How does the cost of homeowner associations (HOA) fees affect overall property value?

DATASCI 203 Wed 4pm (PST), Fall 2022, Tanya Roosta

Jessica Stockham, Derrick Chan-Sew, Jammy (Chi Hung) Chan

Intended Audience: Homeowners, homeowners associations and government officials who have a vested interested in homeowner association costs and market value of homes.

12/07/2022

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Introduction

Home Owner Association (HOA) is an organization that makes and enforces rules and guidelines for a subdivision, planned community, or condominium building.

HOA Fees are collected from homeowners to pay for common area maintenance and shared services supports.

Research Question

*How does the cost of homeowner associations (HOA) fees affect **overall property value?***

Data source and variables

US Census 2021 American Housing Survey study

United States Census Bureau

64,141
Homeowners

8,010
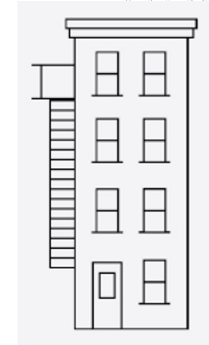Apartment/Single detached/attached homes

BASE MODEL (model 1)

Outcome: log of Market Value of Home (in dollars)

Key Independent Variable:
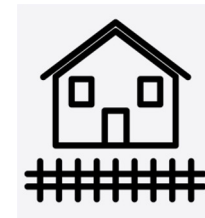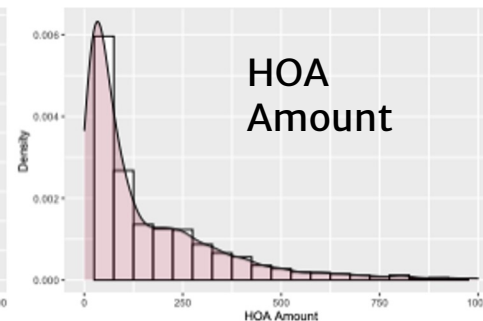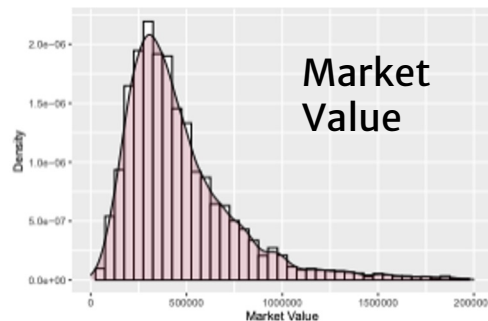- Log of HOA Amount (in dollars) * House Type

Market Value

HOA Amount

Reference Category

apartment

townhome/duplex

Single-family house

Image credit: noun project

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Adding Predictors in Groups

MODELS 2-4:
- Considered groups of predictors in the following 3 batches.
- Goal: minimize omitted variable bias and account for geographic clustering

House Characteristics:
- Year Built
- Lot Size
- Unit Size
- Garage

Neighborhood Characteristics:
- Good schools
- Crime
- Disaster/flood zone
- Neighborhood rating

Geography:
- Metropolitan area code vs non-metropolitan area

Linear Regression Models Evaluations

Baseline data model
(HOA + HouseType)
(model 1)

House Characteristics variables
(model 2)

Neighborhood Characteristics variables
(model 3)

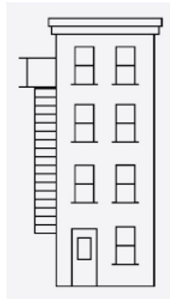**Geographic Location variables**
(model 4)

Table 1: Estimated Regressions

	Output Variable: Market Value			
	(1)	(2)	(3)	(4)
HOA Amount	0.28*** (0.06)	0.24*** (0.05)	0.24*** (0.05)	0.18*** (0.05)
Single-Family (D)	1.50*** (0.36)	0.79** (0.28)	0.80** (0.28)	0.64* (0.27)
Single-Family (A)	1.20** (0.39)	0.74* (0.30)	0.76* (0.30)	0.66* (0.29)
Garage - No		−0.23*** (0.04)	−0.22*** (0.04)	−0.18*** (0.04)
Near petty crime - No			−0.04 (0.03)	−0.04 (0.03)
Near serious crime - No			0.002 (0.10)	0.07 (0.09)
Near a disaster area - No			−0.13** (0.04)	−0.16*** (0.04)
$HOAAmount \cdot SingleFamily(D)$	−0.15* (0.06)	−0.13** (0.05)	−0.13** (0.05)	−0.10* (0.05)
$HOAAmount \cdot SingleFamily(A)$	−0.19** (0.07)	−0.14** (0.05)	−0.14** (0.05)	−0.12* (0.05)
Constant	11.00*** (0.36)	12.00*** (0.32)	11.00*** (0.39)	11.00*** (0.35)
Lot Size	✓	✓	✓	✓
Square Footage	✓	✓	✓	✓
Year Built	✓	✓	✓	✓
Neighborhood Rating			✓	✓
School Rating			✓	✓
Metro Code				✓
Observations	5,580	5,580	5,580	5,580
R^2	0.12	0.33	0.34	0.48
Residual Std. Error	27.00 (df = 5574)	24.00 (df = 5548)	24.00 (df = 5534)	21.00 (df = 5518)

Note: HC_1 robust standard errors in parentheses. HOA Amount is logged. D = Detached, A = Attached.

Key Findings

Log − Log model. Interpret coefficient as percentage change
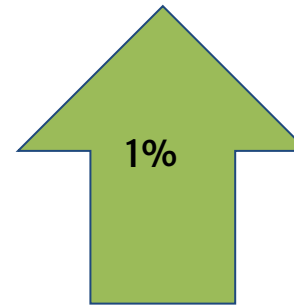
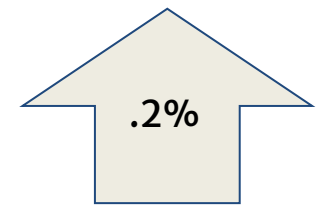- For **apartments**, HOA fees are positively correlated with market value across all all 4 models, a point estimate around .2

- Less clear is there is a relationship between HOA fees and the market value of **single value homes** (substantially dampened)

1%

HOA Amount

.2%

Market Value for Apartments

EXAMPLE

$500 HOA

$450,000 Apt

Raise by $5

Increase value by 9,000

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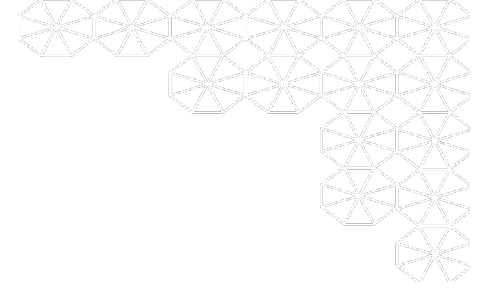
Limitations

IID Assumption

Spatial dependence of housing prices

Potential Biases

- **Omitted variable bias**

  e.g., fancy amenities like a nice gym

- **Self-reported survey data**

- **Did not account for complex sample design of survey** -> biased standard errors.

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BACKUP SLIDES

Data source and variables

US Census 2021 American Housing Survey study

United States Census Bureau

64,141
Homeowners

8,010
Apartment/Single detached/attached homes

Variable	Type	Description
marketval	Outcome (Y)	House market value
HOAamount	Independent (X)	HOA fees amount
HouseType	Variable has conditional effect with HOAamount (X_t)	House categories. Considering only Apartments, Single detached and attached houses.
YearBuilt, Lotsize, Unitsize, Parking	House characteristic omitted Variables (X_h)	Year built, House lot size, House size and parking space availability
Good School, Neighborhood rating, crime condition, disaster zone	Neighborhood characteristic omitted Variables (X_n)	Some boolean or ordinal ratings: School condition, neighborhood rating, crime condition, disaster status like flood zone.
Home city/county location	Geographic omitted Variables (X_g)	Code associated with metro cities.

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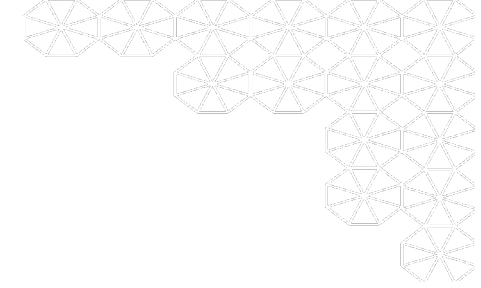
Introduction - HOAs
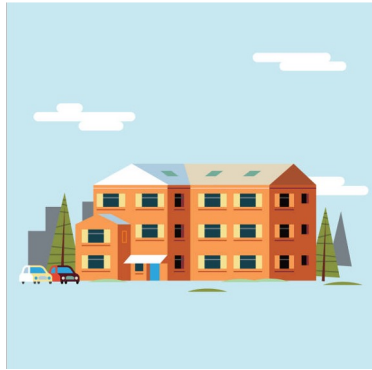
Managing Common Areas

Providing Services to Residents

Protecting Property Values

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Data Analysis - Preliminary

Summary

Citations

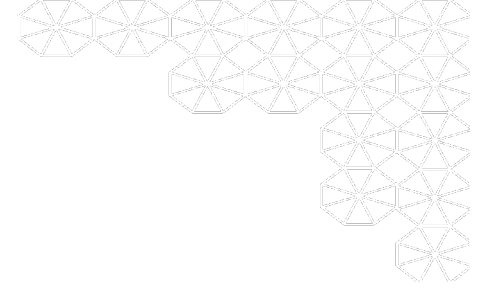https://www.census.gov/programs-surveys/ahs/data/2021/ahs-2021-public-use-file--puf-/ahs-2021-national-public-use-file--puf-.html

Appendix

Data

64,141

Homeowners in the US Census 2021 American Housing Survey study

8,010

Homeowners of single-family detached homes, single-family attached homes or apartment structures

22

Variables of interest

Data Analysis - Transformations
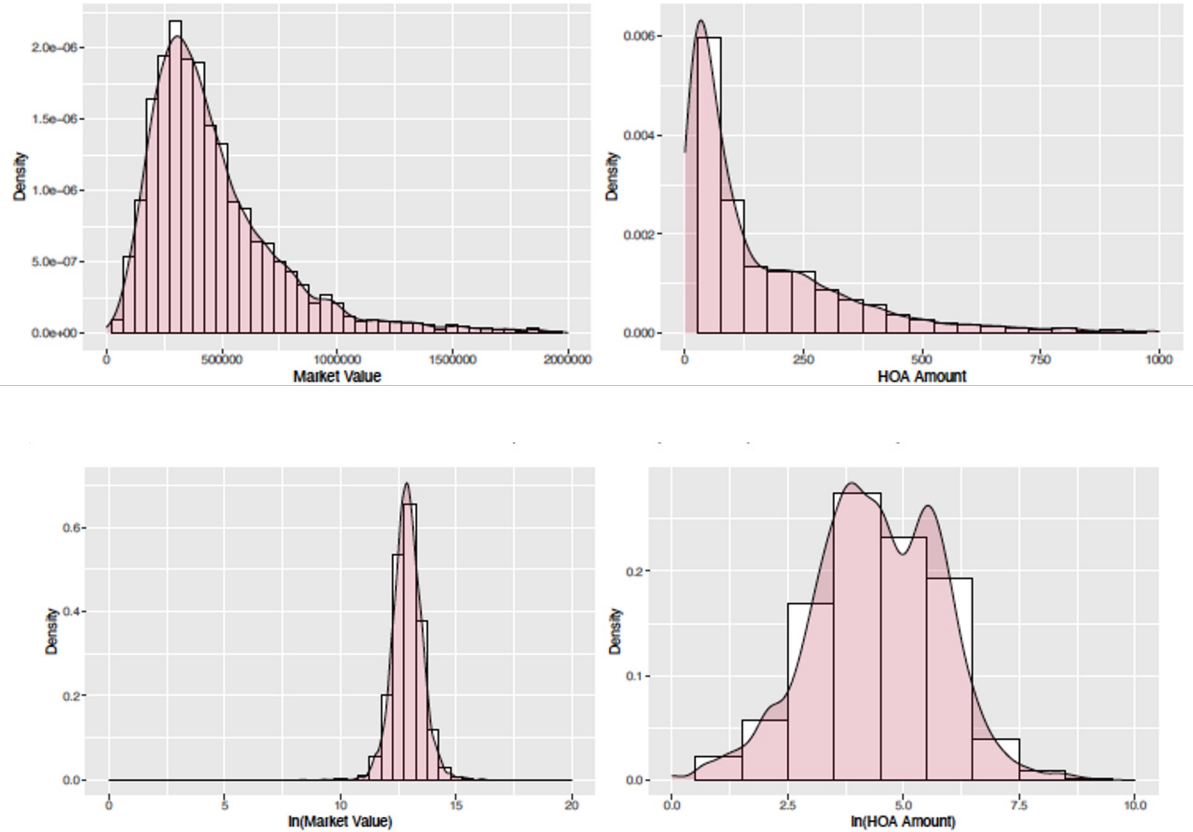
Model building and evaluation

$$[Model_4] : log(\widehat{marketvalue}) = \beta_0 + \beta_1 \cdot log(HOA\ amount) \cdot HouseType$$
$$+ \beta_2 \cdot Year\ Built + \beta_3 \cdot Lot\ Size + \beta_4 \cdot Number\ Of\ Bedrooms$$
$$+ \beta_5 \cdot Good\ School + \beta_6 \cdot Neighborhood\ Rating$$
$$+ \beta_7 \cdot Crime\ Condition + \beta_8 \cdot Diaster\ Zone$$
$$+ \beta_9 \cdot Geographic\ Location$$
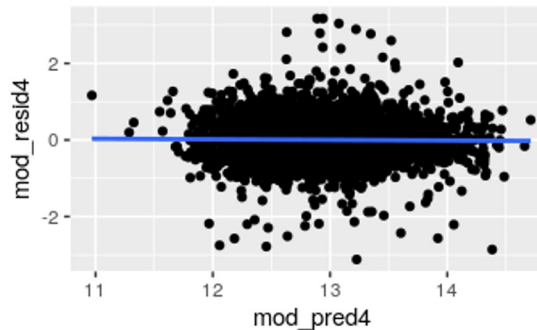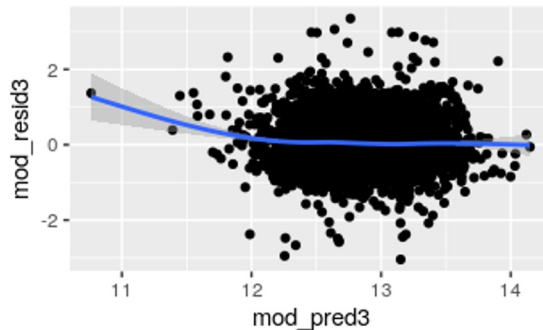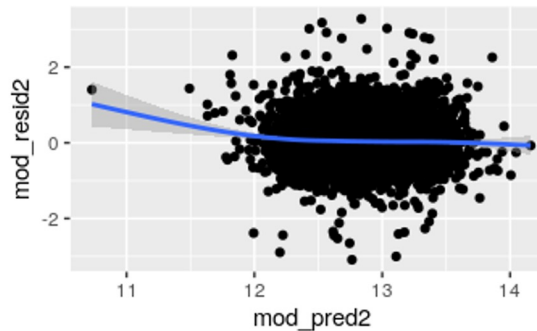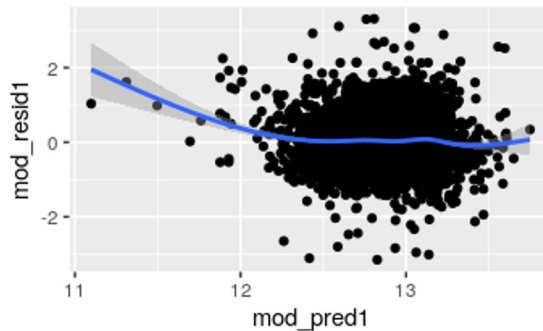
Model accuracy testing

Correlation Analysis
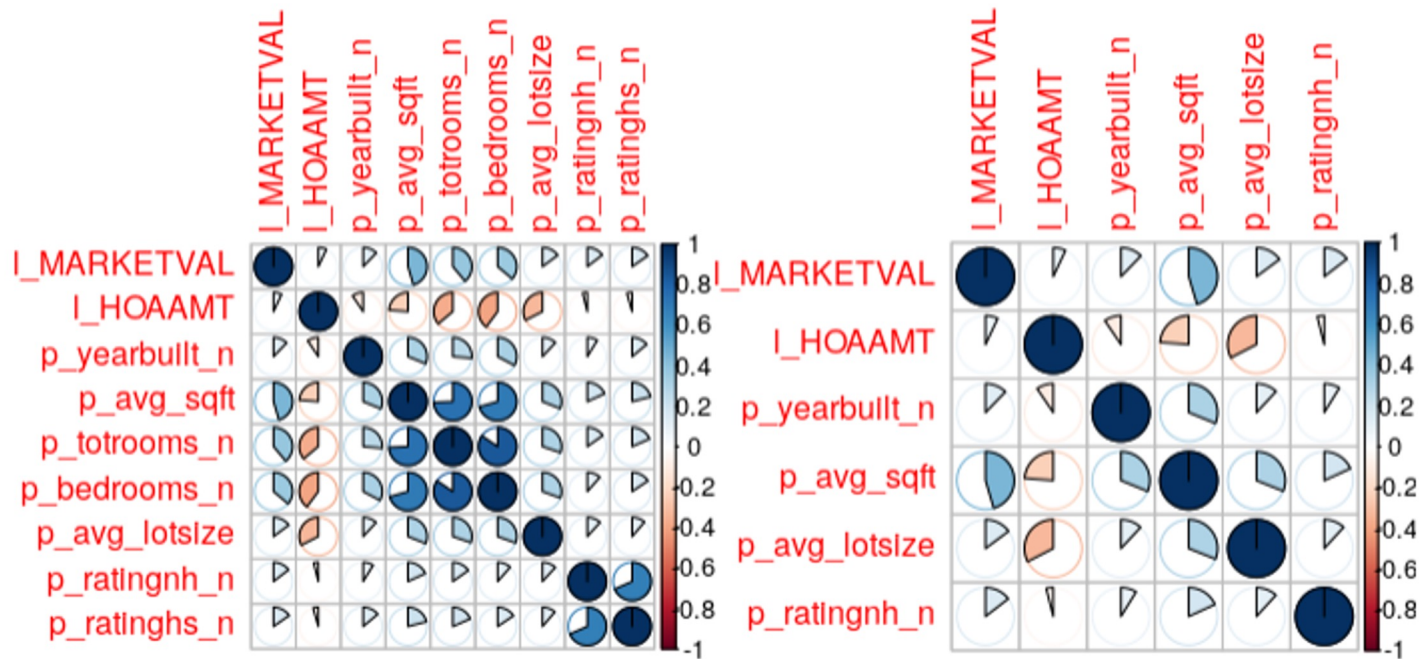
Linear Regression Models Evaluations

```
> summary(model_4)

Call:
lm(formula = l_MARKETVAL ~ l_HOAAMT * p_housetype + p_yearbuilt +
    p_lotsize + p_sqft + p_garage + p_nhqschool + p_nhqcrime +
    p_nhqcrime_s + p_diaster + p_ratingnh + p_metro_code, data = ahs_m,
    weights = WEIGHT, na.action = na.exclude)

Weighted Residuals:
    Min      1Q  Median      3Q     Max
-162.24   -9.49   -0.06    9.12  154.71

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)         10.90802    0.25491   42.79  < 2e-16 ***
l_HOAAMT             0.17894    0.01955    9.15  < 2e-16 ***
p_housetype2         0.63556    0.12111    5.25  1.6e-07 ***
p_housetype3         0.65545    0.14807    4.43  9.8e-06 ***
p_yearbuilt1930     -0.66096    0.12059   -5.48  4.4e-08 ***
p_yearbuilt1940     -0.49601    0.10178   -4.87  1.1e-06 ***
p_yearbuilt1950     -0.59382    0.07109   -8.35  < 2e-16 ***
p_yearbuilt1960     -0.58972    0.06153   -9.58  < 2e-16 ***
p_yearbuilt1970     -0.55699    0.05561  -10.02  < 2e-16 ***
p_yearbuilt1980     -0.50524    0.05440   -9.29  < 2e-16 ***
p_yearbuilt1990     -0.52239    0.05437   -9.61  < 2e-16 ***
p_yearbuilt2000     -0.53871    0.05378  -10.02  < 2e-16 ***
p_yearbuilt2010     -0.53007    0.06757   -7.84  5.2e-15 ***
p_yearbuilt2020     -0.44239    0.05483   -8.07  8.7e-16 ***
p_lotsize1           0.10947    0.02792    3.92  8.9e-05 ***
p_lotsize2           0.12084    0.02831    4.27  2.0e-05 ***
p_lotsize3           0.13752    0.03051    4.51  6.7e-06 ***
p_lotsize4           0.10984    0.03672    2.99   0.0028 **
p_lotsize5           0.19531    0.03760    5.19  2.1e-07 ***
p_lotsize6           0.41066    0.06829    6.01  1.9e-09 ***
p_lotsize7           0.17094    0.08950    1.91   0.0562 .
p_sqft2             -0.23223    0.12692   -1.83   0.0673 .
p_sqft3             -0.10853    0.12170   -0.89   0.3725
p_sqft4             -0.00696    0.11875   -0.06   0.9533
p_sqft5              0.17965    0.11823    1.52   0.1287
p_sqft6              0.37466    0.11850    3.16   0.0016 **
p_sqft7              0.50554    0.11882    4.25  2.1e-05 ***
p_sqft8              0.67992    0.11871    5.73  1.1e-08 ***
p_sqft9              0.93591    0.12019    7.79  8.1e-15 ***
p_garage1           -0.17921    0.02384   -7.52  6.5e-14 ***
p_nhqschool1        -0.05967    0.02741   -2.18   0.0295 *
p_nhqschool-1        0.00875    0.02518    0.35   0.7283
p_nhqcrime2         -0.03549    0.02275   -1.56   0.1189
p_nhqcrime_s2        0.06706    0.04914    1.36   0.1724
p_diaster2          -0.16467    0.02462   -6.69  2.5e-11 ***
p_ratingnh2          1.07120    0.27567    3.89   0.0001 ***
p_ratingnh3          0.41498    0.27469    1.51   0.1309
p_ratingnh4          0.57510    0.22765    2.53   0.0116 *
p_ratingnh5          0.76933    0.19581    3.93  8.6e-05 ***
p_ratingnh6          0.82071    0.19191    4.28  1.9e-05 ***
p_ratingnh7          0.94275    0.18930    4.98  6.5e-07 ***
p_ratingnh8          0.94729    0.18883    5.02  5.4e-07 ***
p_ratingnh9          0.99477    0.18902    5.26  1.5e-07 ***
p_ratingnh10         0.99635    0.18880    5.28  1.4e-07 ***
p_metro_code'14460'  0.70872    0.07061   10.04  < 2e-16 ***
p_metro_code'16980'  0.08105    0.04791    1.69   0.0907 .
p_metro_code'19100'  0.05393    0.04763    1.13   0.2576
p_metro_code'19820' -0.01162    0.05676   -0.20   0.8378
p_metro_code'26420' -0.18142    0.04385   -4.14  3.6e-05 ***
p_metro_code'31080'  1.02134    0.04964   20.57  < 2e-16 ***
p_metro_code'33100'  0.17371    0.04803    3.62   0.0003 ***
p_metro_code'35620'  0.46845    0.05160    9.08  < 2e-16 ***
p_metro_code'37980'  0.18937    0.05796    3.27   0.0011 **
p_metro_code'38060'  0.30885    0.04666    6.62  3.9e-11 ***
p_metro_code'40140'  0.38087    0.06435    5.92  3.4e-09 ***
p_metro_code'41860'  1.22801    0.06104   20.12  < 2e-16 ***
p_metro_code'42660'  0.78736    0.05871   13.41  < 2e-16 ***
p_metro_code'47900'  0.49563    0.04591   10.80  < 2e-16 ***
p_metro_code'99998'  0.15164    0.03435    4.41  1.0e-05 ***
p_metro_code'99999'  0.21883    0.04646    4.71  2.5e-06 ***
l_HOAAMT:p_housetype2 -0.09610   0.02039   -4.71  2.5e-06 ***
l_HOAAMT:p_housetype3 -0.12361   0.02581   -4.79  1.7e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 21 on 5518 degrees of freedom
Multiple R-squared:  0.48,       Adjusted R-squared:  0.474
F-statistic: 83.4 on 61 and 5518 DF,  p-value: <2e-16
```

Linear Regression Models Evaluations

Table 1: Estimated Regressions

	Output Variable: Market Value			
	(1)	(2)	(3)	(4)
HOA Amount	0.28*** (0.06)	0.24*** (0.05)	0.24*** (0.05)	0.18*** (0.05)
Single-Family (D)	1.50*** (0.36)	0.79** (0.28)	0.80** (0.28)	0.64* (0.27)
Single-Family (A)	1.20** (0.39)	0.74* (0.30)	0.76* (0.30)	0.66* (0.29)
Garage - No		−0.71*** (0.16)	−0.68*** (0.16)	−0.66*** (0.14)
Near petty crime - No		−0.55** (0.18)	−0.54** (0.18)	−0.50** (0.17)
Near serious crime - No		−0.62*** (0.11)	−0.62*** (0.11)	−0.59*** (0.10)
Near a disaster area - No		−0.61*** (0.10)	−0.61*** (0.10)	−0.59*** (0.09)
$HOAAmount \cdot SingleFamily(D)$		−0.63*** (0.10)	−0.62*** (0.09)	−0.56*** (0.09)
$HOAAmount \cdot SingleFamily(A)$		−0.58*** (0.09)	−0.57*** (0.09)	−0.51*** (0.08)
Constant		−0.62*** (0.09)	−0.62*** (0.09)	−0.52*** (0.08)
p_yearbuilt2000		−0.66*** (0.09)	−0.65*** (0.09)	−0.54*** (0.08)
p_yearbuilt2010		−0.67*** (0.10)	−0.66*** (0.10)	−0.53*** (0.09)
p_yearbuilt2020		−0.57*** (0.09)	−0.56*** (0.09)	−0.44*** (0.08)
p_lotsize1		0.15*** (0.03)	0.16*** (0.03)	0.11*** (0.03)
p_lotsize2		0.08* (0.04)	0.08* (0.04)	0.12*** (0.03)
p_lotsize3		0.10** (0.04)	0.10* (0.04)	0.14*** (0.04)
p_lotsize4		0.09 (0.05)	0.08 (0.05)	0.11* (0.05)
p_lotsize5		0.17** (0.05)	0.16** (0.05)	0.20*** (0.05)
p_lotsize6		0.46*** (0.10)	0.45*** (0.10)	0.41*** (0.09)
p_lotsize7		0.17 (0.12)	0.15 (0.11)	0.17 (0.11)
p_sqft2		−0.32* (0.12)	−0.32* (0.13)	−0.23 (0.15)
p_sqft3		−0.20 (0.10)	−0.21 (0.11)	−0.11 (0.13)
p_sqft4		−0.11 (0.10)	−0.12 (0.11)	−0.01 (0.13)
p_sqft5		0.07 (0.10)	0.06 (0.11)	0.18 (0.12)
p_sqft6		0.27** (0.09)	0.26* (0.11)	0.37** (0.12)
p_sqft7		0.40*** (0.10)	0.38*** (0.11)	0.51*** (0.13)
p_sqft8		0.56*** (0.10)	0.55*** (0.11)	0.68*** (0.13)
p_sqft9		0.83*** (0.10)	0.82*** (0.11)	0.94*** (0.13)
p_garage1		−0.23*** (0.04)	−0.22*** (0.04)	−0.18*** (0.04)
p_nhqschool1			−0.02 (0.03)	−0.06 (0.03)
p_nhqschool-1			0.01 (0.04)	0.01 (0.03)
p_nhqcrime2			−0.04 (0.03)	−0.04 (0.03)
p_nhqcrime_s2			0.002 (0.10)	0.07 (0.09)
p_diaster2			−0.13** (0.04)	−0.16*** (0.04)
p_ratingnh2			1.00*** (0.29)	1.10*** (0.25)
p_ratingnh3			0.39 (0.30)	0.41 (0.23)
p_ratingnh4			0.54 (0.40)	0.58 (0.36)
p_ratingnh5			0.83*** (0.24)	0.77*** (0.19)
p_ratingnh6			0.90*** (0.24)	0.82*** (0.19)
p_ratingnh7			1.00*** (0.23)	0.94*** (0.18)
p_ratingnh8			0.99*** (0.23)	0.95*** (0.18)
p_ratingnh9			1.10*** (0.23)	0.99*** (0.18)
p_ratingnh10			1.00*** (0.23)	1.00*** (0.18)
p_metro_code'14460'				0.71*** (0.05)
p_metro_code'16980'				0.08 (0.04)
p_metro_code'19100'				0.05 (0.04)
p_metro_code'19820'				−0.01 (0.05)
p_metro_code'26420'				−0.18*** (0.04)
p_metro_code'31080'				1.00*** (0.05)
p_metro_code'33100'				0.17*** (0.04)
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p_metro_code'37980'				0.19*** (0.04)
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l_HOAAMT:p_housetype2	−0.15* (0.06)	−0.13** (0.05)	−0.13** (0.05)	−0.10* (0.05)
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Constant	11.00*** (0.36)	12.00*** (0.32)	11.00*** (0.39)	11.00*** (0.35)
Observations	5,580	5,580	5,580	5,580
R^2	0.12	0.33	0.34	0.48
Residual Std. Error	27.00 (df = 5574)	24.00 (df = 5548)	24.00 (df = 5534)	21.00 (df = 5518)

Note: HC_1 robust standard errors in parentheses. HOA Amount is logged. D = Detached, A = Attached.

Linear Regression Models Evaluations

| Baseline data model (HOA + HouseType) (model 1) | House Characteristics variables (model 2) | Neighborhood Characteristics variables (model 3) | Geographic Location variables (model 4) |

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Near petty crime - No			−0.04 (0.03)	−0.04 (0.03)
Near serious crime - No			0.002 (0.10)	0.07 (0.09)
Near a disaster area - No			−0.13** (0.04)	−0.16*** (0.04)
$HOAAmount \cdot SingleFamily(D)$	−0.15* (0.06)	−0.13** (0.05)	−0.13** (0.05)	−0.10* (0.05)
$HOAAmount \cdot SingleFamily(A)$	−0.19** (0.07)	−0.14** (0.05)	−0.14** (0.05)	−0.12* (0.05)
Constant	11.00*** (0.36)	12.00*** (0.32)	11.00*** (0.39)	11.00*** (0.35)
Lot Size		✓	✓	✓
Square Footage		✓	✓	✓
Year Built		✓	✓	✓
Neighborhood Rating			✓	✓
School Rating			✓	✓
Metro Code				✓
Observations	5,580	5,580	5,580	5,580
R^2	0.12	0.33	0.34	0.48
Residual Std. Error	27.00 (df = 5574)	24.00 (df = 5548)	24.00 (df = 5534)	21.00 (df = 5518)

Note: HC_1 robust standard errors in parentheses. HOA Amount is logged. D = Detached, A = Attached.

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