

# Predicting the Past:

Estimating Historical Appraisals  
with OCR and Machine Learning



Mihir Bhaskar  
Asmita Hajra

Jun Tao Luo  
Junia Howell

Zihan Geng  
Matthew R. Gormley

A stylized map of the United States in a dark red color, set against a dark green background. Several orange house icons are scattered across the map. Three specific price labels are overlaid on the map in a white, serif font with a drop shadow. The label "\$900,000" is in the upper left, "\$290,000" is in the center-right, and "\$90,000" is in the lower center.

\$900,000

\$290,000

\$90,000





# The Increasing Effect of Neighborhood Racial Composition on Housing Values, 1980–2015

Junia Howell<sup>1</sup> and Elizabeth Korver-Glenn<sup>2</sup>

<sup>1</sup>University of Pittsburgh, <sup>2</sup>University of New Mexico

## ABSTRACT

Beginning in the 1930s, neighborhood racial composition became a factor in the evaluation of U.S. home values. This deliberate practice began in the 1960s and 1970s, but the correlation between neighborhood racial composition and home values persists. Using Census Bureau data from 1980 to 2015, we examine the changing relationship between neighborhood racial composition and home values, as well as the mechanisms that drive it. Contrary to what is often assumed, neighborhood racial composition was a stronger determinant of appraised home values in 2015 than in 1980. Results suggest this is primarily due to contemporary appraisals to influence contemporary values and appraise neighborhoods to drive appraisal methods. These findings suggest that persistent racial inequality is driven in part by perpetual devaluation. They suggest further regulation is required to foster equity.

**KEYWORDS:** racial inequality; appraisals; housing redlining.

*Neighborhoods, Housing, and Racial Segregation*

## Neighborhoods, Race, and the Twenty-first-century Housing Appraisal Industry

Junia Howell<sup>1</sup> and Elizabeth Korver-Glenn<sup>2</sup>

### Abstract

The history of the U.S. housing market is bound up in systemic, explicit racism. However, little research has investigated whether racial inequality also persists in the contemporary appraisal industry and, if present, how it happens. The present article addresses this gap by centering the appraisal industry as a key housing market player in the reproduction of racial inequality. Using a census of all single-family tax-appraised homes in Harris County (Houston), Texas, the authors examine the influence of neighborhood racial composition on home values independent of home characteristics and quality; neighborhood housing stock, socioeconomic status, and amenities; and consumer housing demand. Noting that substantial neighborhood racial inequality in home values persists even when these variables are accounted for, the authors then use ethnographic and interview data to investigate the appraisal processes that enable this inequality to continue. The findings suggest that variation in appraisal methods coupled with appraisers' racialized perceptions of neighborhoods perpetuates neighborhood racial disparities in home value. The authors conclude with suggestions for future research and policy interventions aimed at standardizing the appraisal process.



Sociology of Race and Ethnicity  
2018, Vol. 4(4) 473–490  
© American Sociological Association 2018  
DOI: 10.1177/2332649218755178  
sre.sagepub.com  
SAGE

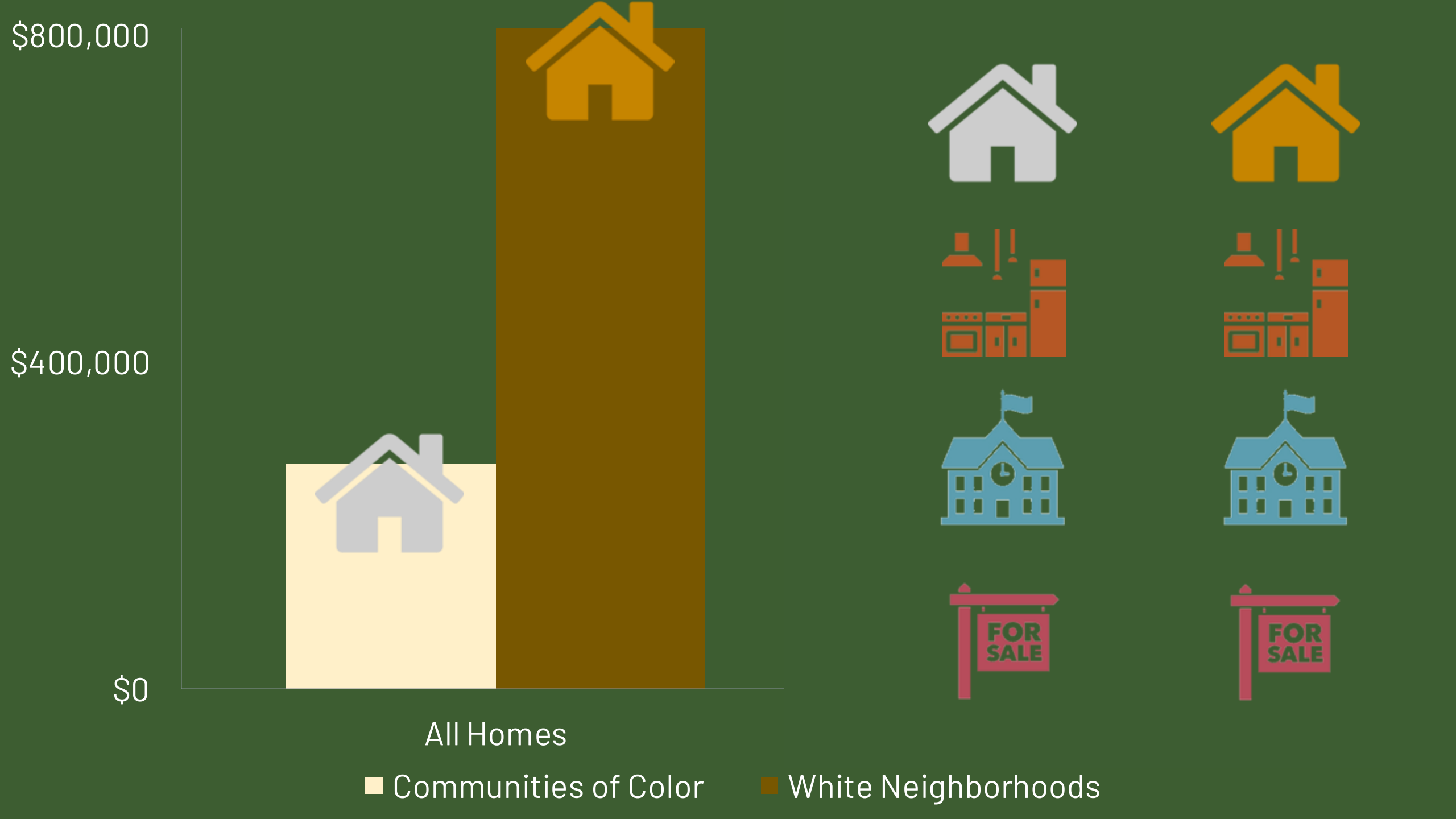
# Appraised:

The Persistent Evaluation of White Neighborhoods as More Valuable Than Communities of Color

JUNIA HOWELL  
ELIZABETH KORVER-GLENN

NOVEMBER 2022





\$800,000

\$400,000

\$0

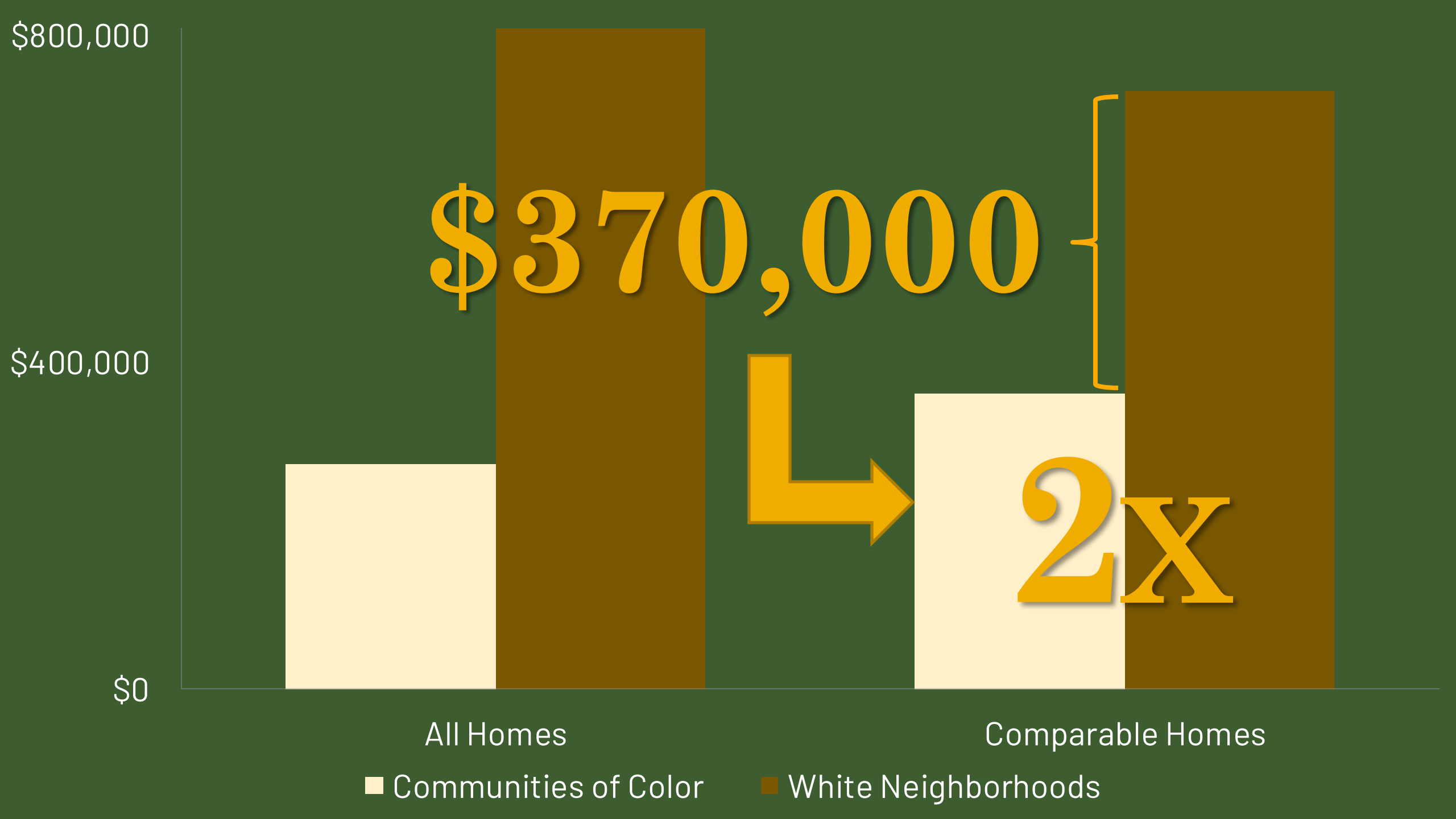
All Homes

Communities of Color

White Neighborhoods









# Appraised:

The Persistent Evaluation of White Neighborhoods  
as More Valuable Than Communities of Color

JUNIA HOWELL  
ELIZABETH KORVER-GLENN

NOVEMBER 2022

*Social Problems*, 2020, 0, 1–21  
doi: 10.1093/socpro/spaa033  
Article

OXFORD

## The Increasing Effect of Neighborhood Racial Composition on Housing Values, 1980–2015

Junia Howell<sup>1</sup> and Elizabeth Korver-Glenn<sup>2</sup>



<sup>1</sup>University of Pittsburgh, <sup>2</sup>University of New Mexico

### ABSTRACT

he 1930s, neighborhood racial composition was an explicit determining  
tion of U.S. home values. This deliberate practice was outlawed in the  
but the correlation between neighborhood racial composition and home  
ing Census Bureau data from 1980 to 2015, the present study investigates  
ionship between neighborhood racial composition and home appraisals,  
hanisms that drive it. Contrary to what is often presumed, neighborhood  
i was a stronger determinant of appraised values in 2015 than it was in  
ggest this is primarily due to contemporary appraising practices.  
se of the sales comparison approach has allowed historical racialized  
ence contemporary values and appraisers' racialized assumptions about  
drive appraisal methods. These findings provide strong evidence that per-  
ality is driven in part by perpetual devaluing of communities of color and  
er regulation is required to foster equity.

cial inequality; appraisals; housing market; neighborhood inequality;

Sociology of Race and Ethnicity  
2018, Vol. 4(4) 473–490  
© American Sociological Association 2018  
DOI: 10.1177/2332649218755178  
sre.sagepub.com  
SAGE

*Neighborhoods, Housing, and Racial Segregation*

## Neighborhoods, Race, and the Twenty-first-century Housing Appraisal Industry

Junia Howell<sup>1</sup> and Elizabeth Korver-Glenn<sup>2</sup>

### Abstract

The history of the U.S. housing market is bound up in systemic, explicit racism. However, little research has investigated whether racial inequality also persists in the contemporary appraisal industry and, if present, how it happens. The present article addresses this gap by centering the appraisal industry as a key housing market player in the reproduction of racial inequality. Using a census of all single-family tax-appraised homes in Harris County (Houston), Texas, the authors examine the influence of neighborhood racial composition on home values independent of home characteristics and quality; neighborhood housing stock, socioeconomic status, and amenities; and consumer housing demand. Noting that substantial neighborhood racial inequality in home values persists even when these variables are accounted for, the authors then use ethnographic and interview data to investigate the appraisal processes that enable this inequality to continue. The findings suggest that variation in appraisal methods coupled with appraisers' racialized perceptions of neighborhoods perpetuates neighborhood racial disparities in home value. The authors conclude with suggestions for future research and policy interventions aimed at standardizing the appraisal process.





1920





\$1000



\$1500



\$50



1920



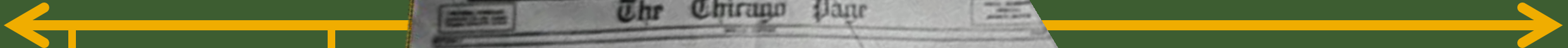
# One Story Single Family Homes

square feet      1-bed    2-bed    3-bed    4-bed    5-bed    6-bed

under 100	\$1500	\$1600	\$1700	\$1800	\$1900	\$2000
100-200	\$2000	\$2100	\$2200	\$2300	\$2400	\$2500
200-300	\$2500	\$2600	\$2700	\$2800	\$2900	\$3000
300-400	\$3000	\$3100	\$3200	\$3300	\$3400	\$3500
400-500	\$3500	\$3600	\$3700	\$3800	\$3900	\$4000
500-600	\$4000	\$4100	\$4200	\$4300	\$4400	\$4500
600-700	\$4500	\$4600	\$4700	\$4800	\$4900	\$5000
700-800	\$5000	\$5100	\$5200	\$5300	\$5400	\$5500
800-900	\$5500	\$5600	\$5700	\$5800	\$5900	\$6000
900-1000	\$6000	\$6100	\$6200	\$6300	\$6400	\$6500

1920





1920

1929



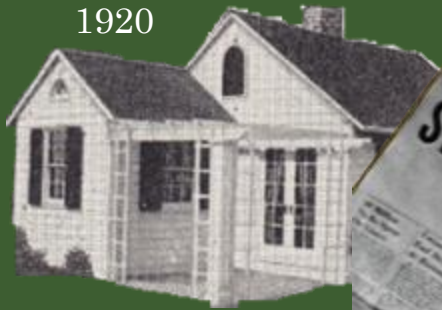




1932



1920



1929



1934



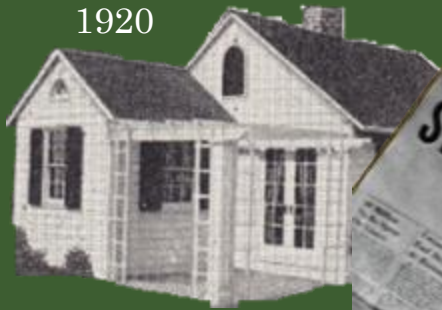




1932



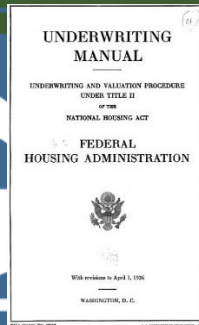
1920

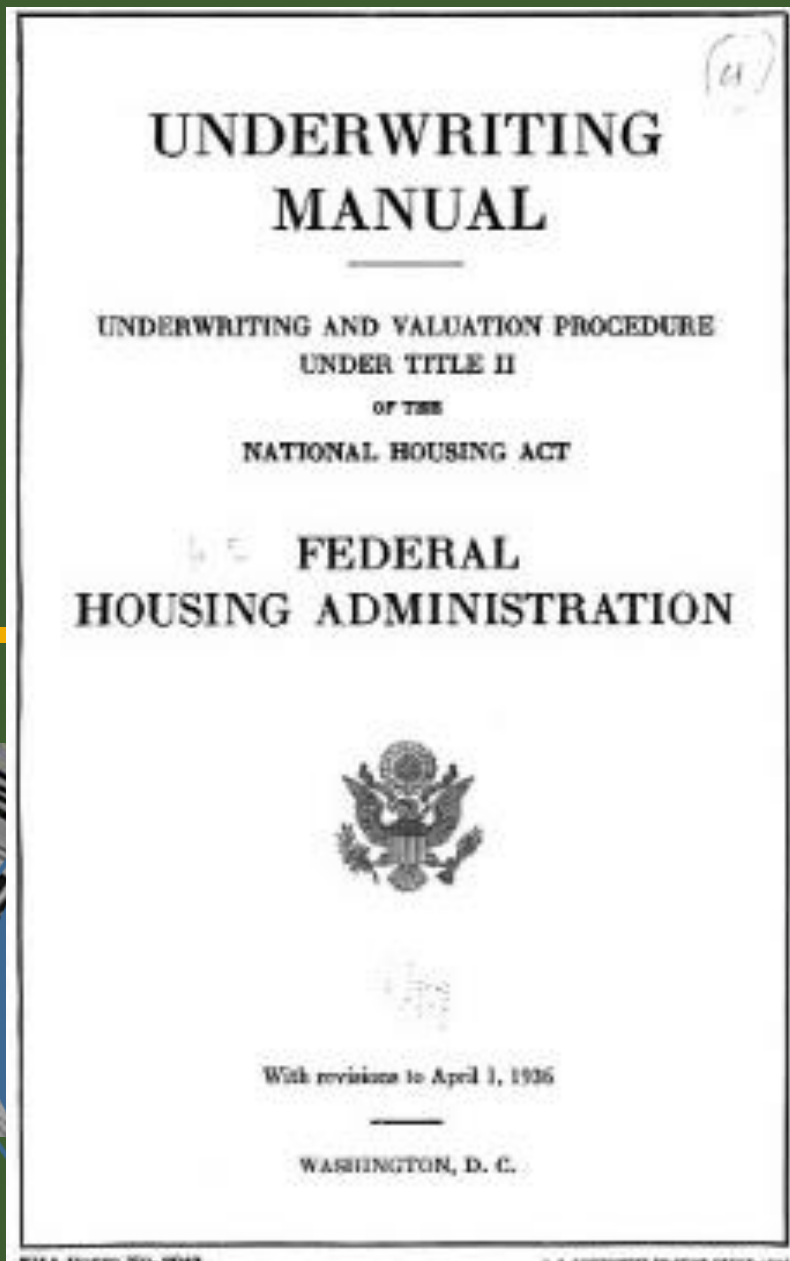
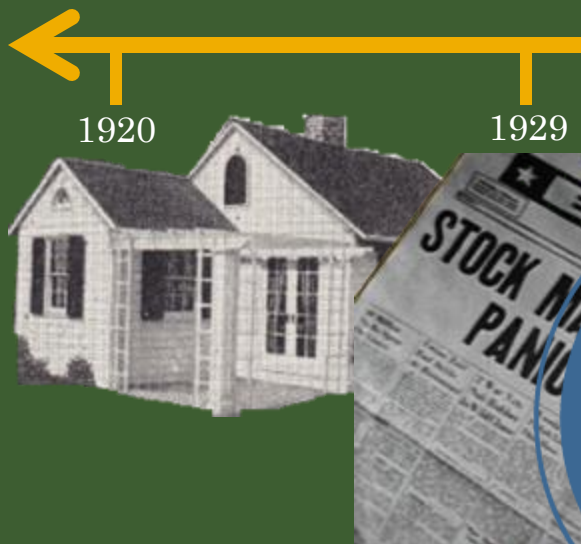


1929



1934





(4)

# UNDERWRITING MANUAL

UNDERWRITING AND VALUATION PROCEDURE  
UNDER TITLE II  
OF THE  
NATIONAL HOUSING ACT

U. S. FEDERAL  
HOUSING ADMINISTRATION



With revisions to April 1, 1936

WASHINGTON, D. C.

(4)

# UNDERWRITING MANUAL

UNDERWRITING AND VALUATION PROCEDURE  
UNDER TITLE II  
OF THE  
NATIONAL HOUSING ACT

FEDERAL  
HOUSING ADMINISTRATION



With revisions to April 1, 1936

WASHINGTON, D. C.



(4)

# UNDERWRITING MANUAL

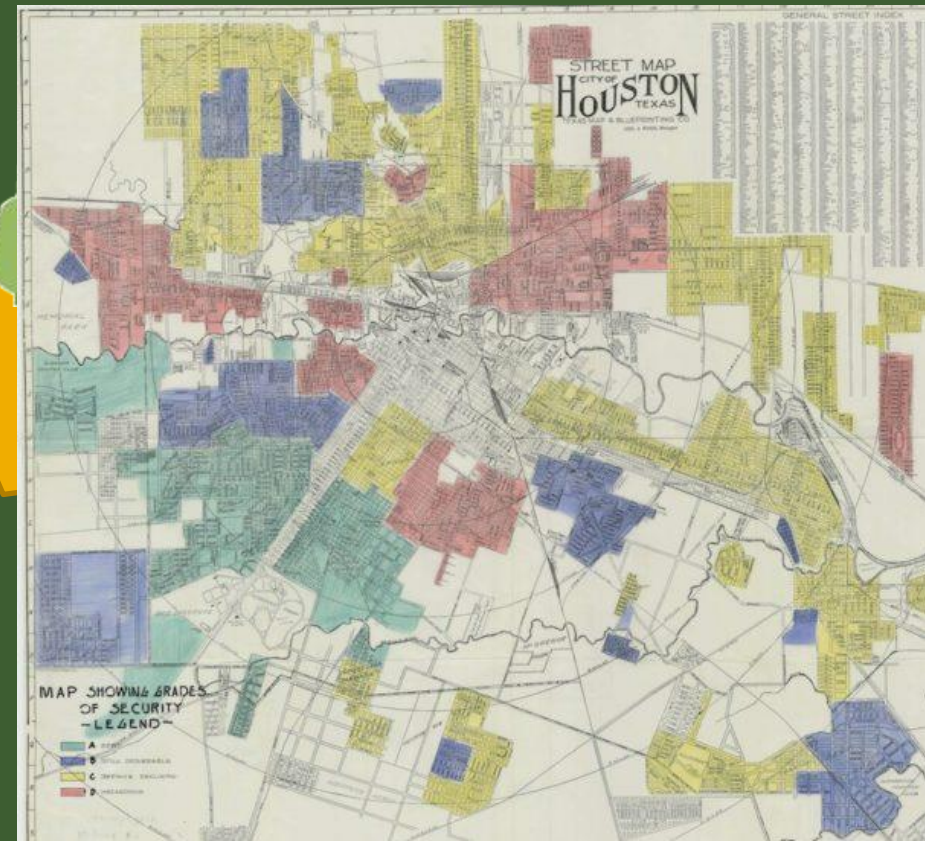
UNDERWRITING AND VALUATION PROCEDURE  
UNDER TITLE II  
OF THE  
NATIONAL HOUSING ACT

FEDERAL  
HOUSING ADMINISTRATION



With revisions to April 1, 1936

WASHINGTON, D. C.



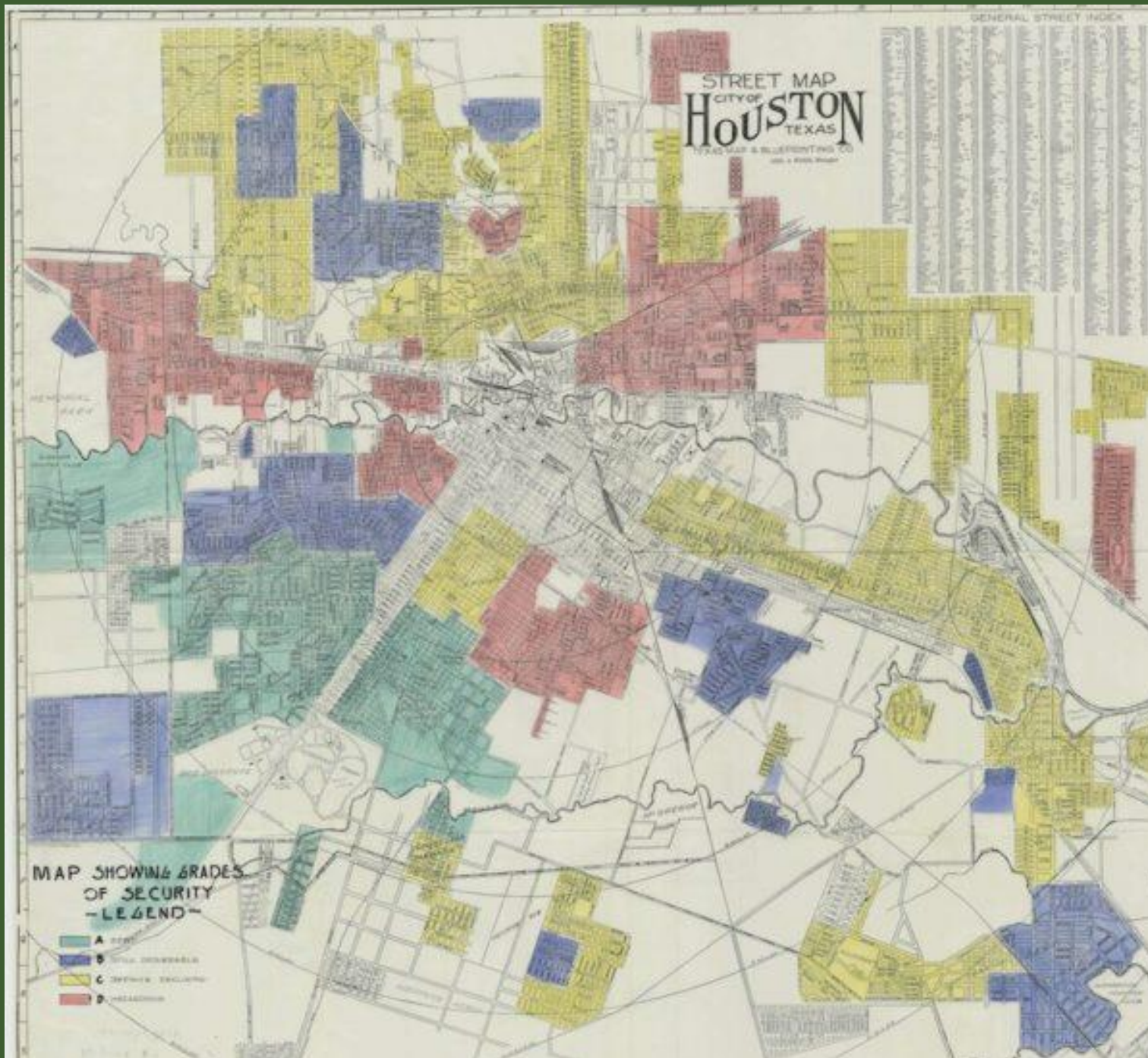


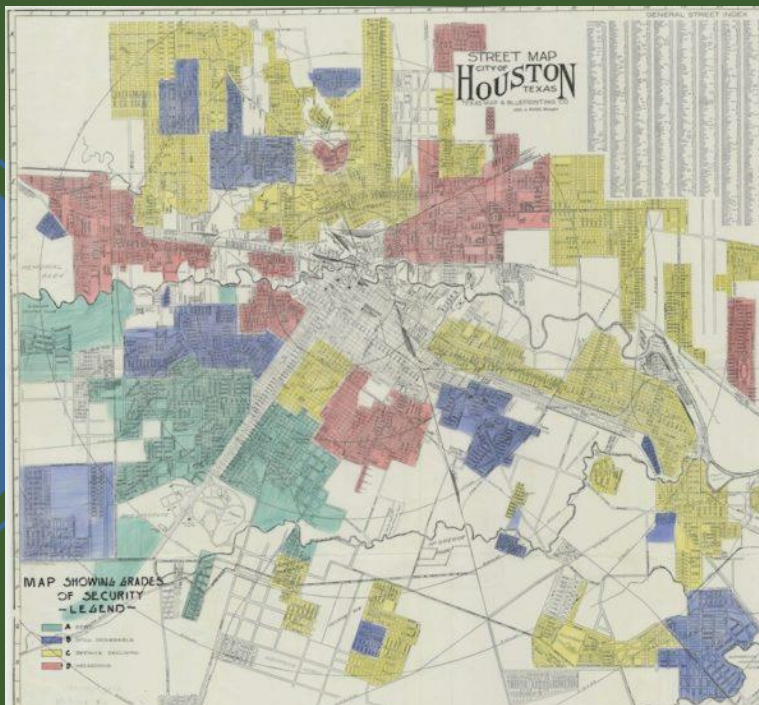
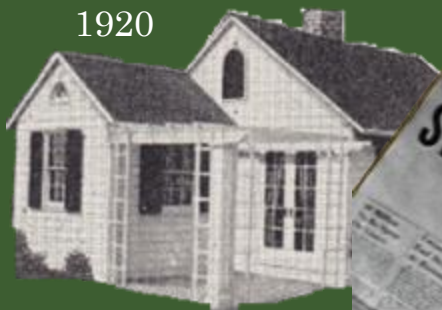
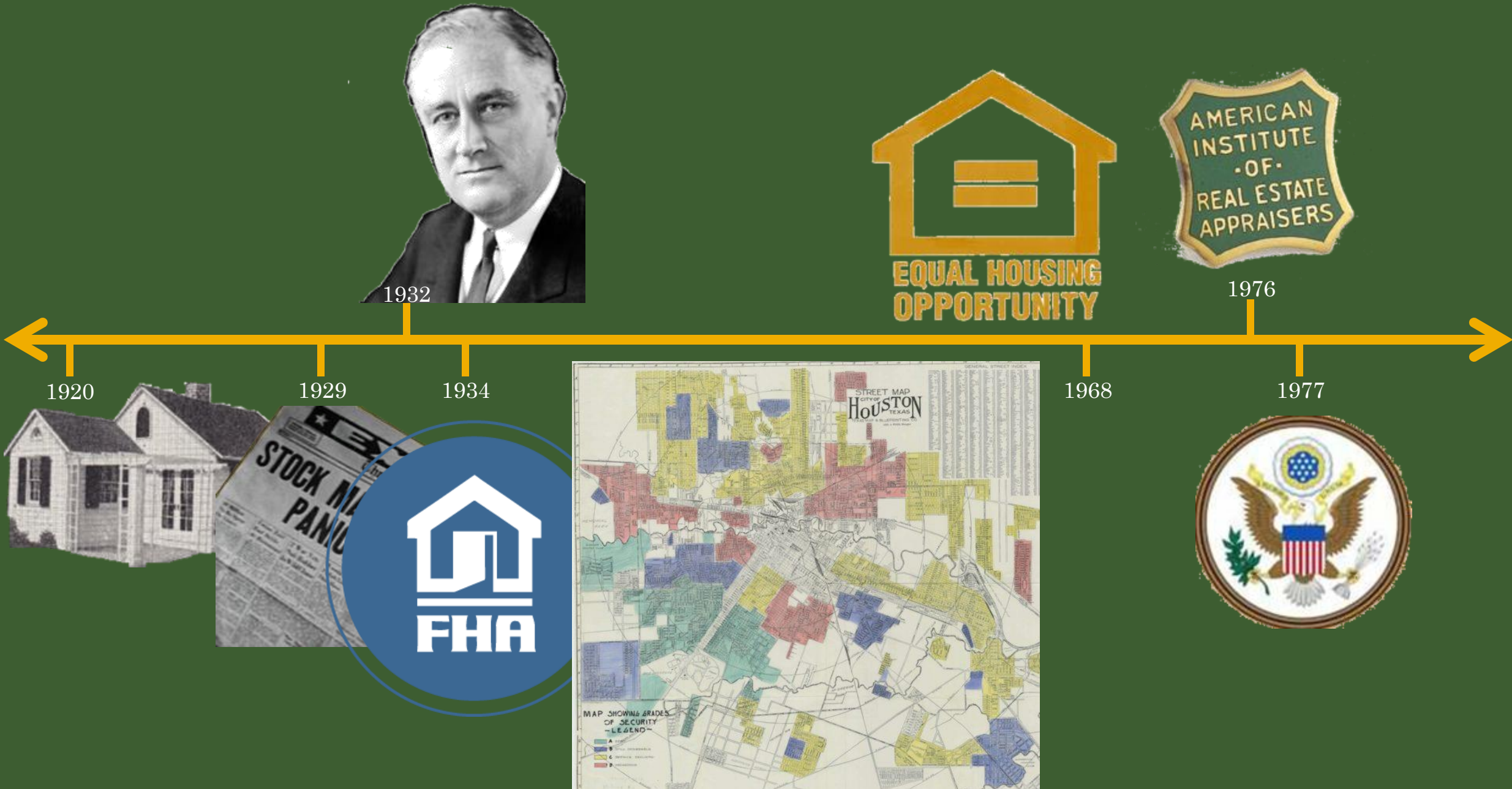
STREET MAP  
CITY OF  
**HOUSTON**  
TEXAS  
TEXAS MAP & BLUEPRINTING CO.  
INC. • 1935, 1936

GENERAL STREET INDEX

MAP SHOWING GRADES  
OF SECURITY  
—LEGEND—

- A. FIRE
- B. FLOOD DANGEROUS
- C. DEFENSE RAILROAD
- D. HOUSING









1976

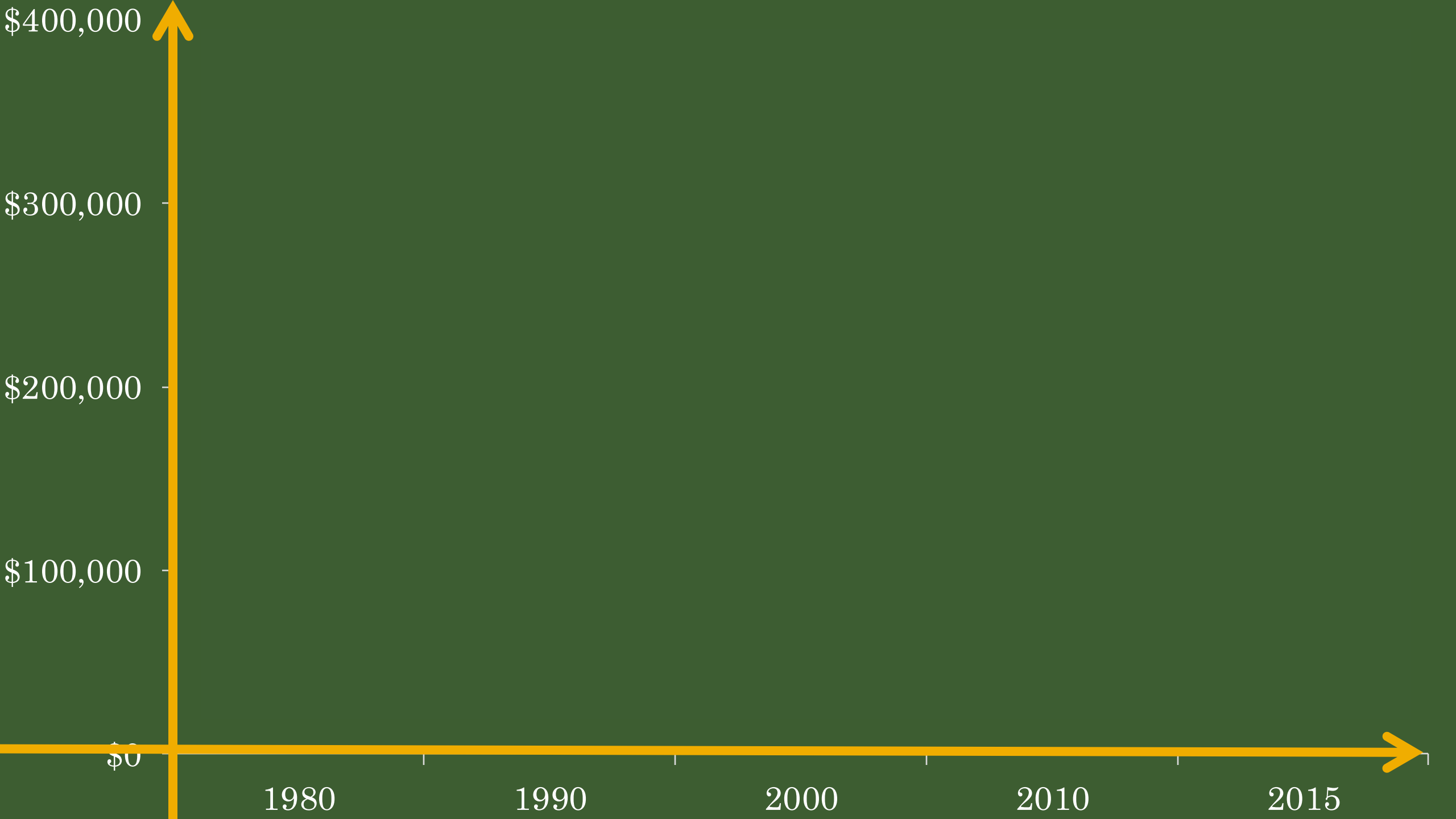
1968

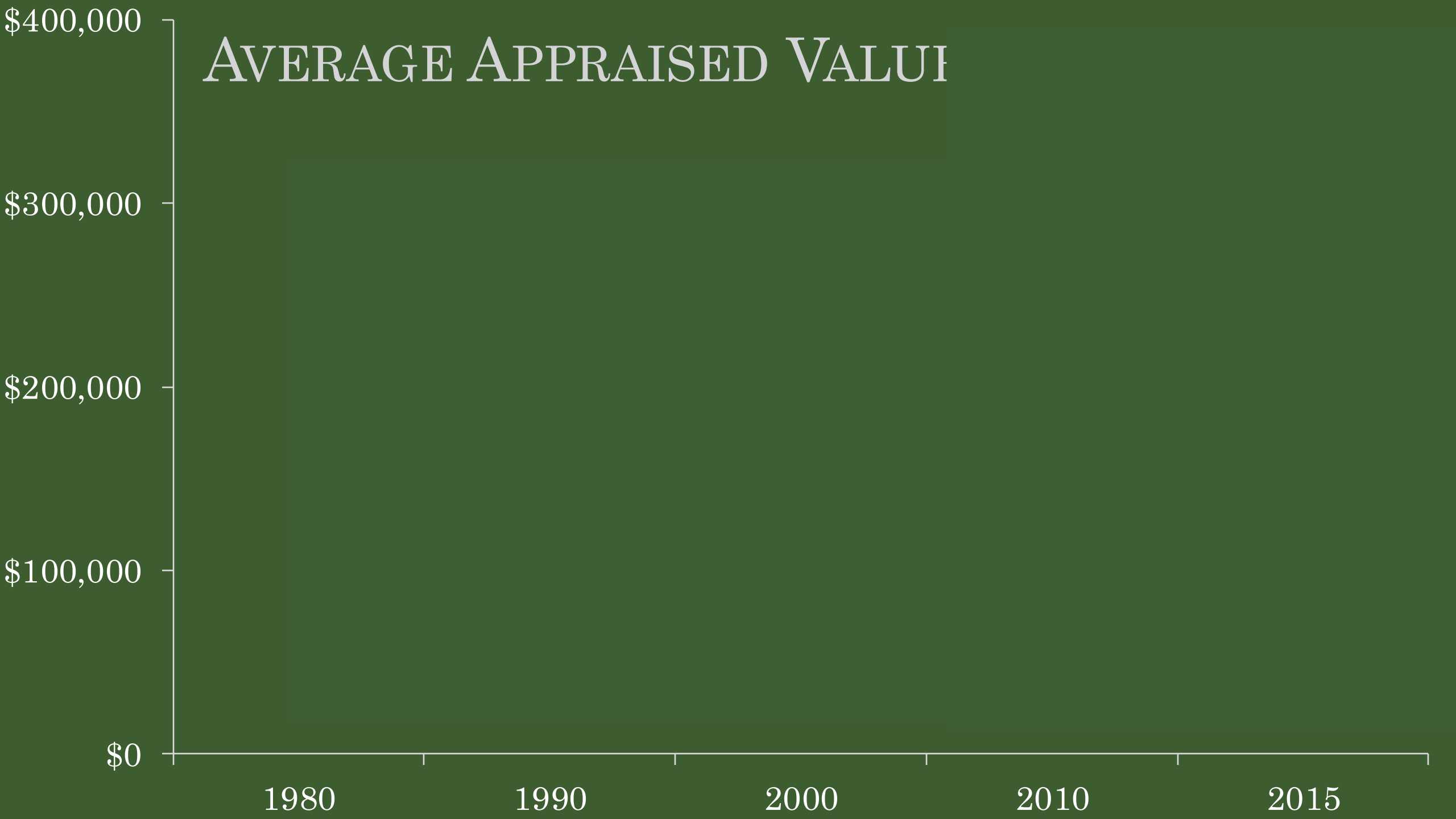
1977



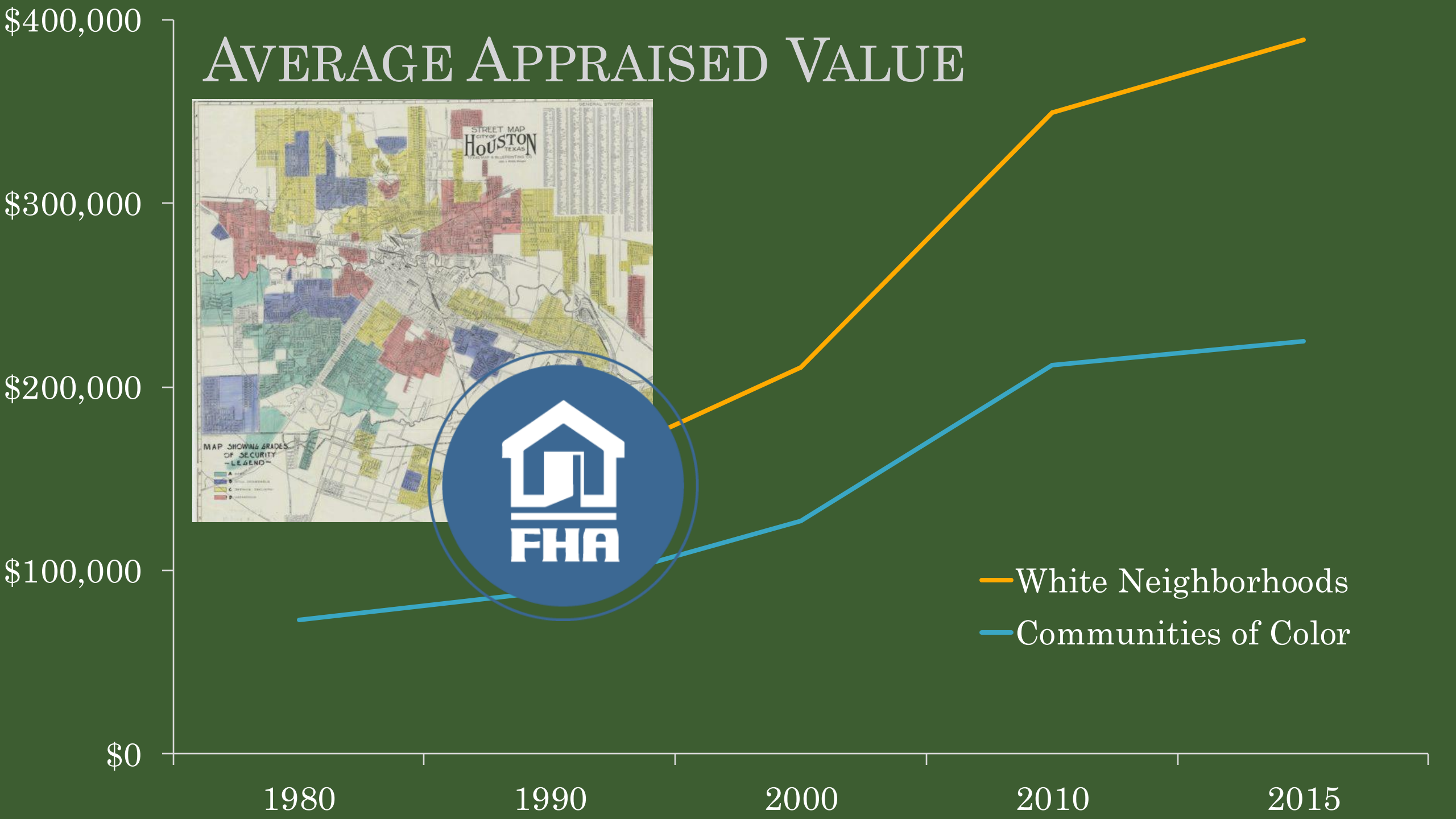


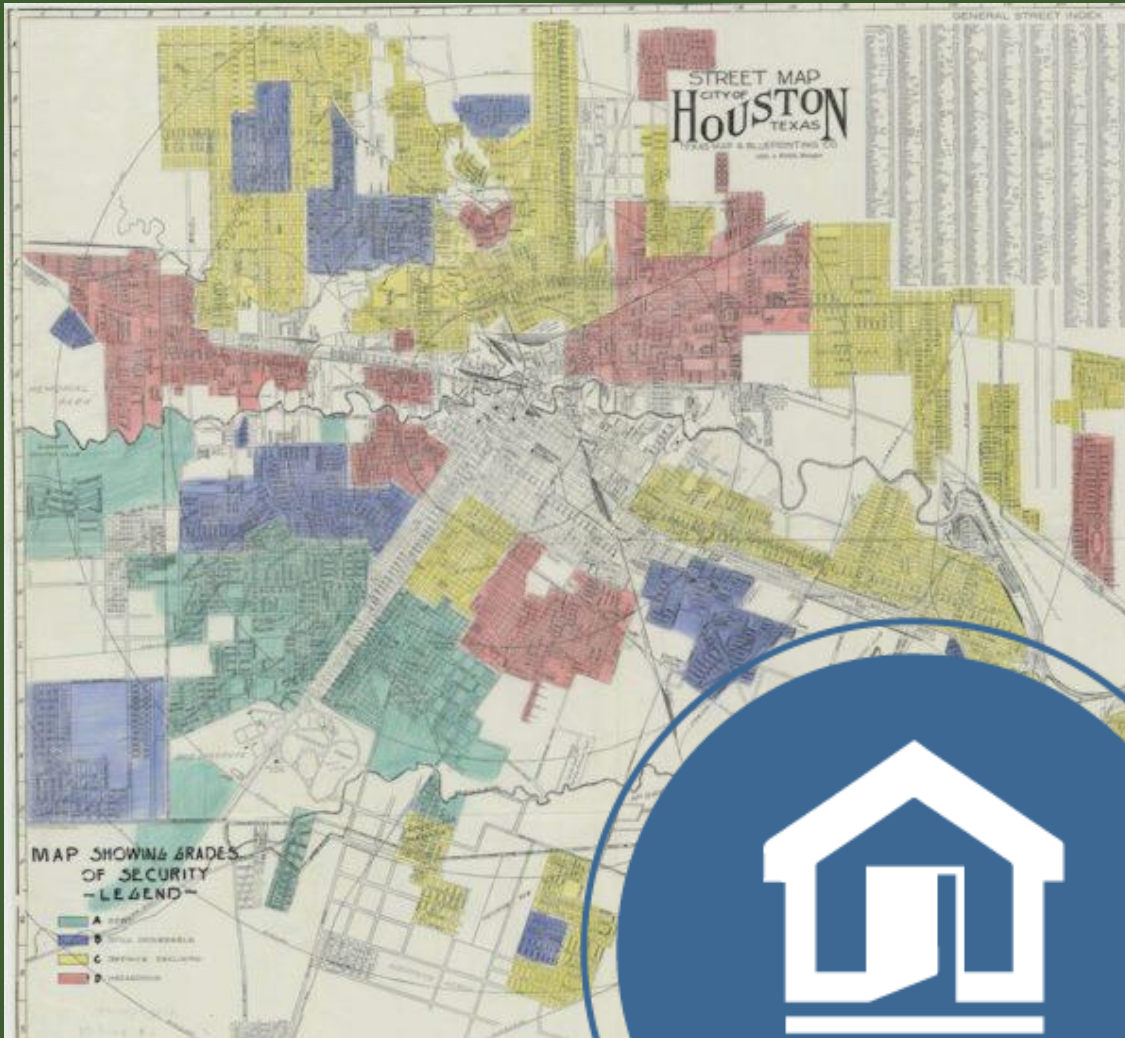






# AVERAGE APPRAISED VALUE





good

news





good  
news



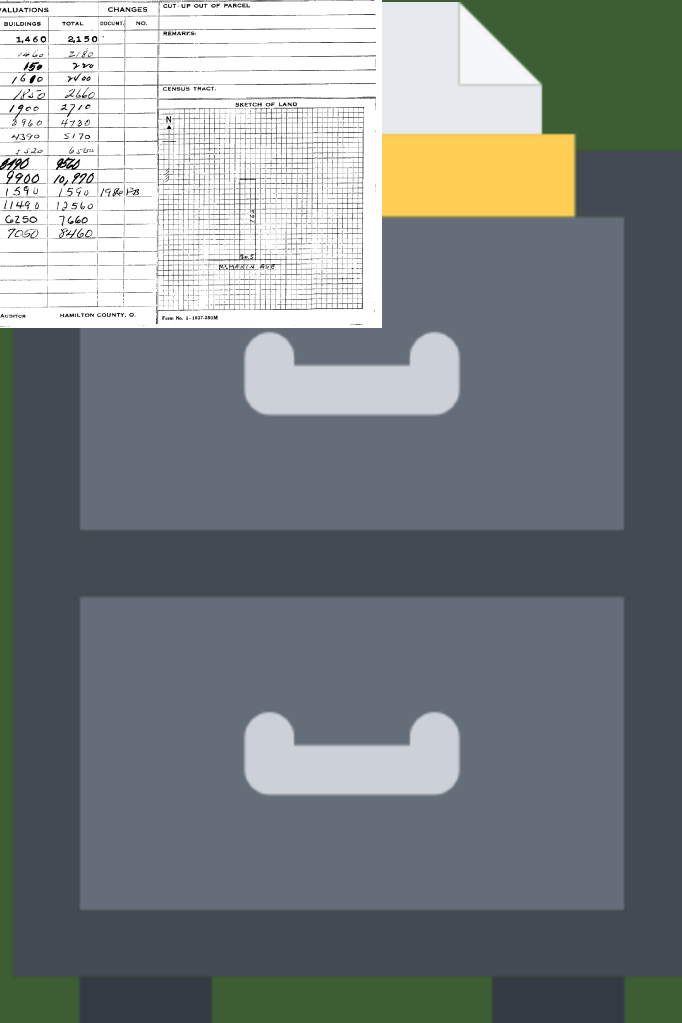
LORAU, C. R. 759 MCWAKEN AVE CITY, O 219 52 75 759 MCWAKEN AVE 30.5 ± 100 EER PT LOT 7 - JANE MCWAKEN										DATE 10 3 41 LORAU HERMAN & ALBERTA M LODDER 4 26 43 OSTENKAMP ETHEL M 10 13 75 OSTENKAMP, PAUL J., & ETHEL M. 1 11 79 OSTENKAMP, ETHEL M. 12 19 80 JONES, WAYNE G. & MARILYN K.									
TAX CODE										TRANSFERRER TO PRESENT OWNER									
BOOK										PARCEL									
DATE										CUT-UPS									
NO.										DA.									
YR.										PARCEL									
FEE										OR									
ACRES										FEE									
OR										ACRES									
LAND										BUILDINGS									
TOTAL										TODAY									
NO.										REMARKS									
690										1,460									
730										1,460									
70										160									
70										160									
810										1,520									
810										1,900									
770										8,860									
780										4,390									
520										1,320									
1070										8,900									
1070										8,900									
1070										1,540									
1070										1,140									
1410										6,250									
1410										7,060									

REAL ESTATE TAX LIST

880. GUCKENBERGER, ALBERTA

HAMILTON COUNTY, O.

Form No. 1, 1977-1978





①

10	3	41	LOHAUS HERMAN & ALBERTA M LODDER
4	26	43	OSTENKAMP ETHEL M
10	13	76	OSTENKAMP, PAUL J., & ETHEL M.
1	11	79	OSTENKAMP, ETHEL M.
12	19	80	JONES, WAYNE G. & MARILYN K.

Form No. 1-1937-250M





good

news

bad

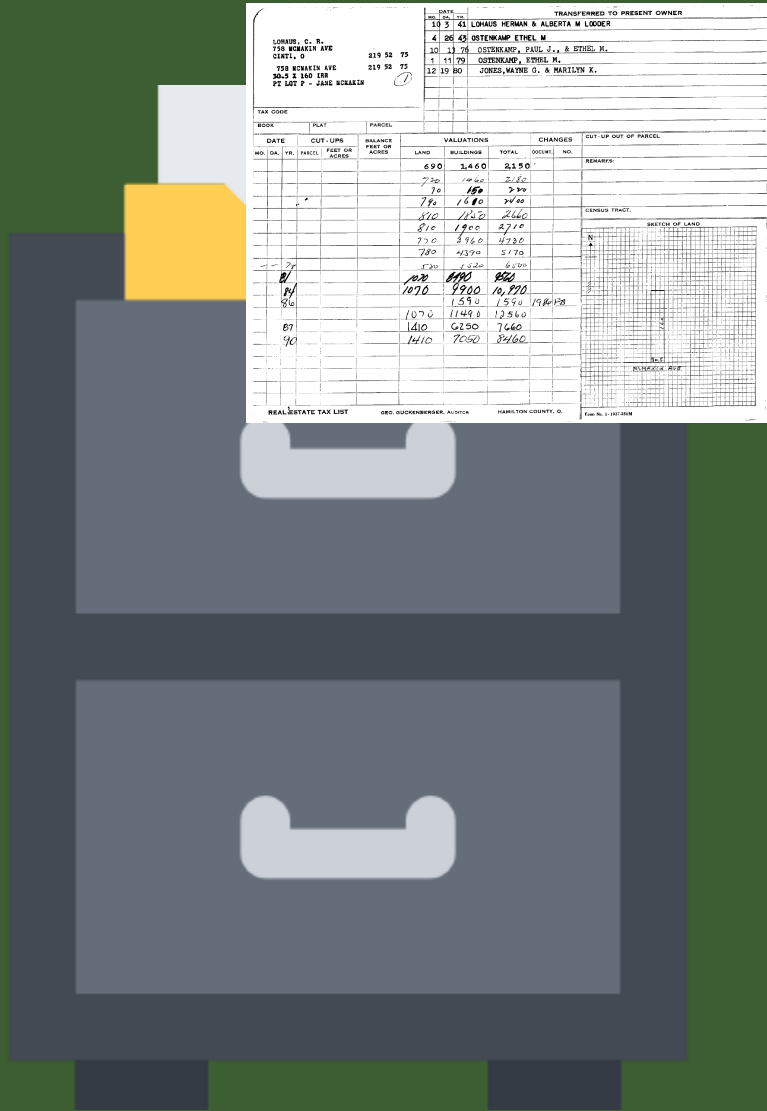
news





# bad news





bad  
news

219 52 75

219 52 75

DATE		
MO.	DA.	YR.

TRANSFERRED TO PRESENT OWNER

10	3	41	LOHAUS HERMAN & ALBERTA M LODDER
4	26	43	OSTENKAMP ETHEL M
10	13	76	OSTENKAMP, PAUL J., & ETHEL M.
1	11	79	OSTENKAMP, ETHEL M.
12	19	80	JONES, WAYNE G. & MARILYN K.

TAX CODE

BOOK

PLAT
------

PARCEL	AREA	PERCENT	ACRES	ADJACENT	OWNER	REMARKS
1	1.00	100.00	1.00			
2	1.00	100.00	1.00			
3	1.00	100.00	1.00			
4	1.00	100.00	1.00			
5	1.00	100.00	1.00			
6	1.00	100.00	1.00			
7	1.00	100.00	1.00			
8	1.00	100.00	1.00			
9	1.00	100.00	1.00			
10	1.00	100.00	1.00			
11	1.00	100.00	1.00			
12	1.00	100.00	1.00			
13	1.00	100.00	1.00			
14	1.00	100.00	1.00			
15	1.00	100.00	1.00			
16	1.00	100.00	1.00			
17	1.00	100.00	1.00			
18	1.00	100.00	1.00			
19	1.00	100.00	1.00			
20	1.00	100.00	1.00			
21	1.00	100.00	1.00			
22	1.00	100.00	1.00			
23	1.00	100.00	1.00			
24	1.00	100.00	1.00			
25	1.00	100.00	1.00			
26	1.00	100.00	1.00			
27	1.00	100.00	1.00			
28	1.00	100.00	1.00			
29	1.00	100.00	1.00			
30	1.00	100.00	1.00			
31	1.00	100.00	1.00			
32	1.00	100.00	1.00			
33	1.00	100.00	1.00			
34	1.00	100.00	1.00			
35	1.00	100.00	1.00			
36	1.00	100.00	1.00			
37	1.00	100.00	1.00			
38	1.00	100.00	1.00			
39	1.00	100.00	1.00			
40	1.00	100.00	1.00			
41	1.00	100.00	1.00			
42	1.00	100.00	1.00			
43	1.00	100.00	1.00			
44	1.00	100.00	1.00			
45	1.00	100.00	1.00			
46	1.00	100.00	1.00			
47	1.00	100.00	1.00			
48	1.00	100.00	1.00			
49	1.00	100.00	1.00			
50	1.00	100.00	1.00			
51	1.00	100.00	1.00			
52	1.00	100.00	1.00			
53	1.00	100.00	1.00			
54	1.00	100.00	1.00			
55	1.00	100.00	1.00			
56	1.00	100.00	1.00			
57	1.00	100.00	1.00			
58	1.00	100.00	1.00			
59	1.00	100.00	1.00			
60	1.00	100.00	1.00			
61	1.00	100.00	1.00			
62	1.00	100.00	1.00			
63	1.00	100.00	1.00			
64	1.00	100.00	1.00			
65	1.00	100.00	1.00			

DATE			CUT - UPS		BALANCE FEET OR ACRES	VALUATIONS			CHANGES		CUT - UP OUT OF PARCEL
MO.	DA.	YR.	PARCEL	FEET OR ACRES		LAND	BUILDINGS	TOTAL	DOCUMT.	NO.	
						690	1,460	2,150			REMARKS:
						720	1460	2180			
						70	150	220			
						790	1600	2400			
						810	1850	2660			CENSUS TRACT.
						810	1900	2710			<p style="text-align: center;">SKETCH OF LAND</p>
						770	3960	4730			
						780	4390	5170			
						520	5520	6500			
						1070	8490	9560			
						1070	9900	10,970			
							1590	1590	1980	PB	
						1070	11490	12560			
						1410	6250	7660			
						1410	7050	8460			

758 MCMARKY  
30 F

219 52 75

DATE			TRANSFERRED TO PRESENT OWNER
MO.	DA.	YR.	
10	3	41	LOHAUS HERMAN & ALBERTA M LODDER
4	26	43	OSTENKAMP ETHEL M
10	13	76	OSTENKAMP, PAUL J., & ETHEL M.
1	11	79	OSTENKAMP, ETHEL M.
12	19	80	JONES, WAYNE G. & MARILYN K.

CHANGES	TOTAL	DOCUMENT
---------	-------	----------

60	2,150
----	-------

2180

220

2400

2660

2710

4730

5170

0	6500
---	------

9570

50	10,970
----	--------

1990	1590	1980	1
------	------	------	---

1490	12560
------	-------

6250	7660
------	------

7050	8460
------	------

# scanning

# tabulation

Form No. 1 - 1937-250M





**Building  
Dataset**

**Predicting  
Values**



# Building Dataset

LOHAUS, C. R.  
758 MCWAKIN AVE  
CINTI, O  
758 MCWAKIN AVE  
30.5 x 160 IRR  
PT LOT P - JANE MCWAKIN

TAX CODE PLAT  
BOOK CUT-1  
DATE PARCEL FEET OR ACRES  
MO. DA. YR.

LOHAUS, C. R.  
758 MCWAKIN AVE  
CINTI, O  
758 MCWAKIN AVE  
30.5 x 160 IRR  
PT LOT P - JANE MCWAKIN

TAX CODE PLAT  
BOOK CUT-UPS  
DATE PARCEL FEET OR ACRES  
MO. DA. YR.

78  
81  
84  
86  
87  
90

REAL ESTATE TAX LIST  
GEO. GUCKENBERGER, AUDITOR  
HAMILTON COUNTY, O.  
Form No. 1-1937-250M

REAL ESTATE TAX LIST  
GEO. GUCKENBERGER, AUDITOR  
HAMILTON COUNTY, O.  
Form No. 1-1937-250M

REAL ESTATE TAX LIST  
GEO. GUCKENBERGER, AUDITOR  
HAMILTON COUNTY, O.  
Form No. 1-1937-250M

LOHAUS, C. R.  
758 MCWAKIN AVE  
CINTI, O  
758 MCWAKIN AVE  
30.5 x 160 IRR  
PT LOT P - JANE MCWAKIN

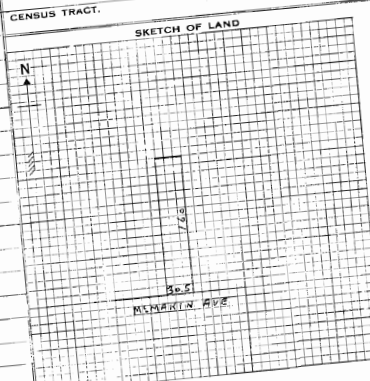
219 52 75  
219 52 75

DATE  
MO. DA. YR.  
10 3 41  
4 26 43  
10 13 76  
1 11 79  
12 19 80

LOHAUS HERMAN & ALBERTA M LODDER  
OSTENKAMP ETHEL M  
OSTENKAMP, PAUL J., & ETHEL M.  
OSTENKAMP, ETHEL M.  
JONES, WAYNE G. & MARILYN K.

TRANSFERRED TO PRESENT OWNER

TAX CODE			PLAT		PARCEL		VALUATIONS			CHANGES		CUT-UP OUT OF PARCEL	
BOOK			DATE		CUT-UPS		BALANCE		TOTAL		DOCUM. NO.		REMARKS:
MO.	DA.	YR.	PARCEL	FEET OR ACRES	FEET OR ACRES	FEET OR ACRES	LAND	BUILDINGS	LAND	BUILDINGS	DOCUM.	NO.	
							690	1460	2150				
							720	1460	2180				
							70	150	220				
							790	1680	2400				
							810	1830	2660				
							810	1900	2710				
							770	3960	4730				
							780	4390	5170				
							520	520	6500				
							1020	8190	8500				
							1070	9900	10,820				
								1590	1590	1980			
							1070	11490	12560				
							1410	6250	7660				
							1410	7050	8460				



Form No. 1-1937-250M

758 MCMAKIN AVE  
30.5 X 160 IRR  
PT LOT P - JANE MCMAKIN

219 52 75

1

DATE		
MO.	DA.	YR.

10	3	41	LOHAUS HERMAN & ALBERTA M LODDER
4	26	43	OSTENKAMP ETHEL M
10	13	76	OSTENKAMP, PAUL J., & ETHEL M.
1	11	79	OSTENKAMP, ETHEL M.
12	19	80	JONES, WAYNE G. & MARILYN K.

PARCEL	AREA	PERMITS	REMARKS
1	1.00	1.00	1.00
2	1.00	1.00	1.00
3	1.00	1.00	1.00
4	1.00	1.00	1.00
5	1.00	1.00	1.00
6	1.00	1.00	1.00
7	1.00	1.00	1.00
8	1.00	1.00	1.00
9	1.00	1.00	1.00
10	1.00	1.00	1.00
11	1.00	1.00	1.00
12	1.00	1.00	1.00
13	1.00	1.00	1.00
14	1.00	1.00	1.00
15	1.00	1.00	1.00
16	1.00	1.00	1.00
17	1.00	1.00	1.00
18	1.00	1.00	1.00
19	1.00	1.00	1.00
20	1.00	1.00	1.00
21	1.00	1.00	1.00
22	1.00	1.00	1.00
23	1.00	1.00	1.00
24	1.00	1.00	1.00
25	1.00	1.00	1.00
26	1.00	1.00	1.00
27	1.00	1.00	1.00
28	1.00	1.00	1.00
29	1.00	1.00	1.00
30	1.00	1.00	1.00
31	1.00	1.00	1.00
32	1.00	1.00	1.00
33	1.00	1.00	1.00
34	1.00	1.00	1.00
35	1.00	1.00	1.00
36	1.00	1.00	1.00
37	1.00	1.00	1.00
38	1.00	1.00	1.00
39	1.00	1.00	1.00
40	1.00	1.00	1.00
41	1.00	1.00	1.00
42	1.00	1.00	1.00
43	1.00	1.00	1.00
44	1.00	1.00	1.00
45	1.00	1.00	1.00
46	1.00	1.00	1.00
47	1.00	1.00	1.00
48	1.00	1.00	1.00
49	1.00	1.00	1.00
50	1.00	1.00	1.00
51	1.00	1.00	1.00
52	1.00	1.00	1.00
53	1.00	1.00	1.00
54	1.00	1.00	1.00
55	1.00	1.00	1.00
56	1.00	1.00	1.00
57	1.00	1.00	1.00
58	1.00	1.00	1.00
59	1.00	1.00	1.00
60	1.00	1.00	1.00
61	1.00	1.00	1.00
62	1.00	1.00	1.00
63	1.00	1.00	1.00
64	1.00	1.00	1.00
65	1.00	1.00	1.00
66	1.00	1.00	1.00
67	1.00	1.00	1.00
68	1.00	1.00	1.00
69	1.00	1.00	1.00
70	1.00	1.00	1.00
71	1.00	1.00	1.00
72	1.00	1.00	1.00
73	1.00	1.00	1.00
74	1.00	1.00	1.00
75	1.00	1.00	1.00
76	1.00	1.00	1.00
77	1.00	1.00	1.00
78	1.00	1.00	1.00
79	1.00	1.00	1.00
80	1.00	1.00	1.00
81	1.00	1.00	1.00
82	1.00	1.00	1.00
83	1.00	1.00	1.00
84	1.00	1.00	1.00
85	1.00	1.00	1.00
86	1.00	1.00	1.00
87	1.00	1.00	1.00
88	1.00	1.00	1.00
89	1.00	1.00	1.00
90	1.00	1.00	1.00

DATE			CUT - UPS		BALANCE FEET OR ACRES	VALUATIONS			CHANGES		CUT - UP OUT OF PARCEL
MO.	DA.	YR.	PARCEL	FEET OR ACRES		LAND	BUILDINGS	TOTAL	DOCUMT.	NO.	
						690	1,460	2,150			REMARKS:
						720	1460	2180			
						70	150	220			
						790	1680	2400			
						810	1850	2660			CENSUS TRACT.
						810	1900	2710			<div style="text-align: center;">SKETCH OF LAND</div>
						770	3960	4730			
						780	4390	5170			
						520	5520	6500			
						1070	8190	9560			
						1070	9900	10,970			
							1590	1590	1980 PB		
						1070	11490	12560			
						1410	6250	7660			
						1410	7050	8460			

SKETCH OF LAND



MC MARLIN AVE

LOHAUS, C. R.  
758 MCKAKIN AVE  
CINTI, O

758 MCKAKIN AVE  
30.5 X 160 IRR  
PT LOT P - JANE MCKAKIN

219 52 75

219 52 75

(1)

DATE  
MO. DA. YR.

TRANSFERRED TO PRESENT OWNER

10	3	41	LOHAUS HERMAN & ALBERTA M LODDER
4	26	43	OSTENKAMP ETHEL M
10	13	76	OSTENKAMP, PAUL J., & ETHEL M.
1	11	79	OSTENKAMP, ETHEL M.
12	19	80	JONES, WAYNE G. & MARILYN K.

TAX CODE

BOOK

PLAT

PARCEL

DATE			CUT - UPS		BALANCE FEET OR ACRES	VALUATIONS			CHANGES		CUT - UP OUT OF PARCEL
MO.	DA.	YR.	PARCEL	FEET OR ACRES		LAND	BUILDINGS	TOTAL	DOCUMT.	NO.	
						690	1,460	2,150			REMARKS:
						720		2180			
						70	150	220			
						790	1680	2400			
						810	1850	2660			CENSUS TRACT.
						810	1900	2710			
						770	3960	4730			
						780	4390	5170			
						580	5520	6500			
						1070	8190	9560			
						1070	9900	10,970			
							1590	1590	1980	PB	
						1070	11490	12560			
						1410	6250	7660			
						1410	7050	8460			

SKETCH OF LAND

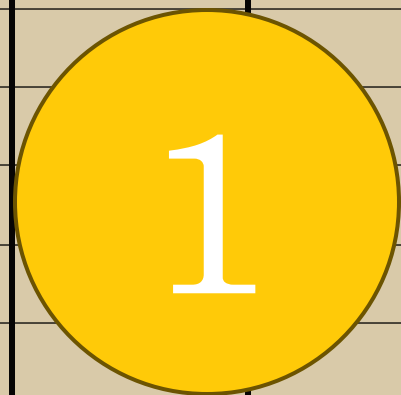
N

MEMARKIN AVE

1

Tabular  
Segmentation





Tabular  
Segmentation



OCR  
Model



1

Tabular  
Segmentation

Preprocessing:  
Lighting conditions  
taken into account

## Detect keypoints, compute descriptors using **ORB**

Match descriptors with **BFMatcher** and **Hamming distance**, retaining top 5% of 5,000 matches

## Filter enforcing quadrant consistency

TAX CODE			BOOK			PLAT			PARCEL			DATE			VALUATIONS			CHANGES		OUT-OF-DATE OF PARCEL	
MO.	DA.	YR.	MO.	DA.	YR.	MO.	DA.	YR.	MO.	DA.	YR.	MO.	DA.	YR.	MO.	DA.	YR.	MO.	DA.	YR.	
TRANSFERRED TO PRESENT OWNER																					
REAL ESTATE TAX LIST																					
GEO. LUCKENBACHER, Auditor																					
FAMILTON COUNTY, O.																					
Form No. 1-1927-10-11																					

100-66

DATE  
MO. DA. YR.

TRANSFERRED TO PRESENT OWNER

29 50 Greene, Ruth M  
94 GREENE, JOHN C. EXP S

LESS, LUELLA & RUTH W. GREENE  
180 COA 273  
180 COA 273  
73 X 130  
N. S. RAILROAD RUN 25. 214.95 FT. W.  
OF WEST OVER COX TR. EXTD.

TAX CODE: 01-01-01

BOOK PLAT PAGE

DATE			CUT UPS		BALANCE FEET OR ACRES	VALUATIONS			CHANGE		CUT UP OUT OF PARCELS 180-COA-4
MO.	DA.	YR.	PARCEL	FEET OR ACRES		LAND	BUILDINGS	TOTAL	AMOUNT	NO.	
-	-	46				1290	5610	6900	216	6570	REMARKS: Deceased Calling by De # 1742
						130	560	690			
						1420	6170	7590			
						1720	6810	8580			
						1770	6500	8270			
						2240	6140	8380			
							1380	1380	316	1555	
						2040	4760	7000			
						2250	7920	10180			
							540	540		2110 E-X-550	
						2250	7590	9840			
						2720	8950	11670			
						3000	14350	17350			
						3200	15490	19090			
						4080	19450	23530			
						4080	21230	31310			

CENSUS TRACT.

SKETCH OF LAND

7/14 76  
8/16 76  
78  
81  
84  
87  
90

REAL ESTATE TAX LIST  
GEO. GUCKENBERGER, AUDITOR  
FAMILY, 10 COUNTY, 2

DATE			TRANSFERRED TO PRESENT OWNER	
MO.	DA.	YR.		
6	24	54	PARISOTTO, NATALE & MARIE	
1	18	45	SHEAR, IDA	
11	8	55	TRIE, MARY	
9	4	58	SHEAR, IDA	
12	27	51	KEILIN, JACK F.	
2	16	52	MC NAMARA, MARY ELLEN	
2	16	71	FOWLER, FREDERICK R & AGNES	

DATE			CUT-UPS		BALANCE	VALUATIONS			CHANGES		OUT-UP OUT OF PARCEL	
MO.	DA.	YR.	PARCEL	FEET OR ACRES	FEET OR ACRES	LAND	BUILDINGS	TOTAL	DOCUMT.	NO.	REMARKS:	
						800	6270	7070				
						880	6270	7150				
						90	620	710				
						970	6890	7860				
						1200	7570	8770				
							1290	1290	INC	10		
						1200	8840	10040				
						1200	8450	9650				
						1320	7880	9200				
						1320	9490	10810				
						1340	9540	10880				
						1960	14180	16140				
						1,960	17,120	19,080				
						2540	15,450	20,000				
						2290	22280	24520				

REAL ESTATE TAX LIST		GEO. GUCKENBERGER, AUDITOR		HAMILTON COUNTY, O.	
DETHLE, VIRGINIA M.		119 3A 17			
1528 YARMOUTH AVE		119 3A 17			
CINTL. O					
1528 YARMOUTH AVE		119 3A 17			
40 X 149.73					
LOT 22 YARMOUTH PARK SUB					

DATE		CUT-UPS		BALANCE	VALUATIONS			CHANGES		OUT-UP OUT OF PARCEL	
MO.	DA.	YR.	PARCEL	FEET OR ACRES	FEET OR ACRES	LAND	BUILDINGS	TOTAL	DOCUMT.	NO.	
						800	6270	7070			
						880	6270	7150			
						90	620	710			
						970	6890	7860			
						1200	7570	8770			
							1290	1290	INC	10	
						1200	8840	10040			
						1200	8450	9650			
						1320	7880	9200			
						1320	9490	10810			
						1340	9540	10880			
						1960	14180	16140			
						1,960	17,120	19,080			
						2540	15,450	20,000			
						2290	22280	24520			

REAL ESTATE TAX LIST		GEO. GUCKENBERGER, AUDITOR		HAMILTON COUNTY, O.	
DETHLE, VIRGINIA M.		119 3A 17			
1528 YARMOUTH AVE		119 3A 17			
CINTL. O					
1528 YARMOUTH AVE		119 3A 17			
40 X 149.73					
LOT 22 YARMOUTH PARK SUB					

DATE		CUT-UPS		BALANCE	VALUATIONS			CHANGES		OUT-UP OUT OF PARCEL	
MO.	DA.	YR.	PARCEL	FEET OR ACRES	FEET OR ACRES	LAND	BUILDINGS	TOTAL	DOCUMT.	NO.	
						800	6270	7070			
						880	6270	7150			
						90	620	710			
						970	6890	7860			
						1200	7570	8770			
							1290	1290	INC	10	
						1200	8840	10040			
						1200	8450	9650			
						1320	7880	9200			
						1320	9490	10810			
						1340	9540	10880			
						1960	14180	16140			
						1,960	17,120	19,080			
						2540	15,450	20,000			
						2290	22280	24520			

REAL ESTATE TAX LIST		GEO. GUCKENBERGER, AUDITOR		HAMILTON COUNTY, O.	
DETHLE, VIRGINIA M.		119 3A 17			
1528 YARMOUTH AVE		119 3A 17			
CINTL. O					
1528 YARMOUTH AVE		119 3A 17			
40 X 149.73					
LOT 22 YARMOUTH PARK SUB					

DATE		CUT-UPS		BALANCE	VALUATIONS			CHANGES		OUT-UP OUT OF PARCEL	
MO.	DA.	YR.	PARCEL	FEET OR ACRES	FEET OR ACRES	LAND	BUILDINGS	TOTAL	DOCUMT.	NO.	
						800	6270	7070			
						880	6270	7150			
						90	620	710			
						970	6890	7860			
						1200	7570	8770			
							1290	1290	INC	10	
						1200	8840	10040			
						1200	8450	9650			
						1320	7880	9200			
						1320	9490	10810			
						1340	9540	10880			
						1960	14180	16140			
						1,960	17,120	19,080			
						2540	15,450	20,000			
						2290	22280	24520			

REAL ESTATE TAX LIST		GEO. GUCKENBERGER, AUDITOR		HAMILTON COUNTY, O.	
DETHLE, VIRGINIA M.		119 3A 17			
1528 YARMOUTH AVE		119 3A 17			
CINTL. O					
1528 YARMOUTH AVE		119 3A 17			
40 X 149.73					
LOT 22 YARMOUTH PARK SUB					

DATE		CUT-UPS		BALANCE	VALUATIONS			CHANGES		OUT-UP OUT OF PARCEL	
MO.	DA.	YR.	PARCEL	FEET OR ACRES	FEET OR ACRES	LAND	BUILDINGS	TOTAL	DOCUMT.	NO.	
						800	6270	7070			
						880	6270	7150			
						90	620	710			
						970	6890	7860			
						1200	7570	8770			
							1290	1290	INC	10	
						1200	8840	10040			
						1200	8450	9650			
						1320	7880	9200			
						1320	9490	10810			
						1340	9540	10880			
						1960	14180	16140			
						1,960	17,120	19,080			
						2540	15,450	20,000			
						2290	22280	24520			

REAL ESTATE TAX LIST		GEO. GUCKENBERGER, AUDITOR		HAMILTON COUNTY, O.	
DETHLE, VIRGINIA M.		119 3A 17			
1528 YARMOUTH AVE		119 3A 17			
CINTL. O					
1528 YARMOUTH AVE		119 3A 17			
40 X 149.73					
LOT 22 YARMOUTH PARK SUB					

DATE		CUT-UPS		BALANCE	VALUATIONS			CHANGES		OUT-UP OUT OF PARCEL	
MO.	DA.	YR.	PARCEL	FEET OR ACRES	FEET OR ACRES	LAND	BUILDINGS	TOTAL	DOCUMT.	NO.	
						800	6270	7070			
						880	6270	7150			
						90	620	710			
						970	6890	7860			
						1200	7570	8770			
							1290	1290	INC	10	
						1200	8840	10040			
						1200	8450	9650			
						1320	7880	9200			
						1320	9490	10810			
						1340	9540	10880			
						1960	14180	16140			
						1,960	17,120	19,080			
						2540	15,450	20,000			
						2290	22280	24520			

REAL ESTATE TAX LIST		GEO. GUCKENBERGER, AUDITOR		HAMILTON COUNTY, O.	
DETHLE, VIRGINIA M.		119 3A 17			
1528 YARMOUTH AVE		119 3A 17			
CINTL. O					
1528 YARMOUTH AVE		119 3A 17			
40 X 149.73					
LOT 22 YARMOUTH PARK SUB					

DATE		CUT-UPS		BALANCE	VALUATIONS			CHANGES		OUT-UP OUT OF PARCEL	
MO.	DA.	YR.	PARCEL	FEET OR ACRES	FEET OR ACRES	LAND	BUILDINGS	TOTAL	DOCUMT.	NO.	
						800	6270	7070			
						880	6270	7150			
						90	620	710			
						970	6890	7860			
						1200	7570	8770			
							1290	1290	INC	10	
						1200	8840	10040			
						1200	8450	9650			
						1320	7880	9200			
						1320	9490	10810			
						1340	9540	10880			
						1960	14180	16140			
						1,960	17,120	19,080			
						2540	15,450	20,000			
						2290	22280	24520			

REAL ESTATE TAX LIST		GEO. GUCKENBERGER, AUDITOR		HAMILTON COUNTY, O.	
DETHLE, VIRGINIA M.		119 3A 17			
1528 YARMOUTH AVE		1			

6

Now we know exact pixel locations for all cells

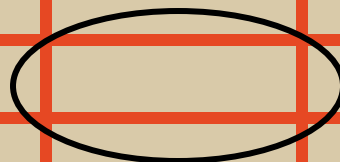
7

Extract cells of interest

8

2,680

Feed to OCR model



1

Tabular  
Segmentation

2

OCR  
Model

2

OCR  
Model

hand  
annotated

CAR-B

DIDA

Fine-Tune  
TrOCR

results



# How we evaluate performance

## Segmentation

### 3 Step Alignment

- Homography matrix match count ( $>15$  matches, max reprojection error  $\leq 6\text{px}$ )
- Increase ORB match pairs (5,000  $\rightarrow$  7,000  $\rightarrow$  10,000) across 3 attempts
- Manual inspection

**99.7%**

On 836 property cards

# How we evaluate performance

## OCR Model Results

### **$R^2$ (Coefficient of Determination)**

How well predicted values approximate actual values.

**0.76**

### **MAPE (Mean Absolute Percentage Error)**

Average absolute percentage difference between predicted and true values.

**3.25%**

### **RMSPE (Root Mean Absolute Percentage Error)**

Similar to MAPE but penalizes larger errors more.

**36.59%**

### **MPE (Mean Percentage Error)**

Indicates bias (over- or under-prediction tendency).

**0.36%**

# How we evaluate performance

## OCR Model Results

### Confidence-Based Accuracy

Within 5% of True Value	96.52%
Within 10% of True Value	96.98%
Within 20% of True Value	97.38%

# Why off-the-shelf solutions failed

## Existing Programs

Significantly worse than TrOCR

- TesseractOCR
- LayoutLMv3
- Microsoft Azure AI Document Intelligence
- LayoutParser
- ChatGPT

Poor table cell detection (<20% accuracy)

accuracy

Poor table cell detection (<67 %accuracy)

cost

Very expensive: \$1600 for 56,000 cards (just one county)

# Why off-the-shelf solutions failed

## User-friendly GPT4o

### Accuracy

Great for **Single-cell OCR** → Matches TrOCR performance

Unreliable for **Whole-card OCR** → Needs heavy prompt engineering

### Latency

10–20 sec per image

1 county (56k cards): **\$600**

100 counties: **\$60k**

v/s

1 time investment of  
hiring for model  
development:

**~\$5000**

### Cost

Effective for very small datasets

Scales poorly





**Building  
Dataset**

**Predicting  
Values**



# Predicting Values





### One Story Single Family Homes

square feet	1-bed	2-bed	3-bed	4-bed	5-bed	6-bed
under 100	\$1500	\$1600	\$1700	\$1800	\$1900	\$2000
100-200	\$2000	\$2100	\$2200	\$2300	\$2400	\$2500
200-300	\$2500	\$2600	\$2700	\$2800	\$2900	\$3000
300-400	\$3000	\$3100	\$3200	\$3300	\$3400	\$3500
400-500	\$3500	\$3600	\$3700	\$3800	\$3900	\$4000
500-600	\$4000	\$4100	\$4200	\$4300	\$4400	\$4500
600-700	\$4500	\$4600	\$4700	\$4800	\$4900	\$5000
700-800	\$5000	\$5100	\$5200	\$5300	\$5400	\$5500
800-900	\$5500	\$5600	\$5700	\$5800	\$5900	\$6000
900-1000	\$6000	\$6100	\$6200	\$6300	\$6400	\$6500

1933





1933



VALUATIONS	
BUILDINGS	
	1,460

Rooms

10

$$y = b_0 + b_1X + b_2X$$

Sq. Ft.

850



Rooms

10

$$y = f(b_0 + b_1X + b_2X)$$

1933



VALUATIONS

BUILDINGS

1,460

Sq. Ft.

850

VALUATIONS	
BUILDINGS	
1,460	



VALUATIONS	
BUILDINGS	
2680	

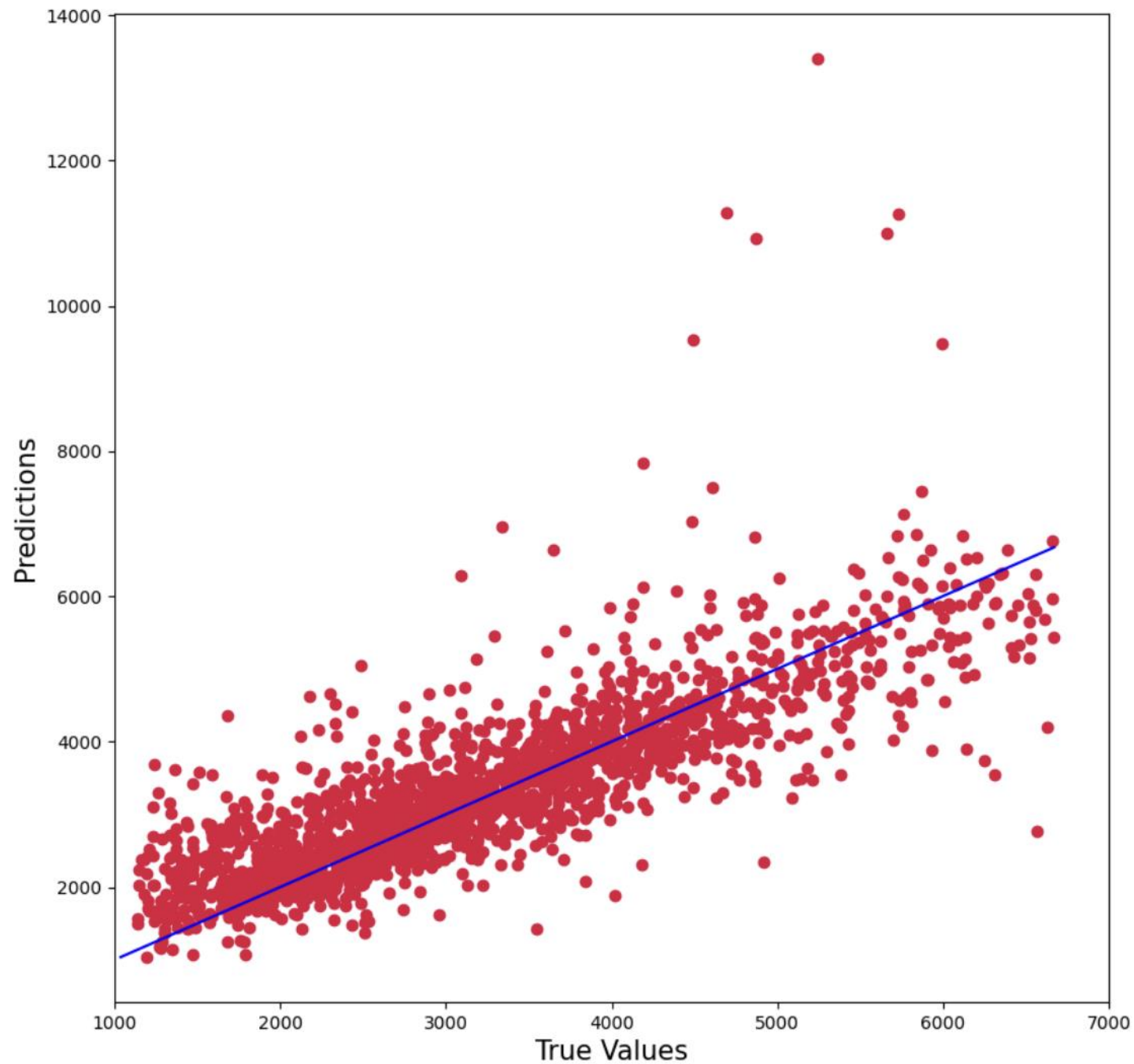


VALUATIONS	
BUILDINGS	
1880	



VALUATIONS	
BUILDINGS	
2720	



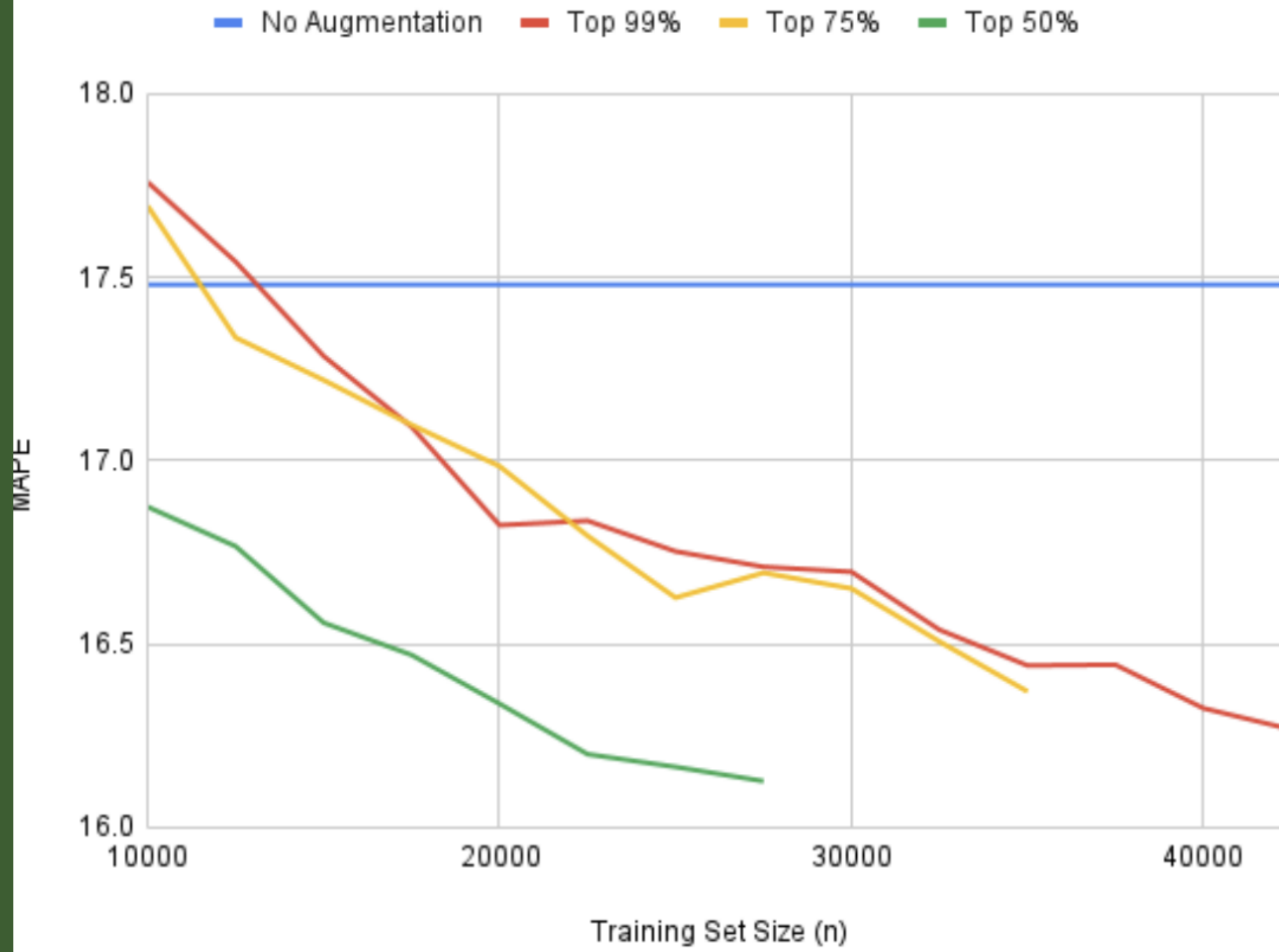


$R^2$  :  
0.62

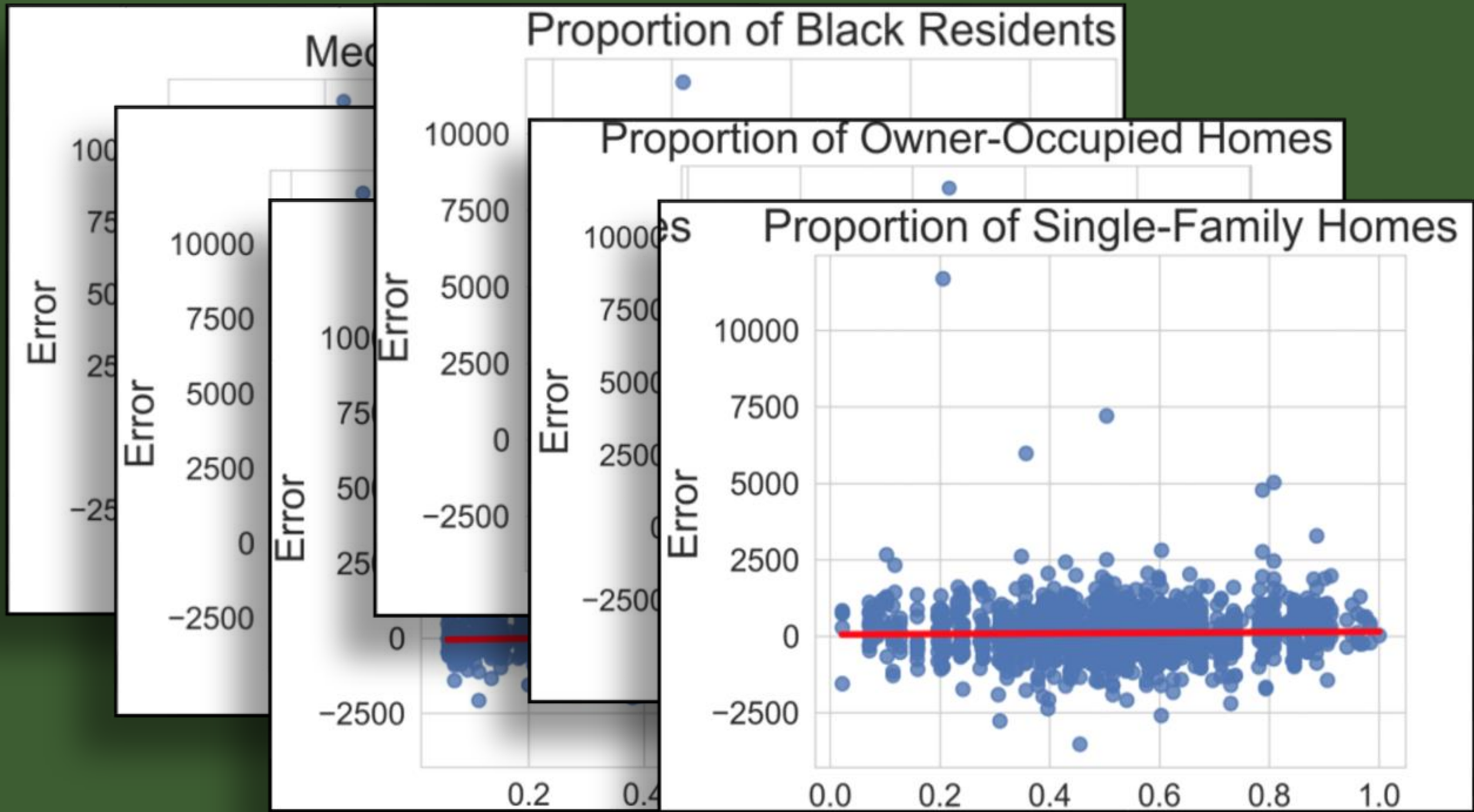
MAPE:  
17.5%

OCR MAPE:  
14.72%





**Figure 9: MAPE and OCR Confidence Threshold vs n**



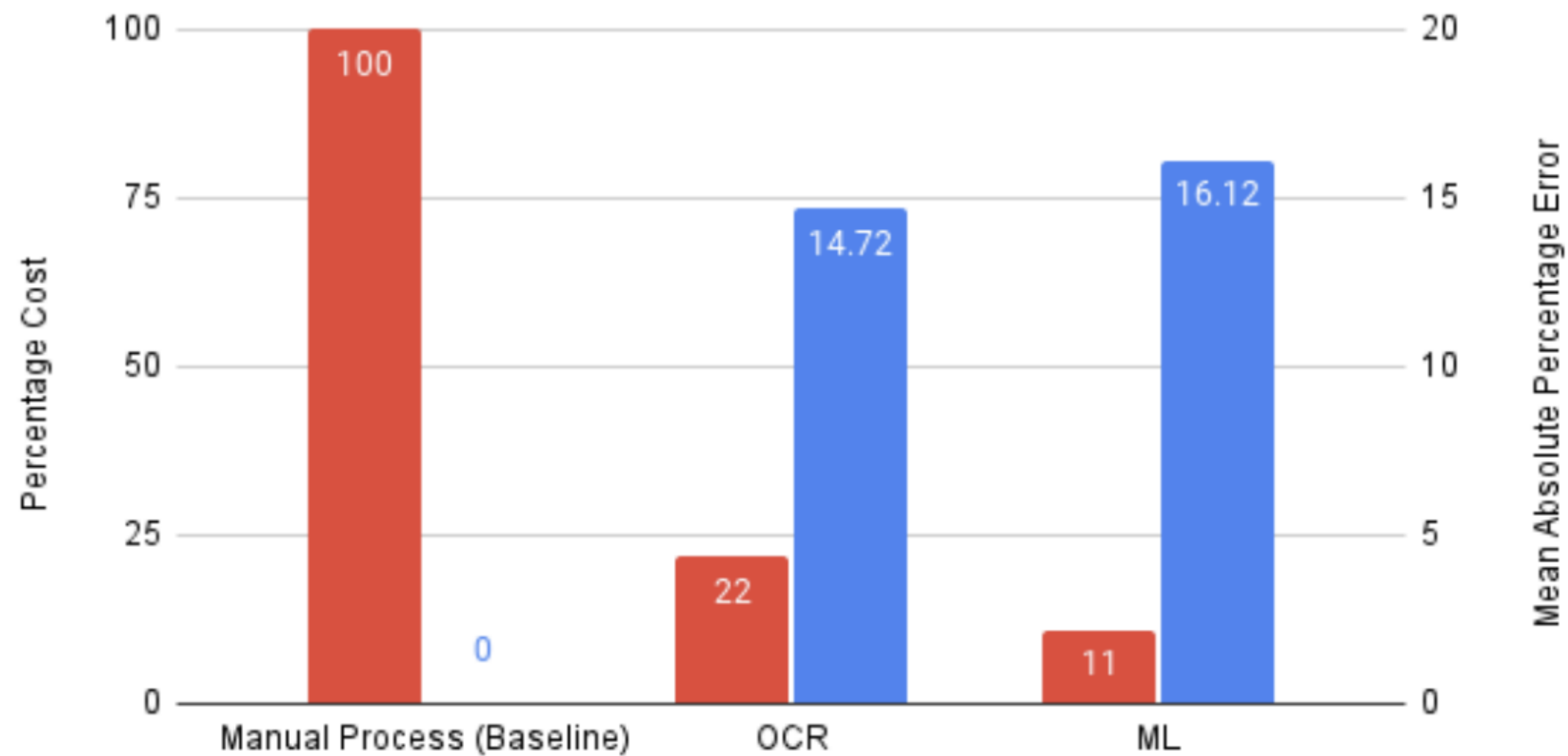


**Building  
Dataset**

**Predicting  
Values**



■ Percentage Cost (lower is better)    ■ Mean Absolute Percentage Error (lower is better)



# For More:

