Fair Market Value Assessment, City of Ames, Iowa

Iowa Department of Management

Background and Problem Statement

- Property sale price is an analog for fair market value which can be used as metric for estimating tax revenue
    - Property tax is a significant portion of city budgeting for essential services and infrastructure
- Regular assessment of property values can inform decision on future land use and development

- **Problem Statement:** Can we establish a way of predicting fair market value for a collection of properties in Ames, Iowa for the purposes of evaluating upcoming property tax revenue?

Description of Data

Models used were trained on sales records of houses sold between 2006 and 2010.

Characteristics of houses included approximately 70 values including:

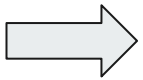
- Square footage area by room / area
- Quality ratings for the house as a whole as well as individual area such as kitchen
- Number of bedrooms, bathrooms
- Categories describing lot shape, adjacent streets
- Many more

Methodology

Machine Learning via Linear Regression:

Models of this type learn direct relationships between chosen house characteristics and sale price, using them to then calculate a likely sale price.

Varieties: OLS, Ridge



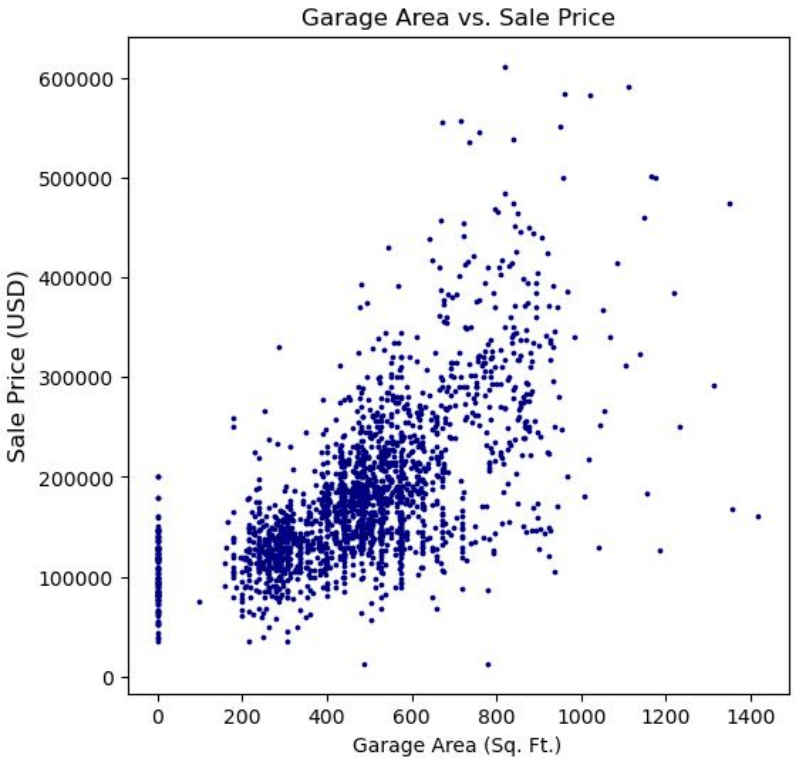
Application:

- Models trained on a majority of given data with known Sale Price
- Benchmarked against a subset of data also with known Sale Price that is, until prediction, “unseen”

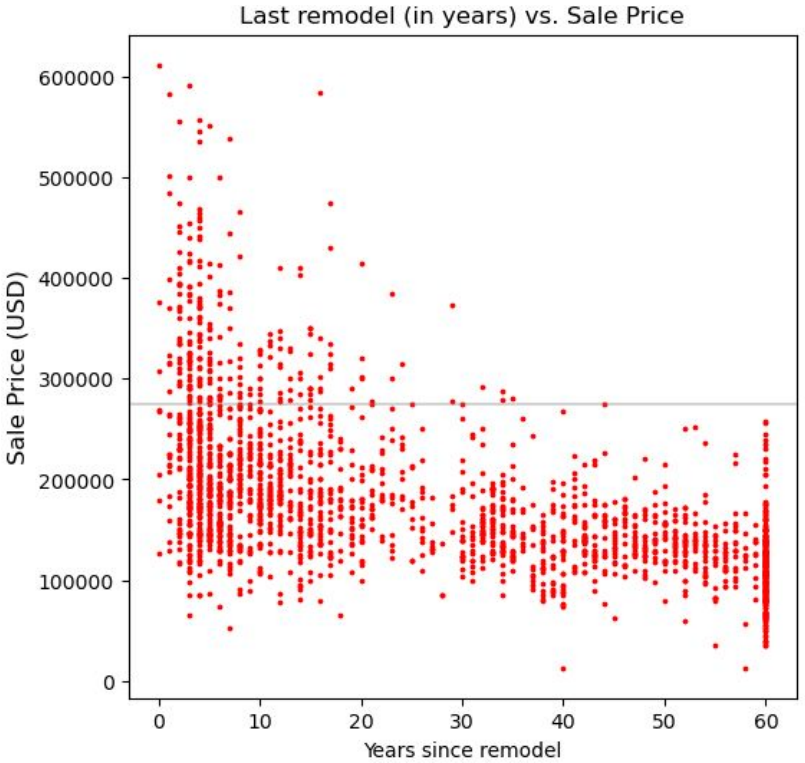
Data Strategy

Action Taken	Rationale
Certain missing values were replaced with “NA”	These values could be inferred given the absence of any “NA” values whatsoever in a scale that allows for that choice
Categorical data converted away from numeric	Numbers not truly represented a measurement were treated as categories in stead (i.e. overall quality score)
Characteristics with a large majority converted to true/false, ex. “Has pub utilities”, “Gentle Slope”	This consolidated minority values and reduced noise
Years of build, remodel converted to age	Easier interpretation
Individual categorical values (i.e. Kitchen quality “Fair”) broken out to separate features	This allowed the model to evaluate the impact of each category value on its own rather than as an aggregate of one scale

Significant findings - positive correlations



Significant findings - detractors



Results Summarized

- The most effective model within the given data:
  - had very similar performance between training data and “unseen” data
    - Each model actually **performed better** on unseen then on training data
    - Suggests overfitting was not an issue
  - was capable of explaining 88% of the variability in sales price on new data
  - On average predicted sale price within $19,600
  - Drastically outperformed the baseline model that predicted within $61,800

Evaluating Error

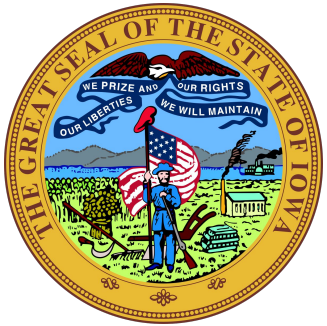
Opportunities for improvement and further research:

- Model was susceptible to outlier data
- Relationships between specific variables could be explored to improve amount of error
    - This could also be explored to find more definitive positive indicators of Sales Price
- Additional features commonly associated with sales price could be introduced, such as quality of school or public amenities available

Key Takeaways

- The model can be used to reliably predict property tax revenue based on predicted fair market value, given that:
  - An appropriate cushion for the remaining variability be accounted for
- For the upcoming tax year (based on the properties provided in the unassessed data):
  - using 2010 mill rate, of 10.84, the Department of Management may expect about $1.7M in property tax revenue
- Based on observed positive relationships of living area, garage area, and even deck area, the City might consider reducing permit prices to encourage building and expansion of areas with a significant relationship to market value

”Our liberties we prize, and our rights we will maintain”



Citations and acknowledgments

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- Emily Rogalski for information on column transformation
- Google Bard for presentation prompt ideas, and for some confirmations on modeling techniques that were chosen
- Kaggle – DSI-910 Ames Housing Challenge [Online] Available: https://www.kaggle.com/competitions/dsi-910-ames-housing-challenge/data
- Iowa Department of Management. "County Property Tax Rates - FY 2010." Accessed October 5, 2023. https://tax.iowa.gov/iowa-tax-rate-history
- Python language
- Matplotlib.pyplot library
- Pandas library
- Numpy library
- Seaborn library
- SciKit-Learn