

The CRE equivalent of Zestimate: Combining machine learning and spatial modelling to mine big data

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Agenda

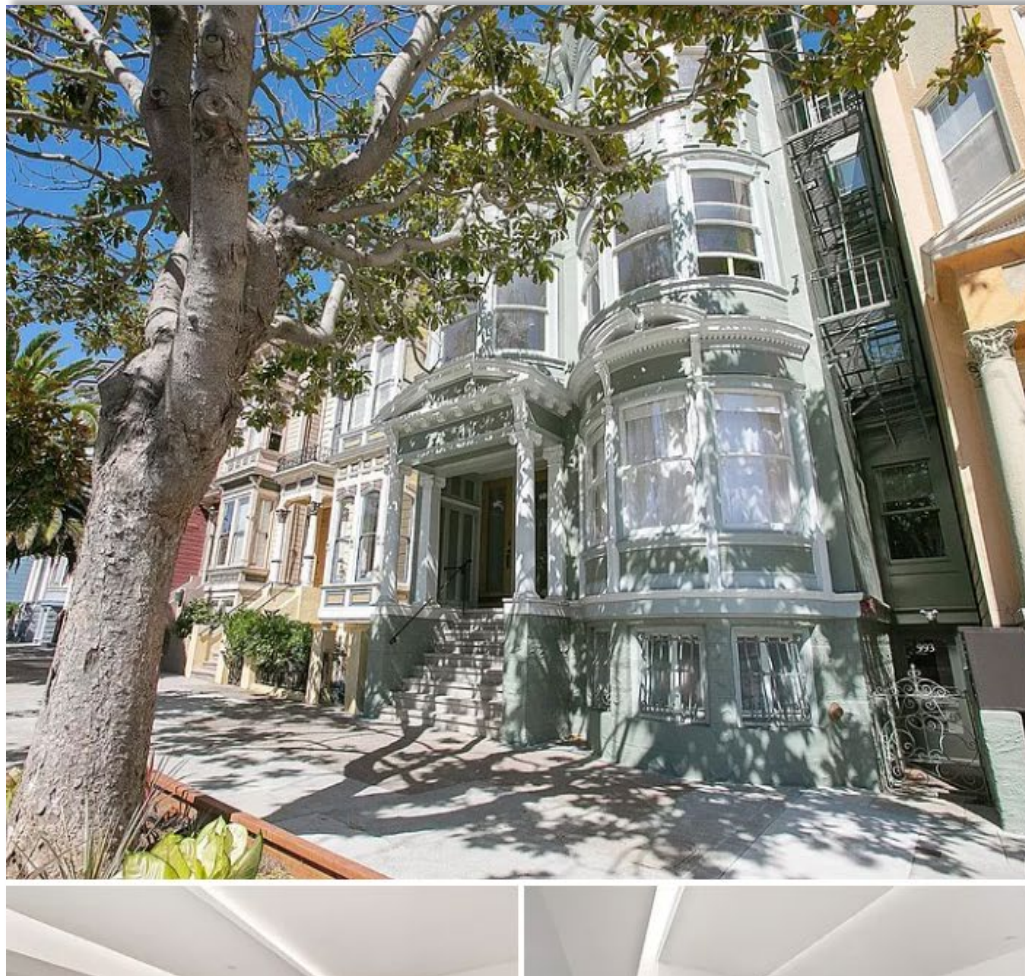
1. Real Estate Valuation Overview
2. Comparable Properties and Leases
3. Rent Prediction and Property Valuation
4. Key Takeaways
5. Questions & Answers

1

Real Estate Valuation
Overview

Real Estate Valuation Overview

Residential



Zillow Save Share More

\$995,000 2 bd | 2 ba | 1,175 sqft
993 Dolores St, San Francisco, CA 94110
Est. payment: \$4,964/mo [Get pre-qualified](#)

Contact Agent Take a Tour

Overview Facts and features **Home value** Price and tax history

Zestimate®
\$1,297,826
Estimated sales range: \$1.18M - \$1.39M

Zestimate history

This home	San Francisco
\$1.3M	\$1.4M

Listed for \$995K on 8/16/19

REDFIN

trulia

realtor.com®

RE/MAX

CHASE

Comparable Homes



Homes with location proximity and attribute similarity

Zillow [Save](#) [Share](#) [More](#) **Similar homes** [See all](#)

\$995,000 2 bd | 2 ba | 1,175 sqft
993 Dolores St, San Francisco, CA 94110
For sale | Zestimate®: \$1,295,000 | [View Details](#)
Est. payment: \$4,986/mo | [Get pre-qualified](#)

[Contact Agent](#) [Take a Tour](#)

Overview

Time on Zillow	Views	Saves
31 days	13,018	266

993 Dolores at 23rd street is an all-new 2-Bed 2-Bath Garden Unit that was just added to a classic Mission Dolores Edwardian. Access to the shared back yard is through a floor to ceiling folding glass NanaWall, a full-size in-unit Washer/Dryer is included, heat is through a building-wide radiant system, there is shared bike storage, access to the unit is at the ground floor, no stairs to climb, there's a private side patio off the kitchen, sqft measurement is approx 1,175

[Read more](#)



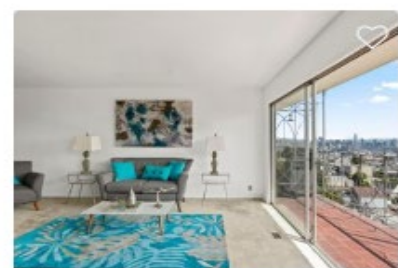
\$995,000
2830 22nd St Apt 1, San Francisco, CA 94110
2 bd · 1 ba · 858 sqft



\$995,000
174 San Carlos St, San Francisco, CA 94110
2 bd · 1 ba · 1k sqft

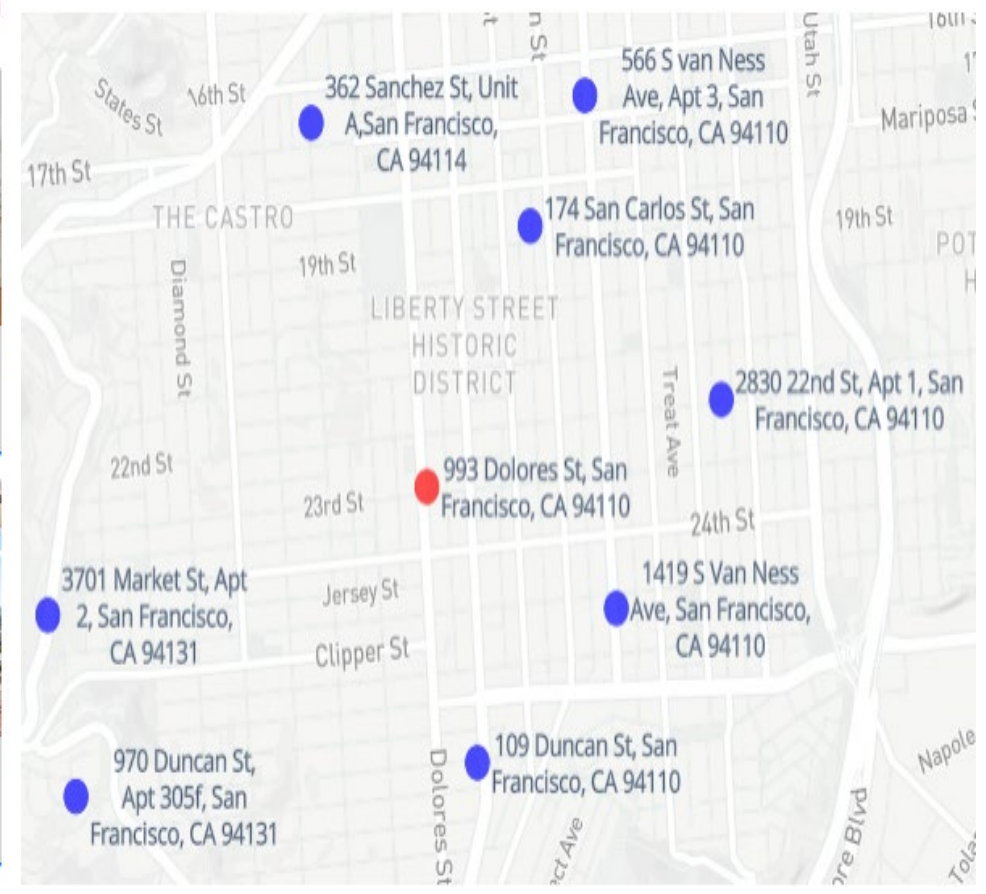


\$1,195,000
109 Duncan St, San Francisco, CA 94110
2 bd · 1 ba · 1k sqft



\$998,000
3701 Market St Apt 2, San Francisco, CA 94131
2 bd · 2 ba · 1.2k sqft

[See more similar homes](#)

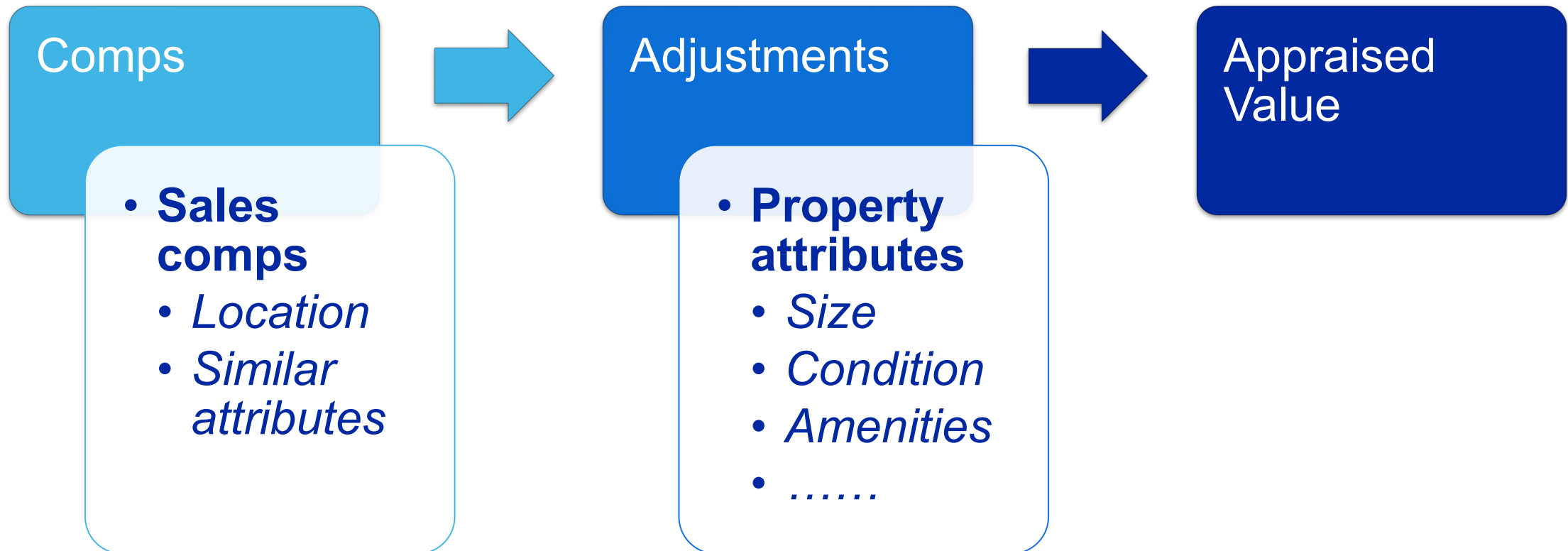


Real Estate Valuation Overview

Real Estate Appraisal Process



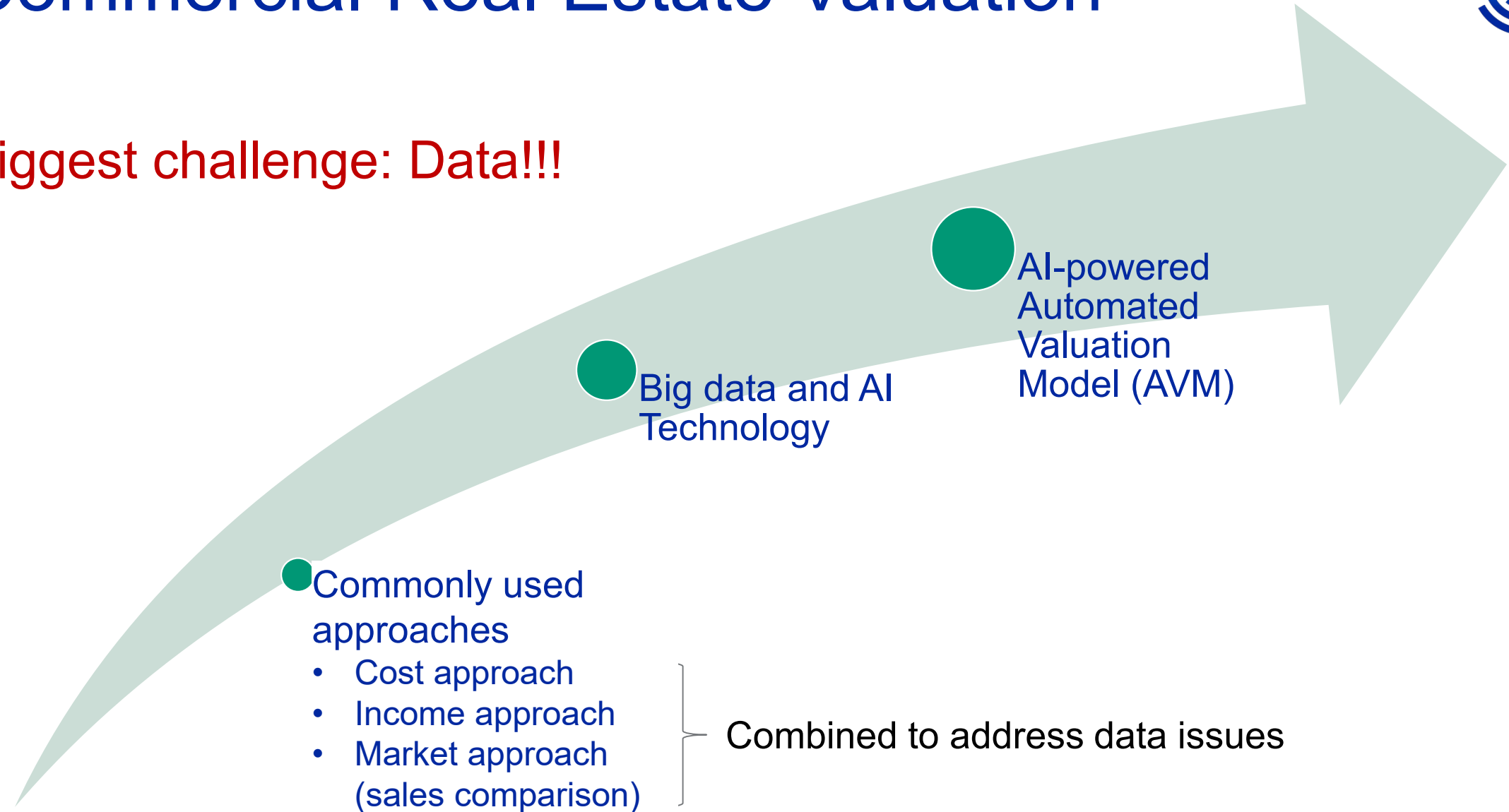
Sales Comparison Approach



Commercial Real Estate Valuation



Biggest challenge: Data!!!



Companies Using AI for CRE Valuation



“GeoPhy’s automated valuation model (AVM) provides that much-needed innovation with enterprise-grade, **AI-powered** insight into the value, and value drivers of commercial real estate assets.”



“Skyline AI partners with leading commercial real estate firms to establish next-generation investment vehicles augmented by **artificial intelligence**.”

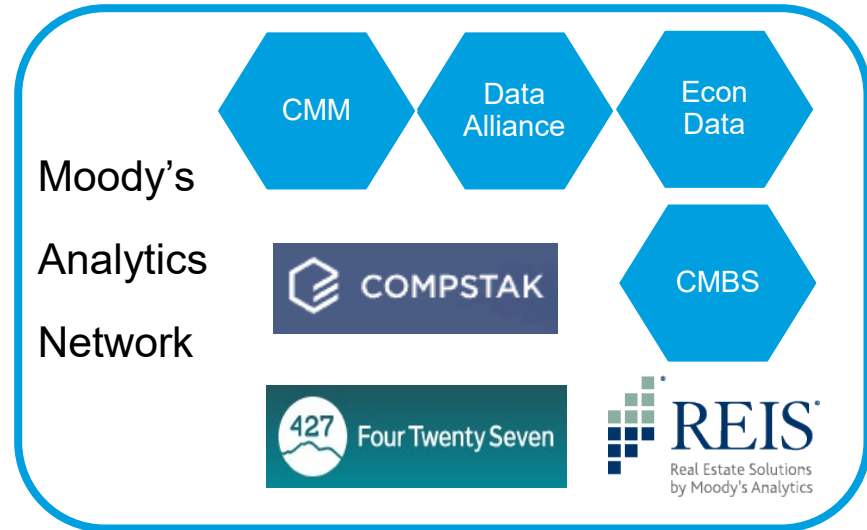


“Built on a highly scalable and resilient next-generation cloud infrastructure, our intelligent models with self-improving **Machine Learning** capabilities and **deep learning algorithms**, deliver diverse aspects of properties across the nation.”



“We use **machine learning** on dozens of disparate data sources to build the Standalone Value...We offer this information to property owners for free to help owners better understand their property values and sell for a premium to market valuation.”

Big Data



- Economic data
- Business activities
- Property records
- Crime data
- Transportation
- Amenities
- Social media
- Environmental data



Lease



Property



Loan



Location



Market



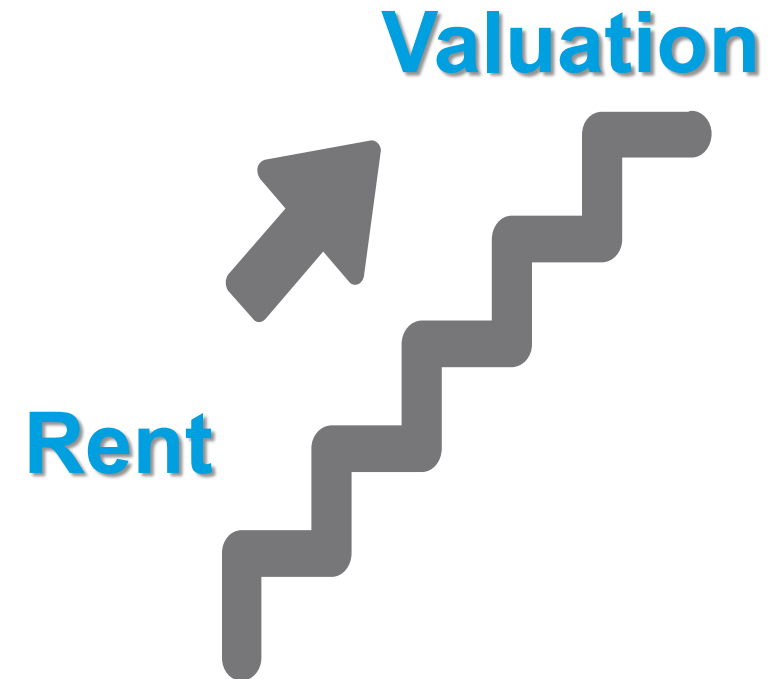
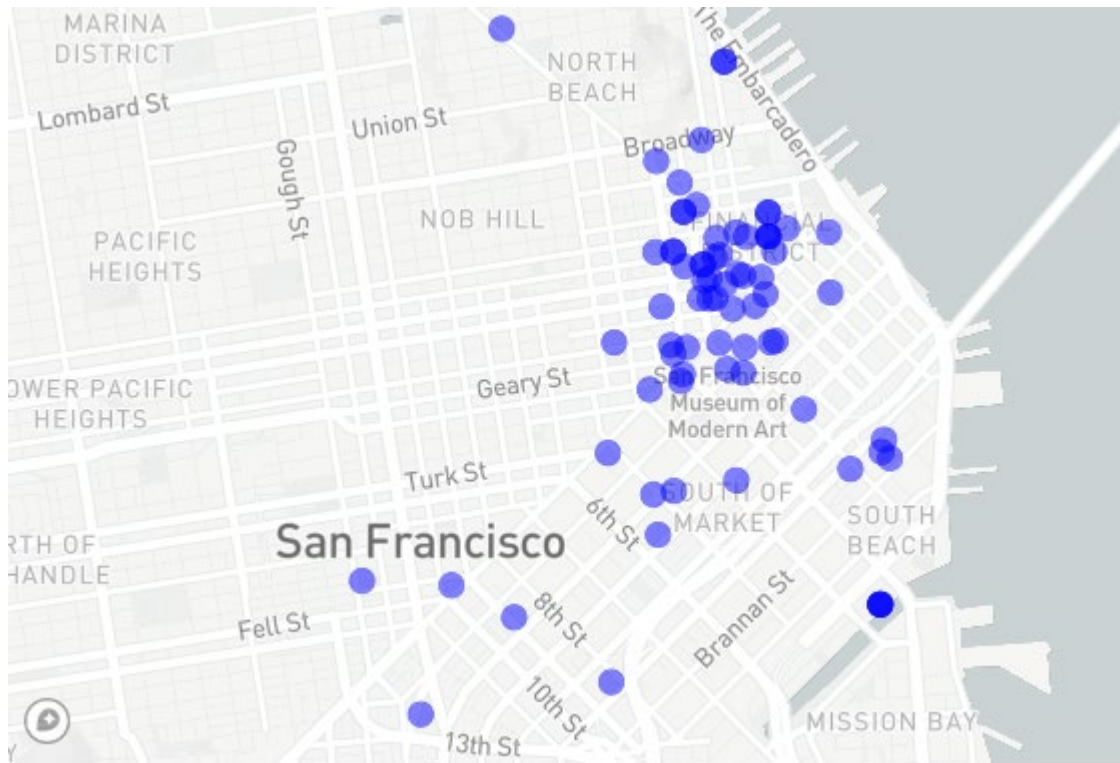
Risk



Use Big Data to Help “Small” Data

↳ Sales Transactions

Office Transactions vs. New leases of San Francisco in May, 2017



2

Comparable Properties and Leases

Comparable Properties and Leases

Commercial



REIS Real Estate Solutions by Moody's Analytics

Welcome back Wenjing Wang

MARKET REPORTS PROPERTY COMPS TRANSACTION ANALYTICS MARKET ANALYTICS VALUATION

Home | Property Comps | Comps Review

Comps Review

REPORTING PERIOD
RENT COMPS

Class:
 A (59)
 B/C (16)

Limit Result by:

Asking Rent PSF (\$) Lock
\$17.3 - \$124.8

Vacancy %
0 - 31.6

Size (Square Feet)
228,573 - 1,012,010

Floors
4 - 48

Year Built
1955 - 2014

SALES COMPS
NEW CONSTRUCTION COMPS

405 Howard Street, San Francisco, CA 94105

View: Comparable Properties Nearest Properties

Custom Polygon Clear ? ADD YOUR OWN COMP »

Show Only the Comps Type Under Review

Include: Rent Comps Sales Comps New Construction Comps Investment Analysis

GENERATE REPORT

View: Comparable Properties Nearest Properties

Custom Polygon Clear ? ADD YOUR OWN COMP »

Radius: 0 5

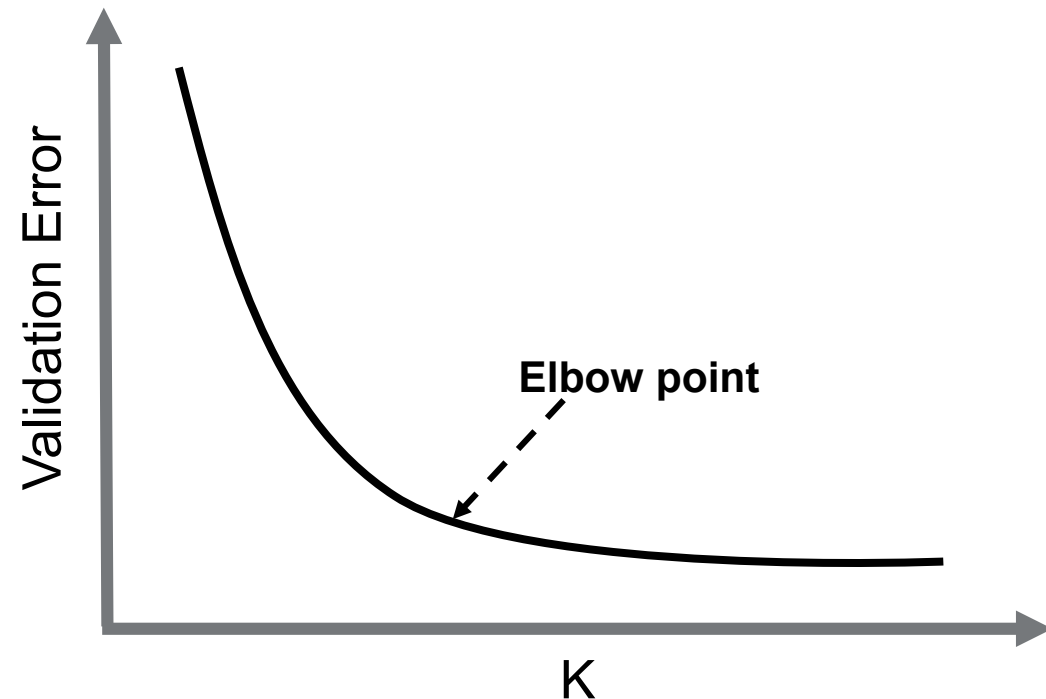
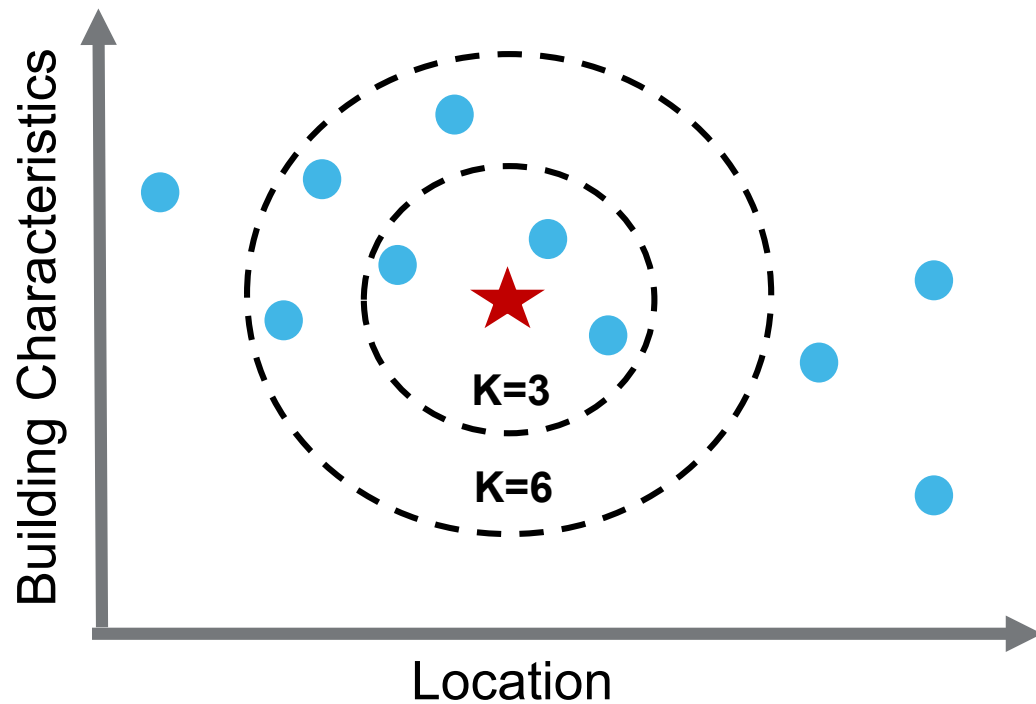
GENERATE REPORT

Comparable Properties and Leases

Commercial

k-nearest neighbors (k-NN) algorithm

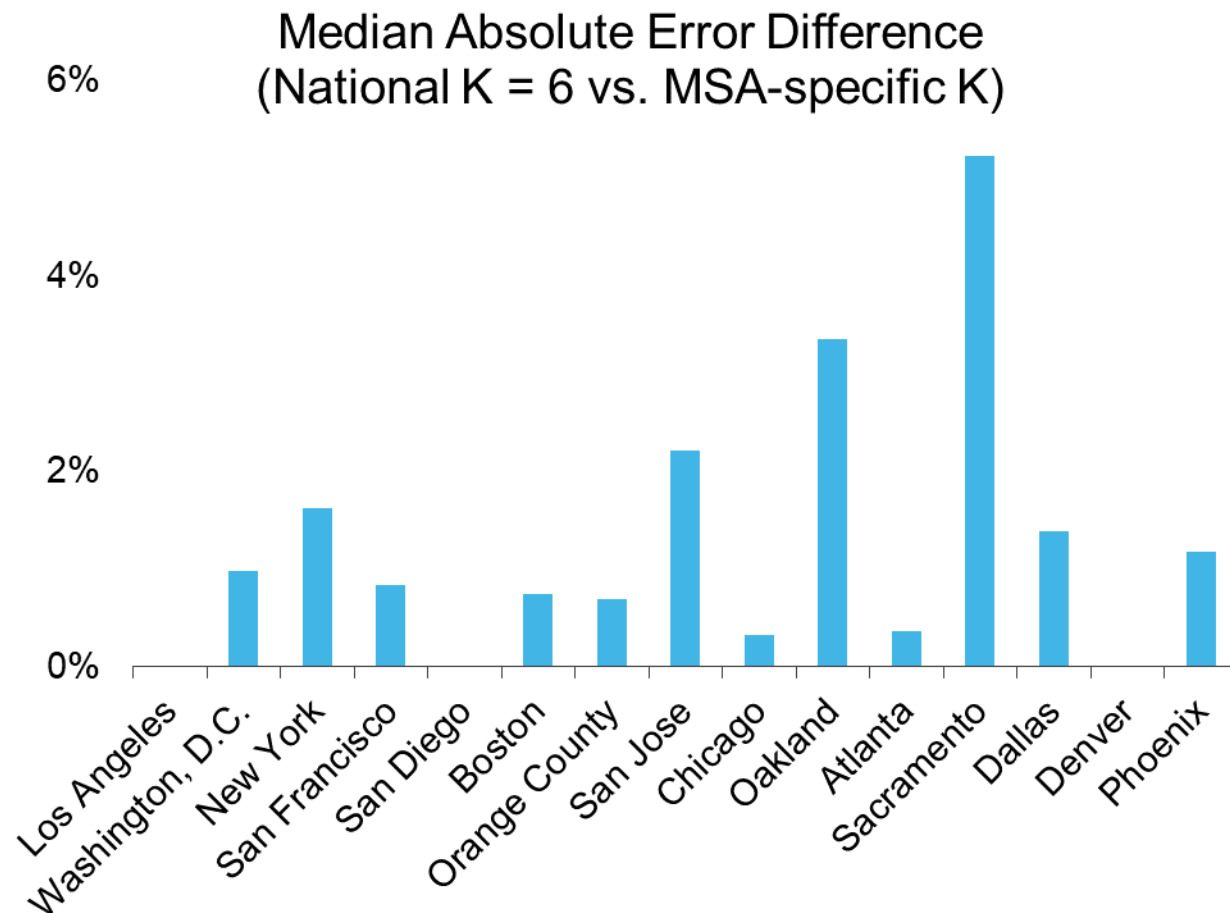
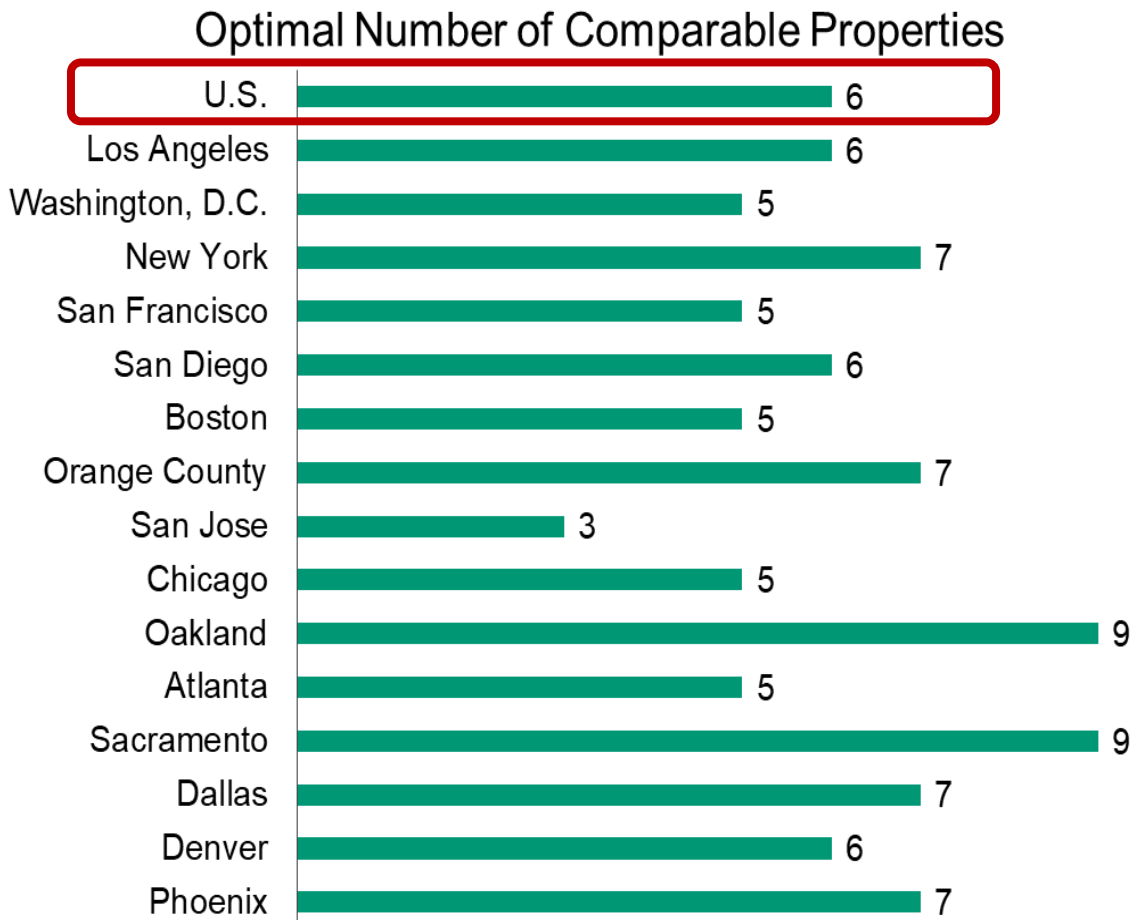
Intuitive and easy-to-implement supervised machine learning algorithm.



Comparable Properties and Leases

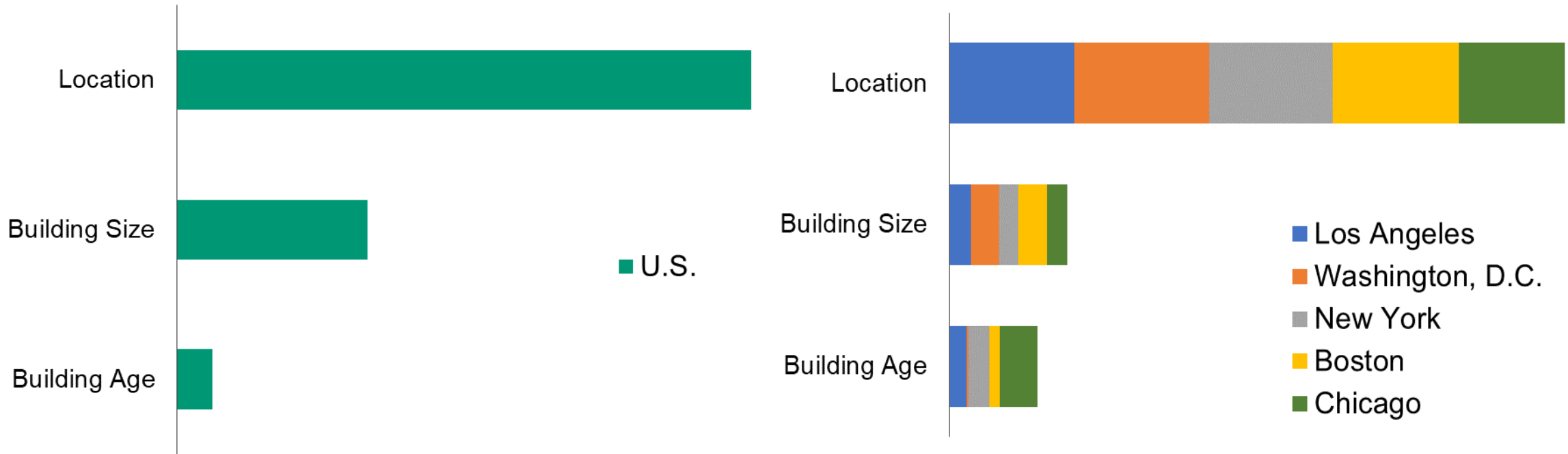


Optimal Number of Comps: National or Local?

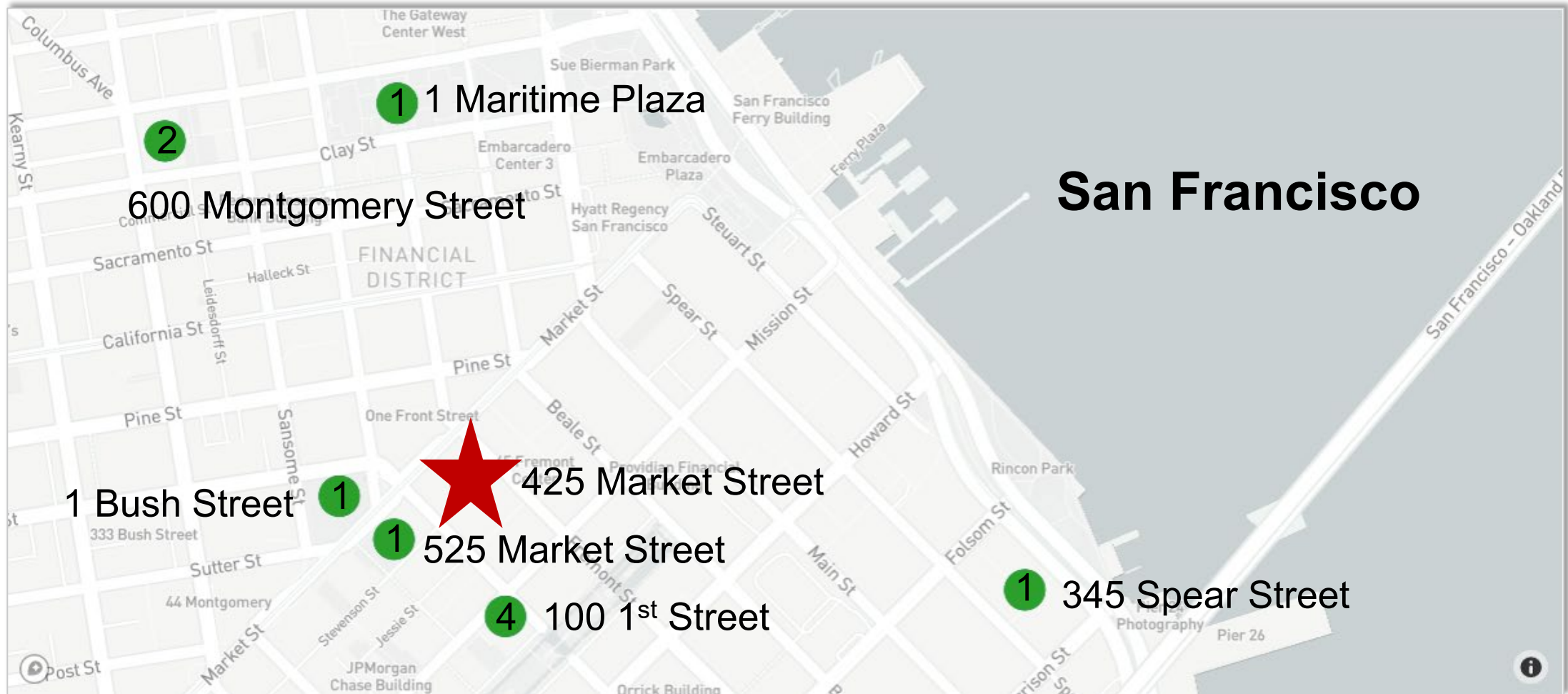


Feature Importance

Location is the most important feature



Comparable Property and Leases

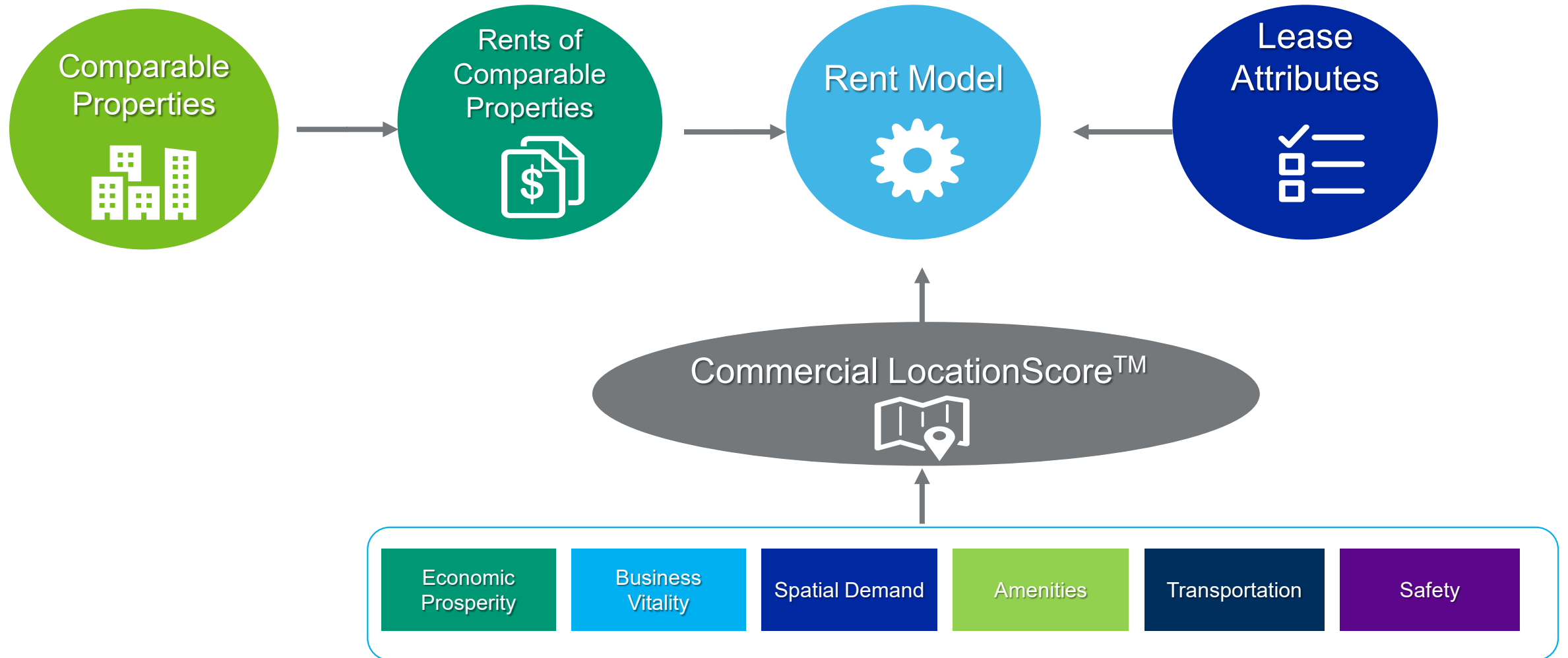


3

Rent Prediction and Property Valuation

Rent Prediction and Property Valuation

Structure of Rent Prediction Model

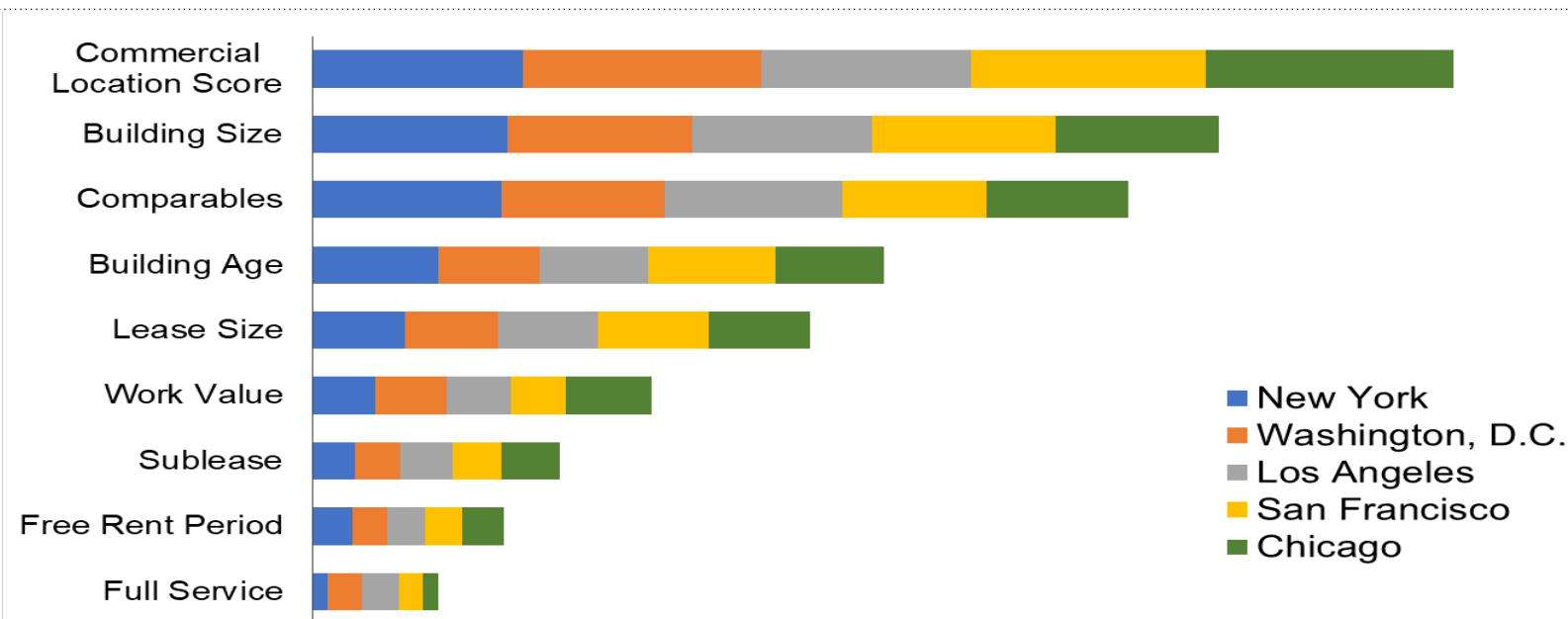


Rent Prediction Model



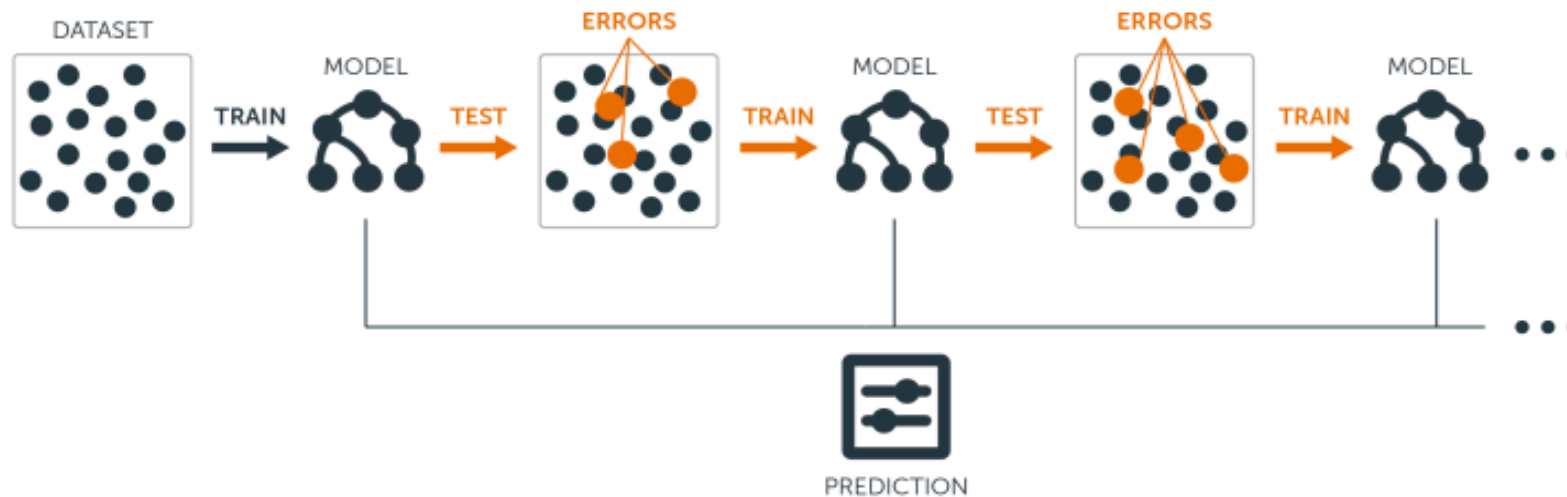
Out-of-sample Performance (Median Absolute Error)

	New York	Los Angeles	Washington, D.C.	San Francisco	Chicago
Linear Model	17.2%	15.6%	13.2%	13.3%	13.8%
Gradient Boosting	12.1%	👍 9.9%	👍 8.9%	👍 10.5%	👍 11.1%

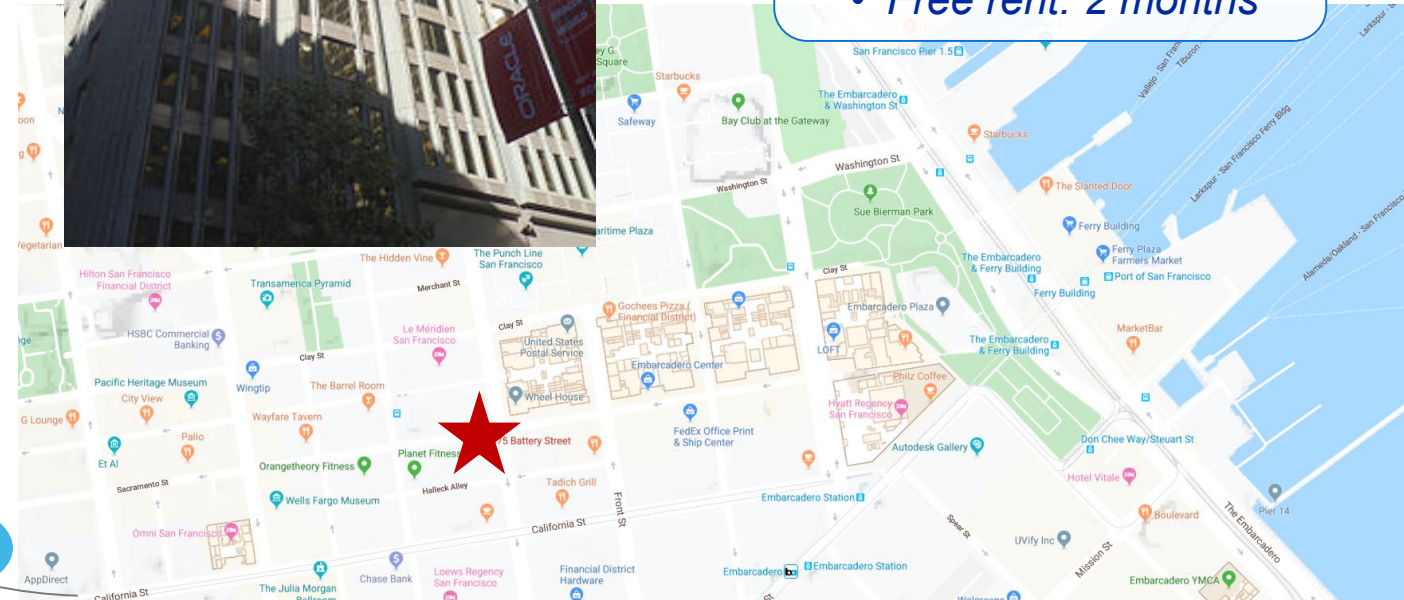
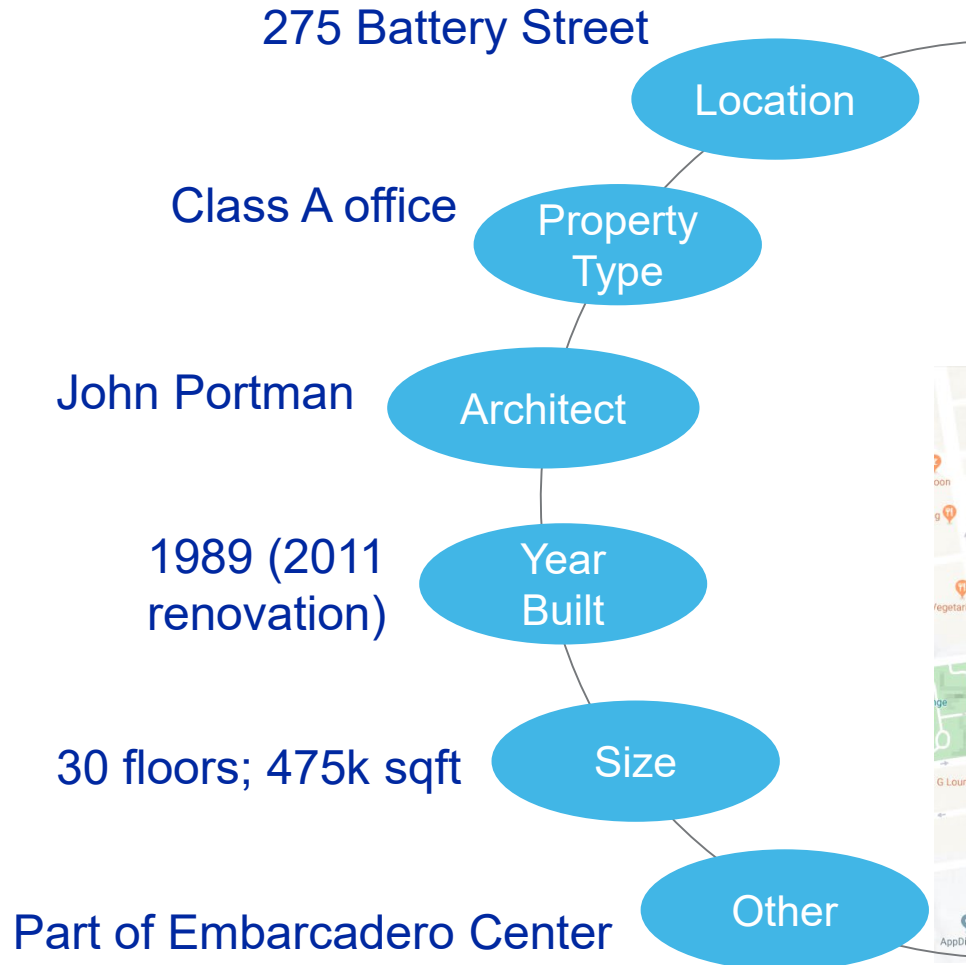


Gradient Boosting Algorithm

- » The algorithm creates an ensemble of regression trees
 - Each tree is dependent on prior trees
 - It learns by fitting the residuals of the trees that preceded it



Embarcadero West – San Francisco



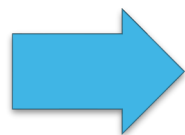
Vacant Space

- Space size: 9,630
- Full service
- Work value: \$10/sqft
- Free rent: 2 months

Embarcadero West

Initial estimate
(\$58.32)

- Rent comps
- Commercial Location Score
 - *Economic prosperity*
 - *Business vitality*
 - *Spatial demand*
 - *Amenity*
 - *Transportation*
 - *Safety*

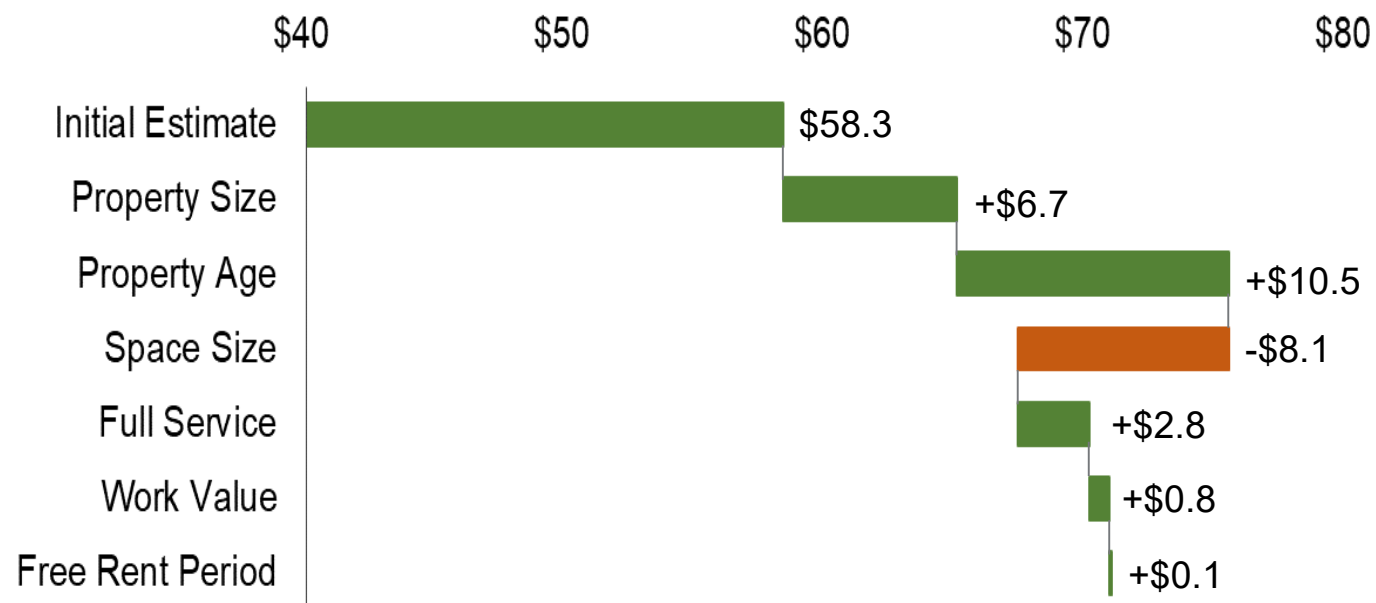


Adjustments (±)



Estimated rent
(\$70.9)

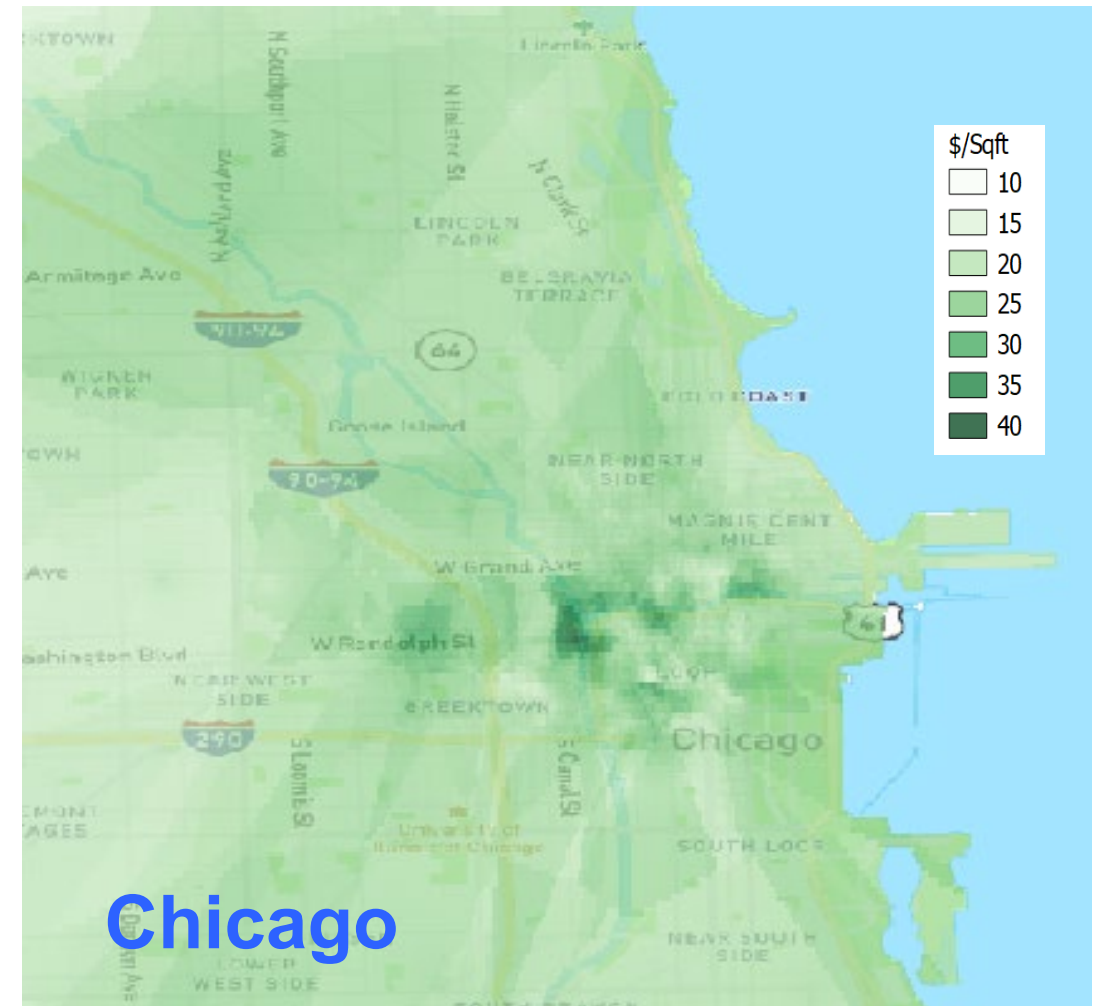
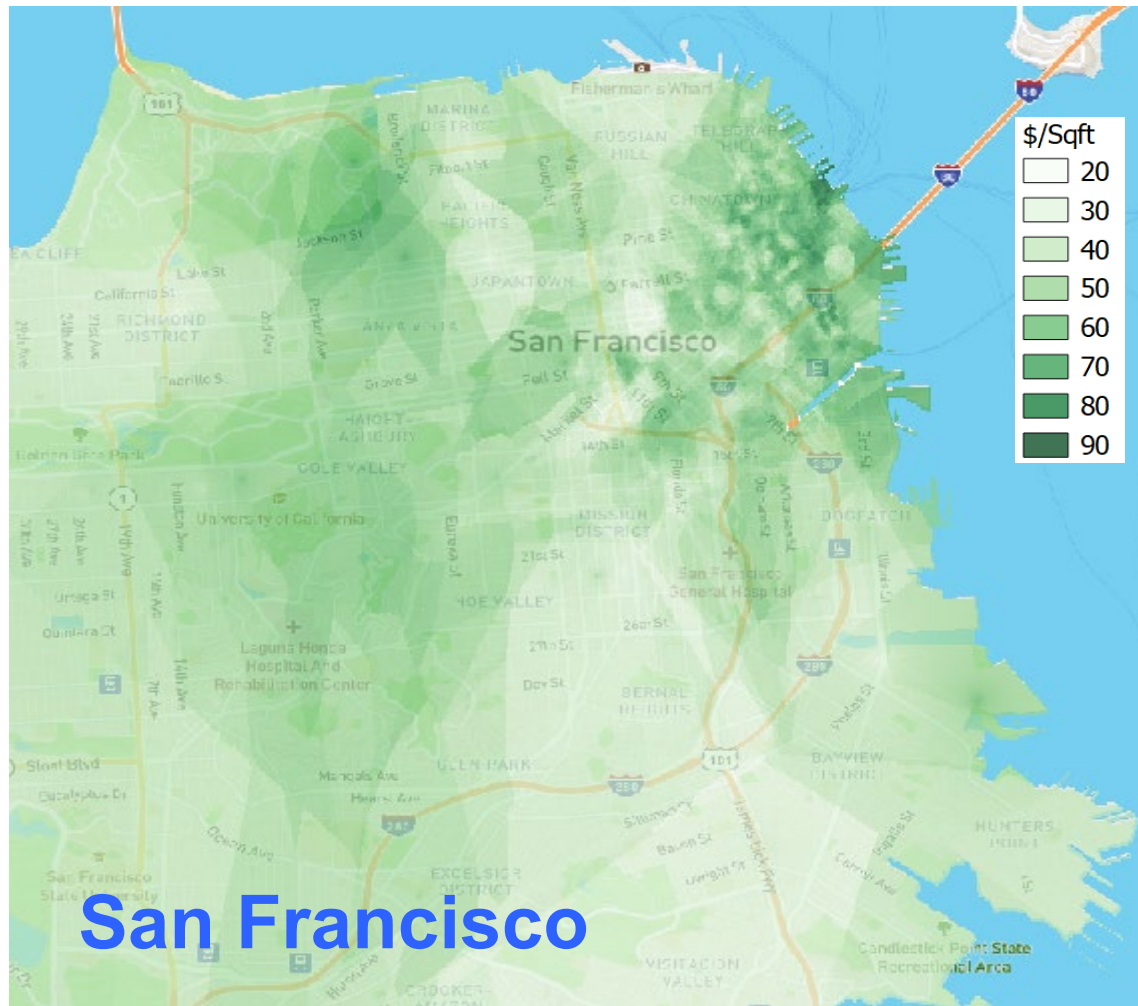
Actual rent: \$71.0



- **Another lease:**
 - *Same building*
 - *Same month*
 - *Different lease terms*

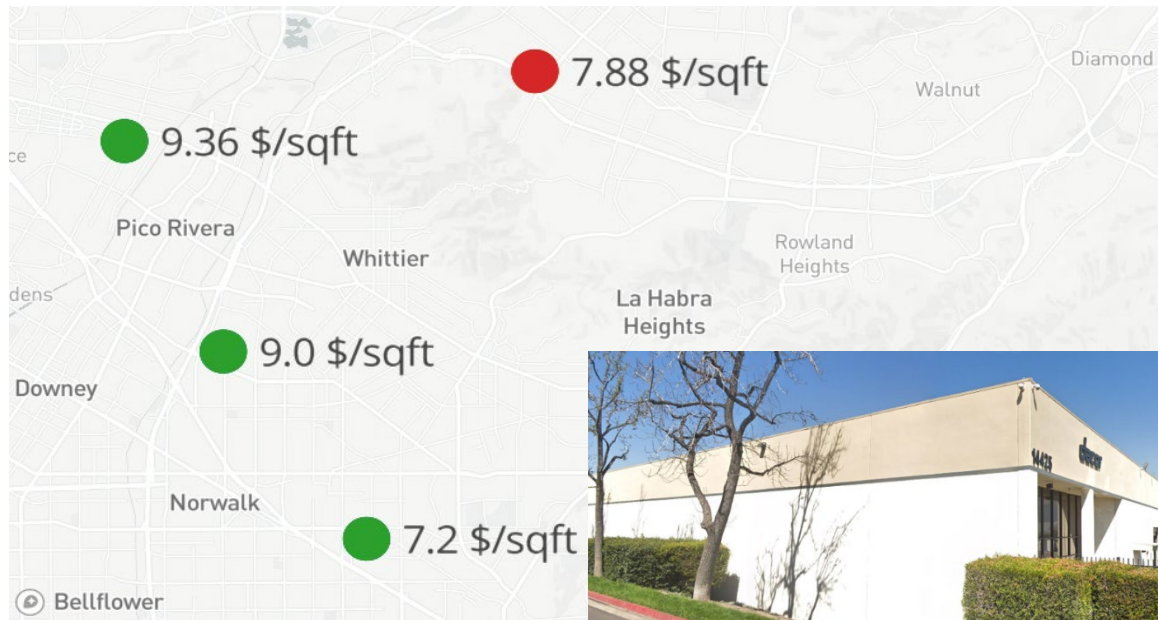
Estimated rent: \$76.2
Actual rent: \$74

Office Rent Prediction in Multiple MSAs



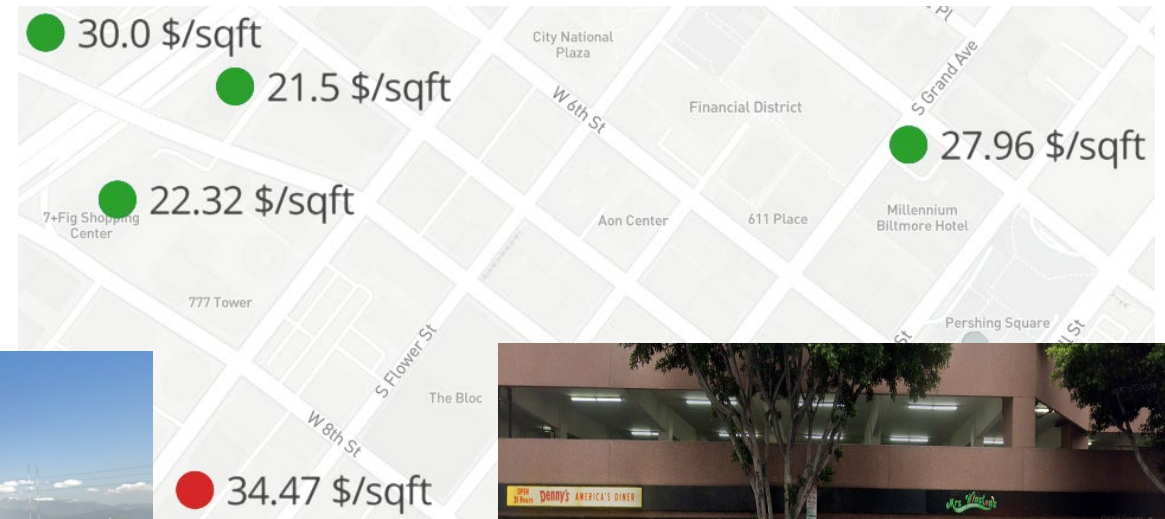
Other Property Types

Industrial



14425 Clark Avenue, City Of Industry, CA 91745

Retail



888 South Figueroa Street, Los Angeles, CA 90017

Rent Prediction and Property Valuation

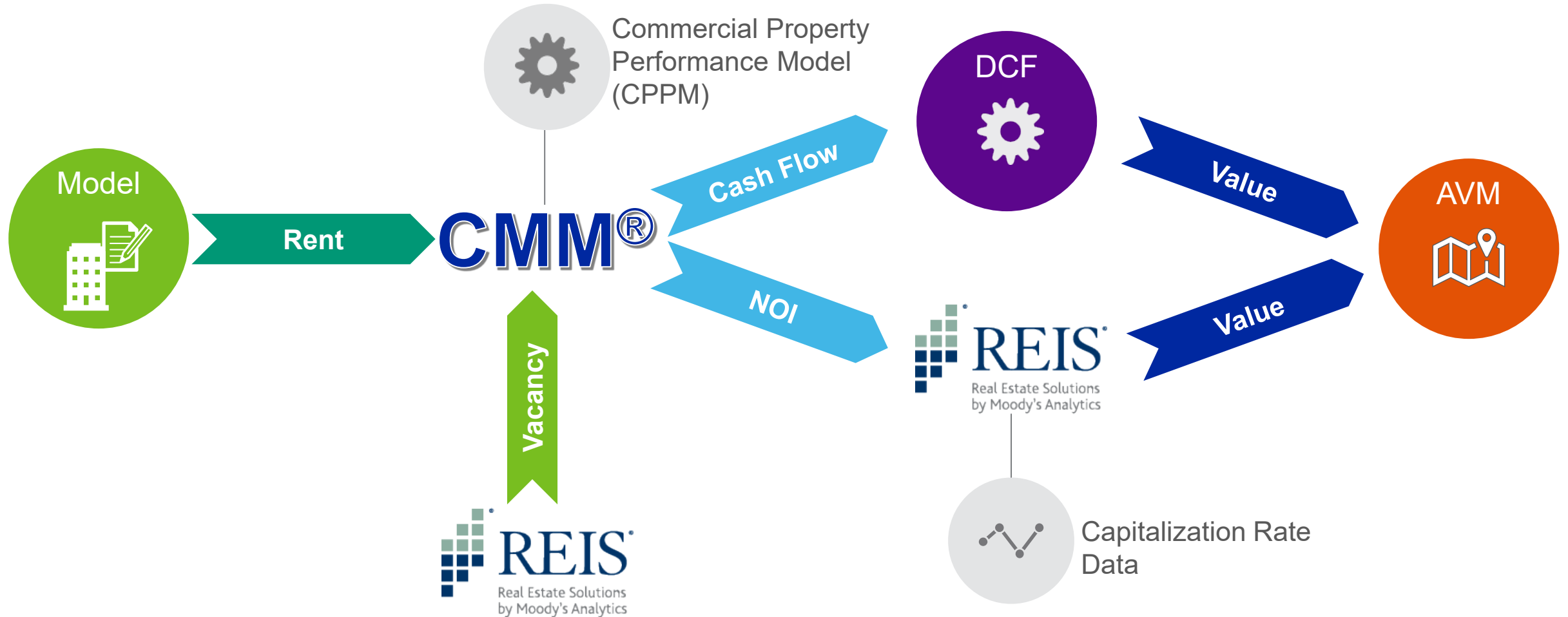


Rent Prediction Demo



Rent Prediction and Property Valuation

Leveraging Existing Moody's Analytics CRE Network



Rent Prediction and Property Valuation

Example Use Cases



Appraisers

- Augment valuation process



Brokers

- Brokerage for CRE leases
- Brokerage for CRE sales



Investors

- Pinpoint Investment opportunities
- Portfolio diversification



Lenders

- Loan underwriting
- Risk monitoring

4

Key Takeaways

Key Takeaways

- » Most effective route to commercial property AVM:
 - Start with rent (Big Data available) – Focus of our project
 - CRE value can then be estimated by combining with additional approaches
- » Machine learning shows promising improvements over traditional methods
 - K-nearest neighbors algorithm automates comps selection
 - Gradient Boosting algorithm minimizes office rent prediction error to ~10%
- » Automated rent prediction has tremendous value across multiple business fronts



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