113e+09 1.8658e+12 56633
## - Foundation     3 8.1930e+09 1.8691e+12 56634
## - Roof.Style     3 9.1332e+09 1.8700e+12 56636
## - Bedroom.AbvGr  1 7.0104e+09 1.8679e+12 56637
## - House.Style    2 8.4237e+09 1.8693e+12 56637
## - Condition.1    3 1.0294e+10 1.8712e+12 56637
## - Pool.Area      1 7.8608e+09 1.8688e+12 56638
## - Fireplaces     1 8.2429e+09 1.8691e+12 56638
## - Garage.Type    3 1.1624e+10 1.8725e+12 56639
## - Bsmt.Qual      1 9.0868e+09 1.8700e+12 56640
## - Bath           1 1.0459e+10 1.8714e+12 56642
## - Sale.Condition 3 1.4941e+10 1.8758e+12 56644
## - Total.Bsmt.SF  1 1.3200e+10 1.8741e+12 56646
## - Mas.Vnr.Type   2 1.5821e+10 1.8767e+12 56648
## - Lot.Area       1 1.5526e+10 1.8764e+12 56649
## - Year.Built     1 1.5704e+10 1.8766e+12 56650
## - Screen.Porch   1 1.7676e+10 1.8786e+12 56652
## - Exter.Qual     1 1.8293e+10 1.8792e+12 56653
## - Kitchen.Qual   1 2.2512e+10 1.8834e+12 56660
## - Mas.Vnr.Area   1 2.8528e+10 1.8894e+12 56668
## - Land.Contour   3 3.5776e+10 1.8967e+12 56675
## - Overall.Cond   1 5.8075e+10 1.9190e+12 56712
## - BsmtFin.SF     1 9.0208e+10 1.9511e+12 56758
## - Overall.Qual   1 1.1114e+11 1.9720e+12 56787
## - Bldg.Type      4 1.4064e+11 2.0015e+12 56823
## - Gr.Liv.Area    1 1.6482e+11 2.0257e+12 56862
## - Neighborhood   26 3.5261e+11 2.2135e+12 57058
##
## Step:  AIC=56626.26
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Exter.Cond + Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF +
## Heating.QC + Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
## Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
## Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch + Screen.Porch +
## Pool.Area + Sale.Type + Sale.Condition + Bath
##
##           Df Sum of Sq      RSS   AIC
## - Exter.Cond      1 9.8749e+07 1.8611e+12 56624
## - Fireplace.Qu     1 2.1015e+08 1.8612e+12 56625
## - Enclosed.Porch   1 2.9433e+08 1.8613e+12 56625

```

```

## - Lot.Shape      1 1.2109e+09 1.8622e+12 56626
## <none>           1.8610e+12 56626
## - TotRms.AbvGrd  1 1.3998e+09 1.8624e+12 56626
## - X1st.Flr.SF    1 2.0172e+09 1.8630e+12 56627
## - Heating.QC     1 2.1679e+09 1.8631e+12 56627
## - Wood.Deck.SF   1 2.3156e+09 1.8633e+12 56628
## - Open.Porch.SF  1 2.9951e+09 1.8640e+12 56629
## - Sale.Type      3 6.2447e+09 1.8672e+12 56630
## - Garage.Finish  1 3.6557e+09 1.8646e+12 56630
## - Garage.Area    1 3.8293e+09 1.8648e+12 56630
## - Central.Air    1 3.8784e+09 1.8648e+12 56630
## - Garage.Cars    1 4.9202e+09 1.8659e+12 56632
## - Foundation     3 8.1501e+09 1.8691e+12 56632
## - Roof.Style     3 9.1461e+09 1.8701e+12 56634
## - Bedroom.AbvGr  1 6.9524e+09 1.8679e+12 56635
## - House.Style    2 8.5148e+09 1.8695e+12 56635
## - Condition.1    3 1.0347e+10 1.8713e+12 56636
## - Pool.Area      1 7.9164e+09 1.8689e+12 56636
## - Fireplaces     1 8.2296e+09 1.8692e+12 56637
## - Garage.Type    3 1.1584e+10 1.8725e+12 56637
## - Bsmt.Qual      1 9.0240e+09 1.8700e+12 56638
## - Bath           1 1.0394e+10 1.8714e+12 56640
## - Sale.Condition 3 1.4963e+10 1.8759e+12 56643
## - Total.Bsmt.SF  1 1.3271e+10 1.8742e+12 56644
## - Mas.Vnr.Type   2 1.5798e+10 1.8768e+12 56646
## - Lot.Area       1 1.5501e+10 1.8765e+12 56647
## - Year.Built     1 1.6578e+10 1.8775e+12 56649
## - Screen.Porch   1 1.7662e+10 1.8786e+12 56651
## - Exter.Qual     1 1.8298e+10 1.8793e+12 56651
## - Kitchen.Qual   1 2.2447e+10 1.8834e+12 56658
## - Mas.Vnr.Area   1 2.8544e+10 1.8895e+12 56667
## - Land.Contour   3 3.5724e+10 1.8967e+12 56673
## - Overall.Cond   1 5.8773e+10 1.9197e+12 56711
## - BsmtFin.SF     1 9.0386e+10 1.9513e+12 56756
## - Overall.Qual   1 1.1163e+11 1.9726e+12 56786
## - Bldg.Type      4 1.4057e+11 2.0015e+12 56821
## - Gr.Liv.Area    1 1.6503e+11 2.0260e+12 56860
## - Neighborhood   26 3.5256e+11 2.2135e+12 57056
##
## Step:  AIC=56624.41
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
## Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
## Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch + Screen.Porch +
## Pool.Area + Sale.Type + Sale.Condition + Bath
##
##           Df Sum of Sq      RSS   AIC
## - Fireplace.Qu  1 2.0862e+08 1.8613e+12 56623
## - Enclosed.Porch 1 3.0345e+08 1.8614e+12 56623
## - Lot.Shape     1 1.2123e+09 1.8623e+12 56624

```

```

## <none> 1.8611e+12 56624
## - TotRms.AbvGrd 1 1.4087e+09 1.8625e+12 56625
## - X1st.Flr.SF 1 2.0294e+09 1.8631e+12 56625
## - Heating.QC 1 2.2501e+09 1.8633e+12 56626
## - Wood.Deck.SF 1 2.3229e+09 1.8634e+12 56626
## - Open.Porch.SF 1 2.9839e+09 1.8640e+12 56627
## - Sale.Type 3 6.1925e+09 1.8673e+12 56628
## - Garage.Finish 1 3.6601e+09 1.8647e+12 56628
## - Garage.Area 1 3.8756e+09 1.8649e+12 56628
## - Central.Air 1 3.8780e+09 1.8649e+12 56628
## - Garage.Cars 1 4.8666e+09 1.8659e+12 56630
## - Foundation 3 8.0802e+09 1.8691e+12 56630
## - Roof.Style 3 9.0902e+09 1.8702e+12 56632
## - Bedroom.AbvGr 1 6.9151e+09 1.8680e+12 56633
## - House.Style 2 8.5816e+09 1.8696e+12 56633
## - Condition.1 3 1.0327e+10 1.8714e+12 56634
## - Pool.Area 1 7.8865e+09 1.8689e+12 56634
## - Fireplaces 1 8.2226e+09 1.8693e+12 56635
## - Garage.Type 3 1.1535e+10 1.8726e+12 56636
## - Bsmt.Qual 1 9.0089e+09 1.8701e+12 56636
## - Bath 1 1.0542e+10 1.8716e+12 56638
## - Sale.Condition 3 1.4916e+10 1.8760e+12 56641
## - Total.Bsmt.SF 1 1.3199e+10 1.8743e+12 56642
## - Mas.Vnr.Type 2 1.5832e+10 1.8769e+12 56644
## - Lot.Area 1 1.5627e+10 1.8767e+12 56646
## - Year.Built 1 1.6643e+10 1.8777e+12 56647
## - Screen.Porch 1 1.7712e+10 1.8788e+12 56649
## - Exter.Qual 1 1.8634e+10 1.8797e+12 56650
## - Kitchen.Qual 1 2.2442e+10 1.8835e+12 56656
## - Mas.Vnr.Area 1 2.8714e+10 1.8898e+12 56665
## - Land.Contour 3 3.5647e+10 1.8967e+12 56671
## - Overall.Cond 1 6.7630e+10 1.9287e+12 56722
## - BsmtFin.SF 1 9.0493e+10 1.9516e+12 56754
## - Overall.Qual 1 1.1154e+11 1.9726e+12 56784
## - Bldg.Type 4 1.4062e+11 2.0017e+12 56819
## - Gr.Liv.Area 1 1.6523e+11 2.0263e+12 56859
## - Neighborhood 26 3.5247e+11 2.2135e+12 57054
##
## Step: AIC=56622.72
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Garage.Type +
## Garage.Finish + Garage.Cars + Garage.Area + Wood.Deck.SF +
## Open.Porch.SF + Enclosed.Porch + Screen.Porch + Pool.Area +
## Sale.Type + Sale.Condition + Bath
##
## Df Sum of Sq RSS AIC
## - Enclosed.Porch 1 3.1391e+08 1.8616e+12 56621
## - Lot.Shape 1 1.2153e+09 1.8625e+12 56623
## <none> 1.8613e+12 56623
## - TotRms.AbvGrd 1 1.4690e+09 1.8627e+12 56623

```

```
## - X1st.Flr.SF      1 2.0291e+09 1.8633e+12 56624
## - Heating.QC       1 2.2766e+09 1.8635e+12 56624
## - Wood.Deck.SF     1 2.2920e+09 1.8636e+12 56624
## - Open.Porch.SF    1 3.0002e+09 1.8643e+12 56625
## - Sale.Type        3 6.2039e+09 1.8675e+12 56626
## - Garage.Finish    1 3.5998e+09 1.8649e+12 56626
## - Garage.Area      1 3.8719e+09 1.8651e+12 56626
## - Central.Air      1 3.8950e+09 1.8652e+12 56627
## - Garage.Cars      1 4.8403e+09 1.8661e+12 56628
## - Foundation       3 8.0885e+09 1.8694e+12 56629
## - Roof.Style       3 9.0879e+09 1.8704e+12 56630
## - Bedroom.AbvGr    1 6.8304e+09 1.8681e+12 56631
## - House.Style      2 8.5555e+09 1.8698e+12 56631
## - Condition.1      3 1.0441e+10 1.8717e+12 56632
## - Pool.Area        1 8.1873e+09 1.8695e+12 56633
## - Garage.Type      3 1.1505e+10 1.8728e+12 56634
## - Bsmt.Qual        1 9.0381e+09 1.8703e+12 56634
## - Bath             1 1.0683e+10 1.8720e+12 56637
## - Sale.Condition   3 1.4872e+10 1.8761e+12 56639
## - Total.Bsmt.SF    1 1.3241e+10 1.8745e+12 56640
## - Mas.Vnr.Type     2 1.5911e+10 1.8772e+12 56642
## - Lot.Area         1 1.5818e+10 1.8771e+12 56644
## - Year.Built       1 1.6717e+10 1.8780e+12 56646
## - Fireplaces       1 1.7489e+10 1.8788e+12 56647
## - Screen.Porch     1 1.7756e+10 1.8790e+12 56647
## - Exter.Qual       1 1.8541e+10 1.8798e+12 56648
## - Kitchen.Qual     1 2.2269e+10 1.8835e+12 56654
## - Mas.Vnr.Area     1 2.8700e+10 1.8900e+12 56663
## - Land.Contour     3 3.5585e+10 1.8969e+12 56669
## - Overall.Cond     1 6.8014e+10 1.9293e+12 56720
## - BsmtFin.SF       1 9.1178e+10 1.9524e+12 56754
## - Overall.Qual     1 1.1138e+11 1.9726e+12 56782
## - Bldg.Type        4 1.4042e+11 2.0017e+12 56817
## - Gr.Liv.Area      1 1.6504e+11 2.0263e+12 56857
## - Neighborhood    26 3.5311e+11 2.2144e+12 57053
```

```
##
```

```
## Step: AIC=56621.19
```

```
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Garage.Type +
## Garage.Finish + Garage.Cars + Garage.Area + Wood.Deck.SF +
## Open.Porch.SF + Screen.Porch + Pool.Area + Sale.Type + Sale.Condition +
## Bath
```

```
##
```

```
##           Df Sum of Sq      RSS   AIC
## - Lot.Shape      1 1.2112e+09 1.8628e+12 56621
## <none>                                1.8616e+12 56621
## - TotRms.AbvGrd  1 1.5045e+09 1.8631e+12 56621
## - X1st.Flr.SF    1 2.1129e+09 1.8637e+12 56622
## - Wood.Deck.SF   1 2.1621e+09 1.8637e+12 56622
## - Heating.QC     1 2.3058e+09 1.8639e+12 56623
```

```
## - Open.Porch.SF      1 3.1010e+09 1.8647e+12 56624
## - Sale.Type          3 6.1734e+09 1.8678e+12 56624
## - Garage.Finish      1 3.5861e+09 1.8652e+12 56625
## - Central.Air        1 3.9026e+09 1.8655e+12 56625
## - Garage.Area        1 3.9504e+09 1.8655e+12 56625
## - Garage.Cars        1 4.8173e+09 1.8664e+12 56626
## - Foundation         3 8.2875e+09 1.8699e+12 56628
## - Roof.Style         3 9.0401e+09 1.8706e+12 56629
## - Bedroom.AbvGr      1 6.7931e+09 1.8684e+12 56629
## - House.Style        2 8.5651e+09 1.8701e+12 56630
## - Condition.1        3 1.0358e+10 1.8719e+12 56631
## - Pool.Area          1 8.6430e+09 1.8702e+12 56632
## - Garage.Type        3 1.1431e+10 1.8730e+12 56632
## - Bsmt.Qual          1 8.9808e+09 1.8706e+12 56633
## - Bath               1 1.0717e+10 1.8723e+12 56635
## - Sale.Condition     3 1.4791e+10 1.8764e+12 56637
## - Total.Bsmt.SF      1 1.3655e+10 1.8752e+12 56639
## - Mas.Vnr.Type       2 1.5918e+10 1.8775e+12 56641
## - Lot.Area           1 1.6081e+10 1.8777e+12 56643
## - Year.Built         1 1.6426e+10 1.8780e+12 56644
## - Screen.Porch       1 1.7454e+10 1.8790e+12 56645
## - Fireplaces         1 1.7735e+10 1.8793e+12 56646
## - Exter.Qual         1 1.8432e+10 1.8800e+12 56647
## - Kitchen.Qual       1 2.2401e+10 1.8840e+12 56652
## - Mas.Vnr.Area       1 2.8542e+10 1.8901e+12 56661
## - Land.Contour       3 3.5558e+10 1.8971e+12 56668
## - Overall.Cond       1 6.7701e+10 1.9293e+12 56718
## - BsmtFin.SF         1 9.1055e+10 1.9526e+12 56752
## - Overall.Qual       1 1.1217e+11 1.9737e+12 56782
## - Bldg.Type          4 1.4023e+11 2.0018e+12 56815
## - Gr.Liv.Area        1 1.6544e+11 2.0270e+12 56856
## - Neighborhood      26 3.5303e+11 2.2146e+12 57052
##
```

```
## Step: AIC=56620.99
```

```
## SalePrice ~ Lot.Area + Land.Contour + Neighborhood + Condition.1 +
## Bldg.Type + House.Style + Overall.Qual + Overall.Cond + Year.Built +
## Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Foundation +
## Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
## X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
## TotRms.AbvGrd + Fireplaces + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Screen.Porch + Pool.Area + Sale.Type + Sale.Condition + Bath
##
```

```
##           Df Sum of Sq      RSS   AIC
## <none>                1.8628e+12 56621
## - TotRms.AbvGrd      1 1.4973e+09 1.8643e+12 56621
## - Wood.Deck.SF       1 2.0104e+09 1.8648e+12 56622
## - X1st.Flr.SF        1 2.0487e+09 1.8648e+12 56622
## - Heating.QC         1 2.3753e+09 1.8652e+12 56623
## - Open.Porch.SF      1 3.1609e+09 1.8660e+12 56624
## - Garage.Finish      1 3.4505e+09 1.8662e+12 56624
## - Sale.Type          3 6.2293e+09 1.8690e+12 56624
## - Central.Air        1 3.8118e+09 1.8666e+12 56625
## - Garage.Area        1 3.9154e+09 1.8667e+12 56625
```



```
## - Garage.Cars      1 4.8336e+09 1.8676e+12 56626
## - Foundation       3 8.3158e+09 1.8711e+12 56627
## - Roof.Style       3 9.5014e+09 1.8723e+12 56629
## - Bedroom.AbvGr   1 6.8155e+09 1.8696e+12 56629
## - House.Style      2 8.4041e+09 1.8712e+12 56629
## - Condition.1     3 9.9905e+09 1.8728e+12 56630
## - Garage.Type      3 1.1247e+10 1.8740e+12 56632
## - Pool.Area        1 8.7532e+09 1.8715e+12 56632
## - Bsmt.Qual        1 8.8887e+09 1.8717e+12 56632
## - Bath             1 1.0763e+10 1.8736e+12 56635
## - Sale.Condition   3 1.4670e+10 1.8775e+12 56637
## - Total.Bsmt.SF    1 1.3609e+10 1.8764e+12 56639
## - Mas.Vnr.Type     2 1.6037e+10 1.8788e+12 56641
## - Lot.Area         1 1.5252e+10 1.8780e+12 56642
## - Year.Built       1 1.5996e+10 1.8788e+12 56643
## - Screen.Porch     1 1.7332e+10 1.8801e+12 56645
## - Fireplaces       1 1.7725e+10 1.8805e+12 56645
## - Exter.Qual       1 1.8399e+10 1.8812e+12 56646
## - Kitchen.Qual     1 2.2461e+10 1.8853e+12 56652
## - Mas.Vnr.Area     1 2.8876e+10 1.8917e+12 56662
## - Land.Contour     3 3.4948e+10 1.8977e+12 56667
## - Overall.Cond     1 6.7235e+10 1.9300e+12 56717
## - BsmtFin.SF       1 9.0582e+10 1.9534e+12 56751
## - Overall.Qual     1 1.1180e+11 1.9746e+12 56781
## - Bldg.Type        4 1.4006e+11 2.0029e+12 56814
## - Gr.Liv.Area      1 1.6498e+11 2.0278e+12 56855
## - Neighborhood    26 3.5183e+11 2.2146e+12 57050
```

```
length(backward_model$coefficients)
```

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

```
both = step(model, direction = 'both')
```

```
## Start: AIC=56643
## SalePrice ~ MS.Zoning + Lot.Area + Lot.Shape + Land.Contour +
## Neighborhood + Condition.1 + Bldg.Type + House.Style + Overall.Qual +
## Overall.Cond + Year.Built + Year.Remod.Add + Roof.Style +
## Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation +
## Bsmt.Qual + Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
## Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
## Paved.Drive + Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch +
## X3Ssn.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
## Sale.Condition + Yr.Sold + Bath
```

```
##
##          Df Sum of Sq      RSS   AIC
## - Yr.Sold      4 2.4873e+09 1.8599e+12 56639
## - MS.Zoning      2 9.8095e+08 1.8584e+12 56640
## - Paved.Drive      1 1.1985e+07 1.8575e+12 56641
## - X3Ssn.Porch      1 2.6008e+07 1.8575e+12 56641
## - Bsmt.Cond      1 3.6363e+07 1.8575e+12 56641
## - Year.Remod.Add      1 6.1302e+07 1.8575e+12 56641
## - Fence      1 6.6678e+07 1.8575e+12 56641
## - Exter.Cond      1 1.3226e+08 1.8576e+12 56641
## - Fireplace.Qu      1 1.7648e+08 1.8576e+12 56641
## - Enclosed.Porch      1 2.9594e+08 1.8577e+12 56641
## <none>                                1.8574e+12 56643
## - Lot.Shape      1 1.3603e+09 1.8588e+12 56643
## - TotRms.AbvGrd      1 1.4354e+09 1.8589e+12 56643
## - X1st.Flr.SF      1 1.8471e+09 1.8593e+12 56644
## - Wood.Deck.SF      1 2.0660e+09 1.8595e+12 56644
## - Heating.QC      1 2.2010e+09 1.8596e+12 56644
## - Open.Porch.SF      1 3.1345e+09 1.8606e+12 56646
## - Sale.Type      3 6.1291e+09 1.8636e+12 56646
## - Garage.Area      1 3.5249e+09 1.8610e+12 56646
## - Garage.Finish      1 3.7443e+09 1.8612e+12 56647
## - Central.Air      1 3.8014e+09 1.8612e+12 56647
## - Garage.Cars      1 5.1932e+09 1.8626e+12 56649
## - Foundation      3 8.5447e+09 1.8660e+12 56650
## - Roof.Style      3 9.4320e+09 1.8669e+12 56651
## - Condition.1      3 9.7473e+09 1.8672e+12 56652
## - Bedroom.AbvGr      1 7.1991e+09 1.8646e+12 56652
## - House.Style      2 8.6174e+09 1.8661e+12 56652
## - Pool.Area      1 7.3169e+09 1.8648e+12 56652
## - Fireplaces      1 8.0824e+09 1.8655e+12 56653
## - Garage.Type      3 1.1111e+10 1.8686e+12 56654
## - Bsmt.Qual      1 9.5061e+09 1.8670e+12 56655
## - Bath      1 1.0244e+10 1.8677e+12 56656
## - Sale.Condition      3 1.5345e+10 1.8728e+12 56660
## - Total.Bsmt.SF      1 1.2968e+10 1.8704e+12 56660
## - Lot.Area      1 1.4434e+10 1.8719e+12 56663
## - Mas.Vnr.Type      2 1.5798e+10 1.8732e+12 56663
## - Year.Built      1 1.4861e+10 1.8723e+12 56663
## - Screen.Porch      1 1.7292e+10 1.8747e+12 56667
## - Exter.Qual      1 1.8614e+10 1.8761e+12 56669
```

```

## - Kitchen.Qual      1 2.2143e+10 1.8796e+12 56674
## - Mas.Vnr.Area      1 2.7918e+10 1.8854e+12 56682
## - Land.Contour      3 3.5888e+10 1.8933e+12 56690
## - Overall.Cond      1 5.6622e+10 1.9141e+12 56724
## - BsmtFin.SF        1 8.9223e+10 1.9467e+12 56771
## - Overall.Qual      1 1.0952e+11 1.9670e+12 56800
## - Bldg.Type         4 1.2661e+11 1.9841e+12 56818
## - Gr.Liv.Area       1 1.6475e+11 2.0222e+12 56877
## - Neighborhood     26 3.4788e+11 2.2053e+12 57068
##
## Step:  AIC=56638.72
## SalePrice ~ MS.Zoning + Lot.Area + Lot.Shape + Land.Contour +
##   Neighborhood + Condition.1 + Bldg.Type + House.Style + Overall.Qual +
##   Overall.Cond + Year.Built + Year.Remod.Add + Roof.Style +
##   Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation +
##   Bsmt.Qual + Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
##   Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
##   Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
##   Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
##   Paved.Drive + Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch +
##   X3Ssn.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
##   Sale.Condition + Bath
##
##              Df  Sum of Sq      RSS   AIC
## - MS.Zoning      2 8.3971e+08 1.8608e+12 56636
## - Paved.Drive     1 1.1921e+07 1.8599e+12 56637
## - X3Ssn.Porch     1 3.2096e+07 1.8600e+12 56637
## - Bsmt.Cond       1 3.6644e+07 1.8600e+12 56637
## - Fence           1 5.5417e+07 1.8600e+12 56637
## - Year.Remod.Add  1 6.6667e+07 1.8600e+12 56637
## - Exter.Cond      1 1.0978e+08 1.8600e+12 56637
## - Fireplace.Qu    1 1.8369e+08 1.8601e+12 56637
## - Enclosed.Porch  1 2.9785e+08 1.8602e+12 56637
## - TotRms.AbvGrd   1 1.3175e+09 1.8612e+12 56639
## <none>                                1.8599e+12 56639
## - Lot.Shape       1 1.3423e+09 1.8613e+12 56639
## - X1st.Flr.SF     1 1.8353e+09 1.8618e+12 56639
## - Wood.Deck.SF    1 2.1352e+09 1.8621e+12 56640
## - Heating.QC      1 2.2323e+09 1.8622e+12 56640
## - Open.Porch.SF   1 3.1022e+09 1.8630e+12 56641
## - Garage.Area     1 3.4201e+09 1.8634e+12 56642
## - Sale.Type       3 6.2418e+09 1.8662e+12 56642
## - Garage.Finish   1 3.6747e+09 1.8636e+12 56642
## - Central.Air     1 3.9065e+09 1.8638e+12 56643
## + Yr.Sold         4 2.4873e+09 1.8574e+12 56643
## - Garage.Cars     1 5.3198e+09 1.8653e+12 56645
## - Foundation      3 8.2465e+09 1.8682e+12 56645
## - Roof.Style      3 9.1551e+09 1.8691e+12 56646
## - House.Style     2 8.2746e+09 1.8682e+12 56647
## - Bedroom.AbvGr   1 7.0509e+09 1.8670e+12 56647
## - Condition.1     3 9.8883e+09 1.8698e+12 56647
## - Pool.Area       1 7.5928e+09 1.8675e+12 56648
## - Fireplaces      1 7.9870e+09 1.8679e+12 56649
## - Garage.Type     3 1.1240e+10 1.8712e+12 56649

```

```

## - Bsmt.Qual      1 9.3357e+09 1.8693e+12 56651
## - Bath           1 1.0177e+10 1.8701e+12 56652
## - Sale.Condition 3 1.4859e+10 1.8748e+12 56655
## - Total.Bsmt.SF  1 1.3032e+10 1.8730e+12 56656
## - Mas.Vnr.Type   2 1.5564e+10 1.8755e+12 56658
## - Lot.Area       1 1.5308e+10 1.8752e+12 56659
## - Year.Built     1 1.5532e+10 1.8755e+12 56660
## - Screen.Porch   1 1.7358e+10 1.8773e+12 56663
## - Exter.Qual     1 1.8324e+10 1.8783e+12 56664
## - Kitchen.Qual   1 2.1874e+10 1.8818e+12 56669
## - Mas.Vnr.Area   1 2.8203e+10 1.8881e+12 56679
## - Land.Contour   3 3.6298e+10 1.8962e+12 56686
## - Overall.Cond   1 5.7312e+10 1.9172e+12 56721
## - BsmtFin.SF     1 9.0021e+10 1.9500e+12 56768
## - Overall.Qual   1 1.1140e+11 1.9713e+12 56798
## - Bldg.Type      4 1.2494e+11 1.9849e+12 56811
## - Gr.Liv.Area    1 1.6334e+11 2.0233e+12 56871
## - Neighborhood   26 3.4807e+11 2.2080e+12 57063
##
## Step:  AIC=56635.98
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
##      Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
##      Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
##      Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
##      Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
##      X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
##      TotRms.AbvGrd + Fireplaces + Fireplace.Qu + Garage.Type +
##      Garage.Finish + Garage.Cars + Garage.Area + Paved.Drive +
##      Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch + X3Ssn.Porch +
##      Screen.Porch + Pool.Area + Fence + Sale.Type + Sale.Condition +
##      Bath
##
##              Df  Sum of Sq      RSS    AIC
## - Paved.Drive   1 7.0633e+06 1.8608e+12 56634
## - Bsmt.Cond     1 2.5234e+07 1.8608e+12 56634
## - X3Ssn.Porch   1 3.1156e+07 1.8608e+12 56634
## - Fence         1 6.1154e+07 1.8608e+12 56634
## - Year.Remod.Add 1 6.8319e+07 1.8608e+12 56634
## - Exter.Cond    1 1.0199e+08 1.8609e+12 56634
## - Fireplace.Qu  1 1.9707e+08 1.8610e+12 56634
## - Enclosed.Porch 1 2.8073e+08 1.8611e+12 56634
## - Lot.Shape     1 1.2207e+09 1.8620e+12 56636
## <none>                                1.8608e+12 56636
## - TotRms.AbvGrd 1 1.3806e+09 1.8622e+12 56636
## - X1st.Flr.SF   1 1.9761e+09 1.8627e+12 56637
## - Wood.Deck.SF  1 2.2256e+09 1.8630e+12 56637
## - Heating.QC    1 2.2345e+09 1.8630e+12 56637
## - Open.Porch.SF 1 3.0206e+09 1.8638e+12 56638
## + MS.Zoning     2 8.3971e+08 1.8599e+12 56639
## - Sale.Type     3 6.3140e+09 1.8671e+12 56639
## - Garage.Finish 1 3.6521e+09 1.8644e+12 56639
## - Garage.Area   1 3.7891e+09 1.8646e+12 56640
## - Central.Air   1 3.8911e+09 1.8647e+12 56640
## + Yr.Sold       4 2.3461e+09 1.8584e+12 56640

```

```

## - Garage.Cars      1 4.9354e+09 1.8657e+12 56641
## - Foundation       3 8.1066e+09 1.8689e+12 56642
## - Roof.Style       3 9.0446e+09 1.8698e+12 56643
## - Bedroom.AbvGr   1 7.0404e+09 1.8678e+12 56644
## - House.Style      2 8.4337e+09 1.8692e+12 56645
## - Pool.Area        1 7.5481e+09 1.8683e+12 56645
## - Condition.1      3 1.0289e+10 1.8711e+12 56645
## - Fireplaces       1 8.2047e+09 1.8690e+12 56646
## - Garage.Type      3 1.1362e+10 1.8721e+12 56647
## - Bsmt.Qual        1 9.0486e+09 1.8698e+12 56647
## - Bath             1 1.0486e+10 1.8713e+12 56650
## - Sale.Condition   3 1.4975e+10 1.8757e+12 56652
## - Total.Bsmt.SF    1 1.3229e+10 1.8740e+12 56654
## - Mas.Vnr.Type     2 1.5761e+10 1.8765e+12 56655
## - Year.Built       1 1.5071e+10 1.8758e+12 56656
## - Lot.Area         1 1.5480e+10 1.8763e+12 56657
## - Screen.Porch     1 1.7414e+10 1.8782e+12 56660
## - Exter.Qual       1 1.8378e+10 1.8791e+12 56661
## - Kitchen.Qual     1 2.2403e+10 1.8832e+12 56667
## - Mas.Vnr.Area     1 2.8478e+10 1.8892e+12 56676
## - Land.Contour     3 3.5827e+10 1.8966e+12 56683
## - Overall.Cond     1 5.7026e+10 1.9178e+12 56718
## - BsmtFin.SF       1 8.9776e+10 1.9505e+12 56765
## - Overall.Qual     1 1.1068e+11 1.9715e+12 56794
## - Bldg.Type        4 1.3954e+11 2.0003e+12 56829
## - Gr.Liv.Area      1 1.6445e+11 2.0252e+12 56869
## - Neighborhood    26 3.5144e+11 2.2122e+12 57065
##
## Step:  AIC=56633.99
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
## X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
## TotRms.AbvGrd + Fireplaces + Fireplace.Qu + Garage.Type +
## Garage.Finish + Garage.Cars + Garage.Area + Wood.Deck.SF +
## Open.Porch.SF + Enclosed.Porch + X3Ssn.Porch + Screen.Porch +
## Pool.Area + Fence + Sale.Type + Sale.Condition + Bath
##
##           Df Sum of Sq      RSS   AIC
## - Bsmt.Cond      1 2.4606e+07 1.8608e+12 56632
## - X3Ssn.Porch    1 3.1495e+07 1.8608e+12 56632
## - Fence          1 6.2392e+07 1.8608e+12 56632
## - Year.Remod.Add  1 6.8398e+07 1.8608e+12 56632
## - Exter.Cond     1 1.0468e+08 1.8609e+12 56632
## - Fireplace.Qu   1 1.9745e+08 1.8610e+12 56632
## - Enclosed.Porch 1 2.8019e+08 1.8611e+12 56632
## - Lot.Shape      1 1.2188e+09 1.8620e+12 56634
## <none>                                1.8608e+12 56634
## - TotRms.AbvGrd  1 1.3859e+09 1.8622e+12 56634
## - X1st.Flr.SF    1 1.9744e+09 1.8628e+12 56635
## - Wood.Deck.SF   1 2.2224e+09 1.8630e+12 56635
## - Heating.QC     1 2.2397e+09 1.8630e+12 56635

```

```
## + Paved.Drive      1 7.0633e+06 1.8608e+12 56636
## - Open.Porch.SF    1 3.0184e+09 1.8638e+12 56636
## + MS.Zoning         2 8.3485e+08 1.8599e+12 56637
## - Sale.Type        3 6.3072e+09 1.8671e+12 56637
## - Garage.Finish    1 3.6451e+09 1.8644e+12 56637
## - Garage.Area      1 3.8108e+09 1.8646e+12 56638
## - Central.Air      1 3.8989e+09 1.8647e+12 56638
## + Yr.Sold           4 2.3463e+09 1.8584e+12 56638
## - Garage.Cars      1 4.9290e+09 1.8657e+12 56639
## - Foundation       3 8.1023e+09 1.8689e+12 56640
## - Roof.Style       3 9.0477e+09 1.8698e+12 56641
## - Bedroom.AbvGr    1 7.0348e+09 1.8678e+12 56642
## - House.Style      2 8.4292e+09 1.8692e+12 56643
## - Pool.Area        1 7.5411e+09 1.8683e+12 56643
## - Condition.1      3 1.0336e+10 1.8711e+12 56643
## - Fireplaces       1 8.2153e+09 1.8690e+12 56644
## - Garage.Type      3 1.1674e+10 1.8725e+12 56645
## - Bsmt.Qual        1 9.0597e+09 1.8698e+12 56645
## - Bath             1 1.0488e+10 1.8713e+12 56648
## - Sale.Condition   3 1.4992e+10 1.8758e+12 56650
## - Total.Bsmt.SF    1 1.3245e+10 1.8740e+12 56652
## - Mas.Vnr.Type     2 1.5759e+10 1.8765e+12 56653
## - Lot.Area         1 1.5599e+10 1.8764e+12 56655
## - Year.Built       1 1.5768e+10 1.8765e+12 56655
## - Screen.Porch     1 1.7414e+10 1.8782e+12 56658
## - Exter.Qual       1 1.8375e+10 1.8792e+12 56659
## - Kitchen.Qual     1 2.2403e+10 1.8832e+12 56665
## - Mas.Vnr.Area     1 2.8474e+10 1.8893e+12 56674
## - Land.Contour     3 3.5821e+10 1.8966e+12 56681
## - Overall.Cond     1 5.7150e+10 1.9179e+12 56716
## - BsmtFin.SF       1 8.9988e+10 1.9508e+12 56763
## - Overall.Qual     1 1.1087e+11 1.9716e+12 56793
## - Bldg.Type        4 1.3954e+11 2.0003e+12 56827
## - Gr.Liv.Area      1 1.6466e+11 2.0254e+12 56868
## - Neighborhood    26 3.5151e+11 2.2123e+12 57063
##
```

```
## Step: AIC=56632.02
```

```
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air + X1st.Flr.SF +
## Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual + TotRms.AbvGrd +
## Fireplaces + Fireplace.Qu + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Enclosed.Porch + X3Ssn.Porch + Screen.Porch + Pool.Area +
## Fence + Sale.Type + Sale.Condition + Bath
##
```

```
##           Df Sum of Sq      RSS   AIC
## - X3Ssn.Porch  1 3.2553e+07 1.8608e+12 56630
## - Fence        1 6.2629e+07 1.8609e+12 56630
## - Year.Remod.Add 1 6.4516e+07 1.8609e+12 56630
## - Exter.Cond   1 1.0062e+08 1.8609e+12 56630
## - Fireplace.Qu 1 1.9734e+08 1.8610e+12 56630
```

```

## - Enclosed.Porch 1 2.7926e+08 1.8611e+12 56630
## - Lot.Shape 1 1.2178e+09 1.8620e+12 56632
## <none> 1.8608e+12 56632
## - TotRms.AbvGrd 1 1.3938e+09 1.8622e+12 56632
## - X1st.Flr.SF 1 1.9639e+09 1.8628e+12 56633
## - Wood.Deck.SF 1 2.2205e+09 1.8630e+12 56633
## - Heating.QC 1 2.2345e+09 1.8630e+12 56633
## + Bsmt.Cond 1 2.4606e+07 1.8608e+12 56634
## + Paved.Drive 1 6.4350e+06 1.8608e+12 56634
## - Open.Porch.SF 1 3.0229e+09 1.8638e+12 56635
## + MS.Zoning 2 8.2385e+08 1.8600e+12 56635
## - Sale.Type 3 6.2909e+09 1.8671e+12 56635
## - Garage.Finish 1 3.6657e+09 1.8645e+12 56635
## - Garage.Area 1 3.8115e+09 1.8646e+12 56636
## - Central.Air 1 3.9447e+09 1.8647e+12 56636
## + Yr.Sold 4 2.3476e+09 1.8585e+12 56637
## - Garage.Cars 1 4.9326e+09 1.8657e+12 56637
## - Foundation 3 8.2228e+09 1.8690e+12 56638
## - Roof.Style 3 9.1036e+09 1.8699e+12 56640
## - Bedroom.AbvGr 1 7.0446e+09 1.8678e+12 56641
## - House.Style 2 8.4208e+09 1.8692e+12 56641
## - Pool.Area 1 7.5480e+09 1.8684e+12 56641
## - Condition.1 3 1.0322e+10 1.8711e+12 56641
## - Fireplaces 1 8.2019e+09 1.8690e+12 56642
## - Garage.Type 3 1.1668e+10 1.8725e+12 56643
## - Bsmt.Qual 1 9.1069e+09 1.8699e+12 56644
## - Bath 1 1.0463e+10 1.8713e+12 56646
## - Sale.Condition 3 1.4982e+10 1.8758e+12 56648
## - Total.Bsmt.SF 1 1.3223e+10 1.8740e+12 56650
## - Mas.Vnr.Type 2 1.5787e+10 1.8766e+12 56651
## - Lot.Area 1 1.5584e+10 1.8764e+12 56653
## - Year.Built 1 1.5753e+10 1.8766e+12 56653
## - Screen.Porch 1 1.7482e+10 1.8783e+12 56656
## - Exter.Qual 1 1.8380e+10 1.8792e+12 56657
## - Kitchen.Qual 1 2.2441e+10 1.8832e+12 56663
## - Mas.Vnr.Area 1 2.8490e+10 1.8893e+12 56672
## - Land.Contour 3 3.5866e+10 1.8967e+12 56679
## - Overall.Cond 1 5.7871e+10 1.9187e+12 56715
## - BsmtFin.SF 1 9.0141e+10 1.9509e+12 56761
## - Overall.Qual 1 1.1086e+11 1.9717e+12 56791
## - Bldg.Type 4 1.3955e+11 2.0004e+12 56825
## - Gr.Liv.Area 1 1.6491e+11 2.0257e+12 56866
## - Neighborhood 26 3.5178e+11 2.2126e+12 57061
##
## Step: AIC=56630.07
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air + X1st.Flr.SF +
## Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual + TotRms.AbvGrd +
## Fireplaces + Fireplace.Qu + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Enclosed.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +

```

```

##      Sale.Condition + Bath
##
##      Df  Sum of Sq      RSS    AIC
## - Fence      1 6.0777e+07 1.8609e+12 56628
## - Year.Remod.Add 1 6.5085e+07 1.8609e+12 56628
## - Exter.Cond   1 9.9922e+07 1.8609e+12 56628
## - Fireplace.Qu 1 2.0058e+08 1.8610e+12 56628
## - Enclosed.Porch 1 2.8660e+08 1.8611e+12 56628
## - Lot.Shape    1 1.2181e+09 1.8621e+12 56630
## <none>                                1.8608e+12 56630
## - TotRms.AbvGrd 1 1.3827e+09 1.8622e+12 56630
## - X1st.Flr.SF   1 1.9645e+09 1.8628e+12 56631
## - Heating.QC    1 2.2200e+09 1.8631e+12 56631
## - Wood.Deck.SF  1 2.2415e+09 1.8631e+12 56631
## + X3Ssn.Porch   1 3.2553e+07 1.8608e+12 56632
## + Bsmt.Cond     1 2.5665e+07 1.8608e+12 56632
## + Paved.Drive   1 6.7511e+06 1.8608e+12 56632
## - Open.Porch.SF 1 3.0097e+09 1.8638e+12 56633
## + MS.Zoning     2 8.2254e+08 1.8600e+12 56633
## - Sale.Type     3 6.2886e+09 1.8671e+12 56633
## - Garage.Finish 1 3.6742e+09 1.8645e+12 56634
## - Garage.Area   1 3.7960e+09 1.8646e+12 56634
## - Central.Air   1 3.9441e+09 1.8648e+12 56634
## + Yr.Sold       4 2.3537e+09 1.8585e+12 56635
## - Garage.Cars   1 4.9350e+09 1.8658e+12 56635
## - Foundation    3 8.1975e+09 1.8690e+12 56636
## - Roof.Style    3 9.0938e+09 1.8699e+12 56638
## - Bedroom.AbvGr 1 7.0252e+09 1.8679e+12 56639
## - House.Style   2 8.4292e+09 1.8693e+12 56639
## - Pool.Area     1 7.5543e+09 1.8684e+12 56639
## - Condition.1   3 1.0329e+10 1.8712e+12 56639
## - Fireplaces    1 8.2277e+09 1.8691e+12 56640
## - Garage.Type   3 1.1664e+10 1.8725e+12 56641
## - Bsmt.Qual     1 9.0986e+09 1.8699e+12 56642
## - Bath         1 1.0445e+10 1.8713e+12 56644
## - Sale.Condition 3 1.4983e+10 1.8758e+12 56646
## - Total.Bsmt.SF 1 1.3206e+10 1.8740e+12 56648
## - Mas.Vnr.Type  2 1.5845e+10 1.8767e+12 56650
## - Lot.Area      1 1.5587e+10 1.8764e+12 56651
## - Year.Built    1 1.5757e+10 1.8766e+12 56651
## - Screen.Porch  1 1.7630e+10 1.8785e+12 56654
## - Exter.Qual    1 1.8349e+10 1.8792e+12 56655
## - Kitchen.Qual  1 2.2439e+10 1.8833e+12 56661
## - Mas.Vnr.Area  1 2.8509e+10 1.8893e+12 56670
## - Land.Contour  3 3.5836e+10 1.8967e+12 56677
## - Overall.Cond  1 5.7839e+10 1.9187e+12 56713
## - BsmtFin.SF    1 9.0109e+10 1.9509e+12 56759
## - Overall.Qual  1 1.1099e+11 1.9718e+12 56789
## - Bldg.Type     4 1.3954e+11 2.0004e+12 56823
## - Gr.Liv.Area   1 1.6488e+11 2.0257e+12 56864
## - Neighborhood  26 3.5262e+11 2.2135e+12 57060
##
## Step:  AIC=56628.16
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +

```



```
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Year.Remod.Add + Roof.Style + Mas.Vnr.Type +
## Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation + Bsmt.Qual +
## BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air + X1st.Flr.SF +
## Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual + TotRms.AbvGrd +
## Fireplaces + Fireplace.Qu + Garage.Type + Garage.Finish +
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
## Enclosed.Porch + Screen.Porch + Pool.Area + Sale.Type + Sale.Condition +
## Bath
```

```
##
## Df Sum of Sq RSS AIC
## - Year.Remod.Add 1 6.5434e+07 1.8610e+12 56626
## - Exter.Cond 1 1.0213e+08 1.8610e+12 56626
## - Fireplace.Qu 1 2.0177e+08 1.8611e+12 56626
## - Enclosed.Porch 1 2.8860e+08 1.8612e+12 56627
## - Lot.Shape 1 1.2141e+09 1.8621e+12 56628
## <none> 1.8609e+12 56628
## - TotRms.AbvGrd 1 1.3798e+09 1.8623e+12 56628
## - X1st.Flr.SF 1 1.9596e+09 1.8629e+12 56629
## - Heating.QC 1 2.2025e+09 1.8631e+12 56629
## - Wood.Deck.SF 1 2.3253e+09 1.8632e+12 56630
## + Fence 1 6.0777e+07 1.8608e+12 56630
## + X3Ssn.Porch 1 3.0701e+07 1.8609e+12 56630
## + Bsmt.Cond 1 2.5872e+07 1.8609e+12 56630
## + Paved.Drive 1 7.9329e+06 1.8609e+12 56630
## - Open.Porch.SF 1 2.9978e+09 1.8639e+12 56631
## + MS.Zoning 2 8.2783e+08 1.8601e+12 56631
## - Sale.Type 3 6.2644e+09 1.8672e+12 56631
## - Garage.Finish 1 3.6811e+09 1.8646e+12 56632
## - Garage.Area 1 3.8029e+09 1.8647e+12 56632
## - Central.Air 1 3.9258e+09 1.8648e+12 56632
## + Yr.Sold 4 2.3410e+09 1.8586e+12 56633
## - Garage.Cars 1 4.9113e+09 1.8658e+12 56633
## - Foundation 3 8.1930e+09 1.8691e+12 56634
## - Roof.Style 3 9.1332e+09 1.8700e+12 56636
## - Bedroom.AbvGr 1 7.0104e+09 1.8679e+12 56637
## - House.Style 2 8.4237e+09 1.8693e+12 56637
## - Condition.1 3 1.0294e+10 1.8712e+12 56637
## - Pool.Area 1 7.8608e+09 1.8688e+12 56638
## - Fireplaces 1 8.2429e+09 1.8691e+12 56638
## - Garage.Type 3 1.1624e+10 1.8725e+12 56639
## - Bsmt.Qual 1 9.0868e+09 1.8700e+12 56640
## - Bath 1 1.0459e+10 1.8714e+12 56642
## - Sale.Condition 3 1.4941e+10 1.8758e+12 56644
## - Total.Bsmt.SF 1 1.3200e+10 1.8741e+12 56646
## - Mas.Vnr.Type 2 1.5821e+10 1.8767e+12 56648
## - Lot.Area 1 1.5526e+10 1.8764e+12 56649
## - Year.Built 1 1.5704e+10 1.8766e+12 56650
## - Screen.Porch 1 1.7676e+10 1.8786e+12 56652
## - Exter.Qual 1 1.8293e+10 1.8792e+12 56653
## - Kitchen.Qual 1 2.2512e+10 1.8834e+12 56660
## - Mas.Vnr.Area 1 2.8528e+10 1.8894e+12 56668
## - Land.Contour 3 3.5776e+10 1.8967e+12 56675
## - Overall.Cond 1 5.8075e+10 1.9190e+12 56712
```

```

## - BsmtFin.SF      1 9.0208e+10 1.9511e+12 56758
## - Overall.Qual    1 1.1114e+11 1.9720e+12 56787
## - Bldg.Type       4 1.4064e+11 2.0015e+12 56823
## - Gr.Liv.Area     1 1.6482e+11 2.0257e+12 56862
## - Neighborhood   26 3.5261e+11 2.2135e+12 57058
##
## Step:  AIC=56626.26
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Exter.Cond + Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF +
## Heating.QC + Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
## Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
## Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch + Screen.Porch +
## Pool.Area + Sale.Type + Sale.Condition + Bath
##
##           Df  Sum of Sq      RSS    AIC
## - Exter.Cond      1 9.8749e+07 1.8611e+12 56624
## - Fireplace.Qu     1 2.1015e+08 1.8612e+12 56625
## - Enclosed.Porch   1 2.9433e+08 1.8613e+12 56625
## - Lot.Shape        1 1.2109e+09 1.8622e+12 56626
## <none>                                1.8610e+12 56626
## - TotRms.AbvGrd    1 1.3998e+09 1.8624e+12 56626
## - X1st.Flr.SF      1 2.0172e+09 1.8630e+12 56627
## - Heating.QC       1 2.1679e+09 1.8631e+12 56627
## - Wood.Deck.SF     1 2.3156e+09 1.8633e+12 56628
## + Year.Remod.Add   1 6.5434e+07 1.8609e+12 56628
## + Fence            1 6.1126e+07 1.8609e+12 56628
## + X3Ssn.Porch      1 3.1250e+07 1.8609e+12 56628
## + Bsmt.Cond        1 2.1869e+07 1.8609e+12 56628
## + Paved.Drive      1 8.0771e+06 1.8610e+12 56628
## - Open.Porch.SF    1 2.9951e+09 1.8640e+12 56629
## + MS.Zoning        2 8.3021e+08 1.8601e+12 56629
## - Sale.Type        3 6.2447e+09 1.8672e+12 56630
## - Garage.Finish    1 3.6557e+09 1.8646e+12 56630
## - Garage.Area      1 3.8293e+09 1.8648e+12 56630
## - Central.Air      1 3.8784e+09 1.8648e+12 56630
## + Yr.Sold          4 2.3458e+09 1.8586e+12 56631
## - Garage.Cars      1 4.9202e+09 1.8659e+12 56632
## - Foundation       3 8.1501e+09 1.8691e+12 56632
## - Roof.Style       3 9.1461e+09 1.8701e+12 56634
## - Bedroom.AbvGr    1 6.9524e+09 1.8679e+12 56635
## - House.Style      2 8.5148e+09 1.8695e+12 56635
## - Condition.1      3 1.0347e+10 1.8713e+12 56636
## - Pool.Area        1 7.9164e+09 1.8689e+12 56636
## - Fireplaces       1 8.2296e+09 1.8692e+12 56637
## - Garage.Type      3 1.1584e+10 1.8725e+12 56637
## - Bsmt.Qual        1 9.0240e+09 1.8700e+12 56638
## - Bath             1 1.0394e+10 1.8714e+12 56640
## - Sale.Condition   3 1.4963e+10 1.8759e+12 56643
## - Total.Bsmt.SF    1 1.3271e+10 1.8742e+12 56644
## - Mas.Vnr.Type     2 1.5798e+10 1.8768e+12 56646
## - Lot.Area         1 1.5501e+10 1.8765e+12 56647

```

```

## - Year.Built      1 1.6578e+10 1.8775e+12 56649
## - Screen.Porch   1 1.7662e+10 1.8786e+12 56651
## - Exter.Qual      1 1.8298e+10 1.8793e+12 56651
## - Kitchen.Qual    1 2.2447e+10 1.8834e+12 56658
## - Mas.Vnr.Area    1 2.8544e+10 1.8895e+12 56667
## - Land.Contour    3 3.5724e+10 1.8967e+12 56673
## - Overall.Cond    1 5.8773e+10 1.9197e+12 56711
## - BsmtFin.SF      1 9.0386e+10 1.9513e+12 56756
## - Overall.Qual    1 1.1163e+11 1.9726e+12 56786
## - Bldg.Type       4 1.4057e+11 2.0015e+12 56821
## - Gr.Liv.Area     1 1.6503e+11 2.0260e+12 56860
## - Neighborhood   26 3.5256e+11 2.2135e+12 57056
##
## Step:  AIC=56624.41
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
##      Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
##      Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
##      Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
##      Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
##      Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
##      Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
##      Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch + Screen.Porch +
##      Pool.Area + Sale.Type + Sale.Condition + Bath
##
##      Df  Sum of Sq      RSS    AIC
## - Fireplace.Qu    1 2.0862e+08 1.8613e+12 56623
## - Enclosed.Porch  1 3.0345e+08 1.8614e+12 56623
## - Lot.Shape       1 1.2123e+09 1.8623e+12 56624
## <none>                                1.8611e+12 56624
## - TotRms.AbvGrd   1 1.4087e+09 1.8625e+12 56625
## - X1st.Flr.SF     1 2.0294e+09 1.8631e+12 56625
## - Heating.QC      1 2.2501e+09 1.8633e+12 56626
## - Wood.Deck.SF    1 2.3229e+09 1.8634e+12 56626
## + Exter.Cond      1 9.8749e+07 1.8610e+12 56626
## + Fence           1 6.3295e+07 1.8610e+12 56626
## + Year.Remod.Add  1 6.2052e+07 1.8610e+12 56626
## + X3Ssn.Porch     1 3.0521e+07 1.8610e+12 56626
## + Bsmt.Cond       1 1.8178e+07 1.8610e+12 56626
## + Paved.Drive     1 1.0934e+07 1.8610e+12 56626
## - Open.Porch.SF   1 2.9839e+09 1.8640e+12 56627
## + MS.Zoning       2 8.2278e+08 1.8602e+12 56627
## - Sale.Type       3 6.1925e+09 1.8673e+12 56628
## - Garage.Finish   1 3.6601e+09 1.8647e+12 56628
## - Garage.Area     1 3.8756e+09 1.8649e+12 56628
## - Central.Air     1 3.8780e+09 1.8649e+12 56628
## + Yr.Sold         4 2.3254e+09 1.8587e+12 56629
## - Garage.Cars     1 4.8666e+09 1.8659e+12 56630
## - Foundation      3 8.0802e+09 1.8691e+12 56630
## - Roof.Style      3 9.0902e+09 1.8702e+12 56632
## - Bedroom.AbvGr  1 6.9151e+09 1.8680e+12 56633
## - House.Style     2 8.5816e+09 1.8696e+12 56633
## - Condition.1     3 1.0327e+10 1.8714e+12 56634
## - Pool.Area       1 7.8865e+09 1.8689e+12 56634
## - Fireplaces      1 8.2226e+09 1.8693e+12 56635

```

```

## - Garage.Type      3 1.1535e+10 1.8726e+12 56636
## - Bsmt.Qual        1 9.0089e+09 1.8701e+12 56636
## - Bath             1 1.0542e+10 1.8716e+12 56638
## - Sale.Condition   3 1.4916e+10 1.8760e+12 56641
## - Total.Bsmt.SF    1 1.3199e+10 1.8743e+12 56642
## - Mas.Vnr.Type     2 1.5832e+10 1.8769e+12 56644
## - Lot.Area         1 1.5627e+10 1.8767e+12 56646
## - Year.Built       1 1.6643e+10 1.8777e+12 56647
## - Screen.Porch     1 1.7712e+10 1.8788e+12 56649
## - Exter.Qual       1 1.8634e+10 1.8797e+12 56650
## - Kitchen.Qual     1 2.2442e+10 1.8835e+12 56656
## - Mas.Vnr.Area     1 2.8714e+10 1.8898e+12 56665
## - Land.Contour     3 3.5647e+10 1.8967e+12 56671
## - Overall.Cond     1 6.7630e+10 1.9287e+12 56722
## - BsmtFin.SF       1 9.0493e+10 1.9516e+12 56754
## - Overall.Qual     1 1.1154e+11 1.9726e+12 56784
## - Bldg.Type        4 1.4062e+11 2.0017e+12 56819
## - Gr.Liv.Area      1 1.6523e+11 2.0263e+12 56859
## - Neighborhood    26 3.5247e+11 2.2135e+12 57054
##
## Step:  AIC=56622.72
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Garage.Type +
## Garage.Finish + Garage.Cars + Garage.Area + Wood.Deck.SF +
## Open.Porch.SF + Enclosed.Porch + Screen.Porch + Pool.Area +
## Sale.Type + Sale.Condition + Bath
##
##              Df  Sum of Sq      RSS   AIC
## - Enclosed.Porch  1 3.1391e+08 1.8616e+12 56621
## - Lot.Shape       1 1.2153e+09 1.8625e+12 56623
## <none>                                1.8613e+12 56623
## - TotRms.AbvGrd   1 1.4690e+09 1.8627e+12 56623
## - X1st.Flr.SF     1 2.0291e+09 1.8633e+12 56624
## - Heating.QC      1 2.2766e+09 1.8635e+12 56624
## - Wood.Deck.SF    1 2.2920e+09 1.8636e+12 56624
## + Fireplace.Qu    1 2.0862e+08 1.8611e+12 56624
## + Exter.Cond      1 9.7218e+07 1.8612e+12 56625
## + Year.Remod.Add  1 7.0208e+07 1.8612e+12 56625
## + Fence           1 6.4534e+07 1.8612e+12 56625
## + X3Ssn.Porch     1 3.3750e+07 1.8612e+12 56625
## + Bsmt.Cond       1 1.7948e+07 1.8613e+12 56625
## + Paved.Drive     1 1.1439e+07 1.8613e+12 56625
## - Open.Porch.SF   1 3.0002e+09 1.8643e+12 56625
## + MS.Zoning       2 8.3613e+08 1.8604e+12 56625
## - Sale.Type       3 6.2039e+09 1.8675e+12 56626
## - Garage.Finish   1 3.5998e+09 1.8649e+12 56626
## - Garage.Area     1 3.8719e+09 1.8651e+12 56626
## - Central.Air     1 3.8950e+09 1.8652e+12 56627
## + Yr.Sold         4 2.3334e+09 1.8589e+12 56627
## - Garage.Cars     1 4.8403e+09 1.8661e+12 56628

```

```
## - Foundation      3 8.0885e+09 1.8694e+12 56629
## - Roof.Style      3 9.0879e+09 1.8704e+12 56630
## - Bedroom.AbvGr   1 6.8304e+09 1.8681e+12 56631
## - House.Style     2 8.5555e+09 1.8698e+12 56631
## - Condition.1     3 1.0441e+10 1.8717e+12 56632
## - Pool.Area       1 8.1873e+09 1.8695e+12 56633
## - Garage.Type     3 1.1505e+10 1.8728e+12 56634
## - Bsmt.Qual       1 9.0381e+09 1.8703e+12 56634
## - Bath            1 1.0683e+10 1.8720e+12 56637
## - Sale.Condition  3 1.4872e+10 1.8761e+12 56639
## - Total.Bsmt.SF   1 1.3241e+10 1.8745e+12 56640
## - Mas.Vnr.Type    2 1.5911e+10 1.8772e+12 56642
## - Lot.Area        1 1.5818e+10 1.8771e+12 56644
## - Year.Built      1 1.6717e+10 1.8780e+12 56646
## - Fireplaces      1 1.7489e+10 1.8788e+12 56647
## - Screen.Porch    1 1.7756e+10 1.8790e+12 56647
## - Exter.Qual      1 1.8541e+10 1.8798e+12 56648
## - Kitchen.Qual    1 2.2269e+10 1.8835e+12 56654
## - Mas.Vnr.Area    1 2.8700e+10 1.8900e+12 56663
## - Land.Contour    3 3.5585e+10 1.8969e+12 56669
## - Overall.Cond    1 6.8014e+10 1.9293e+12 56720
## - BsmtFin.SF      1 9.1178e+10 1.9524e+12 56754
## - Overall.Qual    1 1.1138e+11 1.9726e+12 56782
## - Bldg.Type       4 1.4042e+11 2.0017e+12 56817
## - Gr.Liv.Area     1 1.6504e+11 2.0263e+12 56857
## - Neighborhood    26 3.5311e+11 2.2144e+12 57053
```

```
##
```

```
## Step: AIC=56621.19
```

```
## SalePrice ~ Lot.Area + Lot.Shape + Land.Contour + Neighborhood +
## Condition.1 + Bldg.Type + House.Style + Overall.Qual + Overall.Cond +
## Year.Built + Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
## Foundation + Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
## Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
## Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Garage.Type +
## Garage.Finish + Garage.Cars + Garage.Area + Wood.Deck.SF +
## Open.Porch.SF + Screen.Porch + Pool.Area + Sale.Type + Sale.Condition +
## Bath
```

```
##
```

```
##           Df Sum of Sq      RSS   AIC
## - Lot.Shape      1 1.2112e+09 1.8628e+12 56621
## <none>              1.8616e+12 56621
## - TotRms.AbvGrd  1 1.5045e+09 1.8631e+12 56621
## - X1st.Flr.SF    1 2.1129e+09 1.8637e+12 56622
## - Wood.Deck.SF   1 2.1621e+09 1.8637e+12 56622
## - Heating.QC     1 2.3058e+09 1.8639e+12 56623
## + Enclosed.Porch 1 3.1391e+08 1.8613e+12 56623
## + Fireplace.Qu   1 2.1908e+08 1.8614e+12 56623
## + Exter.Cond     1 1.0639e+08 1.8615e+12 56623
## + Year.Remod.Add 1 7.6388e+07 1.8615e+12 56623
## + Fence          1 6.6837e+07 1.8615e+12 56623
## + X3Ssn.Porch    1 4.1629e+07 1.8615e+12 56623
## + Bsmt.Cond      1 1.6904e+07 1.8616e+12 56623
## + Paved.Drive    1 1.0950e+07 1.8616e+12 56623
## - Open.Porch.SF  1 3.1010e+09 1.8647e+12 56624
```

```

## + MS.Zoning      2 8.1868e+08 1.8608e+12 56624
## - Sale.Type      3 6.1734e+09 1.8678e+12 56624
## - Garage.Finish  1 3.5861e+09 1.8652e+12 56625
## - Central.Air    1 3.9026e+09 1.8655e+12 56625
## - Garage.Area    1 3.9504e+09 1.8655e+12 56625
## + Yr.Sold        4 2.3379e+09 1.8592e+12 56626
## - Garage.Cars    1 4.8173e+09 1.8664e+12 56626
## - Foundation     3 8.2875e+09 1.8699e+12 56628
## - Roof.Style     3 9.0401e+09 1.8706e+12 56629
## - Bedroom.AbvGr  1 6.7931e+09 1.8684e+12 56629
## - House.Style    2 8.5651e+09 1.8701e+12 56630
## - Condition.1    3 1.0358e+10 1.8719e+12 56631
## - Pool.Area      1 8.6430e+09 1.8702e+12 56632
## - Garage.Type    3 1.1431e+10 1.8730e+12 56632
## - Bsmt.Qual      1 8.9808e+09 1.8706e+12 56633
## - Bath           1 1.0717e+10 1.8723e+12 56635
## - Sale.Condition 3 1.4791e+10 1.8764e+12 56637
## - Total.Bsmt.SF  1 1.3655e+10 1.8752e+12 56639
## - Mas.Vnr.Type   2 1.5918e+10 1.8775e+12 56641
## - Lot.Area       1 1.6081e+10 1.8777e+12 56643
## - Year.Built     1 1.6426e+10 1.8780e+12 56644
## - Screen.Porch   1 1.7454e+10 1.8790e+12 56645
## - Fireplaces     1 1.7735e+10 1.8793e+12 56646
## - Exter.Qual     1 1.8432e+10 1.8800e+12 56647
## - Kitchen.Qual   1 2.2401e+10 1.8840e+12 56652
## - Mas.Vnr.Area   1 2.8542e+10 1.8901e+12 56661
## - Land.Contour   3 3.5558e+10 1.8971e+12 56668
## - Overall.Cond   1 6.7701e+10 1.9293e+12 56718
## - BsmtFin.SF     1 9.1055e+10 1.9526e+12 56752
## - Overall.Qual   1 1.1217e+11 1.9737e+12 56782
## - Bldg.Type      4 1.4023e+11 2.0018e+12 56815
## - Gr.Liv.Area    1 1.6544e+11 2.0270e+12 56856
## - Neighborhood   26 3.5303e+11 2.2146e+12 57052

```

```
##
```

```
## Step: AIC=56620.99
```

```
## SalePrice ~ Lot.Area + Land.Contour + Neighborhood + Condition.1 +
```

```
## Bldg.Type + House.Style + Overall.Qual + Overall.Cond + Year.Built +
```

```
## Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Foundation +
```

```
## Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
```

```
## X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
```

```
## TotRms.AbvGrd + Fireplaces + Garage.Type + Garage.Finish +
```

```
## Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
```

```
## Screen.Porch + Pool.Area + Sale.Type + Sale.Condition + Bath
```

```
##
```

```

##          Df Sum of Sq      RSS      AIC
## <none>                1.8628e+12 56621
## + Lot.Shape      1 1.2112e+09 1.8616e+12 56621
## - TotRms.AbvGrd  1 1.4973e+09 1.8643e+12 56621
## - Wood.Deck.SF   1 2.0104e+09 1.8648e+12 56622
## - X1st.Flr.SF    1 2.0487e+09 1.8648e+12 56622
## + Enclosed.Porch 1 3.0986e+08 1.8625e+12 56623
## - Heating.QC     1 2.3753e+09 1.8652e+12 56623
## + Fireplace.Qu   1 2.2206e+08 1.8626e+12 56623
## + Exter.Cond     1 1.0776e+08 1.8627e+12 56623

```

```
## + Year.Remod.Add 1 7.2943e+07 1.8627e+12 56623
## + Fence 1 6.2647e+07 1.8627e+12 56623
## + X3Ssn.Porch 1 4.2014e+07 1.8628e+12 56623
## + Bsmt.Cond 1 1.6101e+07 1.8628e+12 56623
## + Paved.Drive 1 8.5958e+06 1.8628e+12 56623
## - Open.Porch.SF 1 3.1609e+09 1.8660e+12 56624
## + MS.Zoning 2 7.0081e+08 1.8621e+12 56624
## - Garage.Finish 1 3.4505e+09 1.8662e+12 56624
## - Sale.Type 3 6.2293e+09 1.8690e+12 56624
## - Central.Air 1 3.8118e+09 1.8666e+12 56625
## - Garage.Area 1 3.9154e+09 1.8667e+12 56625
## + Yr.Sold 4 2.3317e+09 1.8605e+12 56626
## - Garage.Cars 1 4.8336e+09 1.8676e+12 56626
## - Foundation 3 8.3158e+09 1.8711e+12 56627
## - Roof.Style 3 9.5014e+09 1.8723e+12 56629
## - Bedroom.AbvGr 1 6.8155e+09 1.8696e+12 56629
## - House.Style 2 8.4041e+09 1.8712e+12 56629
## - Condition.1 3 9.9905e+09 1.8728e+12 56630
## - Garage.Type 3 1.1247e+10 1.8740e+12 56632
## - Pool.Area 1 8.7532e+09 1.8715e+12 56632
## - Bsmt.Qual 1 8.8887e+09 1.8717e+12 56632
## - Bath 1 1.0763e+10 1.8736e+12 56635
## - Sale.Condition 3 1.4670e+10 1.8775e+12 56637
## - Total.Bsmt.SF 1 1.3609e+10 1.8764e+12 56639
## - Mas.Vnr.Type 2 1.6037e+10 1.8788e+12 56641
## - Lot.Area 1 1.5252e+10 1.8780e+12 56642
## - Year.Built 1 1.5996e+10 1.8788e+12 56643
## - Screen.Porch 1 1.7332e+10 1.8801e+12 56645
## - Fireplaces 1 1.7725e+10 1.8805e+12 56645
## - Exter.Qual 1 1.8399e+10 1.8812e+12 56646
## - Kitchen.Qual 1 2.2461e+10 1.8853e+12 56652
## - Mas.Vnr.Area 1 2.8876e+10 1.8917e+12 56662
## - Land.Contour 3 3.4948e+10 1.8977e+12 56667
## - Overall.Cond 1 6.7235e+10 1.9300e+12 56717
## - BsmtFin.SF 1 9.0582e+10 1.9534e+12 56751
## - Overall.Qual 1 1.1180e+11 1.9746e+12 56781
## - Bldg.Type 4 1.4006e+11 2.0029e+12 56814
## - Gr.Liv.Area 1 1.6498e+11 2.0278e+12 56855
## - Neighborhood 26 3.5183e+11 2.2146e+12 57050
```

```
length(both$coefficients)
```

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

```
anova(forward_model, both)
```

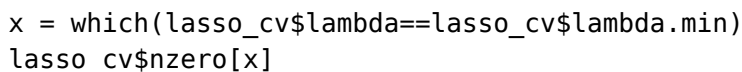
```
## Analysis of Variance Table
##
## Model 1: SalePrice ~ MS.Zoning + Lot.Area + Lot.Shape + Land.Contour +
##   Neighborhood + Condition.1 + Bldg.Type + House.Style + Overall.Qual +
##   Overall.Cond + Year.Built + Year.Remod.Add + Roof.Style +
##   Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Exter.Cond + Foundation +
##   Bsmt.Qual + Bsmt.Cond + BsmtFin.SF + Total.Bsmt.SF + Heating.QC +
##   Central.Air + X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr +
##   Kitchen.Qual + TotRms.AbvGrd + Fireplaces + Fireplace.Qu +
##   Garage.Type + Garage.Finish + Garage.Cars + Garage.Area +
##   Paved.Drive + Wood.Deck.SF + Open.Porch.SF + Enclosed.Porch +
##   X3Ssn.Porch + Screen.Porch + Pool.Area + Fence + Sale.Type +
##   Sale.Condition + Yr.Sold + Bath
## Model 2: SalePrice ~ Lot.Area + Land.Contour + Neighborhood + Condition.1 +
##   Bldg.Type + House.Style + Overall.Qual + Overall.Cond + Year.Built +
##   Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Foundation +
##   Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
##   X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
##   TotRms.AbvGrd + Fireplaces + Garage.Type + Garage.Finish +
##   Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
##   Screen.Porch + Pool.Area + Sale.Type + Sale.Condition + Bath
##   Res.Df      RSS   Df Sum of Sq    F Pr(>F)
## 1    2682 1.8574e+12
## 2    2697 1.8628e+12 -15 -5.35e+09 0.515 0.9341
```

```
anova(backward_model,both)
```

```
## Analysis of Variance Table
##
## Model 1: SalePrice ~ Lot.Area + Land.Contour + Neighborhood + Condition.1 +
##   Bldg.Type + House.Style + Overall.Qual + Overall.Cond + Year.Built +
##   Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Foundation +
##   Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
##   X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
##   TotRms.AbvGrd + Fireplaces + Garage.Type + Garage.Finish +
##   Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
##   Screen.Porch + Pool.Area + Sale.Type + Sale.Condition + Bath
## Model 2: SalePrice ~ Lot.Area + Land.Contour + Neighborhood + Condition.1 +
##   Bldg.Type + House.Style + Overall.Qual + Overall.Cond + Year.Built +
##   Roof.Style + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Foundation +
##   Bsmt.Qual + BsmtFin.SF + Total.Bsmt.SF + Heating.QC + Central.Air +
##   X1st.Flr.SF + Gr.Liv.Area + Bedroom.AbvGr + Kitchen.Qual +
##   TotRms.AbvGrd + Fireplaces + Garage.Type + Garage.Finish +
##   Garage.Cars + Garage.Area + Wood.Deck.SF + Open.Porch.SF +
##   Screen.Porch + Pool.Area + Sale.Type + Sale.Condition + Bath
##   Res.Df      RSS   Df Sum of Sq F Pr(>F)
## 1    2697 1.8628e+12
## 2    2697 1.8628e+12  0          0
```


Question 4: Variable Selection via LASSO and Elastic Net

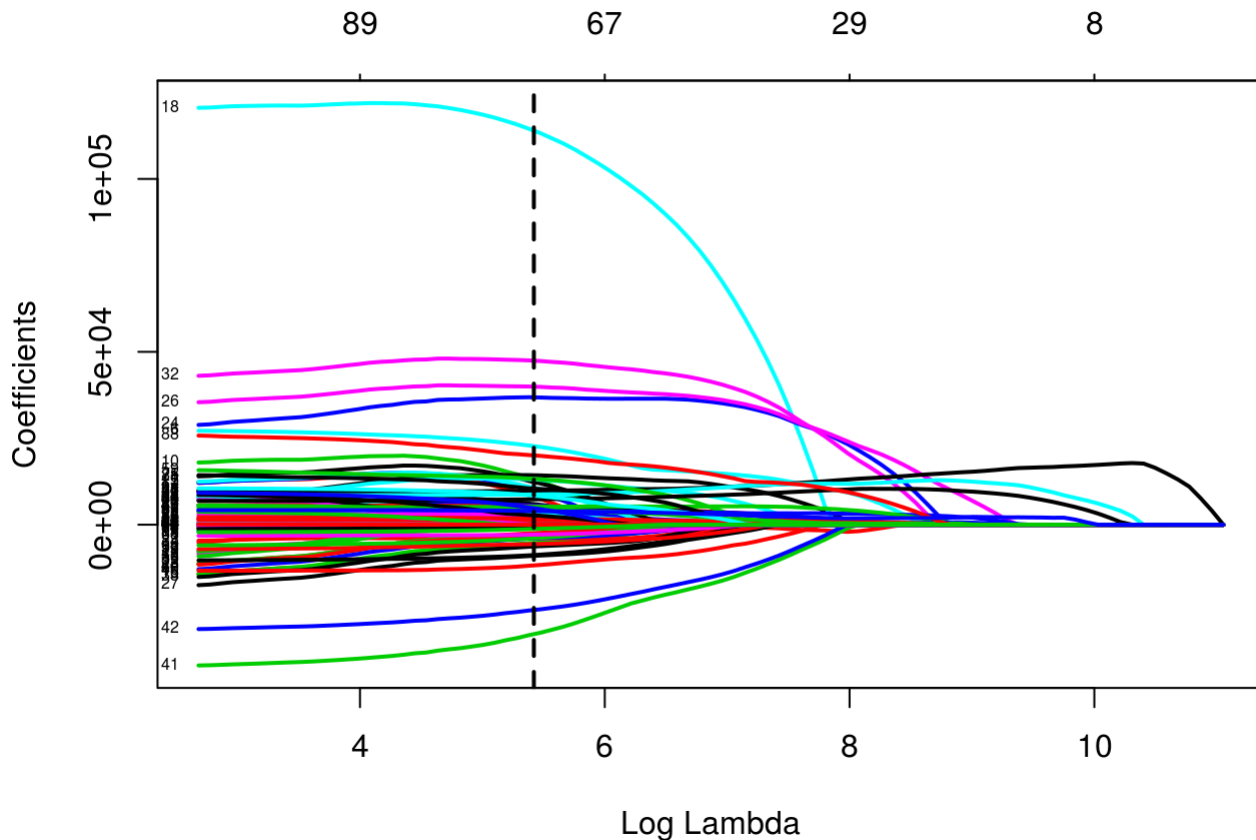
```
lasso_cv = cv.glmnet(x = model.matrix(~.,house[-47]),y = house$SalePrice,alpha = 1,nfold
s = 10)
lasso = glmnet(x = model.matrix(~.,house[-47]),y = house$SalePrice,alpha = 1, nlambda =
100)
plot(lasso, xvar='lambda',label=TRUE, lwd=2)
abline(v=log(lasso_cv$lambda.min),col='black',lty=2,lwd=2)
```



The best lambda is 149.82 out of 95 model coefficients are not zero in the fit.

73/79

```
enet_cv = cv.glmnet(x = model.matrix(~.,house[-47]),y = house$SalePrice,alpha = 0.5,nfolds = 10)
enet = glmnet(x = model.matrix(~.,house[-47]),y = house$SalePrice,alpha = 1, nlambda = 100)
plot(enet, xvar='lambda',label=TRUE, lwd=2)
abline(v=log(enet_cv$lambda.min),col='black',lty=2,lwd=2)
```



```
x = which(enet_cv$lambda==enet_cv$lambda.min)
enet_cv$nzzero[x]
```

```
## s68
## 83
```

The best lambda is 226 . 78 out of 95 model coefficients are not zero in the fit. There are 4 parameters less in the elastic net model compared to the lasso model. elastic net is a combination of lasso and ridge regression. because ridge does not perform variable selection, it makes the elastic net model with more variables.

c.

```
coef(lasso,s=lasso_cv$lambda.min)
```

```
## 98 x 1 sparse Matrix of class "dgCMatrix"
##              1
## (Intercept)  -1.103043e+05
## (Intercept)      .
## MS.ZoningRL      .
## MS.ZoningRM     -3.393068e+03
## Lot.Area        6.588883e-01
## Lot.ShapeReg    1.172505e+03
## Land.ContourHLS  2.431118e+04
## Land.ContourLow  7.256887e+03
## Land.ContourLvl  7.331201e+03
## NeighborhoodBlueste 1.200281e+04
## NeighborhoodBrDale 1.710120e+04
## NeighborhoodBrkSide 4.129751e+03
## NeighborhoodClearCr 2.892091e+03
## NeighborhoodCollgCr -8.189252e+02
## NeighborhoodCrawfor 1.434044e+04
## NeighborhoodEdwards -6.668224e+03
## NeighborhoodGilbert -6.265705e+03
## NeighborhoodGreens 1.306496e+04
## NeighborhoodGrnHill 1.185605e+05
## NeighborhoodIDOTRR .
## NeighborhoodLandmrk .
## NeighborhoodMeadowV 1.541299e+04
## NeighborhoodMitchel -3.293851e+03
## NeighborhoodNAmes -3.665886e+03
## NeighborhoodNoRidge 3.650127e+04
## NeighborhoodNPkVill 1.344725e+04
## NeighborhoodNridgHt 4.015266e+04
## NeighborhoodNWAmes -9.793104e+03
## NeighborhoodOldTown -4.090614e+03
## NeighborhoodSawyer .
## NeighborhoodSawyerW -4.883763e+03
## NeighborhoodSomerst 1.329967e+04
## NeighborhoodStoneBr 4.788808e+04
## NeighborhoodSWISU -7.190915e+03
## NeighborhoodTimber 6.900616e+02
## NeighborhoodVeenker .
## Condition.lNorm 6.107520e+03
## Condition.lRail 3.510494e+03
## Condition.lPosN 1.525742e+03
## Bldg.Type2fmCon -9.370408e+03
## Bldg.TypeDuplex -1.258607e+04
## Bldg.TypeTwnhs -3.475785e+04
## Bldg.TypeTwnhsE -2.633434e+04
## House.Style1Story 4.484629e+03
## House.StyleSplit 3.117170e+03
## Overall.Qual 9.678437e+03
## Overall.Cond 5.410276e+03
## Year.Built -2.429692e+02
## Year.Remod.AddTRUE .
## Roof.StyleGarble .
## Roof.StyleGarbles 2.282662e+03
```

```

## Roof.StyleHip          4.666602e+03
## Mas.Vnr.TypeBrick      -5.889580e+03
## Mas.Vnr.TypeStone     -4.926981e+01
## Mas.Vnr.Area          2.624470e+01
## Exter.Qual             8.610070e+03
## Exter.Cond            2.665848e+02
## FoundationCBlock      .
## FoundationPConc       1.049255e+03
## FoundationOther       1.387658e+04
## Bsmt.Qual             4.211313e+03
## Bsmt.Cond             .
## BsmtFin.SF            1.881290e+01
## Total.Bsmt.SF         1.101182e+01
## Heating.QC            1.160124e+03
## Central.AirY          -4.661240e+03
## X1st.Flr.SF           .
## Gr.Liv.Area           4.826225e+01
## Bedroom.AbvGr         -3.020393e+03
## Kitchen.Qual          7.181278e+03
## TotRms.AbvGrd         -1.383332e+02
## Fireplaces            5.128195e+03
## Fireplace.Qu          .
## Garage.TypeAttchd     -2.055189e+02
## Garage.TypeDetchd     1.088221e+03
## Garage.TypeNo         1.181659e+04
## Garage.Finish         1.911311e+03
## Garage.Cars           4.440700e+03
## Garage.Area           1.474468e+01
## Paved.Drive           .
## Wood.Deck.SF          8.278254e+00
## Open.Porch.SF         -1.314450e+01
## Enclosed.Porch        1.987472e+00
## X3Ssn.Porch           .
## Screen.Porch          4.408537e+01
## Pool.Area             4.716320e+01
## Fence                 .
## Sale.TypeOther        4.035931e+03
## Sale.TypeNEW          2.142658e+04
## Sale.TypeWD           5.569021e+02
## Sale.ConditionOther   6.494514e+03
## Sale.ConditionNormal  9.359943e+03
## Sale.ConditionPartial .
## Yr.Sold2007           -6.479642e+02
## Yr.Sold2008           .
## Yr.Sold2009           -1.590241e+03
## Yr.Sold2010           .
## Bath                  4.113777e+03

```

```
coef(enet,s=enet_cv$lambda.min)
```

```
## 98 x 1 sparse Matrix of class "dgCMatrix"
##              1
## (Intercept)  -1.063490e+05
## (Intercept)      .
## MS.ZoningRL      .
## MS.ZoningRM     -2.660253e+03
## Lot.Area        6.597978e-01
## Lot.ShapeReg    7.462333e+02
## Land.ContourHLS  2.272440e+04
## Land.ContourLow  5.746858e+03
## Land.ContourLvl  5.962407e+03
## NeighborhoodBlueste 8.051492e+03
## NeighborhoodBrDale 1.312406e+04
## NeighborhoodBrkSide 3.797667e+03
## NeighborhoodClearCr 2.645746e+03
## NeighborhoodCollgCr -3.005565e+01
## NeighborhoodCrawfor 1.429886e+04
## NeighborhoodEdwards -5.836539e+03
## NeighborhoodGilbert -5.254945e+03
## NeighborhoodGreens  9.685681e+03
## NeighborhoodGrnHill 1.139652e+05
## NeighborhoodIDOTRR  .
## NeighborhoodLandmrk  .
## NeighborhoodMeadowV 1.234250e+04
## NeighborhoodMitchel -2.441938e+03
## NeighborhoodNAmes  -3.171918e+03
## NeighborhoodNoRidge 3.683016e+04
## NeighborhoodNPKVill 1.070129e+04
## NeighborhoodNridgHt 3.991932e+04
## NeighborhoodNWAmes  -9.006658e+03
## NeighborhoodOldTown -3.965650e+03
## NeighborhoodSawyer  .
## NeighborhoodSawyerW -3.961915e+03
## NeighborhoodSomerst 1.308024e+04
## NeighborhoodStoneBr 4.743932e+04
## NeighborhoodSWISU  -6.301709e+03
## NeighborhoodTimber  8.459643e+02
## NeighborhoodVeenker  .
## Condition.lNorm    5.530794e+03
## Condition.lRail     2.493494e+03
## Condition.lPosN     5.531464e+02
## Bldg.Type2fmCon     -8.776860e+03
## Bldg.TypeDuplex     -1.177468e+04
## Bldg.TypeTwnhs      -3.165592e+04
## Bldg.TypeTwnhsE     -2.467326e+04
## House.Style1Story   3.676931e+03
## House.StyleSplit    2.035758e+03
## Overall.Qual        9.791153e+03
## Overall.Cond        5.276607e+03
## Year.Built          -2.313947e+02
## Year.Remod.AddTRUE  .
## Roof.StyleGarble    .
## Roof.StyleGarbles   1.168021e+03
```

```

## Roof.StyleHip          4.625343e+03
## Mas.Vnr.TypeBrick      -5.603691e+03
## Mas.Vnr.TypeStone      .
## Mas.Vnr.Area           2.583437e+01
## Exter.Qual             8.735454e+03
## Exter.Cond             1.014437e+02
## FoundationCBlock       .
## FoundationPConc        8.215759e+02
## FoundationOther        1.323785e+04
## Bsmt.Qual              4.063019e+03
## Bsmt.Cond              .
## BsmtFin.SF             1.893376e+01
## Total.Bsmt.SF          1.142751e+01
## Heating.QC             1.096074e+03
## Central.AirY           -3.931711e+03
## X1st.Flr.SF            .
## Gr.Liv.Area            4.691044e+01
## Bedroom.AbvGr         -2.871628e+03
## Kitchen.Qual           7.338832e+03
## TotRms.AbvGrd          .
## Fireplaces             5.189218e+03
## Fireplace.Qu           .
## Garage.TypeAttchd      -4.560581e+02
## Garage.TypeDetchd      2.640687e+01
## Garage.TypeNo          1.042445e+04
## Garage.Finish          1.743724e+03
## Garage.Cars            4.213050e+03
## Garage.Area            1.572406e+01
## Paved.Drive            .
## Wood.Deck.SF           8.464526e+00
## Open.Porch.SF          -1.038695e+01
## Enclosed.Porch         .
## X3Ssn.Porch            .
## Screen.Porch           4.217500e+01
## Pool.Area              4.583021e+01
## Fence                  .
## Sale.TypeOther         2.709500e+03
## Sale.TypeNEW           2.004232e+04
## Sale.TypeWD            .
## Sale.ConditionOther    4.764367e+03
## Sale.ConditionNormal   8.402714e+03
## Sale.ConditionPartial  .
## Yr.Sold2007            -2.130790e+02
## Yr.Sold2008            .
## Yr.Sold2009            -1.235591e+03
## Yr.Sold2010            .
## Bath                   3.958885e+03

```

Question 5: Variable Selection via Group LASSO

a.

```
library(gglasso)
set.seed(1)

group = c(48,rep(1,2),2,3,rep(4,3),rep(5,27), rep(6,3), rep(7,4), rep(8,2), 9, 10, 11, 1
2, rep(13,2), rep(14,2), 15, 16, 17,

      rep(18,3), 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, rep(32,3), 33,
34, 35, 36, 37, 38, 39, 40, 41, 42,

      43, rep(44,3), rep(45,3), rep(46,4), 47)

cv = cv.gglasso(model.matrix(model_log), house$SalePrice, group, loss="ls"); cv$lambda.m
in
```

```
## [1] 129781.1
```

```
glassomdl = gglasso(model.matrix(model_log), house$SalePrice, group, lambda = cv$lambda.
min)

nnzero(glassomdl$beta)
```

```
## [1] 9
```

```
()
```