136_Liz_Project_Step4_Regressions

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Import Cleaned Data

```
H_Clean<-read.csv( file = "C:\\Users\\Hyunkyung
Kim\\Desktop\\CKME999\\136\\dataset\\all\\H_clean.csv")

Train<-H_Clean[!is.na(H_Clean$SalePrice),-1] #Remove ID
Test<-H_Clean[is.na(H_Clean$SalePrice),-1]
```

For cross validataion.

```
set.seed(999)
Mycontrols<-trainControl(method='repeatedcv',number=10, repeats=5,verboseIter = F)
```

Forward Selection results- Option 1.

Model 1: SalePrice ~ OverallQual + GrLivArea + Neighborhood + BsmtFinSF1 + RoofMatl + MSSubClass + BsmtExposure + KitchenQual + Condition2 + SaleCondition + LotArea + YearBuilt + OverallCond + MasVnrArea + PoolQC + BedroomAbvGr + GarageCars + MasVnrType + TotalBsmtSF + BldgType + Functional + ExterQual + BsmtCond + Condition1 + Exterior1st + MoSold + GarageCond + ScreenPorch + LandContour + LowQualFinSF + LotConfig + LotFrontage + TotRmsAbvGrd + KitchenAbvGr + WoodDeckSF + Street + GarageArea + LotShape + BsmtQual + Fireplaces + FireplaceQu + PoolArea + RoofStyle + BsmtFinSF2 + Utilities + ExterCond

c(OverallQual , GrLivArea , Neighborhood , BsmtFinSF1 , RoofMatl , MSSubClass , BsmtExposure , KitchenQual , Condition2 , SaleCondition , LotArea , YearBuilt , OverallCond , MasVnrArea , PoolQC , BedroomAbvGr , GarageCars , MasVnrType , TotalBsmtSF , BldgType , Functional , ExterQual , BsmtCond , Condition1 , Exterior1st , MoSold , GarageCond , ScreenPorch , LandContour , LowQualFinSF , LotConfig , LotFrontage , TotRmsAbvGrd , KitchenAbvGr , WoodDeckSF , Street , GarageArea , LotShape , BsmtQual , Fireplaces , FireplaceQu , PoolArea , RoofStyle , BsmtFinSF2 , Utilities , ExterCond)

Backwards Elimination results - Option 2.

Model 2: SalePrice ~ LotFrontage + LotArea + Street + LotShape + LandContour + Utilities + LotConfig + Neighborhood + Condition1 + Condition2 + BldgType + HouseStyle + OverallQual + OverallCond + YearBuilt + RoofMatl + Exterior1st + MasVnrType + MasVnrArea + ExterQual + ExterCond + Foundation + BsmtQual + BsmtCond + BsmtExposure + BsmtFinSF1 + BsmtFinSF2 + BsmtUnfSF + X1stFlrSF + X2ndFlrSF + HalfBath + BedroomAbvGr + KitchenAbvGr + KitchenQual + TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu + GarageType + GarageCars + GarageArea + WoodDeckSF + X3SsnPorch + ScreenPorch + PoolQC + Fence + MiscFeature + MoSold + SaleCondition

c(LotFrontage , LotArea , Street , LotShape , LandContour , Utilities , LotConfig , Neighborhood , Condition1 , Condition2 , BldgType , HouseStyle , OverallQual , OverallCond , YearBuilt , RoofMatl , Exterior1st , MasVnrType , MasVnrArea , ExterQual , ExterCond , Foundation , BsmtQual , BsmtCond , BsmtExposure , BsmtFinSF1 , BsmtFinSF2 , BsmtUnfSF , X1stFlrSF , X2ndFlrSF , HalfBath , BedroomAbvGr , KitchenAbvGr , KitchenQual , TotRmsAbvGrd , Functional , Fireplaces , FireplaceQu , GarageType , GarageCars , GarageArea , WoodDeckSF , X3SsnPorch , ScreenPorch , PoolQC , Fence , MiscFeature , MoSold , SaleCondition)

Selected Feature from Boruta - Random forest selection - Option 3

MSSubClass+MSZoning+LotFrontage+LotArea+Alley+LotShape+LandContour+LandSlope+Neighborhood+
BldgType+HouseStyle+OverallQual+OverallCond+YearBuilt+YearRemodAdd+RoofStyle+Exterior1st+Exterior2nd+
MasVnrType+MasVnrArea+ExterQual+Foundation+BsmtQual+BsmtCond+BsmtExposure+BsmtFinType1+BsmtFinSF1+
BsmtFinType2+BsmtUnfSF+TotalBsmtSF+HeatingQC+CentralAir+X1stFlrSF+X2ndFlrSF+GrLivArea+BsmtFullBath+
FullBath+HalfBath+BedroomAbvGr+KitchenAbvGr+KitchenQual+TotRmsAbvGrd+Fireplaces+FireplaceQu+GarageType+
GarageYrBlt+GarageFinish+GarageCars+GarageArea+GarageQual+GarageCond+PavedDrive+WoodDeckSF+OpenPorchSF

c(MSSubClass,MSZoning,LotFrontage,LotArea,Alley,LotShape,LandContour,LandSlope,Neighborhood,
BldgType,HouseStyle,OverallQual,OverallCond,YearBuilt,YearRemodAdd,RoofStyle,Exterior1st,Exterior2nd,
MasVnrType,MasVnrArea,ExterQual,Foundation,BsmtQual,BsmtCond,BsmtExposure,BsmtFinType1,BsmtFinSF1,
BsmtFinType2,BsmtUnfSF,TotalBsmtSF,HeatingQC,CentralAir,X1stFlrSF,X2ndFlrSF,GrLivArea,BsmtFullBath,
FullBath,HalfBath,BedroomAbvGr,KitchenAbvGr,KitchenQual,TotRmsAbvGrd,Fireplaces,FireplaceQu,GarageType,
GarageYrBlt,GarageFinish,GarageCars,GarageArea,GarageQual,GarageCond,PavedDrive,WoodDeckSF,OpenPorchSF)

```
#MyIndex<-sample(2,nrow(Train),replace=T,prob=c(0.7,0.3))
```

Linear Regression
```
#All
myLm1<-lm(SalePrice~.,data=Train) # All

myLm2<-lm(SalePrice ~ OverallQual + GrLivArea + Neighborhood + BsmtFinSF1 +
    RoofMatl + MSSubClass + BsmtExposure + KitchenQual + Condition2 +
    SaleCondition + LotArea + YearBuilt + OverallCond + MasVnrArea +
    PoolQC + BedroomAbvGr + GarageCars + MasVnrType + TotalBsmtSF +
    BldgType + Functional + ExterQual + BsmtCond + Condition1 +
    Exterior1st + MoSold + GarageCond + ScreenPorch + LandContour +
    LowQualFinSF + LotConfig + LotFrontage + TotRmsAbvGrd + KitchenAbvGr +
    WoodDeckSF + Street + GarageArea + LotShape + BsmtQual +
    Fireplaces + FireplaceQu + PoolArea + RoofStyle + BsmtFinSF2 +
    Utilities + ExterCond, data = Train)
myLm3<-lm(SalePrice ~ LotFrontage + LotArea + Street + LotShape + LandContour +
    Utilities + LotConfig + Neighborhood + Condition1 + Condition2 +
    BldgType + HouseStyle + OverallQual + OverallCond + YearBuilt +
    RoofMatl + Exterior1st + MasVnrType + MasVnrArea + ExterQual +
    ExterCond + Foundation + BsmtQual + BsmtCond + BsmtExposure +
    BsmtFinSF1 + BsmtFinSF2 + BsmtUnfSF + X1stFlrSF + X2ndFlrSF +
    HalfBath + BedroomAbvGr + KitchenAbvGr + KitchenQual + TotRmsAbvGrd +
    Functional + Fireplaces + FireplaceQu + GarageType + GarageCars +
    GarageArea + WoodDeckSF + X3SsnPorch + ScreenPorch + PoolQC +
    Fence + MiscFeature + MoSold + SaleCondition    , data = Train)
myLm4<-lm(SalePrice ~
```

```
MSSubClass+MSZoning+LotFrontage+LotArea+Alley+LotShape+LandContour+LandSlope+Neighborhood
+
BldgType+HouseStyle+OverallQual+OverallCond+YearBuilt+YearRemodAdd+RoofStyle+Exterior1st+
Exterior2nd+
MasVnrType+MasVnrArea+ExterQual+Foundation+BsmtQual+BsmtCond+BsmtExposure+BsmtFinType1+Bs
mtFinSF1+
BsmtFinType2+BsmtUnfSF+TotalBsmtSF+HeatingQC+CentralAir+X1stFlrSF+X2ndFlrSF+GrLivArea+Bsm
tFullBath+
FullBath+HalfBath+BedroomAbvGr+KitchenAbvGr+KitchenQual+TotRmsAbvGrd+Fireplaces+Fireplace
Qu+GarageType+
GarageYrBlt+GarageFinish+GarageCars+GarageArea+GarageQual+GarageCond+PavedDrive+WoodDeckS
F+OpenPorchSF
,data=Train)



summary(myLm1)

## 
## Call:
## lm(formula = SalePrice ~ ., data = Train)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max 
## -170748  -11535       0   11479  170748 
## 
## Coefficients: (3 not defined because of singularities)
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)           -1.358e+06  1.091e+06  -1.244 0.213676
## MSSubClass            -7.186e+01  4.449e+01  -1.615 0.106529
## MSZoningFV             2.886e+04  1.255e+04   2.299 0.021649 *
## MSZoningRH             2.620e+04  1.254e+04   2.090 0.036833 *
## MSZoningRL             2.471e+04  1.063e+04   2.325 0.020231 *
## MSZoningRM             2.241e+04  1.001e+04   2.238 0.025409 *
## LotFrontage            1.063e+02  4.455e+01   2.386 0.017173 *
## LotArea                4.100e-01  9.777e-02   4.194 2.93e-05 ***
## StreetPave             2.195e+04  1.212e+04   1.811 0.070382 .
## AlleyNoAlley          -1.392e+03  4.414e+03  -0.315 0.752586
## AlleyPave             -1.786e+02  6.320e+03  -0.028 0.977455
## LotShapeIR2            1.076e+04  4.382e+03   2.456 0.014185 *
## LotShapeIR3            4.116e+03  9.311e+03   0.442 0.658525
## LotShapeReg            2.316e+03  1.688e+03   1.372 0.170301
## LandContourHLS         9.028e+03  5.378e+03   1.679 0.093465 .
## LandContourLow        -6.591e+03  6.582e+03  -1.001 0.316796
## LandContourLvl         3.966e+03  3.866e+03   1.026 0.305152
## Utilities              1.522e+04  9.141e+03   1.664 0.096274 .
## LotConfigCulDSac       1.189e+04  3.715e+03   3.200 0.001410 **
## LotConfigFR2          -4.402e+03  4.270e+03  -1.031 0.302778
## LotConfigFR3          -1.996e+04  1.330e+04  -1.500 0.133784
## LotConfigInside        1.852e+02  1.896e+03   0.098 0.922200
## LandSlope             -8.392e+01  3.648e+03  -0.023 0.981649
## NeighborhoodBlueste    1.634e+04  1.998e+04   0.818 0.413468
## NeighborhoodBrDale     9.742e+03  1.094e+04   0.891 0.373250
## NeighborhoodBrkSide    5.072e+03  9.588e+03   0.529 0.596914
## NeighborhoodClearCr   -9.409e+03  9.519e+03  -0.988 0.323106
```

```
## NeighborhoodCollgCr     -1.047e+04  7.467e+03   -1.402 0.161296
## NeighborhoodCrawfor      1.598e+04  8.797e+03    1.817 0.069454 .
## NeighborhoodEdwards      -1.146e+04  8.208e+03   -1.397 0.162776
## NeighborhoodGilbert      -9.124e+03  7.901e+03   -1.155 0.248418
## NeighborhoodIDOTRR       -4.458e+03  1.090e+04   -0.409 0.682691
## NeighborhoodMeadowV      -2.644e+03  1.162e+04   -0.227 0.820116
## NeighborhoodMitchel      -1.151e+04  8.376e+03   -1.374 0.169736
## NeighborhoodNAmes        -1.002e+04  8.049e+03   -1.244 0.213632
## NeighborhoodNoRidge       2.176e+04  8.708e+03    2.498 0.012603 *
## NeighborhoodNPkVill       1.633e+04  1.469e+04    1.111 0.266572
## NeighborhoodNridgHt       3.079e+04  7.639e+03    4.031 5.89e-05 ***
## NeighborhoodNWAmes       -1.367e+04  8.295e+03   -1.648 0.099617 .
## NeighborhoodOldTown      -5.777e+03  9.865e+03   -0.586 0.558270
## NeighborhoodSawyer       -1.294e+03  8.372e+03   -0.155 0.877195
## NeighborhoodSawyerW      -2.996e+03  8.062e+03   -0.372 0.710278
## NeighborhoodSomerst      -1.995e+03  9.367e+03   -0.213 0.831387
## NeighborhoodStoneBr       4.042e+04  8.682e+03    4.655 3.58e-06 ***
## NeighborhoodSWISU        -3.422e+03  1.003e+04   -0.341 0.733021
## NeighborhoodTimber       -7.234e+03  8.430e+03   -0.858 0.391003
## NeighborhoodVeenker       3.152e+03  1.096e+04    0.287 0.773808
## Condition1Feedr           3.751e+03  5.191e+03    0.723 0.470065
## Condition1Norm            1.404e+04  4.306e+03    3.262 0.001136 **
## Condition1PosA            5.769e+03  1.052e+04    0.548 0.583453
## Condition1PosN            9.018e+03  7.747e+03    1.164 0.244656
## Condition1RRAe           -1.381e+04  9.171e+03   -1.505 0.132485
## Condition1RRAn            1.480e+04  7.271e+03    2.035 0.042045 *
## Condition1RRNe           -7.139e+03  1.859e+04   -0.384 0.701072
## Condition1RRNn            1.341e+04  1.344e+04    0.998 0.318703
## Condition2Feedr          -1.530e+04  2.371e+04   -0.645 0.518992
## Condition2Norm           -1.665e+04  2.035e+04   -0.818 0.413278
## Condition2PosA            3.815e+04  3.446e+04    1.107 0.268453
## Condition2PosN           -2.352e+05  2.834e+04   -8.299 2.68e-16 ***
## Condition2RRAe           -7.148e+04  6.740e+04   -1.061 0.289075
## Condition2RRAn           -9.186e+03  3.214e+04   -0.286 0.775053
## Condition2RRNn           -6.793e+03  2.773e+04   -0.245 0.806523
## BldgType                  4.923e+03  1.777e+03    2.770 0.005694 **
## HouseStyle1.5Unf          9.755e+03  7.973e+03    1.224 0.221346
## HouseStyle1Story          9.753e+03  4.184e+03    2.331 0.019920 *
## HouseStyle2.5Fin         -1.556e+04  1.265e+04   -1.230 0.218986
## HouseStyle2.5Unf         -1.133e+04  9.431e+03   -1.201 0.229855
## HouseStyle2Story         -5.156e+03  3.434e+03   -1.501 0.133486
## HouseStyleSFoyer          1.448e+03  6.067e+03    0.239 0.811351
## HouseStyleSLvl            6.873e+03  5.230e+03    1.314 0.189013
## OverallQual               8.368e+03  1.056e+03    7.922 5.09e-15 ***
## OverallCond               5.364e+03  8.968e+02    5.981 2.89e-09 ***
## YearBuilt                 2.767e+02  8.244e+01    3.356 0.000815 ***
## YearRemodAdd              1.581e+01  5.717e+01    0.276 0.782230
## RoofStyleGable            1.578e+03  1.919e+04    0.082 0.934468
## RoofStyleGambrel          2.607e+03  2.090e+04    0.125 0.900761
## RoofStyleHip              5.301e+03  1.926e+04    0.275 0.783152
## RoofStyleMansard          1.037e+04  2.240e+04    0.463 0.643605
## RoofStyleShed             5.217e+04  3.530e+04    1.478 0.139668
## RoofMatlCompShg           6.720e+05  3.524e+04   19.068  < 2e-16 ***
## RoofMatlMembran           7.254e+05  4.813e+04   15.072  < 2e-16 ***
## RoofMatlMetal             6.924e+05  4.815e+04   14.381  < 2e-16 ***
```

```
## RoofMatlRoll            6.514e+05  4.368e+04  14.912  < 2e-16 ***
## RoofMatlTar&Grv         6.671e+05  4.043e+04  16.500  < 2e-16 ***
## RoofMatlWdShake         6.475e+05  3.879e+04  16.694  < 2e-16 ***
## RoofMatlWdShngl         7.523e+05  3.675e+04  20.472  < 2e-16 ***
## Exterior1stAsphShn     -1.711e+04  3.478e+04  -0.492 0.622833
## Exterior1stBrkComm     -1.747e+04  2.870e+04  -0.609 0.542749
## Exterior1stBrkFace      6.813e+03  1.327e+04   0.513 0.607741
## Exterior1stCBlock       1.034e+03  2.687e+04   0.038 0.969304
## Exterior1stCemntBd     -6.758e+03  1.976e+04  -0.342 0.732406
## Exterior1stHdBoard     -1.086e+04  1.339e+04  -0.811 0.417544
## Exterior1stImStucc     -3.880e+04  2.952e+04  -1.315 0.188913
## Exterior1stMetalSd     -1.620e+03  1.509e+04  -0.107 0.914558
## Exterior1stPlywood     -1.615e+04  1.323e+04  -1.221 0.222268
## Exterior1stStone        1.605e+03  2.498e+04   0.064 0.948796
## Exterior1stStucco       1.628e+03  1.454e+04   0.112 0.910853
## Exterior1stVinylSd     -1.206e+04  1.391e+04  -0.867 0.386272
## Exterior1stWd Sdng     -1.072e+04  1.283e+04  -0.836 0.403540
## Exterior1stWdShing     -3.507e+03  1.385e+04  -0.253 0.800183
## Exterior2ndAsphShn      1.047e+04  2.323e+04   0.451 0.652135
## Exterior2ndBrk Cmn      1.445e+04  2.090e+04   0.691 0.489696
## Exterior2ndBrkFace      2.328e+03  1.361e+04   0.171 0.864201
## Exterior2ndCBlock             NA         NA      NA       NA
## Exterior2ndCmentBd      1.561e+04  1.942e+04   0.804 0.421795
## Exterior2ndHdBoard      5.434e+03  1.271e+04   0.428 0.668938
## Exterior2ndImStucc      2.744e+04  1.480e+04   1.854 0.063965 .
## Exterior2ndMetalSd      3.957e+03  1.467e+04   0.270 0.787440
## Exterior2ndOther       -2.264e+04  2.874e+04  -0.788 0.430868
## Exterior2ndPlywood      6.978e+03  1.235e+04   0.565 0.572061
## Exterior2ndStone       -6.028e+03  1.771e+04  -0.340 0.733588
## Exterior2ndStucco      -5.806e+03  1.404e+04  -0.413 0.679360
## Exterior2ndVinylSd      1.024e+04  1.332e+04   0.769 0.441955
## Exterior2ndWd Sdng      8.665e+03  1.225e+04   0.707 0.479463
## Exterior2ndWd Shng     -5.015e+02  1.288e+04  -0.039 0.968937
## MasVnrTypeBrkFace       6.918e+03  7.010e+03   0.987 0.323913
## MasVnrTypeNone          1.319e+04  7.062e+03   1.868 0.061968 .
## MasVnrTypeStone         1.327e+04  7.442e+03   1.783 0.074877 .
## MasVnrArea              3.116e+01  6.014e+00   5.182 2.56e-07 ***
## ExterQual               4.105e+03  2.191e+03   1.874 0.061196 .
## ExterCond              -3.296e+03  2.214e+03  -1.488 0.136882
## FoundationCBlock        3.198e+03  3.262e+03   0.980 0.327141
## FoundationPConc         4.181e+03  3.553e+03   1.177 0.239482
## FoundationSlab          1.509e+04  9.445e+03   1.598 0.110262
## FoundationStone         5.615e+03  1.168e+04   0.481 0.630666
## FoundationWood         -3.085e+04  1.566e+04  -1.970 0.049007 *
## BsmtQual                3.749e+03  1.784e+03   2.102 0.035776 *
## BsmtCond               -5.638e+03  2.235e+03  -2.523 0.011750 *
## BsmtExposure            5.282e+03  8.848e+02   5.970 3.07e-09 ***
## BsmtFinType1           -1.290e+02  5.324e+02  -0.242 0.808567
## BsmtFinSF1              3.577e+01  5.026e+00   7.118 1.83e-12 ***
## BsmtFinType2           -8.406e+01  1.360e+03  -0.062 0.950731
## BsmtFinSF2              2.299e+01  8.537e+00   2.693 0.007179 **
## BsmtUnfSF               1.546e+01  4.542e+00   3.404 0.000685 ***
## TotalBsmtSF                   NA         NA      NA       NA
## HeatingGasA            -6.307e+03  2.647e+04  -0.238 0.811680
## HeatingGasW            -7.954e+03  2.723e+04  -0.292 0.770265
```

```
## HeatingGrav                   -4.322e+03  2.822e+04  -0.153 0.878290
## HeatingOthW                   -4.467e+04  3.259e+04  -1.370 0.170795
## HeatingWall                    5.452e+03  3.057e+04   0.178 0.858497
## HeatingQC                      1.134e+03  1.008e+03   1.125 0.260648
## CentralAirY                   -1.389e+03  4.006e+03  -0.347 0.728904
## ElectricalFuseF               -1.562e+03  5.978e+03  -0.261 0.793852
## ElectricalFuseP                8.364e+02  1.783e+04   0.047 0.962592
## ElectricalMix                  1.155e+04  2.732e+04   0.423 0.672519
## ElectricalSBrkr               -3.758e+03  3.087e+03  -1.217 0.223724
## X1stFlrSF                      4.636e+01  5.597e+00   8.283 3.05e-16 ***
## X2ndFlrSF                      6.358e+01  5.842e+00  10.883  < 2e-16 ***
## LowQualFinSF                   1.650e+01  1.942e+01   0.850 0.395611
## GrLivArea                            NA         NA      NA       NA
## BsmtFullBath                   1.840e+03  2.045e+03   0.900 0.368539
## BsmtHalfBath                   4.227e+02  3.161e+03   0.134 0.893632
## FullBath                       2.662e+03  2.285e+03   1.165 0.244363
## HalfBath                       2.853e+03  2.189e+03   1.303 0.192748
## BedroomAbvGr                  -5.866e+03  1.395e+03  -4.204 2.80e-05 ***
## KitchenAbvGr                  -1.052e+04  4.681e+03  -2.246 0.024849 *
## KitchenQual                    7.074e+03  1.719e+03   4.114 4.13e-05 ***
## TotRmsAbvGrd                   3.257e+03  9.890e+02   3.294 0.001017 **
## Functional                     5.922e+03  1.171e+03   5.057 4.90e-07 ***
## Fireplaces                     5.919e+03  2.314e+03   2.557 0.010667 *
## FireplaceQu                   -1.603e+03  8.361e+02  -1.917 0.055450 .
## GarageTypeAttchd               1.219e+04  1.160e+04   1.051 0.293327
## GarageTypeBasment              2.016e+04  1.343e+04   1.501 0.133637
## GarageTypeBuiltIn              1.343e+04  1.211e+04   1.109 0.267515
## GarageTypeCarPort              1.603e+04  1.499e+04   1.069 0.285109
## GarageTypeDetchd               1.743e+04  1.157e+04   1.506 0.132347
## GarageTypeNoGarage             4.143e+04  1.620e+04   2.558 0.010651 *
## GarageYrBlt                   -1.614e+01  6.275e+01  -0.257 0.797108
## GarageFinish                   8.042e+02  1.260e+03   0.638 0.523540
## GarageCars                     5.016e+03  2.358e+03   2.127 0.033608 *
## GarageArea                     1.536e+01  8.231e+00   1.866 0.062254 .
## GarageQual                     5.690e+03  3.991e+03   1.426 0.154225
## GarageCond                    -1.522e+03  4.089e+03  -0.372 0.709713
## PavedDrive                    -2.401e+01  1.732e+03  -0.014 0.988939
## WoodDeckSF                     1.287e+01  6.138e+00   2.097 0.036210 *
## OpenPorchSF                    9.704e+00  1.197e+01   0.811 0.417805
## EnclosedPorch                 -3.309e+00  1.305e+01  -0.254 0.799895
## X3SsnPorch                     3.834e+01  2.365e+01   1.621 0.105281
## ScreenPorch                    4.231e+01  1.300e+01   3.254 0.001168 **
## PoolArea                      -2.288e+01  5.634e+01  -0.406 0.684696
## PoolQC                         2.054e+04  8.513e+03   2.413 0.015981 *
## FenceGdWo                      1.046e+04  5.118e+03   2.044 0.041132 *
## FenceMnPrv                     1.091e+04  4.171e+03   2.616 0.008990 **
## FenceMnWw                      5.759e+03  8.637e+03   0.667 0.505075
## FenceNoFence                   9.584e+03  3.806e+03   2.518 0.011913 *
## MiscFeatureNoMiscFeature       4.583e+04  9.996e+04   0.459 0.646640
## MiscFeatureOthr                6.085e+04  9.242e+04   0.658 0.510385
## MiscFeatureShed                4.570e+04  9.577e+04   0.477 0.633331
## MiscFeatureTenC               -3.030e+04  9.374e+04  -0.323 0.746596
## MiscVal                        2.863e+00  6.258e+00   0.457 0.647440
## MoSold                        -6.934e+02  2.555e+02  -2.714 0.006739 **
## YrSold                        -9.613e+01  5.336e+02  -0.180 0.857063
```

```
## SaleTypeCon                  2.740e+04  1.866e+04   1.469 0.142193
## SaleTypeConLD                1.633e+04  1.012e+04   1.613 0.107054
## SaleTypeConLI                5.559e+03  1.221e+04   0.455 0.648880
## SaleTypeConLw               -8.507e+02  1.254e+04  -0.068 0.945946
## SaleTypeCWD                  1.609e+04  1.354e+04   1.188 0.235041
## SaleTypeNew                  3.515e+04  1.610e+04   2.184 0.029178 *
## SaleTypeOth                  1.104e+04  1.543e+04   0.716 0.474268
## SaleTypeWD                   4.405e+02  4.401e+03   0.100 0.920284
## SaleConditionAdjLand         1.479e+04  1.503e+04   0.984 0.325309
## SaleConditionAlloca          8.348e+03  8.979e+03   0.930 0.352689
## SaleConditionFamily         -1.214e+02  6.447e+03  -0.019 0.984983
## SaleConditionNormal          7.474e+03  3.025e+03   2.471 0.013619 *
## SaleConditionPartial        -8.874e+03  1.549e+04  -0.573 0.566860
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 24260 on 1258 degrees of freedom
## Multiple R-squared:  0.9196, Adjusted R-squared:  0.9067
## F-statistic: 71.57 on 201 and 1258 DF,  p-value: < 2.2e-16
```

```r
summary(myLm2)
```

```
##
## Call:
## lm(formula = SalePrice ~ OverallQual + GrLivArea + Neighborhood +
##     BsmtFinSF1 + RoofMatl + MSSubClass + BsmtExposure + KitchenQual +
##     Condition2 + SaleCondition + LotArea + YearBuilt + OverallCond +
##     MasVnrArea + PoolQC + BedroomAbvGr + GarageCars + MasVnrType +
##     TotalBsmtSF + BldgType + Functional + ExterQual + BsmtCond +
##     Condition1 + Exterior1st + MoSold + GarageCond + ScreenPorch +
##     LandContour + LowQualFinSF + LotConfig + LotFrontage + TotRmsAbvGrd +
##     KitchenAbvGr + WoodDeckSF + Street + GarageArea + LotShape +
##     BsmtQual + Fireplaces + FireplaceQu + PoolArea + RoofStyle +
##     BsmtFinSF2 + Utilities + ExterCond, data = Train)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -167510  -11473     222   11201  167510
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)            -1.671e+06  1.340e+05 -12.471  < 2e-16 ***
## OverallQual             7.652e+03  9.855e+02   7.765 1.62e-14 ***
## GrLivArea               5.487e+01  3.302e+00  16.619  < 2e-16 ***
## NeighborhoodBlueste     2.071e+02  1.875e+04   0.011 0.991190
## NeighborhoodBrDale      4.778e+03  9.529e+03   0.501 0.616196
## NeighborhoodBrkSide     6.805e+03  8.478e+03   0.803 0.422315
## NeighborhoodClearCr    -8.189e+03  9.133e+03  -0.897 0.370074
## NeighborhoodCollgCr    -1.051e+04  7.141e+03  -1.472 0.141186
## NeighborhoodCrawfor     1.502e+04  8.389e+03   1.790 0.073606 .
## NeighborhoodEdwards    -8.914e+03  7.742e+03  -1.151 0.249775
## NeighborhoodGilbert    -8.244e+03  7.575e+03  -1.088 0.276618
## NeighborhoodIDOTRR     -5.778e+03  8.901e+03  -0.649 0.516376
## NeighborhoodMeadowV    -1.122e+04  1.032e+04  -1.087 0.277362
## NeighborhoodMitchel    -1.317e+04  7.940e+03  -1.659 0.097402 .
## NeighborhoodNAmes      -9.760e+03  7.591e+03  -1.286 0.198745
```

```
## NeighborhoodNoRidge      2.372e+04   8.354e+03    2.839 0.004588 **
## NeighborhoodNPkVill      1.791e+04   1.106e+04    1.618 0.105797
## NeighborhoodNridgHt      3.143e+04   7.350e+03    4.276 2.04e-05 ***
## NeighborhoodNWAmes      -1.495e+04   7.895e+03   -1.894 0.058416 .
## NeighborhoodOldTown     -7.359e+03   8.256e+03   -0.891 0.372881
## NeighborhoodSawyer      -2.571e+03   7.981e+03   -0.322 0.747383
## NeighborhoodSawyerW     -4.148e+03   7.750e+03   -0.535 0.592640
## NeighborhoodSomerst      3.100e+03   7.362e+03    0.421 0.673788
## NeighborhoodStoneBr      3.987e+04   8.435e+03    4.726 2.53e-06 ***
## NeighborhoodSWISU       -7.164e+00   9.521e+03   -0.001 0.999400
## NeighborhoodTimber      -7.593e+03   8.149e+03   -0.932 0.351599
## NeighborhoodVeenker      4.880e+03   1.044e+04    0.467 0.640274
## BsmtFinSF1               2.048e+01   1.982e+00   10.338  < 2e-16 ***
## RoofMatlCompShg          6.958e+05   3.310e+04   21.023  < 2e-16 ***
## RoofMatlMembran          7.533e+05   4.615e+04   16.323  < 2e-16 ***
## RoofMatlMetal            7.248e+05   4.582e+04   15.819  < 2e-16 ***
## RoofMatlRoll             6.851e+05   4.166e+04   16.444  < 2e-16 ***
## RoofMatlTar&Grv          6.924e+05   3.794e+04   18.251  < 2e-16 ***
## RoofMatlWdShake          6.742e+05   3.625e+04   18.597  < 2e-16 ***
## RoofMatlWdShngl          7.767e+05   3.455e+04   22.482  < 2e-16 ***
## MSSubClass              -9.178e+01   3.318e+01   -2.766 0.005760 **
## BsmtExposure             5.289e+03   8.056e+02    6.566 7.37e-11 ***
## KitchenQual              7.340e+03   1.601e+03    4.585 4.97e-06 ***
## Condition2Feedr         -1.788e+04   2.181e+04   -0.820 0.412460
## Condition2Norm          -1.592e+04   1.865e+04   -0.854 0.393458
## Condition2PosA           5.104e+04   3.144e+04    1.624 0.104715
## Condition2PosN          -2.345e+05   2.701e+04   -8.681  < 2e-16 ***
## Condition2RRAe          -8.175e+04   4.314e+04   -1.895 0.058314 .
## Condition2RRAn          -8.471e+03   3.097e+04   -0.274 0.784456
## Condition2RRNn          -6.282e+03   2.586e+04   -0.243 0.808078
## SaleConditionAdjLand     1.845e+04   1.337e+04    1.379 0.167975
## SaleConditionAlloca      6.465e+03   8.386e+03    0.771 0.440911
## SaleConditionFamily     -2.203e+02   6.178e+03   -0.036 0.971560
## SaleConditionNormal      7.132e+03   2.707e+03    2.635 0.008516 **
## SaleConditionPartial     2.466e+04   3.826e+03    6.446 1.60e-10 ***
## LotArea                  3.999e-01   8.886e-02    4.501 7.36e-06 ***
## YearBuilt                3.877e+02   5.990e+01    6.473 1.35e-10 ***
## OverallCond              5.939e+03   7.685e+02    7.728 2.13e-14 ***
## MasVnrArea               3.312e+01   5.814e+00    5.696 1.51e-08 ***
## PoolQC                   3.098e+04   7.611e+03    4.071 4.96e-05 ***
## BedroomAbvGr            -5.584e+03   1.300e+03   -4.295 1.87e-05 ***
## GarageCars               3.939e+03   2.240e+03    1.758 0.078930 .
## MasVnrTypeBrkFace        9.442e+03   6.740e+03    1.401 0.161521
## MasVnrTypeNone           1.654e+04   6.794e+03    2.434 0.015046 *
## MasVnrTypeStone          1.478e+04   7.150e+03    2.067 0.038930 *
## TotalBsmtSF              1.190e+01   2.951e+00    4.033 5.81e-05 ***
## BldgType                 4.225e+03   1.461e+03    2.891 0.003900 **
## Functional               5.728e+03   1.072e+03    5.342 1.08e-07 ***
## ExterQual                5.421e+03   2.097e+03    2.585 0.009842 **
## BsmtCond                -7.298e+03   1.850e+03   -3.945 8.39e-05 ***
## Condition1Feedr          2.843e+03   4.935e+03    0.576 0.564669
## Condition1Norm           1.315e+04   4.064e+03    3.237 0.001240 **
## Condition1PosA           3.287e+03   1.015e+04    0.324 0.746185
## Condition1PosN           7.959e+03   7.419e+03    1.073 0.283609
## Condition1RRAe          -1.204e+04   8.809e+03   -1.367 0.171930
```

```
## Condition1RRAn        1.256e+04  6.833e+03   1.838 0.066267 .
## Condition1RRNe       -5.278e+03  1.826e+04  -0.289 0.772531
## Condition1RRNn        1.626e+04  1.258e+04   1.293 0.196273
## Exterior1stAsphShn   -1.797e+04  2.567e+04  -0.700 0.484062
## Exterior1stBrkComm    1.623e+03  1.918e+04   0.085 0.932566
## Exterior1stBrkFace    1.857e+04  7.011e+03   2.648 0.008191 **
## Exterior1stCBlock     1.419e+04  2.564e+04   0.553 0.580018
## Exterior1stCemntBd    1.452e+04  7.367e+03   1.971 0.048948 *
## Exterior1stHdBoard    1.313e+03  6.334e+03   0.207 0.835810
## Exterior1stImStucc   -1.647e+04  2.570e+04  -0.641 0.521834
## Exterior1stMetalSd    7.884e+03  6.161e+03   1.280 0.200895
## Exterior1stPlywood   -3.606e+03  6.672e+03  -0.540 0.588981
## Exterior1stStone     -2.532e+03  2.031e+04  -0.125 0.900814
## Exterior1stStucco     7.085e+03  7.829e+03   0.905 0.365669
## Exterior1stVinylSd    3.954e+03  6.211e+03   0.637 0.524478
## Exterior1stWd Sdng    3.651e+03  6.147e+03   0.594 0.552591
## Exterior1stWdShing    4.398e+03  7.712e+03   0.570 0.568602
## MoSold               -6.655e+02  2.463e+02  -2.702 0.006988 **
## GarageCond           -4.465e+03  1.263e+03  -3.535 0.000421 ***
## ScreenPorch           3.817e+01  1.239e+01   3.080 0.002112 **
## LandContourHLS        1.012e+04  5.121e+03   1.977 0.048272 *
## LandContourLow       -8.245e+03  6.095e+03  -1.353 0.176396
## LandContourLvl        3.887e+03  3.567e+03   1.090 0.276036
## LowQualFinSF         -4.612e+01  1.486e+01  -3.102 0.001960 **
## LotConfigCulDSac      1.181e+04  3.565e+03   3.314 0.000945 ***
## LotConfigFR2         -4.001e+03  4.127e+03  -0.969 0.332486
## LotConfigFR3         -2.121e+04  1.305e+04  -1.625 0.104353
## LotConfigInside       3.297e+02  1.830e+03   0.180 0.857050
## LotFrontage           1.066e+02  4.162e+01   2.562 0.010523 *
## TotRmsAbvGrd          2.659e+03  9.465e+02   2.810 0.005032 **
## KitchenAbvGr         -8.465e+03  4.226e+03  -2.003 0.045399 *
## WoodDeckSF            1.240e+01  5.898e+00   2.102 0.035710 *
## StreetPave            2.628e+04  1.121e+04   2.345 0.019158 *
## GarageArea            1.774e+01  7.547e+00   2.350 0.018905 *
## LotShapeIR2           9.280e+03  4.255e+03   2.181 0.029345 *
## LotShapeIR3           6.863e+03  8.828e+03   0.777 0.437071
## LotShapeReg           2.284e+03  1.647e+03   1.387 0.165782
## BsmtQual              3.265e+03  1.593e+03   2.050 0.040549 *
## Fireplaces            6.334e+03  2.247e+03   2.819 0.004881 **
## FireplaceQu          -1.679e+03  8.089e+02  -2.076 0.038089 *
## PoolArea             -1.003e+02  4.890e+01  -2.052 0.040352 *
## RoofStyleGable        4.778e+03  1.861e+04   0.257 0.797397
## RoofStyleGambrel      6.236e+03  2.012e+04   0.310 0.756680
## RoofStyleHip          9.532e+03  1.866e+04   0.511 0.609596
## RoofStyleMansard      1.638e+04  2.134e+04   0.768 0.442750
## RoofStyleShed         5.431e+04  3.432e+04   1.583 0.113756
## BsmtFinSF2            8.567e+00  4.568e+00   1.875 0.060941 .
## Utilities             1.326e+04  8.535e+03   1.554 0.120488
## ExterCond            -3.035e+03  2.105e+03  -1.442 0.149510
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 24330 on 1341 degrees of freedom
## Multiple R-squared:  0.9138, Adjusted R-squared:  0.9062
## F-statistic: 120.5 on 118 and 1341 DF,  p-value: < 2.2e-16
```

```
summary(myLm3)

##
## Call:
## lm(formula = SalePrice ~ LotFrontage + LotArea + Street + LotShape +
##     LandContour + Utilities + LotConfig + Neighborhood + Condition1 +
##     Condition2 + BldgType + HouseStyle + OverallQual + OverallCond +
##     YearBuilt + RoofMatl + Exterior1st + MasVnrType + MasVnrArea +
##     ExterQual + ExterCond + Foundation + BsmtQual + BsmtCond +
##     BsmtExposure + BsmtFinSF1 + BsmtFinSF2 + BsmtUnfSF + X1stFlrSF +
##     X2ndFlrSF + HalfBath + BedroomAbvGr + KitchenAbvGr + KitchenQual +
##     TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu + GarageType +
##     GarageCars + GarageArea + WoodDeckSF + X3SsnPorch + ScreenPorch +
##     PoolQC + Fence + MiscFeature + MoSold + SaleCondition, data = Train)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -171434  -11629       0   11196  171434
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)          -1.625e+06  1.448e+05 -11.225  < 2e-16 ***
## LotFrontage           1.226e+02  4.302e+01   2.850 0.004434 **
## LotArea               3.862e-01  8.939e-02   4.320 1.67e-05 ***
## StreetPave            2.452e+04  1.151e+04   2.130 0.033325 *
## LotShapeIR2           1.080e+04  4.271e+03   2.530 0.011534 *
## LotShapeIR3           5.438e+03  8.870e+03   0.613 0.539917
## LotShapeReg           2.336e+03  1.641e+03   1.424 0.154745
## LandContourHLS        9.152e+03  5.180e+03   1.767 0.077467 .
## LandContourLow       -8.472e+03  6.090e+03  -1.391 0.164424
## LandContourLvl        3.908e+03  3.611e+03   1.082 0.279357
## Utilities             1.262e+04  8.793e+03   1.436 0.151312
## LotConfigCulDSac      1.231e+04  3.601e+03   3.419 0.000649 ***
## LotConfigFR2         -4.564e+03  4.113e+03  -1.110 0.267324
## LotConfigFR3         -2.027e+04  1.299e+04  -1.560 0.118897
## LotConfigInside       4.267e+02  1.830e+03   0.233 0.815658
## NeighborhoodBlueste   1.422e+04  1.914e+04   0.743 0.457598
## NeighborhoodBrDale    8.185e+03  9.811e+03   0.834 0.404301
## NeighborhoodBrkSide   5.904e+03  8.577e+03   0.688 0.491390
## NeighborhoodClearCr  -7.501e+03  9.040e+03  -0.830 0.406805
## NeighborhoodCollgCr  -9.959e+03  7.131e+03  -1.396 0.162817
## NeighborhoodCrawfor   1.566e+04  8.413e+03   1.862 0.062834 .
## NeighborhoodEdwards  -9.020e+03  7.803e+03  -1.156 0.247885
## NeighborhoodGilbert  -7.752e+03  7.636e+03  -1.015 0.310196
## NeighborhoodIDOTRR   -7.103e+03  8.984e+03  -0.791 0.429304
## NeighborhoodMeadowV  -5.250e+03  1.050e+04  -0.500 0.617099
## NeighborhoodMitchel  -9.358e+03  7.949e+03  -1.177 0.239267
## NeighborhoodNAmes    -8.663e+03  7.662e+03  -1.131 0.258409
## NeighborhoodNoRidge   2.270e+04  8.386e+03   2.707 0.006882 **
## NeighborhoodNPkVill   2.056e+04  1.119e+04   1.837 0.066427 .
## NeighborhoodNridgHt   3.117e+04  7.367e+03   4.230 2.50e-05 ***
## NeighborhoodNWAmes   -1.258e+04  7.917e+03  -1.589 0.112187
## NeighborhoodOldTown  -6.290e+03  8.288e+03  -0.759 0.448053
## NeighborhoodSawyer   -4.577e+02  8.012e+03  -0.057 0.954453
## NeighborhoodSawyerW  -2.662e+03  7.749e+03  -0.344 0.731222
## NeighborhoodSomerst   3.276e+03  7.390e+03   0.443 0.657604
```

```
## NeighborhoodStoneBr      3.871e+04  8.425e+03    4.594 4.76e-06 ***
## NeighborhoodSWISU       -1.005e+03  9.538e+03   -0.105 0.916116
## NeighborhoodTimber      -5.250e+03  8.134e+03   -0.645 0.518764
## NeighborhoodVeenker      3.868e+03  1.045e+04    0.370 0.711395
## Condition1Feedr          3.211e+03  4.957e+03    0.648 0.517256
## Condition1Norm           1.297e+04  4.125e+03    3.145 0.001697 **
## Condition1PosA           3.563e+03  1.017e+04    0.350 0.726100
## Condition1PosN           8.190e+03  7.493e+03    1.093 0.274595
## Condition1RRAe          -1.520e+04  8.915e+03   -1.705 0.088363 .
## Condition1RRAn           1.410e+04  6.919e+03    2.039 0.041695 *
## Condition1RRNe          -9.543e+03  1.840e+04   -0.519 0.604012
## Condition1RRNn           1.708e+04  1.273e+04    1.342 0.179945
## Condition2Feedr         -1.138e+04  2.234e+04   -0.509 0.610503
## Condition2Norm          -1.536e+04  1.919e+04   -0.801 0.423479
## Condition2PosA           5.404e+04  3.287e+04    1.644 0.100401
## Condition2PosN          -2.348e+05  2.734e+04   -8.591  < 2e-16 ***
## Condition2RRAe          -4.215e+04  4.028e+04   -1.046 0.295589
## Condition2RRAn          -1.235e+04  3.130e+04   -0.395 0.693224
## Condition2RRNn          -9.396e+03  2.625e+04   -0.358 0.720437
## BldgType                 6.882e+03  1.065e+03    6.465 1.42e-10 ***
## HouseStyle1.5Unf         1.102e+04  7.520e+03    1.465 0.143110
## HouseStyle1Story         1.152e+04  3.666e+03    3.141 0.001722 **
## HouseStyle2.5Fin        -7.309e+03  9.942e+03   -0.735 0.462383
## HouseStyle2.5Unf        -1.811e+04  8.585e+03   -2.109 0.035100 *
## HouseStyle2Story        -5.564e+03  3.190e+03   -1.744 0.081400 .
## HouseStyleSFoyer        -3.469e+02  5.769e+03   -0.060 0.952050
## HouseStyleSLvl           4.605e+03  4.825e+03    0.955 0.339998
## OverallQual              8.599e+03  1.007e+03    8.542  < 2e-16 ***
## OverallCond              5.759e+03  7.792e+02    7.390 2.59e-13 ***
## YearBuilt                3.357e+02  6.637e+01    5.058 4.83e-07 ***
## RoofMatlCompShg          6.964e+05  3.355e+04   20.759  < 2e-16 ***
## RoofMatlMembran          7.471e+05  4.314e+04   17.320  < 2e-16 ***
## RoofMatlMetal            7.160e+05  4.251e+04   16.843  < 2e-16 ***
## RoofMatlRoll             6.854e+05  4.179e+04   16.400  < 2e-16 ***
## RoofMatlTar&Grv          6.860e+05  3.454e+04   19.862  < 2e-16 ***
## RoofMatlWdShake          6.871e+05  3.588e+04   19.149  < 2e-16 ***
## RoofMatlWdShngl          7.759e+05  3.502e+04   22.156  < 2e-16 ***
## Exterior1stAsphShn      -6.506e+03  2.619e+04   -0.248 0.803833
## Exterior1stBrkComm      -9.107e+02  1.923e+04   -0.047 0.962236
## Exterior1stBrkFace       1.425e+04  7.106e+03    2.005 0.045194 *
## Exterior1stCBlock        4.518e+03  2.569e+04    0.176 0.860423
## Exterior1stCemntBd       1.048e+04  7.470e+03    1.402 0.161046
## Exterior1stHdBoard      -3.346e+03  6.484e+03   -0.516 0.605965
## Exterior1stImStucc      -1.022e+04  2.589e+04   -0.395 0.693005
## Exterior1stMetalSd       4.819e+03  6.272e+03    0.768 0.442419
## Exterior1stPlywood      -7.035e+03  6.774e+03   -1.039 0.299215
## Exterior1stStone        -7.497e+03  2.012e+04   -0.373 0.709461
## Exterior1stStucco        2.850e+03  7.930e+03    0.359 0.719328
## Exterior1stVinylSd      -3.054e+02  6.327e+03   -0.048 0.961508
## Exterior1stWd Sdng       5.941e+02  6.264e+03    0.095 0.924457
## Exterior1stWdShing       9.918e+02  7.793e+03    0.127 0.898747
## MasVnrTypeBrkFace        6.291e+03  6.857e+03    0.917 0.359098
## MasVnrTypeNone           1.250e+04  6.908e+03    1.809 0.070623 .
## MasVnrTypeStone          1.174e+04  7.244e+03    1.620 0.105380
## MasVnrArea               3.170e+01  5.811e+00    5.455 5.83e-08 ***
```

```
## ExterQual                    4.908e+03  2.126e+03   2.309 0.021093 *
## ExterCond                   -3.254e+03  2.106e+03  -1.545 0.122616
## FoundationCBlock             3.578e+03  3.064e+03   1.168 0.243147
## FoundationPConc              5.308e+03  3.415e+03   1.555 0.120294
## FoundationSlab               1.740e+04  8.467e+03   2.055 0.040088 *
## FoundationStone              3.448e+03  1.059e+04   0.326 0.744740
## FoundationWood              -3.373e+04  1.542e+04  -2.187 0.028904 *
## BsmtQual                     3.584e+03  1.693e+03   2.117 0.034427 *
## BsmtCond                    -6.477e+03  2.073e+03  -3.124 0.001823 **
## BsmtExposure                 5.466e+03  8.449e+02   6.469 1.38e-10 ***
## BsmtFinSF1                   3.722e+01  4.426e+00   8.409  < 2e-16 ***
## BsmtFinSF2                   2.501e+01  5.787e+00   4.322 1.66e-05 ***
## BsmtUnfSF                    1.601e+01  4.304e+00   3.721 0.000207 ***
## X1stFlrSF                    4.845e+01  5.199e+00   9.320  < 2e-16 ***
## X2ndFlrSF                    6.463e+01  5.154e+00  12.540  < 2e-16 ***
## HalfBath                     2.613e+03  1.910e+03   1.368 0.171388
## BedroomAbvGr                -6.339e+03  1.324e+03  -4.789 1.87e-06 ***
## KitchenAbvGr                -1.068e+04  4.240e+03  -2.519 0.011882 *
## KitchenQual                  7.428e+03  1.609e+03   4.617 4.27e-06 ***
## TotRmsAbvGrd                 3.558e+03  9.457e+02   3.763 0.000175 ***
## Functional                   5.535e+03  1.088e+03   5.089 4.13e-07 ***
## Fireplaces                   6.279e+03  2.254e+03   2.786 0.005417 **
## FireplaceQu                 -1.781e+03  8.136e+02  -2.189 0.028777 *
## GarageTypeAttchd             1.146e+04  1.106e+04   1.037 0.299932
## GarageTypeBasment            1.794e+04  1.273e+04   1.409 0.159077
## GarageTypeBuiltIn            1.326e+04  1.154e+04   1.149 0.250958
## GarageTypeCarPort            1.048e+04  1.410e+04   0.743 0.457468
## GarageTypeDetchd             1.624e+04  1.099e+04   1.478 0.139714
## GarageTypeNoGarage           2.827e+04  1.193e+04   2.370 0.017926 *
## GarageCars                   4.372e+03  2.284e+03   1.914 0.055779 .
## GarageArea                   1.633e+01  7.612e+00   2.146 0.032065 *
## WoodDeckSF                   1.215e+01  5.944e+00   2.044 0.041175 *
## X3SsnPorch                   4.279e+01  2.323e+01   1.842 0.065693 .
## ScreenPorch                  4.074e+01  1.256e+01   3.243 0.001212 **
## PoolQC                       1.855e+04  2.921e+03   6.352 2.92e-10 ***
## FenceGdWo                    1.044e+04  4.955e+03   2.106 0.035398 *
## FenceMnPrv                   1.152e+04  4.035e+03   2.854 0.004389 **
## FenceMnWw                    7.350e+03  8.382e+03   0.877 0.380726
## FenceNoFence                 9.794e+03  3.685e+03   2.658 0.007957 **
## MiscFeatureNoMiscFeature     1.035e+03  2.464e+04   0.042 0.966504
## MiscFeatureOthr              1.367e+04  3.036e+04   0.450 0.652552
## MiscFeatureShed              3.158e+03  2.489e+04   0.127 0.899049
## MiscFeatureTenC             -7.769e+04  3.635e+04  -2.137 0.032772 *
## MoSold                      -6.348e+02  2.461e+02  -2.580 0.009996 **
## SaleConditionAdjLand         2.096e+04  1.331e+04   1.574 0.115640
## SaleConditionAlloca          5.207e+03  8.443e+03   0.617 0.537499
## SaleConditionFamily          1.099e+03  6.177e+03   0.178 0.858832
## SaleConditionNormal          7.750e+03  2.708e+03   2.862 0.004280 **
## SaleConditionPartial         2.474e+04  3.823e+03   6.472 1.36e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 24170 on 1321 degrees of freedom
## Multiple R-squared:  0.9162, Adjusted R-squared:  0.9075
## F-statistic: 104.7 on 138 and 1321 DF,  p-value: < 2.2e-16
```

```
summary(myLm4)

##
## Call:
## lm(formula = SalePrice ~ MSSubClass + MSZoning + LotFrontage +
##     LotArea + Alley + LotShape + LandContour + LandSlope + Neighborhood +
##     BldgType + HouseStyle + OverallQual + OverallCond + YearBuilt +
##     YearRemodAdd + RoofStyle + Exterior1st + Exterior2nd + MasVnrType +
##     MasVnrArea + ExterQual + Foundation + BsmtQual + BsmtCond +
##     BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
##     BsmtUnfSF + TotalBsmtSF + HeatingQC + CentralAir + X1stFlrSF +
##     X2ndFlrSF + GrLivArea + BsmtFullBath + FullBath + HalfBath +
##     BedroomAbvGr + KitchenAbvGr + KitchenQual + TotRmsAbvGrd +
##     Fireplaces + FireplaceQu + GarageType + GarageYrBlt + GarageFinish +
##     GarageCars + GarageArea + GarageQual + GarageCond + PavedDrive +
##     WoodDeckSF + OpenPorchSF, data = Train)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -309513  -13454     -66   12063  242906
##
## Coefficients: (1 not defined because of singularities)
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)          -4.348e+05  2.040e+05  -2.132 0.033197 *
## MSSubClass           -2.233e+01  4.973e+01  -0.449 0.653441
## MSZoningFV            3.862e+04  1.452e+04   2.660 0.007905 **
## MSZoningRH            3.843e+04  1.445e+04   2.660 0.007906 **
## MSZoningRL            3.426e+04  1.204e+04   2.846 0.004497 **
## MSZoningRM            2.893e+04  1.125e+04   2.572 0.010220 *
## LotFrontage          -9.088e+01  4.558e+01  -1.994 0.046362 *
## LotArea               4.508e-01  1.098e-01   4.107 4.26e-05 ***
## AlleyNoAlley         -2.223e+03  5.154e+03  -0.431 0.666362
## AlleyPave            -9.861e+02  7.438e+03  -0.133 0.894547
## LotShapeIR2           1.114e+04  5.155e+03   2.160 0.030926 *
## LotShapeIR3          -2.637e+04  1.046e+04  -2.521 0.011825 *
## LotShapeReg           1.048e+03  1.908e+03   0.549 0.583000
## LandContourHLS        2.148e+04  6.273e+03   3.424 0.000635 ***
## LandContourLow        1.394e+04  7.639e+03   1.826 0.068141 .
## LandContourLvl        1.451e+04  4.448e+03   3.262 0.001134 **
## LandSlope             1.041e+03  4.163e+03   0.250 0.802567
## NeighborhoodBlueste   4.490e+03  2.349e+04   0.191 0.848454
## NeighborhoodBrDale    2.072e+04  1.298e+04   1.595 0.110849
## NeighborhoodBrkSide   4.700e+03  1.121e+04   0.419 0.674990
## NeighborhoodClearCr  -6.298e+03  1.126e+04  -0.560 0.575872
## NeighborhoodCollgCr  -6.119e+03  8.901e+03  -0.687 0.491902
## NeighborhoodCrawfor   1.954e+04  1.043e+04   1.874 0.061118 .
## NeighborhoodEdwards  -1.471e+04  9.751e+03  -1.508 0.131702
## NeighborhoodGilbert  -7.926e+03  9.412e+03  -0.842 0.399884
## NeighborhoodIDOTRR   -2.861e+03  1.282e+04  -0.223 0.823457
## NeighborhoodMeadowV   3.650e+03  1.377e+04   0.265 0.790937
## NeighborhoodMitchel  -8.308e+03  9.958e+03  -0.834 0.404223
## NeighborhoodNAmes    -9.640e+03  9.528e+03  -1.012 0.311850
## NeighborhoodNoRidge   4.059e+04  1.027e+04   3.951 8.20e-05 ***
## NeighborhoodNPkVill   7.944e+03  1.761e+04   0.451 0.651998
## NeighborhoodNridgHt   4.494e+04  9.082e+03   4.948 8.47e-07 ***
## NeighborhoodNWAmes   -1.346e+04  9.762e+03  -1.379 0.168202
```

```
## NeighborhoodOldTown  -7.633e+03  1.164e+04  -0.656 0.512092
## NeighborhoodSawyer    -6.089e+03  9.970e+03  -0.611 0.541511
## NeighborhoodSawyerW   -3.566e+03  9.594e+03  -0.372 0.710156
## NeighborhoodSomerst    9.551e+03  1.100e+04   0.868 0.385551
## NeighborhoodStoneBr    4.976e+04  1.038e+04   4.795 1.81e-06 ***
## NeighborhoodSWISU     -5.761e+03  1.197e+04  -0.481 0.630455
## NeighborhoodTimber    -5.339e+03  1.001e+04  -0.533 0.593980
## NeighborhoodVeenker    9.728e+03  1.278e+04   0.761 0.446608
## BldgType               9.760e+03  2.028e+03   4.813 1.66e-06 ***
## HouseStyle1.5Unf       1.143e+04  9.196e+03   1.243 0.214140
## HouseStyle1Story       2.142e+04  4.766e+03   4.494 7.60e-06 ***
## HouseStyle2.5Fin      -1.616e+04  1.461e+04  -1.106 0.269101
## HouseStyle2.5Unf      -1.139e+04  1.040e+04  -1.095 0.273777
## HouseStyle2Story      -1.083e+04  3.972e+03  -2.726 0.006489 **
## HouseStyleSFoyer       5.688e+03  7.071e+03   0.804 0.421341
## HouseStyleSLvl         6.552e+03  5.977e+03   1.096 0.273221
## OverallQual            9.862e+03  1.214e+03   8.124 1.03e-15 ***
## OverallCond            4.700e+03  1.007e+03   4.669 3.33e-06 ***
## YearBuilt              1.176e+02  9.310e+01   1.263 0.206650
## YearRemodAdd          -1.344e+01  6.634e+01  -0.203 0.839443
## RoofStyleGable        -7.596e+02  9.709e+03  -0.078 0.937656
## RoofStyleGambrel      -1.196e+03  1.380e+04  -0.087 0.930980
## RoofStyleHip           4.664e+03  9.925e+03   0.470 0.638497
## RoofStyleMansard       1.506e+03  1.577e+04   0.096 0.923887
## RoofStyleShed         -1.143e+04  2.367e+04  -0.483 0.629285
## Exterior1stAsphShn    -1.668e+04  4.088e+04  -0.408 0.683337
## Exterior1stBrkComm    -3.652e+04  3.315e+04  -1.102 0.270771
## Exterior1stBrkFace     1.167e+03  1.483e+04   0.079 0.937320
## Exterior1stCBlock     -2.218e+03  3.166e+04  -0.070 0.944169
## Exterior1stCemntBd    -9.529e+02  2.305e+04  -0.041 0.967024
## Exterior1stHdBoard    -1.837e+04  1.486e+04  -1.236 0.216612
## Exterior1stImStucc    -7.058e+04  3.450e+04  -2.046 0.040999 *
## Exterior1stMetalSd    -1.415e+04  1.707e+04  -0.829 0.407068
## Exterior1stPlywood    -1.655e+04  1.458e+04  -1.135 0.256683
## Exterior1stStone      -2.157e+04  2.735e+04  -0.789 0.430410
## Exterior1stStucco     -6.050e+03  1.652e+04  -0.366 0.714281
## Exterior1stVinylSd    -2.187e+04  1.557e+04  -1.404 0.160483
## Exterior1stWd Sdng    -1.959e+04  1.434e+04  -1.366 0.172325
## Exterior1stWdShing    -1.023e+04  1.566e+04  -0.653 0.513629
## Exterior2ndAsphShn     2.342e+04  2.714e+04   0.863 0.388400
## Exterior2ndBrk Cmn     2.320e+04  2.469e+04   0.940 0.347588
## Exterior2ndBrkFace     1.559e+04  1.581e+04   0.986 0.324154
## Exterior2ndCBlock            NA         NA      NA       NA
## Exterior2ndCmentBd     8.882e+03  2.298e+04   0.387 0.699178
## Exterior2ndHdBoard     1.332e+04  1.454e+04   0.916 0.359600
## Exterior2ndImStucc     4.685e+04  1.698e+04   2.759 0.005875 **
## Exterior2ndMetalSd     1.635e+04  1.699e+04   0.962 0.336041
## Exterior2ndOther       9.358e+03  3.425e+04   0.273 0.784700
## Exterior2ndPlywood     1.420e+04  1.407e+04   1.010 0.312833
## Exterior2ndStone       3.977e+03  2.045e+04   0.195 0.845781
## Exterior2ndStucco     -8.870e+03  1.622e+04  -0.547 0.584471
## Exterior2ndVinylSd     2.193e+04  1.533e+04   1.430 0.152888
## Exterior2ndWd Sdng     1.853e+04  1.417e+04   1.307 0.191287
## Exterior2ndWd Shng     3.541e+03  1.491e+04   0.238 0.812267
## MasVnrTypeBrkFace      1.039e+04  8.263e+03   1.257 0.209020
```

```
## MasVnrTypeNone          1.560e+04  8.315e+03   1.877 0.060786 .
## MasVnrTypeStone         1.584e+04  8.773e+03   1.805 0.071232 .
## MasVnrArea              2.346e+01  7.017e+00   3.343 0.000852 ***
## ExterQual               4.917e+03  2.547e+03   1.931 0.053753 .
## FoundationCBlock        6.449e+03  3.833e+03   1.683 0.092701 .
## FoundationPConc         5.074e+03  4.196e+03   1.209 0.226776
## FoundationSlab          2.451e+04  1.031e+04   2.377 0.017602 *
## FoundationStone         7.338e+03  1.321e+04   0.556 0.578636
## FoundationWood         -1.152e+04  1.843e+04  -0.625 0.531997
## BsmtQual                7.189e+03  2.069e+03   3.475 0.000528 ***
## BsmtCond               -3.457e+03  2.562e+03  -1.349 0.177466
## BsmtExposure            6.931e+03  1.038e+03   6.677 3.57e-11 ***
## BsmtFinType1            1.290e+03  6.190e+02   2.085 0.037293 *
## BsmtFinSF1              1.096e+00  8.828e+00   0.124 0.901193
## BsmtFinType2           -6.156e+02  1.591e+03  -0.387 0.698822
## BsmtUnfSF              -4.263e+00  8.720e+00  -0.489 0.624959
## TotalBsmtSF             6.851e+00  9.827e+00   0.697 0.485856
## HeatingQC               4.478e+02  1.157e+03   0.387 0.698784
## CentralAirY            -1.929e+03  4.269e+03  -0.452 0.651357
## X1stFlrSF              -3.065e+00  2.216e+01  -0.138 0.890045
## X2ndFlrSF               2.137e+01  2.129e+01   1.004 0.315539
## GrLivArea               4.126e+01  2.168e+01   1.903 0.057207 .
## BsmtFullBath            5.018e+03  2.266e+03   2.214 0.026985 *
## FullBath                5.630e+03  2.647e+03   2.127 0.033603 *
## HalfBath                5.637e+03  2.560e+03   2.202 0.027845 *
## BedroomAbvGr           -5.025e+03  1.612e+03  -3.117 0.001869 **
## KitchenAbvGr           -5.968e+03  5.206e+03  -1.146 0.251855
## KitchenQual             7.598e+03  2.004e+03   3.791 0.000157 ***
## TotRmsAbvGrd            4.009e+03  1.149e+03   3.489 0.000501 ***
## Fireplaces              4.562e+03  2.706e+03   1.686 0.092063 .
## FireplaceQu            -3.397e+02  9.817e+02  -0.346 0.729393
## GarageTypeAttchd        1.805e+04  1.347e+04   1.340 0.180372
## GarageTypeBasment       2.375e+04  1.541e+04   1.541 0.123485
## GarageTypeBuiltIn       1.601e+04  1.406e+04   1.139 0.254835
## GarageTypeCarPort       1.795e+04  1.725e+04   1.041 0.298067
## GarageTypeDetchd        1.998e+04  1.343e+04   1.488 0.137035
## GarageTypeNoGarage      6.014e+04  1.870e+04   3.216 0.001331 **
## GarageYrBlt            -1.701e+01  7.328e+01  -0.232 0.816477
## GarageFinish            1.788e+03  1.496e+03   1.195 0.232349
## GarageCars              1.318e+04  2.755e+03   4.783 1.92e-06 ***
## GarageArea             -4.334e+00  9.693e+00  -0.447 0.654838
## GarageQual              1.024e+04  4.565e+03   2.243 0.025041 *
## GarageCond             -1.581e+03  4.629e+03  -0.342 0.732776
## PavedDrive              5.349e+02  2.014e+03   0.266 0.790603
## WoodDeckSF              9.707e+00  7.075e+00   1.372 0.170310
## OpenPorchSF            -1.309e+00  1.382e+01  -0.095 0.924536
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 29420 on 1327 degrees of freedom
## Multiple R-squared:  0.8753, Adjusted R-squared:  0.8629
## F-statistic: 70.56 on 132 and 1327 DF,  p-value: < 2.2e-16
```
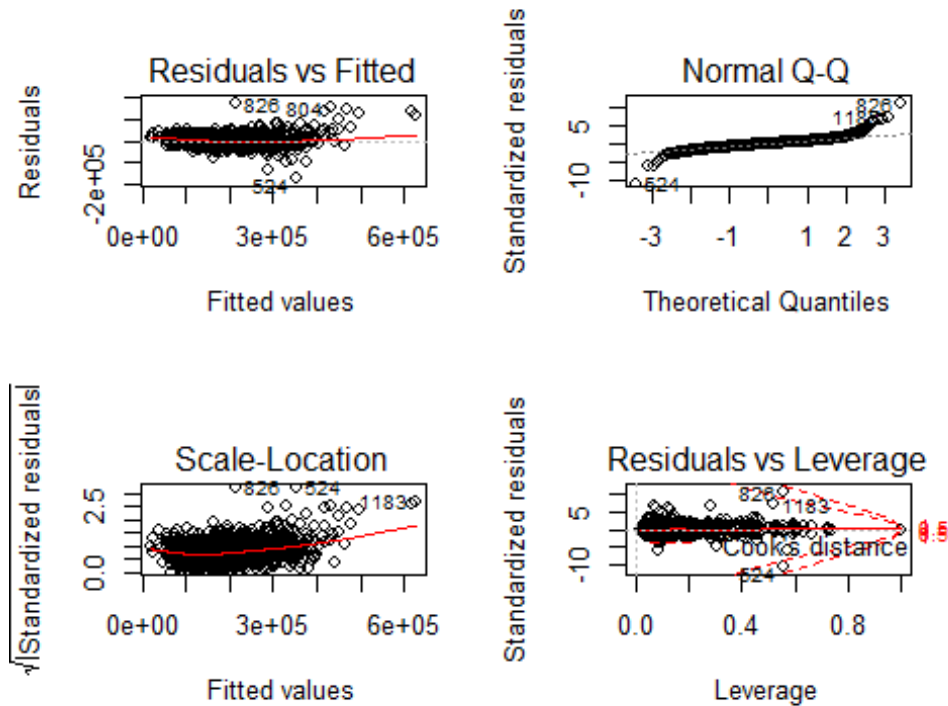
```r
par(mfrow=c(2,2))
plot(myLm1)
```

```
## Warning: not plotting observations with leverage one:
##    121, 272, 347, 584, 596, 945, 1004, 1012, 1188, 1231, 1271, 1276, 1299, 1322, 1371,
## 1387
```

```
## Warning: not plotting observations with leverage one:
##    121, 272, 347, 584, 596, 945, 1004, 1012, 1188, 1231, 1271, 1276, 1299, 1322, 1371,
## 1387
```

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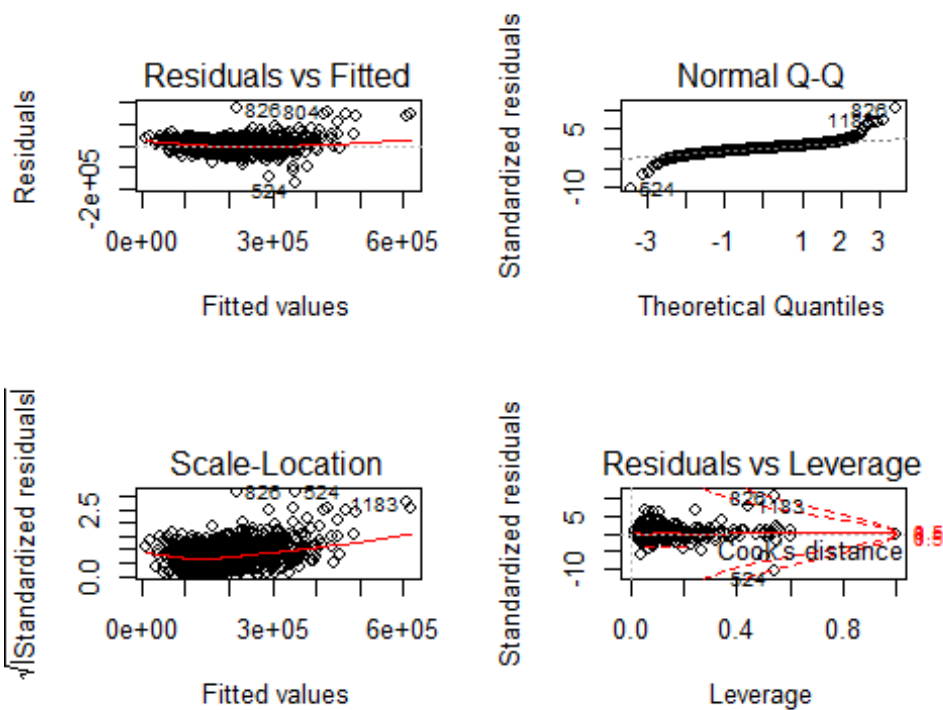
```
## Warning in sqrt(crit * p * (1 - hh)/hh): NaNs produced
```



```r
plot(myLm2)
```

```
## Warning: not plotting observations with leverage one:
##    272, 584, 945, 1004, 1012, 1188, 1231, 1271, 1276, 1299, 1371
```

```
## Warning: not plotting observations with leverage one:
##    272, 584, 945, 1004, 1012, 1188, 1231, 1271, 1276, 1299, 1371
```

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

```
## Warning in sqrt(crit * p * (1 - hh)/hh): NaNs produced
```
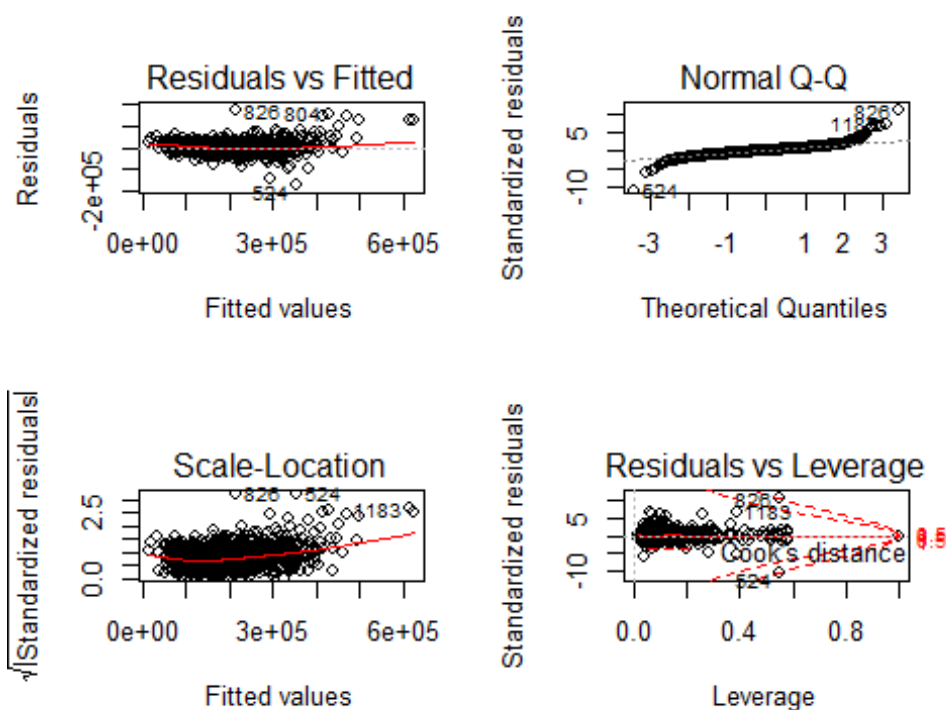
```
plot(myLm3)

## Warning: not plotting observations with leverage one:
##    121, 272, 347, 945, 1004, 1012, 1188, 1231, 1276, 1299, 1371, 1387

## Warning: not plotting observations with leverage one:
##    121, 272, 347, 945, 1004, 1012, 1188, 1231, 1276, 1299, 1371, 1387

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

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

```
plot(myLm4)

## Warning: not plotting observations with leverage one:
##    1012, 1188, 1371

## Warning: not plotting observations with leverage one:
##    1012, 1188, 1371

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

## Warning in sqrt(crit * p * (1 - hh)/hh): NaNs produced
```
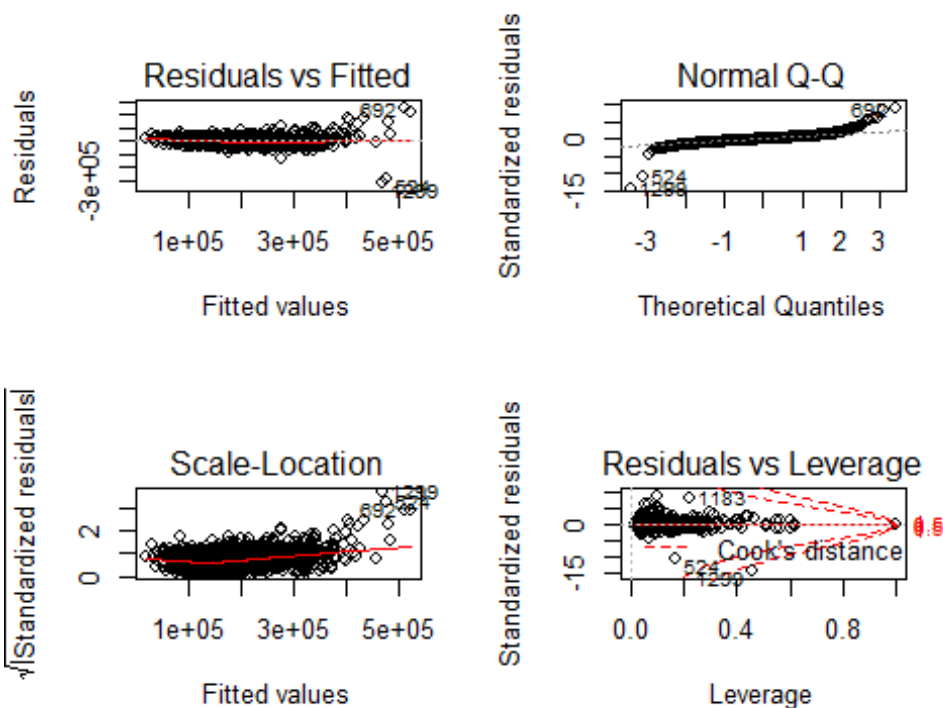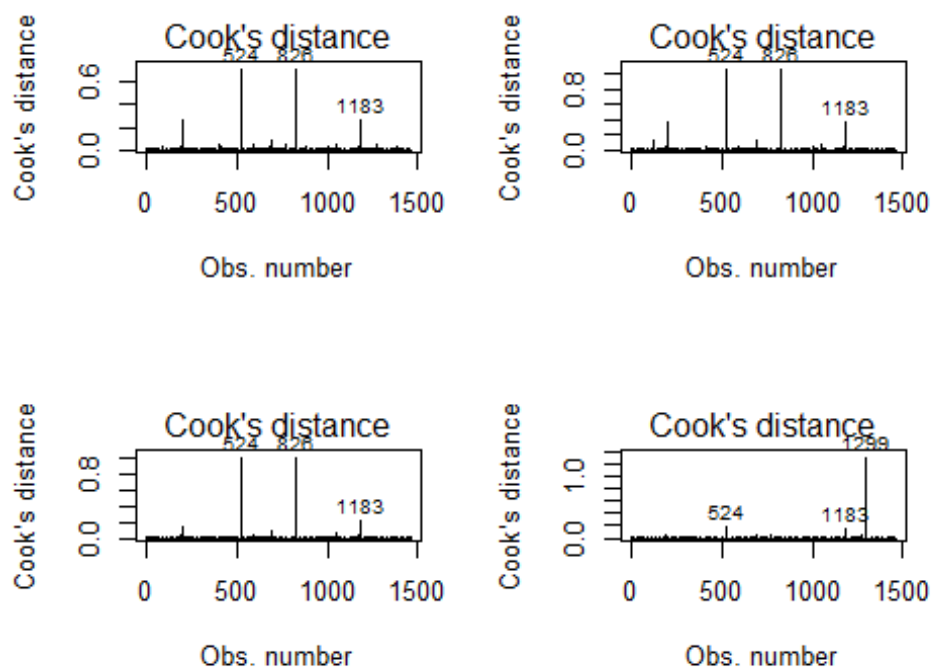
```
plot(myLm1,which=c(4))
plot(myLm2,which=c(4))
plot(myLm3,which=c(4))
plot(myLm4,which=c(4))
```


 Where all linear feature selection shows 524, 826 1183 as outlier, random forest selection chooses 1299 more of a problem than 524 or 1183.

Prediction using all 4 linear models

```
pd1<-predict(myLm1,interval='prediction',newdata=Test)

## Warning in predict.lm(myLm1, interval = "prediction", newdata = Test):
## prediction from a rank-deficient fit may be misleading

pd2<-predict(myLm2,interval='prediction',newdata=Test)
pd3<-predict(myLm3,interval='prediction',newdata=Test)
pd4<-predict(myLm4,interval='prediction',newdata=Test)

## Warning in predict.lm(myLm4, interval = "prediction", newdata = Test):
## prediction from a rank-deficient fit may be misleading
```
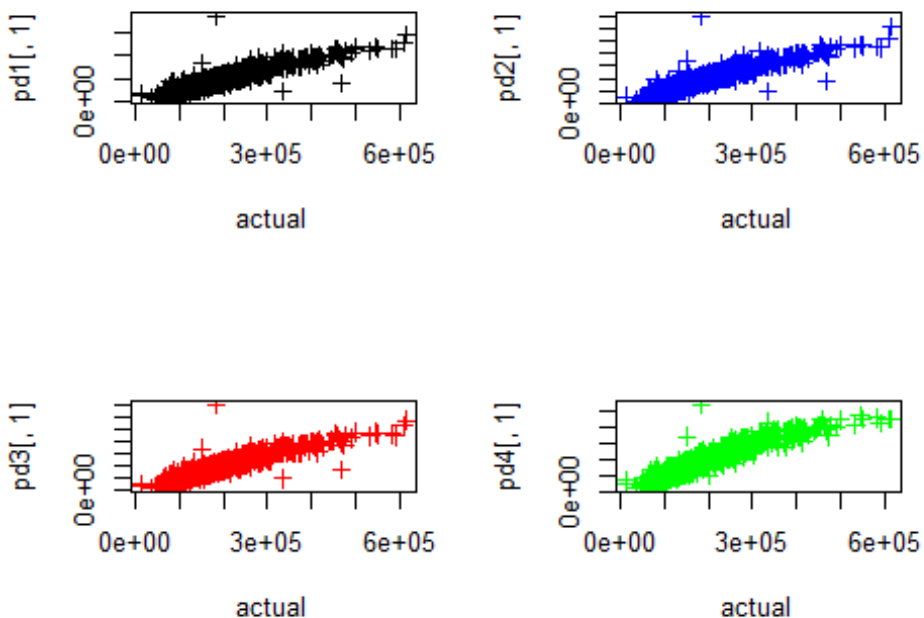
Prediction VS Actual plot

RMSLE / RMSE calculated for test set.

```
act<-read.csv( file = "C:\\Users\\Hyunkyung
Kim\\Desktop\\CKME999\\136\\dataset\\all\\AMES_test.csv")
actual<-act[1461:2919,2]
par(mfrow=c(2,2))
plot(actual,pd1[,1],pch=3)
plot(actual,pd2[,1],pch=3, col='blue')
plot(actual,pd3[,1],pch=3, col='red')
plot(actual,pd4[,1],pch=3, col='green')
```



```
RMSLE(pd1[,1],actual)

## [1] 0.1837928

RMSLE(pd2[,1],actual)

## [1] 0.1636028

RMSLE(pd3[,1],actual)
```

```
## [1] 0.1769506
```

```r
RMSLE(pd4[,1],actual)
```

```
## [1] 0.1735936
```

```r
RMSE(pd1[,1],actual)
```

```
## [1] 29630.08
```

```r
RMSE(pd2[,1],actual)
```

```
## [1] 28584.97
```

```r
RMSE(pd3[,1],actual)
```

```
## [1] 28721.35
```

```r
RMSE(pd4[,1],actual)
```

```
## [1] 27252.57
```

Random Forest

RF1<-RandomForest()

```r
RF1<-randomForest(SalePrice~.,data=Train)

RF2<-randomForest(SalePrice ~ OverallQual + GrLivArea + Neighborhood + BsmtFinSF1 +
    RoofMatl + MSSubClass + BsmtExposure + KitchenQual + Condition2 +
    SaleCondition + LotArea + YearBuilt + OverallCond + MasVnrArea +
    PoolQC + BedroomAbvGr + GarageCars + MasVnrType + TotalBsmtSF +
    BldgType + Functional + ExterQual + BsmtCond + Condition1 +
    Exterior1st + MoSold + GarageCond + ScreenPorch + LandContour +
    LowQualFinSF + LotConfig + LotFrontage + TotRmsAbvGrd + KitchenAbvGr +
    WoodDeckSF + Street + GarageArea + LotShape + BsmtQual +
    Fireplaces + FireplaceQu + PoolArea + RoofStyle + BsmtFinSF2 +
    Utilities + ExterCond, data = Train)
RF3<-randomForest(SalePrice ~ LotFrontage + LotArea + Street + LotShape + LandContour +
    Utilities + LotConfig + Neighborhood + Condition1 + Condition2 +
    BldgType + HouseStyle + OverallQual + OverallCond + YearBuilt +
    RoofMatl + Exterior1st + MasVnrType + MasVnrArea + ExterQual +
    ExterCond + Foundation + BsmtQual + BsmtCond + BsmtExposure +
    BsmtFinSF1 + BsmtFinSF2 + BsmtUnfSF + X1stFlrSF + X2ndFlrSF +
    HalfBath + BedroomAbvGr + KitchenAbvGr + KitchenQual + TotRmsAbvGrd +
    Functional + Fireplaces + FireplaceQu + GarageType + GarageCars +
    GarageArea + WoodDeckSF + X3SsnPorch + ScreenPorch + PoolQC +
    Fence + MiscFeature + MoSold + SaleCondition     , data = Train)
RF4<-randomForest(SalePrice ~
MSSubClass+MSZoning+LotFrontage+LotArea+Alley+LotShape+LandContour+LandSlope+Neighborhood
+
BldgType+HouseStyle+OverallQual+OverallCond+YearBuilt+YearRemodAdd+RoofStyle+Exterior1st+
Exterior2nd+
MasVnrType+MasVnrArea+ExterQual+Foundation+BsmtQual+BsmtCond+BsmtExposure+BsmtFinType1+Bs
mtFinSF1+
BsmtFinType2+BsmtUnfSF+TotalBsmtSF+HeatingQC+CentralAir+X1stFlrSF+X2ndFlrSF+GrLivArea+Bsm
tFullBath+
FullBath+HalfBath+BedroomAbvGr+KitchenAbvGr+KitchenQual+TotRmsAbvGrd+Fireplaces+Fireplace
```

```
Qu+GarageType+
GarageYrBlt+GarageFinish+GarageCars+GarageArea+GarageQual+GarageCond+PavedDrive+WoodDeckS
F+OpenPorchSF
,data=Train)




summary(myLm1)

## 
## Call:
## lm(formula = SalePrice ~ ., data = Train)
## 
## Residuals:
##     Min      1Q  Median      3Q     Max 
## -170748  -11535       0   11479  170748 
## 
## Coefficients: (3 not defined because of singularities)
##                        Estimate Std. Error t value Pr(>|t|)    
## (Intercept)          -1.358e+06  1.091e+06  -1.244 0.213676    
## MSSubClass           -7.186e+01  4.449e+01  -1.615 0.106529    
## MSZoningFV            2.886e+04  1.255e+04   2.299 0.021649 *  
## MSZoningRH            2.620e+04  1.254e+04   2.090 0.036833 *  
## MSZoningRL            2.471e+04  1.063e+04   2.325 0.020231 *  
## MSZoningRM            2.241e+04  1.001e+04   2.238 0.025409 *  
## LotFrontage           1.063e+02  4.455e+01   2.386 0.017173 *  
## LotArea               4.100e-01  9.777e-02   4.194 2.93e-05 ***
## StreetPave            2.195e+04  1.212e+04   1.811 0.070382 .  
## AlleyNoAlley         -1.392e+03  4.414e+03  -0.315 0.752586    
## AlleyPave            -1.786e+02  6.320e+03  -0.028 0.977455    
## LotShapeIR2           1.076e+04  4.382e+03   2.456 0.014185 *  
## LotShapeIR3           4.116e+03  9.311e+03   0.442 0.658525    
## LotShapeReg           2.316e+03  1.688e+03   1.372 0.170301    
## LandContourHLS        9.028e+03  5.378e+03   1.679 0.093465 .  
## LandContourLow       -6.591e+03  6.582e+03  -1.001 0.316796    
## LandContourLvl        3.966e+03  3.866e+03   1.026 0.305152    
## Utilities             1.522e+04  9.141e+03   1.664 0.096274 .  
## LotConfigCulDSac      1.189e+04  3.715e+03   3.200 0.001410 ** 
## LotConfigFR2         -4.402e+03  4.270e+03  -1.031 0.302778    
## LotConfigFR3         -1.996e+04  1.330e+04  -1.500 0.133784    
## LotConfigInside       1.852e+02  1.896e+03   0.098 0.922200    
## LandSlope            -8.392e+01  3.648e+03  -0.023 0.981649    
## NeighborhoodBlueste   1.634e+04  1.998e+04   0.818 0.413468    
## NeighborhoodBrDale    9.742e+03  1.094e+04   0.891 0.373250    
## NeighborhoodBrkSide   5.072e+03  9.588e+03   0.529 0.596914    
## NeighborhoodClearCr  -9.409e+03  9.519e+03  -0.988 0.323106    
## NeighborhoodCollgCr  -1.047e+04  7.467e+03  -1.402 0.161296    
## NeighborhoodCrawfor   1.598e+04  8.797e+03   1.817 0.069454 .  
## NeighborhoodEdwards  -1.146e+04  8.208e+03  -1.397 0.162776    
## NeighborhoodGilbert  -9.124e+03  7.901e+03  -1.155 0.248418    
## NeighborhoodIDOTRR   -4.458e+03  1.090e+04  -0.409 0.682691    
## NeighborhoodMeadowV  -2.644e+03  1.162e+04  -0.227 0.820116    
## NeighborhoodMitchel  -1.151e+04  8.376e+03  -1.374 0.169736    
## NeighborhoodNAmes    -1.002e+04  8.049e+03  -1.244 0.213632    
## NeighborhoodNoRidge   2.176e+04  8.708e+03   2.498 0.012603 *  
```

```
## NeighborhoodNPkVill       1.633e+04  1.469e+04    1.111 0.266572
## NeighborhoodNridgHt       3.079e+04  7.639e+03    4.031 5.89e-05 ***
## NeighborhoodNWAmes       -1.367e+04  8.295e+03   -1.648 0.099617 .
## NeighborhoodOldTown      -5.777e+03  9.865e+03   -0.586 0.558270
## NeighborhoodSawyer       -1.294e+03  8.372e+03   -0.155 0.877195
## NeighborhoodSawyerW      -2.996e+03  8.062e+03   -0.372 0.710278
## NeighborhoodSomerst      -1.995e+03  9.367e+03   -0.213 0.831387
## NeighborhoodStoneBr       4.042e+04  8.682e+03    4.655 3.58e-06 ***
## NeighborhoodSWISU        -3.422e+03  1.003e+04   -0.341 0.733021
## NeighborhoodTimber       -7.234e+03  8.430e+03   -0.858 0.391003
## NeighborhoodVeenker       3.152e+03  1.096e+04    0.287 0.773808
## Condition1Feedr           3.751e+03  5.191e+03    0.723 0.470065
## Condition1Norm            1.404e+04  4.306e+03    3.262 0.001136 **
## Condition1PosA            5.769e+03  1.052e+04    0.548 0.583453
## Condition1PosN            9.018e+03  7.747e+03    1.164 0.244656
## Condition1RRAe           -1.381e+04  9.171e+03   -1.505 0.132485
## Condition1RRAn            1.480e+04  7.271e+03    2.035 0.042045 *
## Condition1RRNe           -7.139e+03  1.859e+04   -0.384 0.701072
## Condition1RRNn            1.341e+04  1.344e+04    0.998 0.318703
## Condition2Feedr          -1.530e+04  2.371e+04   -0.645 0.518992
## Condition2Norm           -1.665e+04  2.035e+04   -0.818 0.413278
## Condition2PosA            3.815e+04  3.446e+04    1.107 0.268453
## Condition2PosN           -2.352e+05  2.834e+04   -8.299 2.68e-16 ***
## Condition2RRAe           -7.148e+04  6.740e+04   -1.061 0.289075
## Condition2RRAn           -9.186e+03  3.214e+04   -0.286 0.775053
## Condition2RRNn           -6.793e+03  2.773e+04   -0.245 0.806523
## BldgType                  4.923e+03  1.777e+03    2.770 0.005694 **
## HouseStyle1.5Unf          9.755e+03  7.973e+03    1.224 0.221346
## HouseStyle1Story          9.753e+03  4.184e+03    2.331 0.019920 *
## HouseStyle2.5Fin         -1.556e+04  1.265e+04   -1.230 0.218986
## HouseStyle2.5Unf         -1.133e+04  9.431e+03   -1.201 0.229855
## HouseStyle2Story         -5.156e+03  3.434e+03   -1.501 0.133486
## HouseStyleSFoyer          1.448e+03  6.067e+03    0.239 0.811351
## HouseStyleSLvl            6.873e+03  5.230e+03    1.314 0.189013
## OverallQual               8.368e+03  1.056e+03    7.922 5.09e-15 ***
## OverallCond               5.364e+03  8.968e+02    5.981 2.89e-09 ***
## YearBuilt                 2.767e+02  8.244e+01    3.356 0.000815 ***
## YearRemodAdd              1.581e+01  5.717e+01    0.276 0.782230
## RoofStyleGable            1.578e+03  1.919e+04    0.082 0.934468
## RoofStyleGambrel          2.607e+03  2.090e+04    0.125 0.900761
## RoofStyleHip              5.301e+03  1.926e+04    0.275 0.783152
## RoofStyleMansard          1.037e+04  2.240e+04    0.463 0.643605
## RoofStyleShed             5.217e+04  3.530e+04    1.478 0.139668
## RoofMatlCompShg           6.720e+05  3.524e+04   19.068  < 2e-16 ***
## RoofMatlMembran           7.254e+05  4.813e+04   15.072  < 2e-16 ***
## RoofMatlMetal             6.924e+05  4.815e+04   14.381  < 2e-16 ***
## RoofMatlRoll              6.514e+05  4.368e+04   14.912  < 2e-16 ***
## RoofMatlTar&Grv           6.671e+05  4.043e+04   16.500  < 2e-16 ***
## RoofMatlWdShake           6.475e+05  3.879e+04   16.694  < 2e-16 ***
## RoofMatlWdShngl           7.523e+05  3.675e+04   20.472  < 2e-16 ***
## Exterior1stAsphShn       -1.711e+04  3.478e+04   -0.492 0.622833
## Exterior1stBrkComm       -1.747e+04  2.870e+04   -0.609 0.542749
## Exterior1stBrkFace        6.813e+03  1.327e+04    0.513 0.607741
## Exterior1stCBlock         1.034e+03  2.687e+04    0.038 0.969304
## Exterior1stCemntBd       -6.758e+03  1.976e+04   -0.342 0.732406
```

```
## Exterior1stHdBoard      -1.086e+04  1.339e+04  -0.811 0.417544
## Exterior1stImStucc      -3.880e+04  2.952e+04  -1.315 0.188913
## Exterior1stMetalSd      -1.620e+03  1.509e+04  -0.107 0.914558
## Exterior1stPlywood      -1.615e+04  1.323e+04  -1.221 0.222268
## Exterior1stStone         1.605e+03  2.498e+04   0.064 0.948796
## Exterior1stStucco        1.628e+03  1.454e+04   0.112 0.910853
## Exterior1stVinylSd      -1.206e+04  1.391e+04  -0.867 0.386272
## Exterior1stWd Sdng      -1.072e+04  1.283e+04  -0.836 0.403540
## Exterior1stWdShing      -3.507e+03  1.385e+04  -0.253 0.800183
## Exterior2ndAsphShn       1.047e+04  2.323e+04   0.451 0.652135
## Exterior2ndBrk Cmn       1.445e+04  2.090e+04   0.691 0.489696
## Exterior2ndBrkFace       2.328e+03  1.361e+04   0.171 0.864201
## Exterior2ndCBlock              NA         NA      NA       NA
## Exterior2ndCmentBd       1.561e+04  1.942e+04   0.804 0.421795
## Exterior2ndHdBoard       5.434e+03  1.271e+04   0.428 0.668938
## Exterior2ndImStucc       2.744e+04  1.480e+04   1.854 0.063965 .
## Exterior2ndMetalSd       3.957e+03  1.467e+04   0.270 0.787440
## Exterior2ndOther        -2.264e+04  2.874e+04  -0.788 0.430868
## Exterior2ndPlywood       6.978e+03  1.235e+04   0.565 0.572061
## Exterior2ndStone        -6.028e+03  1.771e+04  -0.340 0.733588
## Exterior2ndStucco       -5.806e+03  1.404e+04  -0.413 0.679360
## Exterior2ndVinylSd       1.024e+04  1.332e+04   0.769 0.441955
## Exterior2ndWd Sdng       8.665e+03  1.225e+04   0.707 0.479463
## Exterior2ndWd Shng      -5.015e+02  1.288e+04  -0.039 0.968937
## MasVnrTypeBrkFace        6.918e+03  7.010e+03   0.987 0.323913
## MasVnrTypeNone           1.319e+04  7.062e+03   1.868 0.061968 .
## MasVnrTypeStone          1.327e+04  7.442e+03   1.783 0.074877 .
## MasVnrArea               3.116e+01  6.014e+00   5.182 2.56e-07 ***
## ExterQual                4.105e+03  2.191e+03   1.874 0.061196 .
## ExterCond               -3.296e+03  2.214e+03  -1.488 0.136882
## FoundationCBlock         3.198e+03  3.262e+03   0.980 0.327141
## FoundationPConc          4.181e+03  3.553e+03   1.177 0.239482
## FoundationSlab           1.509e+04  9.445e+03   1.598 0.110262
## FoundationStone          5.615e+03  1.168e+04   0.481 0.630666
## FoundationWood          -3.085e+04  1.566e+04  -1.970 0.049007 *
## BsmtQual                 3.749e+03  1.784e+03   2.102 0.035776 *
## BsmtCond                -5.638e+03  2.235e+03  -2.523 0.011750 *
## BsmtExposure             5.282e+03  8.848e+02   5.970 3.07e-09 ***
## BsmtFinType1            -1.290e+02  5.324e+02  -0.242 0.808567
## BsmtFinSF1               3.577e+01  5.026e+00   7.118 1.83e-12 ***
## BsmtFinType2            -8.406e+01  1.360e+03  -0.062 0.950731
## BsmtFinSF2               2.299e+01  8.537e+00   2.693 0.007179 **
## BsmtUnfSF                1.546e+01  4.542e+00   3.404 0.000685 ***
## TotalBsmtSF                    NA         NA      NA       NA
## HeatingGasA             -6.307e+03  2.647e+04  -0.238 0.811680
## HeatingGasW             -7.954e+03  2.723e+04  -0.292 0.770265
## HeatingGrav             -4.322e+03  2.822e+04  -0.153 0.878290
## HeatingOthW             -4.467e+04  3.259e+04  -1.370 0.170795
## HeatingWall              5.452e+03  3.057e+04   0.178 0.858497
## HeatingQC                1.134e+03  1.008e+03   1.125 0.260648
## CentralAirY             -1.389e+03  4.006e+03  -0.347 0.728904
## ElectricalFuseF         -1.562e+03  5.978e+03  -0.261 0.793852
## ElectricalFuseP          8.364e+02  1.783e+04   0.047 0.962592
## ElectricalMix            1.155e+04  2.732e+04   0.423 0.672519
## ElectricalSBrkr         -3.758e+03  3.087e+03  -1.217 0.223724
```

```
## X1stFlrSF                    4.636e+01  5.597e+00   8.283 3.05e-16 ***
## X2ndFlrSF                    6.358e+01  5.842e+00  10.883  < 2e-16 ***
## LowQualFinSF                 1.650e+01  1.942e+01   0.850 0.395611
## GrLivArea                           NA         NA      NA       NA
## BsmtFullBath                 1.840e+03  2.045e+03   0.900 0.368539
## BsmtHalfBath                 4.227e+02  3.161e+03   0.134 0.893632
## FullBath                     2.662e+03  2.285e+03   1.165 0.244363
## HalfBath                     2.853e+03  2.189e+03   1.303 0.192748
## BedroomAbvGr                -5.866e+03  1.395e+03  -4.204 2.80e-05 ***
## KitchenAbvGr                -1.052e+04  4.681e+03  -2.246 0.024849 *
## KitchenQual                  7.074e+03  1.719e+03   4.114 4.13e-05 ***
## TotRmsAbvGrd                 3.257e+03  9.890e+02   3.294 0.001017 **
## Functional                   5.922e+03  1.171e+03   5.057 4.90e-07 ***
## Fireplaces                   5.919e+03  2.314e+03   2.557 0.010667 *
## FireplaceQu                 -1.603e+03  8.361e+02  -1.917 0.055450 .
## GarageTypeAttchd             1.219e+04  1.160e+04   1.051 0.293327
## GarageTypeBasment            2.016e+04  1.343e+04   1.501 0.133637
## GarageTypeBuiltIn            1.343e+04  1.211e+04   1.109 0.267515
## GarageTypeCarPort            1.603e+04  1.499e+04   1.069 0.285109
## GarageTypeDetchd             1.743e+04  1.157e+04   1.506 0.132347
## GarageTypeNoGarage           4.143e+04  1.620e+04   2.558 0.010651 *
## GarageYrBlt                 -1.614e+01  6.275e+01  -0.257 0.797108
## GarageFinish                 8.042e+02  1.260e+03   0.638 0.523540
## GarageCars                   5.016e+03  2.358e+03   2.127 0.033608 *
## GarageArea                   1.536e+01  8.231e+00   1.866 0.062254 .
## GarageQual                   5.690e+03  3.991e+03   1.426 0.154225
## GarageCond                  -1.522e+03  4.089e+03  -0.372 0.709713
## PavedDrive                  -2.401e+01  1.732e+03  -0.014 0.988939
## WoodDeckSF                   1.287e+01  6.138e+00   2.097 0.036210 *
## OpenPorchSF                  9.704e+00  1.197e+01   0.811 0.417805
## EnclosedPorch               -3.309e+00  1.305e+01  -0.254 0.799895
## X3SsnPorch                   3.834e+01  2.365e+01   1.621 0.105281
## ScreenPorch                  4.231e+01  1.300e+01   3.254 0.001168 **
## PoolArea                    -2.288e+01  5.634e+01  -0.406 0.684696
## PoolQC                       2.054e+04  8.513e+03   2.413 0.015981 *
## FenceGdWo                    1.046e+04  5.118e+03   2.044 0.041132 *
## FenceMnPrv                   1.091e+04  4.171e+03   2.616 0.008990 **
## FenceMnWw                    5.759e+03  8.637e+03   0.667 0.505075
## FenceNoFence                 9.584e+03  3.806e+03   2.518 0.011913 *
## MiscFeatureNoMiscFeature     4.583e+04  9.996e+04   0.459 0.646640
## MiscFeatureOthr              6.085e+04  9.242e+04   0.658 0.510385
## MiscFeatureShed              4.570e+04  9.577e+04   0.477 0.633331
## MiscFeatureTenC             -3.030e+04  9.374e+04  -0.323 0.746596
## MiscVal                      2.863e+00  6.258e+00   0.457 0.647440
## MoSold                      -6.934e+02  2.555e+02  -2.714 0.006739 **
## YrSold                      -9.613e+01  5.336e+02  -0.180 0.857063
## SaleTypeCon                  2.740e+04  1.866e+04   1.469 0.142193
## SaleTypeConLD                1.633e+04  1.012e+04   1.613 0.107054
## SaleTypeConLI                5.559e+03  1.221e+04   0.455 0.648880
## SaleTypeConLw               -8.507e+02  1.254e+04  -0.068 0.945946
## SaleTypeCWD                  1.609e+04  1.354e+04   1.188 0.235041
## SaleTypeNew                  3.515e+04  1.610e+04   2.184 0.029178 *
## SaleTypeOth                  1.104e+04  1.543e+04   0.716 0.474268
## SaleTypeWD                   4.405e+02  4.401e+03   0.100 0.920284
## SaleConditionAdjLand         1.479e+04  1.503e+04   0.984 0.325309
```

```
## SaleConditionAlloca        8.348e+03   8.979e+03    0.930 0.352689
## SaleConditionFamily       -1.214e+02   6.447e+03   -0.019 0.984983
## SaleConditionNormal        7.474e+03   3.025e+03    2.471 0.013619 *
## SaleConditionPartial      -8.874e+03   1.549e+04   -0.573 0.566860
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 24260 on 1258 degrees of freedom
## Multiple R-squared:  0.9196, Adjusted R-squared:  0.9067
## F-statistic: 71.57 on 201 and 1258 DF,  p-value: < 2.2e-16
```

```r
summary(myLm2)
```

```
##
## Call:
## lm(formula = SalePrice ~ OverallQual + GrLivArea + Neighborhood +
##     BsmtFinSF1 + RoofMatl + MSSubClass + BsmtExposure + KitchenQual +
##     Condition2 + SaleCondition + LotArea + YearBuilt + OverallCond +
##     MasVnrArea + PoolQC + BedroomAbvGr + GarageCars + MasVnrType +
##     TotalBsmtSF + BldgType + Functional + ExterQual + BsmtCond +
##     Condition1 + Exterior1st + MoSold + GarageCond + ScreenPorch +
##     LandContour + LowQualFinSF + LotConfig + LotFrontage + TotRmsAbvGrd +
##     KitchenAbvGr + WoodDeckSF + Street + GarageArea + LotShape +
##     BsmtQual + Fireplaces + FireplaceQu + PoolArea + RoofStyle +
##     BsmtFinSF2 + Utilities + ExterCond, data = Train)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -167510  -11473     222   11201  167510
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)           -1.671e+06  1.340e+05 -12.471  < 2e-16 ***
## OverallQual            7.652e+03  9.855e+02   7.765 1.62e-14 ***
## GrLivArea              5.487e+01  3.302e+00  16.619  < 2e-16 ***
## NeighborhoodBlueste    2.071e+02  1.875e+04   0.011 0.991190
## NeighborhoodBrDale     4.778e+03  9.529e+03   0.501 0.616196
## NeighborhoodBrkSide    6.805e+03  8.478e+03   0.803 0.422315
## NeighborhoodClearCr   -8.189e+03  9.133e+03  -0.897 0.370074
## NeighborhoodCollgCr   -1.051e+04  7.141e+03  -1.472 0.141186
## NeighborhoodCrawfor    1.502e+04  8.389e+03   1.790 0.073606 .
## NeighborhoodEdwards   -8.914e+03  7.742e+03  -1.151 0.249775
## NeighborhoodGilbert   -8.244e+03  7.575e+03  -1.088 0.276618
## NeighborhoodIDOTRR    -5.778e+03  8.901e+03  -0.649 0.516376
## NeighborhoodMeadowV   -1.122e+04  1.032e+04  -1.087 0.277362
## NeighborhoodMitchel   -1.317e+04  7.940e+03  -1.659 0.097402 .
## NeighborhoodNAmes     -9.760e+03  7.591e+03  -1.286 0.198745
## NeighborhoodNoRidge    2.372e+04  8.354e+03   2.839 0.004588 **
## NeighborhoodNPkVill    1.791e+04  1.106e+04   1.618 0.105797
## NeighborhoodNridgHt    3.143e+04  7.350e+03   4.276 2.04e-05 ***
## NeighborhoodNWAmes    -1.495e+04  7.895e+03  -1.894 0.058416 .
## NeighborhoodOldTown   -7.359e+03  8.256e+03  -0.891 0.372881
## NeighborhoodSawyer    -2.571e+03  7.981e+03  -0.322 0.747383
## NeighborhoodSawyerW   -4.148e+03  7.750e+03  -0.535 0.592640
## NeighborhoodSomerst    3.100e+03  7.362e+03   0.421 0.673788
## NeighborhoodStoneBr    3.987e+04  8.435e+03   4.726 2.53e-06 ***
```

```
## NeighborhoodSWISU       -7.164e+00  9.521e+03  -0.001 0.999400
## NeighborhoodTimber      -7.593e+03  8.149e+03  -0.932 0.351599
## NeighborhoodVeenker      4.880e+03  1.044e+04   0.467 0.640274
## BsmtFinSF1               2.048e+01  1.982e+00  10.338  < 2e-16 ***
## RoofMatlCompShg          6.958e+05  3.310e+04  21.023  < 2e-16 ***
## RoofMatlMembran          7.533e+05  4.615e+04  16.323  < 2e-16 ***
## RoofMatlMetal            7.248e+05  4.582e+04  15.819  < 2e-16 ***
## RoofMatlRoll             6.851e+05  4.166e+04  16.444  < 2e-16 ***
## RoofMatlTar&Grv          6.924e+05  3.794e+04  18.251  < 2e-16 ***
## RoofMatlWdShake          6.742e+05  3.625e+04  18.597  < 2e-16 ***
## RoofMatlWdShngl          7.767e+05  3.455e+04  22.482  < 2e-16 ***
## MSSubClass              -9.178e+01  3.318e+01  -2.766 0.005760 **
## BsmtExposure             5.289e+03  8.056e+02   6.566 7.37e-11 ***
## KitchenQual              7.340e+03  1.601e+03   4.585 4.97e-06 ***
## Condition2Feedr         -1.788e+04  2.181e+04  -0.820 0.412460
## Condition2Norm          -1.592e+04  1.865e+04  -0.854 0.393458
## Condition2PosA           5.104e+04  3.144e+04   1.624 0.104715
## Condition2PosN          -2.345e+05  2.701e+04  -8.681  < 2e-16 ***
## Condition2RRAe          -8.175e+04  4.314e+04  -1.895 0.058314 .
## Condition2RRAn          -8.471e+03  3.097e+04  -0.274 0.784456
## Condition2RRNn          -6.282e+03  2.586e+04  -0.243 0.808078
## SaleConditionAdjLand     1.845e+04  1.337e+04   1.379 0.167975
## SaleConditionAlloca      6.465e+03  8.386e+03   0.771 0.440911
## SaleConditionFamily     -2.203e+02  6.178e+03  -0.036 0.971560
## SaleConditionNormal      7.132e+03  2.707e+03   2.635 0.008516 **
## SaleConditionPartial     2.466e+04  3.826e+03   6.446 1.60e-10 ***
## LotArea                  3.999e-01  8.886e-02   4.501 7.36e-06 ***
## YearBuilt                3.877e+02  5.990e+01   6.473 1.35e-10 ***
## OverallCond              5.939e+03  7.685e+02   7.728 2.13e-14 ***
## MasVnrArea               3.312e+01  5.814e+00   5.696 1.51e-08 ***
## PoolQC                   3.098e+04  7.611e+03   4.071 4.96e-05 ***
## BedroomAbvGr            -5.584e+03  1.300e+03  -4.295 1.87e-05 ***
## GarageCars               3.939e+03  2.240e+03   1.758 0.078930 .
## MasVnrTypeBrkFace        9.442e+03  6.740e+03   1.401 0.161521
## MasVnrTypeNone           1.654e+04  6.794e+03   2.434 0.015046 *
## MasVnrTypeStone          1.478e+04  7.150e+03   2.067 0.038930 *
## TotalBsmtSF              1.190e+01  2.951e+00   4.033 5.81e-05 ***
## BldgType                 4.225e+03  1.461e+03   2.891 0.003900 **
## Functional               5.728e+03  1.072e+03   5.342 1.08e-07 ***
## ExterQual                5.421e+03  2.097e+03   2.585 0.009842 **
## BsmtCond                -7.298e+03  1.850e+03  -3.945 8.39e-05 ***
## Condition1Feedr          2.843e+03  4.935e+03   0.576 0.564669
## Condition1Norm           1.315e+04  4.064e+03   3.237 0.001240 **
## Condition1PosA           3.287e+03  1.015e+04   0.324 0.746185
## Condition1PosN           7.959e+03  7.419e+03   1.073 0.283609
## Condition1RRAe          -1.204e+04  8.809e+03  -1.367 0.171930
## Condition1RRAn           1.256e+04  6.833e+03   1.838 0.066267 .
## Condition1RRNe          -5.278e+03  1.826e+04  -0.289 0.772531
## Condition1RRNn           1.626e+04  1.258e+04   1.293 0.196273
## Exterior1stAsphShn      -1.797e+04  2.567e+04  -0.700 0.484062
## Exterior1stBrkComm       1.623e+03  1.918e+04   0.085 0.932566
## Exterior1stBrkFace       1.857e+04  7.011e+03   2.648 0.008191 **
## Exterior1stCBlock        1.419e+04  2.564e+04   0.553 0.580018
## Exterior1stCemntBd       1.452e+04  7.367e+03   1.971 0.048948 *
## Exterior1stHdBoard       1.313e+03  6.334e+03   0.207 0.835810
```

```
## Exterior1stImStucc    -1.647e+04  2.570e+04  -0.641 0.521834
## Exterior1stMetalSd     7.884e+03  6.161e+03   1.280 0.200895
## Exterior1stPlywood    -3.606e+03  6.672e+03  -0.540 0.588981
## Exterior1stStone      -2.532e+03  2.031e+04  -0.125 0.900814
## Exterior1stStucco      7.085e+03  7.829e+03   0.905 0.365669
## Exterior1stVinylSd     3.954e+03  6.211e+03   0.637 0.524478
## Exterior1stWd Sdng     3.651e+03  6.147e+03   0.594 0.552591
## Exterior1stWdShing     4.398e+03  7.712e+03   0.570 0.568602
## MoSold                -6.655e+02  2.463e+02  -2.702 0.006988 **
## GarageCond            -4.465e+03  1.263e+03  -3.535 0.000421 ***
## ScreenPorch            3.817e+01  1.239e+01   3.080 0.002112 **
## LandContourHLS         1.012e+04  5.121e+03   1.977 0.048272 *
## LandContourLow        -8.245e+03  6.095e+03  -1.353 0.176396
## LandContourLvl         3.887e+03  3.567e+03   1.090 0.276036
## LowQualFinSF          -4.612e+01  1.486e+01  -3.102 0.001960 **
## LotConfigCulDSac       1.181e+04  3.565e+03   3.314 0.000945 ***
## LotConfigFR2          -4.001e+03  4.127e+03  -0.969 0.332486
## LotConfigFR3          -2.121e+04  1.305e+04  -1.625 0.104353
## LotConfigInside        3.297e+02  1.830e+03   0.180 0.857050
## LotFrontage            1.066e+02  4.162e+01   2.562 0.010523 *
## TotRmsAbvGrd           2.659e+03  9.465e+02   2.810 0.005032 **
## KitchenAbvGr          -8.465e+03  4.226e+03  -2.003 0.045399 *
## WoodDeckSF             1.240e+01  5.898e+00   2.102 0.035710 *
## StreetPave             2.628e+04  1.121e+04   2.345 0.019158 *
## GarageArea             1.774e+01  7.547e+00   2.350 0.018905 *
## LotShapeIR2            9.280e+03  4.255e+03   2.181 0.029345 *
## LotShapeIR3            6.863e+03  8.828e+03   0.777 0.437071
## LotShapeReg            2.284e+03  1.647e+03   1.387 0.165782
## BsmtQual               3.265e+03  1.593e+03   2.050 0.040549 *
## Fireplaces             6.334e+03  2.247e+03   2.819 0.004881 **
## FireplaceQu           -1.679e+03  8.089e+02  -2.076 0.038089 *
## PoolArea              -1.003e+02  4.890e+01  -2.052 0.040352 *
## RoofStyleGable         4.778e+03  1.861e+04   0.257 0.797397
## RoofStyleGambrel       6.236e+03  2.012e+04   0.310 0.756680
## RoofStyleHip           9.532e+03  1.866e+04   0.511 0.609596
## RoofStyleMansard       1.638e+04  2.134e+04   0.768 0.442750
## RoofStyleShed          5.431e+04  3.432e+04   1.583 0.113756
## BsmtFinSF2             8.567e+00  4.568e+00   1.875 0.060941 .
## Utilities              1.326e+04  8.535e+03   1.554 0.120488
## ExterCond             -3.035e+03  2.105e+03  -1.442 0.149510
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 24330 on 1341 degrees of freedom
## Multiple R-squared:  0.9138, Adjusted R-squared:  0.9062
## F-statistic: 120.5 on 118 and 1341 DF,  p-value: < 2.2e-16
```

```r
summary(myLm3)
```

```
##
## Call:
## lm(formula = SalePrice ~ LotFrontage + LotArea + Street + LotShape +
##     LandContour + Utilities + LotConfig + Neighborhood + Condition1 +
##     Condition2 + BldgType + HouseStyle + OverallQual + OverallCond +
##     YearBuilt + RoofMatl + Exterior1st + MasVnrType + MasVnrArea +
##     ExterQual + ExterCond + Foundation + BsmtQual + BsmtCond +
```

```
##      BsmtExposure + BsmtFinSF1 + BsmtFinSF2 + BsmtUnfSF + X1stFlrSF +
##      X2ndFlrSF + HalfBath + BedroomAbvGr + KitchenAbvGr + KitchenQual +
##      TotRmsAbvGrd + Functional + Fireplaces + FireplaceQu + GarageType +
##      GarageCars + GarageArea + WoodDeckSF + X3SsnPorch + ScreenPorch +
##      PoolQC + Fence + MiscFeature + MoSold + SaleCondition, data = Train)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -171434  -11629       0   11196  171434
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)          -1.625e+06  1.448e+05 -11.225  < 2e-16 ***
## LotFrontage           1.226e+02  4.302e+01   2.850 0.004434 **
## LotArea               3.862e-01  8.939e-02   4.320 1.67e-05 ***
## StreetPave            2.452e+04  1.151e+04   2.130 0.033325 *
## LotShapeIR2           1.080e+04  4.271e+03   2.530 0.011534 *
## LotShapeIR3           5.438e+03  8.870e+03   0.613 0.539917
## LotShapeReg           2.336e+03  1.641e+03   1.424 0.154745
## LandContourHLS        9.152e+03  5.180e+03   1.767 0.077467 .
## LandContourLow       -8.472e+03  6.090e+03  -1.391 0.164424
## LandContourLvl        3.908e+03  3.611e+03   1.082 0.279357
## Utilities             1.262e+04  8.793e+03   1.436 0.151312
## LotConfigCulDSac      1.231e+04  3.601e+03   3.419 0.000649 ***
## LotConfigFR2         -4.564e+03  4.113e+03  -1.110 0.267324
## LotConfigFR3         -2.027e+04  1.299e+04  -1.560 0.118897
## LotConfigInside       4.267e+02  1.830e+03   0.233 0.815658
## NeighborhoodBlueste   1.422e+04  1.914e+04   0.743 0.457598
## NeighborhoodBrDale    8.185e+03  9.811e+03   0.834 0.404301
## NeighborhoodBrkSide   5.904e+03  8.577e+03   0.688 0.491390
## NeighborhoodClearCr  -7.501e+03  9.040e+03  -0.830 0.406805
## NeighborhoodCollgCr  -9.959e+03  7.131e+03  -1.396 0.162817
## NeighborhoodCrawfor   1.566e+04  8.413e+03   1.862 0.062834 .
## NeighborhoodEdwards  -9.020e+03  7.803e+03  -1.156 0.247885
## NeighborhoodGilbert  -7.752e+03  7.636e+03  -1.015 0.310196
## NeighborhoodIDOTRR   -7.103e+03  8.984e+03  -0.791 0.429304
## NeighborhoodMeadowV  -5.250e+03  1.050e+04  -0.500 0.617099
## NeighborhoodMitchel  -9.358e+03  7.949e+03  -1.177 0.239267
## NeighborhoodNAmes    -8.663e+03  7.662e+03  -1.131 0.258409
## NeighborhoodNoRidge   2.270e+04  8.386e+03   2.707 0.006882 **
## NeighborhoodNPkVill   2.056e+04  1.119e+04   1.837 0.066427 .
## NeighborhoodNridgHt   3.117e+04  7.367e+03   4.230 2.50e-05 ***
## NeighborhoodNWAmes   -1.258e+04  7.917e+03  -1.589 0.112187
## NeighborhoodOldTown  -6.290e+03  8.288e+03  -0.759 0.448053
## NeighborhoodSawyer   -4.577e+02  8.012e+03  -0.057 0.954453
## NeighborhoodSawyerW  -2.662e+03  7.749e+03  -0.344 0.731222
## NeighborhoodSomerst   3.276e+03  7.390e+03   0.443 0.657604
## NeighborhoodStoneBr   3.871e+04  8.425e+03   4.594 4.76e-06 ***
## NeighborhoodSWISU    -1.005e+03  9.538e+03  -0.105 0.916116
## NeighborhoodTimber   -5.250e+03  8.134e+03  -0.645 0.518764
## NeighborhoodVeenker   3.868e+03  1.045e+04   0.370 0.711395
## Condition1Feedr       3.211e+03  4.957e+03   0.648 0.517256
## Condition1Norm        1.297e+04  4.125e+03   3.145 0.001697 **
## Condition1PosA        3.563e+03  1.017e+04   0.350 0.726100
## Condition1PosN        8.190e+03  7.493e+03   1.093 0.274595
```

```
## Condition1RRAe          -1.520e+04  8.915e+03  -1.705 0.088363 .
## Condition1RRAn           1.410e+04  6.919e+03   2.039 0.041695 *
## Condition1RRNe          -9.543e+03  1.840e+04  -0.519 0.604012
## Condition1RRNn           1.708e+04  1.273e+04   1.342 0.179945
## Condition2Feedr         -1.138e+04  2.234e+04  -0.509 0.610503
## Condition2Norm          -1.536e+04  1.919e+04  -0.801 0.423479
## Condition2PosA           5.404e+04  3.287e+04   1.644 0.100401
## Condition2PosN          -2.348e+05  2.734e+04  -8.591  < 2e-16 ***
## Condition2RRAe          -4.215e+04  4.028e+04  -1.046 0.295589
## Condition2RRAn          -1.235e+04  3.130e+04  -0.395 0.693224
## Condition2RRNn          -9.396e+03  2.625e+04  -0.358 0.720437
## BldgType                 6.882e+03  1.065e+03   6.465 1.42e-10 ***
## HouseStyle1.5Unf         1.102e+04  7.520e+03   1.465 0.143110
## HouseStyle1Story         1.152e+04  3.666e+03   3.141 0.001722 **
## HouseStyle2.5Fin        -7.309e+03  9.942e+03  -0.735 0.462383
## HouseStyle2.5Unf        -1.811e+04  8.585e+03  -2.109 0.035100 *
## HouseStyle2Story        -5.564e+03  3.190e+03  -1.744 0.081400 .
## HouseStyleSFoyer        -3.469e+02  5.769e+03  -0.060 0.952050
## HouseStyleSLvl           4.605e+03  4.825e+03   0.955 0.339998
## OverallQual              8.599e+03  1.007e+03   8.542  < 2e-16 ***
## OverallCond              5.759e+03  7.792e+02   7.390 2.59e-13 ***
## YearBuilt                3.357e+02  6.637e+01   5.058 4.83e-07 ***
## RoofMatlCompShg          6.964e+05  3.355e+04  20.759  < 2e-16 ***
## RoofMatlMembran          7.471e+05  4.314e+04  17.320  < 2e-16 ***
## RoofMatlMetal            7.160e+05  4.251e+04  16.843  < 2e-16 ***
## RoofMatlRoll             6.854e+05  4.179e+04  16.400  < 2e-16 ***
## RoofMatlTar&Grv          6.860e+05  3.454e+04  19.862  < 2e-16 ***
## RoofMatlWdShake          6.871e+05  3.588e+04  19.149  < 2e-16 ***
## RoofMatlWdShngl          7.759e+05  3.502e+04  22.156  < 2e-16 ***
## Exterior1stAsphShn      -6.506e+03  2.619e+04  -0.248 0.803833
## Exterior1stBrkComm      -9.107e+02  1.923e+04  -0.047 0.962236
## Exterior1stBrkFace       1.425e+04  7.106e+03   2.005 0.045194 *
## Exterior1stCBlock        4.518e+03  2.569e+04   0.176 0.860423
## Exterior1stCemntBd       1.048e+04  7.470e+03   1.402 0.161046
## Exterior1stHdBoard      -3.346e+03  6.484e+03  -0.516 0.605965
## Exterior1stImStucc      -1.022e+04  2.589e+04  -0.395 0.693005
## Exterior1stMetalSd       4.819e+03  6.272e+03   0.768 0.442419
## Exterior1stPlywood      -7.035e+03  6.774e+03  -1.039 0.299215
## Exterior1stStone        -7.497e+03  2.012e+04  -0.373 0.709461
## Exterior1stStucco        2.850e+03  7.930e+03   0.359 0.719328
## Exterior1stVinylSd      -3.054e+02  6.327e+03  -0.048 0.961508
## Exterior1stWd Sdng       5.941e+02  6.264e+03   0.095 0.924457
## Exterior1stWdShing       9.918e+02  7.793e+03   0.127 0.898747
## MasVnrTypeBrkFace        6.291e+03  6.857e+03   0.917 0.359098
## MasVnrTypeNone           1.250e+04  6.908e+03   1.809 0.070623 .
## MasVnrTypeStone          1.174e+04  7.244e+03   1.620 0.105380
## MasVnrArea               3.170e+01  5.811e+00   5.455 5.83e-08 ***
## ExterQual                4.908e+03  2.126e+03   2.309 0.021093 *
## ExterCond               -3.254e+03  2.106e+03  -1.545 0.122616
## FoundationCBlock         3.578e+03  3.064e+03   1.168 0.243147
## FoundationPConc          5.308e+03  3.415e+03   1.555 0.120294
## FoundationSlab           1.740e+04  8.467e+03   2.055 0.040088 *
## FoundationStone          3.448e+03  1.059e+04   0.326 0.744740
## FoundationWood          -3.373e+04  1.542e+04  -2.187 0.028904 *
## BsmtQual                 3.584e+03  1.693e+03   2.117 0.034427 *
```

```
## BsmtCond                    -6.477e+03  2.073e+03  -3.124 0.001823 **
## BsmtExposure                 5.466e+03  8.449e+02   6.469 1.38e-10 ***
## BsmtFinSF1                   3.722e+01  4.426e+00   8.409  < 2e-16 ***
## BsmtFinSF2                   2.501e+01  5.787e+00   4.322 1.66e-05 ***
## BsmtUnfSF                    1.601e+01  4.304e+00   3.721 0.000207 ***
## X1stFlrSF                    4.845e+01  5.199e+00   9.320  < 2e-16 ***
## X2ndFlrSF                    6.463e+01  5.154e+00  12.540  < 2e-16 ***
## HalfBath                     2.613e+03  1.910e+03   1.368 0.171388
## BedroomAbvGr                -6.339e+03  1.324e+03  -4.789 1.87e-06 ***
## KitchenAbvGr                -1.068e+04  4.240e+03  -2.519 0.011882 *
## KitchenQual                  7.428e+03  1.609e+03   4.617 4.27e-06 ***
## TotRmsAbvGrd                 3.558e+03  9.457e+02   3.763 0.000175 ***
## Functional                   5.535e+03  1.088e+03   5.089 4.13e-07 ***
## Fireplaces                   6.279e+03  2.254e+03   2.786 0.005417 **
## FireplaceQu                 -1.781e+03  8.136e+02  -2.189 0.028777 *
## GarageTypeAttchd             1.146e+04  1.106e+04   1.037 0.299932
## GarageTypeBasment            1.794e+04  1.273e+04   1.409 0.159077
## GarageTypeBuiltIn            1.326e+04  1.154e+04   1.149 0.250958
## GarageTypeCarPort            1.048e+04  1.410e+04   0.743 0.457468
## GarageTypeDetchd             1.624e+04  1.099e+04   1.478 0.139714
## GarageTypeNoGarage           2.827e+04  1.193e+04   2.370 0.017926 *
## GarageCars                   4.372e+03  2.284e+03   1.914 0.055779 .
## GarageArea                   1.633e+01  7.612e+00   2.146 0.032065 *
## WoodDeckSF                   1.215e+01  5.944e+00   2.044 0.041175 *
## X3SsnPorch                   4.279e+01  2.323e+01   1.842 0.065693 .
## ScreenPorch                  4.074e+01  1.256e+01   3.243 0.001212 **
## PoolQC                       1.855e+04  2.921e+03   6.352 2.92e-10 ***
## FenceGdWo                    1.044e+04  4.955e+03   2.106 0.035398 *
## FenceMnPrv                   1.152e+04  4.035e+03   2.854 0.004389 **
## FenceMnWw                    7.350e+03  8.382e+03   0.877 0.380726
## FenceNoFence                 9.794e+03  3.685e+03   2.658 0.007957 **
## MiscFeatureNoMiscFeature     1.035e+03  2.464e+04   0.042 0.966504
## MiscFeatureOthr              1.367e+04  3.036e+04   0.450 0.652552
## MiscFeatureShed              3.158e+03  2.489e+04   0.127 0.899049
## MiscFeatureTenC             -7.769e+04  3.635e+04  -2.137 0.032772 *
## MoSold                      -6.348e+02  2.461e+02  -2.580 0.009996 **
## SaleConditionAdjLand         2.096e+04  1.331e+04   1.574 0.115640
## SaleConditionAlloca          5.207e+03  8.443e+03   0.617 0.537499
## SaleConditionFamily          1.099e+03  6.177e+03   0.178 0.858832
## SaleConditionNormal          7.750e+03  2.708e+03   2.862 0.004280 **
## SaleConditionPartial         2.474e+04  3.823e+03   6.472 1.36e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 24170 on 1321 degrees of freedom
## Multiple R-squared:  0.9162, Adjusted R-squared:  0.9075
## F-statistic: 104.7 on 138 and 1321 DF,  p-value: < 2.2e-16
```

```
summary(myLm4)
```

```
##
## Call:
## lm(formula = SalePrice ~ MSSubClass + MSZoning + LotFrontage +
##     LotArea + Alley + LotShape + LandContour + LandSlope + Neighborhood +
##     BldgType + HouseStyle + OverallQual + OverallCond + YearBuilt +
##     YearRemodAdd + RoofStyle + Exterior1st + Exterior2nd + MasVnrType +
```

```
##       MasVnrArea + ExterQual + Foundation + BsmtQual + BsmtCond +
##       BsmtExposure + BsmtFinType1 + BsmtFinSF1 + BsmtFinType2 +
##       BsmtUnfSF + TotalBsmtSF + HeatingQC + CentralAir + X1stFlrSF +
##       X2ndFlrSF + GrLivArea + BsmtFullBath + FullBath + HalfBath +
##       BedroomAbvGr + KitchenAbvGr + KitchenQual + TotRmsAbvGrd +
##       Fireplaces + FireplaceQu + GarageType + GarageYrBlt + GarageFinish +
##       GarageCars + GarageArea + GarageQual + GarageCond + PavedDrive +
##       WoodDeckSF + OpenPorchSF, data = Train)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -309513  -13454     -66   12063  242906
##
## Coefficients: (1 not defined because of singularities)
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)         -4.348e+05  2.040e+05  -2.132 0.033197 *
## MSSubClass          -2.233e+01  4.973e+01  -0.449 0.653441
## MSZoningFV           3.862e+04  1.452e+04   2.660 0.007905 **
## MSZoningRH           3.843e+04  1.445e+04   2.660 0.007906 **
## MSZoningRL           3.426e+04  1.204e+04   2.846 0.004497 **
## MSZoningRM           2.893e+04  1.125e+04   2.572 0.010220 *
## LotFrontage         -9.088e+01  4.558e+01  -1.994 0.046362 *
## LotArea              4.508e-01  1.098e-01   4.107 4.26e-05 ***
## AlleyNoAlley        -2.223e+03  5.154e+03  -0.431 0.666362
## AlleyPave           -9.861e+02  7.438e+03  -0.133 0.894547
## LotShapeIR2          1.114e+04  5.155e+03   2.160 0.030926 *
## LotShapeIR3         -2.637e+04  1.046e+04  -2.521 0.011825 *
## LotShapeReg          1.048e+03  1.908e+03   0.549 0.583000
## LandContourHLS       2.148e+04  6.273e+03   3.424 0.000635 ***
## LandContourLow       1.394e+04  7.639e+03   1.826 0.068141 .
## LandContourLvl       1.451e+04  4.448e+03   3.262 0.001134 **
## LandSlope            1.041e+03  4.163e+03   0.250 0.802567
## NeighborhoodBlueste  4.490e+03  2.349e+04   0.191 0.848454
## NeighborhoodBrDale   2.072e+04  1.298e+04   1.595 0.110849
## NeighborhoodBrkSide  4.700e+03  1.121e+04   0.419 0.674990
## NeighborhoodClearCr -6.298e+03  1.126e+04  -0.560 0.575872
## NeighborhoodCollgCr -6.119e+03  8.901e+03  -0.687 0.491902
## NeighborhoodCrawfor  1.954e+04  1.043e+04   1.874 0.061118 .
## NeighborhoodEdwards -1.471e+04  9.751e+03  -1.508 0.131702
## NeighborhoodGilbert -7.926e+03  9.412e+03  -0.842 0.399884
## NeighborhoodIDOTRR  -2.861e+03  1.282e+04  -0.223 0.823457
## NeighborhoodMeadowV  3.650e+03  1.377e+04   0.265 0.790937
## NeighborhoodMitchel -8.308e+03  9.958e+03  -0.834 0.404223
## NeighborhoodNAmes   -9.640e+03  9.528e+03  -1.012 0.311850
## NeighborhoodNoRidge  4.059e+04  1.027e+04   3.951 8.20e-05 ***
## NeighborhoodNPkVill  7.944e+03  1.761e+04   0.451 0.651998
## NeighborhoodNridgHt  4.494e+04  9.082e+03   4.948 8.47e-07 ***
## NeighborhoodNWAmes  -1.346e+04  9.762e+03  -1.379 0.168202
## NeighborhoodOldTown -7.633e+03  1.164e+04  -0.656 0.512092
## NeighborhoodSawyer  -6.089e+03  9.970e+03  -0.611 0.541511
## NeighborhoodSawyerW -3.566e+03  9.594e+03  -0.372 0.710156
## NeighborhoodSomerst  9.551e+03  1.100e+04   0.868 0.385551
## NeighborhoodStoneBr  4.976e+04  1.038e+04   4.795 1.81e-06 ***
## NeighborhoodSWISU   -5.761e+03  1.197e+04  -0.481 0.630455
## NeighborhoodTimber  -5.339e+03  1.001e+04  -0.533 0.593980
```

```
## NeighborhoodVeenker    9.728e+03  1.278e+04    0.761 0.446608
## BldgType                9.760e+03  2.028e+03    4.813 1.66e-06 ***
## HouseStyle1.5Unf        1.143e+04  9.196e+03    1.243 0.214140
## HouseStyle1Story        2.142e+04  4.766e+03    4.494 7.60e-06 ***
## HouseStyle2.5Fin       -1.616e+04  1.461e+04   -1.106 0.269101
## HouseStyle2.5Unf       -1.139e+04  1.040e+04   -1.095 0.273777
## HouseStyle2Story       -1.083e+04  3.972e+03   -2.726 0.006489 **
## HouseStyleSFoyer        5.688e+03  7.071e+03    0.804 0.421341
## HouseStyleSLvl          6.552e+03  5.977e+03    1.096 0.273221
## OverallQual             9.862e+03  1.214e+03    8.124 1.03e-15 ***
## OverallCond             4.700e+03  1.007e+03    4.669 3.33e-06 ***
## YearBuilt               1.176e+02  9.310e+01    1.263 0.206650
## YearRemodAdd           -1.344e+01  6.634e+01   -0.203 0.839443
## RoofStyleGable         -7.596e+02  9.709e+03   -0.078 0.937656
## RoofStyleGambrel       -1.196e+03  1.380e+04   -0.087 0.930980
## RoofStyleHip            4.664e+03  9.925e+03    0.470 0.638497
## RoofStyleMansard        1.506e+03  1.577e+04    0.096 0.923887
## RoofStyleShed          -1.143e+04  2.367e+04   -0.483 0.629285
## Exterior1stAsphShn     -1.668e+04  4.088e+04   -0.408 0.683337
## Exterior1stBrkComm     -3.652e+04  3.315e+04   -1.102 0.270771
## Exterior1stBrkFace      1.167e+03  1.483e+04    0.079 0.937320
## Exterior1stCBlock      -2.218e+03  3.166e+04   -0.070 0.944169
## Exterior1stCemntBd     -9.529e+02  2.305e+04   -0.041 0.967024
## Exterior1stHdBoard     -1.837e+04  1.486e+04   -1.236 0.216612
## Exterior1stImStucc     -7.058e+04  3.450e+04   -2.046 0.040999 *
## Exterior1stMetalSd     -1.415e+04  1.707e+04   -0.829 0.407068
## Exterior1stPlywood     -1.655e+04  1.458e+04   -1.135 0.256683
## Exterior1stStone       -2.157e+04  2.735e+04   -0.789 0.430410
## Exterior1stStucco      -6.050e+03  1.652e+04   -0.366 0.714281
## Exterior1stVinylSd     -2.187e+04  1.557e+04   -1.404 0.160483
## Exterior1stWd Sdng     -1.959e+04  1.434e+04   -1.366 0.172325
## Exterior1stWdShing     -1.023e+04  1.566e+04   -0.653 0.513629
## Exterior2ndAsphShn      2.342e+04  2.714e+04    0.863 0.388400
## Exterior2ndBrk Cmn      2.320e+04  2.469e+04    0.940 0.347588
## Exterior2ndBrkFace      1.559e+04  1.581e+04    0.986 0.324154
## Exterior2ndCBlock             NA         NA       NA       NA
## Exterior2ndCmentBd      8.882e+03  2.298e+04    0.387 0.699178
## Exterior2ndHdBoard      1.332e+04  1.454e+04    0.916 0.359600
## Exterior2ndImStucc      4.685e+04  1.698e+04    2.759 0.005875 **
## Exterior2ndMetalSd      1.635e+04  1.699e+04    0.962 0.336041
## Exterior2ndOther        9.358e+03  3.425e+04    0.273 0.784700
## Exterior2ndPlywood      1.420e+04  1.407e+04    1.010 0.312833
## Exterior2ndStone        3.977e+03  2.045e+04    0.195 0.845781
## Exterior2ndStucco      -8.870e+03  1.622e+04   -0.547 0.584471
## Exterior2ndVinylSd      2.193e+04  1.533e+04    1.430 0.152888
## Exterior2ndWd Sdng      1.853e+04  1.417e+04    1.307 0.191287
## Exterior2ndWd Shng      3.541e+03  1.491e+04    0.238 0.812267
## MasVnrTypeBrkFace       1.039e+04  8.263e+03    1.257 0.209020
## MasVnrTypeNone          1.560e+04  8.315e+03    1.877 0.060786 .
## MasVnrTypeStone         1.584e+04  8.773e+03    1.805 0.071232 .
## MasVnrArea              2.346e+01  7.017e+00    3.343 0.000852 ***
## ExterQual               4.917e+03  2.547e+03    1.931 0.053753 .
## FoundationCBlock        6.449e+03  3.833e+03    1.683 0.092701 .
## FoundationPConc         5.074e+03  4.196e+03    1.209 0.226776
## FoundationSlab          2.451e+04  1.031e+04    2.377 0.017602 *
```

```
## FoundationStone       7.338e+03  1.321e+04   0.556 0.578636
## FoundationWood       -1.152e+04  1.843e+04  -0.625 0.531997
## BsmtQual              7.189e+03  2.069e+03   3.475 0.000528 ***
## BsmtCond             -3.457e+03  2.562e+03  -1.349 0.177466
## BsmtExposure          6.931e+03  1.038e+03   6.677 3.57e-11 ***
## BsmtFinType1          1.290e+03  6.190e+02   2.085 0.037293 *
## BsmtFinSF1            1.096e+00  8.828e+00   0.124 0.901193
## BsmtFinType2         -6.156e+02  1.591e+03  -0.387 0.698822
## BsmtUnfSF            -4.263e+00  8.720e+00  -0.489 0.624959
## TotalBsmtSF           6.851e+00  9.827e+00   0.697 0.485856
## HeatingQC             4.478e+02  1.157e+03   0.387 0.698784
## CentralAirY          -1.929e+03  4.269e+03  -0.452 0.651357
## X1stFlrSF            -3.065e+00  2.216e+01  -0.138 0.890045
## X2ndFlrSF             2.137e+01  2.129e+01   1.004 0.315539
## GrLivArea             4.126e+01  2.168e+01   1.903 0.057207 .
## BsmtFullBath          5.018e+03  2.266e+03   2.214 0.026985 *
## FullBath              5.630e+03  2.647e+03   2.127 0.033603 *
## HalfBath              5.637e+03  2.560e+03   2.202 0.027845 *
## BedroomAbvGr         -5.025e+03  1.612e+03  -3.117 0.001869 **
## KitchenAbvGr         -5.968e+03  5.206e+03  -1.146 0.251855
## KitchenQual           7.598e+03  2.004e+03   3.791 0.000157 ***
## TotRmsAbvGrd          4.009e+03  1.149e+03   3.489 0.000501 ***
## Fireplaces            4.562e+03  2.706e+03   1.686 0.092063 .
## FireplaceQu          -3.397e+02  9.817e+02  -0.346 0.729393
## GarageTypeAttchd      1.805e+04  1.347e+04   1.340 0.180372
## GarageTypeBasment     2.375e+04  1.541e+04   1.541 0.123485
## GarageTypeBuiltIn     1.601e+04  1.406e+04   1.139 0.254835
## GarageTypeCarPort     1.795e+04  1.725e+04   1.041 0.298067
## GarageTypeDetchd      1.998e+04  1.343e+04   1.488 0.137035
## GarageTypeNoGarage    6.014e+04  1.870e+04   3.216 0.001331 **
## GarageYrBlt          -1.701e+01  7.328e+01  -0.232 0.816477
## GarageFinish          1.788e+03  1.496e+03   1.195 0.232349
## GarageCars            1.318e+04  2.755e+03   4.783 1.92e-06 ***
## GarageArea           -4.334e+00  9.693e+00  -0.447 0.654838
## GarageQual            1.024e+04  4.565e+03   2.243 0.025041 *
## GarageCond           -1.581e+03  4.629e+03  -0.342 0.732776
## PavedDrive            5.349e+02  2.014e+03   0.266 0.790603
## WoodDeckSF            9.707e+00  7.075e+00   1.372 0.170310
## OpenPorchSF          -1.309e+00  1.382e+01  -0.095 0.924536
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 29420 on 1327 degrees of freedom
## Multiple R-squared:  0.8753, Adjusted R-squared:  0.8629
## F-statistic: 70.56 on 132 and 1327 DF,  p-value: < 2.2e-16
```

Some coefficients not defined due to singularities.
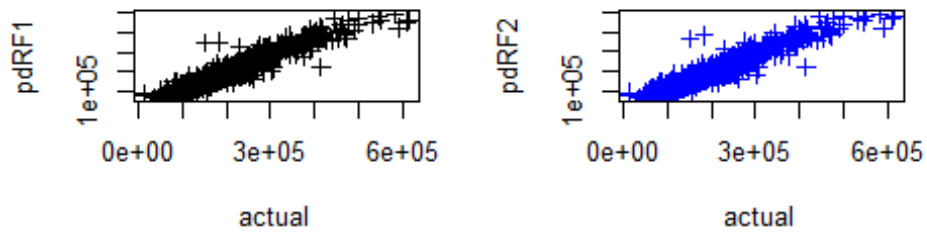
Prediction with Random Forest

```
pdRF1<-predict(RF1,interval='prediction',newdata=Test)
pdRF2<-predict(RF2,interval='prediction',newdata=Test)
pdRF3<-predict(RF3,interval='prediction',newdata=Test)
pdRF4<-predict(RF4,interval='prediction',newdata=Test)


par(mfrow=c(2,2))
plot(actual,pdRF1,pch=3, main='Prediction VS Actual, all var')
```
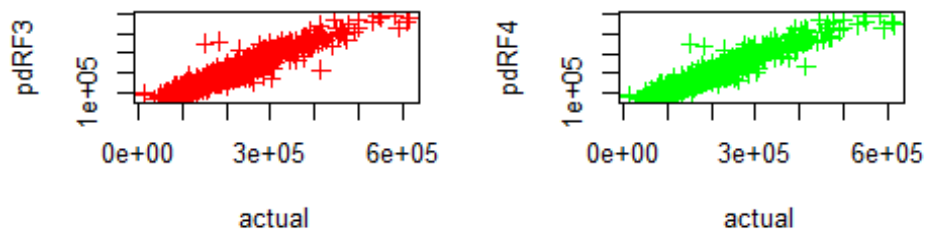
```
plot(actual,pdRF2,pch=3, col='blue',main='Prediction VS Actual, FowardSelect')
plot(actual,pdRF3,pch=3, col='red',main='Prediction VS Actual, Backwards Elim')
plot(actual,pdRF4,pch=3, col='green',main='Prediction VS Actual, Boruta')
```

Prediction VS Actual, all varPrediction VS Actual, FowardSe

redection VS Actual, Backwards   Prediction VS Actual, Boruta


```
RMSLE(pdRF1,actual)
```

```
## [1] 0.1448963
```

```
RMSLE(pdRF2,actual)
```

```
## [1] 0.1446436
```

```
RMSLE(pdRF3,actual)
```

```
## [1] 0.1509232
```

```
RMSLE(pdRF4,actual)
```

```
## [1] 0.1443035
```

```
RMSE(pdRF1,actual)
```

```
## [1] 23507.14
```

```
RMSE(pdRF2,actual)
```

```
## [1] 23668.95
```

```
RMSE(pdRF3,actual)
```

```
## [1] 24408.31
```

```
RMSE(pdRF4,actual)
```

```
## [1] 23437.68
```

SV Regression

model <- svm(Y ~ X, data)

```r
SV1<-svm(SalePrice~.,data=Train, cost=4)


SV2<-svm(SalePrice ~ OverallQual + GrLivArea + Neighborhood + BsmtFinSF1 +
    RoofMatl + MSSubClass + BsmtExposure + KitchenQual + Condition2 +
    SaleCondition + LotArea + YearBuilt + OverallCond + MasVnrArea +
    PoolQC + BedroomAbvGr + GarageCars + MasVnrType + TotalBsmtSF +
    BldgType + Functional + ExterQual + BsmtCond + Condition1 +
    Exterior1st + MoSold + GarageCond + ScreenPorch + LandContour +
    LowQualFinSF + LotConfig + LotFrontage + TotRmsAbvGrd + KitchenAbvGr +
    WoodDeckSF + Street + GarageArea + LotShape + BsmtQual +
    Fireplaces + FireplaceQu + PoolArea + RoofStyle + BsmtFinSF2 +
    Utilities + ExterCond, data=Train, cost=4)


SV3<-svm(SalePrice ~ LotFrontage + LotArea + Street + LotShape + LandContour +
    Utilities + LotConfig + Neighborhood + Condition1 + Condition2 +
    BldgType + HouseStyle + OverallQual + OverallCond + YearBuilt +
    RoofMatl + Exterior1st + MasVnrType + MasVnrArea + ExterQual +
    ExterCond + Foundation + BsmtQual + BsmtCond + BsmtExposure +
    BsmtFinSF1 + BsmtFinSF2 + BsmtUnfSF + X1stFlrSF + X2ndFlrSF +
    HalfBath + BedroomAbvGr + KitchenAbvGr + KitchenQual + TotRmsAbvGrd +
    Functional + Fireplaces + FireplaceQu + GarageType + GarageCars +
    GarageArea + WoodDeckSF + X3SsnPorch + ScreenPorch + PoolQC +
    Fence + MiscFeature + MoSold + SaleCondition, data=Train, cost=4)

SV4<-
svm(SalePrice~MSSubClass+MSZoning+LotFrontage+LotArea+Alley+LotShape+LandContour+LandSlope+Neighborhood+
BldgType+HouseStyle+OverallQual+OverallCond+YearBuilt+YearRemodAdd+RoofStyle+Exterior1st+Exterior2nd+
MasVnrType+MasVnrArea+ExterQual+Foundation+BsmtQual+BsmtCond+BsmtExposure+BsmtFinType1+BsmtFinSF1+
BsmtFinType2+BsmtUnfSF+TotalBsmtSF+HeatingQC+CentralAir+X1stFlrSF+X2ndFlrSF+GrLivArea+BsmtFullBath+
FullBath+HalfBath+BedroomAbvGr+KitchenAbvGr+KitchenQual+TotRmsAbvGrd+Fireplaces+FireplaceQu+GarageType+
GarageYrBlt+GarageFinish+GarageCars+GarageArea+GarageQual+GarageCond+PavedDrive+WoodDeckSF+OpenPorchSF, data=Train, cost=4)


pdSV1<-predict(SV1,newdata=Test[,-80])
pdSV2<-predict(SV2,newdata=Test[,-80])
pdSV3<-predict(SV3,newdata=Test[,-80])
pdSV4<-predict(SV4,newdata=Test[,-80])

summary(SV1)

##
## Call:
## svm(formula = SalePrice ~ ., data = Train, cost = 4)
```
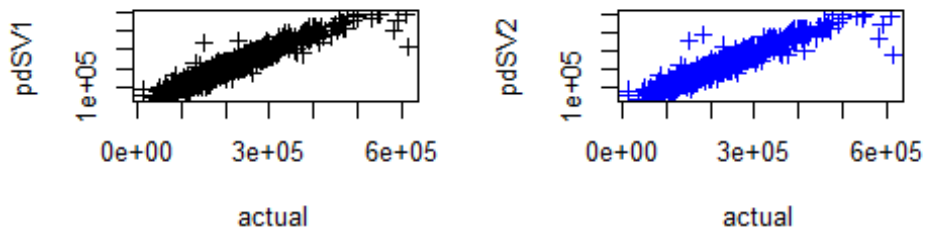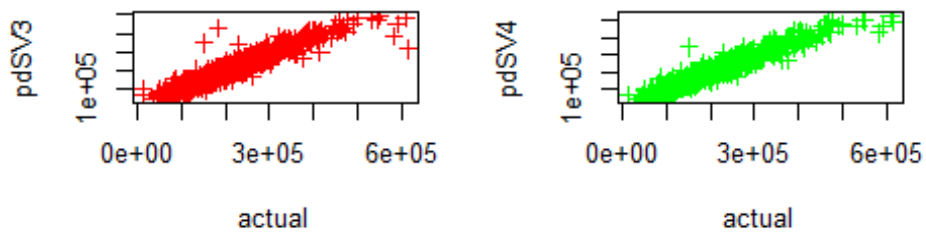
```
## 
## 
## Parameters:
##    SVM-Type:  eps-regression
##  SVM-Kernel:  radial
##        cost:  4
##       gamma:  0.004878049
##     epsilon:  0.1
## 
## 
## Number of Support Vectors:  814

par(mfrow=c(2,2))
plot(actual,pdSV1,pch=3, main='Prediction VS Actual, all var')
plot(actual,pdSV2,pch=3, col='blue',main='Prediction VS Actual, FowardSelect')
plot(actual,pdSV3,pch=3, col='red',main='Prediction VS Actual, Backwards Elim')
plot(actual,pdSV4,pch=3, col='green',main='Prediction VS Actual, Boruta')
```



```
RMSLE(pdSV1,actual)

## [1] 0.1287456

RMSLE(pdSV2,actual)

## [1] 0.1323565

RMSLE(pdSV3,actual)

## [1] 0.134205

RMSLE(pdSV4,actual)

## [1] 0.1299854
```

```
RMSE(pdSV1,actual)
```

[1] 21198.8

```
RMSE(pdRF2,actual)
```

[1] 23668.95

```
RMSE(pdRF3,actual)
```

[1] 24408.31

```
RMSE(pdRF4,actual)
```

[1] 23437.68

Looking at below comparison, overall SVM > Random Forest > OLS.

It looks like the SVM is showing the best result oddly enough with all variables then followed by Boruta selection. This could be because the dataset has many none normal distributions, has colinearity issues, and variance is not consistent and thus is not perfect candidate for using linear regression. I will transform some skewed items to log scale and try linear fit again to fine tune and also will tune SVM and Random forest to acheive better results.

Model 1 RMLSE [1] 0.1837928 VS [1] 0.1436806 [1] 0.1287456 RMSE [1] 29630.08 VS [1] 23335.57 [1] 21198.8

Model 2 [1] 0.1636028 VS [1] 0.1446042 [1] 0.1323565 [1] 28584.97 VS [1] 23778.01 [1] 23668.95

Model 3 [1] 0.1769506 VS [1] 0.1508996 [1] 0.134205 [1] 28721.35 VS [1] 24579.31 [1] 24408.31

Model 4 [1] 0.1735936 VS [1] 0.1436703 [1] 0.1299854 [1] 27252.57 VS [1] 23337.88 1] 23437.68