

DSCI 445 Project Presentation

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Motivation

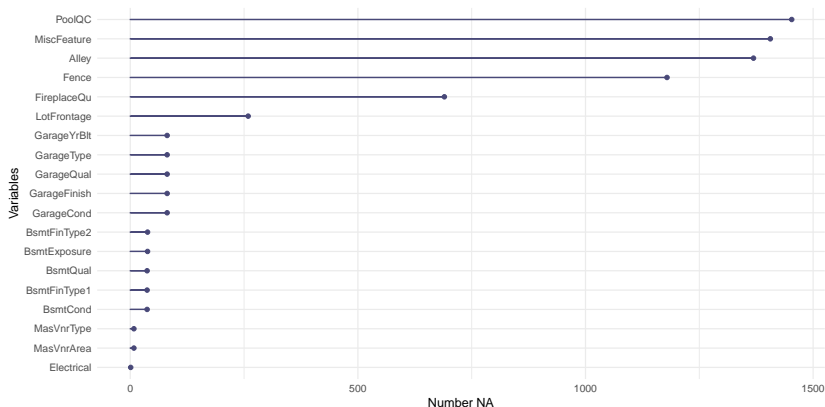
- Housing prices affects U.S. economy
 - 65-percent of houses are owner occupied
 - Housing is a profitable investment
 - Housing Market accounts for 13.3
- Many professions and industries would benefit
 - Appraisers
 - Tax assessors
 - Mortgage lenders
 - Insurers
 - Home Builders
 - Worked with co-owner of Deluxe Homes LLC
 - Anticipate building costs
 - Need for flexible predictions based on specifics of home

Methodology

- Kaggle Knowledge Competition
 - Dataset includes 79 variables
 - 23 ordinal
 - 14 discrete
 - 20 continuous
 - Exploratory Analysis
 - Preprocessing
 - Advanced Regression Techniques
 - Decision Tree
 - Random Forest
 - LASSO
 - Boosting

Handling Missing Values

We visualized the number of missing values for each variable and produced a plot which shows the number of NA values for variables with at least 1 NA value.



Missing Categorical/Character Variable Values

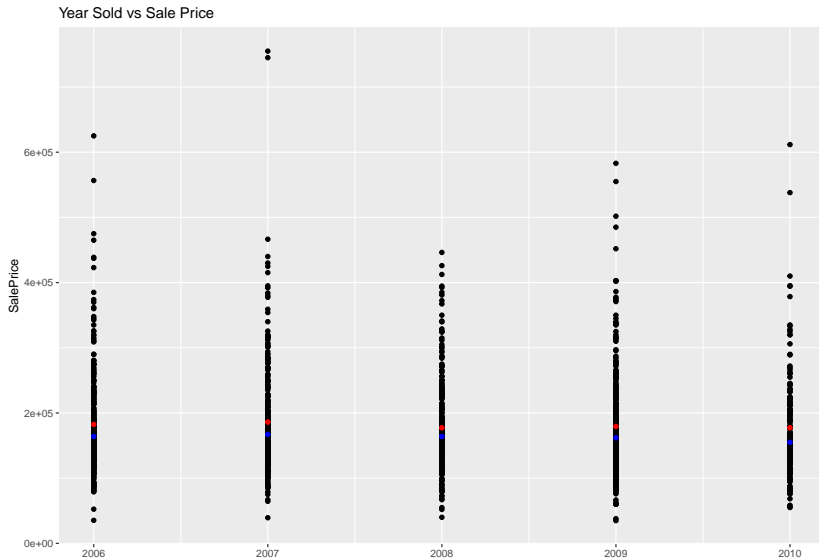
The categorical variables that have missing values are PoolQC, Fence, MiscFeature, Alley, FireplaceQu, GarageType, GarageFinish, GarageQual, GarageCond, BsmtQual, BsmtExposure, BsmtFinType1, BsmtFinType2, BsmtCond, MasVnrType, and Electrical. NAs for all of these variables, except for Electrical, likely represent the absence of a pool, fence, alley access, fireplace, garage, basement, etc. For these variables, we replaced the missing values with the level “None”. For Electrical, there was only one missing value, which we replaced with the most common Electrical type.

Missing Numeric Variable Values

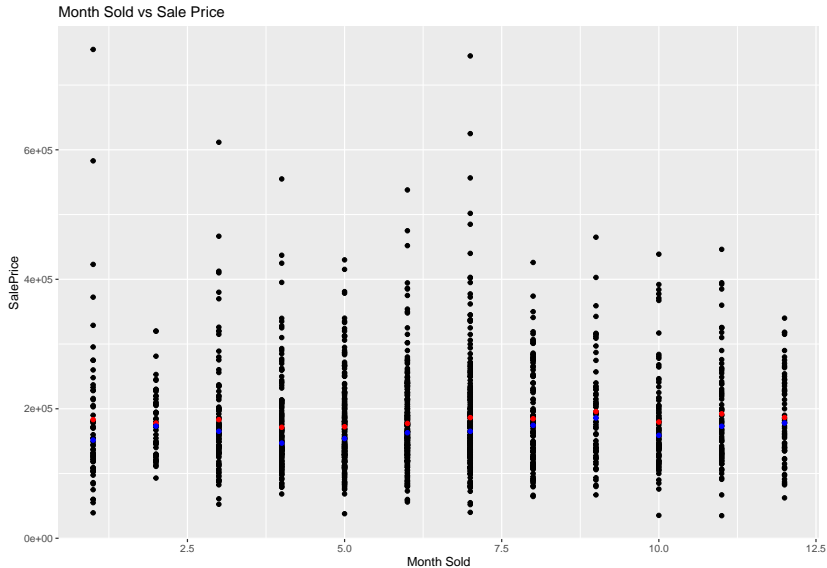
The numerical variables that have missing values are LotFrontage, GarageYrBuilt, and MasVnrArea. The missing values for these variables, similarly, likely mean that there is no garage, masonry veneer, or street connected to the property. Therefore, we replaced these missing values with 0.

Exploratory Data Analysis

We first looked at some of the time variables vs Sale Price. We included red dots for the mean and blue dots for the median.

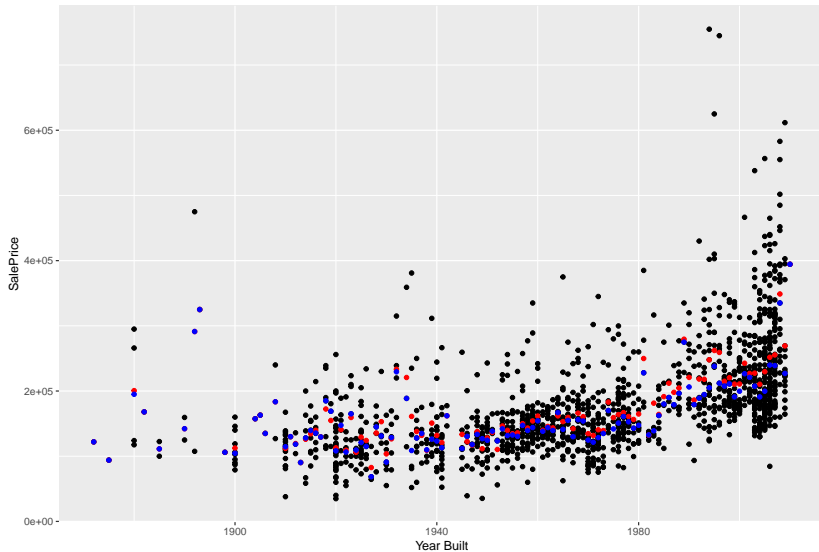


Exploratory Data Analysis Cont.



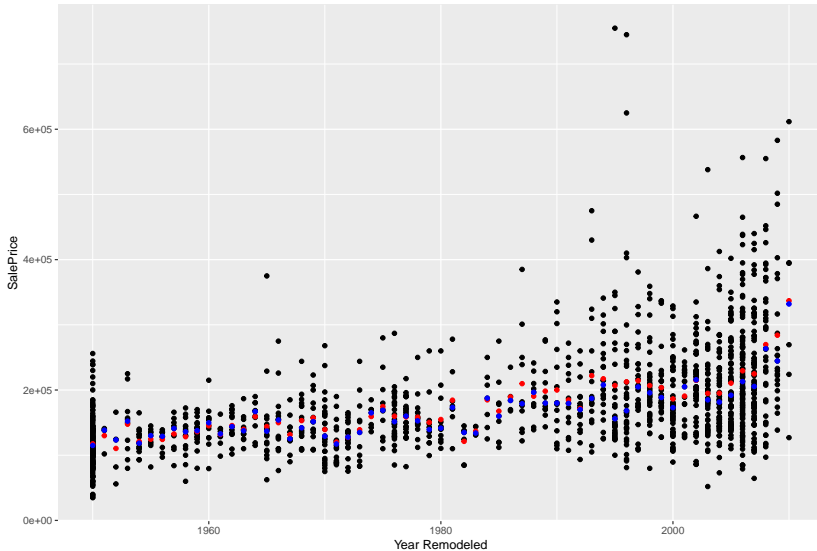
Exploratory Data Analysis Cont.

Year Built vs Sale Price



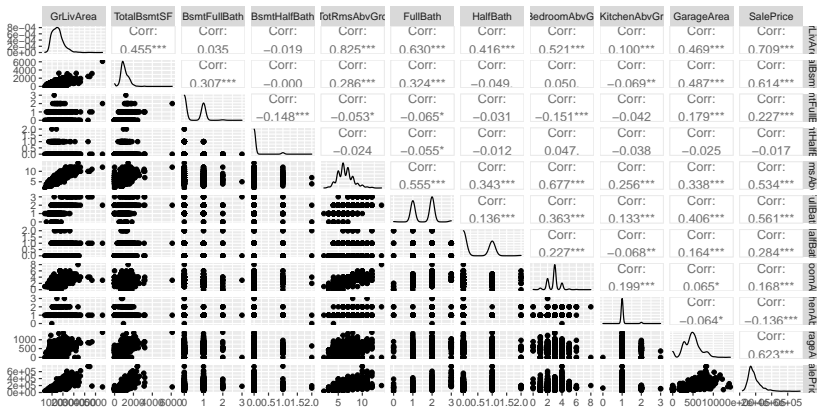
Exploratory Data Analysis Cont.

Year Remodeled vs Sale Price



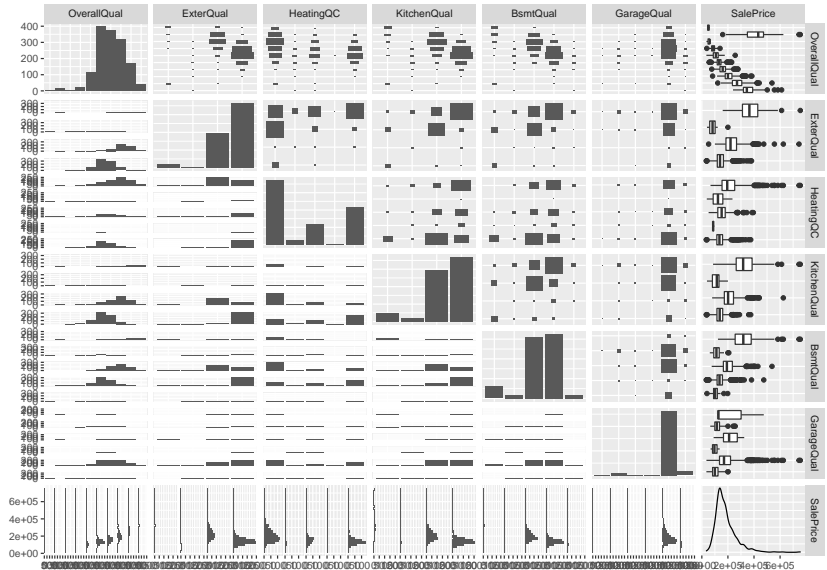
Exploratory Data Analysis Cont.

After this, we subsetting the variables into different general categories to make ggpair plots. This first plot shows variables which indicate size of the house. These include square feet of different living areas, number of bedrooms, number of bathrooms, etc.



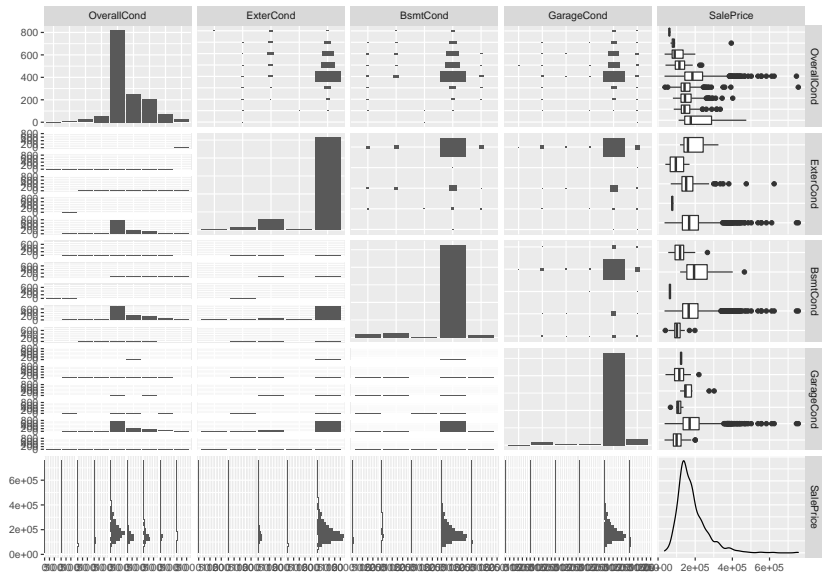
Exploratory Data Analysis Cont.

This plot shows variables which indicate the quality of the house.



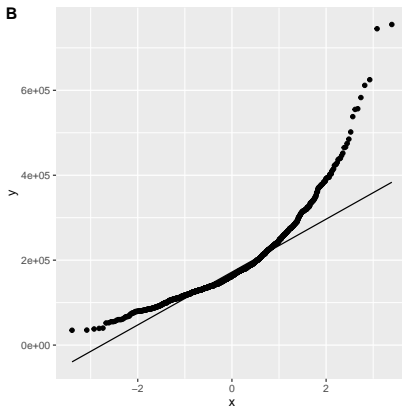
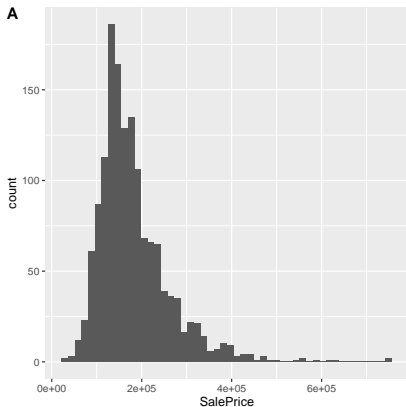
Exploratory Data Analysis Cont.

This plot shows variables which indicate the condition of the house.



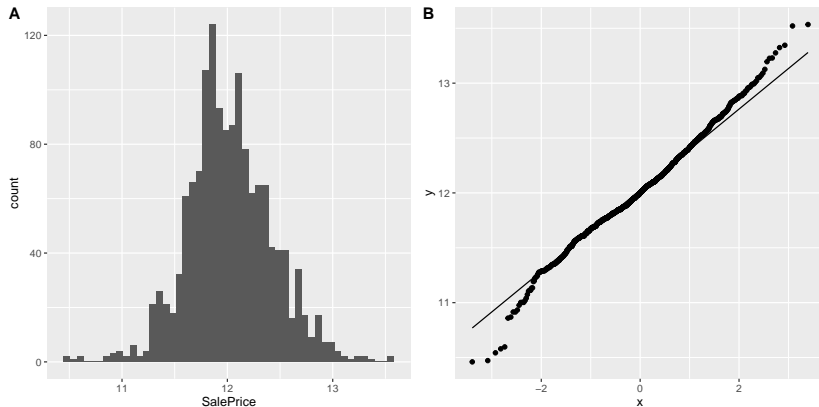
Log Transform the Data

We decided to log transform Sale Price as it violates the assumption of normality. These are the plots showing Sale Price before the transformation.



Log Transform the Data

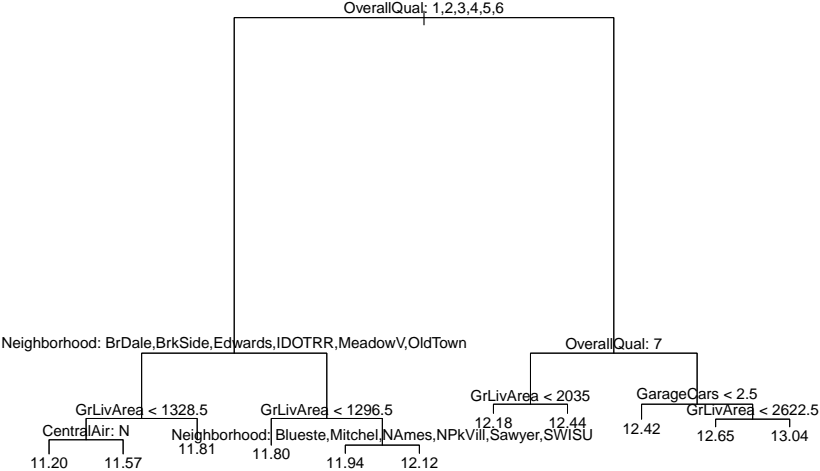
These are the plots showing Sale Price after the log transformation.



Tree-Based Methods

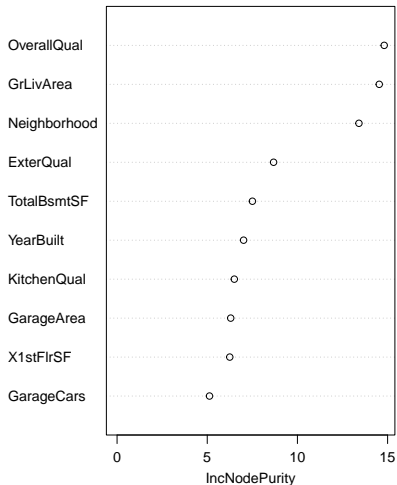
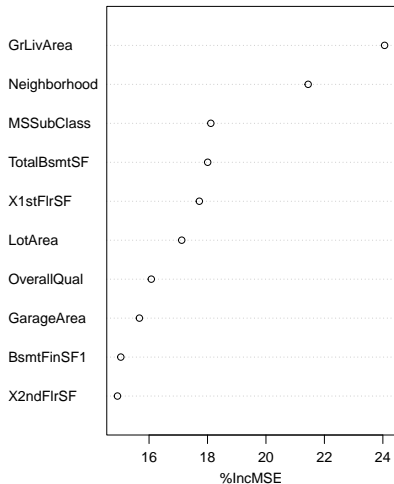
- Variety of Trees-Based Methods used
 - Curious which model might perform better
 - Allow for good prediction
 - Goal is to predict Sale Price
 - Allow for ease of interpretation
 - Good visualization
 - Suggest which variables are most significant

Decision Tree

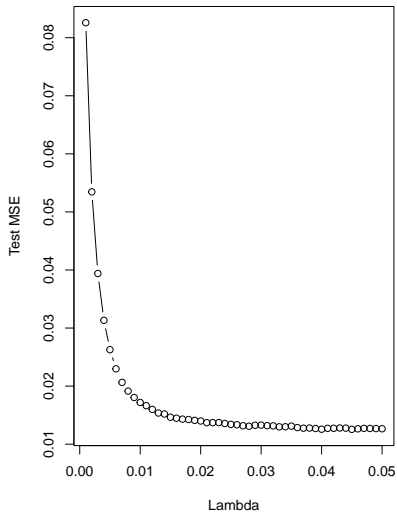
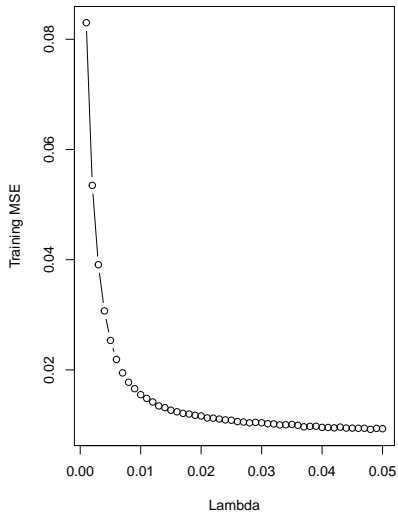


Random Forest

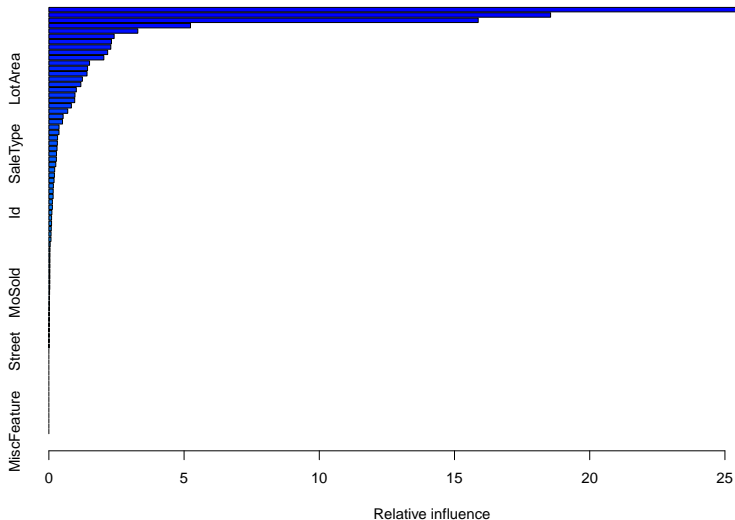
Variables with most Predictive Power



Boosting



Boosting Cont.



```
##                var      rel.inf
## OverallQual    OverallQual 28.620280312
## GrLivArea      GrLivArea  18.553677330
```

Boosting Cont.

##		var	rel.inf
## OverallQual	OverallQual	28.620280	
## GrLivArea	GrLivArea	18.553677	
## Neighborhood	Neighborhood	15.875801	
## TotalBsmtSF	TotalBsmtSF	5.237568	
## KitchenQual	KitchenQual	3.289479	
## OverallCond	OverallCond	2.414015	
## X1stFlrSF	X1stFlrSF	2.315245	
## GarageType	GarageType	2.290376	
## GarageArea	GarageArea	2.174446	
## ExterQual	ExterQual	2.032960	
## YearRemodAdd	YearRemodAdd	1.504338	
## CentralAir	CentralAir	1.431267	
## BsmtFinSF1	BsmtFinSF1	1.411325	
## LotArea	LotArea	1.239949	
## SaleCondition	SaleCondition	1.182974	

Lasso

- Many predictor variables (72 total)
- Desire to determine which subset to use
- Allow for ease of interpretation

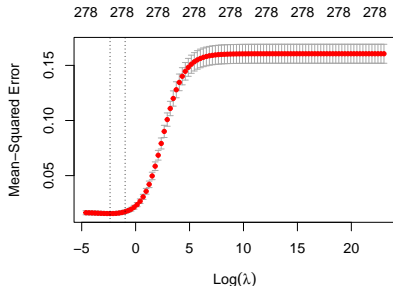
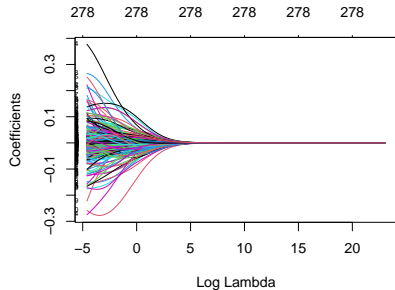


Table of Test MSE Values

Table 1: Test MSE Values for Different Models

Model	MSE
Decision Tree	0.0394
Random Forest	0.0097
Boosted Forest	0.0126
LASSO	0.0165

Outside Exploration

- Wanted to attempt to use best model to predict sale prices in Northern Colorado
- Worked with co-owner of Deluxe Homes LLC
- Some issues were discovered:
 - Using models:
 - Overall Quality and Neighborhood are significant
 - Quality is subjective
 - Neighborhood is very different from Ames, Iowa
 - Additional aspects not considered:
 - Supply and price of building materials can change
 - Soil quality will impact price of foundation
- Data snapshot in time

References

Ames, Iowa: Alternative to the Boston Housing Data as an ...
<http://jse.amstat.org/v19n3/decock.pdf>.

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Sprecher, Stu. “Deluxe Homes LLC Housing Prices.” 1 Dec. 2021.