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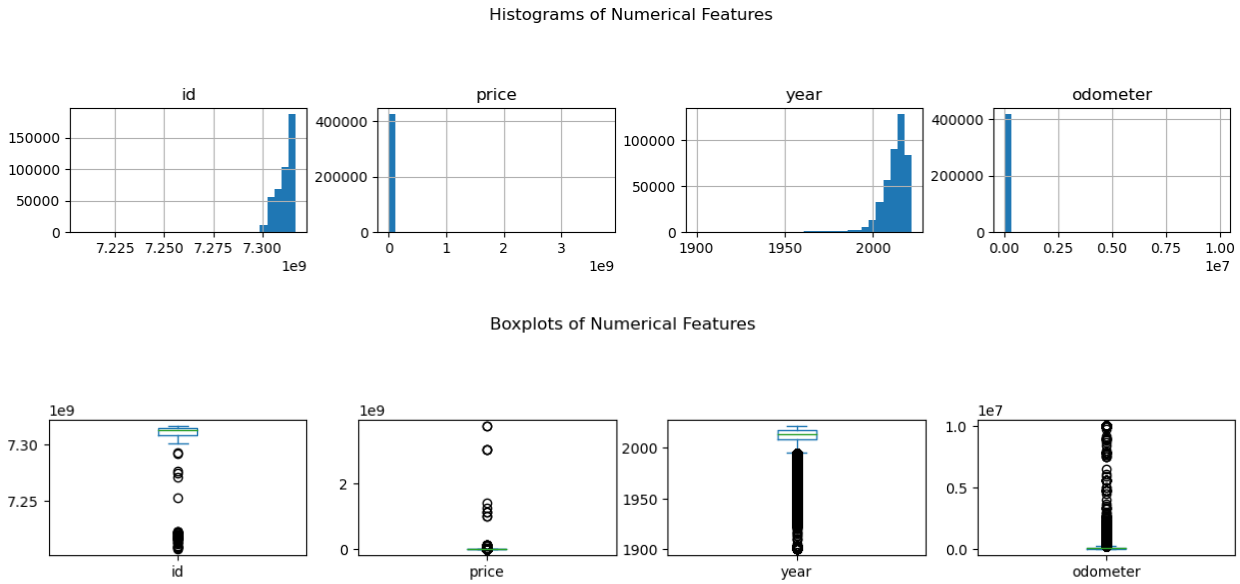
Understanding Factors Affecting Used Car Prices

Executive Summary

This report outlines findings from an analysis of a dataset including 426K used cars. Factors that significantly influence the prices of used cars are identified and can be used to fine-tune prices of dealers' inventories.

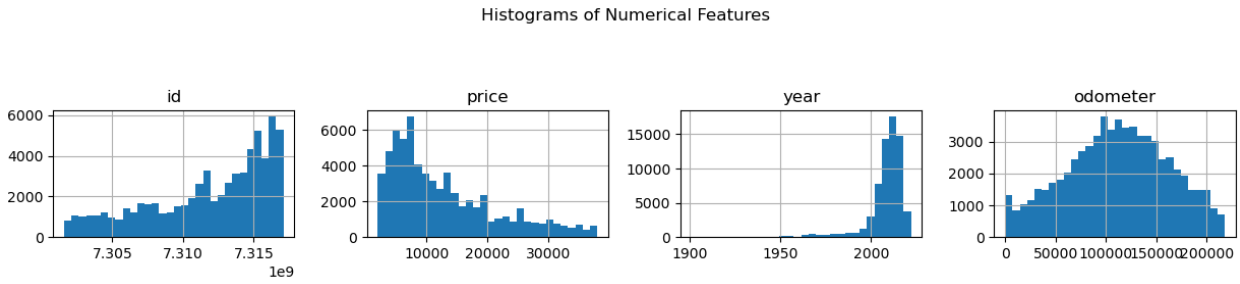
Data Analysis

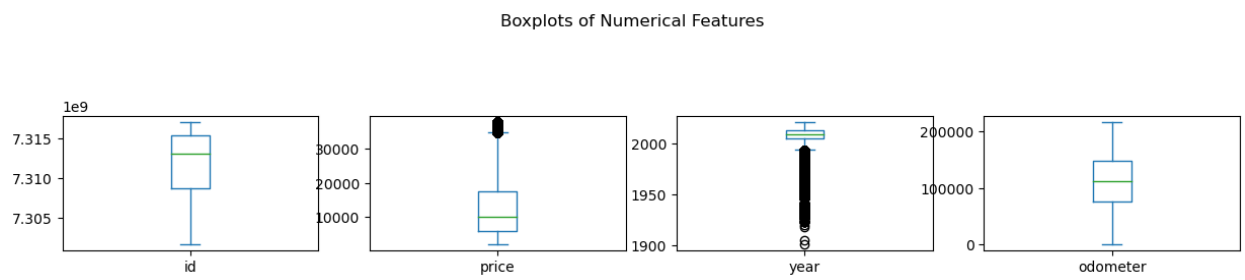
The dataset includes some numerical features and categorical features. Numerical features include ID, year, odometer, and price. Their distributions are visualized below.



Data Preparation

Outlier prices and odometer readings are filtered out.





Pearson correlation for numerical features are calculated. Ranked Numerical Features by Correlation Strength indicating a degree of association between the variable and price:

- odometer 0.414961
- year 0.240999

ANOVA for each categorical feature is calculated. Ranked Categorical Features by ANOVA p-value, indicating whether observed differences among group means could be due to specific variable being studied or if they are just due to chance:

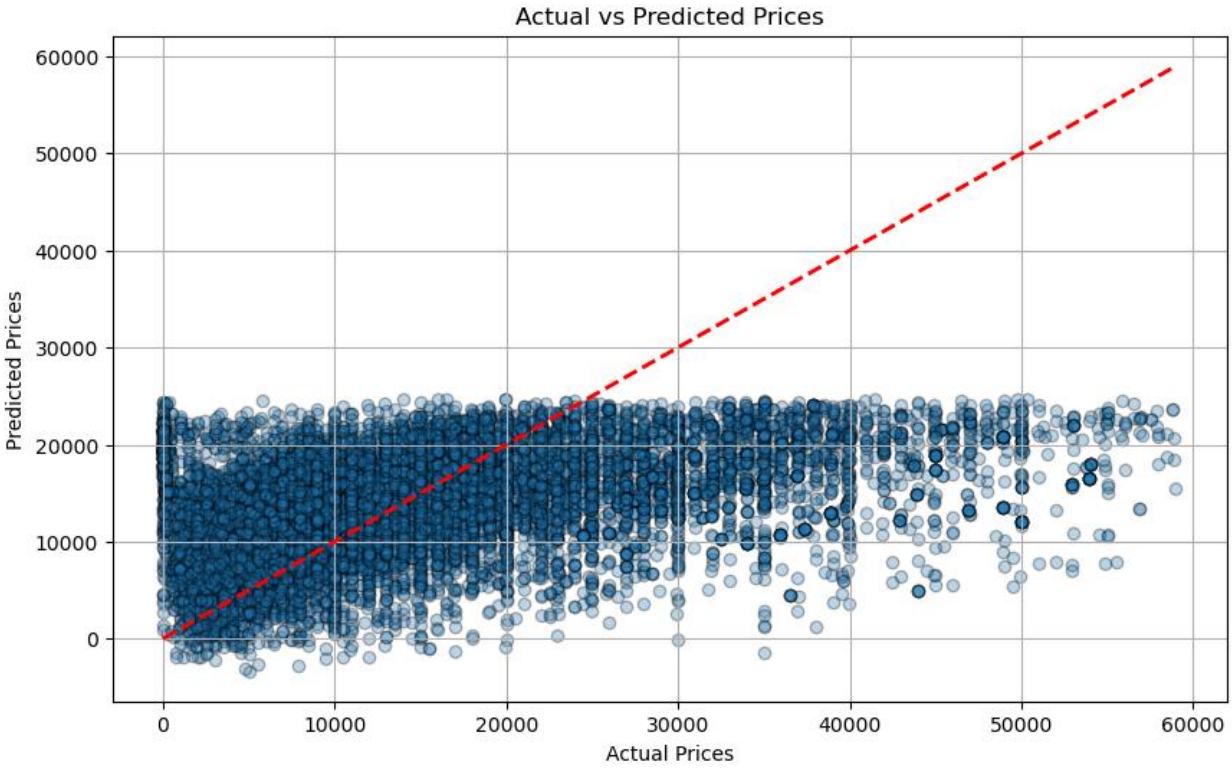
- region: F-Statistic = 17.11, p-value = 0.00
- model: F-Statistic = 8.37, p-value = 0.00
- condition: F-Statistic = 1305.45, p-value = 0.00
- cylinders: F-Statistic = 1198.19, p-value = 0.00
- fuel: F-Statistic = 2747.30, p-value = 0.00
- drive: F-Statistic = 5651.68, p-value = 0.00
- size: F-Statistic = 1999.38, p-value = 0.00
- type: F-Statistic = 1719.88, p-value = 0.00
- paint_color: F-Statistic = 304.11, p-value = 0.00
- state: F-Statistic = 56.00, p-value = 0.00

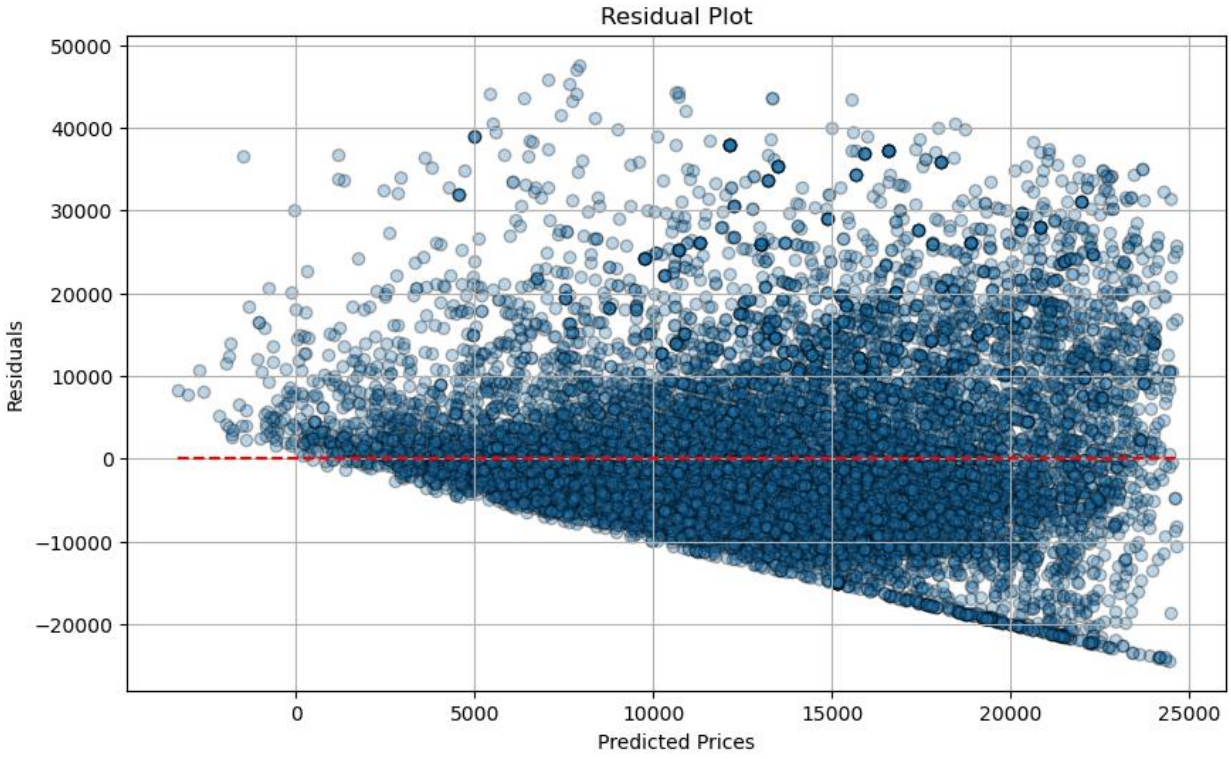
Modeling

Three models are built using different training data or algorithms.

1. Model 1 – linear regression model trained using only two numerical features, odometer and year.

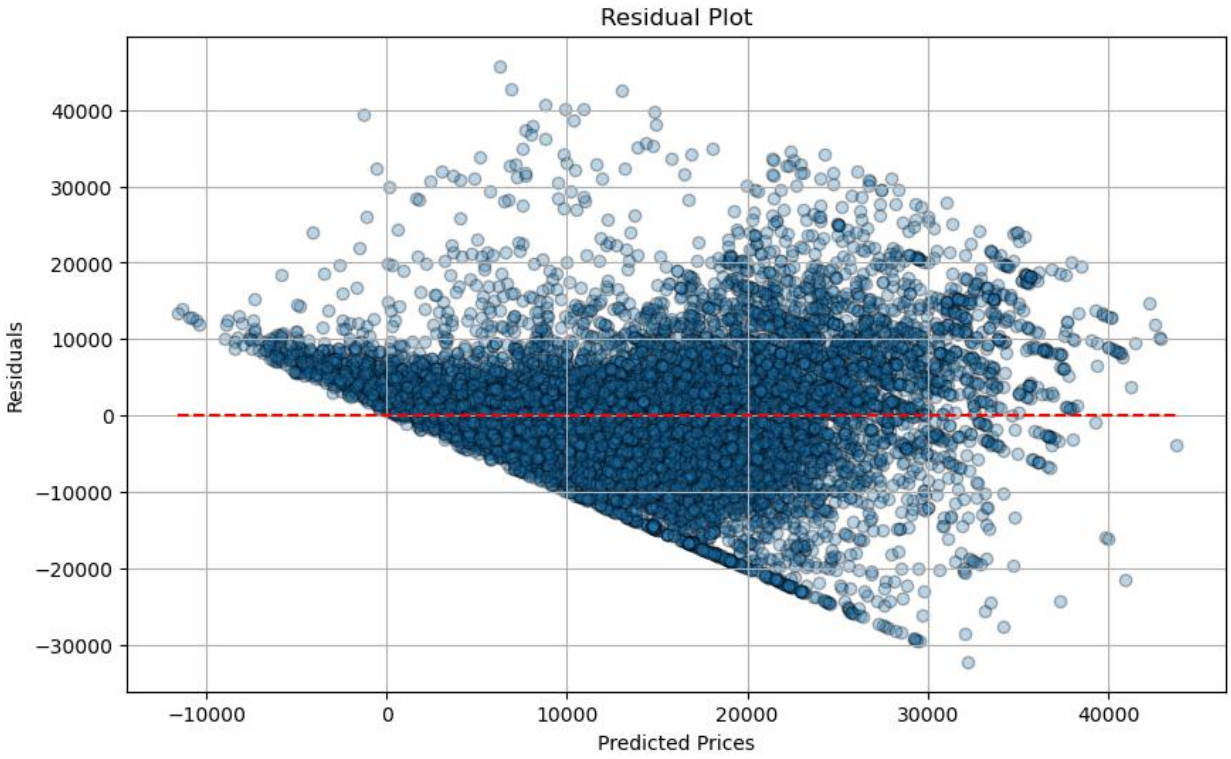
   Model Evaluation Metrics:
   Mean Squared Error: 98024874.99423555
   R^2 Score: 0.21155398282392646





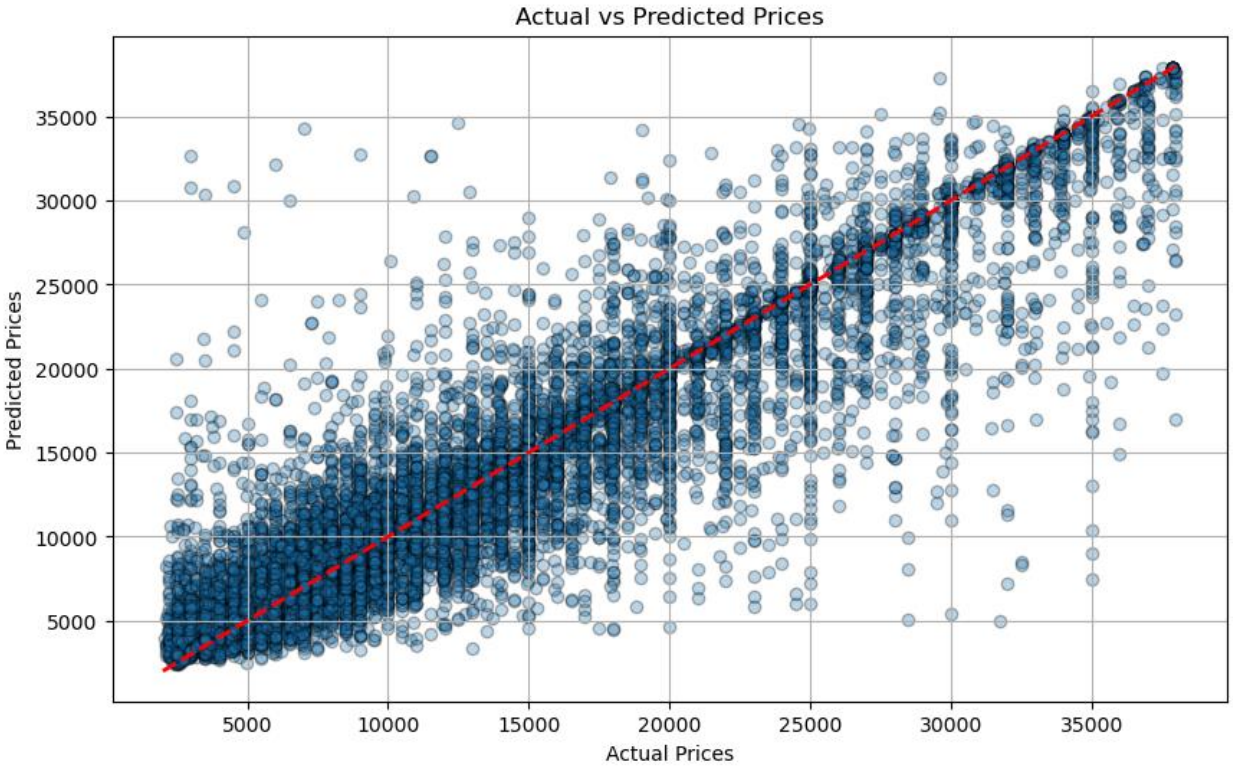
2. Model 2 – linear regression model trained using the two numerical features and the above listed categorical features.

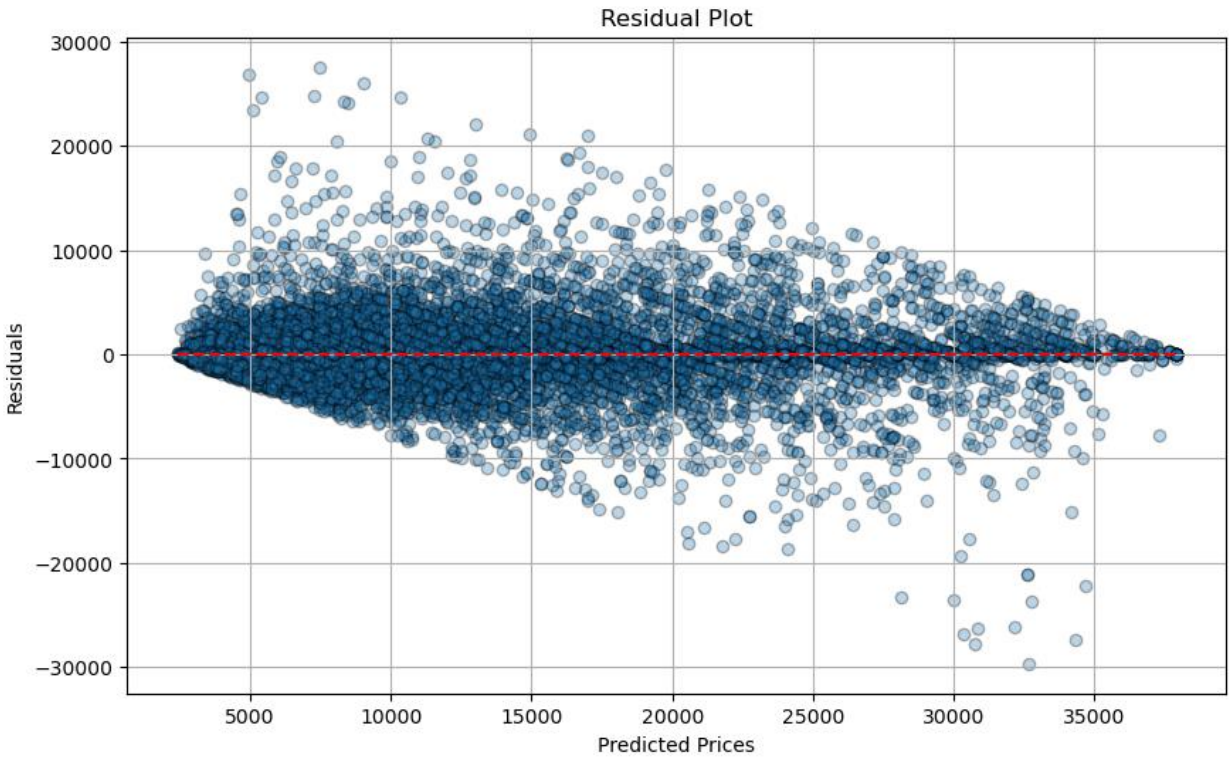
Model Evaluation Metrics:
Mean Squared Error (MSE): 17041510.93282232
R-Squared (R2): 0.8629295735145145



3. Model 3 – random forest regressor model trained using the two numerical features and the above listed categorical features.

Model Evaluation Metrics:
Mean Squared Error (MSE): 17041510.93282232
R-Squared (R2): 0.8629295735145145

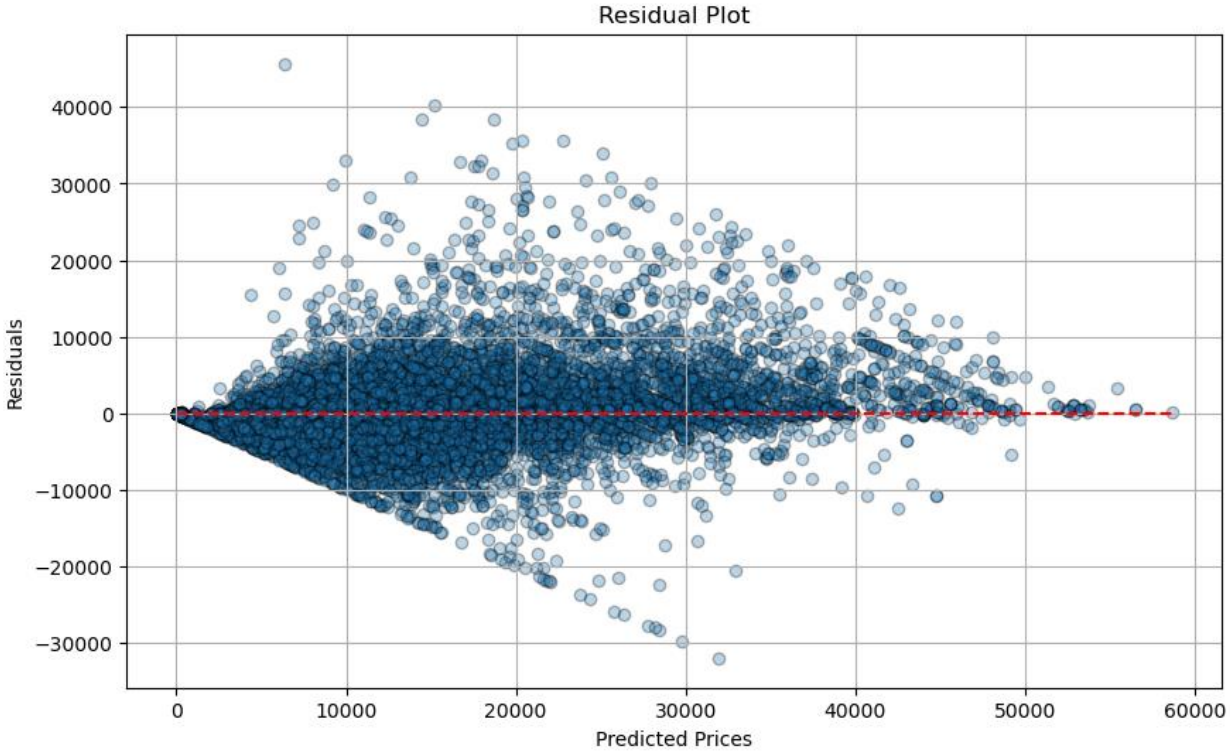




4. Model 4 – grid search for the random forest regressor model.

Model Evaluation Metrics:
Mean Squared Error: 20940511.22238466
R^2 Score: 0.8315686434500327


Actual vs Predicted Prices
Predicted Prices
Actual Prices
0
10000
20000
30000
40000
50000
60000


Residual Plot
Residuals
Predicted Prices
40000
30000
20000
10000
0
−10000
−20000
−30000
0
10000
20000
30000
40000
50000
60000

Evaluation

R-squared ranges from 0 to 1, where 0 means that the model does not explain any of the variability of the response data around its mean, and 1 means it explains all the variability. As shown above, model 3 is much better than model 2, which is much better than model 1. Interestingly, model 4's R-Squared is decent, but it does not match up to model 3.