MSDS 6371 Project - Fall 2022

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Introduction

This analysis focuses on applying multi-linear regression techniques to predict the sales price of homes in the Ames, Iowa area. Two specific questions of interest (QOI) were identified:

1. Focusing on 3 specific neighborhoods in Ames, what is the best linear regression model that can be constructed solely utilizing the square footage of the living room and what can be interpreted from that model?
2. Utilizing all available variables and focusing on every neighborhood, what are the best linear regression models that can be constructed?

Data Description

For this analysis, housing data was obtained between the years of 2006 and 2010 from 1,460 homes in the Ames area. Approximately 80 variables were collected for each home identifying various features that may contribute to a homes final sale price.

Upon analysis of the data, numerous variables were found to have a high amount of associated missing values and were subsequently removed from the analysis.

Many numerical variables in the available data showed high variance and were therefore given a log transformation to better perform in a linear regression model. The full list of variables that received a log transformation can be found below. It should be noted that sales price was among the variables.

- LotArea
- FirstFlrSF
- SecondFlrSF
- GrLivArea
- WoodDeckSF
- OpenPorchSF

- EnclosedPorch
- ThirdSsnPorch
- ScreenPorch
- PoolArea
- MiscVal
- SalePrice

Analysis

Question 1

(Brief introduction to the questions of interest and the setting of the problem.)

Restatement of the Problem

(Where did the data come from? How big is it? How many observations? Where can we find out more? What are the specific variables that we need to know with respect to your analysis?)

Build and Fit the Model

Checking the Assumptions

(Residual Plots Influential point analysis (Cook's D and Leverage) Make sure to address each assumption.)

Comparing Competing Models

(Adj R2 Internal CV Press)

Parameters

(Estimates Interpretation Confidence Intervals)

Conclusion

(A short summary of the analysis.)

R Shiny: Price v. Living Area Chart

A web application was created to provide access to the model and can be found at the link below:

www.google.com

Question 2

For the second question of interest, the objective was to utilize all available data and variables to create the best linear regression model possible for predicting home sales prices. There are numerous techniques available for creating multi-linear regression models. This QOI focused on applying forward selection, backwards elimination, and stepwise selection to produce the highest performing models. Additionally, a final custom model was fit using cross validation techniques.

Model Selection

The olsrr package in R was utilized to perform each of the 3 stepping regression fittings. Minimizing the Akaike Information Criterion (AIC) was used as the model criteria. The following linear forms below were identified to produce the lowest AIC for forward, backward, and step selection respectively. A custom model was also attempted, however, it was unable to achieve higher accuracy than the forward selection model and thus was discarded.

Forward selection:

SalePrice = OverallQual + GrLivArea + Neighborhood + OverallCond + HouseStyle + YearBuilt + LotArea + RoofMatl + KitchenAbvGr + SaleCondition + Condition2 + Foundation + Fireplaces + Heating + ExterQual + Condition1 + PoolArea + ScreenPorch + WoodDeckSF + HeatingQC + CentralAir + BedroomAbvGr + FirstFlrSF + `2ndFlrSF` + Street + LandSlope + HalfBath + EnclosedPorch + SecondFlrSF + MiscVal + PavedDrive + `1stFlrSF` + BldgType + ExterCond + YearRemodAdd

Backwards elimination:

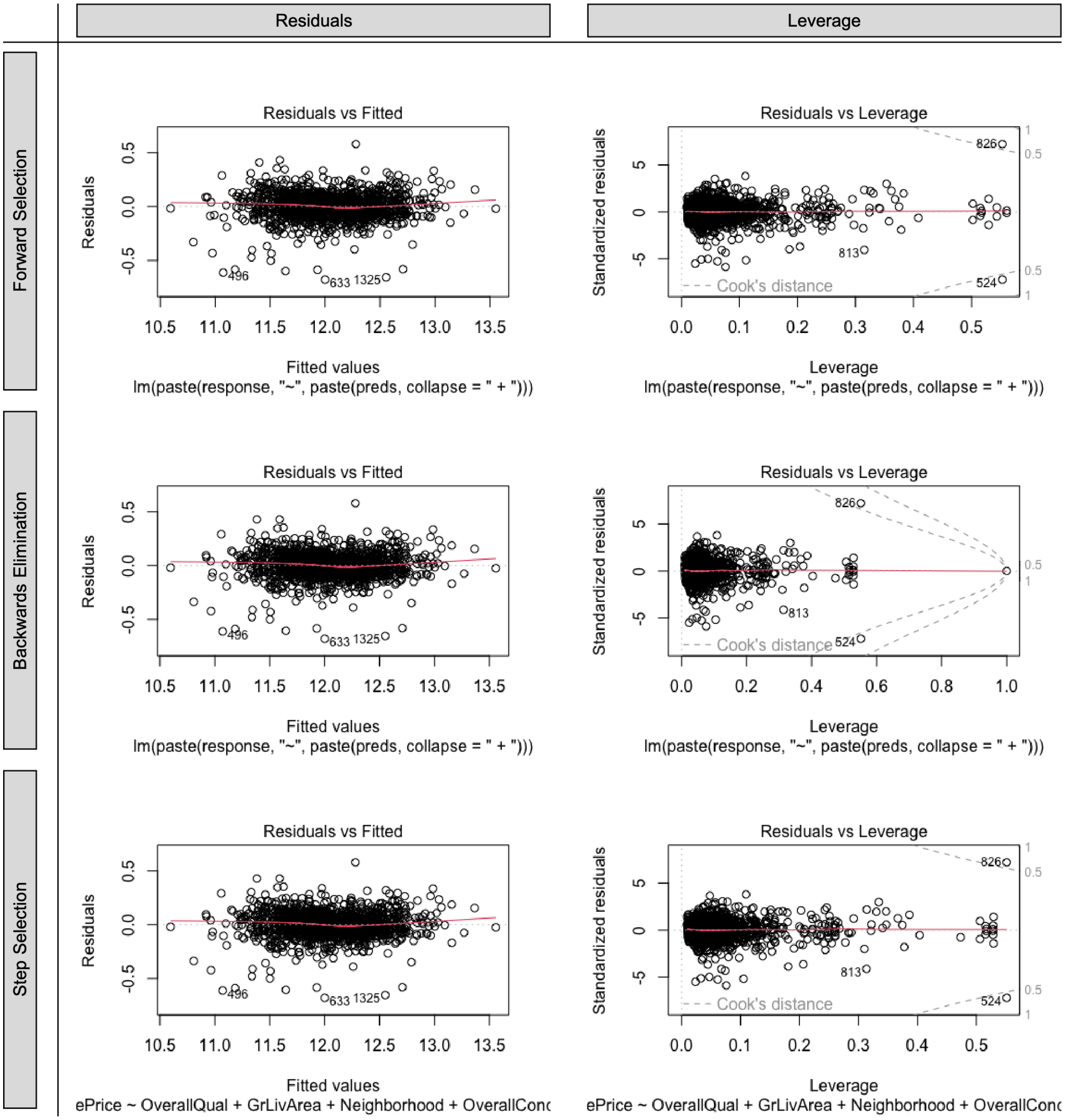
SalePrice = LotArea + Street + LotConfig + LandSlope + Neighborhood + Condition1 + Condition2 + BldgType + OverallQual + OverallCond + YearBuilt + YearRemodAdd + RoofMatl + ExterQual + ExterCond + Foundation + Heating + HeatingQC + CentralAir + `1stFlrSF` + `2ndFlrSF` + GrLivArea + HalfBath + BedroomAbvGr + KitchenAbvGr + Fireplaces + PavedDrive + WoodDeckSF + EnclosedPorch + ScreenPorch + PoolArea + MiscVal + SaleCondition + FirstFlrSF + SecondFlrSF

Stepwise selection:

SalePrice = OverallQual + GrLivArea + Neighborhood + OverallCond + YearBuilt + LotArea + RoofMatl + KitchenAbvGr + SaleCondition + Condition2 + Foundation + Fireplaces + Heating + ExterQual + Condition1 + PoolArea + ScreenPorch + WoodDeckSF + HeatingQC + CentralAir + BedroomAbvGr + FirstFlrSF + `2ndFlrSF` + Street + LandSlope + HalfBath + EnclosedPorch + SecondFlrSF + MiscVal + PavedDrive + BldgType + `1stFlrSF` + ExterCond + LotConfig + YearRemodAdd

Checking Assumptions

(Residual Plots Influential point analysis (Cook's D and Leverage) Make sure to address each assumption)



Comparing Competing Models

The table below summarizes the key performance metrics associated with each of the three models produced. Each model was found to have the same Adjusted R Squared metric without rounding errors.

Model	Adjusted R2	CV Press	Kaggle Score
Forward Selection	0.9094	X	0.13496
Backward Elimination	0.9094	X	0.13554
Stepwise Selection	0.9094	X	0.13554

Conclusion

(A short summary of the analysis)

Appendix

The entire code for this analysis can be found below: