



Regression Analysis for Housing Prices in Ames, Iowa


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Agenda

- ◎ Background
 - ◎ Problem Statement
 - ◎ Existing Prediction Model
 - ◎ Exploratory Data Analysis
 - ◎ Recommended Prediction Model
 - ◎ Conclusion and Recommendations
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A decorative network diagram in the top-left corner, featuring a complex web of interconnected nodes and lines. The nodes are represented by small circles, some of which are larger and have concentric circles, suggesting a hierarchical or multi-layered structure. The lines are thin and gray, connecting the nodes in a non-linear fashion.

1.

Background

Who we are and what we do




Who we are

- ◎ Reputable real estate agency established in 1990
- ◎ Top agency in Ames, Iowa for achieving high sales volume in the last 20 years
- ◎ Well-known for our proprietary ***Prop-Price Estimator*** ©
 - *What it is:* A prediction model that provides customers with best estimated price for their property



How does Prop-Price Estimator© work?

Paid buyer's access



Ames Property Group

\$299,900 3 bd | 4 ba | 1,540 sqft
5023 Kansas Dr, Ames, IA 50014

For sale **Estimate** **\$295,423**

Est. payment: \$1,900/mo [Get pre-qualified](#)

[Request a tour](#)
as early as today at 11:00 am

[Contact agent](#)

[Overview](#) [Facts and features](#) [Home value](#) [Price and tax](#)

[Schedule a tour](#)

Likely to sell faster than 92% nearby.

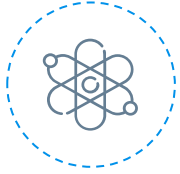
- Single family residence
- Built in 1993
- Forced air
- Central air
- 2 Attached garage spaces
- 9,109 sqft
- \$195 price/sqft
- 3.00% buyers agency fee

Data collection (For price estimation)

Ames Property Group Home Feature Checklist

- | | Lower Level |
|---|--|
| Kitchen | <ul style="list-style-type: none">Radiant Heat FlooringGas FireplaceFour Large Windows/ Abundant Natural LightBuilt-in Shelving for TVKitchenette with Full Fridge and Built-in Oven and MicrowaveCurtain CountertopsIntegrated SinkUnder Cabinet Lights8" Deckover Entrance Room/Chf RoomKids Play NookHeated Tile Flooring in Hall |
| Great Room | |
| <ul style="list-style-type: none">Vaulted CeilingWired for Surround SoundGas FireplaceRadiant Heat Flooring | |
| Master Bed and Bath | |
| <ul style="list-style-type: none">Octagonal Tray CeilingCeramic FlooringHeater FanLarge Walk-in ClosetCustomized Marble CountertopsDouble Integrated SinksBirch CabinetsLinen ClosetMaster Walk-in Closet | <ul style="list-style-type: none">Beautiful LandscapingLarge Lot Next to Bike TrailIrreversible FencingHot Water Faucet to BackyardLarge Brick PatioMature Hickory Tree"Portrait Famb" on Driveway |
| Main Bathroom | |
| <ul style="list-style-type: none">Customized Marble CountertopsDouble SinksSeparate Toilet/Shower/Tub AreaHeater Fan in Shower AreaArea for Changing Table | <ul style="list-style-type: none">Extra Large 3-CarDry WallboardPaintedShelvingCharging Station for Electric Car |
| Garage | |

Importance of accurate price prediction



Strategic Pricing

- ◎ Price estimation based on most sought-after property features
- ◎ Maximise seller profit based on market demand



Listing Duration

- ◎ Accurate price lead to increased interest and faster sales
- ◎ Reduce listing management time
- ◎ Decrease buyers' bargaining power



Increase Engagement

- ◎ Remain go-to agency for clients
- ◎ Generate trust in our data-driven technology

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2.

Problem Statement

The challenge at hand

Problem statement & objective



- ◎ Increasingly competitive real estate market
 - Competitors offer higher-accuracy predictions
- ◎ Shrinking market share
 - More customers looking for better predictions

- ◎ Data scientists tasked to improve prediction accuracy
 - Enhance existing model or develop a new one
- ◎ Model must beat top competitors

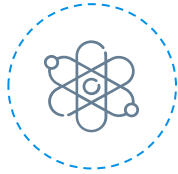


3.

Existing Prediction Model

The science behind the Prop-Price Estimator©

What we are currently using



Ridge Regression Model

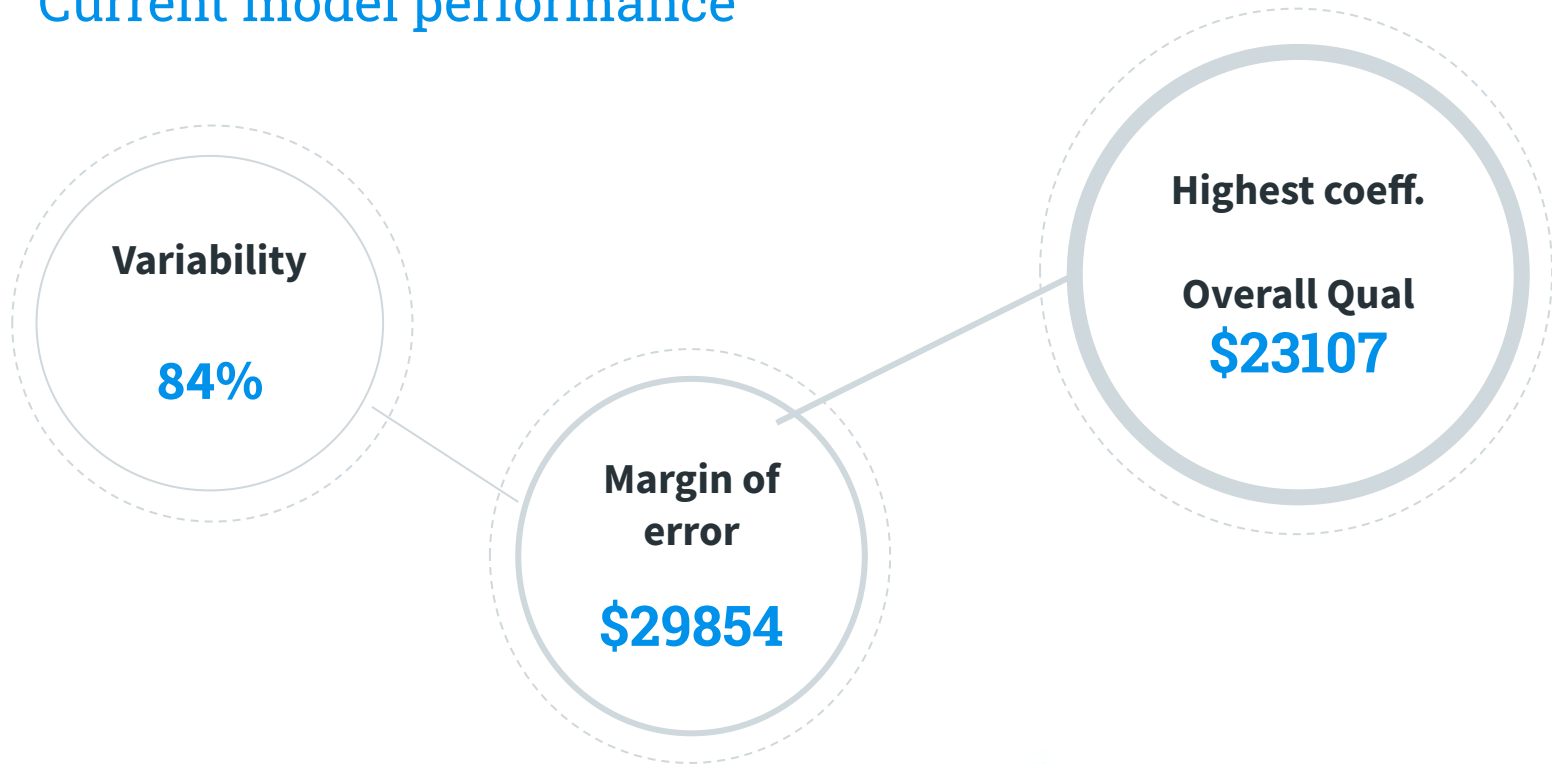
- ⊙ Designed by external vendor
- ⊙ Deployed 2 years ago
- ⊙ Retrains with new data every two months



Key Variables

- ⊙ Overall Material Quality
- ⊙ Living Area size
- ⊙ Neighborhood
- ⊙ 1st Floor area
- ⊙ Garage Area
- ⊙ Basement Quality

Current model performance



Why we need to upgrade our model

External Factors



Market competition

- Rising number of competitors
- Shift of focus toward prediction accuracy
- Competitors error margin is 27.000\$



Increasing customer demands

- For more accurate selling price
- Fast and simple prediction
- Better recommendations to optimize property value

Why we need to upgrade our model

Internal Factors



Brand

- Reputation as number 1 predictor in the market
- Defend market leader position in the housing market

Client trust for over two generations



Cost management

- Run time of model
- Memory usage and technology management
- Better recommendation support for our agents

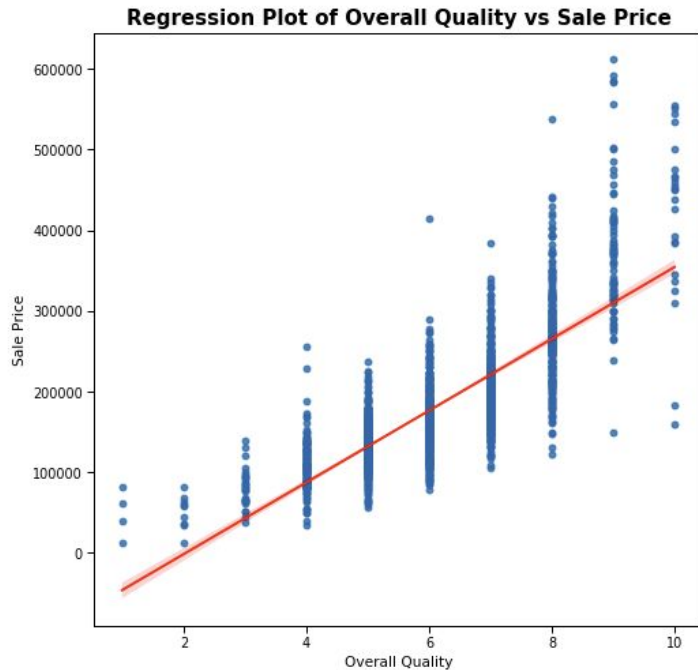


4.

Exploratory Data Analysis

Deriving insights through new data set

Overall Quality positively correlated with Sale Price



- The average overall quality is 6.11
- Average sale price for top, mid and low quality:
 - Rated 10: \$417,397
 - Rated 6: \$134,964
 - Rated 1: \$28,725

Ground Living Area positively correlated with Sale Price^(1/3)



- The ground living area is 1,499 square feet
- Most ground living area range from 1,129 to 1,728 square feet

Kitchen Quality positively correlated with Sale Price

Ordinal values were scaled from 0-4



The average housing prices based on kitchen quality:

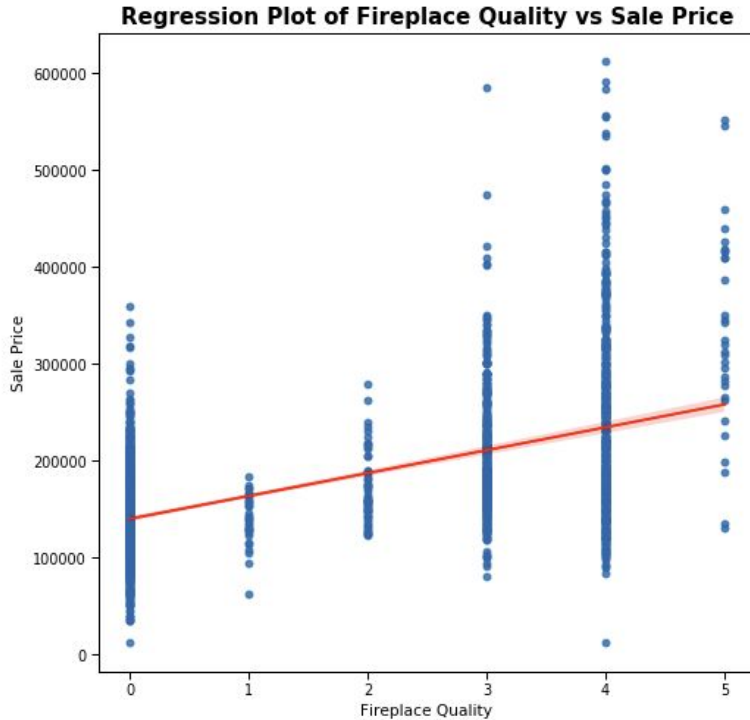
- Excellent - \$336,424
- Good - \$211,639
- Typical/Average - \$139,502
- Fair - \$101,335



Better-rated kitchen will result in higher price

Fireplace Quality positively correlated with Sale Price

Ordinal values were scaled from 0-5



The average housing prices based on kitchen quality:

- Excellent - \$331,481
- Good - \$233,578
- Typical/Average - \$204,894
- Fair - \$170,287
- Poor - \$139,264



Better-rated fireplaces will result in higher price

Garage Cars positively correlated with Sale Price



The average housing prices based on number of cars in a garage:

- 5 cars - \$126,500
- 4 cars - \$229,653
- 3 cars - \$309,383
- 2 cars - \$184,037
- 1 car - \$126,916
- No garage - \$105,669



Being able to fit more cars in a garage will result in higher price

Newer built homes have higher Sales Prices



The average sale price of oldest homes:

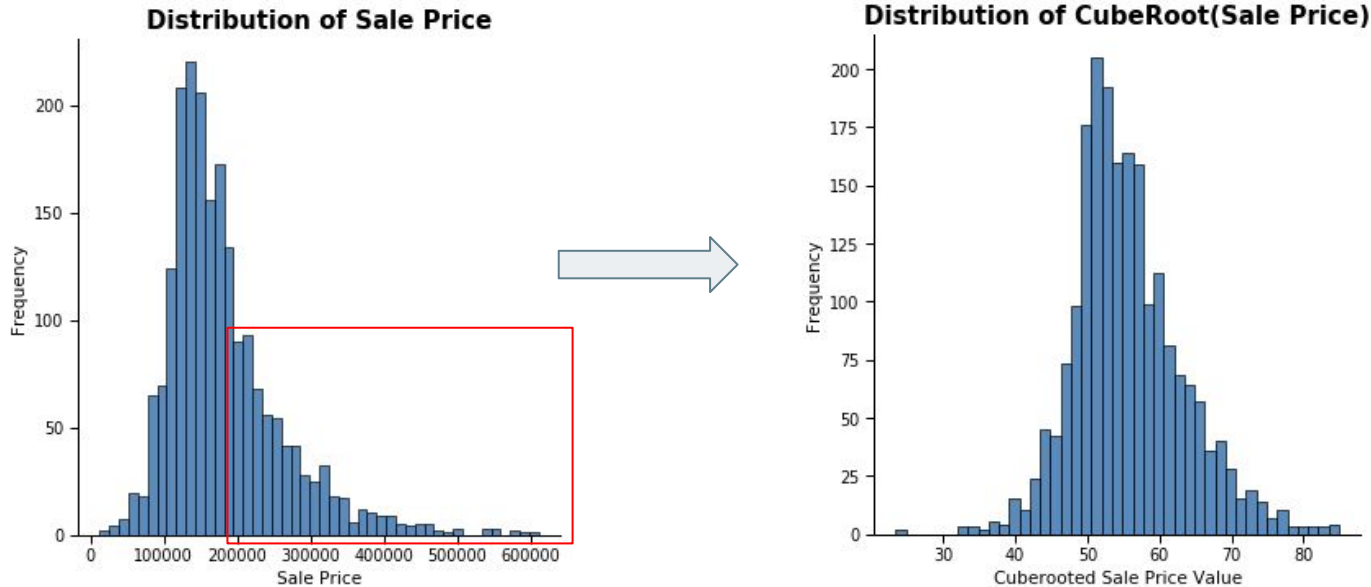
- 1872 - \$122,000
- 1875 - \$94,000
- 1879 - \$185,000



The average sale price of newer homes:

- 2010 - \$267,916
- 2009 - \$294,460
- 2008 - \$326,057

Applying cube root resolves right skewness of sale price distribution



The average sale price of a house in Ames, Iowa is \$181,469

The smallest transaction was \$79,259, while the largest price sold was \$611,657

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5.

Recommended Pricing Model

How we can regain our edge

LINEAR REGRESSION

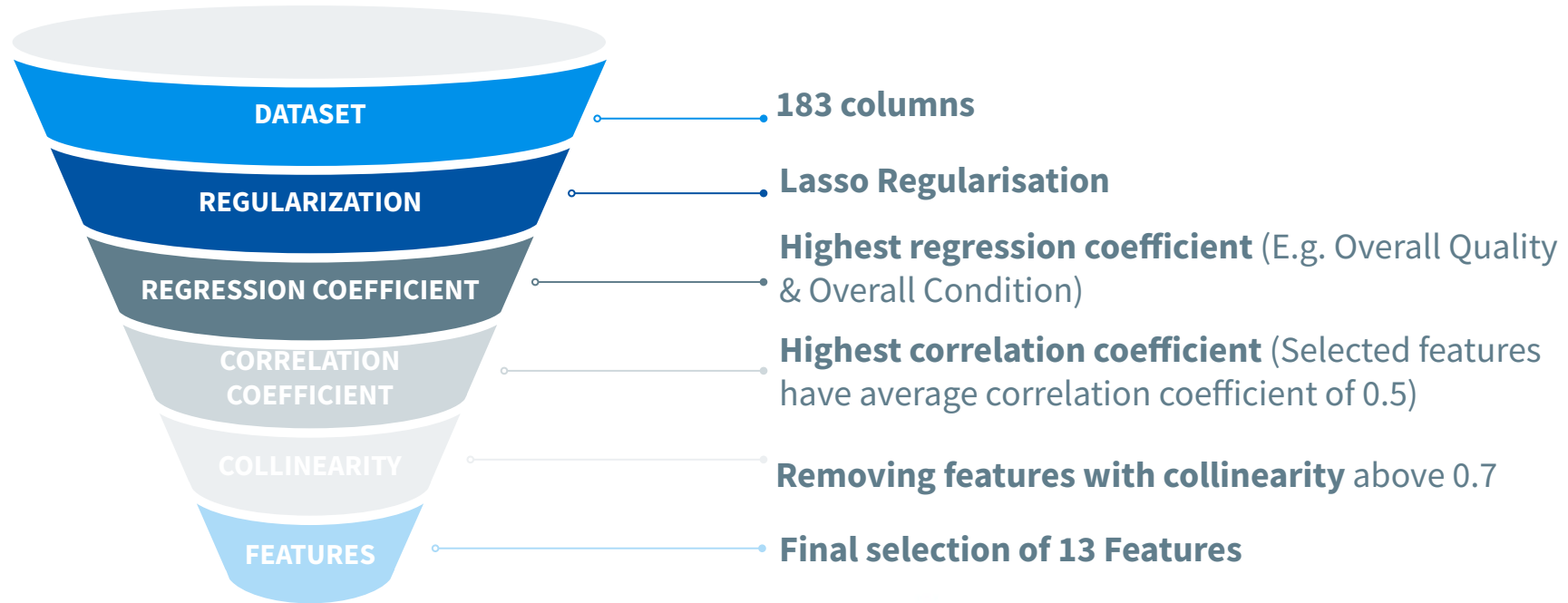
LINEAR REGRESSION EVERYWHERE

imgflip.com



Selected Features

Which features we want to use



Selected housing features

5

Ordinal

Overall Quality

Overall Condition

Kitchen Quality

Fireplace Quality

Basement Exposure

7

Numerical

Year Built

Misc Value

Total Basement Area

No. of cars the garage
can fit

Type 1 finished sf

Abv ground living area

Lot Area

1

Categorical

Neighborhood
(NorthRidge Heights)



Evaluation of Models

How we'll be measuring performance

**High R2
Score**

0 - 100%



**Low Root
Mean
Squared
Error**
(\$ Value)

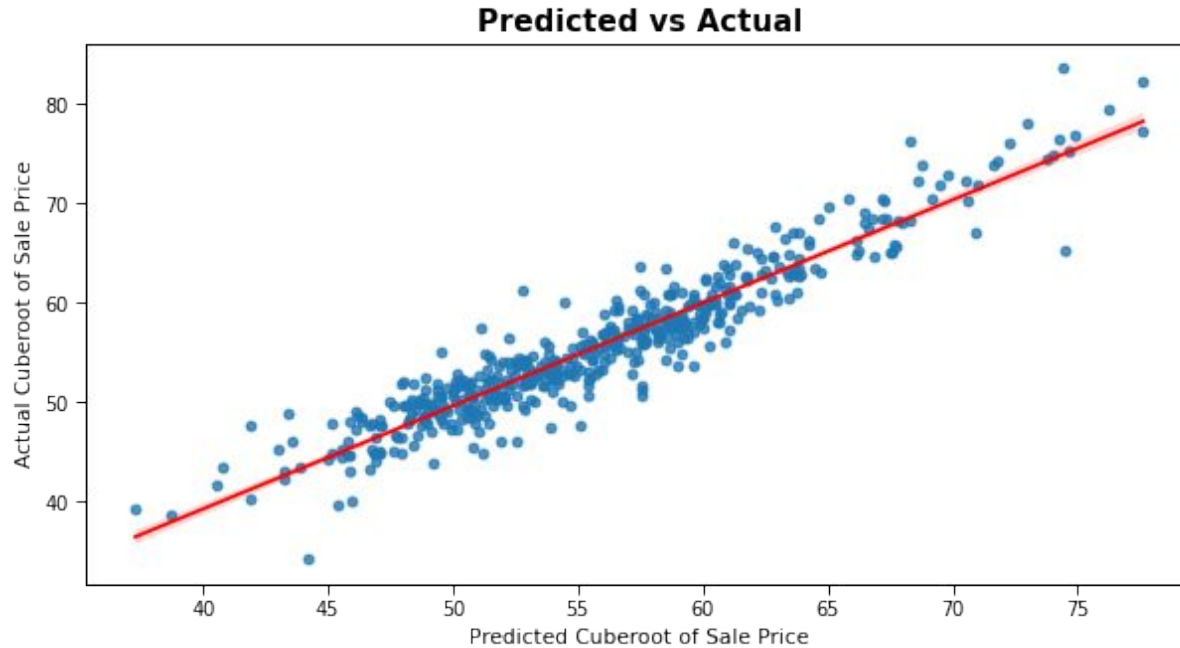


**Optimal
No.of
Features**

How our new model is faring

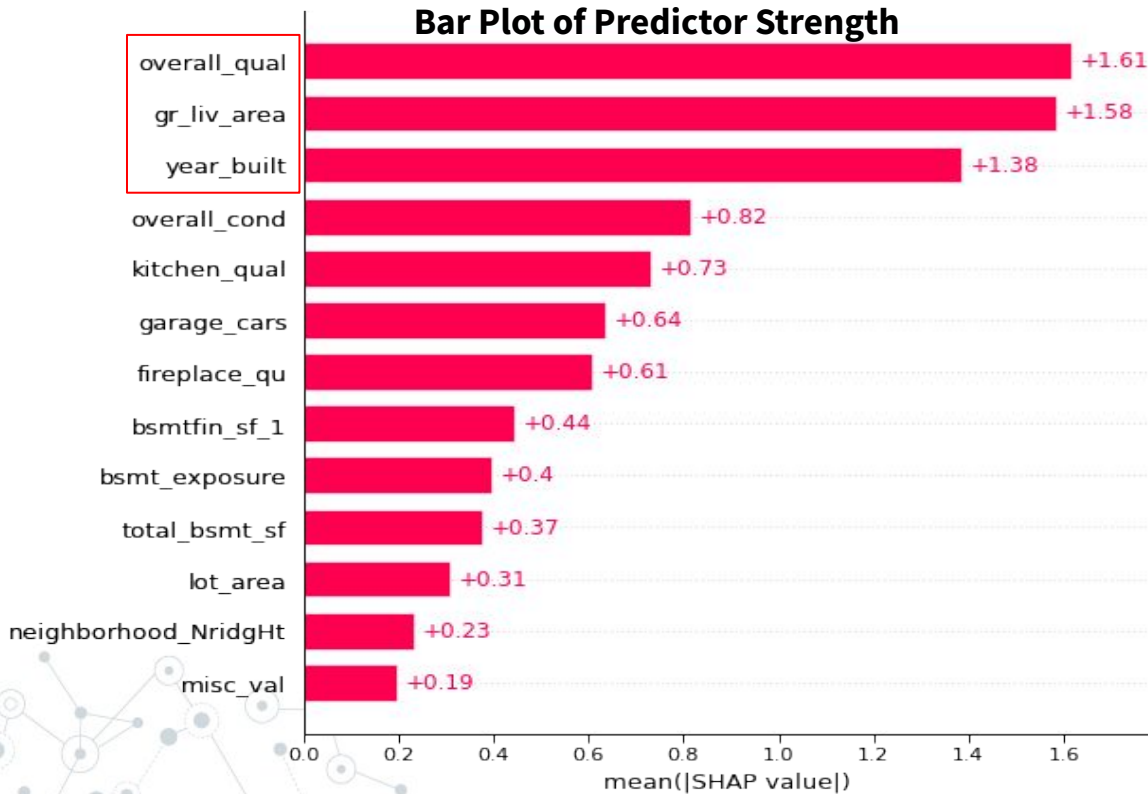
	TRAINING SET R ² SCORE (%)	TEST SET R ² SCORE (%)	MARGIN OF ERROR (\$)	# OF HOUSING FEATURES
Current Model	83.22	83.75	29,854	6
Market Best	84.12	85.57	27,000	17
New Model	86.96	89.55	24,488	13

Predictive capabilities and reliability



Predicted values are within close proximity of **actual values**

Influence of each feature on pricing



Top 3 Predictors

1. Overall Quality
2. Above ground living area (Sq. ft.)
3. Year Built

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6.

Conclusion & Recommendations

Summing up our findings

In a nutshell

Current Price Predictors

- ❑ Overall Material Quality
- ❑ Living Area size
- ❑ Neighborhood
- ❑ 1st Floor area
- ❑ Garage Area
- ❑ Basement Quality

*With our new
prediction model*



New Set of Variables

- ❑ Overall quality
- ❑ Living area size
- ❑ Year built
- ❑ Overall condition
- ❑ Kitchen quality
- ❑ Capacity of garage
- ❑ Fireplace quality
- ❑ Basement size
- ❑ Basement exposure / access
- ❑ Lot area
- ❑ Neighborhood

Black: Existing variables
Blue: New additions

Prediction model limitations



Sensitivity

Model sensitivity to outliers whenever there's huge difference in features and/or price



Overlaps

Overlapping characters and input for categorical variables, e.g. quality ratings "Average" and "Fair" sound similar



Representation

Unrepresentative data from each neighbourhood



External Factors

Economical push that influence house prices such as the [2008](#) housing crisis in the US

Building more accurate prediction model

Counsel homeowners to improve property's market value through the top predictors



Further investigate features and ensure representation in data collection



Ensure all home listings feature the top predictors



Better define characteristics for categorical variables





Thanks!

Any questions?

You can find us at:
intelligence@ameshousegrp.com