

# Predicting Housing Prices in Ames, Iowa

Matthew Adair

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## Introduction

The intent of this project was to see how well I could predict the sale prices of housing in Ames, Iowa. Additionally, since real estate is relatively foreign to me I was interested in what components of a house really were important in predicting sales price for the city of Ames. For this project I implemented various linear regression models, from the standard ordinary least squared method to elastic regression, as well as k nearest neighbor and a random forest model.

The data set began with 80 variables with 32 variables being quantitative, 17 ordinal variables, and the other 31 being qualitative variables. Most of the categorical variables could be converted into ordinal variables I found, for example roofing materials, it is a categorical variable that had factor levels that varied in terms of quality and price, such as clay or tile shingles are more expensive and of better quality than that of the standard composite shingles. This would allow me to keep and implement the variables that I would not be able to utilize. Through preliminary viewing of the data I came up with a hypothesis that the biggest influencers on the sale price of a house are going to be the type of dwelling, known as MSSubclass, the lot area of the property stored as LotArea, the neighborhood stored as Neighborhood, proximity to parks or major roads which are stored as Condition1 or Condition2, the quality and condition of the house stored as OverallQual and OverallCond, as well as other various quality and conditions of components of the house. The reason why I think these variables are going to be most influential is due to how they visibly affect the appeal of the house or they heavily influence the sellers ability to sell the house at higher price due to quality and condition of the house.

## Cleaning

The cleaning that I performed for this project came from the perspective of a real estate agent trying to maximize profits. So as you will see when I converted categorical variables into numeric ordered variables I did so with the perspective of what factor levels would produce the highest price for selling a house. The reason why I took this approach rather than the perspective of the buyer, which would look to find the best bang-for-your-buck option, is because the data is only going to be used by real state agents and likely not buyers.

I created the idealI began with deleting the variables Heating, Electrical, and LotFrontage. The reason why I deleted those two variables were because Heating and Electrical just stated what type of system the house used and the reason why I deleted the variable LotFrontage is because I thought that LotArea essentially covered the same concept but better in the sense that more people are concerned with total square footage of a lot rather than how many square feet they have along a road. For the variable "Alley" I changed all of the NAs into "NoAcc" because the NAs stand for no access as seen in the data dictionary. Furthermore, for the variables Utilities I converted all of the NAs into "AllPub" since 99% percent of the observations contained "AllPub." I also converted all of the NAs for the variable MSZoning into RL since RL makes up 78% of the observations. For the variable "BldngType" I changed the Twnhs to TwnhsE because I could not find any distinguishing characteristics between an inside and end townhouse unit, thus since there were no TwnhsI, I just converted Twnhs into TwnhsE. For the NAs in "Exterior1st" with VinylSd because it makes up a 1/3 of all the records, and so if I'm going to have the greatest chance of classifying it correctly it would make sense to classify it as VinylSd. For the NAs in "Exterior2nd" with VinylSd because generally I found that majority of the time a building had VinylSd as its Exterior1st it also had a VinylSd for the variable Exterior2nd.

For the variable MasVnrType I filled in NAs proportionally, with around 60% of NAs filled as None, around 30% as Brkfc, and the remaining 10% as Stone. For the variable MasVnrArea I converted all of the NAs that had "None" as there MasVnrType to 0. For all of the other records that contained NA I just found the average for the "MasVnrArea" based on "MasVnrType" and substituted those averages for the NAs. For the variable BsmtQual I replaced all of the NAs, which meant no basement, with NoBsmnt so as to keep the records. Following BsmtQual, for the variable BsmtExposure, replaced NAs with NO because 2/3 of the data contained NO, which means no exposure. With the variable BsmtFinishType1, I replaced all NAs with NoBsmnt because that is what NA means as stated in the data dictionary. For the variable BsmntFinType2 I filled in all NA with no basement NoBsmnt and the one NA that represented unknown I filled with Unf because around 85% of the records contained Unf. Replaced the one NA in variable BsmtFinSF2 with 0 because all of the previous basement observations show that there is no basement for that particular record. For the variable TotalBsmtSF I replaced the one NA with zero because it does not have a basement. Filled in the NAs for the variable BsmtFullBath with zero because more than 50% of the records contain zero and thus it is more likely that the basement does not have a full bathroom than does. For the variable GarageType I converted it into a numeric ordered variable based off of how the type of garage would increase price of the house. I believed that a detached garage would be less attractive than an attached garage and that a builtin garage would be worth more because it can have an extra room on top and thus make the value of the house more likely increase. Additionally, with the variable BsmtHalfBath I filled in the two NAs with zero because 95% of the records do not contain half bathrooms and those records that contained NAs both had 1 full bath so it would not make too much sense for them to have both a full and a half bathroom.

Some last noteworthy cleaning points before moving to discussing how I converted some categorical and ordinal variables into numeric and ordered. For the variable GarageArea I substituted all NAs with zero if they did not have a garage and then for the NAs that had a garage I substituted them with the averages area based on year and type of garage. With the variable GarageCond I substituted all of NAs with no garage with None and the NAs that had garages I substituted them with most frequently occurring condition based off year and type. Changed all of the NAs in variable "PoolQC" to NP for no pool. Then for the records that had pools I changed the NAs to either Gd or Ex which were the most occurring levels other than NP.

Now for the variables that are categorical but ordinal or binary in nature I converted into numeric and ordered data. Through researching the different variables and seeing how the various variables affected price from a real estate agent's perspective I ordered the levels numerically. For instance I made LotShape a numeric and ordered variable with irregular lot shape being zero, moderately irregular being one, slightly irregular being two, and a regular lot valued at three. For the variable RoofMatl I converted Membrane, roll, and tar and gravel to zero and composite shingles to one because they are the standard for roofing shingles, I converted both wood shingles and shakes as two because they are more costly than tar and shingles, while making clay tiles and metal roofing three because they are the most expensive roofing shingles. I did this to many more variables as you can see in the R script file. Lastly, all the variables that dealt with quality and condition I made into numeric and ordered variables.

## OLS Regression

I began my analysis with the standard ordinary least squared regression. I first used an ordinary least squared regression with all of the variables except for ID to predict the missing sales price values of the test set. Once I gained those values I merged the test and training sets together to create a final dataframe that would be randomly partitioned and split with half of the observations in the training set and the other half in the test set. I performed a backward stepwise regression for my feature selection and found some interesting points. The first is that all of the variables that I thought would be important made it in the final model. Secondly, I found that the type of mason veneer and square footage of the mason veneer were selected as important variables to predict price. Additionally, the type of finishing of the basement is significantly impactful on determining the price of a house. When looking more into this, it makes sense that the type of finishing of the basement would be impactful when looking at how most of the houses in Ames, Iowa have basements. Thus, suggesting that basements are an important part of a house and the type of finishing, which can help dictate whether the basement could be used as an extra room if it is finished or more likely to be used as just a storage space if it is mostly unfinished. This ability to have an extra room does definitely add or detract value for the price of the house whole. What is interesting overall is that there are a lot of variables included that deal with the garage, deck, and basement. The rest of the variables included in the selection model are logical and do not need much thinking as to why they are included.

```
## Warning in predict.lm(lmmdl, test): prediction from a rank-deficient fit may be
## misleading
```

```
##
```

```
## Call:
```

```
## lm(formula = SalePrice ~ . - ID, data = train)
```

```
##
```

```
## Residuals:
```

```
##      Min       1Q   Median       3Q      Max
## -128990  -4411     149    4608   128503
```

```
##
```

```
## Coefficients: (10 not defined because of singularities)
```

```
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    3.964e+05  7.240e+05   0.547  0.584148
## MSSubClass30    3.817e+03  3.181e+03   1.200  0.230327
## MSSubClass40    5.869e+04  2.282e+04   2.571  0.010243 *
## MSSubClass45   -5.309e+03  1.093e+04  -0.486  0.627317
## MSSubClass50   -2.953e+01  6.170e+03  -0.005  0.996182
## MSSubClass60    6.543e+03  5.015e+03   1.305  0.192207
## MSSubClass70    7.169e+03  5.555e+03   1.291  0.197080
## MSSubClass75   -1.975e+04  1.278e+04  -1.546  0.122341
## MSSubClass80   -7.334e+02  8.972e+03  -0.082  0.934862
## MSSubClass85   -1.469e+04  7.357e+03  -1.997  0.046091 *
## MSSubClass90   -9.026e+03  5.595e+03  -1.613  0.106977
## MSSubClass120  -1.870e+04  1.240e+04  -1.508  0.131860
## MSSubClass160  -1.220e+04  1.373e+04  -0.888  0.374617
## MSSubClass180  -1.595e+04  1.553e+04  -1.027  0.304726
## MSSubClass190    2.065e+03  2.115e+04   0.098  0.922227
## MSZoning4      4.067e+04  9.016e+03   4.511  7.08e-06 ***
## MSZoning2      2.818e+04  9.229e+03   3.053  0.002314 **
## MSZoning3      2.992e+04  7.954e+03   3.762  0.000177 ***
## MSZoning1      2.611e+04  7.455e+03   3.503  0.000477 ***
## LotArea        7.538e-01  8.063e-02   9.350  < 2e-16 ***
## Street.L       1.330e+04  5.750e+03   2.313  0.020862 *
## Alley.L       -2.924e+03  2.565e+03  -1.140  0.254544
## Alley.Q       -2.663e+03  2.559e+03  -1.040  0.298334
```

## LotShape.L	-3.296e+02	3.817e+03	-0.086	0.931211	
## LotShape.Q	-7.731e+02	3.067e+03	-0.252	0.801014	
## LotShape.C	2.104e+03	2.337e+03	0.900	0.368184	
## LandContour.L	9.143e+03	2.626e+03	3.482	0.000515	***
## LandContour.Q	-2.635e+03	2.510e+03	-1.050	0.293931	
## LandContour.C	-2.290e+03	2.577e+03	-0.889	0.374326	
## Utilities	3.199e+04	1.959e+04	1.633	0.102674	
## LotConfigCulDSac	6.848e+03	2.347e+03	2.918	0.003589	**
## LotConfigFR2	-7.689e+03	3.014e+03	-2.551	0.010855	*
## LotConfigFR3	-1.365e+04	7.403e+03	-1.844	0.065486	.
## LotConfigInside	-2.133e+03	1.265e+03	-1.686	0.092071	.
## LandSlope.L	2.579e+04	5.947e+03	4.336	1.57e-05	***
## LandSlope.Q	-2.198e+04	3.791e+03	-5.798	8.51e-09	***
## NeighborhoodBlueste	-1.215e+03	1.032e+04	-0.118	0.906247	
## NeighborhoodBrDale	-1.733e+03	8.301e+03	-0.209	0.834616	
## NeighborhoodBrkSide	1.043e+03	6.721e+03	0.155	0.876683	
## NeighborhoodClearCr	-8.504e+03	7.135e+03	-1.192	0.233504	
## NeighborhoodCollgCr	-2.103e+03	5.236e+03	-0.402	0.687938	
## NeighborhoodCrawfor	1.859e+04	6.067e+03	3.064	0.002229	**
## NeighborhoodEdwards	-1.691e+04	5.743e+03	-2.944	0.003296	**
## NeighborhoodGilbert	-6.420e+03	5.420e+03	-1.184	0.236475	
## NeighborhoodIDOTRR	-8.227e+03	7.261e+03	-1.133	0.257417	
## NeighborhoodMeadowV	-9.164e+03	8.320e+03	-1.101	0.270950	
## NeighborhoodMitchel	-1.391e+04	5.908e+03	-2.354	0.018711	*
## NeighborhoodNames	-1.138e+04	5.639e+03	-2.017	0.043878	*
## NeighborhoodNoRidge	3.135e+04	6.108e+03	5.133	3.31e-07	***
## NeighborhoodNPkVill	1.174e+04	1.419e+04	0.828	0.407973	
## NeighborhoodNridgHt	2.201e+04	5.373e+03	4.096	4.48e-05	***
## NeighborhoodNWames	-1.163e+04	5.824e+03	-1.996	0.046148	*
## NeighborhoodOldTown	-9.894e+03	6.845e+03	-1.446	0.148569	
## NeighborhoodSawyer	-6.365e+03	5.786e+03	-1.100	0.271486	
## NeighborhoodSawyerW	2.192e+02	5.509e+03	0.040	0.968273	
## NeighborhoodSomerst	1.589e+03	6.090e+03	0.261	0.794160	
## NeighborhoodStoneBr	4.279e+04	5.999e+03	7.133	1.67e-12	***
## NeighborhoodSWISU	-9.351e+02	6.891e+03	-0.136	0.892076	
## NeighborhoodTimber	-7.581e+03	5.900e+03	-1.285	0.199076	
## NeighborhoodVeenker	3.100e+03	7.447e+03	0.416	0.677239	
## Condition1.L	4.704e+03	4.170e+03	1.128	0.259554	
## Condition1.Q	-3.548e+03	3.476e+03	-1.021	0.307658	
## Condition1.C	-1.102e+04	3.513e+03	-3.135	0.001758	**
## Condition1^4	4.541e+03	3.162e+03	1.436	0.151263	
## Condition1^5	1.577e+03	2.103e+03	0.750	0.453298	
## Condition2.L	5.560e+04	1.256e+04	4.427	1.04e-05	***
## Condition2.Q	2.341e+04	1.129e+04	2.073	0.038356	*
## Condition2.C	3.415e+04	9.502e+03	3.594	0.000338	***
## Condition2^4	5.662e+03	7.589e+03	0.746	0.455736	
## BldgType2fmCon	-1.448e+04	2.080e+04	-0.696	0.486554	
## BldgTypeDuplex	NA	NA	NA	NA	
## BldgTypeTwnhsE	-2.388e+03	1.228e+04	-0.194	0.845847	
## HouseStyle1.5Unf	1.719e+04	1.070e+04	1.607	0.108360	
## HouseStyle1Story	4.821e+03	6.337e+03	0.761	0.446903	
## HouseStyle2.5Fin	1.934e+03	1.488e+04	0.130	0.896652	
## HouseStyle2.5Unf	1.499e+03	1.214e+04	0.123	0.901760	
## HouseStyle2Story	-1.203e+04	5.391e+03	-2.231	0.025861	*

## HouseStyleSFoyer	7.723e+03	8.098e+03	0.954	0.340428	
## HouseStyleSLvl	5.091e+03	9.598e+03	0.530	0.595928	
## OverallQual	6.837e+03	7.140e+02	9.575	< 2e-16	***
## OverallCond	5.220e+03	5.913e+02	8.828	< 2e-16	***
## YearBuilt	3.145e+02	5.948e+01	5.287	1.47e-07	***
## YearRemodAdd	1.316e+02	3.923e+01	3.356	0.000816	***
## RoofStyleGable	-1.871e+04	1.216e+04	-1.539	0.124118	
## RoofStyleGambrel	-1.956e+04	1.358e+04	-1.440	0.150236	
## RoofStyleHip	-1.722e+04	1.222e+04	-1.409	0.159113	
## RoofStyleMansard	-1.799e+04	1.351e+04	-1.332	0.183222	
## RoofStyleShed	-3.564e+04	1.648e+04	-2.163	0.030729	*
## RoofMatl.L	2.771e+04	1.340e+04	2.068	0.038842	*
## RoofMatl.Q	-1.445e+04	1.460e+04	-0.990	0.322596	
## RoofMatl.C	-1.324e+04	6.454e+03	-2.052	0.040400	*
## Exterior1stAsphShn	-1.068e+04	2.513e+04	-0.425	0.670846	
## Exterior1stBrkComm	-1.602e+03	1.727e+04	-0.093	0.926091	
## Exterior1stBrkFace	1.505e+04	1.224e+04	1.230	0.219049	
## Exterior1stCemntBd	-9.854e+03	1.531e+04	-0.644	0.519828	
## Exterior1stHdBoard	-1.059e+04	1.209e+04	-0.876	0.381219	
## Exterior1stMetalSd	1.234e+02	1.281e+04	0.010	0.992313	
## Exterior1stPlywood	-9.113e+03	1.210e+04	-0.753	0.451449	
## Exterior1stStone	-2.461e+04	2.293e+04	-1.073	0.283440	
## Exterior1stStucco	-7.074e+03	1.214e+04	-0.583	0.560298	
## Exterior1stVinylSd	-8.835e+03	1.180e+04	-0.749	0.454154	
## Exterior1stWd Sdng	-1.012e+04	1.168e+04	-0.866	0.386436	
## Exterior1stWdShing	-3.688e+03	1.226e+04	-0.301	0.763555	
## Exterior2ndAsphShn	8.646e+03	2.130e+04	0.406	0.684859	
## Exterior2ndBrk Cmn	3.189e+03	1.760e+04	0.181	0.856227	
## Exterior2ndBrkFace	-3.121e+03	1.224e+04	-0.255	0.798830	
## Exterior2ndCBlock	-8.543e+03	1.820e+04	-0.469	0.638821	
## Exterior2ndCmentBd	1.297e+04	1.499e+04	0.865	0.386998	
## Exterior2ndHdBoard	6.727e+03	1.161e+04	0.580	0.562316	
## Exterior2ndImStucc	5.609e+03	1.354e+04	0.414	0.678840	
## Exterior2ndMetalSd	1.334e+02	1.237e+04	0.011	0.991397	
## Exterior2ndOther	-1.548e+04	2.037e+04	-0.760	0.447342	
## Exterior2ndPlywood	3.120e+03	1.157e+04	0.270	0.787359	
## Exterior2ndStone	-3.459e+04	1.716e+04	-2.016	0.044013	*
## Exterior2ndStucco	3.824e+03	1.150e+04	0.333	0.739497	
## Exterior2ndVinylSd	8.886e+03	1.136e+04	0.782	0.434106	
## Exterior2ndWd Sdng	8.467e+03	1.126e+04	0.752	0.452367	
## Exterior2ndWd Shng	4.961e+02	1.140e+04	0.044	0.965290	
## MasVnrTypeBrkFace	8.441e+03	5.291e+03	1.595	0.110900	
## MasVnrTypeNone	-6.783e+03	6.282e+03	-1.080	0.280470	
## MasVnrTypeStone	1.826e+04	5.521e+03	3.307	0.000971	***
## MasVnrArea	1.132e+02	1.402e+01	8.076	1.58e-15	***
## ExterQual0	-2.381e+04	6.299e+03	-3.780	0.000165	***
## ExterQual2	-2.631e+04	3.355e+03	-7.841	9.61e-15	***
## ExterQual1	-2.653e+04	3.797e+03	-6.986	4.61e-12	***
## ExterCond1	7.936e+02	8.393e+03	0.095	0.924677	
## ExterCond3	-5.581e+03	7.537e+03	-0.741	0.459108	
## ExterCond0	1.955e+04	2.014e+04	0.971	0.331815	
## ExterCond2	-5.107e+02	7.497e+03	-0.068	0.945700	
## FoundationCBlock	5.562e+03	2.161e+03	2.574	0.010159	*
## FoundationPConc	5.391e+03	2.363e+03	2.281	0.022713	*

## FoundationSlab	6.068e+03	6.508e+03	0.932	0.351328	
## FoundationStone	1.652e+04	7.380e+03	2.238	0.025399	*
## FoundationWood	-2.680e+04	1.296e+04	-2.068	0.038889	*
## BsmtQual.L	1.564e+05	6.961e+04	2.247	0.024833	*
## BsmtQual.Q	-1.236e+05	5.881e+04	-2.101	0.035814	*
## BsmtQual.C	8.899e+04	3.479e+04	2.558	0.010642	*
## BsmtQual^4	-2.717e+04	1.322e+04	-2.055	0.040129	*
## BsmtCond.L	-1.283e+05	3.369e+04	-3.809	0.000147	***
## BsmtCond.Q	8.654e+04	2.309e+04	3.749	0.000186	***
## BsmtCond.C	-3.102e+04	8.683e+03	-3.573	0.000367	***
## BsmtCond^4	NA	NA	NA	NA	
## BsmtExposure.L	2.630e+04	7.470e+03	3.521	0.000446	***
## BsmtExposure.Q	2.233e+03	6.672e+03	0.335	0.737967	
## BsmtExposure.C	8.485e+03	4.135e+03	2.052	0.040400	*
## BsmtExposure^4	NA	NA	NA	NA	
## BsmtFinType1.L	-3.343e+03	2.777e+04	-0.120	0.904192	
## BsmtFinType1.Q	1.308e+04	2.707e+04	0.483	0.629015	
## BsmtFinType1.C	-1.044e+04	2.029e+04	-0.515	0.606945	
## BsmtFinType1^4	6.571e+03	1.195e+04	0.550	0.582379	
## BsmtFinType1^5	2.443e+03	5.271e+03	0.463	0.643109	
## BsmtFinType1^6	NA	NA	NA	NA	
## BsmtFinSF1	3.272e+01	3.522e+00	9.290	< 2e-16	***
## BsmtFinType2.L	-3.147e+04	4.576e+04	-0.688	0.491781	
## BsmtFinType2.Q	4.924e+04	4.393e+04	1.121	0.262627	
## BsmtFinType2.C	-2.555e+04	3.324e+04	-0.769	0.442195	
## BsmtFinType2^4	1.674e+04	1.928e+04	0.868	0.385303	
## BsmtFinType2^5	-7.937e+03	9.668e+03	-0.821	0.411837	
## BsmtFinType2^6	NA	NA	NA	NA	
## BsmtFinSF2	2.506e+01	6.447e+00	3.887	0.000107	***
## BsmtUnfSF	2.312e+01	3.222e+00	7.177	1.23e-12	***
## TotalBsmtSF	NA	NA	NA	NA	
## HeatingQC.L	3.607e+02	2.131e+03	0.169	0.865629	
## HeatingQC.Q	3.234e+03	1.632e+03	1.981	0.047815	*
## HeatingQC.C	2.524e+01	1.190e+03	0.021	0.983075	
## CentralAir1	-1.219e+03	2.410e+03	-0.506	0.613090	
## X1stFlrSF	4.093e+01	3.816e+00	10.725	< 2e-16	***
## X2ndFlrSF	6.301e+01	3.958e+00	15.919	< 2e-16	***
## LowQualFinSF	8.127e+00	1.444e+01	0.563	0.573679	
## GrLivArea	NA	NA	NA	NA	
## BsmtFullBath	3.037e+03	1.351e+03	2.248	0.024748	*
## BsmtHalfBath	1.203e+03	2.036e+03	0.591	0.554527	
## FullBath	4.538e+03	1.478e+03	3.071	0.002181	**
## HalfBath	1.059e+03	1.456e+03	0.727	0.467236	
## BedroomAbvGr	-4.334e+03	9.643e+02	-4.495	7.62e-06	***
## KitchenAbvGr	-8.340e+03	5.180e+03	-1.610	0.107649	
## KitchenQual.L	1.293e+04	2.774e+03	4.659	3.52e-06	***
## KitchenQual.Q	1.061e+04	1.944e+03	5.457	5.84e-08	***
## KitchenQual.C	4.120e+03	1.147e+03	3.592	0.000341	***
## TotRmsAbvGrd	1.658e+03	6.551e+02	2.531	0.011498	*
## Functional.L	4.076e+04	1.068e+04	3.817	0.000142	***
## Functional.Q	-1.443e+04	1.033e+04	-1.398	0.162477	
## Functional.C	1.798e+04	8.437e+03	2.131	0.033306	*
## Functional^4	-8.869e+03	7.109e+03	-1.248	0.212415	
## Functional^5	6.147e+03	5.506e+03	1.116	0.264474	

## Functional^6	1.150e+04	5.562e+03	2.067	0.038911	*
## Fireplaces	2.547e+03	1.827e+03	1.394	0.163483	
## FireplaceQu.L	-2.377e+03	3.337e+03	-0.712	0.476362	
## FireplaceQu.Q	5.733e+03	2.980e+03	1.924	0.054618	.
## FireplaceQu.C	1.359e+04	2.814e+03	4.831	1.53e-06	***
## FireplaceQu^4	-9.916e+03	2.647e+03	-3.746	0.000188	***
## FireplaceQu^5	9.490e+03	2.417e+03	3.926	9.10e-05	***
## GarageType.L	1.317e+05	6.619e+04	1.989	0.046896	*
## GarageType.Q	-1.509e+05	6.051e+04	-2.494	0.012757	*
## GarageType.C	8.313e+04	4.136e+04	2.010	0.044658	*
## GarageType^4	-5.478e+04	2.139e+04	-2.561	0.010569	*
## GarageType^5	1.298e+04	7.365e+03	1.763	0.078157	.
## GarageYrBlt	-5.628e+01	4.237e+01	-1.328	0.184309	
## GarageFinish.L	-4.882e+03	3.407e+03	-1.433	0.152085	
## GarageFinish.Q	4.687e+03	2.373e+03	1.976	0.048414	*
## GarageFinish.C	NA	NA	NA	NA	
## GarageCars	6.583e+03	1.637e+03	4.021	6.16e-05	***
## GarageArea	7.261e+00	5.634e+00	1.289	0.197714	
## GarageQual.L	3.394e+04	5.300e+04	0.640	0.522127	
## GarageQual.Q	1.408e+05	4.842e+04	2.907	0.003714	**
## GarageQual.C	3.070e+03	2.282e+04	0.135	0.892994	
## GarageQual^4	6.492e+04	1.315e+04	4.936	9.06e-07	***
## GarageQual^5	NA	NA	NA	NA	
## GarageCond.L	-3.116e+04	3.018e+04	-1.032	0.302082	
## GarageCond.Q	1.085e+04	2.065e+04	0.525	0.599466	
## GarageCond.C	-1.526e+04	9.556e+03	-1.597	0.110512	
## GarageCond^4	NA	NA	NA	NA	
## PavedDrive.L	4.935e+02	1.622e+03	0.304	0.760970	
## PavedDrive.Q	2.110e+03	2.871e+03	0.735	0.462640	
## WoodDeckSF	1.700e+01	4.198e+00	4.050	5.45e-05	***
## OpenPorchSF	-3.384e+00	8.726e+00	-0.388	0.698210	
## EnclosedPorch	2.138e+01	8.448e+00	2.531	0.011489	*
## X3SsnPorch	3.577e+01	1.501e+01	2.383	0.017340	*
## ScreenPorch	4.825e+01	8.332e+00	5.790	8.91e-09	***
## PoolArea	1.179e+03	9.072e+01	13.001	< 2e-16	***
## PoolQC.L	-3.907e+05	2.475e+04	-15.788	< 2e-16	***
## PoolQC.Q	4.300e+05	3.907e+04	11.006	< 2e-16	***
## PoolQC.C	-7.359e+04	1.529e+04	-4.814	1.66e-06	***
## Fence.L	-2.257e+03	1.322e+03	-1.707	0.088089	.
## Fence.Q	-2.253e+03	1.361e+03	-1.656	0.098056	.
## MiscFeature.L	3.459e+04	7.348e+03	4.707	2.80e-06	***
## MiscFeature.Q	1.744e+04	4.446e+03	3.922	9.27e-05	***
## MiscVal	-4.421e+00	8.967e-01	-4.931	9.32e-07	***
## MoSold	-2.807e+02	1.710e+02	-1.641	0.100981	
## YrSold	-8.365e+02	3.545e+02	-2.360	0.018437	*
## SaleTypeCon	1.183e+04	1.219e+04	0.971	0.331971	
## SaleTypeConLD	1.321e+04	5.421e+03	2.436	0.014976	*
## SaleTypeConLI	3.669e+03	7.522e+03	0.488	0.625793	
## SaleTypeConLw	8.307e+03	1.042e+04	0.797	0.425517	
## SaleTypeCWD	2.053e+04	7.562e+03	2.715	0.006719	**
## SaleTypeNew	2.255e+04	3.554e+03	6.343	3.15e-10	***
## SaleTypeOth	5.669e+03	1.002e+04	0.566	0.571690	
## SaleTypeWD	-1.060e+03	2.950e+03	-0.359	0.719409	
## SaleCondition.L	1.084e+04	6.225e+03	1.740	0.082023	.

```

## SaleCondition.Q      -5.110e+02  3.635e+03  -0.141 0.888240
## MasVnrArea_Sqrt     -2.874e+03  4.781e+02  -6.012 2.41e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15950 on 1228 degrees of freedom
## Multiple R-squared:  0.9652, Adjusted R-squared:  0.9587
## F-statistic: 148.1 on 230 and 1228 DF,  p-value: < 2.2e-16

##
## Call:
## lm(formula = SalePrice ~ . - ID, data = train)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -128990  -4411     149     4608  128503
##
## Coefficients: (10 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    3.964e+05  7.240e+05   0.547 0.584148
## MSSubClass30    3.817e+03  3.181e+03   1.200 0.230327
## MSSubClass40    5.869e+04  2.282e+04   2.571 0.010243 *
## MSSubClass45   -5.309e+03  1.093e+04  -0.486 0.627317
## MSSubClass50   -2.953e+01  6.170e+03  -0.005 0.996182
## MSSubClass60    6.543e+03  5.015e+03   1.305 0.192207
## MSSubClass70    7.169e+03  5.555e+03   1.291 0.197080
## MSSubClass75   -1.975e+04  1.278e+04  -1.546 0.122341
## MSSubClass80   -7.334e+02  8.972e+03  -0.082 0.934862
## MSSubClass85   -1.469e+04  7.357e+03  -1.997 0.046091 *
## MSSubClass90   -9.026e+03  5.595e+03  -1.613 0.106977
## MSSubClass120  -1.870e+04  1.240e+04  -1.508 0.131860
## MSSubClass160  -1.220e+04  1.373e+04  -0.888 0.374617
## MSSubClass180  -1.595e+04  1.553e+04  -1.027 0.304726
## MSSubClass190   2.065e+03  2.115e+04   0.098 0.922227
## MSZoning4       4.067e+04  9.016e+03   4.511 7.08e-06 ***
## MSZoning2       2.818e+04  9.229e+03   3.053 0.002314 **
## MSZoning3       2.992e+04  7.954e+03   3.762 0.000177 ***
## MSZoning1       2.611e+04  7.455e+03   3.503 0.000477 ***
## LotArea        7.538e-01  8.063e-02   9.350 < 2e-16 ***
## Street.L       1.330e+04  5.750e+03   2.313 0.020862 *
## Alley.L       -2.924e+03  2.565e+03  -1.140 0.254544
## Alley.Q       -2.663e+03  2.559e+03  -1.040 0.298334
## LotShape.L    -3.296e+02  3.817e+03  -0.086 0.931211
## LotShape.Q    -7.731e+02  3.067e+03  -0.252 0.801014
## LotShape.C     2.104e+03  2.337e+03   0.900 0.368184
## LandContour.L   9.143e+03  2.626e+03   3.482 0.000515 ***
## LandContour.Q  -2.635e+03  2.510e+03  -1.050 0.293931
## LandContour.C  -2.290e+03  2.577e+03  -0.889 0.374326
## Utilities      3.199e+04  1.959e+04   1.633 0.102674
## LotConfigCulDSac 6.848e+03  2.347e+03   2.918 0.003589 **
## LotConfigFR2   -7.689e+03  3.014e+03  -2.551 0.010855 *
## LotConfigFR3   -1.365e+04  7.403e+03  -1.844 0.065486 .
## LotConfigInside -2.133e+03  1.265e+03  -1.686 0.092071 .
## LandSlope.L    2.579e+04  5.947e+03   4.336 1.57e-05 ***

```



## LandSlope.Q	-2.198e+04	3.791e+03	-5.798	8.51e-09	***
## NeighborhoodBlueste	-1.215e+03	1.032e+04	-0.118	0.906247	
## NeighborhoodBrDale	-1.733e+03	8.301e+03	-0.209	0.834616	
## NeighborhoodBrkSide	1.043e+03	6.721e+03	0.155	0.876683	
## NeighborhoodClearCr	-8.504e+03	7.135e+03	-1.192	0.233504	
## NeighborhoodCollgCr	-2.103e+03	5.236e+03	-0.402	0.687938	
## NeighborhoodCrawfor	1.859e+04	6.067e+03	3.064	0.002229	**
## NeighborhoodEdwards	-1.691e+04	5.743e+03	-2.944	0.003296	**
## NeighborhoodGilbert	-6.420e+03	5.420e+03	-1.184	0.236475	
## NeighborhoodIDOTRR	-8.227e+03	7.261e+03	-1.133	0.257417	
## NeighborhoodMeadowV	-9.164e+03	8.320e+03	-1.101	0.270950	
## NeighborhoodMitchel	-1.391e+04	5.908e+03	-2.354	0.018711	*
## NeighborhoodNames	-1.138e+04	5.639e+03	-2.017	0.043878	*
## NeighborhoodNoRidge	3.135e+04	6.108e+03	5.133	3.31e-07	***
## NeighborhoodNPkVill	1.174e+04	1.419e+04	0.828	0.407973	
## NeighborhoodNridgHt	2.201e+04	5.373e+03	4.096	4.48e-05	***
## NeighborhoodNWAms	-1.163e+04	5.824e+03	-1.996	0.046148	*
## NeighborhoodOldTown	-9.894e+03	6.845e+03	-1.446	0.148569	
## NeighborhoodSawyer	-6.365e+03	5.786e+03	-1.100	0.271486	
## NeighborhoodSawyerW	2.192e+02	5.509e+03	0.040	0.968273	
## NeighborhoodSomerst	1.589e+03	6.090e+03	0.261	0.794160	
## NeighborhoodStoneBr	4.279e+04	5.999e+03	7.133	1.67e-12	***
## NeighborhoodSWISU	-9.351e+02	6.891e+03	-0.136	0.892076	
## NeighborhoodTimber	-7.581e+03	5.900e+03	-1.285	0.199076	
## NeighborhoodVeenker	3.100e+03	7.447e+03	0.416	0.677239	
## Condition1.L	4.704e+03	4.170e+03	1.128	0.259554	
## Condition1.Q	-3.548e+03	3.476e+03	-1.021	0.307658	
## Condition1.C	-1.102e+04	3.513e+03	-3.135	0.001758	**
## Condition1^4	4.541e+03	3.162e+03	1.436	0.151263	
## Condition1^5	1.577e+03	2.103e+03	0.750	0.453298	
## Condition2.L	5.560e+04	1.256e+04	4.427	1.04e-05	***
## Condition2.Q	2.341e+04	1.129e+04	2.073	0.038356	*
## Condition2.C	3.415e+04	9.502e+03	3.594	0.000338	***
## Condition2^4	5.662e+03	7.589e+03	0.746	0.455736	
## BldgType2fmCon	-1.448e+04	2.080e+04	-0.696	0.486554	
## BldgTypeDuplex	NA	NA	NA	NA	
## BldgTypeTwnhsE	-2.388e+03	1.228e+04	-0.194	0.845847	
## HouseStyle1.5Unf	1.719e+04	1.070e+04	1.607	0.108360	
## HouseStyle1Story	4.821e+03	6.337e+03	0.761	0.446903	
## HouseStyle2.5Fin	1.934e+03	1.488e+04	0.130	0.896652	
## HouseStyle2.5Unf	1.499e+03	1.214e+04	0.123	0.901760	
## HouseStyle2Story	-1.203e+04	5.391e+03	-2.231	0.025861	*
## HouseStyleSFoyer	7.723e+03	8.098e+03	0.954	0.340428	
## HouseStyleSLvl	5.091e+03	9.598e+03	0.530	0.595928	
## OverallQual	6.837e+03	7.140e+02	9.575	< 2e-16	***
## OverallCond	5.220e+03	5.913e+02	8.828	< 2e-16	***
## YearBuilt	3.145e+02	5.948e+01	5.287	1.47e-07	***
## YearRemodAdd	1.316e+02	3.923e+01	3.356	0.000816	***
## RoofStyleGable	-1.871e+04	1.216e+04	-1.539	0.124118	
## RoofStyleGambrel	-1.956e+04	1.358e+04	-1.440	0.150236	
## RoofStyleHip	-1.722e+04	1.222e+04	-1.409	0.159113	
## RoofStyleMansard	-1.799e+04	1.351e+04	-1.332	0.183222	
## RoofStyleShed	-3.564e+04	1.648e+04	-2.163	0.030729	*
## RoofMatl.L	2.771e+04	1.340e+04	2.068	0.038842	*

## RoofMatl.Q	-1.445e+04	1.460e+04	-0.990	0.322596	
## RoofMatl.C	-1.324e+04	6.454e+03	-2.052	0.040400	*
## Exterior1stAsphShn	-1.068e+04	2.513e+04	-0.425	0.670846	
## Exterior1stBrkComm	-1.602e+03	1.727e+04	-0.093	0.926091	
## Exterior1stBrkFace	1.505e+04	1.224e+04	1.230	0.219049	
## Exterior1stCemntBd	-9.854e+03	1.531e+04	-0.644	0.519828	
## Exterior1stHdBoard	-1.059e+04	1.209e+04	-0.876	0.381219	
## Exterior1stMetalSd	1.234e+02	1.281e+04	0.010	0.992313	
## Exterior1stPlywood	-9.113e+03	1.210e+04	-0.753	0.451449	
## Exterior1stStone	-2.461e+04	2.293e+04	-1.073	0.283440	
## Exterior1stStucco	-7.074e+03	1.214e+04	-0.583	0.560298	
## Exterior1stVinylSd	-8.835e+03	1.180e+04	-0.749	0.454154	
## Exterior1stWd Sdng	-1.012e+04	1.168e+04	-0.866	0.386436	
## Exterior1stWdShng	-3.688e+03	1.226e+04	-0.301	0.763555	
## Exterior2ndAsphShn	8.646e+03	2.130e+04	0.406	0.684859	
## Exterior2ndBrk Cmn	3.189e+03	1.760e+04	0.181	0.856227	
## Exterior2ndBrkFace	-3.121e+03	1.224e+04	-0.255	0.798830	
## Exterior2ndCBlock	-8.543e+03	1.820e+04	-0.469	0.638821	
## Exterior2ndCmentBd	1.297e+04	1.499e+04	0.865	0.386998	
## Exterior2ndHdBoard	6.727e+03	1.161e+04	0.580	0.562316	
## Exterior2ndImStucc	5.609e+03	1.354e+04	0.414	0.678840	
## Exterior2ndMetalSd	1.334e+02	1.237e+04	0.011	0.991397	
## Exterior2ndOther	-1.548e+04	2.037e+04	-0.760	0.447342	
## Exterior2ndPlywood	3.120e+03	1.157e+04	0.270	0.787359	
## Exterior2ndStone	-3.459e+04	1.716e+04	-2.016	0.044013	*
## Exterior2ndStucco	3.824e+03	1.150e+04	0.333	0.739497	
## Exterior2ndVinylSd	8.886e+03	1.136e+04	0.782	0.434106	
## Exterior2ndWd Sdng	8.467e+03	1.126e+04	0.752	0.452367	
## Exterior2ndWd Shng	4.961e+02	1.140e+04	0.044	0.965290	
## MasVnrTypeBrkFace	8.441e+03	5.291e+03	1.595	0.110900	
## MasVnrTypeNone	-6.783e+03	6.282e+03	-1.080	0.280470	
## MasVnrTypeStone	1.826e+04	5.521e+03	3.307	0.000971	***
## MasVnrArea	1.132e+02	1.402e+01	8.076	1.58e-15	***
## ExterQual0	-2.381e+04	6.299e+03	-3.780	0.000165	***
## ExterQual2	-2.631e+04	3.355e+03	-7.841	9.61e-15	***
## ExterQual1	-2.653e+04	3.797e+03	-6.986	4.61e-12	***
## ExterCond1	7.936e+02	8.393e+03	0.095	0.924677	
## ExterCond3	-5.581e+03	7.537e+03	-0.741	0.459108	
## ExterCond0	1.955e+04	2.014e+04	0.971	0.331815	
## ExterCond2	-5.107e+02	7.497e+03	-0.068	0.945700	
## FoundationCBlock	5.562e+03	2.161e+03	2.574	0.010159	*
## FoundationPConc	5.391e+03	2.363e+03	2.281	0.022713	*
## FoundationSlab	6.068e+03	6.508e+03	0.932	0.351328	
## FoundationStone	1.652e+04	7.380e+03	2.238	0.025399	*
## FoundationWood	-2.680e+04	1.296e+04	-2.068	0.038889	*
## BsmtQual.L	1.564e+05	6.961e+04	2.247	0.024833	*
## BsmtQual.Q	-1.236e+05	5.881e+04	-2.101	0.035814	*
## BsmtQual.C	8.899e+04	3.479e+04	2.558	0.010642	*
## BsmtQual^4	-2.717e+04	1.322e+04	-2.055	0.040129	*
## BsmtCond.L	-1.283e+05	3.369e+04	-3.809	0.000147	***
## BsmtCond.Q	8.654e+04	2.309e+04	3.749	0.000186	***
## BsmtCond.C	-3.102e+04	8.683e+03	-3.573	0.000367	***
## BsmtCond^4	NA	NA	NA	NA	
## BsmtExposure.L	2.630e+04	7.470e+03	3.521	0.000446	***

## BsmtExposure.Q	2.233e+03	6.672e+03	0.335	0.737967	
## BsmtExposure.C	8.485e+03	4.135e+03	2.052	0.040400	*
## BsmtExposure^4	NA	NA	NA	NA	
## BsmtFinType1.L	-3.343e+03	2.777e+04	-0.120	0.904192	
## BsmtFinType1.Q	1.308e+04	2.707e+04	0.483	0.629015	
## BsmtFinType1.C	-1.044e+04	2.029e+04	-0.515	0.606945	
## BsmtFinType1^4	6.571e+03	1.195e+04	0.550	0.582379	
## BsmtFinType1^5	2.443e+03	5.271e+03	0.463	0.643109	
## BsmtFinType1^6	NA	NA	NA	NA	
## BsmtFinSF1	3.272e+01	3.522e+00	9.290	< 2e-16	***
## BsmtFinType2.L	-3.147e+04	4.576e+04	-0.688	0.491781	
## BsmtFinType2.Q	4.924e+04	4.393e+04	1.121	0.262627	
## BsmtFinType2.C	-2.555e+04	3.324e+04	-0.769	0.442195	
## BsmtFinType2^4	1.674e+04	1.928e+04	0.868	0.385303	
## BsmtFinType2^5	-7.937e+03	9.668e+03	-0.821	0.411837	
## BsmtFinType2^6	NA	NA	NA	NA	
## BsmtFinSF2	2.506e+01	6.447e+00	3.887	0.000107	***
## BsmtUnfSF	2.312e+01	3.222e+00	7.177	1.23e-12	***
## TotalBsmtSF	NA	NA	NA	NA	
## HeatingQC.L	3.607e+02	2.131e+03	0.169	0.865629	
## HeatingQC.Q	3.234e+03	1.632e+03	1.981	0.047815	*
## HeatingQC.C	2.524e+01	1.190e+03	0.021	0.983075	
## CentralAir1	-1.219e+03	2.410e+03	-0.506	0.613090	
## X1stFlrSF	4.093e+01	3.816e+00	10.725	< 2e-16	***
## X2ndFlrSF	6.301e+01	3.958e+00	15.919	< 2e-16	***
## LowQualFinSF	8.127e+00	1.444e+01	0.563	0.573679	
## GrLivArea	NA	NA	NA	NA	
## BsmtFullBath	3.037e+03	1.351e+03	2.248	0.024748	*
## BsmtHalfBath	1.203e+03	2.036e+03	0.591	0.554527	
## FullBath	4.538e+03	1.478e+03	3.071	0.002181	**
## HalfBath	1.059e+03	1.456e+03	0.727	0.467236	
## BedroomAbvGr	-4.334e+03	9.643e+02	-4.495	7.62e-06	***
## KitchenAbvGr	-8.340e+03	5.180e+03	-1.610	0.107649	
## KitchenQual.L	1.293e+04	2.774e+03	4.659	3.52e-06	***
## KitchenQual.Q	1.061e+04	1.944e+03	5.457	5.84e-08	***
## KitchenQual.C	4.120e+03	1.147e+03	3.592	0.000341	***
## TotRmsAbvGrd	1.658e+03	6.551e+02	2.531	0.011498	*
## Functional.L	4.076e+04	1.068e+04	3.817	0.000142	***
## Functional.Q	-1.443e+04	1.033e+04	-1.398	0.162477	
## Functional.C	1.798e+04	8.437e+03	2.131	0.033306	*
## Functional^4	-8.869e+03	7.109e+03	-1.248	0.212415	
## Functional^5	6.147e+03	5.506e+03	1.116	0.264474	
## Functional^6	1.150e+04	5.562e+03	2.067	0.038911	*
## Fireplaces	2.547e+03	1.827e+03	1.394	0.163483	
## FireplaceQu.L	-2.377e+03	3.337e+03	-0.712	0.476362	
## FireplaceQu.Q	5.733e+03	2.980e+03	1.924	0.054618	.
## FireplaceQu.C	1.359e+04	2.814e+03	4.831	1.53e-06	***
## FireplaceQu^4	-9.916e+03	2.647e+03	-3.746	0.000188	***
## FireplaceQu^5	9.490e+03	2.417e+03	3.926	9.10e-05	***
## GarageType.L	1.317e+05	6.619e+04	1.989	0.046896	*
## GarageType.Q	-1.509e+05	6.051e+04	-2.494	0.012757	*
## GarageType.C	8.313e+04	4.136e+04	2.010	0.044658	*
## GarageType^4	-5.478e+04	2.139e+04	-2.561	0.010569	*
## GarageType^5	1.298e+04	7.365e+03	1.763	0.078157	.

```

## GarageYrBlt      -5.628e+01  4.237e+01  -1.328  0.184309
## GarageFinish.L   -4.882e+03  3.407e+03  -1.433  0.152085
## GarageFinish.Q    4.687e+03  2.373e+03   1.976  0.048414 *
## GarageFinish.C           NA           NA           NA           NA
## GarageCars        6.583e+03  1.637e+03   4.021  6.16e-05 ***
## GarageArea        7.261e+00  5.634e+00   1.289  0.197714
## GarageQual.L      3.394e+04  5.300e+04   0.640  0.522127
## GarageQual.Q      1.408e+05  4.842e+04   2.907  0.003714 **
## GarageQual.C      3.070e+03  2.282e+04   0.135  0.892994
## GarageQual^4      6.492e+04  1.315e+04   4.936  9.06e-07 ***
## GarageQual^5           NA           NA           NA           NA
## GarageCond.L     -3.116e+04  3.018e+04  -1.032  0.302082
## GarageCond.Q      1.085e+04  2.065e+04   0.525  0.599466
## GarageCond.C     -1.526e+04  9.556e+03  -1.597  0.110512
## GarageCond^4           NA           NA           NA           NA
## PavedDrive.L      4.935e+02  1.622e+03   0.304  0.760970
## PavedDrive.Q      2.110e+03  2.871e+03   0.735  0.462640
## WoodDeckSF        1.700e+01  4.198e+00   4.050  5.45e-05 ***
## OpenPorchSF     -3.384e+00  8.726e+00  -0.388  0.698210
## EnclosedPorch     2.138e+01  8.448e+00   2.531  0.011489 *
## X3SsnPorch        3.577e+01  1.501e+01   2.383  0.017340 *
## ScreenPorch       4.825e+01  8.332e+00   5.790  8.91e-09 ***
## PoolArea          1.179e+03  9.072e+01  13.001  < 2e-16 ***
## PoolQC.L         -3.907e+05  2.475e+04 -15.788  < 2e-16 ***
## PoolQC.Q          4.300e+05  3.907e+04  11.006  < 2e-16 ***
## PoolQC.C         -7.359e+04  1.529e+04  -4.814  1.66e-06 ***
## Fence.L          -2.257e+03  1.322e+03  -1.707  0.088089 .
## Fence.Q          -2.253e+03  1.361e+03  -1.656  0.098056 .
## MiscFeature.L     3.459e+04  7.348e+03   4.707  2.80e-06 ***
## MiscFeature.Q     1.744e+04  4.446e+03   3.922  9.27e-05 ***
## MiscVal          -4.421e+00  8.967e-01  -4.931  9.32e-07 ***
## MoSold           -2.807e+02  1.710e+02  -1.641  0.100981
## YrSold            -8.365e+02  3.545e+02  -2.360  0.018437 *
## SaleTypeCon       1.183e+04  1.219e+04   0.971  0.331971
## SaleTypeConLD     1.321e+04  5.421e+03   2.436  0.014976 *
## SaleTypeConLI     3.669e+03  7.522e+03   0.488  0.625793
## SaleTypeConLw     8.307e+03  1.042e+04   0.797  0.425517
## SaleTypeCWD       2.053e+04  7.562e+03   2.715  0.006719 **
## SaleTypeNew       2.255e+04  3.554e+03   6.343  3.15e-10 ***
## SaleTypeOth       5.669e+03  1.002e+04   0.566  0.571690
## SaleTypeWD       -1.060e+03  2.950e+03  -0.359  0.719409
## SaleCondition.L    1.084e+04  6.225e+03   1.740  0.082023 .
## SaleCondition.Q   -5.110e+02  3.635e+03  -0.141  0.888240
## MasVnrArea_Sqrt  -2.874e+03  4.781e+02  -6.012  2.41e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15950 on 1228 degrees of freedom
## Multiple R-squared:  0.9652, Adjusted R-squared:  0.9587
## F-statistic: 148.1 on 230 and 1228 DF,  p-value: < 2.2e-16

## Start:  AIC=28447.84
## SalePrice ~ (ID + MSSubClass + MSZoning + LotArea + Street +
##      Alley + LotShape + LandContour + Utilities + LotConfig +

```

```

## LandSlope + Neighborhood + Condition1 + Condition2 + BldgType +
## HouseStyle + OverallQual + OverallCond + YearBuilt + YearRemodAdd +
## RoofStyle + RoofMatl + Exterior1st + Exterior2nd + MasVnrType +
## MasVnrArea + ExterQual + ExterCond + Foundation + BsmtQual +
## BsmtCond + BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
## BsmtFinSF2 + BsmtUnfSF + TotalBsmtSF + HeatingQC + CentralAir +
## X1stFlrSF + X2ndFlrSF + LowQualFinSF + GrLivArea + BsmtFullBath +
## BsmtHalfBath + FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr +
## KitchenQual + TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu +
## GarageType + GarageYrBlt + GarageFinish + GarageCars + GarageArea +
## GarageQual + GarageCond + PavedDrive + WoodDeckSF + OpenPorchSF +
## EnclosedPorch + X3SsnPorch + ScreenPorch + PoolArea + PoolQC +
## Fence + MiscFeature + MiscVal + MoSold + YrSold + SaleType +
## SaleCondition + MasVnrArea_Sqrt) - ID
##
##
## Step: AIC=28447.84
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + Alley +
## LotShape + LandContour + Utilities + LotConfig + LandSlope +
## Neighborhood + Condition1 + Condition2 + BldgType + HouseStyle +
## OverallQual + OverallCond + YearBuilt + YearRemodAdd + RoofStyle +
## RoofMatl + Exterior1st + Exterior2nd + MasVnrType + MasVnrArea +
## ExterQual + ExterCond + Foundation + BsmtQual + BsmtCond +
## BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
## BsmtFinSF2 + BsmtUnfSF + TotalBsmtSF + HeatingQC + CentralAir +
## X1stFlrSF + X2ndFlrSF + LowQualFinSF + BsmtFullBath + BsmtHalfBath +
## FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr + KitchenQual +
## TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu + GarageType +
## GarageYrBlt + GarageFinish + GarageCars + GarageArea + GarageQual +
## GarageCond + PavedDrive + WoodDeckSF + OpenPorchSF + EnclosedPorch +
## X3SsnPorch + ScreenPorch + PoolArea + PoolQC + Fence + MiscFeature +
## MiscVal + MoSold + YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##
## Step: AIC=28447.84
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + Alley +
## LotShape + LandContour + Utilities + LotConfig + LandSlope +
## Neighborhood + Condition1 + Condition2 + BldgType + HouseStyle +
## OverallQual + OverallCond + YearBuilt + YearRemodAdd + RoofStyle +
## RoofMatl + Exterior1st + Exterior2nd + MasVnrType + MasVnrArea +
## ExterQual + ExterCond + Foundation + BsmtQual + BsmtCond +
## BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
## BsmtFinSF2 + BsmtUnfSF + HeatingQC + CentralAir + X1stFlrSF +
## X2ndFlrSF + LowQualFinSF + BsmtFullBath + BsmtHalfBath +
## FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr + KitchenQual +
## TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu + GarageType +
## GarageYrBlt + GarageFinish + GarageCars + GarageArea + GarageQual +
## GarageCond + PavedDrive + WoodDeckSF + OpenPorchSF + EnclosedPorch +
## X3SsnPorch + ScreenPorch + PoolArea + PoolQC + Fence + MiscFeature +
## MiscVal + MoSold + YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##
##          Df Sum of Sq      RSS   AIC
## - LotShape    3 3.7771e+08 3.1262e+11 28444
## - BldgType     2 1.3349e+08 3.1237e+11 28444

```

## - PavedDrive	2	1.8385e+08	3.1242e+11	28445
## - RoofStyle	5	1.5542e+09	3.1379e+11	28445
## - Alley	2	4.0952e+08	3.1265e+11	28446
## - OpenPorchSF	1	3.8244e+07	3.1228e+11	28446
## - CentralAir	1	6.5049e+07	3.1230e+11	28446
## - LowQualFinSF	1	8.0535e+07	3.1232e+11	28446
## - BsmtHalfBath	1	8.8856e+07	3.1233e+11	28446
## - HalfBath	1	1.3446e+08	3.1237e+11	28446
## - Exterior2nd	15	6.3807e+09	3.1862e+11	28447
## - GarageCond	3	1.2693e+09	3.1351e+11	28448
## - GarageArea	1	4.2233e+08	3.1266e+11	28448
## <none>			3.1224e+11	28448
## - GarageYrBlt	1	4.4866e+08	3.1269e+11	28448
## - Fireplaces	1	4.9430e+08	3.1273e+11	28448
## - Fence	2	1.0158e+09	3.1325e+11	28449
## - GarageFinish	2	1.0230e+09	3.1326e+11	28449
## - KitchenAbvGr	1	6.5910e+08	3.1290e+11	28449
## - Utilities	1	6.7825e+08	3.1292e+11	28449
## - MoSold	1	6.8500e+08	3.1292e+11	28449
## - BsmtFinType2	5	2.6671e+09	3.1490e+11	28450
## - HouseStyle	7	3.8597e+09	3.1610e+11	28452
## - BsmtFullBath	1	1.2850e+09	3.1352e+11	28452
## - Street	1	1.3609e+09	3.1360e+11	28452
## - ExterCond	4	2.6670e+09	3.1490e+11	28452
## - HeatingQC	3	2.2720e+09	3.1451e+11	28452
## - YrSold	1	1.4160e+09	3.1365e+11	28452
## - X3SsnPorch	1	1.4435e+09	3.1368e+11	28453
## - TotRmsAbvGrd	1	1.6288e+09	3.1387e+11	28453
## - EnclosedPorch	1	1.6291e+09	3.1387e+11	28453
## - MSSubClass	13	6.9499e+09	3.1919e+11	28454
## - FullBath	1	2.3979e+09	3.1464e+11	28457
## - Foundation	5	4.3600e+09	3.1660e+11	28458
## - LandContour	3	3.6887e+09	3.1593e+11	28459
## - BsmtCond	3	3.6907e+09	3.1593e+11	28459
## - YearRemodAdd	1	2.8629e+09	3.1510e+11	28459
## - SaleCondition	2	4.2030e+09	3.1644e+11	28463
## - BsmtFinSF2	1	3.8425e+09	3.1608e+11	28464
## - MSZoning	4	5.2274e+09	3.1747e+11	28464
## - GarageCars	1	4.1105e+09	3.1635e+11	28465
## - WoodDeckSF	1	4.1699e+09	3.1641e+11	28465
## - BedroomAbvGr	1	5.1369e+09	3.1737e+11	28470
## - MiscFeature	2	5.6472e+09	3.1789e+11	28470
## - RoofMatl	3	6.1986e+09	3.1844e+11	28470
## - LotConfig	4	6.9799e+09	3.1922e+11	28472
## - MiscVal	1	6.1815e+09	3.1842e+11	28474
## - GarageType	4	7.7008e+09	3.1994e+11	28475
## - Exterior1st	12	1.1564e+10	3.2380e+11	28477
## - BsmtFinType1	5	8.6337e+09	3.2087e+11	28478
## - YearBuilt	1	7.1072e+09	3.1935e+11	28479
## - Condition2	4	8.5125e+09	3.2075e+11	28479
## - LandSlope	2	8.6724e+09	3.2091e+11	28484
## - FireplaceQu	5	1.0205e+10	3.2244e+11	28485
## - ScreenPorch	1	8.5254e+09	3.2076e+11	28485
## - MasVnrArea_Sqrt	1	9.1916e+09	3.2143e+11	28488

```

## - MasVnrType      3 1.2204e+10 3.2444e+11 28498
## - Functional      6 1.4873e+10 3.2711e+11 28504
## - GarageQual      4 1.4016e+10 3.2625e+11 28504
## - BsmtUnfSF       1 1.3097e+10 3.2533e+11 28506
## - Condition1      5 1.5027e+10 3.2727e+11 28506
## - ExterQual       3 1.5726e+10 3.2796e+11 28514
## - KitchenQual     3 1.6638e+10 3.2888e+11 28518
## - MasVnrArea      1 1.6585e+10 3.2882e+11 28521
## - OverallCond     1 1.9815e+10 3.3205e+11 28536
## - SaleType        8 2.3215e+10 3.3545e+11 28536
## - BsmtQual        3 2.1970e+10 3.3421e+11 28541
## - BsmtFinSF1      1 2.1943e+10 3.3418e+11 28545
## - LotArea         1 2.2227e+10 3.3446e+11 28546
## - OverallQual     1 2.3313e+10 3.3555e+11 28551
## - BsmtExposure    3 2.9274e+10 3.4151e+11 28573
## - X1stFlrSF       1 2.9249e+10 3.4149e+11 28576
## - PoolArea        1 4.2978e+10 3.5522e+11 28634
## - X2ndFlrSF       1 6.4435e+10 3.7667e+11 28720
## - PoolQC          3 7.7800e+10 3.9004e+11 28766
## - Neighborhood    24 1.0331e+11 4.1554e+11 28817
##
## Step: AIC=28443.61
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + Alley +
##   LandContour + Utilities + LotConfig + LandSlope + Neighborhood +
##   Condition1 + Condition2 + BldgType + HouseStyle + OverallQual +
##   OverallCond + YearBuilt + YearRemodAdd + RoofStyle + RoofMatl +
##   Exterior1st + Exterior2nd + MasVnrType + MasVnrArea + ExterQual +
##   ExterCond + Foundation + BsmtQual + BsmtCond + BsmtExposure +
##   BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 + BsmtFinSF2 + BsmtUnfSF +
##   HeatingQC + CentralAir + X1stFlrSF + X2ndFlrSF + LowQualFinSF +
##   BsmtFullBath + BsmtHalfBath + FullBath + HalfBath + BedroomAbvGr +
##   KitchenAbvGr + KitchenQual + TotRmsAbvGrd + Functional +
##   Fireplaces + FireplaceQu + GarageType + GarageYrBlt + GarageFinish +
##   GarageCars + GarageArea + GarageQual + GarageCond + PavedDrive +
##   WoodDeckSF + OpenPorchSF + EnclosedPorch + X3SsnPorch + ScreenPorch +
##   PoolArea + PoolQC + Fence + MiscFeature + MiscVal + MoSold +
##   YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##           Df Sum of Sq      RSS   AIC
## - BldgType      2 1.2384e+08 3.1274e+11 28440
## - PavedDrive     2 1.8125e+08 3.1280e+11 28440
## - RoofStyle      5 1.6186e+09 3.1423e+11 28441
## - Alley          2 4.0437e+08 3.1302e+11 28442
## - OpenPorchSF    1 4.1482e+07 3.1266e+11 28442
## - CentralAir     1 6.1102e+07 3.1268e+11 28442
## - LowQualFinSF   1 7.6231e+07 3.1269e+11 28442
## - BsmtHalfBath   1 1.0204e+08 3.1272e+11 28442
## - HalfBath       1 1.2940e+08 3.1274e+11 28442
## - Exterior2nd    15 6.4427e+09 3.1906e+11 28443
## - GarageArea     1 3.9044e+08 3.1301e+11 28443
## <none>              3.1262e+11 28444
## - GarageYrBlt    1 4.6526e+08 3.1308e+11 28444
## - Fireplaces     1 4.6974e+08 3.1309e+11 28444
## - GarageCond     3 1.3389e+09 3.1395e+11 28444

```

## - Fence	2	9.8445e+08	3.1360e+11	28444
## - GarageFinish	2	1.0540e+09	3.1367e+11	28444
## - KitchenAbvGr	1	6.5480e+08	3.1327e+11	28445
## - MoSold	1	6.7302e+08	3.1329e+11	28445
## - Utilities	1	6.8341e+08	3.1330e+11	28445
## - BsmtFinType2	5	2.8596e+09	3.1548e+11	28447
## - HouseStyle	7	3.8448e+09	3.1646e+11	28447
## - Street	1	1.2893e+09	3.1390e+11	28448
## - BsmtFullBath	1	1.3370e+09	3.1395e+11	28448
## - YrSold	1	1.3937e+09	3.1401e+11	28448
## - HeatingQC	3	2.2684e+09	3.1488e+11	28448
## - ExterCond	4	2.7326e+09	3.1535e+11	28448
## - X3SsnPorch	1	1.4749e+09	3.1409e+11	28448
## - EnclosedPorch	1	1.6256e+09	3.1424e+11	28449
## - TotRmsAbvGrd	1	1.6298e+09	3.1425e+11	28449
## - MSSubClass	13	6.9805e+09	3.1960e+11	28450
## - FullBath	1	2.3807e+09	3.1500e+11	28453
## - Foundation	5	4.4295e+09	3.1705e+11	28454
## - BsmtCond	3	3.6170e+09	3.1623e+11	28454
## - LandContour	3	3.7680e+09	3.1638e+11	28455
## - YearRemodAdd	1	2.9909e+09	3.1561e+11	28456
## - SaleCondition	2	4.1561e+09	3.1677e+11	28459
## - BsmtFinSF2	1	3.7719e+09	3.1639e+11	28459
## - MSZoning	4	5.2572e+09	3.1787e+11	28460
## - WoodDeckSF	1	4.0971e+09	3.1671e+11	28461
## - GarageCars	1	4.1193e+09	3.1673e+11	28461
## - BedroomAbvGr	1	5.2023e+09	3.1782e+11	28466
## - RoofMatl	3	6.1874e+09	3.1880e+11	28466
## - MiscFeature	2	5.9367e+09	3.1855e+11	28467
## - LotConfig	4	7.1752e+09	3.1979e+11	28469
## - GarageType	4	7.7441e+09	3.2036e+11	28471
## - MiscVal	1	6.4661e+09	3.1908e+11	28472
## - BsmtFinType1	5	8.6139e+09	3.2123e+11	28473
## - Exterior1st	12	1.1755e+10	3.2437e+11	28474
## - Condition2	4	8.4975e+09	3.2111e+11	28475
## - YearBuilt	1	7.1853e+09	3.1980e+11	28475
## - LandSlope	2	8.7081e+09	3.2132e+11	28480
## - FireplaceQu	5	1.0250e+10	3.2287e+11	28481
## - ScreenPorch	1	8.6840e+09	3.2130e+11	28482
## - MasVnrArea_Sqrt	1	9.1337e+09	3.2175e+11	28484
## - MasVnrType	3	1.2151e+10	3.2477e+11	28493
## - Functional	6	1.5147e+10	3.2776e+11	28501
## - BsmtUnfSF	1	1.3028e+10	3.2564e+11	28501
## - Condition1	5	1.4907e+10	3.2752e+11	28502
## - GarageQual	4	1.4657e+10	3.2727e+11	28502
## - ExterQual	3	1.6073e+10	3.2869e+11	28511
## - KitchenQual	3	1.6515e+10	3.2913e+11	28513
## - MasVnrArea	1	1.6475e+10	3.2909e+11	28516
## - OverallCond	1	1.9872e+10	3.3249e+11	28532
## - SaleType	8	2.3275e+10	3.3589e+11	28532
## - BsmtQual	3	2.1835e+10	3.3445e+11	28536
## - BsmtFinSF1	1	2.1870e+10	3.3449e+11	28540
## - OverallQual	1	2.3284e+10	3.3590e+11	28546
## - LotArea	1	2.4848e+10	3.3746e+11	28553



```

## - BsmtExposure      3 2.9577e+10 3.4219e+11 28570
## - X1stFlrSF         1 2.9620e+10 3.4224e+11 28574
## - PoolArea          1 4.2864e+10 3.5548e+11 28629
## - X2ndFlrSF         1 6.4805e+10 3.7742e+11 28716
## - PoolQC            3 7.7708e+10 3.9032e+11 28762
## - Neighborhood     24 1.0321e+11 4.1582e+11 28812
##
## Step:  AIC=28440.19
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + Alley +
##   LandContour + Utilities + LotConfig + LandSlope + Neighborhood +
##   Condition1 + Condition2 + HouseStyle + OverallQual + OverallCond +
##   YearBuilt + YearRemodAdd + RoofStyle + RoofMatl + Exterior1st +
##   Exterior2nd + MasVnrType + MasVnrArea + ExterQual + ExterCond +
##   Foundation + BsmtQual + BsmtCond + BsmtExposure + BsmtFinType1 +
##   BsmtFinSF1 + BsmtFinType2 + BsmtFinSF2 + BsmtUnfSF + HeatingQC +
##   CentralAir + X1stFlrSF + X2ndFlrSF + LowQualFinSF + BsmtFullBath +
##   BsmtHalfBath + FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr +
##   KitchenQual + TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu +
##   GarageType + GarageYrBlt + GarageFinish + GarageCars + GarageArea +
##   GarageQual + GarageCond + PavedDrive + WoodDeckSF + OpenPorchSF +
##   EnclosedPorch + X3SsnPorch + ScreenPorch + PoolArea + PoolQC +
##   Fence + MiscFeature + MiscVal + MoSold + YrSold + SaleType +
##   SaleCondition + MasVnrArea_Sqrt
##
##           Df  Sum of Sq      RSS   AIC
## - PavedDrive      2 1.6595e+08 3.1291e+11 28437
## - RoofStyle       5 1.6454e+09 3.1438e+11 28438
## - Alley           2 3.7920e+08 3.1312e+11 28438
## - OpenPorchSF     1 3.6742e+07 3.1278e+11 28438
## - CentralAir      1 5.5513e+07 3.1279e+11 28438
## - LowQualFinSF    1 7.7267e+07 3.1282e+11 28438
## - BsmtHalfBath    1 1.0951e+08 3.1285e+11 28439
## - HalfBath        1 1.3559e+08 3.1287e+11 28439
## - GarageArea      1 3.6876e+08 3.1311e+11 28440
## <none>                3.1274e+11 28440
## - Exterior2nd    15 6.5014e+09 3.1924e+11 28440
## - Fireplaces      1 4.5259e+08 3.1319e+11 28440
## - GarageYrBlt     1 4.6943e+08 3.1321e+11 28440
## - GarageCond      3 1.3641e+09 3.1410e+11 28440
## - Fence           2 9.3624e+08 3.1368e+11 28440
## - GarageFinish    2 1.0380e+09 3.1378e+11 28441
## - KitchenAbvGr    1 6.2985e+08 3.1337e+11 28441
## - MoSold          1 6.8468e+08 3.1342e+11 28441
## - Utilities       1 6.9175e+08 3.1343e+11 28441
## - BsmtFinType2    5 2.8589e+09 3.1560e+11 28444
## - HouseStyle      7 3.7298e+09 3.1647e+11 28444
## - Street          1 1.2947e+09 3.1403e+11 28444
## - BsmtFullBath    1 1.3356e+09 3.1407e+11 28444
## - YrSold           1 1.4134e+09 3.1415e+11 28445
## - HeatingQC       3 2.2839e+09 3.1502e+11 28445
## - ExterCond       4 2.7280e+09 3.1547e+11 28445
## - X3SsnPorch      1 1.4775e+09 3.1422e+11 28445
## - EnclosedPorch   1 1.6013e+09 3.1434e+11 28446
## - TotRmsAbvGrd    1 1.6256e+09 3.1436e+11 28446

```

```

## - FullBath          1 2.3582e+09 3.1510e+11 28449
## - Foundation        5 4.3449e+09 3.1708e+11 28450
## - BsmtCond          3 3.5618e+09 3.1630e+11 28451
## - LandContour       3 3.7139e+09 3.1645e+11 28451
## - YearRemodAdd      1 2.9963e+09 3.1574e+11 28452
## - SaleCondition     2 4.1382e+09 3.1688e+11 28455
## - BsmtFinSF2        1 3.7747e+09 3.1651e+11 28456
## - MSZoning          4 5.3171e+09 3.1806e+11 28457
## - WoodDeckSF        1 4.1277e+09 3.1687e+11 28457
## - GarageCars        1 4.2173e+09 3.1696e+11 28458
## - BedroomAbvGr      1 5.2254e+09 3.1796e+11 28462
## - RoofMatl          3 6.1791e+09 3.1892e+11 28463
## - MiscFeature       2 5.9075e+09 3.1865e+11 28464
## - LotConfig         4 7.2817e+09 3.2002e+11 28466
## - MiscVal           1 6.4659e+09 3.1921e+11 28468
## - GarageType        4 7.7824e+09 3.2052e+11 28468
## - BsmtFinType1      5 8.6099e+09 3.2135e+11 28470
## - Exterior1st      12 1.1845e+10 3.2458e+11 28470
## - Condition2        4 8.5185e+09 3.2126e+11 28471
## - YearBuilt         1 7.2985e+09 3.2004e+11 28472
## - LandSlope         2 8.7756e+09 3.2151e+11 28477
## - FireplaceQu       5 1.0259e+10 3.2300e+11 28477
## - ScreenPorch       1 8.7499e+09 3.2149e+11 28478
## - MasVnrArea_Sqrt   1 9.1263e+09 3.2187e+11 28480
## - MasVnrType        3 1.2142e+10 3.2488e+11 28490
## - Functional        6 1.5112e+10 3.2785e+11 28497
## - BsmtUnfSF         1 1.2946e+10 3.2569e+11 28497
## - Condition1        5 1.4884e+10 3.2762e+11 28498
## - GarageQual        4 1.4604e+10 3.2734e+11 28499
## - ExterQual         3 1.6141e+10 3.2888e+11 28508
## - KitchenQual       3 1.6522e+10 3.2926e+11 28509
## - MasVnrArea        1 1.6464e+10 3.2920e+11 28513
## - MSSubClass        14 2.5672e+10 3.3841e+11 28527
## - OverallCond       1 1.9760e+10 3.3250e+11 28528
## - SaleType          8 2.3187e+10 3.3593e+11 28528
## - BsmtQual          3 2.1831e+10 3.3457e+11 28533
## - BsmtFinSF1        1 2.1789e+10 3.3453e+11 28536
## - OverallQual       1 2.3369e+10 3.3611e+11 28543
## - LotArea           1 2.5123e+10 3.3786e+11 28551
## - BsmtExposure      3 2.9701e+10 3.4244e+11 28567
## - X1stFlrSF         1 2.9659e+10 3.4240e+11 28570
## - PoolArea          1 4.2845e+10 3.5558e+11 28626
## - X2ndFlrSF         1 6.4960e+10 3.7770e+11 28714
## - PoolQC            3 7.7701e+10 3.9044e+11 28758
## - Neighborhood      24 1.0459e+11 4.1733e+11 28813
##
## Step:  AIC=28436.96
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + Alley +
##   LandContour + Utilities + LotConfig + LandSlope + Neighborhood +
##   Condition1 + Condition2 + HouseStyle + OverallQual + OverallCond +
##   YearBuilt + YearRemodAdd + RoofStyle + RoofMatl + Exterior1st +
##   Exterior2nd + MasVnrType + MasVnrArea + ExterQual + ExterCond +
##   Foundation + BsmtQual + BsmtCond + BsmtExposure + BsmtFinType1 +
##   BsmtFinSF1 + BsmtFinType2 + BsmtFinSF2 + BsmtUnfSF + HeatingQC +

```

```

##      CentralAir + X1stFlrSF + X2ndFlrSF + LowQualFinSF + BsmtFullBath +
##      BsmtHalfBath + FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr +
##      KitchenQual + TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu +
##      GarageType + GarageYrBlt + GarageFinish + GarageCars + GarageArea +
##      GarageQual + GarageCond + WoodDeckSF + OpenPorchSF + EnclosedPorch +
##      X3SsnPorch + ScreenPorch + PoolArea + PoolQC + Fence + MiscFeature +
##      MiscVal + MoSold + YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##      Df      Sum of Sq      RSS      AIC
## - Alley          2 3.6776e+08 3.1327e+11 28435
## - RoofStyle       5 1.6675e+09 3.1457e+11 28435
## - OpenPorchSF     1 4.2914e+07 3.1295e+11 28435
## - CentralAir      1 5.0618e+07 3.1296e+11 28435
## - LowQualFinSF    1 8.7146e+07 3.1299e+11 28435
## - BsmtHalfBath    1 1.1263e+08 3.1302e+11 28436
## - HalfBath        1 1.3800e+08 3.1304e+11 28436
## - GarageArea      1 3.7142e+08 3.1328e+11 28437
## <none>                                3.1291e+11 28437
## - GarageYrBlt     1 4.2948e+08 3.1333e+11 28437
## - Exterior2nd     15 6.5156e+09 3.1942e+11 28437
## - Fireplaces       1 4.6070e+08 3.1337e+11 28437
## - GarageCond       3 1.3295e+09 3.1423e+11 28437
## - Fence            2 9.2199e+08 3.1383e+11 28437
## - GarageFinish     2 1.0529e+09 3.1396e+11 28438
## - KitchenAbvGr     1 6.4887e+08 3.1355e+11 28438
## - MoSold           1 6.5952e+08 3.1356e+11 28438
## - Utilities        1 6.8823e+08 3.1359e+11 28438
## - HouseStyle       7 3.6919e+09 3.1660e+11 28440
## - BsmtFinType2     5 2.8486e+09 3.1575e+11 28440
## - BsmtFullBath     1 1.2908e+09 3.1420e+11 28441
## - Street           1 1.3098e+09 3.1422e+11 28441
## - ExterCond        4 2.6779e+09 3.1558e+11 28441
## - YrSold            1 1.4173e+09 3.1432e+11 28442
## - X3SsnPorch       1 1.4848e+09 3.1439e+11 28442
## - HeatingQC        3 2.3547e+09 3.1526e+11 28442
## - EnclosedPorch    1 1.5602e+09 3.1447e+11 28442
## - TotRmsAbvGrd     1 1.5847e+09 3.1449e+11 28442
## - FullBath         1 2.3276e+09 3.1523e+11 28446
## - Foundation       5 4.3333e+09 3.1724e+11 28447
## - BsmtCond         3 3.5421e+09 3.1645e+11 28447
## - LandContour      3 3.6870e+09 3.1659e+11 28448
## - YearRemodAdd     1 3.0205e+09 3.1593e+11 28449
## - SaleCondition    2 4.0775e+09 3.1698e+11 28452
## - BsmtFinSF2       1 3.7589e+09 3.1666e+11 28452
## - MSZoning         4 5.3597e+09 3.1826e+11 28454
## - WoodDeckSF       1 4.0919e+09 3.1700e+11 28454
## - GarageCars       1 4.1629e+09 3.1707e+11 28454
## - BedroomAbvGr     1 5.1829e+09 3.1809e+11 28459
## - RoofMatl         3 6.1983e+09 3.1910e+11 28460
## - MiscFeature      2 5.8944e+09 3.1880e+11 28460
## - LotConfig        4 7.2678e+09 3.2017e+11 28462
## - MiscVal          1 6.4738e+09 3.1938e+11 28465
## - GarageType       4 7.8733e+09 3.2078e+11 28465
## - BsmtFinType1     5 8.6086e+09 3.2151e+11 28467

```

```

## - Exterior1st      12 1.2036e+10 3.2494e+11 28468
## - Condition2       4 8.5585e+09 3.2146e+11 28468
## - YearBuilt        1 7.4963e+09 3.2040e+11 28470
## - LandSlope        2 8.7646e+09 3.2167e+11 28473
## - FireplaceQu      5 1.0141e+10 3.2305e+11 28474
## - ScreenPorch      1 8.7798e+09 3.2169e+11 28475
## - MasVnrArea_Sqrt  1 9.1094e+09 3.2201e+11 28477
## - MasVnrType       3 1.2126e+10 3.2503e+11 28486
## - BsmtUnfSF        1 1.2872e+10 3.2578e+11 28494
## - Functional       6 1.5115e+10 3.2802e+11 28494
## - GarageQual       4 1.4671e+10 3.2758e+11 28496
## - Condition1       5 1.5127e+10 3.2803e+11 28496
## - ExterQual        3 1.6126e+10 3.2903e+11 28504
## - KitchenQual      3 1.6517e+10 3.2942e+11 28506
## - MasVnrArea       1 1.6456e+10 3.2936e+11 28510
## - MSSubClass      14 2.5603e+10 3.3851e+11 28524
## - OverallCond      1 1.9704e+10 3.3261e+11 28524
## - SaleType         8 2.3218e+10 3.3612e+11 28525
## - BsmtQual         3 2.1835e+10 3.3474e+11 28529
## - BsmtFinSF1       1 2.1813e+10 3.3472e+11 28533
## - OverallQual      1 2.3445e+10 3.3635e+11 28540
## - LotArea          1 2.5084e+10 3.3799e+11 28548
## - BsmtExposure     3 2.9816e+10 3.4272e+11 28564
## - X1stFlrSF        1 2.9971e+10 3.4288e+11 28568
## - PoolArea         1 4.2751e+10 3.5566e+11 28622
## - X2ndFlrSF        1 6.5145e+10 3.7805e+11 28711
## - PoolQC           3 7.7698e+10 3.9060e+11 28755
## - Neighborhood     24 1.0479e+11 4.1770e+11 28810
##
## Step:  AIC=28434.67
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + LandContour +
##   Utilities + LotConfig + LandSlope + Neighborhood + Condition1 +
##   Condition2 + HouseStyle + OverallQual + OverallCond + YearBuilt +
##   YearRemodAdd + RoofStyle + RoofMatl + Exterior1st + Exterior2nd +
##   MasVnrType + MasVnrArea + ExterQual + ExterCond + Foundation +
##   BsmtQual + BsmtCond + BsmtExposure + BsmtFinType1 + BsmtFinSF1 +
##   BsmtFinType2 + BsmtFinSF2 + BsmtUnfSF + HeatingQC + CentralAir +
##   X1stFlrSF + X2ndFlrSF + LowQualFinSF + BsmtFullBath + BsmtHalfBath +
##   FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr + KitchenQual +
##   TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu + GarageType +
##   GarageYrBlt + GarageFinish + GarageCars + GarageArea + GarageQual +
##   GarageCond + WoodDeckSF + OpenPorchSF + EnclosedPorch + X3SsnPorch +
##   ScreenPorch + PoolArea + PoolQC + Fence + MiscFeature + MiscVal +
##   MoSold + YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##           Df Sum of Sq      RSS   AIC
## - RoofStyle      5 1.6390e+09 3.1491e+11 28432
## - CentralAir      1 4.8774e+07 3.1332e+11 28433
## - OpenPorchSF     1 5.0742e+07 3.1332e+11 28433
## - LowQualFinSF    1 6.4058e+07 3.1334e+11 28433
## - BsmtHalfBath    1 1.1105e+08 3.1338e+11 28433
## - HalfBath        1 1.2139e+08 3.1339e+11 28433
## - Exterior2nd    15 6.4677e+09 3.1974e+11 28434
## - GarageArea      1 4.0118e+08 3.1367e+11 28434

```

## <none>		3.1327e+11	28435
## - GarageYrBlt	1	4.6668e+08	3.1374e+11 28435
## - Fireplaces	1	4.6816e+08	3.1374e+11 28435
## - Fence	2	9.1727e+08	3.1419e+11 28435
## - GarageCond	3	1.3617e+09	3.1463e+11 28435
## - MoSold	1	6.1372e+08	3.1389e+11 28436
## - KitchenAbvGr	1	6.4424e+08	3.1392e+11 28436
## - GarageFinish	2	1.0808e+09	3.1435e+11 28436
## - Utilities	1	7.0246e+08	3.1398e+11 28436
## - HouseStyle	7	3.6205e+09	3.1689e+11 28437
## - BsmtFinType2	5	2.7890e+09	3.1606e+11 28438
## - BsmtFullBath	1	1.2655e+09	3.1454e+11 28439
## - Street	1	1.2682e+09	3.1454e+11 28439
## - YrSold	1	1.3763e+09	3.1465e+11 28439
## - ExterCond	4	2.7116e+09	3.1598e+11 28439
## - EnclosedPorch	1	1.4440e+09	3.1472e+11 28439
## - X3SsnPorch	1	1.4738e+09	3.1475e+11 28440
## - HeatingQC	3	2.3847e+09	3.1566e+11 28440
## - TotRmsAbvGrd	1	1.6940e+09	3.1497e+11 28440
## - FullBath	1	2.3536e+09	3.1563e+11 28444
## - Foundation	5	4.2887e+09	3.1756e+11 28444
## - BsmtCond	3	3.4755e+09	3.1675e+11 28445
## - LandContour	3	3.6504e+09	3.1692e+11 28446
## - YearRemodAdd	1	2.9561e+09	3.1623e+11 28446
## - SaleCondition	2	4.1624e+09	3.1744e+11 28450
## - BsmtFinSF2	1	3.7531e+09	3.1703e+11 28450
## - MSZoning	4	5.3214e+09	3.1859e+11 28451
## - GarageCars	1	4.1129e+09	3.1739e+11 28452
## - WoodDeckSF	1	4.1799e+09	3.1745e+11 28452
## - BedroomAbvGr	1	5.1699e+09	3.1844e+11 28457
## - RoofMatl	3	6.2502e+09	3.1952e+11 28458
## - MiscFeature	2	5.9009e+09	3.1917e+11 28458
## - LotConfig	4	7.2009e+09	3.2047e+11 28460
## - MiscVal	1	6.4505e+09	3.1972e+11 28462
## - GarageType	4	7.8932e+09	3.2117e+11 28463
## - BsmtFinType1	5	8.6595e+09	3.2193e+11 28464
## - Exterior1st	12	1.1828e+10	3.2510e+11 28465
## - Condition2	4	8.5723e+09	3.2185e+11 28466
## - YearBuilt	1	7.6590e+09	3.2093e+11 28468
## - LandSlope	2	8.7179e+09	3.2199e+11 28471
## - FireplaceQu	5	1.0213e+10	3.2349e+11 28472
## - ScreenPorch	1	8.8126e+09	3.2209e+11 28473
## - MasVnrArea_Sqrt	1	9.1236e+09	3.2240e+11 28475
## - MasVnrType	3	1.2015e+10	3.2529e+11 28484
## - BsmtUnfSF	1	1.2769e+10	3.2604e+11 28491
## - Functional	6	1.5062e+10	3.2833e+11 28491
## - Condition1	5	1.4937e+10	3.2821e+11 28493
## - GarageQual	4	1.4813e+10	3.2809e+11 28494
## - ExterQual	3	1.6111e+10	3.2938e+11 28502
## - KitchenQual	3	1.6703e+10	3.2998e+11 28504
## - MasVnrArea	1	1.6426e+10	3.2970e+11 28507
## - OverallCond	1	1.9884e+10	3.3316e+11 28522
## - SaleType	8	2.3197e+10	3.3647e+11 28523
## - MSSubClass	14	2.6610e+10	3.3988e+11 28526

```

## - BsmtQual          3 2.1886e+10 3.3516e+11 28527
## - BsmtFinSF1        1 2.1667e+10 3.3494e+11 28530
## - OverallQual        1 2.3386e+10 3.3666e+11 28538
## - LotArea           1 2.5012e+10 3.3828e+11 28545
## - BsmtExposure       3 2.9827e+10 3.4310e+11 28561
## - X1stFlrSF          1 3.0023e+10 3.4330e+11 28566
## - PoolArea           1 4.3026e+10 3.5630e+11 28620
## - X2ndFlrSF          1 6.4800e+10 3.7807e+11 28707
## - PoolQC             3 7.7752e+10 3.9103e+11 28752
## - Neighborhood      24 1.0553e+11 4.1880e+11 28810
##
## Step:  AIC=28432.29
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + LandContour +
## Utilities + LotConfig + LandSlope + Neighborhood + Condition1 +
## Condition2 + HouseStyle + OverallQual + OverallCond + YearBuilt +
## YearRemodAdd + RoofMatl + Exterior1st + Exterior2nd + MasVnrType +
## MasVnrArea + ExterQual + ExterCond + Foundation + BsmtQual +
## BsmtCond + BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
## BsmtFinSF2 + BsmtUnfSF + HeatingQC + CentralAir + X1stFlrSF +
## X2ndFlrSF + LowQualFinSF + BsmtFullBath + BsmtHalfBath +
## FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr + KitchenQual +
## TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu + GarageType +
## GarageYrBlt + GarageFinish + GarageCars + GarageArea + GarageQual +
## GarageCond + WoodDeckSF + OpenPorchSF + EnclosedPorch + X3SsnPorch +
## ScreenPorch + PoolArea + PoolQC + Fence + MiscFeature + MiscVal +
## MoSold + YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##           Df Sum of Sq      RSS   AIC
## - CentralAir          1 1.2260e+07 3.1492e+11 28430
## - LowQualFinSF         1 5.8982e+07 3.1497e+11 28431
## - OpenPorchSF          1 8.4321e+07 3.1500e+11 28431
## - HalfBath             1 1.0034e+08 3.1501e+11 28431
## - BsmtHalfBath         1 1.2351e+08 3.1504e+11 28431
## - Exterior2nd         15 6.2922e+09 3.2120e+11 28431
## - GarageArea           1 4.0769e+08 3.1532e+11 28432
## <none>                  3.1491e+11 28432
## - Fireplaces           1 4.6434e+08 3.1538e+11 28432
## - GarageYrBlt          1 4.9277e+08 3.1540e+11 28433
## - GarageCond           3 1.3983e+09 3.1631e+11 28433
## - Fence                 2 9.9494e+08 3.1591e+11 28433
## - MoSold                1 6.3717e+08 3.1555e+11 28433
## - GarageFinish         2 1.2135e+09 3.1613e+11 28434
## - Utilities            1 7.8991e+08 3.1570e+11 28434
## - KitchenAbvGr         1 7.9389e+08 3.1571e+11 28434
## - HouseStyle           7 3.6512e+09 3.1856e+11 28435
## - YrSold                1 1.2151e+09 3.1613e+11 28436
## - BsmtFinType2         5 2.9619e+09 3.1787e+11 28436
## - EnclosedPorch        1 1.3033e+09 3.1622e+11 28436
## - Street               1 1.3037e+09 3.1622e+11 28436
## - ExterCond             4 2.6181e+09 3.1753e+11 28436
## - BsmtFullBath         1 1.4247e+09 3.1634e+11 28437
## - X3SsnPorch           1 1.5204e+09 3.1643e+11 28437
## - HeatingQC            3 2.4352e+09 3.1735e+11 28438
## - TotRmsAbvGrd         1 1.7908e+09 3.1670e+11 28439

```

```

## - FullBath          1 2.4069e+09 3.1732e+11 28441
## - BsmtCond          3 3.3664e+09 3.1828e+11 28442
## - Foundation        5 4.3820e+09 3.1929e+11 28442
## - YearRemodAdd       1 2.7343e+09 3.1765e+11 28443
## - LandContour       3 3.8127e+09 3.1872e+11 28444
## - BsmtFinSF2        1 3.4371e+09 3.1835e+11 28446
## - SaleCondition     2 4.3698e+09 3.1928e+11 28448
## - MSZoning          4 5.4209e+09 3.2033e+11 28449
## - GarageCars        1 4.2855e+09 3.1920e+11 28450
## - WoodDeckSF        1 4.2923e+09 3.1920e+11 28450
## - BedroomAbvGr      1 4.9988e+09 3.1991e+11 28453
## - RoofMatl          3 6.1689e+09 3.2108e+11 28455
## - MiscFeature       2 5.8063e+09 3.2072e+11 28455
## - MiscVal           1 6.3233e+09 3.2124e+11 28459
## - LotConfig         4 7.7024e+09 3.2261e+11 28460
## - BsmtFinType1      5 8.3378e+09 3.2325e+11 28460
## - Exterior1st      12 1.1488e+10 3.2640e+11 28461
## - GarageType        4 7.9936e+09 3.2291e+11 28461
## - YearBuilt         1 7.5181e+09 3.2243e+11 28465
## - Condition2       4 9.1693e+09 3.2408e+11 28466
## - LandSlope        2 8.4120e+09 3.2332e+11 28467
## - FireplaceQu      5 1.0094e+10 3.2501e+11 28468
## - ScreenPorch      1 9.1676e+09 3.2408e+11 28472
## - MasVnrArea_Sqrt  1 9.5857e+09 3.2450e+11 28474
## - MasVnrType        3 1.2180e+10 3.2709e+11 28482
## - Functional        6 1.4558e+10 3.2947e+11 28486
## - BsmtUnfSF         1 1.2579e+10 3.2749e+11 28487
## - Condition1       5 1.5122e+10 3.3003e+11 28491
## - GarageQual        4 1.4776e+10 3.2969e+11 28491
## - ExterQual         3 1.6398e+10 3.3131e+11 28500
## - KitchenQual       3 1.7085e+10 3.3200e+11 28503
## - MasVnrArea        1 1.7173e+10 3.3208e+11 28508
## - MSSubClass       14 2.5813e+10 3.4073e+11 28519
## - OverallCond       1 2.0485e+10 3.3540e+11 28522
## - SaleType          8 2.3880e+10 3.3879e+11 28523
## - BsmtFinSF1        1 2.1405e+10 3.3632e+11 28526
## - BsmtQual          3 2.3529e+10 3.3844e+11 28531
## - OverallQual       1 2.3210e+10 3.3812e+11 28534
## - LotArea           1 2.4921e+10 3.3983e+11 28541
## - BsmtExposure      3 2.9777e+10 3.4469e+11 28558
## - X1stFlrSF         1 3.0712e+10 3.4562e+11 28566
## - PoolArea          1 4.6176e+10 3.6109e+11 28630
## - X2ndFlrSF         1 6.4802e+10 3.7971e+11 28703
## - PoolQC            3 8.2894e+10 3.9781e+11 28767
## - Neighborhood     24 1.0718e+11 4.2209e+11 28812
##
## Step:  AIC=28430.34
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + LandContour +
## Utilities + LotConfig + LandSlope + Neighborhood + Condition1 +
## Condition2 + HouseStyle + OverallQual + OverallCond + YearBuilt +
## YearRemodAdd + RoofMatl + Exterior1st + Exterior2nd + MasVnrType +
## MasVnrArea + ExterQual + ExterCond + Foundation + BsmtQual +
## BsmtCond + BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
## BsmtFinSF2 + BsmtUnfSF + HeatingQC + X1stFlrSF + X2ndFlrSF +

```

```

##      LowQualFinSF + BsmtFullBath + BsmtHalfBath + FullBath + HalfBath +
##      BedroomAbvGr + KitchenAbvGr + KitchenQual + TotRmsAbvGrd +
##      Functional + Fireplaces + FireplaceQu + GarageType + GarageYrBlt +
##      GarageFinish + GarageCars + GarageArea + GarageQual + GarageCond +
##      WoodDeckSF + OpenPorchSF + EnclosedPorch + X3SsnPorch + ScreenPorch +
##      PoolArea + PoolQC + Fence + MiscFeature + MiscVal + MoSold +
##      YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##      Df      Sum of Sq      RSS      AIC
## - LowQualFinSF      1 5.9507e+07 3.1498e+11 28429
## - OpenPorchSF      1 8.4419e+07 3.1501e+11 28429
## - HalfBath      1 9.7826e+07 3.1502e+11 28429
## - BsmtHalfBath      1 1.2111e+08 3.1505e+11 28429
## - Exterior2nd     15 6.3174e+09 3.2124e+11 28429
## - GarageArea      1 4.0528e+08 3.1533e+11 28430
## <none>      3.1492e+11 28430
## - Fireplaces      1 4.5826e+08 3.1538e+11 28430
## - GarageYrBlt      1 4.8542e+08 3.1541e+11 28431
## - GarageCond      3 1.4002e+09 3.1632e+11 28431
## - Fence      2 9.8599e+08 3.1591e+11 28431
## - MoSold      1 6.3385e+08 3.1556e+11 28431
## - GarageFinish      2 1.2103e+09 3.1613e+11 28432
## - Utilities      1 7.8365e+08 3.1571e+11 28432
## - KitchenAbvGr      1 7.9001e+08 3.1571e+11 28432
## - HouseStyle      7 3.6444e+09 3.1857e+11 28433
## - YrSold      1 1.2123e+09 3.1614e+11 28434
## - BsmtFinType2      5 2.9683e+09 3.1789e+11 28434
## - Street      1 1.2927e+09 3.1622e+11 28434
## - EnclosedPorch      1 1.2981e+09 3.1622e+11 28434
## - ExterCond      4 2.6064e+09 3.1753e+11 28434
## - BsmtFullBath      1 1.4199e+09 3.1634e+11 28435
## - X3SsnPorch      1 1.5160e+09 3.1644e+11 28435
## - HeatingQC      3 2.4256e+09 3.1735e+11 28436
## - TotRmsAbvGrd      1 1.7883e+09 3.1671e+11 28437
## - FullBath      1 2.4180e+09 3.1734e+11 28440
## - BsmtCond      3 3.3552e+09 3.1828e+11 28440
## - Foundation      5 4.3710e+09 3.1930e+11 28440
## - YearRemodAdd      1 2.7225e+09 3.1765e+11 28441
## - LandContour      3 3.8087e+09 3.1873e+11 28442
## - BsmtFinSF2      1 3.4484e+09 3.1837e+11 28444
## - SaleCondition      2 4.4082e+09 3.1933e+11 28447
## - MSZoning      4 5.4254e+09 3.2035e+11 28447
## - WoodDeckSF      1 4.2901e+09 3.1921e+11 28448
## - GarageCars      1 4.2907e+09 3.1922e+11 28448
## - BedroomAbvGr      1 5.0565e+09 3.1998e+11 28452
## - RoofMatl      3 6.1607e+09 3.2109e+11 28453
## - MiscFeature      2 5.8005e+09 3.2072e+11 28453
## - MiscVal      1 6.3175e+09 3.2124e+11 28457
## - LotConfig      4 7.7205e+09 3.2264e+11 28458
## - Exterior1st     12 1.1478e+10 3.2640e+11 28459
## - BsmtFinType1      5 8.3620e+09 3.2329e+11 28459
## - GarageType      4 8.0481e+09 3.2297e+11 28459
## - YearBuilt      1 7.5181e+09 3.2244e+11 28463
## - Condition2      4 9.1697e+09 3.2409e+11 28464

```



```

## - LandSlope      2 8.4034e+09 3.2333e+11 28465
## - FireplaceQu    5 1.0099e+10 3.2502e+11 28466
## - ScreenPorch    1 9.1604e+09 3.2408e+11 28470
## - MasVnrArea_Sqrt 1 9.5760e+09 3.2450e+11 28472
## - MasVnrType      3 1.2187e+10 3.2711e+11 28480
## - Functional      6 1.4564e+10 3.2949e+11 28484
## - BsmtUnfSF       1 1.2649e+10 3.2757e+11 28486
## - Condition1      5 1.5110e+10 3.3003e+11 28489
## - GarageQual      4 1.4763e+10 3.2969e+11 28489
## - ExterQual       3 1.6439e+10 3.3136e+11 28499
## - KitchenQual     3 1.7112e+10 3.3204e+11 28502
## - MasVnrArea      1 1.7161e+10 3.3209e+11 28506
## - MSSubClass     14 2.5812e+10 3.4074e+11 28517
## - OverallCond     1 2.0587e+10 3.3551e+11 28521
## - SaleType        8 2.4018e+10 3.3894e+11 28522
## - BsmtFinSF1      1 2.1526e+10 3.3645e+11 28525
## - BsmtQual        3 2.3535e+10 3.3846e+11 28530
## - OverallQual     1 2.3198e+10 3.3812e+11 28532
## - LotArea         1 2.4920e+10 3.3984e+11 28540
## - BsmtExposure    3 2.9790e+10 3.4471e+11 28556
## - X1stFlrSF       1 3.0701e+10 3.4563e+11 28564
## - PoolArea        1 4.6187e+10 3.6111e+11 28628
## - X2ndFlrSF       1 6.4956e+10 3.7988e+11 28702
## - PoolQC          3 8.2886e+10 3.9781e+11 28765
## - Neighborhood    24 1.0723e+11 4.2215e+11 28810
##
## Step:  AIC=28428.62
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + LandContour +
##   Utilities + LotConfig + LandSlope + Neighborhood + Condition1 +
##   Condition2 + HouseStyle + OverallQual + OverallCond + YearBuilt +
##   YearRemodAdd + RoofMatl + Exterior1st + Exterior2nd + MasVnrType +
##   MasVnrArea + ExterQual + ExterCond + Foundation + BsmtQual +
##   BsmtCond + BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
##   BsmtFinSF2 + BsmtUnfSF + HeatingQC + X1stFlrSF + X2ndFlrSF +
##   BsmtFullBath + BsmtHalfBath + FullBath + HalfBath + BedroomAbvGr +
##   KitchenAbvGr + KitchenQual + TotRmsAbvGrd + Functional +
##   Fireplaces + FireplaceQu + GarageType + GarageYrBlt + GarageFinish +
##   GarageCars + GarageArea + GarageQual + GarageCond + WoodDeckSF +
##   OpenPorchSF + EnclosedPorch + X3SsnPorch + ScreenPorch +
##   PoolArea + PoolQC + Fence + MiscFeature + MiscVal + MoSold +
##   YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##           Df Sum of Sq      RSS   AIC
## - OpenPorchSF      1 7.9614e+07 3.1506e+11 28427
## - HalfBath          1 1.0069e+08 3.1508e+11 28427
## - BsmtHalfBath      1 1.2014e+08 3.1510e+11 28427
## - Exterior2nd      15 6.3140e+09 3.2130e+11 28428
## - GarageArea        1 4.1107e+08 3.1539e+11 28428
## <none>                                3.1498e+11 28429
## - Fireplaces        1 4.5507e+08 3.1544e+11 28429
## - GarageYrBlt        1 4.8423e+08 3.1547e+11 28429
## - GarageCond         3 1.4007e+09 3.1638e+11 28429
## - Fence              2 9.7053e+08 3.1595e+11 28429
## - MoSold             1 6.1562e+08 3.1560e+11 28430

```

## - Utilities	1	7.8998e+08	3.1577e+11	28430
## - GarageFinish	2	1.2242e+09	3.1621e+11	28430
## - KitchenAbvGr	1	8.0452e+08	3.1579e+11	28430
## - HouseStyle	7	3.6713e+09	3.1866e+11	28432
## - BsmtFinType2	5	2.9658e+09	3.1795e+11	28432
## - YrSold	1	1.2275e+09	3.1621e+11	28432
## - EnclosedPorch	1	1.2664e+09	3.1625e+11	28432
## - ExterCond	4	2.6114e+09	3.1760e+11	28433
## - Street	1	1.3173e+09	3.1630e+11	28433
## - BsmtFullBath	1	1.4385e+09	3.1642e+11	28433
## - X3SsnPorch	1	1.5261e+09	3.1651e+11	28434
## - HeatingQC	3	2.4461e+09	3.1743e+11	28434
## - TotRmsAbvGrd	1	1.8830e+09	3.1687e+11	28435
## - BsmtCond	3	3.3161e+09	3.1830e+11	28438
## - FullBath	1	2.4621e+09	3.1745e+11	28438
## - Foundation	5	4.3743e+09	3.1936e+11	28439
## - YearRemodAdd	1	2.7247e+09	3.1771e+11	28439
## - LandContour	3	3.7639e+09	3.1875e+11	28440
## - BsmtFinSF2	1	3.4690e+09	3.1845e+11	28443
## - SaleCondition	2	4.4425e+09	3.1943e+11	28445
## - MSZoning	4	5.5010e+09	3.2048e+11	28446
## - GarageCars	1	4.2832e+09	3.1927e+11	28446
## - WoodDeckSF	1	4.3674e+09	3.1935e+11	28447
## - BedroomAbvGr	1	5.0135e+09	3.2000e+11	28450
## - RoofMatl	3	6.1604e+09	3.2114e+11	28451
## - MiscFeature	2	5.7775e+09	3.2076e+11	28451
## - MiscVal	1	6.3152e+09	3.2130e+11	28456
## - LotConfig	4	7.7290e+09	3.2271e+11	28456
## - BsmtFinType1	5	8.3144e+09	3.2330e+11	28457
## - Exterior1st	12	1.1537e+10	3.2652e+11	28457
## - GarageType	4	8.1044e+09	3.2309e+11	28458
## - YearBuilt	1	7.4945e+09	3.2248e+11	28461
## - Condition2	4	9.1681e+09	3.2415e+11	28462
## - LandSlope	2	8.3848e+09	3.2337e+11	28463
## - FireplaceQu	5	1.0055e+10	3.2504e+11	28464
## - ScreenPorch	1	9.1586e+09	3.2414e+11	28468
## - MasVnrArea_Sqrt	1	9.5914e+09	3.2458e+11	28470
## - MasVnrType	3	1.2165e+10	3.2715e+11	28478
## - Functional	6	1.4529e+10	3.2951e+11	28482
## - BsmtUnfSF	1	1.2740e+10	3.2772e+11	28484
## - Condition1	5	1.5246e+10	3.3023e+11	28488
## - GarageQual	4	1.5180e+10	3.3016e+11	28489
## - ExterQual	3	1.6410e+10	3.3139e+11	28497
## - KitchenQual	3	1.7081e+10	3.3206e+11	28500
## - MasVnrArea	1	1.7193e+10	3.3218e+11	28504
## - MSSubClass	14	2.5754e+10	3.4074e+11	28515
## - OverallCond	1	2.0572e+10	3.3556e+11	28519
## - SaleType	8	2.3994e+10	3.3898e+11	28520
## - BsmtFinSF1	1	2.1614e+10	3.3660e+11	28524
## - BsmtQual	3	2.3545e+10	3.3853e+11	28528
## - OverallQual	1	2.3412e+10	3.3840e+11	28531
## - LotArea	1	2.4891e+10	3.3987e+11	28538
## - BsmtExposure	3	2.9766e+10	3.4475e+11	28554
## - X1stFlrSF	1	3.0743e+10	3.4573e+11	28562

```

## - PoolArea          1 4.6164e+10 3.6115e+11 28626
## - X2ndFlrSF         1 6.6980e+10 3.8196e+11 28708
## - PoolQC            3 8.2835e+10 3.9782e+11 28763
## - Neighborhood     24 1.0720e+11 4.2219e+11 28808
##
## Step:  AIC=28426.99
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + LandContour +
##   Utilities + LotConfig + LandSlope + Neighborhood + Condition1 +
##   Condition2 + HouseStyle + OverallQual + OverallCond + YearBuilt +
##   YearRemodAdd + RoofMatl + Exterior1st + Exterior2nd + MasVnrType +
##   MasVnrArea + ExterQual + ExterCond + Foundation + BsmtQual +
##   BsmtCond + BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
##   BsmtFinSF2 + BsmtUnfSF + HeatingQC + X1stFlrSF + X2ndFlrSF +
##   BsmtFullBath + BsmtHalfBath + FullBath + HalfBath + BedroomAbvGr +
##   KitchenAbvGr + KitchenQual + TotRmsAbvGrd + Functional +
##   Fireplaces + FireplaceQu + GarageType + GarageYrBlt + GarageFinish +
##   GarageCars + GarageArea + GarageQual + GarageCond + WoodDeckSF +
##   EnclosedPorch + X3SsnPorch + ScreenPorch + PoolArea + PoolQC +
##   Fence + MiscFeature + MiscVal + MoSold + YrSold + SaleType +
##   SaleCondition + MasVnrArea_Sqrt
##
##           Df  Sum of Sq      RSS    AIC
## - HalfBath          1 8.6403e+07 3.1515e+11 28425
## - BsmtHalfBath      1 1.2644e+08 3.1519e+11 28426
## - Exterior2nd      15 6.2854e+09 3.2135e+11 28426
## - GarageArea        1 4.1285e+08 3.1548e+11 28427
## <none>                3.1506e+11 28427
## - Fireplaces        1 4.6539e+08 3.1553e+11 28427
## - GarageYrBlt        1 5.0544e+08 3.1557e+11 28427
## - Fence              2 9.6083e+08 3.1602e+11 28427
## - GarageCond         3 1.4011e+09 3.1646e+11 28428
## - MoSold             1 6.2702e+08 3.1569e+11 28428
## - Utilities          1 8.0621e+08 3.1587e+11 28429
## - KitchenAbvGr       1 8.1503e+08 3.1588e+11 28429
## - GarageFinish       2 1.2492e+09 3.1631e+11 28429
## - HouseStyle         7 3.6451e+09 3.1871e+11 28430
## - YrSold             1 1.2040e+09 3.1627e+11 28431
## - BsmtFinType2       5 2.9440e+09 3.1801e+11 28431
## - ExterCond          4 2.6005e+09 3.1766e+11 28431
## - EnclosedPorch      1 1.3282e+09 3.1639e+11 28431
## - Street             1 1.3540e+09 3.1642e+11 28431
## - BsmtFullBath       1 1.4432e+09 3.1651e+11 28432
## - HeatingQC          3 2.4424e+09 3.1751e+11 28432
## - X3SsnPorch         1 1.5762e+09 3.1664e+11 28432
## - TotRmsAbvGrd       1 1.8957e+09 3.1696e+11 28434
## - FullBath           1 2.4265e+09 3.1749e+11 28436
## - BsmtCond           3 3.3314e+09 3.1839e+11 28436
## - Foundation         5 4.3331e+09 3.1940e+11 28437
## - YearRemodAdd       1 2.6927e+09 3.1776e+11 28437
## - LandContour        3 3.7641e+09 3.1883e+11 28438
## - BsmtFinSF2         1 3.4436e+09 3.1851e+11 28441
## - SaleCondition      2 4.4897e+09 3.1955e+11 28444
## - MSZoning           4 5.4436e+09 3.2051e+11 28444
## - GarageCars         1 4.3542e+09 3.1942e+11 28445

```

```

## - WoodDeckSF      1 4.5418e+09 3.1961e+11 28446
## - BedroomAbvGr    1 4.9584e+09 3.2002e+11 28448
## - RoofMatl        3 6.1817e+09 3.2125e+11 28449
## - MiscFeature      2 5.8791e+09 3.2094e+11 28450
## - LotConfig        4 7.6874e+09 3.2275e+11 28454
## - MiscVal          1 6.4787e+09 3.2154e+11 28455
## - BsmtFinType1     5 8.2850e+09 3.2335e+11 28455
## - Exterior1st     12 1.1573e+10 3.2664e+11 28456
## - GarageType       4 8.1952e+09 3.2326e+11 28456
## - YearBuilt        1 7.5586e+09 3.2262e+11 28460
## - Condition2       4 9.2127e+09 3.2428e+11 28461
## - LandSlope        2 8.4269e+09 3.2349e+11 28462
## - FireplaceQu      5 1.0035e+10 3.2510e+11 28463
## - ScreenPorch      1 9.3181e+09 3.2438e+11 28468
## - MasVnrArea_Sqrt  1 9.6028e+09 3.2467e+11 28469
## - MasVnrType       3 1.2156e+10 3.2722e+11 28476
## - Functional       6 1.4454e+10 3.2952e+11 28480
## - BsmtUnfSF        1 1.2661e+10 3.2772e+11 28482
## - Condition1       5 1.5326e+10 3.3039e+11 28486
## - GarageQual       4 1.5101e+10 3.3016e+11 28487
## - ExterQual        3 1.6373e+10 3.3144e+11 28495
## - KitchenQual      3 1.7049e+10 3.3211e+11 28498
## - MasVnrArea       1 1.7243e+10 3.3231e+11 28503
## - MSSubClass       14 2.5701e+10 3.4076e+11 28513
## - OverallCond      1 2.0563e+10 3.3563e+11 28517
## - SaleType         8 2.4090e+10 3.3915e+11 28518
## - BsmtFinSF1       1 2.1537e+10 3.3660e+11 28522
## - BsmtQual         3 2.3475e+10 3.3854e+11 28526
## - OverallQual      1 2.3445e+10 3.3851e+11 28530
## - LotArea          1 2.4852e+10 3.3992e+11 28536
## - BsmtExposure     3 2.9731e+10 3.4479e+11 28553
## - X1stFlrSF        1 3.0664e+10 3.4573e+11 28560
## - PoolArea         1 4.6193e+10 3.6126e+11 28625
## - X2ndFlrSF        1 6.6901e+10 3.8196e+11 28706
## - PoolQC           3 8.2755e+10 3.9782e+11 28761
## - Neighborhood     24 1.0723e+11 4.2230e+11 28806
##
## Step:  AIC=28425.39
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + LandContour +
##   Utilities + LotConfig + LandSlope + Neighborhood + Condition1 +
##   Condition2 + HouseStyle + OverallQual + OverallCond + YearBuilt +
##   YearRemodAdd + RoofMatl + Exterior1st + Exterior2nd + MasVnrType +
##   MasVnrArea + ExterQual + ExterCond + Foundation + BsmtQual +
##   BsmtCond + BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
##   BsmtFinSF2 + BsmtUnfSF + HeatingQC + X1stFlrSF + X2ndFlrSF +
##   BsmtFullBath + BsmtHalfBath + FullBath + BedroomAbvGr + KitchenAbvGr +
##   KitchenQual + TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu +
##   GarageType + GarageYrBlt + GarageFinish + GarageCars + GarageArea +
##   GarageQual + GarageCond + WoodDeckSF + EnclosedPorch + X3SsnPorch +
##   ScreenPorch + PoolArea + PoolQC + Fence + MiscFeature + MiscVal +
##   MoSold + YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##           Df Sum of Sq      RSS   AIC
## - BsmtHalfBath    1 1.2118e+08 3.1527e+11 28424

```

## - Exterior2nd	15	6.3873e+09	3.2154e+11	28425
## - GarageArea	1	4.1198e+08	3.1556e+11	28425
## <none>			3.1515e+11	28425
## - Fireplaces	1	4.8665e+08	3.1564e+11	28426
## - GarageYrBlt	1	5.0702e+08	3.1566e+11	28426
## - Fence	2	9.7117e+08	3.1612e+11	28426
## - GarageCond	3	1.4159e+09	3.1657e+11	28426
## - MoSold	1	6.4173e+08	3.1579e+11	28426
## - GarageFinish	2	1.2374e+09	3.1639e+11	28427
## - Utilities	1	8.1588e+08	3.1597e+11	28427
## - KitchenAbvGr	1	8.3013e+08	3.1598e+11	28427
## - HouseStyle	7	3.5669e+09	3.1872e+11	28428
## - YrSold	1	1.1856e+09	3.1634e+11	28429
## - BsmtFinType2	5	2.9386e+09	3.1809e+11	28429
## - ExterCond	4	2.5525e+09	3.1770e+11	28429
## - Street	1	1.3552e+09	3.1651e+11	28430
## - EnclosedPorch	1	1.3604e+09	3.1651e+11	28430
## - BsmtFullBath	1	1.4156e+09	3.1657e+11	28430
## - X3SsnPorch	1	1.5482e+09	3.1670e+11	28430
## - HeatingQC	3	2.4293e+09	3.1758e+11	28431
## - TotRmsAbvGrd	1	1.8865e+09	3.1704e+11	28432
## - FullBath	1	2.4392e+09	3.1759e+11	28435
## - BsmtCond	3	3.3551e+09	3.1850e+11	28435
## - Foundation	5	4.3205e+09	3.1947e+11	28435
## - YearRemodAdd	1	2.7099e+09	3.1786e+11	28436
## - LandContour	3	3.7668e+09	3.1892e+11	28437
## - BsmtFinSF2	1	3.4597e+09	3.1861e+11	28439
## - SaleCondition	2	4.4995e+09	3.1965e+11	28442
## - MSZoning	4	5.5717e+09	3.2072e+11	28443
## - GarageCars	1	4.4317e+09	3.1958e+11	28444
## - WoodDeckSF	1	4.6181e+09	3.1977e+11	28445
## - BedroomAbvGr	1	5.0190e+09	3.2017e+11	28446
## - RoofMatl	3	6.2384e+09	3.2139e+11	28448
## - MiscFeature	2	5.9256e+09	3.2108e+11	28449
## - LotConfig	4	7.6550e+09	3.2280e+11	28452
## - MiscVal	1	6.4649e+09	3.2161e+11	28453
## - BsmtFinType1	5	8.2577e+09	3.2341e+11	28453
## - Exterior1st	12	1.1676e+10	3.2683e+11	28454
## - GarageType	4	8.2090e+09	3.2336e+11	28455
## - YearBuilt	1	7.8889e+09	3.2304e+11	28460
## - Condition2	4	9.2289e+09	3.2438e+11	28460
## - LandSlope	2	8.3637e+09	3.2351e+11	28460
## - FireplaceQu	5	1.0020e+10	3.2517e+11	28461
## - ScreenPorch	1	9.3656e+09	3.2452e+11	28466
## - MasVnrArea_Sqrt	1	9.6129e+09	3.2476e+11	28467
## - MasVnrType	3	1.2103e+10	3.2725e+11	28474
## - Functional	6	1.4503e+10	3.2965e+11	28479
## - BsmtUnfSF	1	1.2575e+10	3.2772e+11	28480
## - Condition1	5	1.5313e+10	3.3046e+11	28485
## - GarageQual	4	1.5056e+10	3.3021e+11	28486
## - ExterQual	3	1.6355e+10	3.3150e+11	28493
## - KitchenQual	3	1.7079e+10	3.3223e+11	28496
## - MasVnrArea	1	1.7270e+10	3.3242e+11	28501
## - MSSubClass	14	2.5693e+10	3.4084e+11	28512

```

## - OverallCond      1 2.0536e+10 3.3569e+11 28516
## - SaleType         8 2.4124e+10 3.3927e+11 28517
## - BsmtFinSF1       1 2.1455e+10 3.3661e+11 28520
## - BsmtQual         3 2.3629e+10 3.3878e+11 28525
## - OverallQual      1 2.3365e+10 3.3851e+11 28528
## - LotArea          1 2.4801e+10 3.3995e+11 28534
## - BsmtExposure     3 2.9645e+10 3.4479e+11 28551
## - X1stFlrSF        1 3.1744e+10 3.4689e+11 28563
## - PoolArea         1 4.6110e+10 3.6126e+11 28623
## - X2ndFlrSF        1 7.1259e+10 3.8641e+11 28721
## - PoolQC           3 8.2676e+10 3.9783e+11 28759
## - Neighborhood     24 1.0716e+11 4.2231e+11 28804
##
## Step:  AIC=28423.95
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + LandContour +
##   Utilities + LotConfig + LandSlope + Neighborhood + Condition1 +
##   Condition2 + HouseStyle + OverallQual + OverallCond + YearBuilt +
##   YearRemodAdd + RoofMatl + Exterior1st + Exterior2nd + MasVnrType +
##   MasVnrArea + ExterQual + ExterCond + Foundation + BsmtQual +
##   BsmtCond + BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
##   BsmtFinSF2 + BsmtUnfSF + HeatingQC + X1stFlrSF + X2ndFlrSF +
##   BsmtFullBath + FullBath + BedroomAbvGr + KitchenAbvGr + KitchenQual +
##   TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu + GarageType +
##   GarageYrBlt + GarageFinish + GarageCars + GarageArea + GarageQual +
##   GarageCond + WoodDeckSF + EnclosedPorch + X3SsnPorch + ScreenPorch +
##   PoolArea + PoolQC + Fence + MiscFeature + MiscVal + MoSold +
##   YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##           Df Sum of Sq      RSS   AIC
## - Exterior2nd    15 6.3827e+09 3.2165e+11 28423
## - GarageArea      1 4.1904e+08 3.1569e+11 28424
## <none>                                3.1527e+11 28424
## - Fireplaces      1 4.7167e+08 3.1574e+11 28424
## - GarageYrBlt     1 5.1509e+08 3.1579e+11 28424
## - Fence           2 9.7946e+08 3.1625e+11 28424
## - GarageCond       3 1.4346e+09 3.1671e+11 28425
## - MoSold           1 6.3773e+08 3.1591e+11 28425
## - Utilities        1 7.6438e+08 3.1604e+11 28426
## - GarageFinish     2 1.2490e+09 3.1652e+11 28426
## - KitchenAbvGr    1 8.7532e+08 3.1615e+11 28426
## - HouseStyle       7 3.5589e+09 3.1883e+11 28426
## - BsmtFinType2     5 2.8933e+09 3.1816e+11 28427
## - YrSold           1 1.1781e+09 3.1645e+11 28427
## - ExterCond        4 2.5595e+09 3.1783e+11 28428
## - BsmtFullBath     1 1.2952e+09 3.1657e+11 28428
## - EnclosedPorch    1 1.3540e+09 3.1663e+11 28428
## - Street           1 1.3902e+09 3.1666e+11 28428
## - X3SsnPorch       1 1.5786e+09 3.1685e+11 28429
## - HeatingQC        3 2.4977e+09 3.1777e+11 28430
## - TotRmsAbvGrd     1 1.8929e+09 3.1716e+11 28431
## - FullBath         1 2.4226e+09 3.1769e+11 28433
## - BsmtCond         3 3.3376e+09 3.1861e+11 28433
## - Foundation       5 4.3602e+09 3.1963e+11 28434
## - YearRemodAdd     1 2.7441e+09 3.1802e+11 28435

```

```

## - LandContour      3 3.8483e+09 3.1912e+11 28436
## - BsmtFinSF2       1 3.5709e+09 3.1884e+11 28438
## - SaleCondition    2 4.4879e+09 3.1976e+11 28441
## - MSZoning         4 5.5822e+09 3.2085e+11 28442
## - GarageCars       1 4.4667e+09 3.1974e+11 28442
## - WoodDeckSF       1 4.6063e+09 3.1988e+11 28443
## - BedroomAbvGr     1 4.9368e+09 3.2021e+11 28445
## - RoofMatl         3 6.2644e+09 3.2154e+11 28447
## - MiscFeature      2 5.8559e+09 3.2113e+11 28447
## - LotConfig        4 7.6197e+09 3.2289e+11 28451
## - MiscVal          1 6.3968e+09 3.2167e+11 28451
## - BsmtFinType1     5 8.3453e+09 3.2362e+11 28452
## - Exterior1st     12 1.1598e+10 3.2687e+11 28453
## - GarageType       4 8.1507e+09 3.2342e+11 28453
## - LandSlope        2 8.2964e+09 3.2357e+11 28458
## - YearBuilt        1 7.8573e+09 3.2313e+11 28458
## - Condition2       4 9.3059e+09 3.2458e+11 28458
## - FireplaceQu      5 1.0054e+10 3.2532e+11 28460
## - ScreenPorch      1 9.3708e+09 3.2464e+11 28465
## - MasVnrArea_Sqrt  1 9.6940e+09 3.2497e+11 28466
## - MasVnrType       3 1.2193e+10 3.2746e+11 28473
## - Functional       6 1.4531e+10 3.2980e+11 28478
## - BsmtUnfSF        1 1.2603e+10 3.2787e+11 28479
## - Condition1       5 1.5362e+10 3.3063e+11 28483
## - GarageQual       4 1.5015e+10 3.3029e+11 28484
## - ExterQual        3 1.6387e+10 3.3166e+11 28492
## - KitchenQual      3 1.7133e+10 3.3240e+11 28495
## - MasVnrArea       1 1.7353e+10 3.3262e+11 28500
## - MSSubClass       14 2.5575e+10 3.4085e+11 28510
## - OverallCond      1 2.0597e+10 3.3587e+11 28514
## - SaleType         8 2.4111e+10 3.3938e+11 28516
## - BsmtFinSF1       1 2.1854e+10 3.3713e+11 28520
## - BsmtQual         3 2.3791e+10 3.3906e+11 28524
## - OverallQual      1 2.3297e+10 3.3857e+11 28526
## - LotArea          1 2.4923e+10 3.4019e+11 28533
## - BsmtExposure     3 3.0021e+10 3.4529e+11 28551
## - X1stFlrSF        1 3.1630e+10 3.4690e+11 28561
## - PoolArea         1 4.6045e+10 3.6132e+11 28621
## - X2ndFlrSF        1 7.1139e+10 3.8641e+11 28719
## - PoolQC           3 8.2603e+10 3.9787e+11 28758
## - Neighborhood     24 1.0706e+11 4.2233e+11 28802
##
## Step: AIC=28423.19
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + LandContour +
## Utilities + LotConfig + LandSlope + Neighborhood + Condition1 +
## Condition2 + HouseStyle + OverallQual + OverallCond + YearBuilt +
## YearRemodAdd + RoofMatl + Exterior1st + MasVnrType + MasVnrArea +
## ExterQual + ExterCond + Foundation + BsmtQual + BsmtCond +
## BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
## BsmtFinSF2 + BsmtUnfSF + HeatingQC + X1stFlrSF + X2ndFlrSF +
## BsmtFullBath + FullBath + BedroomAbvGr + KitchenAbvGr + KitchenQual +
## TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu + GarageType +
## GarageYrBlt + GarageFinish + GarageCars + GarageArea + GarageQual +
## GarageCond + WoodDeckSF + EnclosedPorch + X3SsnPorch + ScreenPorch +

```

```

##      PoolArea + PoolQC + Fence + MiscFeature + MiscVal + MoSold +
##      YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##      Df      Sum of Sq      RSS      AIC
## <none>                                3.2165e+11 28423
## - Fireplaces      1 4.6495e+08 3.2212e+11 28423
## - Fence           2 9.4638e+08 3.2260e+11 28424
## - GarageYrBlt     1 5.5289e+08 3.2221e+11 28424
## - MoSold          1 6.1166e+08 3.2227e+11 28424
## - GarageArea      1 6.4522e+08 3.2230e+11 28424
## - BsmtFinType2    5 2.5347e+09 3.2419e+11 28425
## - GarageCond      3 1.6642e+09 3.2332e+11 28425
## - Utilities       1 7.8156e+08 3.2244e+11 28425
## - HouseStyle      7 3.5392e+09 3.2519e+11 28425
## - GarageFinish    2 1.3353e+09 3.2299e+11 28425
## - EnclosedPorch   1 9.3617e+08 3.2259e+11 28425
## - ExterCond       4 2.3458e+09 3.2400e+11 28426
## - YrSold          1 1.1487e+09 3.2280e+11 28426
## - Street          1 1.1684e+09 3.2282e+11 28426
## - BsmtFullBath    1 1.2704e+09 3.2292e+11 28427
## - KitchenAbvGr    1 1.6747e+09 3.2333e+11 28429
## - HeatingQC       3 2.5673e+09 3.2422e+11 28429
## - X3SsnPorch      1 1.7737e+09 3.2343e+11 28429
## - TotRmsAbvGrd    1 2.0840e+09 3.2374e+11 28431
## - FullBath        1 2.2837e+09 3.2394e+11 28432
## - YearRemodAdd     1 2.4818e+09 3.2414e+11 28432
## - BsmtCond        3 3.5111e+09 3.2516e+11 28433
## - LandContour     3 3.6249e+09 3.2528e+11 28434
## - Foundation      5 4.6092e+09 3.2626e+11 28434
## - BsmtFinSF2      1 3.8394e+09 3.2549e+11 28438
## - SaleCondition    2 4.6374e+09 3.2629e+11 28440
## - GarageCars      1 4.2360e+09 3.2589e+11 28440
## - BedroomAbvGr    1 4.6734e+09 3.2633e+11 28442
## - MSZoning         4 6.0350e+09 3.2769e+11 28442
## - WoodDeckSF      1 4.7138e+09 3.2637e+11 28442
## - MiscFeature      2 5.7656e+09 3.2742e+11 28445
## - RoofMatl        3 6.2445e+09 3.2790e+11 28445
## - LotConfig       4 7.5082e+09 3.2916e+11 28449
## - GarageType      4 7.5835e+09 3.2924e+11 28449
## - MiscVal         1 6.2608e+09 3.2791e+11 28449
## - BsmtFinType1    5 8.6963e+09 3.3035e+11 28452
## - Condition2      4 9.0335e+09 3.3069e+11 28456
## - LandSlope       2 8.3577e+09 3.3001e+11 28457
## - FireplaceQu     5 1.0361e+10 3.3201e+11 28459
## - YearBuilt       1 8.9116e+09 3.3057e+11 28461
## - ScreenPorch     1 9.1392e+09 3.3079e+11 28462
## - Exterior1st     12 1.4933e+10 3.3659e+11 28465
## - MasVnrArea_Sqrt  1 1.0411e+10 3.3206e+11 28468
## - MasVnrType      3 1.2220e+10 3.3387e+11 28472
## - Condition1      5 1.4553e+10 3.3621e+11 28478
## - BsmtUnfSF       1 1.2935e+10 3.3459e+11 28479
## - Functional      6 1.5631e+10 3.3728e+11 28480
## - GarageQual      4 1.5276e+10 3.3693e+11 28483
## - ExterQual       3 1.6235e+10 3.3789e+11 28489

```



```

## - KitchenQual      3 1.7518e+10 3.3917e+11 28495
## - MasVnrArea       1 1.8148e+10 3.3980e+11 28501
## - MSSubClass      14 2.5282e+10 3.4694e+11 28506
## - SaleType         8 2.3994e+10 3.4565e+11 28512
## - BsmtFinSF1       1 2.1641e+10 3.4329e+11 28516
## - OverallCond      1 2.2326e+10 3.4398e+11 28519
## - OverallQual      1 2.3298e+10 3.4495e+11 28523
## - LotArea          1 2.3552e+10 3.4521e+11 28524
## - BsmtQual         3 2.5373e+10 3.4703e+11 28528
## - BsmtExposure     3 2.9722e+10 3.5138e+11 28546
## - X1stFlrSF        1 3.2581e+10 3.5423e+11 28562
## - PoolArea         1 4.6647e+10 3.6830e+11 28619
## - X2ndFlrSF        1 7.2882e+10 3.9454e+11 28719
## - PoolQC           3 8.3460e+10 4.0511e+11 28754
## - Neighborhood     24 1.0490e+11 4.2656e+11 28787

## Stepwise Model Path
## Analysis of Deviance Table
##
## Initial Model:
## SalePrice ~ (ID + MSSubClass + MSZoning + LotArea + Street +
##   Alley + LotShape + LandContour + Utilities + LotConfig +
##   LandSlope + Neighborhood + Condition1 + Condition2 + BldgType +
##   HouseStyle + OverallQual + OverallCond + YearBuilt + YearRemodAdd +
##   RoofStyle + RoofMatl + Exterior1st + Exterior2nd + MasVnrType +
##   MasVnrArea + ExterQual + ExterCond + Foundation + BsmtQual +
##   BsmtCond + BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
##   BsmtFinSF2 + BsmtUnfSF + TotalBsmtSF + HeatingQC + CentralAir +
##   X1stFlrSF + X2ndFlrSF + LowQualFinSF + GrLivArea + BsmtFullBath +
##   BsmtHalfBath + FullBath + HalfBath + BedroomAbvGr + KitchenAbvGr +
##   KitchenQual + TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu +
##   GarageType + GarageYrBlt + GarageFinish + GarageCars + GarageArea +
##   GarageQual + GarageCond + PavedDrive + WoodDeckSF + OpenPorchSF +
##   EnclosedPorch + X3SsnPorch + ScreenPorch + PoolArea + PoolQC +
##   Fence + MiscFeature + MiscVal + MoSold + YrSold + SaleType +
##   SaleCondition + MasVnrArea_Sqrt) - ID
##
## Final Model:
## SalePrice ~ MSSubClass + MSZoning + LotArea + Street + LandContour +
##   Utilities + LotConfig + LandSlope + Neighborhood + Condition1 +
##   Condition2 + HouseStyle + OverallQual + OverallCond + YearBuilt +
##   YearRemodAdd + RoofMatl + Exterior1st + MasVnrType + MasVnrArea +
##   ExterQual + ExterCond + Foundation + BsmtQual + BsmtCond +
##   BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
##   BsmtFinSF2 + BsmtUnfSF + HeatingQC + X1stFlrSF + X2ndFlrSF +
##   BsmtFullBath + FullBath + BedroomAbvGr + KitchenAbvGr + KitchenQual +
##   TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu + GarageType +
##   GarageYrBlt + GarageFinish + GarageCars + GarageArea + GarageQual +
##   GarageCond + WoodDeckSF + EnclosedPorch + X3SsnPorch + ScreenPorch +
##   PoolArea + PoolQC + Fence + MiscFeature + MiscVal + MoSold +
##   YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt
##
##
##
## Step Df    Deviance Resid. Df    Resid. Dev    AIC

```

```
## 1      1228 312237807614 28447.84
## 2      - GrLivArea 0      0      1228 312237807614 28447.84
## 3      - TotalBsmtSF 0      0      1228 312237807614 28447.84
## 4      - LotShape 3 377711490 1231 312615519105 28443.61
## 5      - BldgType 2 123843356 1233 312739362461 28440.19
## 6      - PavedDrive 2 165946121 1235 312905308582 28436.96
## 7      - Alley 2 367764596 1237 313273073178 28434.67
## 8      - RoofStyle 5 1639019968 1242 314912093147 28432.29
## 9      - CentralAir 1 12259718 1243 314924352865 28430.34
## 10 - LowQualFinSF 1 59507371 1244 314983860236 28428.62
## 11 - OpenPorchSF 1 79613682 1245 315063473919 28426.99
## 12      - HalfBath 1 86402945 1246 315149876863 28425.39
## 13 - BsmtHalfBath 1 121178633 1247 315271055496 28423.95
## 14 - Exterior2nd 15 6382726011 1262 321653781507 28423.19
```

Below is the best model that I was able to produce with the ordinary least squares with a multiple r square .967 with an root mean squared logarithmic error of .0786. This model would end up producing my lowest rmsle bewtween Ridge, LASSO, and elastic net regressions.

```
##
## Call:
## lm(formula = SalePrice ~ MSSubClass + MSZoning + LotArea + Street +
##      Alley + LandContour + Utilities + LotConfig + LandSlope +
##      Neighborhood + Condition1 + Condition2 + HouseStyle + OverallQual +
##      OverallCond + YearBuilt + YearRemodAdd + RoofMatl + Exterior1st +
##      MasVnrType + MasVnrArea + ExterQual + ExterCond + Foundation +
##      BsmtQual + BsmtCond + BsmtExposure + BsmtFinType1 + BsmtFinSF1 +
##      BsmtFinType2 + BsmtFinSF2 + BsmtUnfSF + HeatingQC + X1stFlrSF +
##      X2ndFlrSF + BsmtFullBath + FullBath + HalfBath + BedroomAbvGr +
##      KitchenAbvGr + KitchenQual + TotRmsAbvGrd + Functional +
##      Fireplaces + FireplaceQu + GarageType + GarageYrBlt + GarageFinish +
##      GarageCars + GarageArea + GarageQual + GarageCond + WoodDeckSF +
##      X3SsnPorch + ScreenPorch + PoolArea + PoolQC + Fence + MoSold +
##      YrSold + SaleType + SaleCondition + MasVnrArea_Sqrt, data = test)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -147491  -4574         0    4443  159423
##
## Coefficients: (8 not defined because of singularities)
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -1.215e+06  7.008e+05  -1.734 0.083104 .
## MSSubClass30    1.100e+03  3.070e+03   0.358 0.720111
## MSSubClass40   -2.133e+03  7.684e+03  -0.278 0.781416
## MSSubClass45    1.247e+03  1.931e+04   0.065 0.948533
## MSSubClass50    4.579e+02  5.168e+03   0.089 0.929412
## MSSubClass60   -2.924e+03  4.865e+03  -0.601 0.547984
## MSSubClass70    3.102e+03  5.332e+03   0.582 0.560809
## MSSubClass75   -2.214e+04  7.939e+03  -2.789 0.005372 **
## MSSubClass80   -8.353e+03  1.081e+04  -0.773 0.439800
## MSSubClass85   -1.216e+04  6.167e+03  -1.972 0.048865 *
## MSSubClass90   -1.710e+04  4.706e+03  -3.634 0.000290 ***
## MSSubClass120  -2.241e+04  2.559e+03  -8.757 < 2e-16 ***
## MSSubClass160  -2.566e+04  5.933e+03  -4.325 1.65e-05 ***
## MSSubClass180  -2.752e+04  8.199e+03  -3.357 0.000812 ***
```

## MSSubClass190	-9.263e+03	4.478e+03	-2.069	0.038797	*
## MSZoning4	3.164e+04	7.041e+03	4.494	7.64e-06	***
## MSZoning2	3.220e+04	7.593e+03	4.241	2.39e-05	***
## MSZoning3	3.432e+04	5.566e+03	6.166	9.43e-10	***
## MSZoning1	3.083e+04	5.255e+03	5.866	5.70e-09	***
## LotArea	3.944e-01	8.938e-02	4.412	1.11e-05	***
## Street.L	2.183e+04	5.477e+03	3.986	7.10e-05	***
## Alley.L	1.406e+03	2.202e+03	0.639	0.523153	
## Alley.Q	-1.181e+03	2.510e+03	-0.471	0.638075	
## LandContour.L	1.086e+04	3.013e+03	3.604	0.000326	***
## LandContour.Q	-3.246e+03	2.577e+03	-1.260	0.208024	
## LandContour.C	-6.156e+03	2.637e+03	-2.334	0.019740	*
## Utilities	NA	NA	NA	NA	
## LotConfigCulDSac	9.563e+03	2.089e+03	4.578	5.16e-06	***
## LotConfigFR2	-8.855e+03	2.714e+03	-3.263	0.001134	**
## LotConfigFR3	-2.414e+04	5.786e+03	-4.172	3.23e-05	***
## LotConfigInside	-5.146e+02	1.142e+03	-0.451	0.652395	
## LandSlope.L	9.771e+03	5.423e+03	1.802	0.071850	.
## LandSlope.Q	-1.204e+04	3.550e+03	-3.391	0.000718	***
## NeighborhoodBlueste	2.068e+03	9.471e+03	0.218	0.827213	
## NeighborhoodBrDale	9.846e+03	8.197e+03	1.201	0.229906	
## NeighborhoodBrkSide	2.172e+03	6.843e+03	0.317	0.750979	
## NeighborhoodClearCr	-1.508e+03	6.633e+03	-0.227	0.820164	
## NeighborhoodCollgCr	3.074e+02	5.717e+03	0.054	0.957119	
## NeighborhoodCrawfor	1.726e+04	6.401e+03	2.697	0.007086	**
## NeighborhoodEdwards	-1.423e+04	6.043e+03	-2.355	0.018686	*
## NeighborhoodGilbert	-3.687e+03	5.828e+03	-0.633	0.527039	
## NeighborhoodIDOTRR	-1.982e+03	7.437e+03	-0.267	0.789889	
## NeighborhoodMeadowV	-6.947e+03	8.338e+03	-0.833	0.404921	
## NeighborhoodMitchel	-1.268e+04	6.091e+03	-2.082	0.037532	*
## NeighborhoodNames	-8.584e+03	5.984e+03	-1.435	0.151678	
## NeighborhoodNoRidge	4.101e+04	6.299e+03	6.510	1.08e-10	***
## NeighborhoodNPkVill	1.010e+04	7.302e+03	1.383	0.167007	
## NeighborhoodNridgHt	3.271e+04	5.835e+03	5.607	2.54e-08	***
## NeighborhoodNWAmes	-7.428e+03	6.139e+03	-1.210	0.226524	
## NeighborhoodOldTown	-8.519e+03	6.817e+03	-1.250	0.211623	
## NeighborhoodSawyer	-7.298e+03	6.116e+03	-1.193	0.233016	
## NeighborhoodSawyerW	2.281e+03	5.962e+03	0.383	0.702114	
## NeighborhoodSomerst	1.592e+04	6.744e+03	2.360	0.018409	*
## NeighborhoodStoneBr	4.877e+04	6.361e+03	7.667	3.51e-14	***
## NeighborhoodSWISU	-2.815e+03	7.094e+03	-0.397	0.691593	
## NeighborhoodTimber	-1.443e+03	6.061e+03	-0.238	0.811831	
## NeighborhoodVeenker	1.467e+04	7.445e+03	1.970	0.049021	*
## Condition1.L	1.089e+04	4.484e+03	2.429	0.015300	*
## Condition1.Q	-9.883e+02	3.937e+03	-0.251	0.801829	
## Condition1.C	-7.361e+03	3.652e+03	-2.015	0.044070	*
## Condition1^4	4.259e+03	3.034e+03	1.403	0.160742	
## Condition1^5	2.675e+02	1.993e+03	0.134	0.893260	
## Condition2.L	-3.843e+04	1.192e+04	-3.223	0.001302	**
## Condition2.Q	5.805e+04	1.013e+04	5.733	1.23e-08	***
## Condition2.C	1.430e+05	1.012e+04	14.126	< 2e-16	***
## Condition2^4	1.297e+05	9.278e+03	13.980	< 2e-16	***
## Condition2^5	7.118e+04	6.482e+03	10.981	< 2e-16	***
## HouseStyle1.5Unf	8.265e+03	1.791e+04	0.462	0.644436	

## HouseStyle1Story	7.455e+03	5.016e+03	1.486	0.137451	
## HouseStyle2.5Fin	1.111e+03	1.209e+04	0.092	0.926777	
## HouseStyle2.5Unf	5.693e+03	7.546e+03	0.755	0.450690	
## HouseStyle2Story	-2.990e+03	5.197e+03	-0.575	0.565224	
## HouseStyleSFoyer	5.145e+03	6.791e+03	0.758	0.448815	
## HouseStyleSLvl	1.179e+04	1.113e+04	1.060	0.289370	
## OverallQual	7.564e+03	6.686e+02	11.313	< 2e-16	***
## OverallCond	5.152e+03	5.797e+02	8.887	< 2e-16	***
## YearBuilt	2.617e+02	5.473e+01	4.782	1.94e-06	***
## YearRemodAdd	4.840e+01	3.625e+01	1.335	0.182076	
## RoofMatl.L	-1.619e+05	1.676e+04	-9.662	< 2e-16	***
## RoofMatl.Q	-1.588e+05	1.280e+04	-12.401	< 2e-16	***
## RoofMatl.C	-7.554e+04	7.421e+03	-10.179	< 2e-16	***
## Exterior1stBrkComm	8.112e+02	1.224e+04	0.066	0.947187	
## Exterior1stBrkFace	7.758e+03	4.460e+03	1.739	0.082212	.
## Exterior1stCBlock	-8.428e+03	1.254e+04	-0.672	0.501762	
## Exterior1stCemntBd	-4.687e+02	4.440e+03	-0.106	0.915954	
## Exterior1stHdBoard	-1.026e+04	3.835e+03	-2.674	0.007584	**
## Exterior1stImStucc	-1.449e+04	1.634e+04	-0.886	0.375627	
## Exterior1stMetalSd	-3.661e+03	3.716e+03	-0.985	0.324725	
## Exterior1stPlywood	-6.618e+03	4.053e+03	-1.633	0.102709	
## Exterior1stStone	-1.811e+04	1.697e+04	-1.068	0.285890	
## Exterior1stStucco	-6.590e+03	5.194e+03	-1.269	0.204760	
## Exterior1stVinylSd	-4.933e+03	3.756e+03	-1.313	0.189259	
## Exterior1stWd Sdng	-6.263e+03	3.683e+03	-1.701	0.089279	.
## Exterior1stWdShing	-1.146e+04	4.661e+03	-2.460	0.014045	*
## MasVnrTypeBrkFace	2.113e+03	4.640e+03	0.455	0.648861	
## MasVnrTypeNone	-1.513e+04	5.807e+03	-2.606	0.009276	**
## MasVnrTypeStone	3.801e+03	4.867e+03	0.781	0.434967	
## MasVnrArea	7.952e+01	1.243e+01	6.395	2.26e-10	***
## ExterQual0	-9.542e+03	6.670e+03	-1.431	0.152791	
## ExterQual2	-1.936e+04	3.319e+03	-5.833	6.94e-09	***
## ExterQual1	-1.730e+04	3.720e+03	-4.650	3.66e-06	***
## ExterCond1	-9.310e+02	7.833e+03	-0.119	0.905417	
## ExterCond3	-7.506e+03	6.941e+03	-1.082	0.279669	
## ExterCond0	7.201e+03	1.514e+04	0.476	0.634378	
## ExterCond2	-3.345e+03	6.893e+03	-0.485	0.627607	
## FoundationCBlock	2.820e+03	2.132e+03	1.323	0.186220	
## FoundationPConc	3.549e+03	2.254e+03	1.575	0.115554	
## FoundationSlab	-3.150e+03	5.819e+03	-0.541	0.588369	
## FoundationStone	1.651e+04	8.544e+03	1.932	0.053607	.
## FoundationWood	-1.882e+04	9.661e+03	-1.949	0.051571	.
## BsmtQual.L	2.592e+05	7.027e+04	3.689	0.000235	***
## BsmtQual.Q	-2.007e+05	5.948e+04	-3.375	0.000762	***
## BsmtQual.C	1.333e+05	3.516e+04	3.791	0.000157	***
## BsmtQual^4	-4.514e+04	1.341e+04	-3.367	0.000783	***
## BsmtCond.L	-7.659e+04	3.584e+04	-2.137	0.032810	*
## BsmtCond.Q	5.743e+04	2.451e+04	2.343	0.019284	*
## BsmtCond.C	-2.415e+04	9.151e+03	-2.639	0.008406	**
## BsmtCond^4	NA	NA	NA	NA	
## BsmtExposure.L	2.287e+04	6.644e+03	3.443	0.000595	***
## BsmtExposure.Q	-4.847e+02	6.075e+03	-0.080	0.936423	
## BsmtExposure.C	8.213e+03	3.749e+03	2.191	0.028645	*
## BsmtExposure^4	NA	NA	NA	NA	

## BsmtFinType1.L	-2.780e+04	2.715e+04	-1.024	0.305991
## BsmtFinType1.Q	3.123e+04	2.655e+04	1.176	0.239754
## BsmtFinType1.C	-1.939e+04	1.992e+04	-0.973	0.330571
## BsmtFinType1^4	1.335e+04	1.171e+04	1.141	0.254186
## BsmtFinType1^5	-4.645e+03	5.065e+03	-0.917	0.359273
## BsmtFinType1^6	NA	NA	NA	NA
## BsmtFinSF1	3.291e+01	2.998e+00	10.979	< 2e-16 ***
## BsmtFinType2.L	-1.430e+05	4.450e+04	-3.213	0.001347 **
## BsmtFinType2.Q	1.545e+05	4.316e+04	3.579	0.000358 ***
## BsmtFinType2.C	-1.037e+05	3.237e+04	-3.205	0.001384 **
## BsmtFinType2^4	6.007e+04	1.927e+04	3.117	0.001871 **
## BsmtFinType2^5	-3.042e+04	9.554e+03	-3.184	0.001487 **
## BsmtFinType2^6	NA	NA	NA	NA
## BsmtFinSF2	3.236e+01	4.926e+00	6.569	7.39e-11 ***
## BsmtUnfSF	1.676e+01	2.762e+00	6.070	1.69e-09 ***
## HeatingQC.L	1.708e+04	7.183e+03	2.378	0.017550 *
## HeatingQC.Q	-9.364e+03	6.013e+03	-1.557	0.119649
## HeatingQC.C	7.081e+03	3.899e+03	1.816	0.069602 .
## HeatingQC^4	-7.309e+02	1.904e+03	-0.384	0.701151
## X1stFlrSF	3.672e+01	3.160e+00	11.621	< 2e-16 ***
## X2ndFlrSF	5.213e+01	3.406e+00	15.303	< 2e-16 ***
## BsmtFullBath	2.569e+03	1.169e+03	2.199	0.028088 *
## FullBath	4.646e+03	1.487e+03	3.125	0.001822 **
## HalfBath	1.005e+03	1.345e+03	0.747	0.455004
## BedroomAbvGr	-3.053e+03	9.065e+02	-3.368	0.000781 ***
## KitchenAbvGr	-1.363e+04	3.882e+03	-3.511	0.000462 ***
## KitchenQual.L	1.266e+04	3.113e+03	4.067	5.06e-05 ***
## KitchenQual.Q	1.410e+04	2.210e+03	6.380	2.49e-10 ***
## KitchenQual.C	4.406e+03	1.197e+03	3.682	0.000242 ***
## TotRmsAbvGrd	2.888e+03	5.922e+02	4.876	1.22e-06 ***
## Functional.L	3.604e+04	1.130e+04	3.189	0.001462 **
## Functional.Q	-1.681e+04	1.053e+04	-1.597	0.110463
## Functional.C	1.498e+04	9.025e+03	1.659	0.097265 .
## Functional^4	-1.515e+03	7.405e+03	-0.205	0.837900
## Functional^5	7.458e+03	6.084e+03	1.226	0.220493
## Functional^6	-1.605e+03	4.409e+03	-0.364	0.715967
## Fireplaces	1.042e+04	1.682e+03	6.197	7.79e-10 ***
## FireplaceQu.L	-9.724e+03	2.863e+03	-3.397	0.000704 ***
## FireplaceQu.Q	4.220e+03	2.556e+03	1.651	0.098931 .
## FireplaceQu.C	-1.523e+03	2.473e+03	-0.616	0.538132
## FireplaceQu^4	-4.381e+03	2.395e+03	-1.830	0.067540 .
## FireplaceQu^5	6.320e+03	2.098e+03	3.013	0.002638 **
## GarageType.L	3.894e+04	6.693e+04	0.582	0.560781
## GarageType.Q	-6.347e+04	6.142e+04	-1.033	0.301679
## GarageType.C	3.043e+04	4.200e+04	0.724	0.468944
## GarageType^4	-2.418e+04	2.168e+04	-1.115	0.264928
## GarageType^5	7.093e+03	7.416e+03	0.956	0.339041
## GarageYrBlt	-3.438e+01	3.938e+01	-0.873	0.382877
## GarageFinish.L	-3.027e+03	3.084e+03	-0.982	0.326452
## GarageFinish.Q	5.398e+03	2.186e+03	2.469	0.013693 *
## GarageFinish.C	NA	NA	NA	NA
## GarageCars	5.793e+03	1.488e+03	3.893	0.000104 ***
## GarageArea	1.779e+01	5.091e+00	3.493	0.000494 ***
## GarageQual.L	1.480e+04	4.700e+04	0.315	0.752853

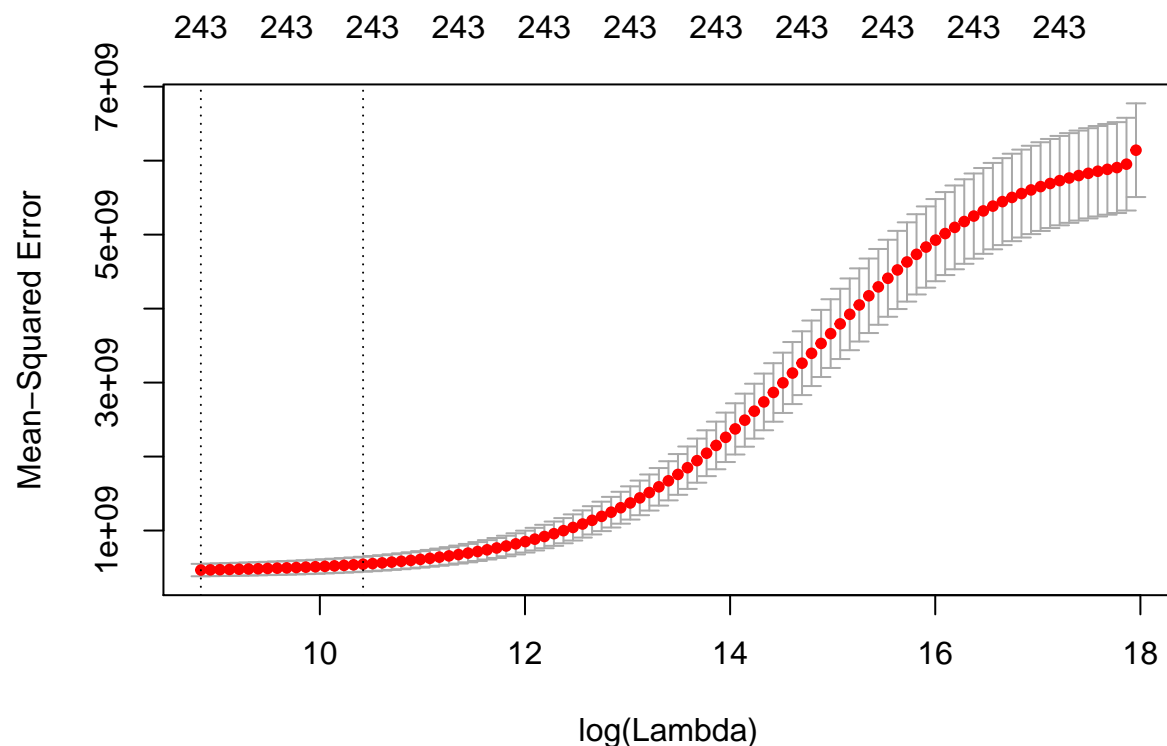
```

## GarageQual.Q      1.494e+05  4.148e+04   3.602 0.000328 ***
## GarageQual.C     -5.236e+03  2.014e+04  -0.260 0.794959
## GarageQual^4      6.053e+04  1.143e+04   5.297 1.39e-07 ***
## GarageQual^5           NA           NA           NA           NA
## GarageCond.L     -2.440e+04  3.435e+04  -0.710 0.477627
## GarageCond.Q     -1.268e+05  3.406e+04  -3.723 0.000206 ***
## GarageCond.C     -1.754e+04  1.678e+04  -1.045 0.295998
## GarageCond^4     -4.917e+04  1.187e+04  -4.143 3.65e-05 ***
## GarageCond^5           NA           NA           NA           NA
## WoodDeckSF        1.201e+01  3.865e+00   3.108 0.001926 **
## X3SsnPorch        8.258e+01  2.545e+01   3.245 0.001207 **
## ScreenPorch       2.921e+01  8.293e+00   3.522 0.000443 ***
## PoolArea          1.530e+03  3.851e+01  39.721 < 2e-16 ***
## PoolQC.L         -4.654e+05  1.213e+04 -38.371 < 2e-16 ***
## PoolQC.Q          6.441e+05  1.941e+04  33.183 < 2e-16 ***
## PoolQC.C         -1.169e+05  1.489e+04  -7.850 8.84e-15 ***
## Fence.L          -3.569e+03  1.150e+03  -3.103 0.001961 **
## Fence.Q          -2.309e+03  1.222e+03  -1.890 0.058944 .
## MoSold           -3.119e+02  1.612e+02  -1.935 0.053160 .
## YrSold            -7.849e+01  3.451e+02  -0.227 0.820127
## SaleTypeCon       2.657e+04  9.728e+03   2.731 0.006407 **
## SaleTypeConLD     2.332e+04  6.256e+03   3.727 0.000202 ***
## SaleTypeConLI     -4.394e+03  9.873e+03  -0.445 0.656369
## SaleTypeConLw     -4.275e+03  7.908e+03  -0.541 0.588932
## SaleTypeCWD       8.982e+03  7.020e+03   1.279 0.200974
## SaleTypeNew       2.129e+04  3.289e+03   6.474 1.37e-10 ***
## SaleTypeOth       1.010e+04  8.330e+03   1.212 0.225641
## SaleTypeWD       -9.642e+02  2.647e+03  -0.364 0.715671
## SaleCondition.L    9.134e+03  4.987e+03   1.832 0.067246 .
## SaleCondition.Q   -1.500e+03  2.929e+03  -0.512 0.608512
## MasVnrArea_Sqrt   -2.440e+03  4.399e+02  -5.546 3.56e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15170 on 1257 degrees of freedom
## Multiple R-squared:  0.9698, Adjusted R-squared:  0.965
## F-statistic: 203.9 on 198 and 1257 DF,  p-value: < 2.2e-16

```

## Ridge Regression

The ridge regression I thought would be a better fit than the ordinary least squares method but worse than the LASSO regression. However, it turns out that the root mean squared logarithmic error of the ridge regression was higher than that of the ordinary least squared method. In the outputs below you see that the ridge regression produced a root mean squares logarithmic error of about 28.00%. However what is interesting when looking at the coefficients is that the value of a miscellaneous feature of the house can have a strong positive impact on the price of a house. Furthermore, it is interesting to see that the type of the garage has a negative impact on the price of a house. This is a little perplexing due to the fact that I thought that an attached or built in garage would have a positive impact on price of a house.



```
## [1] 6904.472
## 246 x 1 sparse Matrix of class "dgCMatrix"
##              1
## (Intercept)  1.385296e+06
## ID          -1.818005e-01
## MSSubClass30  2.648635e+03
## MSSubClass40  3.048014e+04
## MSSubClass45 -1.316131e+03
## MSSubClass50  1.441024e+03
## MSSubClass60  3.190640e+03
## MSSubClass70  2.775833e+03
## MSSubClass75 -8.461605e+03
## MSSubClass80  6.583016e+02
## MSSubClass85 -1.283747e+04
## MSSubClass90 -4.054599e+03
## MSSubClass120 -8.508873e+03
## MSSubClass160 -6.182677e+03
## MSSubClass180 -3.471144e+03
## MSSubClass190 -6.173423e+03
## MSZoning4     1.241383e+04
## MSZoning2     -1.345472e+03
## MSZoning3     3.623516e+03
## MSZoning1     -6.013592e+02
## LotArea       6.126257e-01
## Street.L      1.514222e+04
## Alley.L       -2.548085e+03
## Alley.Q       -5.563311e+02
## LotShape.L    -4.143409e+03
## LotShape.Q    -8.762841e+02
## LotShape.C    2.873845e+03
```

## LandContour.L	7.205541e+03
## LandContour.Q	1.192541e+03
## LandContour.C	-3.271000e+03
## Utilities	3.289135e+04
## LotConfigCulDSac	6.421880e+03
## LotConfigFR2	-7.623516e+03
## LotConfigFR3	-1.358922e+04
## LotConfigInside	-1.171593e+03
## LandSlope.L	1.061160e+04
## LandSlope.Q	-1.275245e+04
## NeighborhoodBlueste	-2.167087e+03
## NeighborhoodBrDale	-4.984977e+03
## NeighborhoodBrkSide	2.202313e+03
## NeighborhoodClearCr	-1.026206e+04
## NeighborhoodCollgCr	-1.407566e+03
## NeighborhoodCrawfor	1.620074e+04
## NeighborhoodEdwards	-1.100125e+04
## NeighborhoodGilbert	-4.338826e+03
## NeighborhoodIDOTRR	-6.861755e+03
## NeighborhoodMeadowV	-9.344699e+03
## NeighborhoodMitchel	-1.409372e+04
## NeighborhoodNames	-8.386043e+03
## NeighborhoodNoRidge	3.488475e+04
## NeighborhoodNPkVill	5.500099e+03
## NeighborhoodNridgHt	2.001520e+04
## NeighborhoodNWAmes	-9.999507e+03
## NeighborhoodOldTown	-6.924502e+03
## NeighborhoodSawyer	-3.880196e+03
## NeighborhoodSawyerW	3.397885e+03
## NeighborhoodSomerst	2.426809e+03
## NeighborhoodStoneBr	3.858888e+04
## NeighborhoodSWISU	-1.530769e+03
## NeighborhoodTimber	-6.230868e+03
## NeighborhoodVeenker	8.578379e+03
## Condition1.L	4.047262e+03
## Condition1.Q	-3.045643e+03
## Condition1.C	-8.305090e+03
## Condition1^4	4.402424e+03
## Condition1^5	1.737450e+03
## Condition2.L	5.785336e+04
## Condition2.Q	2.780078e+04
## Condition2.C	2.440174e+04
## Condition2^4	-8.682499e+03
## Condition2^5	-3.454446e+03
## BldgType2fmCon	-5.796683e+03
## BldgTypeDuplex	-3.958516e+03
## BldgTypeTwnhsE	-7.485198e+03
## HouseStyle1.5Unf	9.068814e+03
## HouseStyle1Story	3.059916e+02
## HouseStyle2.5Fin	1.827061e+04
## HouseStyle2Story	-3.507807e+03
## HouseStyleSFoyer	8.746120e+02
## HouseStyleSLvl	1.751667e+03
## OverallQual	6.883717e+03



## OverallCond	4.416071e+03
## YearBuilt	1.613931e+02
## YearRemodAdd	1.462138e+02
## RoofStyleGable	-2.662207e+03
## RoofStyleGambrel	-9.283468e+03
## RoofStyleHip	6.215383e+02
## RoofStyleMansard	7.416252e+02
## RoofStyleShed	-1.057733e+04
## RoofMatl.L	2.093120e+04
## RoofMatl.Q	-5.160933e+03
## RoofMatl.C	-2.551896e+04
## Exterior1stAsphShn	-1.107222e+03
## Exterior1stBrkComm	7.588372e+02
## Exterior1stBrkFace	1.953365e+04
## Exterior1stCBlock	.
## Exterior1stCemntBd	2.758926e+03
## Exterior1stHdBoard	-9.094417e+02
## Exterior1stImStucc	.
## Exterior1stMetalSd	-1.066789e+02
## Exterior1stPlywood	-1.119597e+02
## Exterior1stStone	-1.982606e+04
## Exterior1stStucco	-1.673635e+03
## Exterior1stVinylSd	3.735101e+02
## Exterior1stWd Sdng	-3.708791e+03
## Exterior1stWdShing	-3.452624e+03
## Exterior2ndAsphShn	1.873351e+03
## Exterior2ndBrk Cmn	-1.388047e+03
## Exterior2ndBrkFace	-6.037841e+03
## Exterior2ndCBlock	-6.870482e+02
## Exterior2ndCmentBd	2.887992e+03
## Exterior2ndHdBoard	-5.618894e+02
## Exterior2ndImStucc	7.122398e+02
## Exterior2ndMetalSd	3.691955e+01
## Exterior2ndOther	-1.923170e+04
## Exterior2ndPlywood	-6.038066e+03
## Exterior2ndStone	-2.964132e+04
## Exterior2ndStucco	-1.263104e+02
## Exterior2ndVinylSd	1.451145e+03
## Exterior2ndWd Sdng	3.120789e+03
## Exterior2ndWd Shng	-1.384505e+03
## MasVnrTypeBrkFace	-2.056588e+03
## MasVnrTypeNone	3.180061e+03
## MasVnrTypeStone	6.377871e+03
## MasVnrArea	3.351450e+01
## ExterQual0	-2.865974e+03
## ExterQual2	-9.234097e+03
## ExterQual1	-8.206305e+03
## ExterCond1	-4.525073e+01
## ExterCond3	-1.988610e+03
## ExterCond0	1.156301e+04
## ExterCond2	-2.882300e+02
## FoundationCBlock	2.995446e+03
## FoundationPConc	3.431209e+03
## FoundationSlab	6.324158e+03

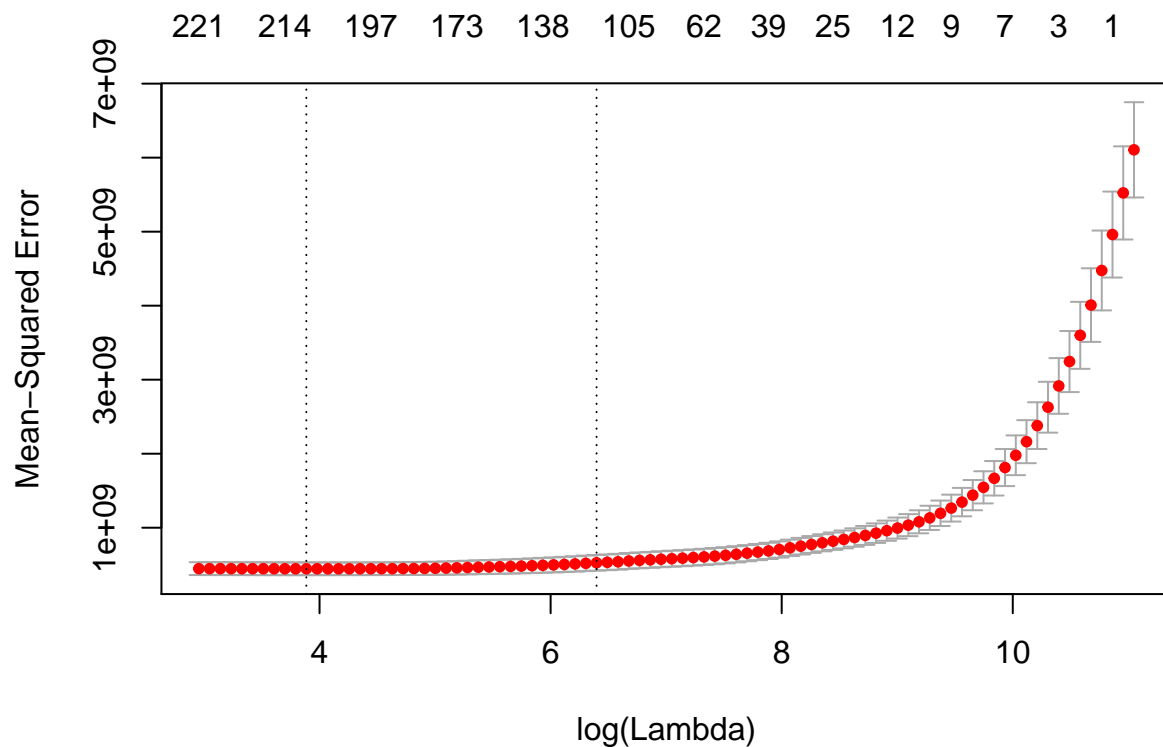
## FoundationStone	6.827684e+03
## FoundationWood	-2.351093e+04
## BsmtQual.L	7.619900e+03
## BsmtQual.Q	1.085894e+04
## BsmtQual.C	1.065180e+04
## BsmtQual^4	2.343481e+03
## BsmtCond.L	-2.587242e+03
## BsmtCond.Q	-9.552602e+02
## BsmtCond.C	5.048369e+03
## BsmtCond^4	-6.694020e+03
## BsmtExposure.L	1.038788e+04
## BsmtExposure.Q	1.416394e+04
## BsmtExposure.C	1.814420e+02
## BsmtExposure^4	4.086608e+03
## BsmtFinType1.L	6.094503e+03
## BsmtFinType1.Q	3.145753e+03
## BsmtFinType1.C	-2.452185e+03
## BsmtFinType1^4	3.347669e+03
## BsmtFinType1^5	2.903739e+03
## BsmtFinType1^6	3.541985e+02
## BsmtFinSF1	1.311950e+01
## BsmtFinType2.L	6.682836e+03
## BsmtFinType2.Q	5.952422e+03
## BsmtFinType2.C	2.443025e+03
## BsmtFinType2^4	-1.389894e+03
## BsmtFinType2^5	6.469279e+02
## BsmtFinType2^6	-1.416084e+03
## BsmtFinSF2	4.034265e+00
## BsmtUnfSF	5.141519e+00
## TotalBsmtSF	1.963706e+01
## HeatingQC.L	1.741199e+03
## HeatingQC.Q	1.736967e+03
## HeatingQC.C	3.098520e+03
## HeatingQC^4	-2.845092e+02
## CentralAir1	1.061827e+03
## X1stFlrSF	9.817592e+00
## X2ndFlrSF	2.069600e+01
## LowQualFinSF	-1.740997e+01
## GrLivArea	2.083326e+01
## BsmtFullBath	3.157848e+03
## BsmtHalfBath	-6.711814e+02
## FullBath	7.152759e+03
## HalfBath	2.203233e+03
## BedroomAbvGr	-1.982700e+03
## KitchenAbvGr	-8.726807e+03
## KitchenQual.L	1.549050e+04
## KitchenQual.Q	1.489619e+04
## KitchenQual.C	3.023393e+03
## TotRmsAbvGrd	2.254489e+03
## Functional.L	1.817628e+04
## Functional.Q	-6.273384e+02
## Functional.C	7.101850e+03
## Functional^4	6.806667e+02
## Functional^5	7.378845e+03

## Functional^6	7.375733e+03
## Fireplaces	2.918118e+03
## FireplaceQu.L	3.005503e+02
## FireplaceQu.Q	3.454052e+03
## FireplaceQu.C	1.129215e+04
## FireplaceQu^4	-5.449976e+03
## FireplaceQu^5	5.742163e+03
## GarageType.L	-1.167489e+04
## GarageType.Q	-1.175445e+04
## GarageType.C	-8.657293e+03
## GarageType^4	-8.172017e+03
## GarageType^5	-1.939695e+03
## GarageYrBltd	-8.182655e-01
## GarageFinish.L	-9.868139e+02
## GarageFinish.Q	1.761631e+03
## GarageFinish.C	2.395609e+03
## GarageCars	5.187618e+03
## GarageArea	1.390469e+01
## GarageQual.L	9.495204e+03
## GarageQual.Q	1.160705e+04
## GarageQual.C	4.951913e+03
## GarageQual^4	4.998986e+03
## GarageQual^5	4.905688e+03
## GarageCond.L	-3.572861e+03
## GarageCond.Q	1.177947e+03
## GarageCond.C	-1.479903e+03
## GarageCond^4	1.048639e+04
## GarageCond^5	3.643112e+03
## PavedDrive.L	1.328224e+03
## PavedDrive.Q	-1.556934e+03
## WoodDeckSF	1.936342e+01
## OpenPorchSF	9.421877e+00
## EnclosedPorch	2.606371e+01
## X3SsnPorch	4.631816e+01
## ScreenPorch	5.267434e+01
## PoolArea	1.372466e+02
## PoolQC.L	-1.145054e+05
## PoolQC.Q	1.060057e+04
## PoolQC.C	-5.009562e+04
## Fence.L	-4.133865e+02
## Fence.Q	-1.309131e+03
## MiscFeature.L	9.876439e+03
## MiscFeature.Q	5.143552e+03
## MiscVal	-1.312475e+00
## MoSold	-3.132891e+02
## YrSold	-1.045890e+03
## SaleTypeCon	8.190101e+03
## SaleTypeConLD	8.985299e+03
## SaleTypeConLI	-3.694844e+02
## SaleTypeConLw	2.907337e+03
## SaleTypeCWD	1.695514e+04
## SaleTypeNew	1.803600e+04
## SaleTypeOth	2.086595e+03
## SaleTypeWD	-5.498631e+03

```
## SaleCondition.L      7.109933e+03
## SaleCondition.Q     -2.769709e+03
## MasVnrArea_Sqrt    -7.263068e+01
## [1] 19.2121
## Warning in log(1 + actual): NaNs produced
## [1] "The RMSLE for Ridge is: NaN or about NaN %"
```

## LASSO Regression

The LASSO regression proved to be a better model than the Ridge regression while also providing insights that I was not able to pick up on in the Ridge regression. The model produced an root mean squared log error of about 18.00% which is better than that of the Ridge regression. Some unique insights of the LASSO is that GarageYrBlt and BsmtExposure are not significant at all in the models. Whereas in the Ridge model BsmtExposure positively impacted price and GarageYrBlt had a small negative impact, so that would actually make sense that it was excluded from the model. Also interesting to note is that majority of the Exterior1st had negative impacts on price while all of the MSZoning had positive impacts. This shows a little bit that where a house is may have a greater impact on housing prices than the actual house itself. This can be backed up when looking at Neighborhood and seeing that most neighborhoods have a strong impact on price.



```
## [1] 48.70968
## 246 x 1 sparse Matrix of class "dgCMatrix"
##              1
## (Intercept)  3.778898e+05
## ID          -5.949315e-03
## MSSubClass30  4.334084e+03
## MSSubClass40  4.286887e+04
## MSSubClass45 -2.317944e+03
## MSSubClass50 -5.335348e+02
```

## MSSubClass60	3.422357e+03
## MSSubClass70	5.604689e+03
## MSSubClass75	-1.538190e+04
## MSSubClass80	5.893746e+02
## MSSubClass85	-1.200146e+04
## MSSubClass90	-6.911893e+03
## MSSubClass120	-9.477852e+03
## MSSubClass160	-5.803316e+03
## MSSubClass180	-3.823097e+03
## MSSubClass190	-3.442198e+03
## MSZoning4	2.109060e+04
## MSZoning2	6.611224e+03
## MSZoning3	1.031830e+04
## MSZoning1	6.641802e+03
## LotArea	7.378698e-01
## Street.L	1.631950e+04
## Alley.L	-2.870956e+03
## Alley.Q	-2.142530e+03
## LotShape.L	-1.079943e+03
## LotShape.Q	-6.730435e+02
## LotShape.C	2.309051e+03
## LandContour.L	8.551852e+03
## LandContour.Q	-1.252433e+03
## LandContour.C	-2.978562e+03
## Utilities	2.745511e+04
## LotConfigCulDSac	6.866070e+03
## LotConfigFR2	-7.428665e+03
## LotConfigFR3	-1.315418e+04
## LotConfigInside	-1.718001e+03
## LandSlope.L	2.126834e+04
## LandSlope.Q	-1.918441e+04
## NeighborhoodBlueste	.
## NeighborhoodBrDale	.
## NeighborhoodBrkSide	3.462667e+03
## NeighborhoodClearCr	-5.393551e+03
## NeighborhoodCollgCr	.
## NeighborhoodCrawfor	2.087147e+04
## NeighborhoodEdwards	-1.275158e+04
## NeighborhoodGilbert	-3.673291e+03
## NeighborhoodIDOTRR	-6.466242e+03
## NeighborhoodMeadowV	-5.099220e+03
## NeighborhoodMitchel	-1.181502e+04
## NeighborhoodNames	-7.852829e+03
## NeighborhoodNoRidge	3.404217e+04
## NeighborhoodNPkVill	8.612889e+03
## NeighborhoodNridgHt	2.307304e+04
## NeighborhoodNWAmes	-9.077565e+03
## NeighborhoodOldTown	-6.978125e+03
## NeighborhoodSawyer	-2.895732e+03
## NeighborhoodSawyerW	2.628244e+03
## NeighborhoodSomerst	2.916096e+03
## NeighborhoodStoneBr	4.316912e+04
## NeighborhoodSWISU	9.000236e+02
## NeighborhoodTimber	-5.375702e+03

```

## NeighborhoodVeenker  6.147873e+03
## Condition1.L         4.536388e+03
## Condition1.Q         -3.094259e+03
## Condition1.C         -1.003533e+04
## Condition1^4         4.142713e+03
## Condition1^5         1.612847e+03
## Condition2.L         5.631758e+04
## Condition2.Q         2.337514e+04
## Condition2.C         2.939988e+04
## Condition2^4        -2.921451e+03
## Condition2^5         .
## BldgType2fmCon      -7.387239e+03
## BldgTypeDuplex      -3.994622e+01
## BldgTypeTwnhsE     -1.040759e+04
## HouseStyle1.5Unf     1.284868e+04
## HouseStyle1Story     2.789712e+03
## HouseStyle2.5Fin     2.663683e+03
## HouseStyle2Story    -1.004714e+04
## HouseStyleSFoyer     2.977540e+03
## HouseStyleSLvl      1.688704e+03
## OverallQual         7.153598e+03
## OverallCond         5.182449e+03
## YearBuilt           3.088800e+02
## YearRemodAdd        1.224370e+02
## RoofStyleGable      -1.817300e+03
## RoofStyleGambrel    -4.888663e+03
## RoofStyleHip         .
## RoofStyleMansard     .
## RoofStyleShed       -1.487769e+04
## RoofMatl.L          2.889926e+04
## RoofMatl.Q          -3.209654e+03
## RoofMatl.C          -1.603348e+04
## Exterior1stAsphShn   .
## Exterior1stBrkComm   3.927109e+03
## Exterior1stBrkFace   2.144281e+04
## Exterior1stCBlock     .
## Exterior1stCemntBd    .
## Exterior1stHdBoard  -1.639404e+03
## Exterior1stImStucc    .
## Exterior1stMetalSd    1.202438e+03
## Exterior1stPlywood   -5.882882e+02
## Exterior1stStone     -1.590700e+04
## Exterior1stStucco    -5.944471e+02
## Exterior1stVinylSd    .
## Exterior1stWd Sdng   -2.338005e+03
## Exterior1stWdShing    2.542289e+03
## Exterior2ndAsphShn   5.554971e+01
## Exterior2ndBrk Cmn    .
## Exterior2ndBrkFace  -8.290304e+03
## Exterior2ndCBlock    -6.705299e+03
## Exterior2ndCmentBd   3.914934e+03
## Exterior2ndHdBoard    .
## Exterior2ndImStucc    .
## Exterior2ndMetalSd    .

```

## Exterior2ndOther	-2.103899e+04
## Exterior2ndPlywood	-4.153061e+03
## Exterior2ndStone	-3.561934e+04
## Exterior2ndStucco	.
## Exterior2ndVinylSd	1.695369e+03
## Exterior2ndWd Sdng	2.465253e+03
## Exterior2ndWd Shng	-4.733592e+03
## MasVnrTypeBrkFace	6.462748e+03
## MasVnrTypeNone	-5.183872e+02
## MasVnrTypeStone	1.603877e+04
## MasVnrArea	8.245092e+01
## ExterQual0	-1.799948e+04
## ExterQual2	-2.341441e+04
## ExterQual1	-2.291403e+04
## ExterCond1	3.177420e+01
## ExterCond3	-3.640917e+03
## ExterCond0	1.628740e+04
## ExterCond2	.
## FoundationCBlock	4.055784e+03
## FoundationPConc	3.694741e+03
## FoundationSlab	2.665980e+03
## FoundationStone	9.029934e+03
## FoundationWood	-2.702122e+04
## BsmtQual.L	5.826863e+03
## BsmtQual.Q	3.541031e+03
## BsmtQual.C	1.450972e+04
## BsmtQual^4	8.832032e+02
## BsmtCond.L	-1.644261e+04
## BsmtCond.Q	.
## BsmtCond.C	1.340244e+04
## BsmtCond^4	-1.381789e+04
## BsmtExposure.L	9.762162e+03
## BsmtExposure.Q	1.589861e+04
## BsmtExposure.C	.
## BsmtExposure^4	3.144604e+03
## BsmtFinType1.L	9.917247e+03
## BsmtFinType1.Q	.
## BsmtFinType1.C	-3.770050e+02
## BsmtFinType1^4	8.672396e+02
## BsmtFinType1^5	4.435595e+03
## BsmtFinType1^6	-1.580023e+02
## BsmtFinSF1	9.398170e+00
## BsmtFinType2.L	6.146293e+03
## BsmtFinType2.Q	1.042661e+04
## BsmtFinType2.C	7.831705e+02
## BsmtFinType2^4	.
## BsmtFinType2^5	.
## BsmtFinType2^6	-1.645341e+03
## BsmtFinSF2	2.324557e-01
## BsmtUnfSF	.
## TotalBsmtSF	2.451307e+01
## HeatingQC.L	.
## HeatingQC.Q	2.065596e+03
## HeatingQC.C	2.706239e+03

## HeatingQC^4	-8.893805e+02
## CentralAir1	.
## X1stFlrSF	.
## X2ndFlrSF	2.157439e+01
## LowQualFinSF	-2.546936e+01
## GrLivArea	3.966731e+01
## BsmtFullBath	2.762515e+03
## BsmtHalfBath	5.327642e+02
## FullBath	4.569311e+03
## HalfBath	9.678803e+02
## BedroomAbvGr	-4.065501e+03
## KitchenAbvGr	-9.736509e+03
## KitchenQual.L	1.293450e+04
## KitchenQual.Q	1.196341e+04
## KitchenQual.C	3.589485e+03
## TotRmsAbvGrd	1.523420e+03
## Functional.L	2.885427e+04
## Functional.Q	-4.632878e+03
## Functional.C	8.703398e+03
## Functional^4	-1.320722e+03
## Functional^5	3.791487e+03
## Functional^6	1.134595e+04
## Fireplaces	1.718835e+03
## FireplaceQu.L	-7.028491e+02
## FireplaceQu.Q	4.419220e+03
## FireplaceQu.C	1.324633e+04
## FireplaceQu^4	-7.955533e+03
## FireplaceQu^5	7.920219e+03
## GarageType.L	-2.346504e+03
## GarageType.Q	-2.570604e+04
## GarageType.C	.
## GarageType^4	-1.216777e+04
## GarageType^5	-5.020465e+02
## GarageYrBlt	.
## GarageFinish.L	.
## GarageFinish.Q	9.272716e+02
## GarageFinish.C	1.803175e+03
## GarageCars	6.688035e+03
## GarageArea	5.663948e+00
## GarageQual.L	4.331932e+04
## GarageQual.Q	7.391059e+04
## GarageQual.C	2.123694e+04
## GarageQual^4	3.271758e+04
## GarageQual^5	5.888240e+03
## GarageCond.L	.
## GarageCond.Q	.
## GarageCond.C	3.710759e+03
## GarageCond^4	8.430457e+03
## GarageCond^5	3.530375e+03
## PavedDrive.L	5.874356e+02
## PavedDrive.Q	5.468560e+02
## WoodDeckSF	1.664871e+01
## OpenPorchSF	.
## EnclosedPorch	2.184568e+01



```

## X3SsnPorch      3.558286e+01
## ScreenPorch     5.013462e+01
## PoolArea        1.021934e+03
## PoolQC.L        -3.543364e+05
## PoolQC.Q         3.593906e+05
## PoolQC.C        -6.389341e+04
## Fence.L         -1.434716e+03
## Fence.Q         -1.974643e+03
## MiscFeature.L    2.565377e+04
## MiscFeature.Q    1.310850e+04
## MiscVal         -3.481032e+00
## MoSold          -2.864965e+02
## YrSold          -8.261203e+02
## SaleTypeCon      9.304037e+03
## SaleTypeConLD    1.239401e+04
## SaleTypeConLI    1.418231e+03
## SaleTypeConLw    5.820654e+03
## SaleTypeCWD      1.875869e+04
## SaleTypeNew      2.235506e+04
## SaleTypeOth      4.400668e+03
## SaleTypeWD       -2.056136e+03
## SaleCondition.L  1.257570e+04
## SaleCondition.Q  .
## MasVnrArea_Sqrt -1.807019e+03

## [1] 19.2121

## Warning in log(1 + actual): NaNs produced

## Warning in log(1 + predicted): NaNs produced

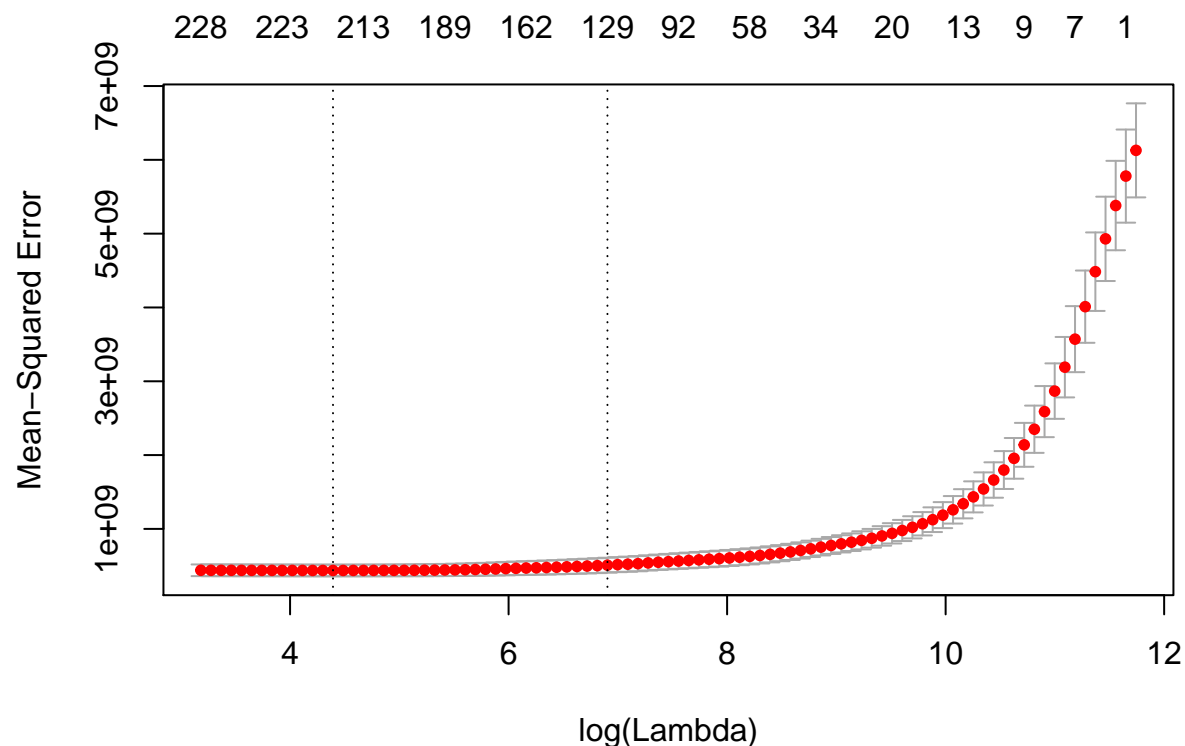
## [1] 1

## [1] "The RMSLE for LASSO is: NaN or about NaN %"

```

## Elastic Net Regression

Next is the elastic net regression and this model performed better than the Ridge regression but worse than the LASSO with an root mean squared logarithmic error of 19.00%. The coefficients of this model showed that, like the other models, showed that YearBuilt, YearRemodAdd, OverallQual, and OverallCond have strong impacts on price. It is interesting to note that throughout all of the models Exterior1st and Exterior2nd have consistently more often than not have negative impacts on price. This could be that the exteriors of the houses available do not fit the mold of the new homeowner, which would therefore lead to more often than not having a negative impact on price of the house. However, this model overall is beneficial for comparing the coefficients of variables against the LASSO regression.



```
## [1] 80.87927
## 246 x 1 sparse Matrix of class "dgCMatrix"
##
## (Intercept)      4.267875e+05
## ID              -1.420902e-02
## MSSubClass30     4.257456e+03
## MSSubClass40     4.479564e+04
## MSSubClass45     -2.748779e+03
## MSSubClass50     -5.246753e+02
## MSSubClass60      3.908159e+03
## MSSubClass70      6.035404e+03
## MSSubClass75     -1.584093e+04
## MSSubClass80      8.152940e+02
## MSSubClass85     -1.237945e+04
## MSSubClass90     -4.787240e+03
## MSSubClass120    -9.483914e+03
## MSSubClass160    -5.363541e+03
## MSSubClass180    -4.067120e+03
## MSSubClass190    -2.664305e+03
## MSZoning4        2.252591e+04
## MSZoning2        8.258384e+03
## MSZoning3        1.184274e+04
## MSZoning1        8.159837e+03
## LotArea          7.407305e-01
## Street.L         1.611274e+04
## Alley.L          -2.973835e+03
## Alley.Q          -2.318956e+03
## LotShape.L       -1.146335e+03
## LotShape.Q       -7.110814e+02
## LotShape.C        2.377040e+03
```

```

## LandContour.L      8.680999e+03
## LandContour.Q      -1.430309e+03
## LandContour.C      -2.912301e+03
## Utilities          2.759216e+04
## LotConfigCulDSac    6.898055e+03
## LotConfigFR2        -7.512395e+03
## LotConfigFR3        -1.321257e+04
## LotConfigInside     -1.732059e+03
## LandSlope.L         2.170453e+04
## LandSlope.Q         -1.945488e+04
## NeighborhoodBlueste .
## NeighborhoodBrDale .
## NeighborhoodBrkSide 3.316609e+03
## NeighborhoodClearCr -5.771085e+03
## NeighborhoodCollgCr -2.678790e+01
## NeighborhoodCrawfor 2.062604e+04
## NeighborhoodEdwards -1.300726e+04
## NeighborhoodGilbert -3.835106e+03
## NeighborhoodIDOTRR  -6.695003e+03
## NeighborhoodMeadowV -5.509302e+03
## NeighborhoodMitchel -1.203148e+04
## NeighborhoodNames   -8.121394e+03
## NeighborhoodNoRidge 3.402302e+04
## NeighborhoodNPkVill 8.926172e+03
## NeighborhoodNridgHt 2.310628e+04
## NeighborhoodNWAmes  -9.260102e+03
## NeighborhoodOldTown -7.308903e+03
## NeighborhoodSawyer  -3.171565e+03
## NeighborhoodSawyerW 2.596845e+03
## NeighborhoodSomerst 3.039391e+03
## NeighborhoodStoneBr 4.319498e+04
## NeighborhoodSWISU   8.132567e+02
## NeighborhoodTimber  -5.508688e+03
## NeighborhoodVeenker 6.142839e+03
## Condition1.L         4.664934e+03
## Condition1.Q         -3.083825e+03
## Condition1.C         -1.007312e+04
## Condition1^4         4.238906e+03
## Condition1^5         1.594788e+03
## Condition2.L         5.671855e+04
## Condition2.Q         2.332335e+04
## Condition2.C         2.952549e+04
## Condition2^4        -3.027576e+03
## Condition2^5         .
## BldgType2fmCon      -8.361306e+03
## BldgTypeDuplex       -2.335587e+03
## BldgTypeTwnhsE      -1.046269e+04
## HouseStyle1.5Unf     1.351464e+04
## HouseStyle1Story     3.051315e+03
## HouseStyle2.5Fin     2.941349e+03
## HouseStyle2Story     -1.053790e+04
## HouseStyleSFoyer     3.587346e+03
## HouseStyleSLvl       1.872585e+03
## OverallQual          7.099442e+03

```

## OverallCond	5.176782e+03
## YearBuilt	3.037069e+02
## YearRemodAdd	1.229911e+02
## RoofStyleGable	-1.873377e+03
## RoofStyleGambrel	-4.782539e+03
## RoofStyleHip	.
## RoofStyleMansard	.
## RoofStyleShed	-1.528003e+04
## RoofMatl.L	2.864486e+04
## RoofMatl.Q	-2.992722e+03
## RoofMatl.C	-1.600711e+04
## Exterior1stAsphShn	.
## Exterior1stBrkComm	3.883814e+03
## Exterior1stBrkFace	2.156059e+04
## Exterior1stCBlock	.
## Exterior1stCemntBd	.
## Exterior1stHdBoard	-1.613060e+03
## Exterior1stImStucc	.
## Exterior1stMetalSd	1.384491e+03
## Exterior1stPlywood	-6.139772e+02
## Exterior1stStone	-1.569340e+04
## Exterior1stStucco	-5.792378e+02
## Exterior1stVinylSd	.
## Exterior1stWd Sdng	-2.478111e+03
## Exterior1stWdShing	2.651991e+03
## Exterior2ndAsphShn	4.923579e+02
## Exterior2ndBrk Cmn	.
## Exterior2ndBrkFace	-8.307035e+03
## Exterior2ndCBlock	-7.345635e+03
## Exterior2ndCmentBd	4.143798e+03
## Exterior2ndHdBoard	.
## Exterior2ndImStucc	.
## Exterior2ndMetalSd	.
## Exterior2ndOther	-2.118185e+04
## Exterior2ndPlywood	-4.043516e+03
## Exterior2ndStone	-3.619866e+04
## Exterior2ndStucco	.
## Exterior2ndVinylSd	1.801165e+03
## Exterior2ndWd Sdng	2.712760e+03
## Exterior2ndWd Shng	-4.674448e+03
## MasVnrTypeBrkFace	6.851346e+03
## MasVnrTypeNone	-5.039868e+02
## MasVnrTypeStone	1.644023e+04
## MasVnrArea	8.364350e+01
## ExterQual0	-1.853334e+04
## ExterQual2	-2.351132e+04
## ExterQual1	-2.302591e+04
## ExterCond1	1.935854e+02
## ExterCond3	-3.738840e+03
## ExterCond0	1.697193e+04
## ExterCond2	.
## FoundationCBlock	4.312498e+03
## FoundationPConc	3.941783e+03
## FoundationSlab	3.303641e+03

## FoundationStone	9.627924e+03
## FoundationWood	-2.695756e+04
## BsmtQual.L	6.088631e+03
## BsmtQual.Q	3.390536e+03
## BsmtQual.C	1.453489e+04
## BsmtQual^4	9.207433e+02
## BsmtCond.L	-1.745269e+04
## BsmtCond.Q	.
## BsmtCond.C	1.411404e+04
## BsmtCond^4	-1.441886e+04
## BsmtExposure.L	9.748378e+03
## BsmtExposure.Q	1.596189e+04
## BsmtExposure.C	.
## BsmtExposure^4	3.167858e+03
## BsmtFinType1.L	9.974809e+03
## BsmtFinType1.Q	.
## BsmtFinType1.C	-3.871328e+02
## BsmtFinType1^4	8.575583e+02
## BsmtFinType1^5	4.538245e+03
## BsmtFinType1^6	-2.644922e+02
## BsmtFinSF1	9.386428e+00
## BsmtFinType2.L	6.728738e+03
## BsmtFinType2.Q	1.036350e+04
## BsmtFinType2.C	1.258320e+03
## BsmtFinType2^4	.
## BsmtFinType2^5	.
## BsmtFinType2^6	-1.698857e+03
## BsmtFinSF2	7.548971e-02
## BsmtUnfSF	.
## TotalBsmtSF	2.475337e+01
## HeatingQC.L	.
## HeatingQC.Q	2.059760e+03
## HeatingQC.C	2.745385e+03
## HeatingQC^4	-8.959818e+02
## CentralAir1	.
## X1stFlrSF	.
## X2ndFlrSF	2.220403e+01
## LowQualFinSF	-2.564180e+01
## GrLivArea	3.920587e+01
## BsmtFullBath	2.800110e+03
## BsmtHalfBath	6.084918e+02
## FullBath	4.690638e+03
## HalfBath	1.016696e+03
## BedroomAbvGr	-4.120400e+03
## KitchenAbvGr	-9.582891e+03
## KitchenQual.L	1.300235e+04
## KitchenQual.Q	1.190497e+04
## KitchenQual.C	3.616395e+03
## TotRmsAbvGrd	1.581283e+03
## Functional.L	3.040657e+04
## Functional.Q	-6.148633e+03
## Functional.C	9.966430e+03
## Functional^4	-2.354400e+03
## Functional^5	4.307876e+03

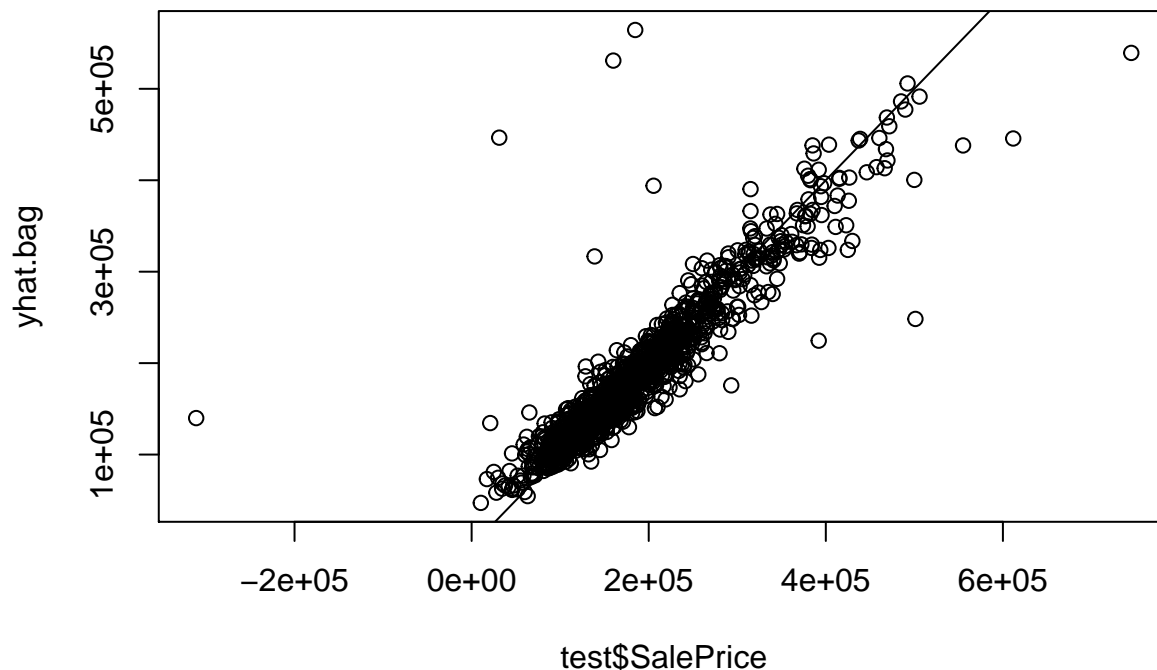
## Functional^6	1.144241e+04
## Fireplaces	1.934052e+03
## FireplaceQu.L	-1.016627e+03
## FireplaceQu.Q	4.586022e+03
## FireplaceQu.C	1.328204e+04
## FireplaceQu^4	-8.198973e+03
## FireplaceQu^5	8.120167e+03
## GarageType.L	-3.447296e+03
## GarageType.Q	-2.531757e+04
## GarageType.C	-1.983789e+02
## GarageType^4	-1.222060e+04
## GarageType^5	-4.288671e+02
## GarageYrBlt	.
## GarageFinish.L	.
## GarageFinish.Q	9.439955e+02
## GarageFinish.C	1.829233e+03
## GarageCars	6.708595e+03
## GarageArea	5.555697e+00
## GarageQual.L	4.541141e+04
## GarageQual.Q	7.472142e+04
## GarageQual.C	2.190423e+04
## GarageQual^4	3.361044e+04
## GarageQual^5	5.768955e+03
## GarageCond.L	.
## GarageCond.Q	.
## GarageCond.C	4.386145e+03
## GarageCond^4	8.274340e+03
## GarageCond^5	3.868528e+03
## PavedDrive.L	6.468792e+02
## PavedDrive.Q	6.253972e+02
## WoodDeckSF	1.666556e+01
## OpenPorchSF	-4.567464e-02
## EnclosedPorch	2.246192e+01
## X3SsnPorch	3.611851e+01
## ScreenPorch	5.005665e+01
## PoolArea	1.000173e+03
## PoolQC.L	-3.483856e+05
## PoolQC.Q	3.512677e+05
## PoolQC.C	-6.507690e+04
## Fence.L	-1.481480e+03
## Fence.Q	-2.023534e+03
## MiscFeature.L	2.639656e+04
## MiscFeature.Q	1.344999e+04
## MiscVal	-3.551103e+00
## MoSold	-2.923260e+02
## YrSold	-8.427851e+02
## SaleTypeCon	9.473508e+03
## SaleTypeConLD	1.260639e+04
## SaleTypeConLI	1.692811e+03
## SaleTypeConLw	6.199292e+03
## SaleTypeCWD	1.903768e+04
## SaleTypeNew	2.234406e+04
## SaleTypeOth	4.540976e+03
## SaleTypeWD	-2.050185e+03

```
## SaleCondition.L      1.254643e+04
## SaleCondition.Q      .
## MasVnrArea_Sqrt     -1.850787e+03
## [1] 19.2121
## Warning in log(1 + actual): NaNs produced
## Warning in log(1 + predicted): NaNs produced
## [1] "The RMSLE for Elastic Net is: NaN or about NaN %"
```

## Random Forest

The last model that I would like to address that proved to be fruitful was random forest. The random forest could explain 89.76% of the variance. However not being able to make a confusion matrix for a regression model however, the importance variables give a little insights into the data itself. Looking at the results below it is evident that OverallQual and Neighborhood increase node purity the most while Foundation and HouseStyle increase the mean squared error the least. The variables OverallQual and Neighborhood increasing node purity makes sense since as we saw with the various types of linear regressions that Neighborhood and OverallQual stuck out as having either strong positive or negative impacts on the models. However, what caught my attention was how Neighborhood also increased mean squared error significantly, so there seems to be a trade off here with the variable Neighborhood.

```
##
## Call:
## randomForest(formula = SalePrice ~ . - ID, data = train, mtry = 76,      ntrees = 1000)
##           Type of random forest: regression
##           Number of trees: 500
## No. of variables tried at each split: 76
##
##           Mean of squared residuals: 716315649
##           % Var explained: 88.35
```



```
##
## Call:
## randomForest(formula = SalePrice ~ . - ID, data = train, mtry = 4, importance = TRUE)
##           Type of random forest: regression
##           Number of trees: 500
## No. of variables tried at each split: 4
##
##           Mean of squared residuals: 801071575
##           % Var explained: 86.98

## Warning in yhat.rf$SalePrice = predict(rf.train, newdata = test): Coercing LHS
## to a list

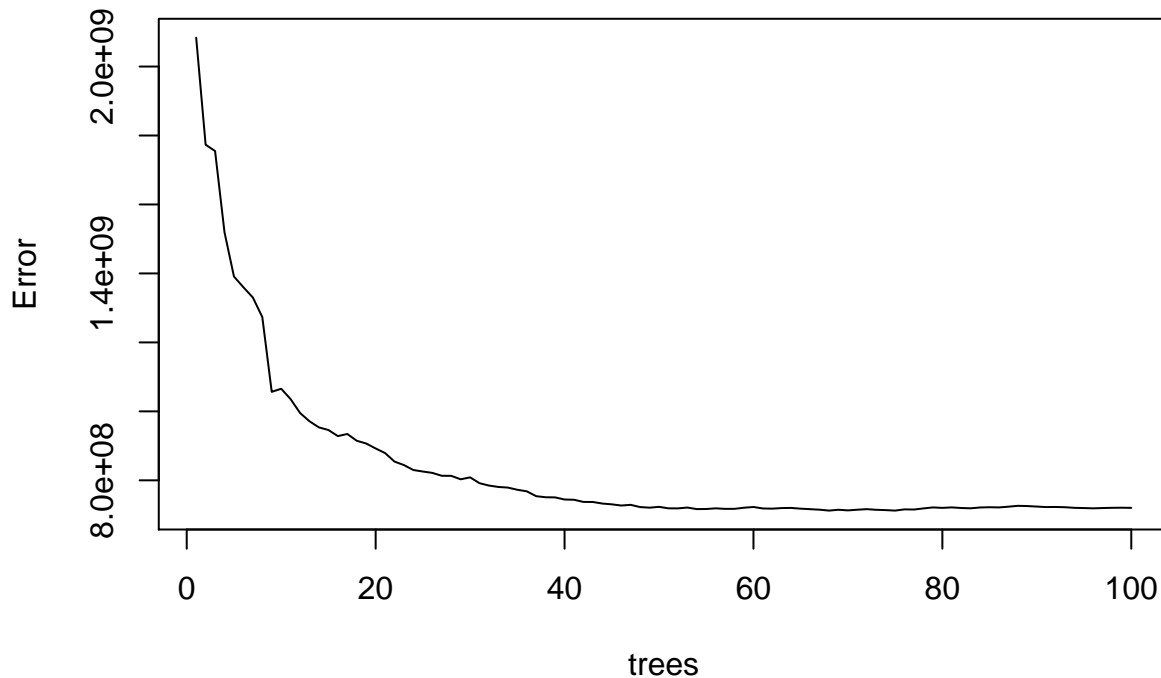
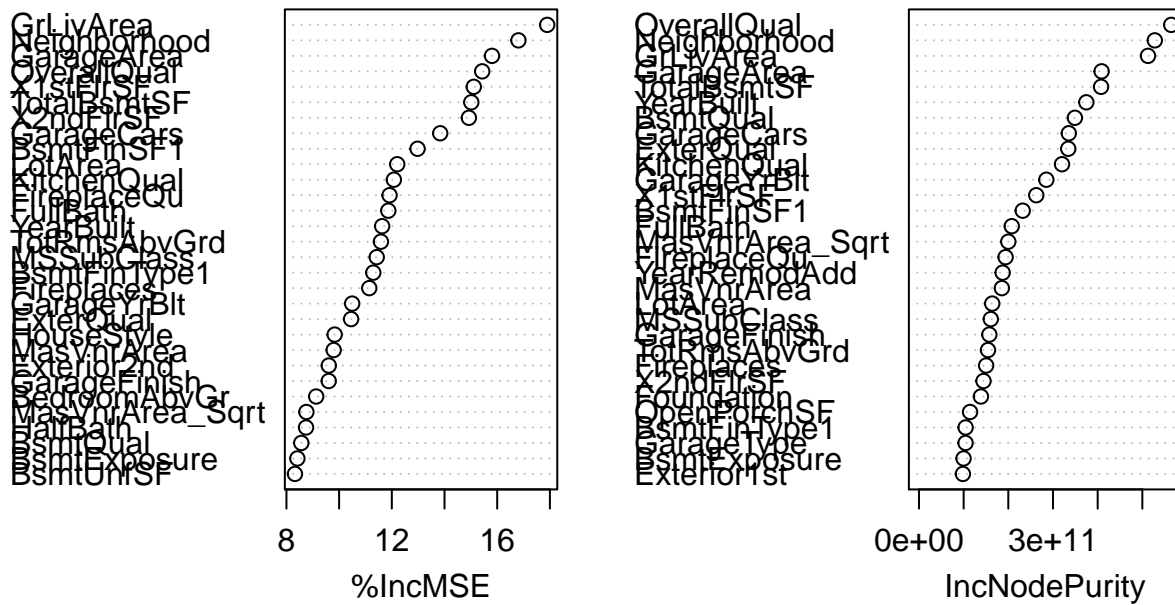
## [1] 1072892570

##           %IncMSE IncNodePurity
## MSSubClass      11.4272103 160748442030
## MSZoning         7.7698580  40285108763
## LotArea         12.2056820 164009326116
## Street          0.1336396  1554189801
## Alley           2.3592470  4790859081
## LotShape        4.5535428  27880214930
## LandContour     2.1286174  18887137847
## Utilities       0.0000000  140820596
## LotConfig       2.7197735  23378752912
## LandSlope       1.2396669  11202495443
## Neighborhood   16.8063861  527873522722
## Condition1      3.3436920  15642542098
## Condition2      1.6115049   3736928174
## BldgType        8.3023588  17379280562
## HouseStyle      9.8309808  43324449602
## OverallQual     15.4307565  564632834160
## OverallCond     4.4590497   48872786908
## YearBuilt       11.6327688  374644418227
## YearRemodAdd    8.2276579  187333057832
## RoofStyle       5.2653903   44111139240
## RoofMatl        1.6530685   14405285759
## Exterior1st     7.3986427   98343009339
## Exterior2nd     9.6075219   94531443022
## MasVnrType      5.3564768   51918833994
## MasVnrArea      9.7935450  185558697878
## ExterQual       10.4543874  334167183281
## ExterCond       2.0979857   12828882859
## Foundation      7.6121398  138661394515
## BsmtQual        8.5639247  349033695601
## BsmtCond        4.9402730   19013114738
## BsmtExposure    8.4150696   99755452870
## BsmtFinType1    11.2959475  104435909947
## BsmtFinSF1     12.9779396  232214296546
## BsmtFinType2     5.1029569   12155169551
## BsmtFinSF2      2.1347108   9599944072
## BsmtUnfSF       8.3230836   62822207555
## TotalBsmtSF     15.0165690  407577435539
## HeatingQC       7.8308460   74651812199
## CentralAir      5.4865979   20715313094
```



## X1stFlrSF	15.1101449	262597807546
## X2ndFlrSF	14.9254970	144446393083
## LowQualFinSF	-0.3949602	6550530537
## GrLivArea	17.8977060	512634340593
## BsmtFullBath	3.3727779	29189540606
## BsmtHalfBath	2.3554052	12665664870
## FullBath	11.8671051	207772833260
## HalfBath	8.7440644	37097218203
## BedroomAbvGr	9.1287487	48968264510
## KitchenAbvGr	3.8238102	4112395084
## KitchenQual	12.0777890	320222974887
## TotRmsAbvGrd	11.5870894	154505798351
## Functional	1.0915741	10922146036
## Fireplaces	11.1444543	150382029652
## FireplaceQu	11.9142605	193880851768
## GarageType	7.8125340	104328728642
## GarageYrBlt	10.4960044	285127483200
## GarageFinish	9.6062004	157568691230
## GarageCars	13.8370027	335411198134
## GarageArea	15.8026508	408867699640
## GarageQual	4.1579664	25024403936
## GarageCond	5.3264879	36492555546
## PavedDrive	4.5109149	21536252343
## WoodDeckSF	5.3068839	92615856264
## OpenPorchSF	7.0294118	114390528366
## EnclosedPorch	1.6610612	11819112346
## X3SsnPorch	2.7422658	3017541852
## ScreenPorch	2.0146606	18735838828
## PoolArea	-2.9865993	8549620079
## PoolQC	-3.8825793	12315297411
## Fence	2.4228569	10043763932
## MiscFeature	-1.0416033	2039217843
## MiscVal	0.6568229	8843043160
## MoSold	-1.0641513	33674240209
## YrSold	1.1252821	20715834529
## SaleType	2.8479391	33872769327
## SaleCondition	2.6366006	16856355555
## MasVnrArea_Sqrt	8.7577532	200003141090

## rf.train



```
##  
## Call:  
## randomForest(formula = SalePrice ~ . - ID, data = train, ntree = 100)  
##           Type of random forest: regression  
##           Number of trees: 100
```

```
## No. of variables tried at each split: 25
##
##           Mean of squared residuals: 720202439
##           % Var explained: 88.29
## Warning in log(1 + actual): NaNs produced
## [1] NaN
```

## Conclusion

My hypothesis for the most part was supported by this project. However, there were plenty of insights that I had gained through using various predictive methods. The parts of the hypothesis that seemed to be disproved was the lack of significance of being next to a busy road or railway found in Condition1 or Condition2. However, the proximity to GrLivArea, such as parks, had significant impact on pricing. Furthermore, what was also surprising was how many variables related to the basement, porch, and garage were involved in the final models and there significant impacts on each model. How basemnt exposure and types of finishes ended up having impactful roles in the elastic, LASSO, and Ridge regression models. Furthermore, what was also a surprise was the fact that the best model of all my models was the ordinary least squares regression. The biggest take away from this analysis overall was how big of an impact the type of variables such as BsmtFinType1 and other variables that seemed not too interesting or impactful ended being very important in the analysis, as seen from the feature selection all the way to the important random forest variables.