BEST FEATURES
TO FETCH HIGHER HOUSE SALE PRICES

Group 2: Adi, Priscilla, Yong Lim, Zhi Hong

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Background

OUR COMPANY

MyHome is an online property listing platform that connects home sellers with potential buyers. The website also provides data-driven recommendations on price trends based on details of the listings to help users optimise their bid/sell prices.

PROBLEM STATEMENT

As analysts with MyHome, the aim of this study is to:

1) Create a regression model to predict home sale prices based on the listing details

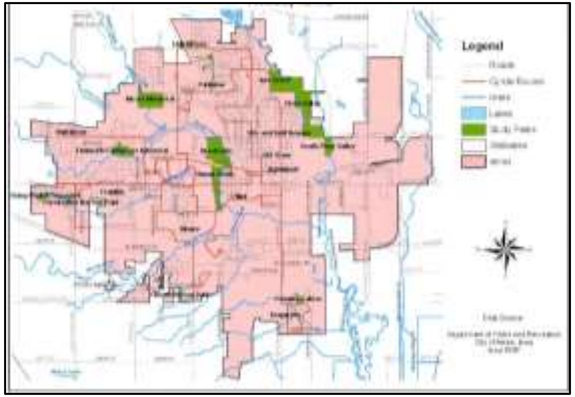
2) Recommend the top 4 features that can fetch higher sale prices for residential properties

MYHOME
REAL ESTATE AT A CLICK

Data Used for Analysis

Ames housing dataset (2006 – 2010)

- 80 variables, 2051 sales entries
- Variables such as sale prices, house size, quality, location, etc
- Continuous, ordinal and nominal variables



Map of neighbourhood locations in Ames

Data Cleaning

1. **Rename column headers to more intuitive names**
2. **Change variable data type to facilitate calculations later**
3. **Map ordinal variables to numeric scale**
4. **Removed outlier data rows based on sale price**
5. **Check and impute missing values**
6. **Drop columns**
   - Too many missing data points
   - Too many of the same values within the column (80% threshold)
   - No significant sale price change observed across categories
   - Identifiers (does not affect trend)
   - Replaced by engineered variables (to be discussed later)

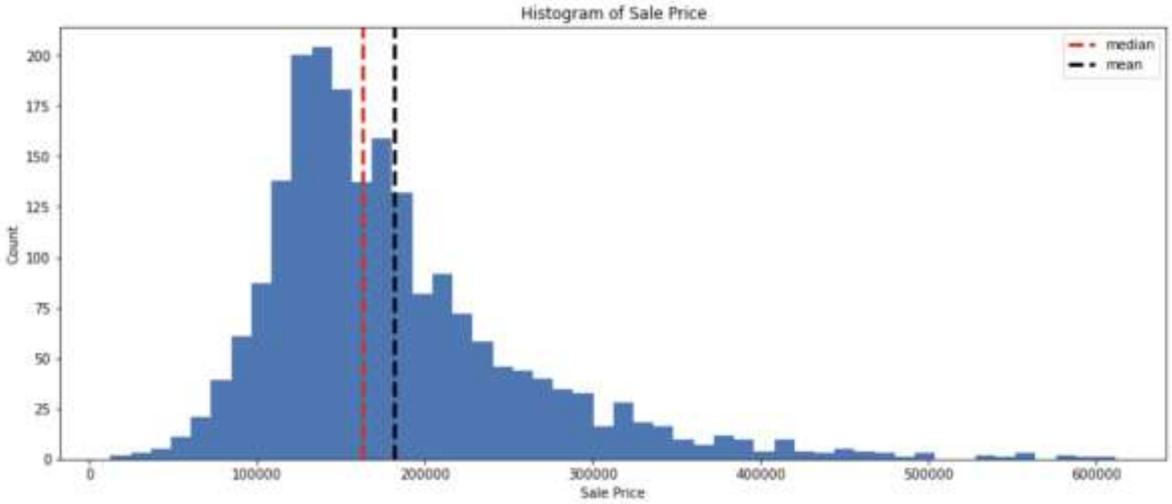
Outliers based on Living Area vs Sale Price

2 outliers are found based on the data:

- Living Area > 4,000 sqft
- Sale Price < $300,000

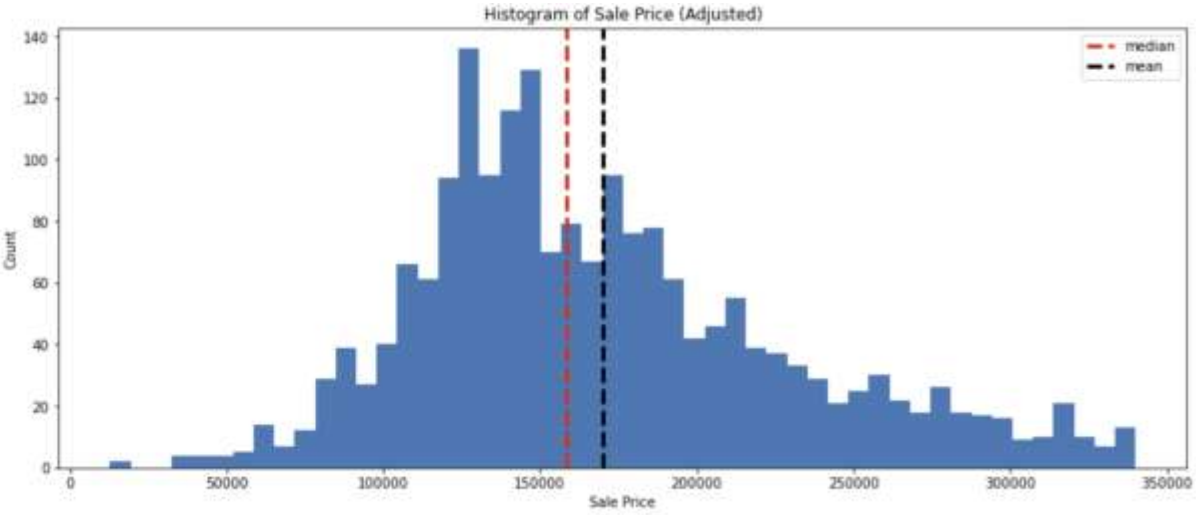
Inappropriate interpretation of the Sale Price based on the Living Area sqft

Outliers based on Sale Price



- To remove high variability outside the upper and lower quartiles on the Sale Price
- Skewness = 1.556

Adjusted Sale Price Histogram



- 95 rows are removed
- Skewness after adjustment = 0.66

Nominal Features to be Excluded

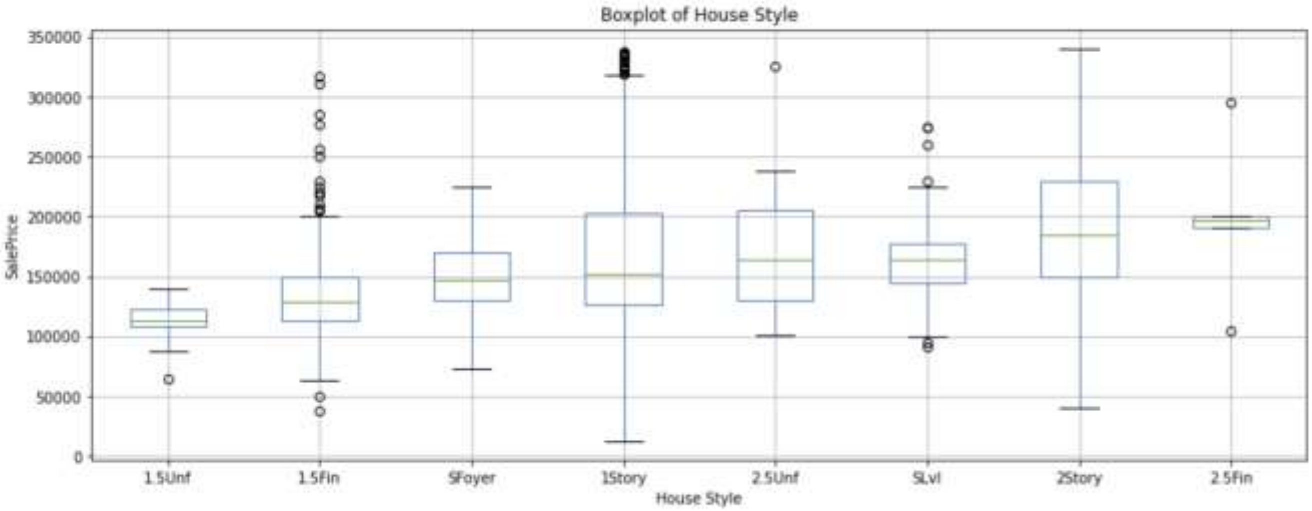
From the histogram of the nominal features, the features below will not be significant since more than **80%** is the same type thus will not be considered:

- Street
- Alley
- Land Contour
- Condition 1
- Condition 2
- Bldg Type
- Roof Style
- Roof Matl
- Heating
- Central Air
- Misc Feature
- Sale Type

The features also will not be included in the model:

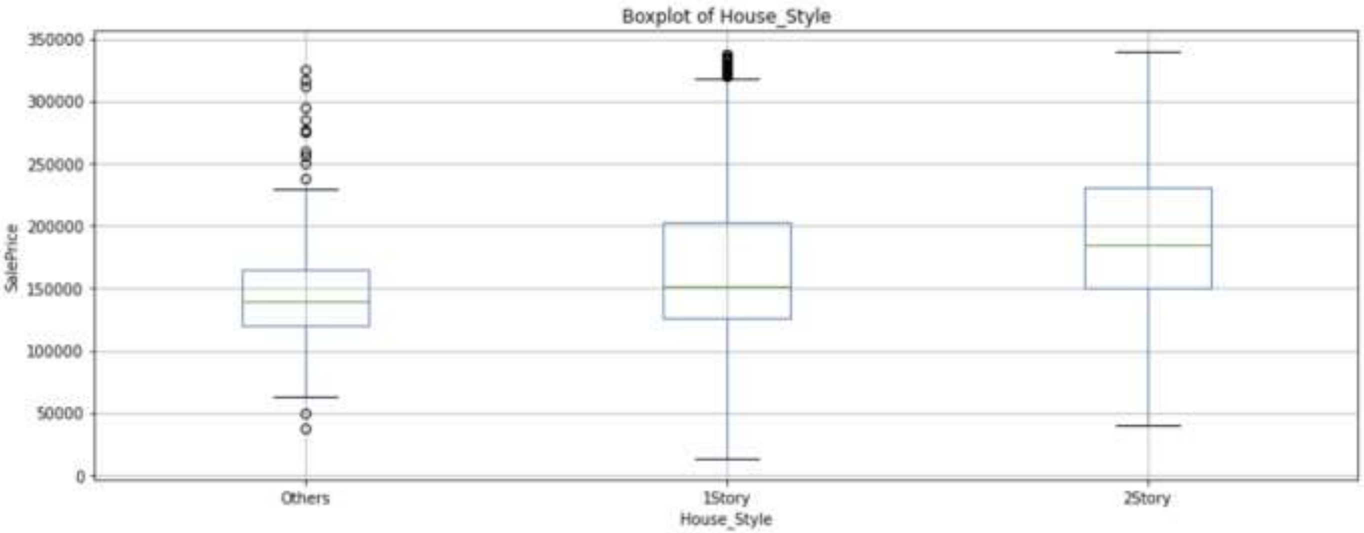
- MS SubClass, overlapped with Bldg Type & Year Built and difficult to interpret
- MS Zoning, overlapped with Neighborhood
- PID, for indexing only
- ID, for indexing only

Boxplot of House Style with Sale Price

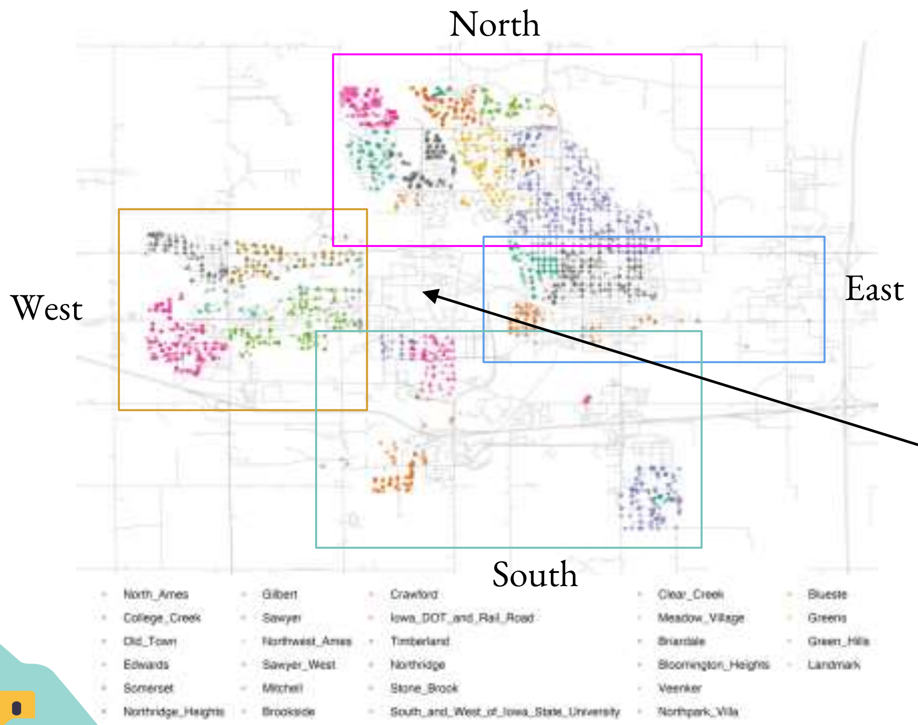


House Style	Proportion
1 Story	0.515
2 Story	0.286
1.5 Fin	0.111
SLvl	0.047
SFoyer	0.026
2.5 Unf	0.007
1.5 Unf	0.006
2.5 Fin	0.003

Boxplot of House_Style with Sale Price



Neighborhood Map of Ames

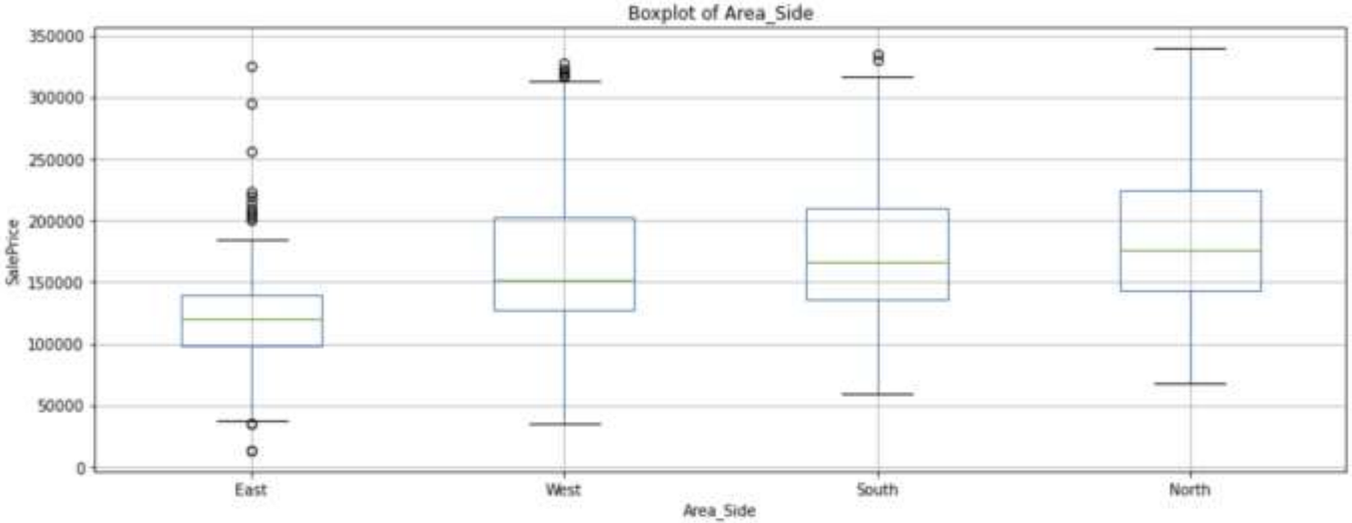


Group based on the location as of the IOWA State University

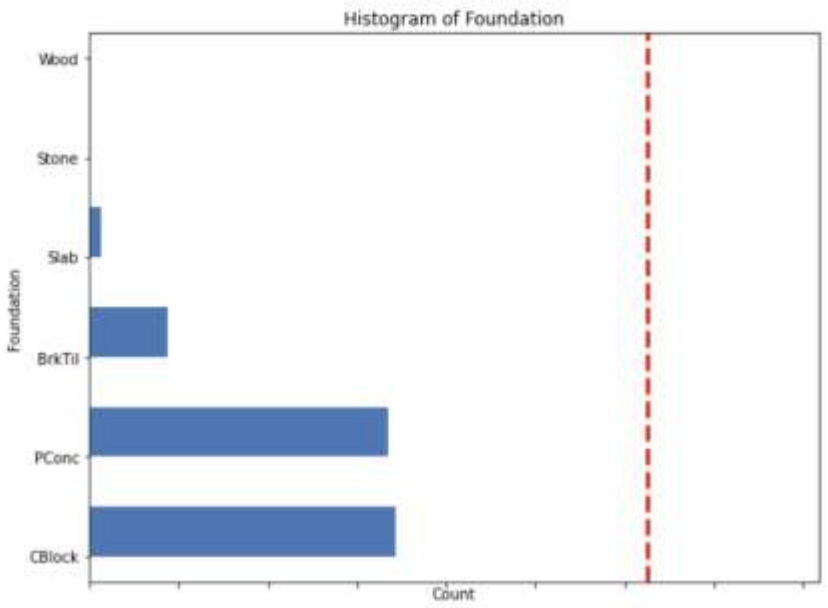
Iowa State University

Correlation of Area with Sale Price

After grouping, the feature to be used for modelling to check if location affects the sale price



Histogram of Foundation

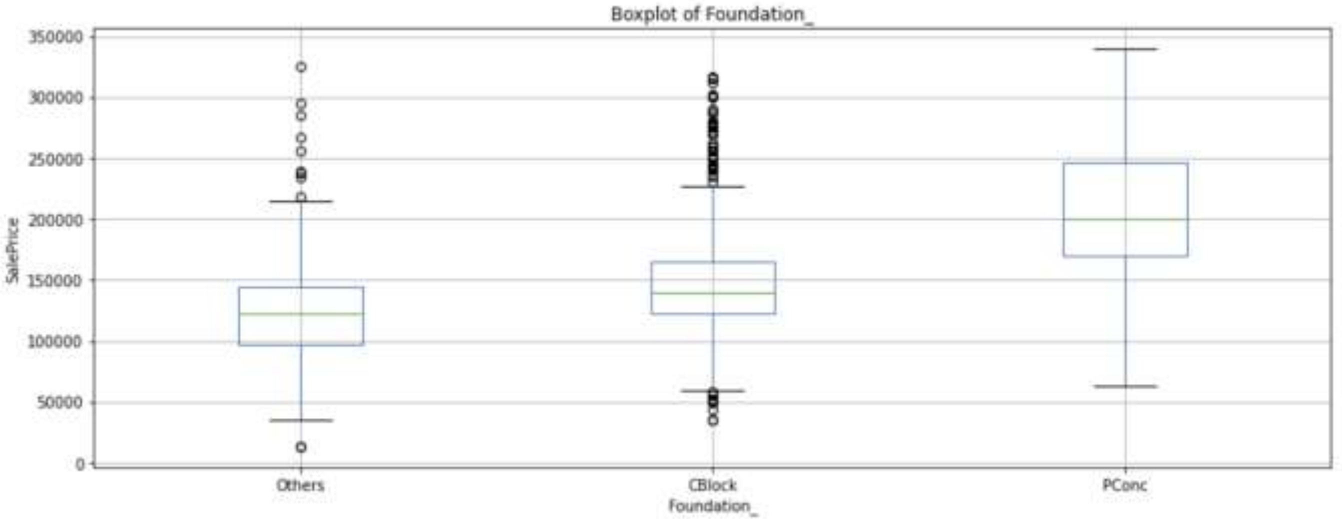


Grouping based on the value counts into 3 categories:

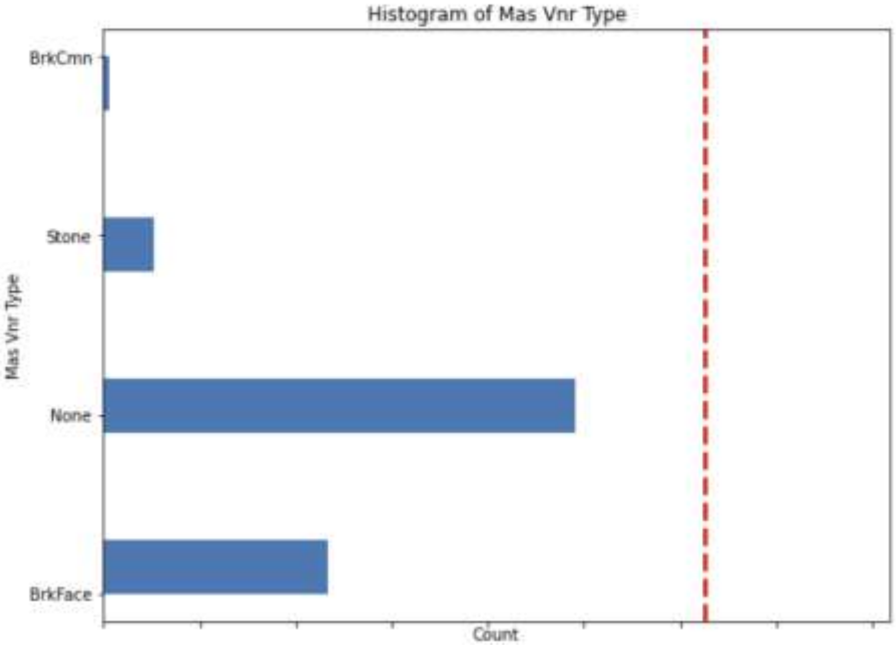
- Cinder Block
- Poured Concrete
- Others

Correlation of Newly Categorised Foundation with Sale Price

There is slight difference in the interquartile range between each category

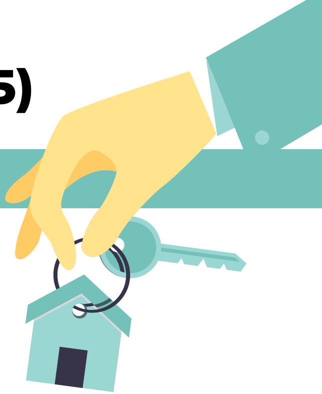


Histogram of Masonry Veneer Type



- Grouping based on availability

Correlation of Numerical Features with Sale Price (p>0.5)



Features	Correlation (p)
Overall Qual	0.789617
Gr Liv Area	0.677887
Exter Qual	0.669849
Kitchen Qual	0.647822
Garage Cars	0.626066
Garage Area	0.615088
Year Built	0.600998
Total Bsmt SF	0.589474
Bsmt Qual	0.588699
Year Remod/Add	0.573572
1st Flr SF	0.566783
Garage Finish	0.566342
Full Bath	0.556303
Fireplace Qu	0.514253

- Quality for every area has high correlation with the Sale Price
- Area also has high correlation

- High collinearity features:
    - Fireplaces and Fireplace Qu (p = 0.86)
    - Overall Qual and Exter Qual (p = 0.72)
    - Total Bsmt SF and 1st Flr SF (p = 0.79)
    - TotRmsAbvGrd and Gr Liv Area (p = 0.8)
    - Garage Cars and Garage Area (p = 0.89)

Feature Engineering (1 of 2)

- Total Bath:

  Full Bath + 0.5(Half Bath) + Bsmt Full Bath + 0.5(Bsmt Half Bath)

- Bedroom to Bathroom Ratio:

  Total Bedroom / Total Bath

- Age of the property as of the year sold:

  Year Sold - Year Built

- Age of the property as of last renovation:

  Year Sold - Year Add/Remod

- Basement QC:

  Total Basement Area x Basement Qual

Feature Engineering (2 of 2)

- Fireplace QC:

    No of Fireplaces x Fireplace Quality

- Overall + External Quality:

    Overall Quality x External Quality

- Area Room Ratio:

    Gr Liv Area/TotRmsAbvGrd

- Garage Ratio:

    Garage Area/Garage Cars

- Ext_Facilities_Area:

    Wood Deck Area + Oper Porch Area + Enclosed Porch Area + Three Season Porch Area + Screen Porch Area

Correlation of New Features with Sale Price

Features	Correlation (p)
Total_Bath	0.64
BR_Bath_Ratio	-0.43
Age	0.6
Age_Renov	-0.57
Bsmt_QC	0.61
Fireplace_QC	0.5
Ovrll_Exter_Qual	0.79
Area_Rm_Ratio	0.56
Garage_Ratio	-0.031
Ext_Facilities_Area	0.37

- Features to be retained with p value > 0.5:
  - Total_Bath, remove Full Bath
  - Age, remove Year Built
  - Age_Renov, remove Year Add/Remod
  - Bsmt QC, remove Total Bsmt SF
  - Area_Rm_Ratio

- Garage Cars feature to be removed as well (Garage Area p-value higher than Garage Cars)

Features to be Included in the Model

TOTAL FEATURES : 26

NOMINAL FEATURES (DUMMIFIED):

House Style
Foundation
Neighborhood Area
Mas Veneer Availability

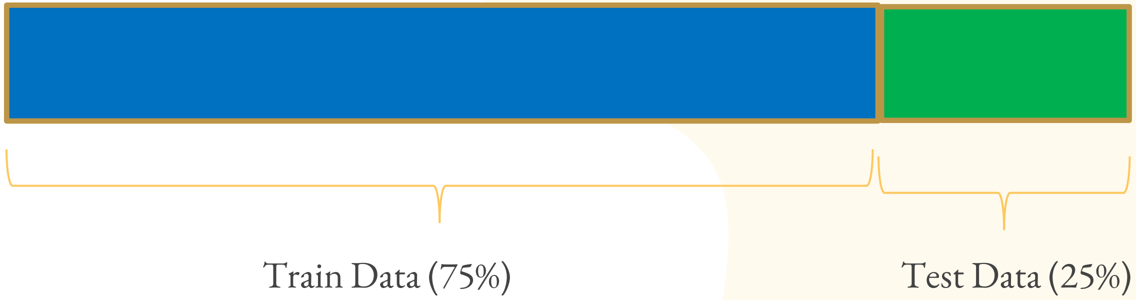
NEW FEATURES :

Total_Bath
Age
Age_Renov
Bsmt_QC
Area_Rm_Ratio

NUMERICAL FEATURES :

Overall Qual
Exter Qual
Bsmt Qual
1st Flr SF
Gr Liv Area
Kitchen Qual
Fireplace Qu
Garage Finish
Garage Area

Train Test Split



Regression Model

Linear Regression

Score: 0.85285

Cross-Validation

Lasso Regression

Score: 0.85272

Cross-Validation

Ridge Regression

Score: 0.85295

R^2 Accuracy

Ridge Regression

R^2 Score
0.826154 → Root Mean Square Error (RMSE)
22392

Linear Regression

R^2 Score
0.8263 → Root Mean Square Error (RMSE)
22393

Lasso Regression

R^2 Score
0.8257 → Root Mean Square Error (RMSE)
22393

Conclusions

1. Various area and quality of the house showed a strong correlation with the housing prices

2. Neighborhood location also showed a strong correlation with the housing prices.

3. Ridge Regression shows the best performance in predicting the sale price of the house

Recommendations

#1
Living Area
- ↑ Area
- ↑ Price (~$16K)

#2
Overall Quality
- ↑ Quality
- ↑ Price (~$12K)

#3
Location
- ↑ North South West East
- ↑ Price (~$12K)

#4
Basement Quality
- ↑ Higher height
- ↑ Price (~$7K)

Recommendations (For buyers)

1. Invest in renovation

2. Invest in:
   - Bigger house
   - House located in North
   - House with higher basement height

3. For buyers with budget constraint, keep a lookout on cheaper deal (e.g. East location) so that they can allocate their budget accordingly based on their preference

Recommendations (For sellers)

1. Highlight the quality of the house
2. Highlight the basement height
3. Ask for higher price if has a big house or located in North

Future Actions

1. Update data set with current year data 2011

2. Important features to make it compulsory during data collection to reduce missing values

3. Research on new features in view home buyer/seller’s perspective may change (e.g. with younger generation buying house)

OUR TEAM

Adi Hartanto Kusuma

Priscilla Ng

Tan Yong Lim

Kwek Zhi Hong

THANKS

Does anyone have any questions?

myhome.com

Data Cleaning

- **Rename columns to more intuitive names**
- **Change variable data type to facilitate calculations later**
- **Map ordinal variables to numeric scale**
- **Removed outlier data rows based on sale price**

- **Check and impute missing values**
  - With suitable value depending on data type and inference from other columns

- **Drop columns**
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  - Too many of the same values within the column (80% threshold)
  - No significant sale price change observed across categories
  - Identifiers (does not affect trend)
  - Replaced by engineered variables (to be discussed later)