Phase 2 Project

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Overview

Client: Zillow Home Group Inc.

Source: King County House Sales

Parameters Used:

- **Dependent** - Price
- **Independent** - Square Feet of Living, Grade, and House Age
  - Extra categorical variables were used

Business Problem

- What makes an expensive house?
- Is the house price market correctly?
- Could we predict the price of a house?

Objective

Zillow Estimation Tool: Zestimate

- Company's Algorithm
- Median Error Rate - **2.4% to 7.49%**

Objective:

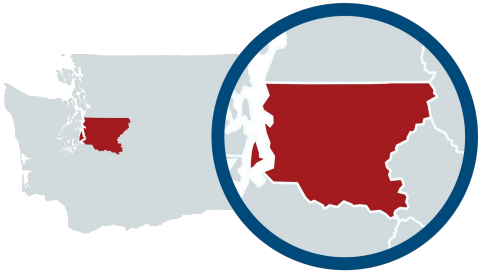
Create a model to incorporate with or replace currently placed algorithm in hopes to improve accuracy for seller and buyers.

Data

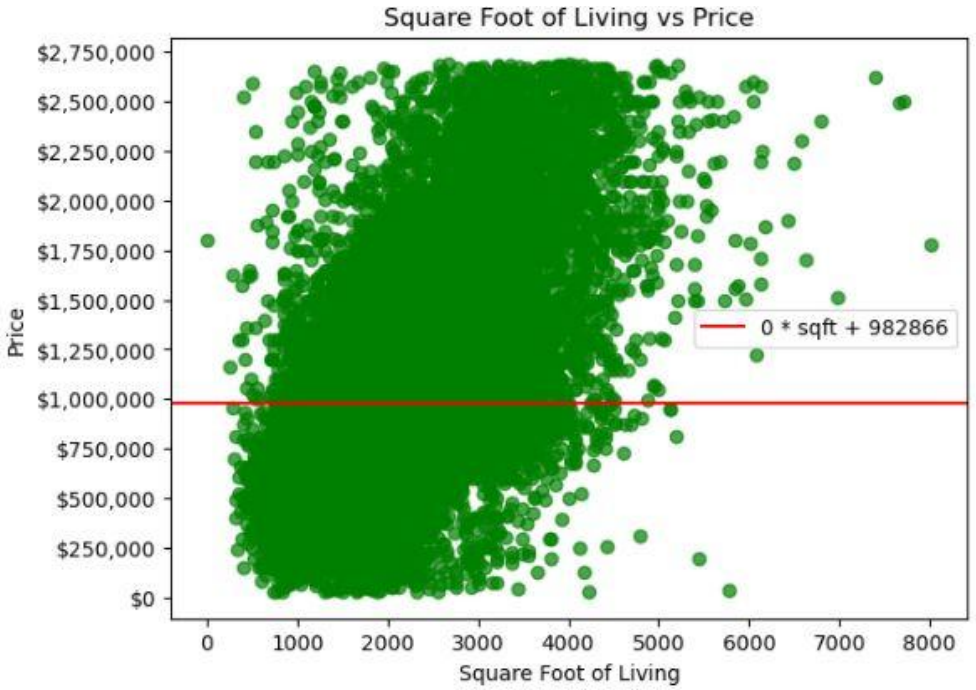
- **30154** samples (3%)
- **25** columns or attributes
- **Numerical** and **Categorical** data types

King County

Analysis should only be applied to houses in King County, Washington



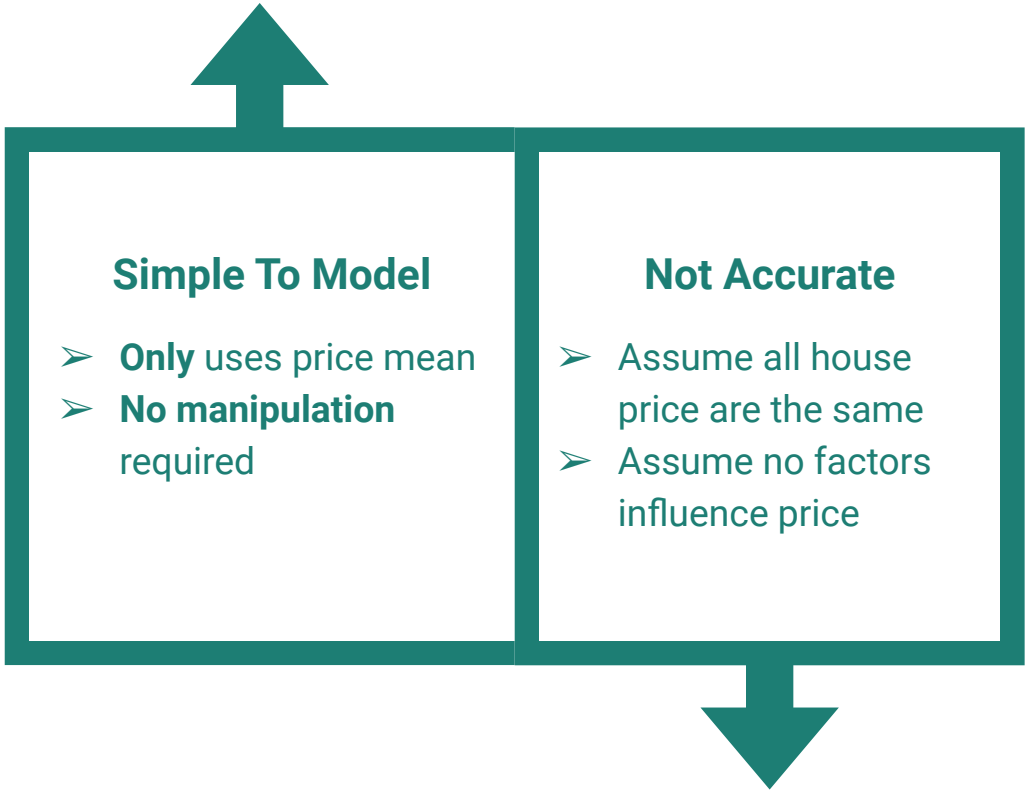
Baseline Model - Intercept-Only Model



Y = 982,866

Interpretation:
All houses are priced at **$982,866**.

Baseline Model - Limitation



Method

A series of modeling and progression plots:

1. **Highest correlation** - Single Variable
2. **Second Highest** - 2 Variables
3. **...** - Multi-Variable

Added parameters:

- **Interaction Terms** - Top Two Highest
- **House Age** - Modify Year Built

Why Linear Regression

1. Explains the **relationship** between two variables.
2. Can be used to **predict prices** with given variables.

Line of Best Fit:

Price = (sqft_living cost * num sqft) + constant

Model Overview

36.2%

Model 1:
+ Square Feet of Living

- Only 1 parameter
- Relatively low house cost

41.8%

Model 2:
+ Grade

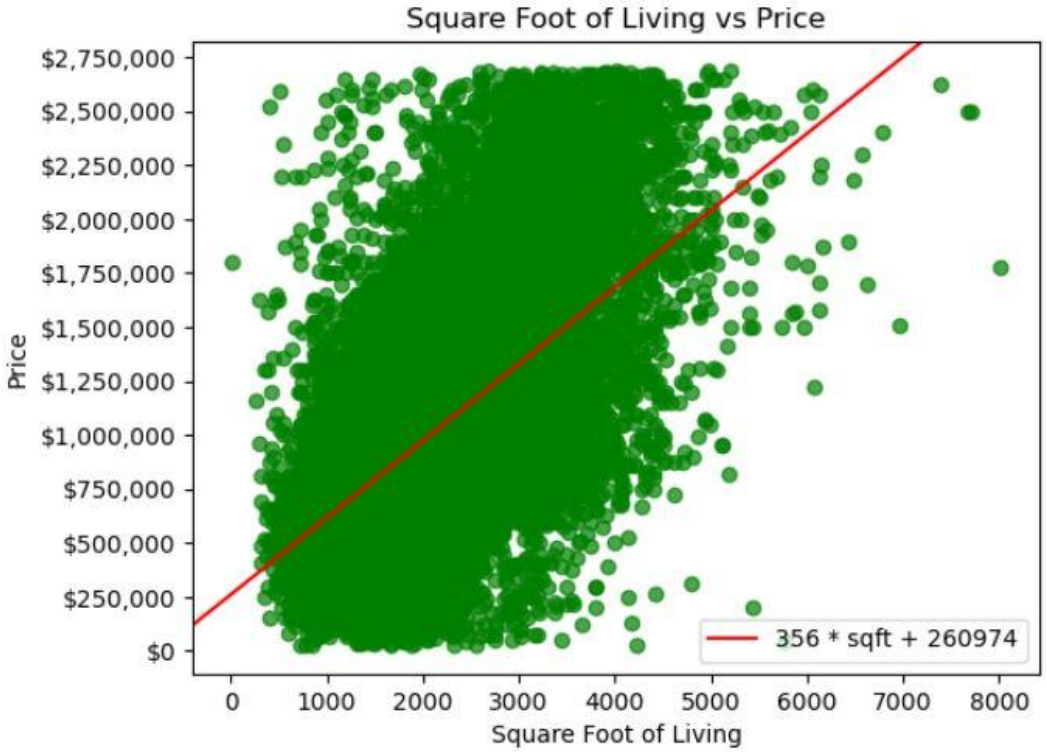
- Two parameters with a negative house cost.
- High grade influence.

46.4%

Model 3:
+ House Age

- A larger negative starting value.
- Lower cost per square foot.
- Bigger grade influence.

Model 1



Interpretation -

- Constant = **$261,000**
- **$356** per square foot

Model 1 Limitations

Simple To Interpret

- **Single** Regression Plot
- **Logical** starting price

Only Explains 36.2% of Variance

- Not Considering **Other parameters**
- “A house with no living cost $261,000”

Multiple Linear Regression

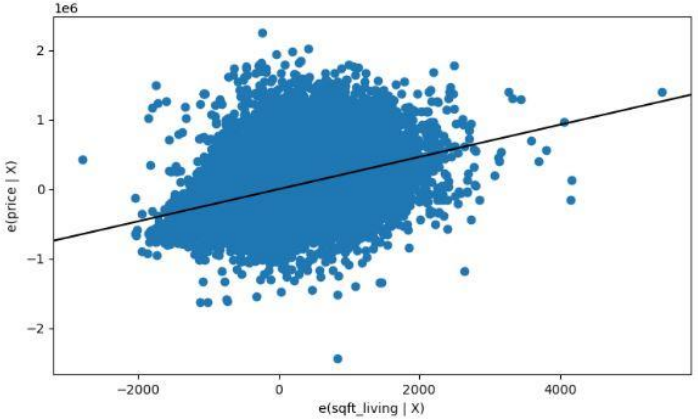
Uses:

- Multiple Variables
- Increase **complexity**

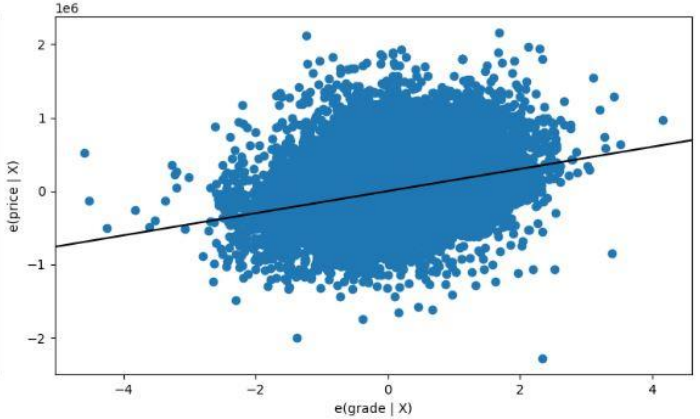
Partial Regression Plots

- Plot values not explained by model against one another
- Shows **benefit** of adding the variable in the model

Model 2



Partial Regression QQ Plot - Sqft_living

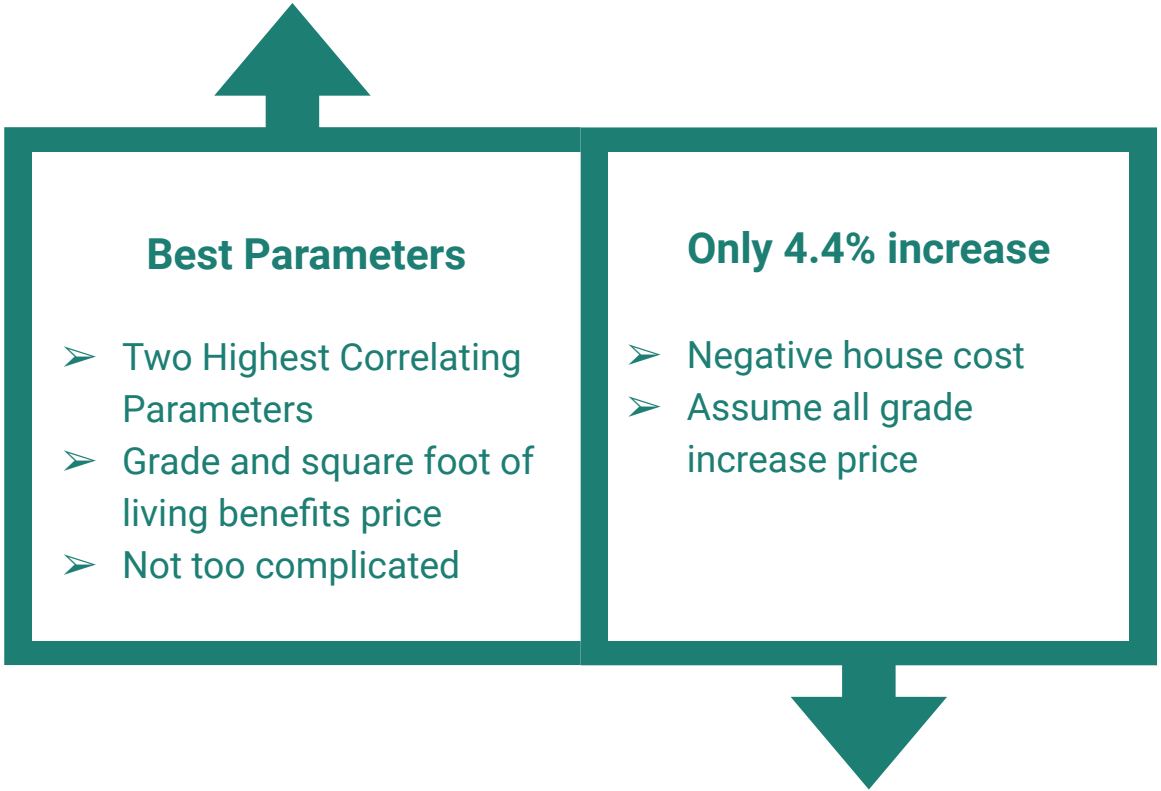


Partial Regression QQ Plot - Grade

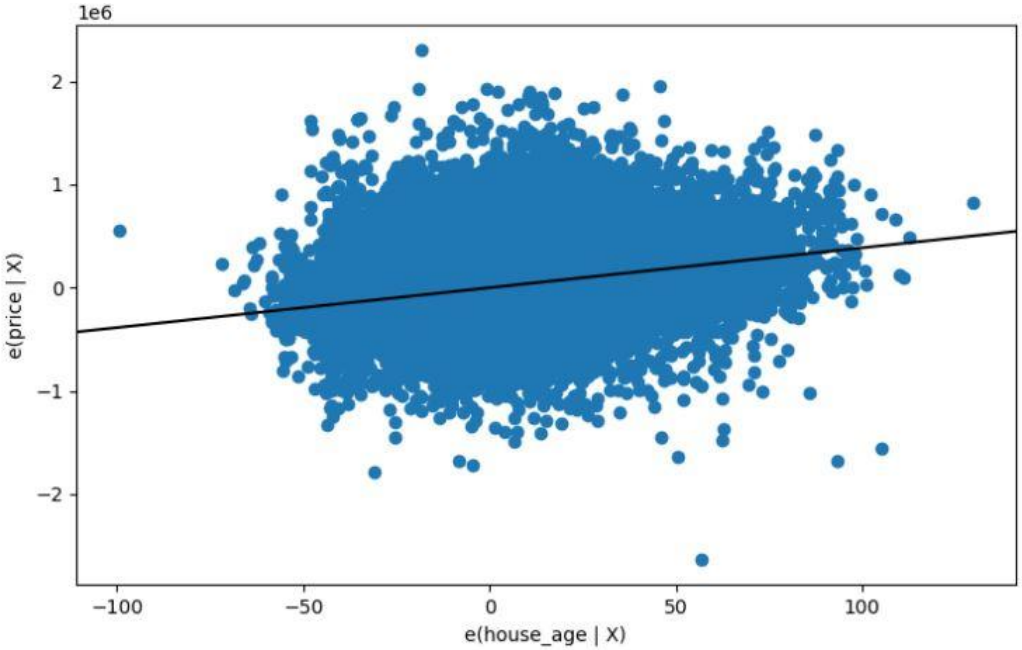
Interpretation -

- Constant = -**$62,690**.
- **$232** per square foot of living
- **$150,700** per grade (1-13)

Model 2 Limitations



Model 3

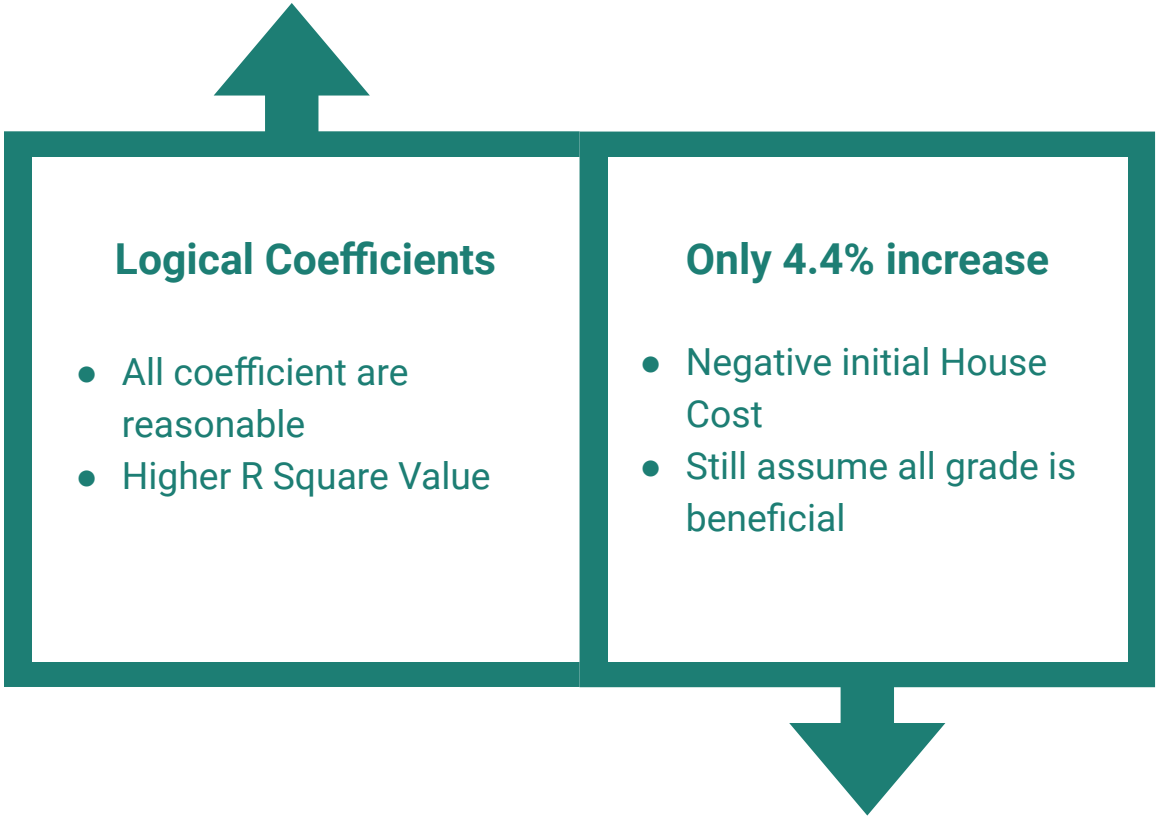


Interpretation -

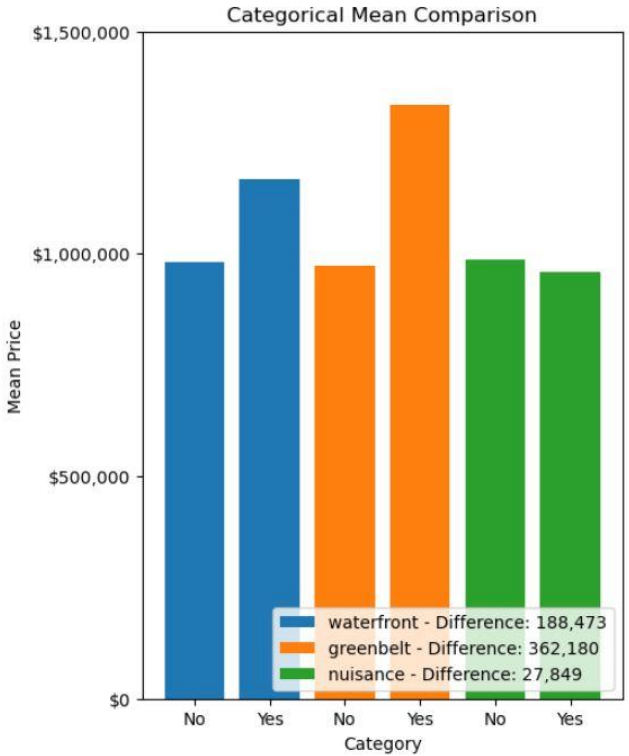
- Constant = **$-1,286,000**
- **$221** per square foot
- **$216,400** per grade
- **$3867** per age of house.

The more parameters added, the larger the constant becomes

Model 3 Limitations



Other Categorical Data



Method: Grouped by category with mean taken for each sub-category

Outcome:
No significant difference in Nuisance

Include: Waterfront and Greenbelt
Exclude: Nuisance

Final Model Reference

The model parameters are in reference to the following:

- No Greenbelt
- No view
- Average Condition
- Oil Heat Source
- Private Sewer System
- Grade 7

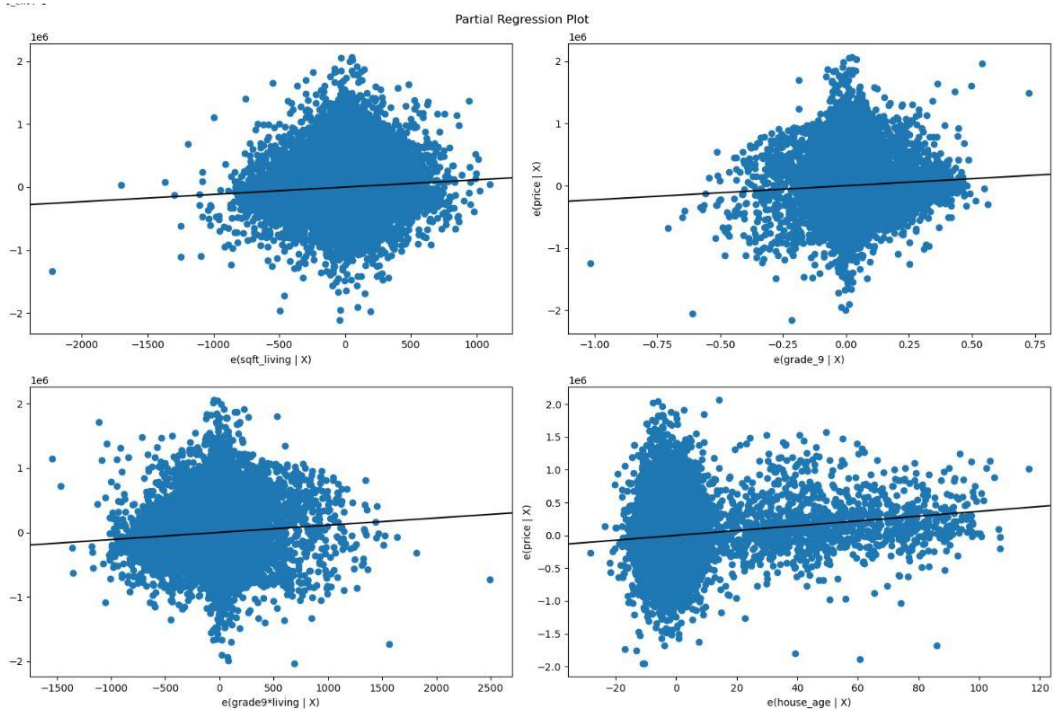
Final Model Key Coefficients

1. **Sqft_living** - $116 per square feet
2. **Grade** (1-13) - Depends on grade
3. **Greenbelt** - $126,900 if on a greenbelt
4. **house_age**- $3673 per year *
5. **Interaction Terms** (9) - $112 per square feet if grade is 9 *
6. **Constant** - $191,400

***** ***Created variables added to the final model***

Other parameters didn't influence price heavily.

Final Model Regression Plots



Slight Positive Linear Relationship

- Not as strong as model 2
- House Age has clear relationship

Legend:
Top Left: Sqft_living
Top Right: Grade 9
Bottom Left: Sqft_living * Grade 9
Bottom Right: House Age

Grade Interpretation

Formula:

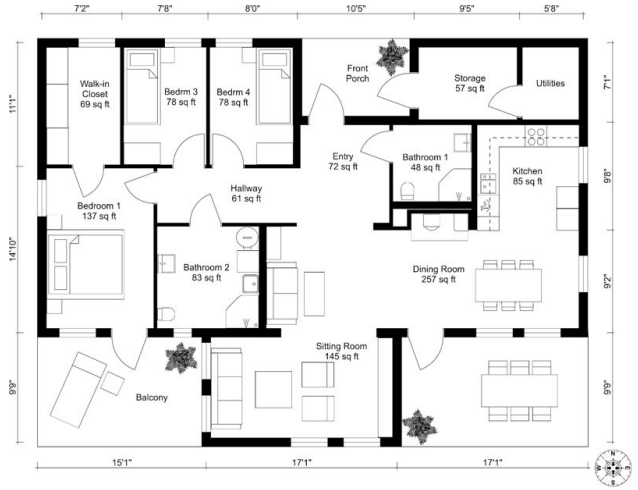
Price = Constant + grade + (interaction * square foot of living) + others*

- Grades below 7 are **negative**
- Grades above 7 are **positive**.
- Grade **doesn't match** their interaction terms.
  - (Positive Grade, Negative Living)
- **Less influence** the closer to Grade 7

Continuous Interpretation

In general, **all parameters** involving square foot of an area are **positive**, **excluding square foot of garage**.

- Garage appears **less valuable** than patio, basement or living.
- The **more square footage**, the **higher the price.**



Other Categorical Parameters

Greenbelt - Yes = $126,900

View -

- Average = $61,690
- Good = $72,050
- Excellent = $288,600

Condition -

- Good = 42,480
- Very Good = 106,700

In general, any parameters that is **better than the reference,** will **increase** house value.

Conclusion

- **More Parameters** → Better modeling
- **Negative Parameter** → More Positive Constant

- **Strongest Effect on Price:** Square living and Grade
- **Not all parameters are useful** such as sqft_above, nuisance, etc.

Recommendations

Zillow: Use model to improve Zestimate.

- Improve Accuracy

Buyers: Inform on expensive and inexpensive aspect of a house.

- Price Checking

Sellers: Renovate or improve aspects to increase price.

- Increase Home Values

Next Step

1. **More interaction terms**
   - ➢ Greenbelt and Square Foot of Living
2. **More outside interaction**
   - ➢ Schools, parks, crime rate
3. **Economic Status**
   - ➢ Recession, Pandemic

Question?

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