Data Analysis - Ames House Prices

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The Dataset

```
library(faraway)
library(dplyr)
library(psych)
library(corrplot)
library(ggplot2)
library(ggcorrplot)
library(lares)
library(reshape2)

housing_data = read.csv("dataset\\AmesHousing.csv")

summary(housing_data)
```

```
##      Order             PID             MS.SubClass      MS.Zoning
##  Min.   :   1.0   Min.   :5.263e+08   Min.   : 20.00   Length:2930
##  1st Qu.: 733.2   1st Qu.:5.285e+08   1st Qu.: 20.00   Class :character
##  Median :1465.5   Median :5.355e+08   Median : 50.00   Mode  :character
##  Mean   :1465.5   Mean   :7.145e+08   Mean   : 57.39
##  3rd Qu.:2197.8   3rd Qu.:9.072e+08   3rd Qu.: 70.00
##  Max.   :2930.0   Max.   :1.007e+09   Max.   :190.00
##
##   Lot.Frontage       Lot.Area         Street             Alley
##  Min.   : 21.00   Min.   :  1300   Length:2930        Length:2930
##  1st Qu.: 58.00   1st Qu.:  7440   Class :character   Class :character
##  Median : 68.00   Median :  9436   Mode  :character   Mode  :character
##  Mean   : 69.22   Mean   : 10148
##  3rd Qu.: 80.00   3rd Qu.: 11555
##  Max.   :313.00   Max.   :215245
##  NA's   :490
##   Lot.Shape         Land.Contour        Utilities          Lot.Config
##  Length:2930        Length:2930        Length:2930        Length:2930
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
##   Land.Slope        Neighborhood       Condition.1        Condition.2
##  Length:2930        Length:2930        Length:2930        Length:2930
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
##   Bldg.Type         House.Style         Overall.Qual     Overall.Cond
##  Length:2930        Length:2930        Min.   : 1.000   Min.   :1.000
##  Class :character   Class :character   1st Qu.: 5.000   1st Qu.:5.000
##  Mode  :character   Mode  :character   Median : 6.000   Median :5.000
##                                        Mean   : 6.095   Mean   :5.563
##                                        3rd Qu.: 7.000   3rd Qu.:6.000
##                                        Max.   :10.000   Max.   :9.000
##
##    Year.Built   Year.Remod.Add  Roof.Style         Roof.Matl
##  Min.   :1872   Min.   :1950   Length:2930        Length:2930
##  1st Qu.:1954   1st Qu.:1965   Class :character   Class :character
##  Median :1973   Median :1993   Mode  :character   Mode  :character
##  Mean   :1971   Mean   :1984
##  3rd Qu.:2001   3rd Qu.:2004
##  Max.   :2010   Max.   :2010
##
##  Exterior.1st       Exterior.2nd       Mas.Vnr.Type        Mas.Vnr.Area
##  Length:2930        Length:2930        Length:2930        Min.   :   0.0
##  Class :character   Class :character   Class :character   1st Qu.:   0.0
##  Mode  :character   Mode  :character   Mode  :character   Median :   0.0
```

```
##                                                    Mean   : 101.9
##                                                    3rd Qu.: 164.0
##                                                    Max.   :1600.0
##                                                    NA's   :23
##   Exter.Qual         Exter.Cond         Foundation         Bsmt.Qual
##  Length:2930        Length:2930        Length:2930        Length:2930
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
##   Bsmt.Cond         Bsmt.Exposure      BsmtFin.Type.1      BsmtFin.SF.1
##  Length:2930        Length:2930        Length:2930        Min.   :   0.0
##  Class :character   Class :character   Class :character   1st Qu.:   0.0
##  Mode  :character   Mode  :character   Mode  :character   Median : 370.0
##                                                           Mean   : 442.6
##                                                           3rd Qu.: 734.0
##                                                           Max.   :5644.0
##                                                           NA's   :1
##  BsmtFin.Type.2      BsmtFin.SF.2      Bsmt.Unf.SF     Total.Bsmt.SF
##  Length:2930        Min.   :   0.00   Min.   :   0.0   Min.   :   0
##  Class :character   1st Qu.:   0.00   1st Qu.: 219.0   1st Qu.: 793
##  Mode  :character   Median :   0.00   Median : 466.0   Median : 990
##                     Mean   :  49.72   Mean   : 559.3   Mean   :1052
##                     3rd Qu.:   0.00   3rd Qu.: 802.0   3rd Qu.:1302
##                     Max.   :1526.00   Max.   :2336.0   Max.   :6110
##                     NA's   :1         NA's   :1        NA's   :1
##    Heating           Heating.QC        Central.Air         Electrical
##  Length:2930        Length:2930        Length:2930        Length:2930
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
##   X1st.Flr.SF      X2nd.Flr.SF     Low.Qual.Fin.SF     Gr.Liv.Area
##  Min.   : 334.0   Min.   :   0.0   Min.   :   0.000   Min.   : 334
##  1st Qu.: 876.2   1st Qu.:   0.0   1st Qu.:   0.000   1st Qu.:1126
##  Median :1084.0   Median :   0.0   Median :   0.000   Median :1442
##  Mean   :1159.6   Mean   : 335.5   Mean   :   4.677   Mean   :1500
##  3rd Qu.:1384.0   3rd Qu.: 703.8   3rd Qu.:   0.000   3rd Qu.:1743
##  Max.   :5095.0   Max.   :2065.0   Max.   :1064.000   Max.   :5642
##
##  Bsmt.Full.Bath   Bsmt.Half.Bath      Full.Bath       Half.Bath
##  Min.   :0.0000   Min.   :0.00000   Min.   :0.000   Min.   :0.0000
##  1st Qu.:0.0000   1st Qu.:0.00000   1st Qu.:1.000   1st Qu.:0.0000
##  Median :0.0000   Median :0.00000   Median :2.000   Median :0.0000
##  Mean   :0.4314   Mean   :0.06113   Mean   :1.567   Mean   :0.3795
##  3rd Qu.:1.0000   3rd Qu.:0.00000   3rd Qu.:2.000   3rd Qu.:1.0000
##  Max.   :3.0000   Max.   :2.00000   Max.   :4.000   Max.   :2.0000
##  NA's   :2        NA's   :2
```

```
##  Bedroom.AbvGr   Kitchen.AbvGr   Kitchen.Qual       TotRms.AbvGrd
##  Min.   :0.000   Min.   :0.000   Length:2930        Min.   : 2.000
##  1st Qu.:2.000   1st Qu.:1.000   Class :character   1st Qu.: 5.000
##  Median :3.000   Median :1.000   Mode  :character   Median : 6.000
##  Mean   :2.854   Mean   :1.044                      Mean   : 6.443
##  3rd Qu.:3.000   3rd Qu.:1.000                      3rd Qu.: 7.000
##  Max.   :8.000   Max.   :3.000                      Max.   :15.000
##
##   Functional          Fireplaces     Fireplace.Qu       Garage.Type
##  Length:2930        Min.   :0.0000   Length:2930        Length:2930
##  Class :character   1st Qu.:0.0000   Class :character   Class :character
##  Mode  :character   Median :1.0000   Mode  :character   Mode  :character
##                     Mean   :0.5993
##                     3rd Qu.:1.0000
##                     Max.   :4.0000
##
##  Garage.Yr.Blt  Garage.Finish       Garage.Cars     Garage.Area
##  Min.   :1895   Length:2930        Min.   :0.000   Min.   :   0.0
##  1st Qu.:1960   Class :character   1st Qu.:1.000   1st Qu.: 320.0
##  Median :1979   Mode  :character   Median :2.000   Median : 480.0
##  Mean   :1978                      Mean   :1.767   Mean   : 472.8
##  3rd Qu.:2002                      3rd Qu.:2.000   3rd Qu.: 576.0
##  Max.   :2207                      Max.   :5.000   Max.   :1488.0
##  NA's   :159                       NA's   :1       NA's   :1
##  Garage.Qual        Garage.Cond        Paved.Drive         Wood.Deck.SF
##  Length:2930        Length:2930        Length:2930        Min.   :   0.00
##  Class :character   Class :character   Class :character   1st Qu.:   0.00
##  Mode  :character   Mode  :character   Mode  :character   Median :   0.00
##                                                           Mean   :  93.75
##                                                           3rd Qu.: 168.00
##                                                           Max.   :1424.00
##
##  Open.Porch.SF    Enclosed.Porch     X3Ssn.Porch       Screen.Porch
##  Min.   :  0.00   Min.   :   0.00   Min.   :  0.000   Min.   :  0
##  1st Qu.:  0.00   1st Qu.:   0.00   1st Qu.:  0.000   1st Qu.:  0
##  Median : 27.00   Median :   0.00   Median :  0.000   Median :  0
##  Mean   : 47.53   Mean   :  23.01   Mean   :  2.592   Mean   : 16
##  3rd Qu.: 70.00   3rd Qu.:   0.00   3rd Qu.:  0.000   3rd Qu.:  0
##  Max.   :742.00   Max.   :1012.00   Max.   :508.000   Max.   :576
##
##    Pool.Area         Pool.QC            Fence           Misc.Feature
##  Min.   :  0.000   Length:2930        Length:2930        Length:2930
##  1st Qu.:  0.000   Class :character   Class :character   Class :character
##  Median :  0.000   Mode  :character   Mode  :character   Mode  :character
##  Mean   :  2.243
##  3rd Qu.:  0.000
##  Max.   :800.000
##
##     Misc.Val           Mo.Sold          Yr.Sold      Sale.Type
##  Min.   :    0.00   Min.   : 1.000   Min.   :2006   Length:2930
##  1st Qu.:    0.00   1st Qu.: 4.000   1st Qu.:2007   Class :character
##  Median :    0.00   Median : 6.000   Median :2008   Mode  :character
```

```
##  Mean   :   50.63   Mean   : 6.216   Mean   :2008
##  3rd Qu.:    0.00   3rd Qu.: 8.000   3rd Qu.:2009
##  Max.   :17000.00   Max.   :12.000   Max.   :2010
##
##  Sale.Condition       SalePrice
##  Length:2930        Min.   : 12789
##  Class :character   1st Qu.:129500
##  Mode  :character   Median :160000
##                     Mean   :180796
##                     3rd Qu.:213500
##                     Max.   :755000
##
```

```
nrow(housing_data)
```

```
## [1] 2930
```

```
ncol(housing_data)
```

```
## [1] 82
```

```
# Using small chunk of dataset for quick testing :)

#housing_data = housing_data[1:100,]

# Coercing categorical predictors into factor variables

housing_data[is.na(housing_data)] = 1

for (i in 1:ncol(housing_data)) {
  if (typeof(housing_data[, i]) == "character") {
    if (length(unique(housing_data[, i])) >= 2) {
      housing_data[, i] = as.factor(housing_data[, i])
    }

  }
}

#str(housing_data)
```

First few examples:

```
housing_data$SalePrice[1:10]
```

```
##  [1] 215000 105000 172000 244000 189900 195500 213500 191500 236500 189000
```

```
housing_data$Lot.Area[1:10]
```

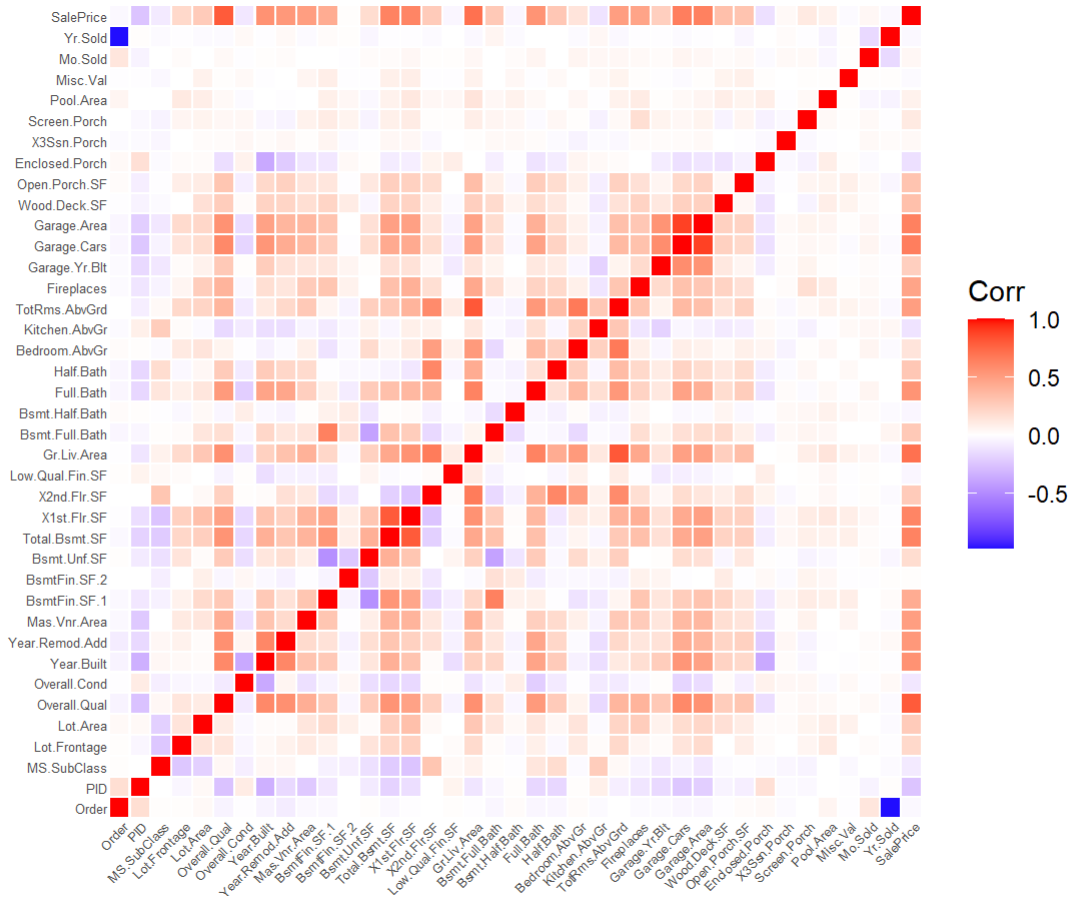
```
##  [1] 31770 11622 14267 11160 13830  9978  4920  5005  5389  7500
```

```
housing_data$Utilities[1:10]
```

```
##  [1] AllPub AllPub AllPub AllPub AllPub AllPub AllPub AllPub AllPub AllPub
## Levels: AllPub NoSeWa NoSewr
```

Collinearity and correlation analysis

```
# Subsetting all the numeric elements of the dataset for collinearity and correlation analysis:

n_idxs = unlist(lapply(housing_data, is.numeric), use.names = FALSE)
numeric_housing_data = housing_data[, n_idxs]

#str(numeric_housing_data)



# MUST specify use = "complete.obs" argument to ignore NA's in dataset
corrs = round(cor(numeric_housing_data, use="complete.obs"), 2)


# some possible correlation plots?

#corrplot(corrs, method="number")
#ggcorrplot(corrs, lab_size = 0.1)

#corrs

ggplot(melt(corrs), aes(Var1, Var2, fill=value)) +
  geom_tile(height=0.9, width=0.9) +
  scale_fill_gradient2(low="blue", mid="white", high="red") +
  theme_minimal() +
  coord_equal() +
  labs(x="",y="",fill="Corr") +
  theme(axis.text.x=element_text(size=5, angle=45, vjust=1, hjust=1,
                                 margin=margin(-3,0,0,0)),
        axis.text.y=element_text(size=5, margin=margin(0,-3,0,0)),
        panel.grid.major=element_blank())
```

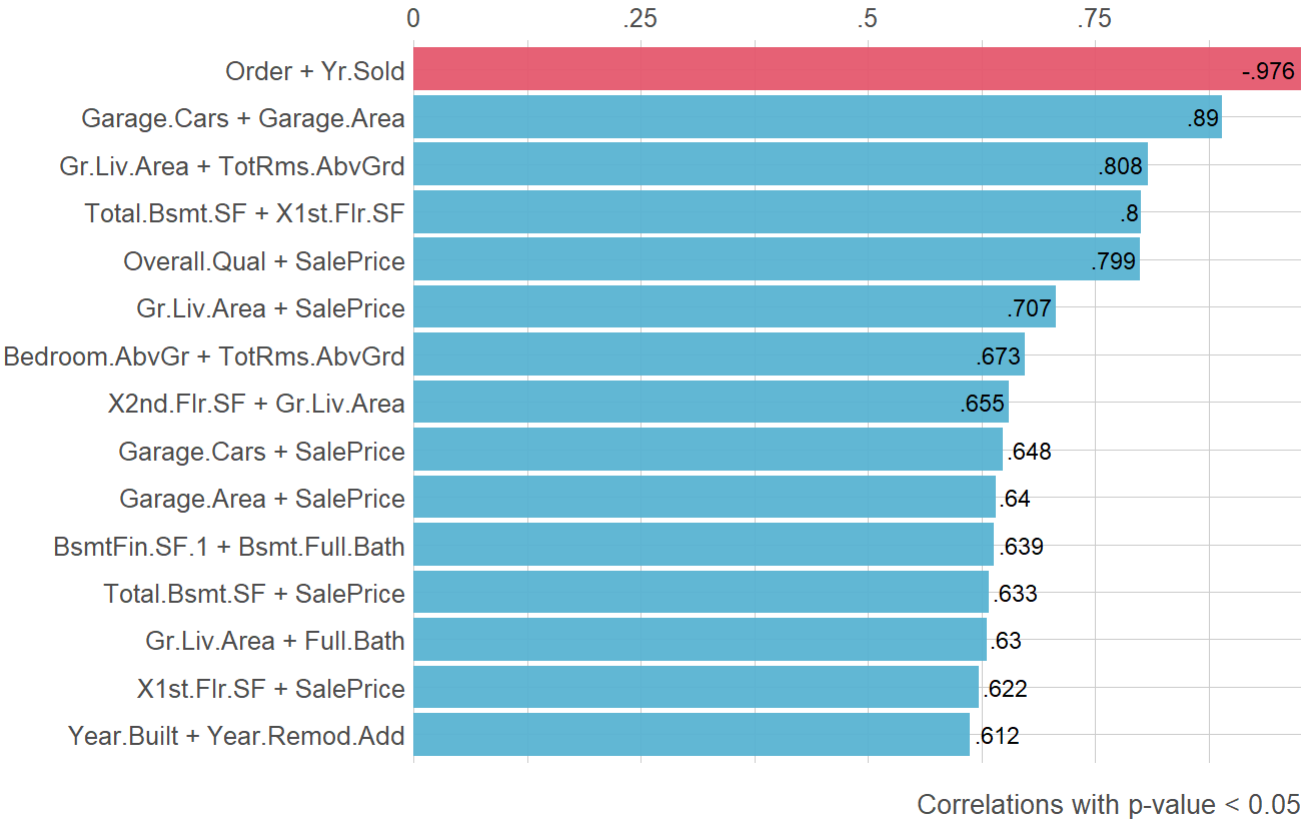


Taking a closer look at some of the most correlated predictors:

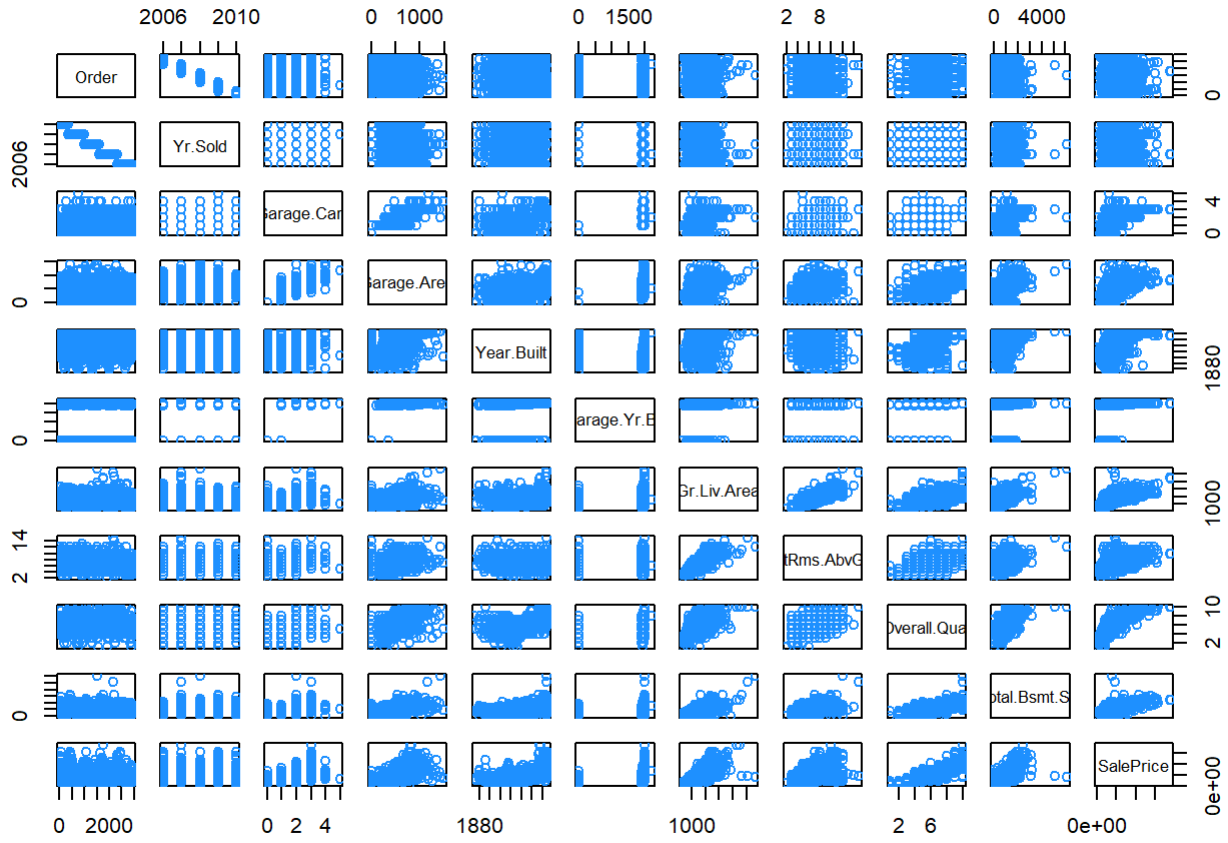
```
corr_cross(numeric_housing_data,
  max_pvalue = 0.05,
  top = 15
)
```

Ranked Cross-Correlations

15 most relevant




```
# A few of these further visualized in pairs:

corr_data = numeric_housing_data[, c("Order", "Yr.Sold", "Garage.Cars", "Garage.Area", "Year.Built", "Garage.Yr.Blt", "Gr.Liv.Area", "TotRms.AbvGrd", "Overall.Qual", "Total.Bsmt.SF", "SalePrice")]

pairs(corr_data, col = "dodgerblue")
```



While some of these high correlation measures are to be expected, such as house year built along garage year built, we can also see some non-trivial patterns start to emerge from the more continuous numeric predictors.

Basic Regression Models

We'll start out with a few preliminary multiple regression models: A full additive model using all available predictors, a reduced additive model that disregards some of the predictors that exhibit collinearity or low significance, and a backwards AIC-selected model.

```
#sapply(lapply(housing_data, unique), length)


# lm() complains when it runs into "NA" values in dataframe, so just replacing any with 0 for no
w...


full_additive = lm(SalePrice ~ ., data = housing_data)

additive_lowcorr = lm(SalePrice ~ . - Gr.Liv.Area - Garage.Cars - Total.Bsmt.SF - Garage.Yr.Blt
- Order - MS.Zoning - Condition.1 - House.Style - Exterior.1st - Exterior.2nd - Bsmt.Qual - Exte
r.Cond - Bsmt.Cond - Bsmt.Exposure - BsmtFin.Type.2 - Heating - Electrical - Garage.Type, data =
housing_data)

additive_aic = step(additive_lowcorr, direction = "backward")
```

```
anova(additive_lowcorr, full_additive)
```

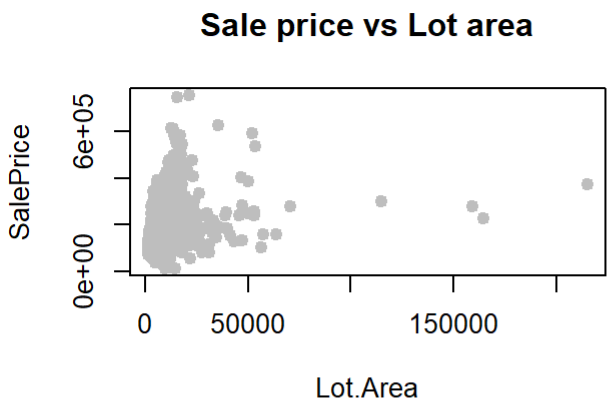
```
## Analysis of Variance Table
##
## Model 1: SalePrice ~ (Order + PID + MS.SubClass + MS.Zoning + Lot.Frontage +
##     Lot.Area + Street + Alley + Lot.Shape + Land.Contour + Utilities +
##     Lot.Config + Land.Slope + Neighborhood + Condition.1 + Condition.2 +
##     Bldg.Type + House.Style + Overall.Qual + Overall.Cond + Year.Built +
##     Year.Remod.Add + Roof.Style + Roof.Matl + Exterior.1st +
##     Exterior.2nd + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
##     Exter.Cond + Foundation + Bsmt.Qual + Bsmt.Cond + Bsmt.Exposure +
##     BsmtFin.Type.1 + BsmtFin.SF.1 + BsmtFin.Type.2 + BsmtFin.SF.2 +
##     Bsmt.Unf.SF + Total.Bsmt.SF + Heating + Heating.QC + Central.Air +
##     Electrical + X1st.Flr.SF + X2nd.Flr.SF + Low.Qual.Fin.SF +
##     Gr.Liv.Area + Bsmt.Full.Bath + Bsmt.Half.Bath + Full.Bath +
##     Half.Bath + Bedroom.AbvGr + Kitchen.AbvGr + Kitchen.Qual +
##     TotRms.AbvGrd + Functional + Fireplaces + Fireplace.Qu +
##     Garage.Type + Garage.Yr.Blt + Garage.Finish + Garage.Cars +
##     Garage.Area + Garage.Qual + Garage.Cond + Paved.Drive + Wood.Deck.SF +
##     Open.Porch.SF + Enclosed.Porch + X3Ssn.Porch + Screen.Porch +
##     Pool.Area + Pool.QC + Fence + Misc.Feature + Misc.Val + Mo.Sold +
##     Yr.Sold + Sale.Type + Sale.Condition) - Gr.Liv.Area - Garage.Cars -
##     Total.Bsmt.SF - Garage.Yr.Blt - Order - MS.Zoning - Condition.1 -
##     House.Style - Exterior.1st - Exterior.2nd - Bsmt.Qual - Exter.Cond -
##     Bsmt.Cond - Bsmt.Exposure - BsmtFin.Type.2 - Heating - Electrical -
##     Garage.Type
## Model 2: SalePrice ~ Order + PID + MS.SubClass + MS.Zoning + Lot.Frontage +
##     Lot.Area + Street + Alley + Lot.Shape + Land.Contour + Utilities +
##     Lot.Config + Land.Slope + Neighborhood + Condition.1 + Condition.2 +
##     Bldg.Type + House.Style + Overall.Qual + Overall.Cond + Year.Built +
##     Year.Remod.Add + Roof.Style + Roof.Matl + Exterior.1st +
##     Exterior.2nd + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
##     Exter.Cond + Foundation + Bsmt.Qual + Bsmt.Cond + Bsmt.Exposure +
##     BsmtFin.Type.1 + BsmtFin.SF.1 + BsmtFin.Type.2 + BsmtFin.SF.2 +
##     Bsmt.Unf.SF + Total.Bsmt.SF + Heating + Heating.QC + Central.Air +
##     Electrical + X1st.Flr.SF + X2nd.Flr.SF + Low.Qual.Fin.SF +
##     Gr.Liv.Area + Bsmt.Full.Bath + Bsmt.Half.Bath + Full.Bath +
##     Half.Bath + Bedroom.AbvGr + Kitchen.AbvGr + Kitchen.Qual +
##     TotRms.AbvGrd + Functional + Fireplaces + Fireplace.Qu +
##     Garage.Type + Garage.Yr.Blt + Garage.Finish + Garage.Cars +
##     Garage.Area + Garage.Qual + Garage.Cond + Paved.Drive + Wood.Deck.SF +
##     Open.Porch.SF + Enclosed.Porch + X3Ssn.Porch + Screen.Porch +
##     Pool.Area + Pool.QC + Fence + Misc.Feature + Misc.Val + Mo.Sold +
##     Yr.Sold + Sale.Type + Sale.Condition
##   Res.Df        RSS Df  Sum of Sq      F    Pr(>F)
## 1   2746 1.3840e+12
## 2   2655 1.2128e+12 91 1.7115e+11 4.1172 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

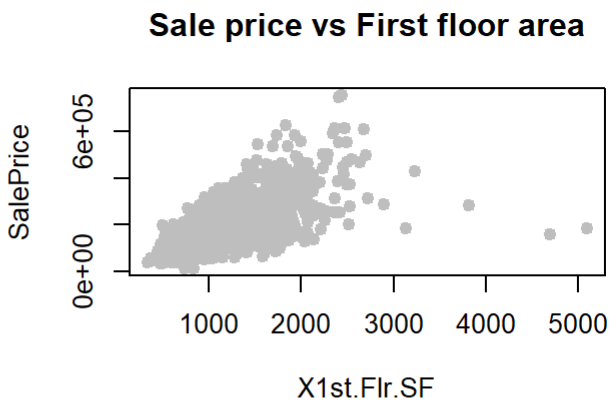
```
anova(additive_aic, full_additive)
```

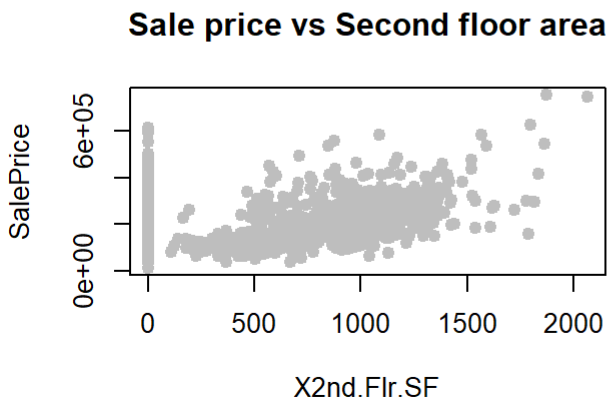
```
## Analysis of Variance Table
##
## Model 1: SalePrice ~ Lot.Frontage + Lot.Area + Street + Land.Contour +
##     Lot.Config + Land.Slope + Neighborhood + Condition.2 + Bldg.Type +
##     Overall.Qual + Overall.Cond + Year.Built + Year.Remod.Add +
##     Roof.Matl + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual + Foundation +
##     BsmtFin.Type.1 + BsmtFin.SF.1 + BsmtFin.SF.2 + Bsmt.Unf.SF +
##     Heating.QC + Central.Air + X1st.Flr.SF + X2nd.Flr.SF + Low.Qual.Fin.SF +
##     Full.Bath + Bedroom.AbvGr + Kitchen.AbvGr + Kitchen.Qual +
##     TotRms.AbvGrd + Functional + Fireplaces + Fireplace.Qu +
##     Garage.Finish + Garage.Area + Garage.Qual + Garage.Cond +
##     Wood.Deck.SF + Screen.Porch + Pool.QC + Misc.Feature + Yr.Sold +
##     Sale.Condition
## Model 2: SalePrice ~ Order + PID + MS.SubClass + MS.Zoning + Lot.Frontage +
##     Lot.Area + Street + Alley + Lot.Shape + Land.Contour + Utilities +
##     Lot.Config + Land.Slope + Neighborhood + Condition.1 + Condition.2 +
##     Bldg.Type + House.Style + Overall.Qual + Overall.Cond + Year.Built +
##     Year.Remod.Add + Roof.Style + Roof.Matl + Exterior.1st +
##     Exterior.2nd + Mas.Vnr.Type + Mas.Vnr.Area + Exter.Qual +
##     Exter.Cond + Foundation + Bsmt.Qual + Bsmt.Cond + Bsmt.Exposure +
##     BsmtFin.Type.1 + BsmtFin.SF.1 + BsmtFin.Type.2 + BsmtFin.SF.2 +
##     Bsmt.Unf.SF + Total.Bsmt.SF + Heating + Heating.QC + Central.Air +
##     Electrical + X1st.Flr.SF + X2nd.Flr.SF + Low.Qual.Fin.SF +
##     Gr.Liv.Area + Bsmt.Full.Bath + Bsmt.Half.Bath + Full.Bath +
##     Half.Bath + Bedroom.AbvGr + Kitchen.AbvGr + Kitchen.Qual +
##     TotRms.AbvGrd + Functional + Fireplaces + Fireplace.Qu +
##     Garage.Type + Garage.Yr.Blt + Garage.Finish + Garage.Cars +
##     Garage.Area + Garage.Qual + Garage.Cond + Paved.Drive + Wood.Deck.SF +
##     Open.Porch.SF + Enclosed.Porch + X3Ssn.Porch + Screen.Porch +
##     Pool.Area + Pool.QC + Fence + Misc.Feature + Misc.Val + Mo.Sold +
##     Yr.Sold + Sale.Type + Sale.Condition
##   Res.Df        RSS  Df  Sum of Sq      F    Pr(>F)
## 1   2784 1.4028e+12
## 2   2655 1.2128e+12 129 1.8991e+11 3.2227 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

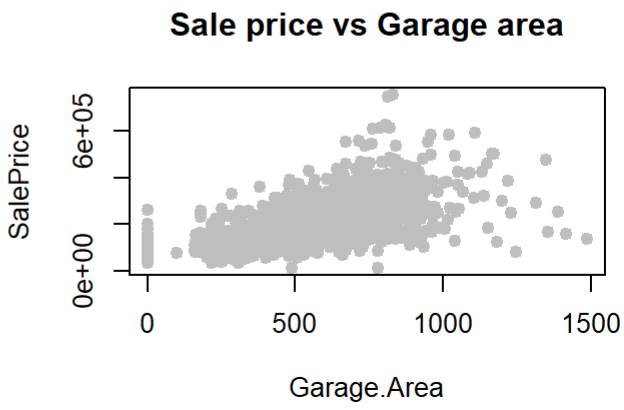
Transformations

```
par(mfrow = c(2, 2))

plot(SalePrice ~ Lot.Area, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs Lot area")

plot(SalePrice ~ X1st.Flr.SF, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs First floor area")

plot(SalePrice ~ X2nd.Flr.SF, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs Second floor area")

plot(SalePrice ~ Garage.Area, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs Garage area")
```

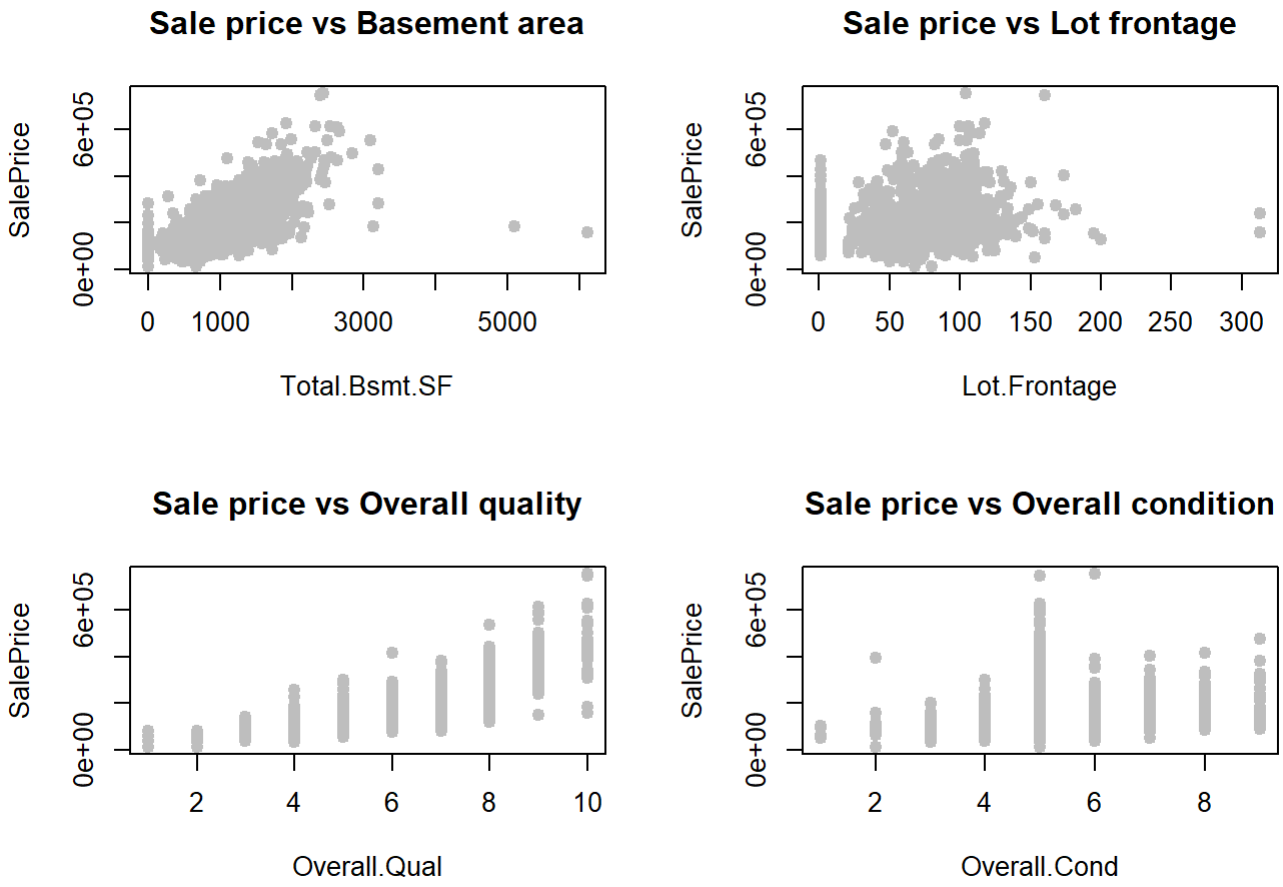








```
par(mfrow = c(2, 2))

plot(SalePrice ~ Total.Bsmt.SF, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs Basement area")

plot(SalePrice ~ Lot.Frontage, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs Lot frontage")

plot(SalePrice ~ Overall.Qual, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs Overall quality")


plot(SalePrice ~ Overall.Cond, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs Overall condition")
```



```
par(mfrow = c(2, 2))

plot(SalePrice ~ Gr.Liv.Area, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs Living area")

plot(SalePrice ~ Full.Bath, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs # of full bathrooms")

plot(SalePrice ~ MS.SubClass, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs MS Subclass")

plot(SalePrice ~ Wood.Deck.SF, data = housing_data, col = "grey", pch = 20, cex = 1.5,
     main = "Sale price vs Deck area")
```


```
#log_p1 = lm(SalePrice ~ . + log(X1st.Flr.SF) + log(Garage.Area) + log(Lot.Frontage), data=housi
ng_data)

log_r1 = lm(log(SalePrice) ~ ., data = housing_data)

#summary(log_p1)
summary(log_r1)
```

```
##
## Call:
## lm(formula = log(SalePrice) ~ ., data = housing_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.37004 -0.04850  0.00000  0.05168  0.50754
##
## Coefficients: (13 not defined because of singularities)
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)            2.880e+01  3.863e+01   0.746 0.456034
## Order                 -1.405e-05  3.048e-05  -0.461 0.644951
## PID                    1.320e-10  3.790e-11   3.483 0.000504 ***
## MS.SubClass           -3.745e-04  2.501e-04  -1.498 0.134347
## MS.ZoningC (all)       2.496e-01  1.521e-01   1.640 0.101065
## MS.ZoningFV            4.691e-01  1.499e-01   3.130 0.001768 **
## MS.ZoningI (all)       4.910e-01  1.786e-01   2.748 0.006030 **
## MS.ZoningRH            5.052e-01  1.525e-01   3.312 0.000939 ***
## MS.ZoningRL            4.825e-01  1.486e-01   3.247 0.001180 **
## MS.ZoningRM            4.186e-01  1.492e-01   2.806 0.005049 **
## Lot.Frontage           5.066e-05  7.584e-05   0.668 0.504218
## Lot.Area               2.469e-06  3.981e-07   6.201 6.47e-10 ***
## StreetPave             9.832e-02  3.757e-02   2.617 0.008920 **
## AlleyGrvl              2.635e-02  1.276e-02   2.064 0.039082 *
## AlleyPave              1.075e-02  1.565e-02   0.687 0.492394
## Lot.ShapeIR2           1.860e-02  1.385e-02   1.343 0.179255
## Lot.ShapeIR3          -1.166e-02  2.984e-02  -0.391 0.695982
## Lot.ShapeReg           3.425e-03  5.354e-03   0.640 0.522406
## Land.ContourHLS        2.788e-02  1.625e-02   1.716 0.086290 .
## Land.ContourLow       -2.284e-03  2.111e-02  -0.108 0.913846
## Land.ContourLvl        2.525e-02  1.200e-02   2.103 0.035520 *
## UtilitiesNoSeWa       -1.082e-01  1.152e-01  -0.939 0.347730
## UtilitiesNoSewr       -1.284e-01  9.407e-02  -1.364 0.172542
## Lot.ConfigCulDSac      5.499e-03  1.072e-02   0.513 0.607905
## Lot.ConfigFR2         -2.914e-02  1.374e-02  -2.122 0.033961 *
## Lot.ConfigFR3         -1.721e-02  3.126e-02  -0.551 0.581867
## Lot.ConfigInside      -7.149e-03  5.755e-03  -1.242 0.214285
## Land.SlopeMod          2.128e-02  1.296e-02   1.642 0.100788
## Land.SlopeSev         -7.334e-02  3.932e-02  -1.865 0.062285 .
## NeighborhoodBlueste   -2.352e-04  4.641e-02  -0.005 0.995957
## NeighborhoodBrDale    -1.109e-02  3.744e-02  -0.296 0.766998
## NeighborhoodBrkSide    1.017e-02  3.162e-02   0.322 0.747794
## NeighborhoodClearCr   -2.331e-03  3.366e-02  -0.069 0.944789
## NeighborhoodCollgCr   -4.971e-02  2.822e-02  -1.762 0.078231 .
## NeighborhoodCrawfor    7.392e-02  3.119e-02   2.370 0.017866 *
## NeighborhoodEdwards   -9.978e-02  2.965e-02  -3.366 0.000775 ***
## NeighborhoodGilbert   -3.548e-03  2.598e-02  -0.137 0.891397
## NeighborhoodGreens     1.281e-01  4.828e-02   2.652 0.008040 **
## NeighborhoodGrnHill    5.015e-01  8.373e-02   5.989 2.40e-09 ***
## NeighborhoodIDOTRR    -2.792e-02  3.482e-02  -0.802 0.422658
## NeighborhoodLandmrk   -9.923e-02  1.151e-01  -0.862 0.388677
## NeighborhoodMeadowV   -1.543e-01  3.881e-02  -3.974 7.24e-05 ***
```

```
## NeighborhoodMitchel   -5.719e-02  3.107e-02  -1.841 0.065746 .
## NeighborhoodNAmes     -1.286e-02  2.672e-02  -0.481 0.630330
## NeighborhoodNoRidge    5.613e-02  2.879e-02   1.949 0.051358 .
## NeighborhoodNPkVill    4.441e-02  5.126e-02   0.866 0.386366
## NeighborhoodNridgHt    7.203e-02  2.563e-02   2.810 0.004994 **
## NeighborhoodNWAmes    -2.379e-02  2.719e-02  -0.875 0.381710
## NeighborhoodOldTown   -5.466e-02  3.170e-02  -1.724 0.084775 .
## NeighborhoodSawyer    -2.778e-02  2.865e-02  -0.970 0.332320
## NeighborhoodSawyerW   -3.772e-02  2.680e-02  -1.407 0.159450
## NeighborhoodSomerst    7.231e-02  2.974e-02   2.432 0.015096 *
## NeighborhoodStoneBr    1.138e-01  2.858e-02   3.981 7.04e-05 ***
## NeighborhoodSWISU     -3.647e-02  3.444e-02  -1.059 0.289685
## NeighborhoodTimber    -2.847e-02  3.147e-02  -0.905 0.365620
## NeighborhoodVeenker    6.529e-03  3.459e-02   0.189 0.850297
## Condition.1Feedr       1.297e-02  1.569e-02   0.826 0.408606
## Condition.1Norm        6.178e-02  1.301e-02   4.749 2.15e-06 ***
## Condition.1PosA        5.406e-02  2.985e-02   1.811 0.070280 .
## Condition.1PosN        7.622e-02  2.310e-02   3.299 0.000983 ***
## Condition.1RRAe        2.964e-02  2.678e-02   1.107 0.268413
## Condition.1RRAn        2.354e-02  2.180e-02   1.080 0.280310
## Condition.1RRNe        3.799e-02  4.829e-02   0.787 0.431529
## Condition.1RRNn        3.093e-02  4.009e-02   0.772 0.440412
## Condition.2Feedr      -2.315e-02  6.012e-02  -0.385 0.700214
## Condition.2Norm       -2.862e-03  5.214e-02  -0.055 0.956221
## Condition.2PosA        8.624e-02  7.942e-02   1.086 0.277618
## Condition.2PosN       -4.677e-01  7.869e-02  -5.944 3.15e-09 ***
## Condition.2RRAe       -1.570e-01  1.541e-01  -1.019 0.308453
## Condition.2RRAn       -5.361e-02  1.218e-01  -0.440 0.659784
## Condition.2RRNn       -7.742e-03  9.431e-02  -0.082 0.934579
## Bldg.Type2fmCon        3.602e-02  3.861e-02   0.933 0.350870
## Bldg.TypeDuplex       -4.920e-02  2.390e-02  -2.059 0.039575 *
## Bldg.TypeTwnhs        -6.696e-02  3.027e-02  -2.212 0.027077 *
## Bldg.TypeTwnhsE       -9.889e-03  2.700e-02  -0.366 0.714189
## House.Style1.5Unf      4.029e-03  2.823e-02   0.143 0.886546
## House.Style1Story     -1.755e-02  1.345e-02  -1.305 0.191950
## House.Style2.5Fin     -8.968e-02  4.783e-02  -1.875 0.060901 .
## House.Style2.5Unf      3.676e-02  2.704e-02   1.359 0.174108
## House.Style2Story     -8.715e-03  1.088e-02  -0.801 0.423374
## House.StyleSFoyer      1.538e-02  1.942e-02   0.792 0.428473
## House.StyleSLvl       -3.640e-04  1.702e-02  -0.021 0.982944
## Overall.Qual           4.794e-02  3.203e-03  14.967  < 2e-16 ***
## Overall.Cond           3.873e-02  2.755e-03  14.057  < 2e-16 ***
## Year.Built             1.764e-03  2.473e-04   7.135 1.24e-12 ***
## Year.Remod.Add         6.713e-04  1.762e-04   3.809 0.000143 ***
## Roof.StyleGable        5.636e-02  5.048e-02   1.116 0.264369
## Roof.StyleGambrel      5.403e-02  5.644e-02   0.957 0.338506
## Roof.StyleHip          5.268e-02  5.089e-02   1.035 0.300651
## Roof.StyleMansard     -5.202e-03  6.257e-02  -0.083 0.933749
## Roof.StyleShed         1.508e-01  8.609e-02   1.751 0.080007 .
## Roof.MatlCompShg       2.724e+00  1.609e-01  16.929  < 2e-16 ***
## Roof.MatlMembran       2.974e+00  2.068e-01  14.385  < 2e-16 ***
## Roof.MatlMetal         2.923e+00  2.061e-01  14.183  < 2e-16 ***
```

```
## Roof.MatlRoll          2.862e+00  1.960e-01  14.601  < 2e-16 ***
## Roof.MatlTar&Grv       2.759e+00  1.666e-01  16.563  < 2e-16 ***
## Roof.MatlWdShake       2.716e+00  1.668e-01  16.284  < 2e-16 ***
## Roof.MatlWdShngl       2.772e+00  1.664e-01  16.659  < 2e-16 ***
## Exterior.1stAsphShn    4.386e-03  1.190e-01   0.037 0.970596
## Exterior.1stBrkComm    1.169e-01  6.765e-02   1.728 0.084088 .
## Exterior.1stBrkFace    1.532e-01  3.977e-02   3.851 0.000120 ***
## Exterior.1stCBlock     3.078e-01  1.388e-01   2.218 0.026618 *
## Exterior.1stCemntBd   -4.720e-02  6.324e-02  -0.746 0.455454
## Exterior.1stHdBoard    5.618e-02  3.887e-02   1.445 0.148484
## Exterior.1stImStucc    3.881e-02  1.196e-01   0.325 0.745496
## Exterior.1stMetalSd    9.580e-02  4.367e-02   2.194 0.028339 *
## Exterior.1stPlywood    7.117e-02  3.816e-02   1.865 0.062263 .
## Exterior.1stPreCast    5.428e-01  1.166e-01   4.656 3.38e-06 ***
## Exterior.1stStone      2.043e-02  9.521e-02   0.215 0.830124
## Exterior.1stStucco     7.341e-02  4.309e-02   1.703 0.088600 .
## Exterior.1stVinylSd    5.362e-02  4.232e-02   1.267 0.205337
## Exterior.1stWd Sdng    5.617e-02  3.752e-02   1.497 0.134461
## Exterior.1stWdShing    6.862e-02  4.066e-02   1.688 0.091574 .
## Exterior.2ndAsphShn    8.638e-02  9.001e-02   0.960 0.337346
## Exterior.2ndBrk Cmn   -3.783e-02  6.169e-02  -0.613 0.539738
## Exterior.2ndBrkFace   -2.470e-02  4.375e-02  -0.564 0.572504
## Exterior.2ndCBlock    -6.131e-02  1.145e-01  -0.536 0.592238
## Exterior.2ndCmentBd    1.320e-01  6.424e-02   2.055 0.039993 *
## Exterior.2ndHdBoard    1.932e-02  4.008e-02   0.482 0.629913
## Exterior.2ndImStucc    5.726e-03  4.859e-02   0.118 0.906209
## Exterior.2ndMetalSd   -1.709e-03  4.470e-02  -0.038 0.969505
## Exterior.2ndOther     -4.785e-02  1.179e-01  -0.406 0.684936
## Exterior.2ndPlywood    8.823e-03  3.862e-02   0.228 0.819286
## Exterior.2ndPreCast           NA         NA      NA       NA
## Exterior.2ndStone     -7.535e-03  6.586e-02  -0.114 0.908929
## Exterior.2ndStucco     2.541e-02  4.406e-02   0.577 0.564276
## Exterior.2ndVinylSd    3.509e-02  4.327e-02   0.811 0.417467
## Exterior.2ndWd Sdng    2.577e-02  3.885e-02   0.663 0.507174
## Exterior.2ndWd Shng    1.455e-02  4.070e-02   0.358 0.720726
## Mas.Vnr.TypeBrkCmn    -2.334e-02  3.279e-02  -0.712 0.476602
## Mas.Vnr.TypeBrkFace    2.397e-04  2.418e-02   0.010 0.992091
## Mas.Vnr.TypeCBlock    -4.732e-01  1.359e-01  -3.481 0.000507 ***
## Mas.Vnr.TypeNone      -1.699e-04  2.357e-02  -0.007 0.994250
## Mas.Vnr.TypeStone      1.537e-02  2.459e-02   0.625 0.532029
## Mas.Vnr.Area           8.695e-06  1.907e-05   0.456 0.648466
## Exter.QualFa           1.398e-03  2.991e-02   0.047 0.962724
## Exter.QualGd          -2.119e-02  1.551e-02  -1.366 0.171922
## Exter.QualTA          -2.417e-02  1.742e-02  -1.387 0.165444
## Exter.CondFa          -5.377e-02  3.757e-02  -1.431 0.152451
## Exter.CondGd          -2.337e-03  3.378e-02  -0.069 0.944861
## Exter.CondPo          -1.659e-01  8.422e-02  -1.970 0.048929 *
## Exter.CondTA           1.503e-02  3.356e-02   0.448 0.654358
## FoundationCBlock       2.024e-02  9.868e-03   2.051 0.040348 *
## FoundationPConc        3.214e-02  1.082e-02   2.969 0.003011 **
## FoundationSlab        -4.851e-03  3.004e-02  -0.161 0.871729
## FoundationStone        9.474e-02  3.605e-02   2.628 0.008634 **
```

```
## FoundationWood        -4.520e-02  5.138e-02  -0.880 0.379117
## Bsmt.Qual1             9.964e-02  1.643e-01   0.606 0.544294
## Bsmt.QualEx            6.572e-02  2.097e-01   0.313 0.754049
## Bsmt.QualFa            9.866e-03  2.094e-01   0.047 0.962434
## Bsmt.QualGd            3.651e-02  2.094e-01   0.174 0.861588
## Bsmt.QualPo            1.958e-01  2.260e-01   0.866 0.386302
## Bsmt.QualTA            3.367e-02  2.093e-01   0.161 0.872227
## Bsmt.Cond1                    NA         NA      NA       NA
## Bsmt.CondEx           -1.837e-02  6.537e-02  -0.281 0.778698
## Bsmt.CondFa           -2.540e-03  1.244e-02  -0.204 0.838155
## Bsmt.CondGd            1.777e-02  1.066e-02   1.668 0.095494 .
## Bsmt.CondPo            9.511e-02  5.854e-02   1.625 0.104355
## Bsmt.CondTA                   NA         NA      NA       NA
## Bsmt.Exposure1                NA         NA      NA       NA
## Bsmt.ExposureAv        1.992e-02  6.284e-02   0.317 0.751310
## Bsmt.ExposureGd        5.075e-02  6.334e-02   0.801 0.423088
## Bsmt.ExposureMn       -5.342e-04  6.299e-02  -0.008 0.993233
## Bsmt.ExposureNo        1.750e-03  6.265e-02   0.028 0.977717
## BsmtFin.Type.11               NA         NA      NA       NA
## BsmtFin.Type.1ALQ      1.095e-02  9.356e-03   1.170 0.242173
## BsmtFin.Type.1BLQ      2.613e-03  9.998e-03   0.261 0.793872
## BsmtFin.Type.1GLQ      1.725e-02  8.851e-03   1.949 0.051363 .
## BsmtFin.Type.1LwQ     -1.276e-02  1.162e-02  -1.098 0.272469
## BsmtFin.Type.1Rec     -8.437e-03  9.722e-03  -0.868 0.385574
## BsmtFin.Type.1Unf             NA         NA      NA       NA
## BsmtFin.SF.1           1.302e-04  1.527e-05   8.526  < 2e-16 ***
## BsmtFin.Type.21               NA         NA      NA       NA
## BsmtFin.Type.2ALQ      7.267e-02  1.112e-01   0.653 0.513570
## BsmtFin.Type.2BLQ      4.263e-02  1.109e-01   0.384 0.700692
## BsmtFin.Type.2GLQ      1.002e-01  1.126e-01   0.890 0.373637
## BsmtFin.Type.2LwQ      6.058e-02  1.109e-01   0.546 0.585024
## BsmtFin.Type.2Rec      5.325e-02  1.108e-01   0.481 0.630737
## BsmtFin.Type.2Unf      7.841e-02  1.107e-01   0.709 0.478649
## BsmtFin.SF.2           1.236e-04  2.657e-05   4.652 3.45e-06 ***
## Bsmt.Unf.SF            6.623e-05  1.398e-05   4.737 2.28e-06 ***
## Total.Bsmt.SF                 NA         NA      NA       NA
## HeatingGasA            7.467e-02  1.133e-01   0.659 0.509815
## HeatingGasW            1.533e-01  1.156e-01   1.326 0.185050
## HeatingGrav           -6.656e-02  1.213e-01  -0.549 0.583232
## HeatingOthW            4.785e-02  1.393e-01   0.344 0.731235
## HeatingWall            8.235e-02  1.275e-01   0.646 0.518348
## Heating.QCFa          -1.915e-02  1.453e-02  -1.318 0.187725
## Heating.QCGd          -9.291e-03  6.630e-03  -1.401 0.161250
## Heating.QCPo          -1.983e-01  7.900e-02  -2.510 0.012140 *
## Heating.QCTA          -2.857e-02  6.514e-03  -4.386 1.20e-05 ***
## Central.AirY           5.003e-02  1.152e-02   4.341 1.47e-05 ***
## ElectricalFuseA       -7.487e-02  1.097e-01  -0.682 0.495016
## ElectricalFuseF       -8.599e-02  1.108e-01  -0.776 0.437624
## ElectricalFuseP       -6.262e-02  1.171e-01  -0.535 0.592998
## ElectricalMix          1.931e-02  1.812e-01   0.107 0.915140
## ElectricalSBrkr       -7.667e-02  1.093e-01  -0.701 0.483209
## X1st.Flr.SF            2.704e-04  1.614e-05  16.754  < 2e-16 ***
```

```
## X2nd.Flr.SF           2.421e-04  1.761e-05  13.749  < 2e-16 ***
## Low.Qual.Fin.SF       2.090e-04  5.343e-05   3.912 9.39e-05 ***
## Gr.Liv.Area                  NA         NA      NA       NA
## Bsmt.Full.Bath        2.003e-02  6.123e-03   3.271 0.001087 **
## Bsmt.Half.Bath       -2.069e-03  9.278e-03  -0.223 0.823557
## Full.Bath             2.131e-02  6.869e-03   3.102 0.001941 **
## Half.Bath             1.203e-02  6.523e-03   1.845 0.065135 .
## Bedroom.AbvGr        -1.848e-03  4.286e-03  -0.431 0.666371
## Kitchen.AbvGr        -2.313e-02  1.900e-02  -1.217 0.223582
## Kitchen.QualFa       -7.739e-02  1.981e-02  -3.907 9.58e-05 ***
## Kitchen.QualGd       -5.310e-02  1.152e-02  -4.608 4.26e-06 ***
## Kitchen.QualPo        1.382e-01  1.156e-01   1.196 0.231983
## Kitchen.QualTA       -6.178e-02  1.286e-02  -4.804 1.64e-06 ***
## TotRms.AbvGrd         4.723e-03  2.923e-03   1.616 0.106276
## FunctionalMaj2       -1.373e-01  4.950e-02  -2.773 0.005596 **
## FunctionalMin1        7.982e-02  3.083e-02   2.589 0.009668 **
## FunctionalMin2        6.179e-02  3.109e-02   1.988 0.046932 *
## FunctionalMod         4.497e-02  3.425e-02   1.313 0.189299
## FunctionalSal        -5.302e-01  1.100e-01  -4.820 1.51e-06 ***
## FunctionalSev        -1.873e-01  8.662e-02  -2.162 0.030702 *
## FunctionalTyp         9.940e-02  2.777e-02   3.580 0.000350 ***
## Fireplaces            1.621e-02  8.101e-03   2.000 0.045549 *
## Fireplace.QuEx       -7.133e-03  2.043e-02  -0.349 0.727051
## Fireplace.QuFa        2.274e-03  1.652e-02   0.138 0.890519
## Fireplace.QuGd        9.199e-03  1.093e-02   0.842 0.399901
## Fireplace.QuPo        9.837e-03  1.886e-02   0.522 0.602010
## Fireplace.QuTA        4.372e-03  1.130e-02   0.387 0.698743
## Garage.Type2Types    -1.607e-01  1.224e-01  -1.313 0.189272
## Garage.TypeAttchd    -1.133e-01  1.202e-01  -0.943 0.345767
## Garage.TypeBasment   -1.299e-01  1.210e-01  -1.074 0.283028
## Garage.TypeBuiltIn   -1.264e-01  1.203e-01  -1.050 0.293601
## Garage.TypeCarPort   -1.640e-01  1.234e-01  -1.329 0.183967
## Garage.TypeDetchd    -1.301e-01  1.200e-01  -1.084 0.278555
## Garage.Yr.Blt         2.823e-04  1.807e-04   1.563 0.118225
## Garage.Finish1               NA         NA      NA       NA
## Garage.FinishFin     -6.113e-01  3.701e-01  -1.652 0.098707 .
## Garage.FinishRFn     -6.122e-01  3.699e-01  -1.655 0.098067 .
## Garage.FinishUnf     -6.063e-01  3.699e-01  -1.639 0.101284
## Garage.Cars           2.269e-02  7.300e-03   3.108 0.001902 **
## Garage.Area           6.096e-05  2.507e-05   2.431 0.015109 *
## Garage.Qual1         -1.908e-01  1.653e-01  -1.154 0.248529
## Garage.QualEx         2.240e-01  9.411e-02   2.380 0.017395 *
## Garage.QualFa        -1.628e-02  1.288e-02  -1.264 0.206304
## Garage.QualGd         1.676e-02  2.512e-02   0.667 0.504602
## Garage.QualPo        -1.233e-01  6.874e-02  -1.793 0.073091 .
## Garage.QualTA                NA         NA      NA       NA
## Garage.Cond1                 NA         NA      NA       NA
## Garage.CondEx        -1.502e-01  9.011e-02  -1.666 0.095734 .
## Garage.CondFa        -3.724e-02  1.614e-02  -2.308 0.021087 *
## Garage.CondGd         8.874e-03  3.106e-02   0.286 0.775117
## Garage.CondPo         5.575e-02  3.843e-02   1.451 0.146994
## Garage.CondTA                NA         NA      NA       NA
```

```
## Paved.DriveP           8.973e-03  1.691e-02   0.531 0.595696
## Paved.DriveY           3.294e-02  1.063e-02   3.098 0.001972 **
## Wood.Deck.SF           5.697e-05  1.881e-05   3.028 0.002484 **
## Open.Porch.SF          3.681e-05  3.564e-05   1.033 0.301727
## Enclosed.Porch         1.527e-04  3.757e-05   4.065 4.94e-05 ***
## X3Ssn.Porch            9.145e-05  8.420e-05   1.086 0.277525
## Screen.Porch           2.504e-04  3.918e-05   6.391 1.94e-10 ***
## Pool.Area             -2.063e-04  2.782e-04  -0.742 0.458353
## Pool.QCEx              9.237e-02  1.138e-01   0.812 0.417105
## Pool.QCFa              2.041e-01  2.115e-01   0.965 0.334631
## Pool.QCGd              2.859e-01  2.056e-01   1.390 0.164621
## Pool.QCTA              1.178e-01  1.431e-01   0.823 0.410485
## FenceGdPrv             2.086e-03  1.118e-02   0.187 0.852002
## FenceGdWo             -1.041e-02  1.112e-02  -0.936 0.349260
## FenceMnPrv             3.601e-03  7.063e-03   0.510 0.610269
## FenceMnWw             -1.143e-02  3.224e-02  -0.354 0.723023
## Misc.FeatureElev      -2.150e+00  1.861e-01 -11.553  < 2e-16 ***
## Misc.FeatureGar2       1.333e-02  9.257e-02   0.144 0.885472
## Misc.FeatureOthr       2.225e-03  6.267e-02   0.036 0.971683
## Misc.FeatureShed      -3.669e-03  1.384e-02  -0.265 0.790912
## Misc.FeatureTenC      -2.663e-01  1.624e-01  -1.640 0.101188
## Misc.Val               3.086e-06  8.408e-06   0.367 0.713622
## Mo.Sold               -2.503e-04  7.890e-04  -0.317 0.751090
## Yr.Sold               -1.317e-02  1.921e-02  -0.686 0.493011
## Sale.TypeCon           1.160e-01  5.163e-02   2.247 0.024743 *
## Sale.TypeConLD         2.840e-02  2.669e-02   1.064 0.287379
## Sale.TypeConLI        -5.078e-02  3.923e-02  -1.294 0.195638
## Sale.TypeConLw         3.312e-02  4.201e-02   0.788 0.430527
## Sale.TypeCWD           2.710e-02  3.449e-02   0.786 0.431986
## Sale.TypeNew           4.362e-02  4.930e-02   0.885 0.376356
## Sale.TypeOth           2.348e-02  4.338e-02   0.541 0.588397
## Sale.TypeVWD          -1.639e-02  1.115e-01  -0.147 0.883162
## Sale.TypeWD            5.915e-03  1.331e-02   0.444 0.656837
## Sale.ConditionAdjLand  2.032e-01  3.643e-02   5.579 2.66e-08 ***
## Sale.ConditionAlloca   7.345e-02  2.772e-02   2.649 0.008118 **
## Sale.ConditionFamily   3.367e-02  1.862e-02   1.808 0.070721 .
## Sale.ConditionNormal   7.984e-02  9.491e-03   8.412  < 2e-16 ***
## Sale.ConditionPartial  6.876e-02  4.755e-02   1.446 0.148283
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1068 on 2655 degrees of freedom
## Multiple R-squared:  0.9378, Adjusted R-squared:  0.9313
## F-statistic:   146 on 274 and 2655 DF,  p-value: < 2.2e-16
```

Interactions

```
#int_mod1 = lm(SalePrice ~ (.)^2, data = housing_data)
```