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## Global Trends on Property Tax Management and Valuation Systems

Paul Bidanset, PhD Candidate

ADB-LX Corp Joint Workshop on Building National Spatial Data Infrastructure

31 October - 4 November 2022, Seoul, South Korea

# Presenter Background

- Founder & Executive Director, Center for Appraisal Research and Technology (CART) → [OpenAppraisal.org](https://OpenAppraisal.org)
- Adjunct Professor of Economics, Regent University, Virginia (USA)
- Previous:
  - Valuation Research Project Manager, IAAO
  - Research Fellow, Lincoln Institute of Land Policy (LILP)
  - CAMA Modeler/Statistician, City of Norfolk, Virginia's Assessor's Office
- AVM experience (building/implementing/quality control/staff training):
  - Romania
  - Moldova
  - Ukraine
  - Estonia
  - United Kingdom
  - United States (Chicago, Detroit, Milwaukee, Albuquerque, and more)

# Goals of this Presentation

- Share best practices for land management and valuation software/computer systems
- Address requirements and functionality between
  - Cadastral data
  - Sales registries
  - Geographic information systems (GIS)
  - Mass valuation
- Highlight international examples
- Recommendations and roadmaps for successful implementation/technical reform.

# What is a “CAMA System”?

- Computer-assisted Mass Appraisal
- Outdated terminology from the 60s & 70s
- Property management system **with** functionality for valuation (mass and single property)
- Asset Management:
  - Ownership information (names, address, purchase date, etc.)
  - Parcel boundaries & location (xy coordinates)
  - Current parcel characteristics
  - Tax/value history
  - Sales history (price, data, property characteristics)
  - Notes/special considerations

Quick Search

Previous

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Appraisal Card

Property Audit Tracking Report

Property Packet

Comparable Sales Report

Navigation

GIS

Reports

Property

Land Information (1)

1. A1-Residential

Improvements (1)

1. Residential

Segments (4)

1. Residential: Type = MA R8 2956

2. Residential: Type = AGF1 R8 756

Property Value: \$917,960

Property

Property Information

Appraisal Information

Neighborhood Information

Last Inspected04/20/2021

AppraiserCastillo, Tayl

Next Insp Date

Reason

Last Appr Year2021

Property Code1d1 (open Space) Ag;

☐ Include in CAD

Misc Code

Late Correction

Comment2019 NC/"MENDICINO, 3 CAR G-L"... DSPERM# R012417-01

Utilities

Topography

Access

Other

Zone

Region

Subset

Shared Flag

Omitted Property

Neighborhood

Map Sheet

Original Builder

Eff. AcresNone

Eff Acres Override

Characteristics

Omitted Improvement

Rendered By

Verified

Sent

▼ SummaryGeneralOwnershipExemptionsAssessmentsAppraisalFinal ValueTransfersAppealsEventsPermitsComp SalesEquity CompsDocumentsHistory

R149239

Legal

OwnerSitus

Tax Year2022As OfPage Not Versioned

Quick Search

PreviousNext

Appraisal Card

Property Audit Tracking Report

Property Packet

Comparable Sales Report

Ready...

00:00:00

FormatPublic Comp SheetTax Year2022Market SetRESIDENTIALMarket AreaTRACT HOME & PLUM CREEK

	Subject	Comp 1	Comp 2	Comp 3	Comp 4	Comp 5
Quick Ref ID	R149239	R149248	R140547	R149216	R140567	R140560
Situs Address						
NBHD	HARRI	HARRI	HARRI	HARRI	HARRI	HARRI
Actual Year Built	2017	2018	2016	2016	2015	2015
Effective Year Built	2017	2018	2016	2016	2015	2015
Quality	R8	R8	R8	R8P	R8M	R8
Main Area Sq. Ft.	2956	2932	2829	2904	2739	2864
Main Area Value	\$668,660	\$664,030	\$644,060	\$669,220	\$591,590	\$644,390
Non MA Value	\$69,300	\$117,860	\$79,140	\$76,040	\$85,480	\$87,540
Land Value	\$180,000	\$180,000	\$180,000	\$180,000	\$180,000	\$180,000
Total Value	917,960	961,890	903,200	925,260	857,070	911,930
Sale Date		1/11/2022	12/23/2021	4/18/2022	8/16/2021	6/2/2021
Sale Price		\$950,000	\$900,000	\$1,025,000	\$975,000	\$1,025,000
Sale Price per SF	.00	\$324.01	\$318.13	\$352.96	\$355.97	\$357.89
MA SF Value Adj		\$4,630	\$24,600	-\$560	\$77,070	\$24,270
Non MA SF Value Adj		-\$48,560	-\$9,840	-\$6,740	-\$16,180	-\$18,240
Land Value Adjustment		0	0	0	0	0
Adjusted Sale Price		906,070	914,760	1,017,700	1,035,890	1,031,030
Indicated Value	\$1,017,700					

R149239

Legal

Owner

Tax Year2022  
As Of08/17/2022

Quick Search

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Appraisal Card

Property Audit Tracking Report

Property Packet

Comparable Sales Report

Ready...

00:00:00

NbhdHARRI - HARRISON HILL

Collapse AllFind Instance IDCopyCalculate Property Value

1. Residential

Segments (4)

1. Residential: Type = MA R8 2956

2. Residential: Type = AGF1 R8 766

3. Residential: Type = CV 124

4. Residential: Type = CV 247

Direct Cap (0)

Timber 1978 Market Values (0)

Segment Value: \$668,660

Residential Improvement

General Information

Adjustments

TypeMain Area

MethodResidential Tables

ClassClass 8

Area2956

Perimeter303

Flat Value

Unit Price

Eff Age Yr2017

Act. Yr. Built2017

Area Factor

Condition

% Good

Neighborhood %130

% Complete

Physical %

Econ CodeDripping Spri

Economic %234

Func Code

Functional %100

Functional %

Building Attributes

Room Adjustments

Additional Factors

Const. Style

FoundationSlab

Heating / AC

CAH

Exter. FinishRock; Brick

Inter. Finish

Fireplace

Roof StyleHip Composition

Flooring

Built Ins

Rooms

Bedrooms

Factor 1

Factor 2

Factor 3

Plumbing Attributes

Homestead Cap

Plumbing

Description

INTERNAL. This information is accessible to ADB Management and staff. It may be shared outside ADB with appropriate permission.

Market Models

- Lease
- Lease
- Reporting
- Utilities
- Manager
- Jobs & Combos
- Jobs & Documents
- Workflow
- Administration
- Job Queue
- Job History
- Job Schedule
- Processes
- End Functions
- Property
- Assessment Notices
- Appeals
- Appeals
- Primary
- ification
- lements
- figuration
- em Code Setup
- MA Setup
- essment Setup
- ket Setup
- s Setup

Current Location

Market Setup

Modelling Results

Sort

MarketArea		# Sales	Sales Used	R <sup>2</sup>	Std Err
G-I	DUPLEX & MF (NOT APT)				
C-PL	TRACT HOME & PLUM CREEK				
H-TWN	CONDOS & TOWNHOMES				
D-E	MIXED USE & MOBILE HOME				
A-B-ABS	ACREAGE, CUSTOM & ABS				
LV	LA VENTANA				

Define Model

Market Set: RESIDENTIALMarket Area: G-I DUPLEX & MF (NOT APT)

Model Parameters

Dependent Var F Limit

MRA Information

R<sup>2</sup>:Standard Error: # Sales Used: MRA Run On: N/A

Sort ☐ Show DeletedCalculate Model

Variable	Coefficient	F Test	C Type	Constraints	95% Confidence
----------	-------------	--------	--------	-------------	----------------

No variables have been added to this model.

Click the Add icon to add a variable.

Copy ModelSaveExit



- Lease
- Lease
- Reporting
- Properties
- Manager
- & Combos
- s & Documents
- Flow
- Administration
- Job Queue
- Job History
- Job Schedule
- Issues
- End Functions
- ed Property
- ssment Notices
- p Appeals
- e Appeals
- inary
- ification
- lements
- guration
- m Code Setup
- A Setup
- ssment Setup
- et Setup
- Setup
- Maintenance
- c Access
- flow Setup
- metry Setup

General

Memorize

Recall

Locations

Appraisal

Tax Year

2022

Prop Type

Auto; Mineral; Mobile Home; Personal; Real

Comment

☐ Summary Only

Sale Date Range and Validity

Start Date

07/01/2021

End Date

06/30/2022

Validity

Allocated sale price; Bank Sale; Community Property-Exemption

Sale Type

Commercial RV Park; Commercial-Hospitality; Commercial-Industrial;

☐ Use Exclude From State Flag

Select Value and Sale Price

Value

Final Value

☒ Actual Sale Price

☐ Adjusted Sale Price

Trended

Sales Ratio Outliers

Outlier Identification

☐ Identify Automatically

☒ 1.5 x Beyond Middle 50% Range

☐ 3.0 x Beyond Middle 50% Range

☐ Identify by Ratio Range

From

%

To

%

Interval

%

☒ No Outlier Trimming

Sort Options

Level 1 Sort

Neighborhood

☒ Group

Level 2 Sort

Sale Type

☐ Group

Level 3 Sort

Sale Date(Descendi

☐ Group

Level 4 Sort

☐ Group

☐ Print Groups Separately?

Report Threshold

Strata

Property ID

From

To

List

Neighborhoods/Market Areas

Nbhds

6CRKS - 6 CREEKS

Mkt Area

Taxing Units

Group

Unit

Unit Type

Legal Description Elements

Abstract

Subdivision

Condominium

MH Park

Appraisers

Appraisers

CAMA Filters

Filters

Special Reporting Options

☐ Include Ratio Histogram

☐ For Each Group Level

☒ For Grand Total Only

☐ Include Ratio to Sale Price Chart

☐ For Each Group Level

☒ For Grand Total Only

☐ Include Ratio to Sale Date Chart

☐ For Each Group Level

☒ For Grand Total Only

Set Columns

☐ Include CSV Source Data Output

# Valuation Component

- Able to estimate market value for land and buildings (mass and single-property)
- Some capable of regression, others require back-end table editing of models (models created in other software such as R, Python, Excel, or SPSS)
- Should allow for data exports of sales (flatfile)
- Compatibility with relational databases (Access, SQL)
- Incorporation of spatial (GIS-driven) modeling and analysis

- Typically based on algorithm of multiple regression analysis (MRA)
- First documented theory/application of AVM → G.C. Haas, 1922
- Gained popularity among governments in the late 60's and early 70's
- Leading technological methodology to valuation today
  - Increased accuracy, and fairness
  - Reduced bias and inefficiencies
- IAAO Standard on AVMs

# Exmple AVM Output

Coefficients:

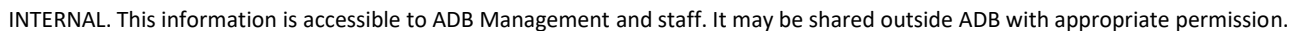
	Estimate	Std. Error	t value	Pr(> t )	
(Intercept)	310044.23657845	14247.81987956	21.761	< 0.0000000000000002	***
totală	9184.02550827	95.65462001	96.012	< 0.0000000000000002	***
Age	-2885.88212877	187.80733555	-15.366	< 0.0000000000000002	***
Age2	10.34319737	2.31624162	4.466	0.00000803748824708	***
Gaz_C	-15616.17104024	19224.00616626	-0.812	0.416615	
peretiorE	125286.88354059	14001.84613454	8.948	< 0.0000000000000002	***
top	-14950.90145110	5099.24249077	-2.932	0.003372	**
bottom	-2892.41635956	4988.42205009	-0.580	0.562039	
Baia	45529.05392495	11206.38675815	4.063	0.00004870231005908	***
Hîncești	-170236.34587637	19569.34818428	-8.699	< 0.0000000000000002	***
Cantemir	-325776.60226535	36279.76174348	-8.980	< 0.0000000000000002	***
Criuleni	-248491.09718164	32001.38459303	-7.765	0.00000000000000861	***
Briceni	-361038.35883807	28669.06033558	-12.593	< 0.0000000000000002	***
Cimișlia	-316290.03971197	32766.16743906	-9.653	< 0.0000000000000002	***
Telenești	-285912.45577838	29310.79433920	-9.755	< 0.0000000000000002	***
Florești	-341762.60955426	39991.99318006	-8.546	< 0.0000000000000002	***
Șoldănești	-401664.97449068	32769.16447066	-12.257	< 0.0000000000000002	***
Taraclia	-484308.05867843	29257.63419801	-16.553	< 0.0000000000000002	***
Basarabasca	-507333.29923101	26155.83397101	-19.397	< 0.0000000000000002	***
Leova	-365383.11318918	27844.57022025	-13.122	< 0.0000000000000002	***
Dondușeni	-420342.05948832	26153.12820758	-16.072	< 0.0000000000000002	***
Glodeni	-418233.52221924	22921.61522056	-18.246	< 0.0000000000000002	***
ȘtefanVodă	-388799.47820790	25584.99407756	-15.196	< 0.0000000000000002	***
AneniiNoi	-351211.45872578	20662.99217265	-16.997	< 0.0000000000000002	***
Sîngerei	-350265.49413039	20321.99971855	-17.236	< 0.0000000000000002	***
Strășeni	-249931.98195700	19302.05312910	-12.948	< 0.0000000000000002	***

# Flatfile Example

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Sale_ID	Parcel_ID	Suburban	X_COR	Y_COR	*GEOCODE	Price	1920-1945	1946-1965	1966-1990	Post 1990	Size sqm	Beds	Baths	Storeys	PRIMARY_TH	POSTCODE	TOWNLAND
2	18770	3152737	1	332011	370724	3.32011E+11	2000000	0	0	0	0	313	5	2	2.5	MALONE PARK	BT9 6NJ	MALONE LOWER
3	6039	3147941	1	332968	370843	3.32968E+11	1850000	1	0	0	0	271	5	0	2	BROOMHILL PARK	BT9 5JB	MALONE LOWER
4	4067	3152769	1	332420	370467	3.3242E+11	1650000	1	0	0	0	426	6	2	2	MALONE PARK	BT9 6NL	MALONE LOWER
5	3018	3147939	1	332935	370847	3.32935E+11	1600000	1	0	0	0	330	6	1	2	BROOMHILL PARK	BT9 5JB	MALONE LOWER
6	8952	3152734	1	331921	370781	3.31921E+11	1550000	0	0	0	0	333	7	2	3	MALONE PARK	BT9 6NJ	MALONE LOWER
7	15444	3152763	1	332300	370547	3.323E+11	1550000	0	0	0	0	349	6	2	2.5	MALONE PARK	BT9 6NL	MALONE LOWER
8	276747	3245075	1	331163	368379	3.31163E+11	1500000	1	0	0	0	552	7	3	2.5	UPPER MALONE ROAD	BT17 9JZ	MALONE UPPER (MAIN PORTION)
9	186	3147940	1	333033	370868	3.33033E+11	1475000	1	0	0	0	375	6	1	2	BROOMHILL PARK	BT9 5JB	MALONE LOWER
10	207	3152728	1	331760	370964	3.3176E+11	1475000	0	0	0	0	372	5	2	2.5	MALONE PARK	BT9 6NH	MALONE LOWER
11	7157	3152775	1	332504	370425	3.32504E+11	1450000	0	0	0	0	352	4	2	2	MALONE PARK	BT9 6NN	MALONE LOWER
12	15500	3148590	1	332730	370167	3.3273E+11	1375000	1	0	0	0	494	5	1	2	NEWFORGE LANE	BT9 5NU	MALONE UPPER
13	9427	3152724	1	331906	370875	3.31906E+11	1345000	0	0	0	0	370	5	2	2	MALONE PARK	BT9 6NH	MALONE LOWER
14	154	3152771	1	332444	370451	3.32444E+11	1300000	1	0	0	0	424	6	3	2	MALONE PARK	BT9 6NN	MALONE LOWER
15	17172	3148130	1	332687	370524	3.32687E+11	1200000	0	0	0	0	288	5	2	2.5	DERAMORE PARK	BT9 5JW	MALONE UPPER
16	8989	3147938	1	332992	370879	3.32992E+11	1185000	1	0	0	0	557	6	1	2	BROOMHILL PARK	BT9 5JB	MALONE LOWER
17	1461	3146235	1	333524	371851	3.33524E+11	1150000	0	0	0	0	388	6	0	2	MOUNT PLEASANT	BT9 5DS	MALONE LOWER
18	2139	3152739	1	332036	370710	3.32036E+11	1150000	1	0	0	0	370	6	2	2.5	MALONE PARK	BT9 6NJ	MALONE LOWER
19	6406	3148242	1	332763	370348	3.32763E+11	1100000	1	0	0	0	340	4	1	2	DERAMORE PARK SOUTH	BT9 5JY	MALONE UPPER
20	6767	3151671	1	332760	371292	3.3276E+11	1100000	0	0	0	0	418	7	0	3	MARLBOROUGH PARK SOUTH	BT9 6HW	MALONE LOWER
21	12133	3152022	1	332233	370926	3.32233E+11	1100000	0	0	0	0	254	5	2	2	OSBORNE PARK	BT9 6JP	MALONE LOWER
22	13901	3244964	1	331018	368396	3.31018E+11	1060000	0	0	0	1	412	5	5	2	BRACKENWOOD LANE	BT17 9JJ	MALONE UPPER (MAIN PORTION)
23	16077	3245080	1	330982	368304	3.30982E+11	1050000	0	0	0	1	585	5	2	2	UPPER MALONE ROAD	BT17 9JZ	MALONE UPPER (MAIN PORTION)
24	2348	3148311	1	332632	370374	3.32632E+11	1050000	1	0	0	0	528	5	2	2	MALONE ROAD	BT9 5LJ	MALONE UPPER
25	6803	3150872	1	332758	371992	3.32758E+11	1025000	0	0	0	0	368	5	3	2	DERRYVOLGIE AVENUE	BT9 6FN	MALONE LOWER
26	19078	3152024	1	332254	370978	3.32254E+11	1025000	0	0	0	0	361	5	2	2	OSBORNE PARK	BT9 6JP	MALONE LOWER
27	2990	3152634	1	331930	370920	3.3193E+11	1000000	0	0	0	0	365	5	1	2.5	MYRTLEFIELD PARK	BT9 6NE	MALONE LOWER
28	13840	3154301	1	331873	369702	3.31873E+11	1000000	1	0	0	0	277	5	1	2	HARBERTON PARK	BT9 6TX	MALONE UPPER
29	270365	3146245	1	333588	371808	3.33588E+11	985000	0	0	0	0	299	6	0	2	MOUNT PLEASANT	BT9 5DS	MALONE LOWER
30	86	3148179	1	332850	370452	3.32851E+11	980000	0	0	0	0	387	6	1	2	DERAMORE PARK SOUTH	BT9 5JY	MALONE UPPER
31	10509	3151382	1	332637	371657	3.32637E+11	980000	1	0	0	0	286	5	3	2	CADOGAN PARK	BT9 6HG	MALONE LOWER
32	3823	3151100	1	332821	371729	3.32821E+11	975000	0	0	0	0	396	7	1	2.5	ADELAIDE PARK	BT9 6FY	MALONE LOWER
33	2586	3151405	1	332697	371636	3.32695E+11	970000	0	1	0	0	305	4	3	2	CADOGAN PARK	BT9 6HH	MALONE LOWER
34	6410	3147926	1	333116	370921	3.33116E+11	960000	1	0	0	0	296	5	1	2	BROOMHILL PARK	BT9 5JB	MALONE LOWER
35	19952	3152447	1	331934	371037	3.31934E+11	950000	0	0	0	0	200	4	0	2	MARYVILLE PARK	BT9 6LN	MALONE LOWER
36	11559	3152679	1	332250	370745	3.3225E+11	935000	1	0	0	0	262	5	1	2	MYRTLEFIELD PARK	BT9 6NF	MALONE LOWER
37	19743	3148315	1	332520	370086	3.3252E+11	930000	0	0	1	0	390	4	2	2	MALONE ROAD	BT9 5LN	MALONE UPPER
38	7605	3151381	1	332586	371724	3.32586E+11	925000	1	0	0	0	294	5	3	2	CADOGAN PARK	BT9 6HG	MALONE LOWER

- Location-based information database
- Data tied to geographic location
- Delineate and update parcel boundaries
- May be internal/part of system
- May also be external /other software (e.g. Esri's ArcGIS)
- Digital mapping layers → helpful in data collection, analysis, and appeals
- Valuation quality control
- Public information
- Government transparency

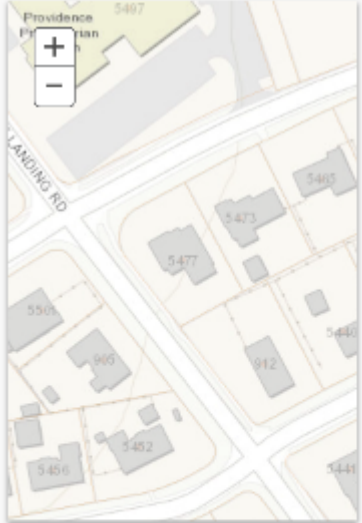




A snapshot of properties within your search results



1

[View On GIS Map](#)

5477 Old Providence Rd

LEGAL DESCRIPTION	Haven Heights Sec 1 Lot 14
GPIN (PARCEL ID)	14661480400000
SERVICE DISTRICT	D01 : D01

LAND VALUE	\$130,000
IMPROVEMENT VALUE	\$172,500
TOTAL VALUE	\$302,500



≡ MORE

UNOFFICIAL ZONING DISTRICT	R10
PROPERTY CODE/CATEGORY	101 Residence
LAND USE	No
WATERSHED	Chesapeake Bay
PLATS (MAP BOOK/INSTRUMENT #)	<a href="#">Download</a>
LAND SQUARE FOOTAGE	14,557.9 sq ft





★ Land/Building Information

☰ Sales History & Tax Information

VB City Services

📍 Geospatial Information

🖼 Images

⋮ MORE

LAND INFORMATION

UNOFFICIAL ZONING DISTRICT	R10
PROPERTY CODE/CATEGORY	101 Residence
LAND USE	No
WATERSHED	Chesapeake Bay
PLATS (MAP BOOK/INSTRUMENT #)	<a href="#">Download</a>
LAND SQUARE FOOTAGE	14,557.9 sq ft

BUILDING INFORMATION

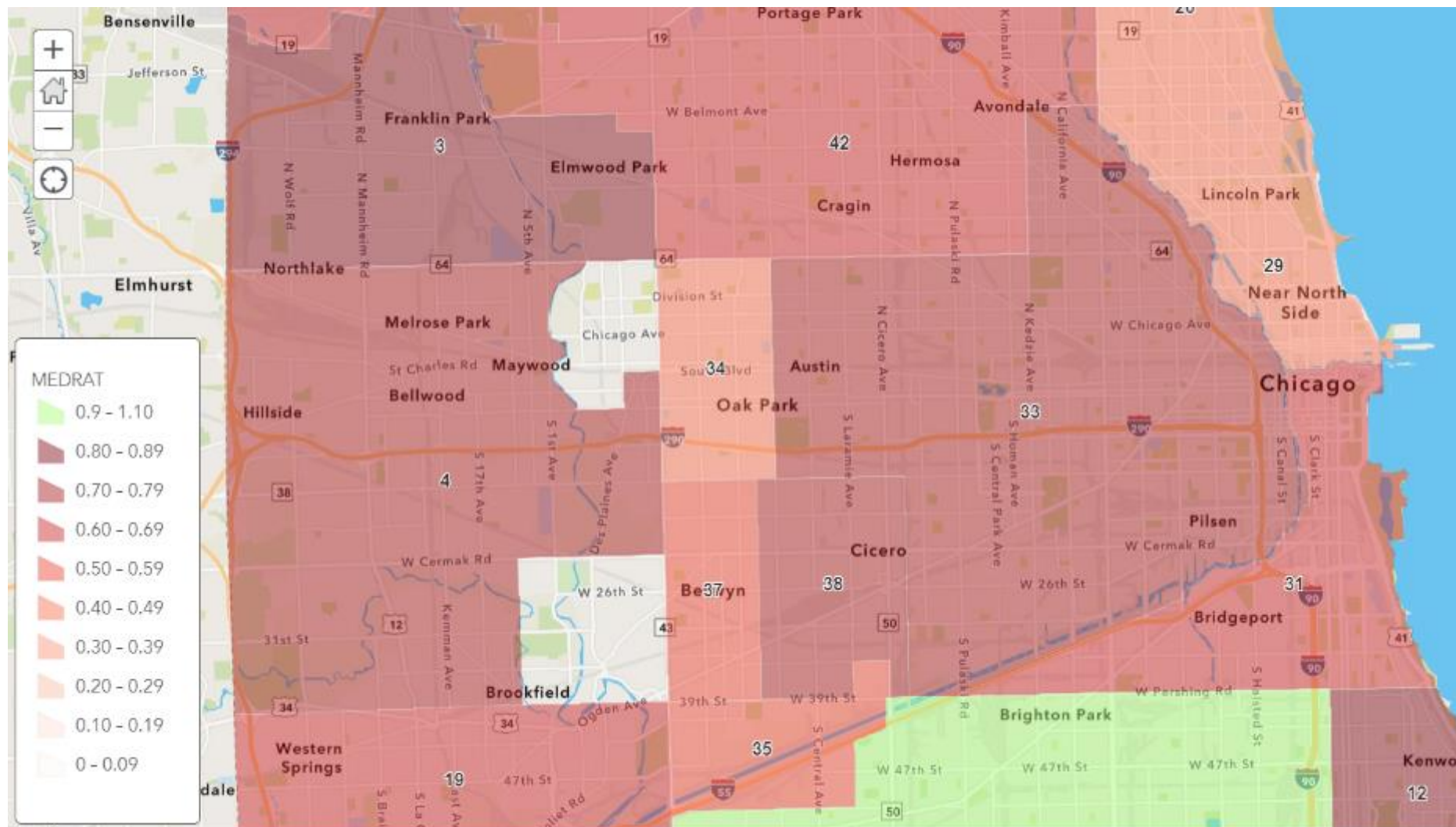
R01

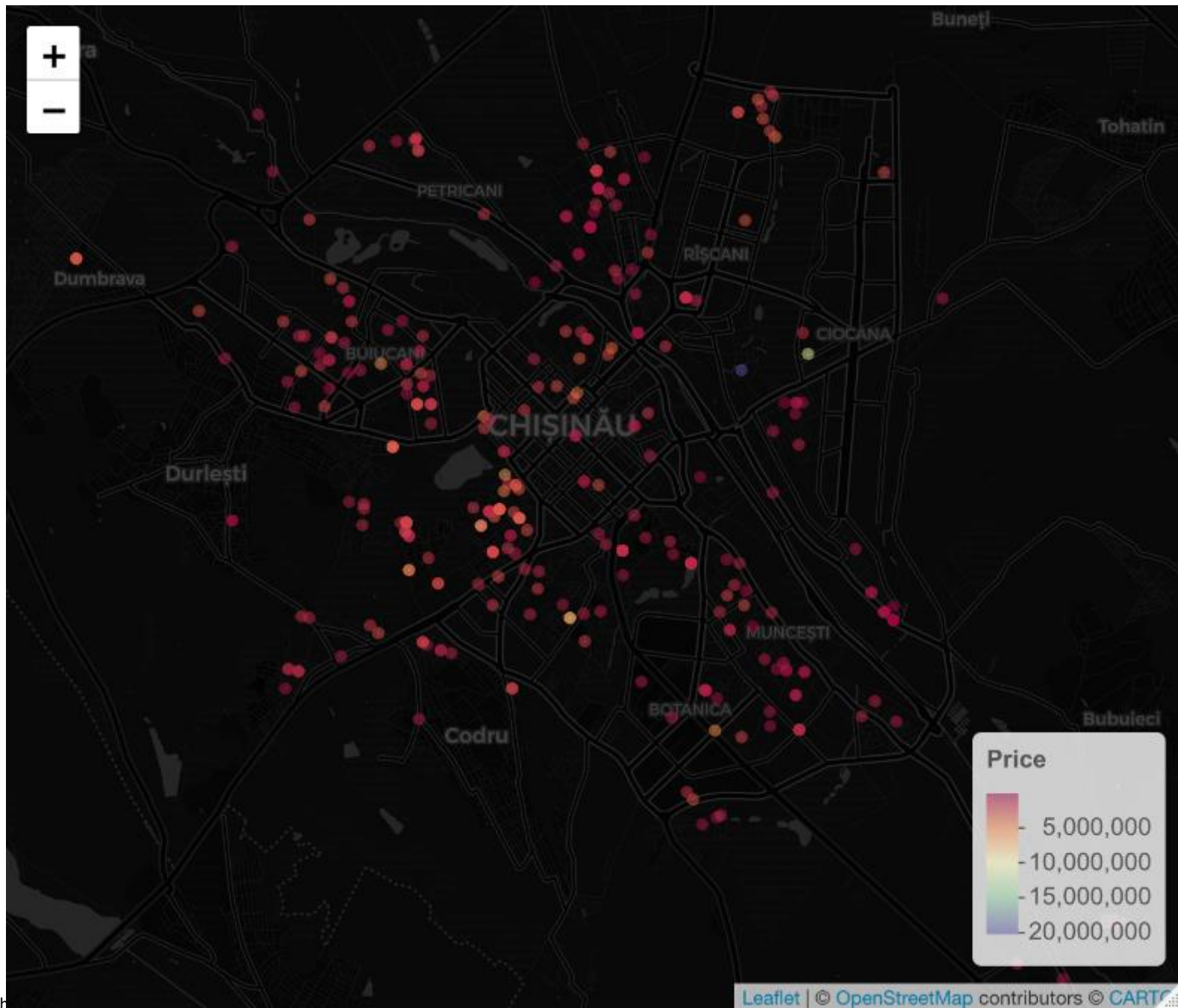
USE CODE	DESCRIPTION	ID #	CONSTRUCTED YR.	SIZE
ATTGAR	Attached Garage	G01	0	462 SF
DWELL	Dwelling	D	1961	2,111 SF

FLOORS	FINISHED AREA	DESCRIPTION
1.0	2,111 SF	
Total	2,111 SF	

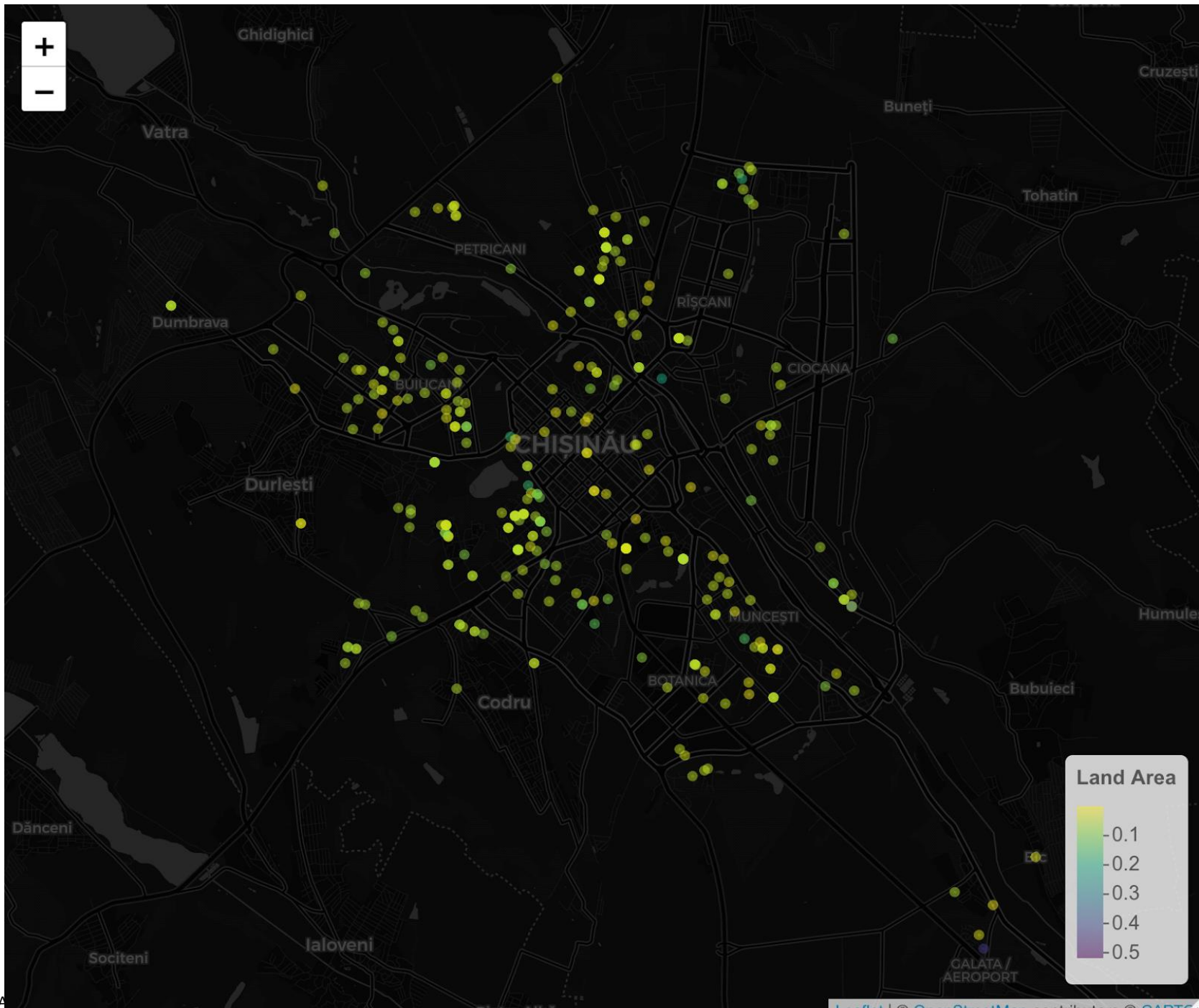
ROOM INFORMATION	
Bedrooms	3
Half Baths	1
Full Baths	2
Total Rooms	7

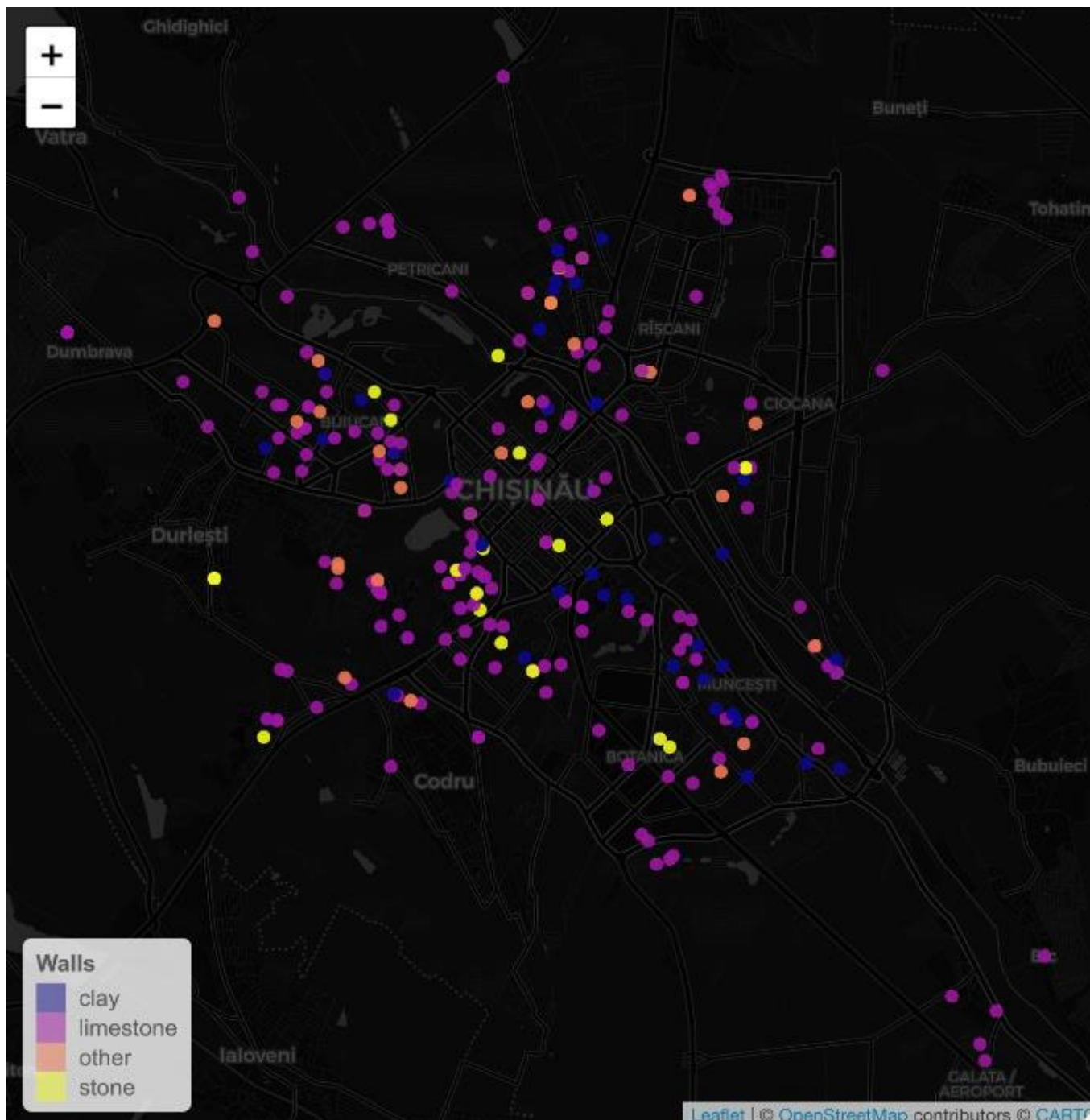
INTERIOR & EXTERIOR FEATURES	SIZE/COUNT
Concrete Patio	162
Conventional Canopy	162
Open Frame Porch	84
Fireplace	1

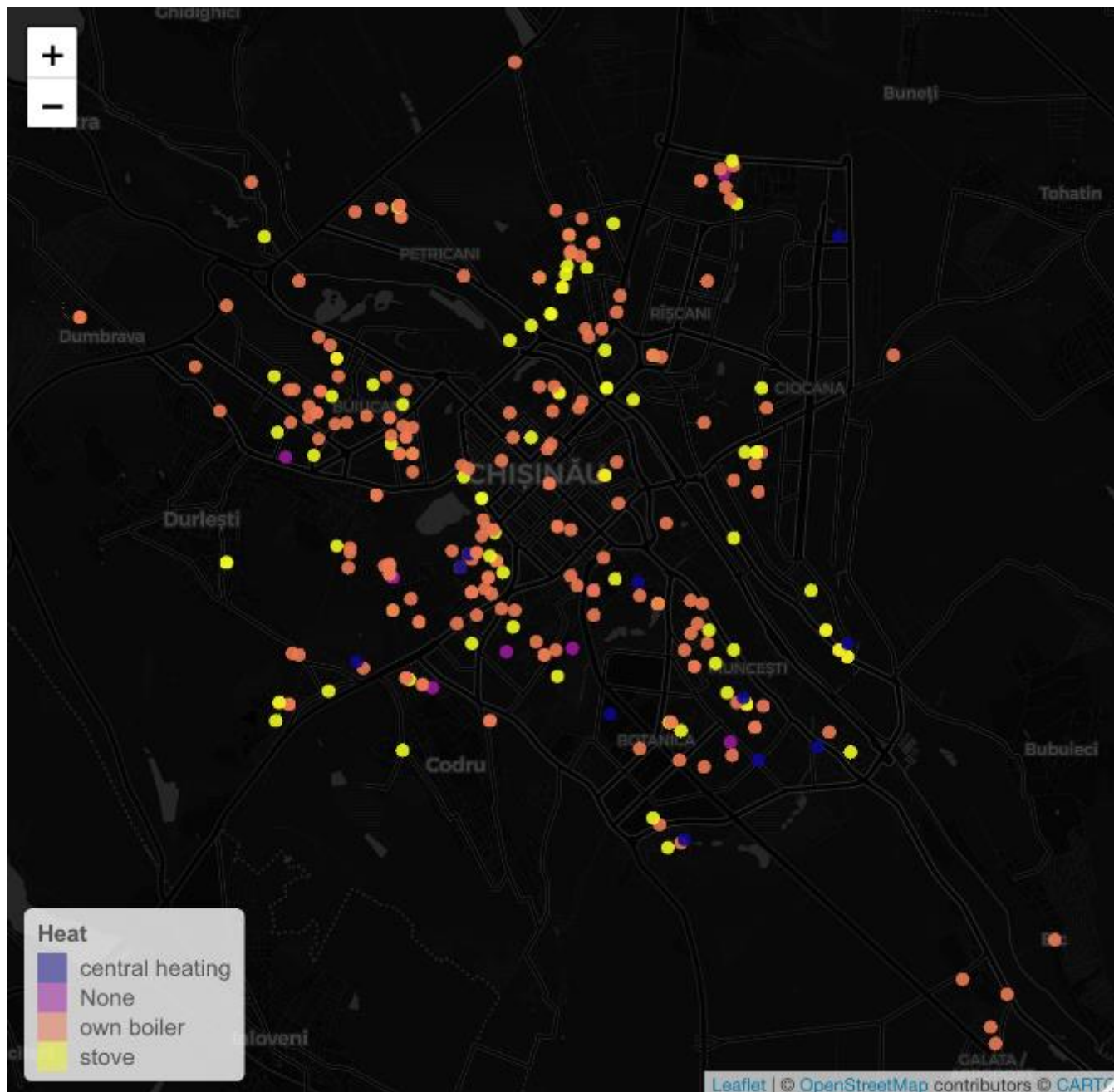




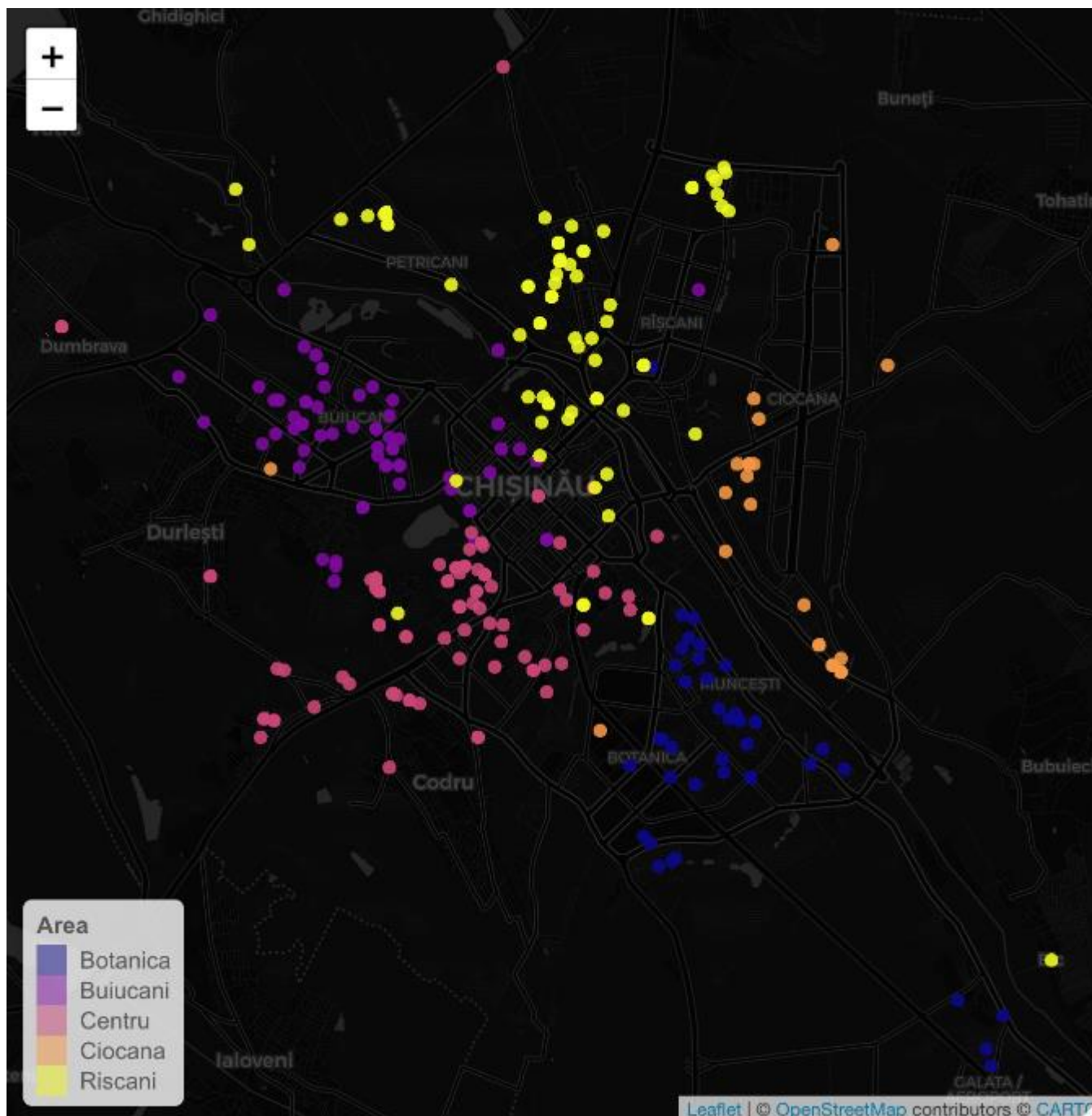












# To Promote Valuation Accuracy & Equity:

## Data Validation

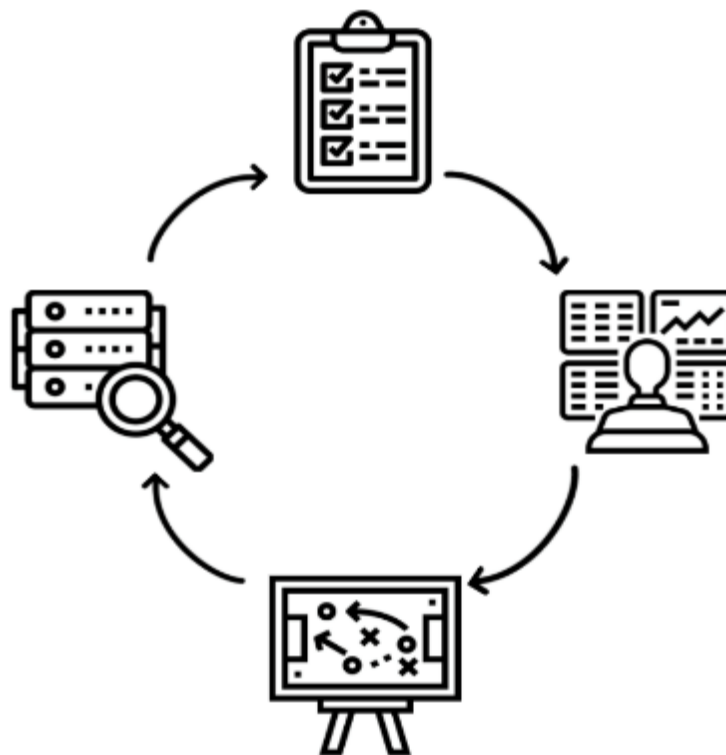
Verify accuracy of data collected. Filter out data not reflective of market (e.g. distressed sales, family sales)

## Data Collection

Collect sales prices, market rents, and property characteristic information.

## Statistical Analysis

Inspect for patterns to locate and estimate potential inequities. Adjust values as needed and re-run.



## Quality Control

Monitor for changes in the market.



# Conclusions

- Land management and valuation software/computer systems → often referred to as “computer-assisted mass appraisal” or “CAMA” systems
- These are asset management systems that incorporate property valuation component (mass and single property)
- These valuation algorithms are referred to as “automated valuation models” or “AVMs”
- Should provide cross-functionality between:
  - Cadastral data (e.g. ownership records, property characteristics)
  - Sales registries (deed information including price, date, parties, and characteristics)
  - Geographic information systems (GIS) --> including
  - Mass valuation → table or regression-based AVMs
  - Database (e.g. SQL Server, MySQL, Access) with output features (flat-file)
- Should be used to for data collection, data validation, statistical analyses, quality control to promote valuation efficiencies, accuracy, and overall tax fairness.
- Use in conjunction with international valuation standards (IAAO, IVSC, etc.)

# Thank You! Questions?

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