AN ALGORITHM FOR IMPROVING SALES

for TransitScreen

About, Well, You, TransitScreen

TRANSIT SCREEN

TransitScreen is a real-time display of transportation and arrival data. In addition to real-time transit information, TransitScreen supports:

- Messaging
- Badging
- TransitScreen GO
- TransitScreens can also be customized with logos, local private shuttle information and a choice of background colors.

TransitScreen is a high-tech amenity that sets a property apart and adds convenience to users' everyday lives.
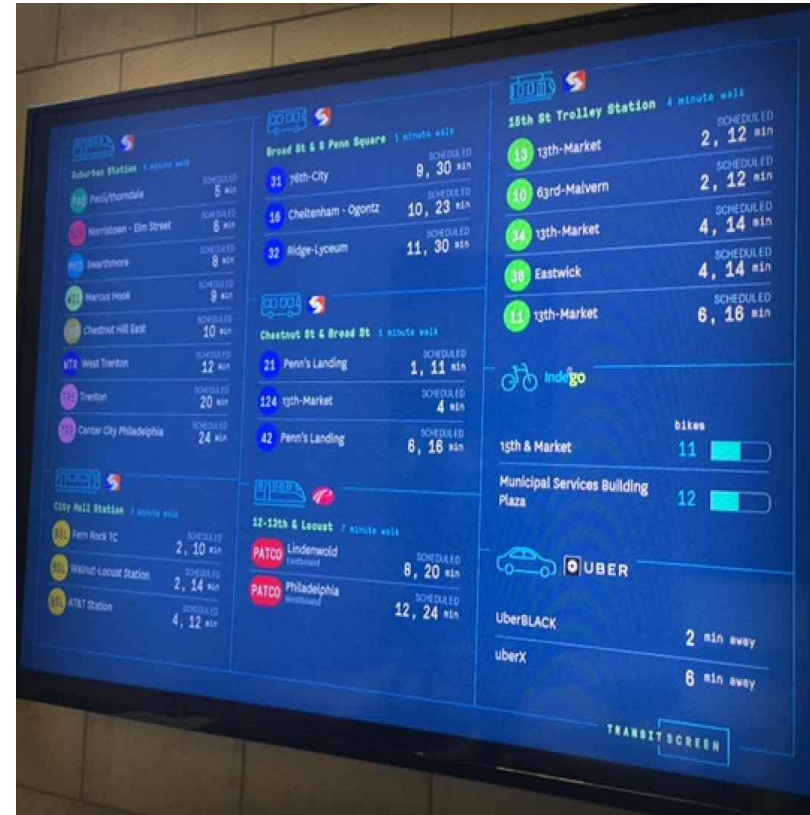
Guiding Questions:

- What are the location characteristics that lead to successful ("closed") sales?

- Where are the best locations to market TransitScreen?

- Based on our model, which opportunities are likely to close?

Methods

- Provided datasets of potential sales (leads), quotes and opportunities

- Enhanced datasets by geocoding them, and calculating distances to nearest TransitScreens, and corrected erroneous addresses

- Conducted exploratory data analysis on provided datasets

- Created an algorithm to predict whether opportunities and leads will close

ABOUT THE DATA

About Our Data

- Quotes dataset had 1938 records

- Opportunities originally had 2499 records. Out of those, 1686 had no address

- Opportunities and Quotes datasets were merged into one, called the "merged dataset" with 2558 records. 893 records had a full address and 1665 records did not have an address at all.

- To fill in missing addresses, we geocoded the merged data with Google's API and conducted web scraping using Selenium

- We acquired 1683 geocoded records with addresses. 875 records had addresses but no geocoding.

About Our Data (con't)

- Of those, 1227 did not close and 456 closed.

- Our definition of closed = stage of closed won, deal signed or invoice sent

- Then we called the TransitScreen dev API to get these scores:

  - Mobility score   Bikeshare score   Mass transit score

  - Carshare score   Rideshare score

- Next, we acquired a dataset of TransitScreen locations which contained 628 addresses; we geocoded 577 records with a latitude and longitude.

- Then for each record in the merged dataset, we determined the distances to the closest TransitScreen. We determined the number of TransitScreens within:

  1/10 mile   1/2 mile   1 mile   5 miles

- And then, we built a variety of models based on our complete data

Visualizing Our Data: Closest TransitScreen
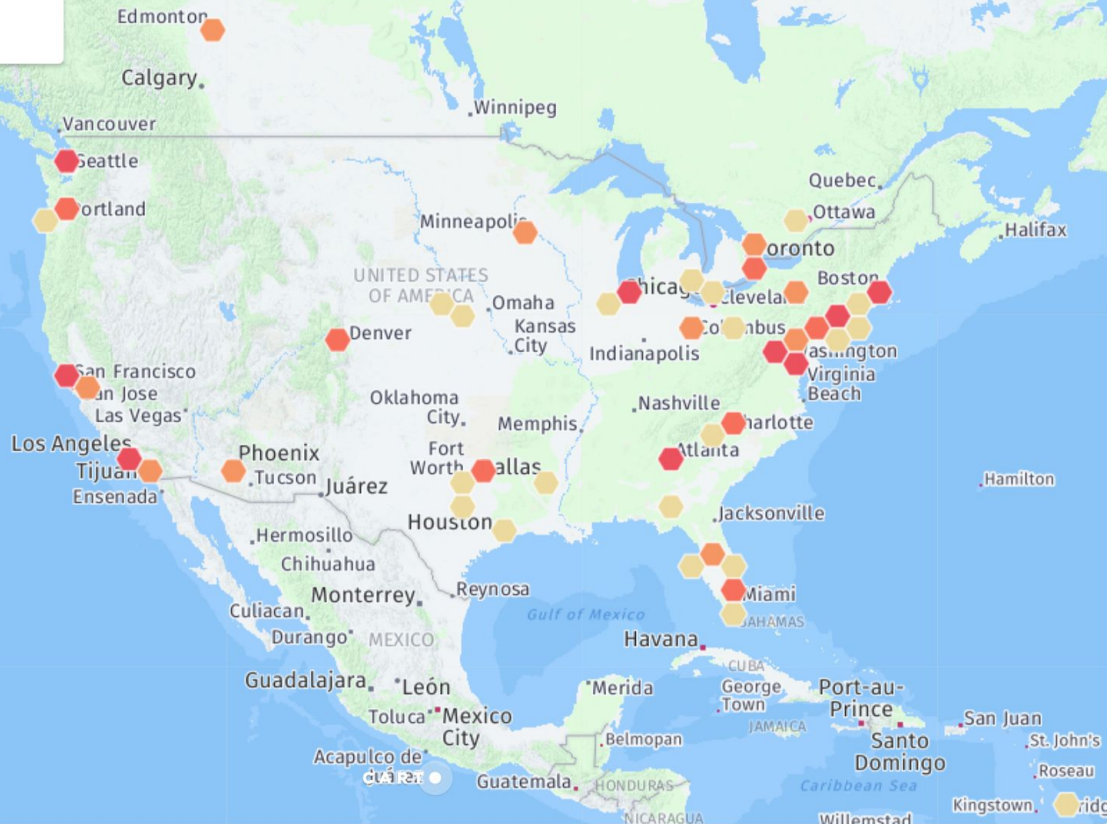
Visualizing Our Data: More on Mobility Score
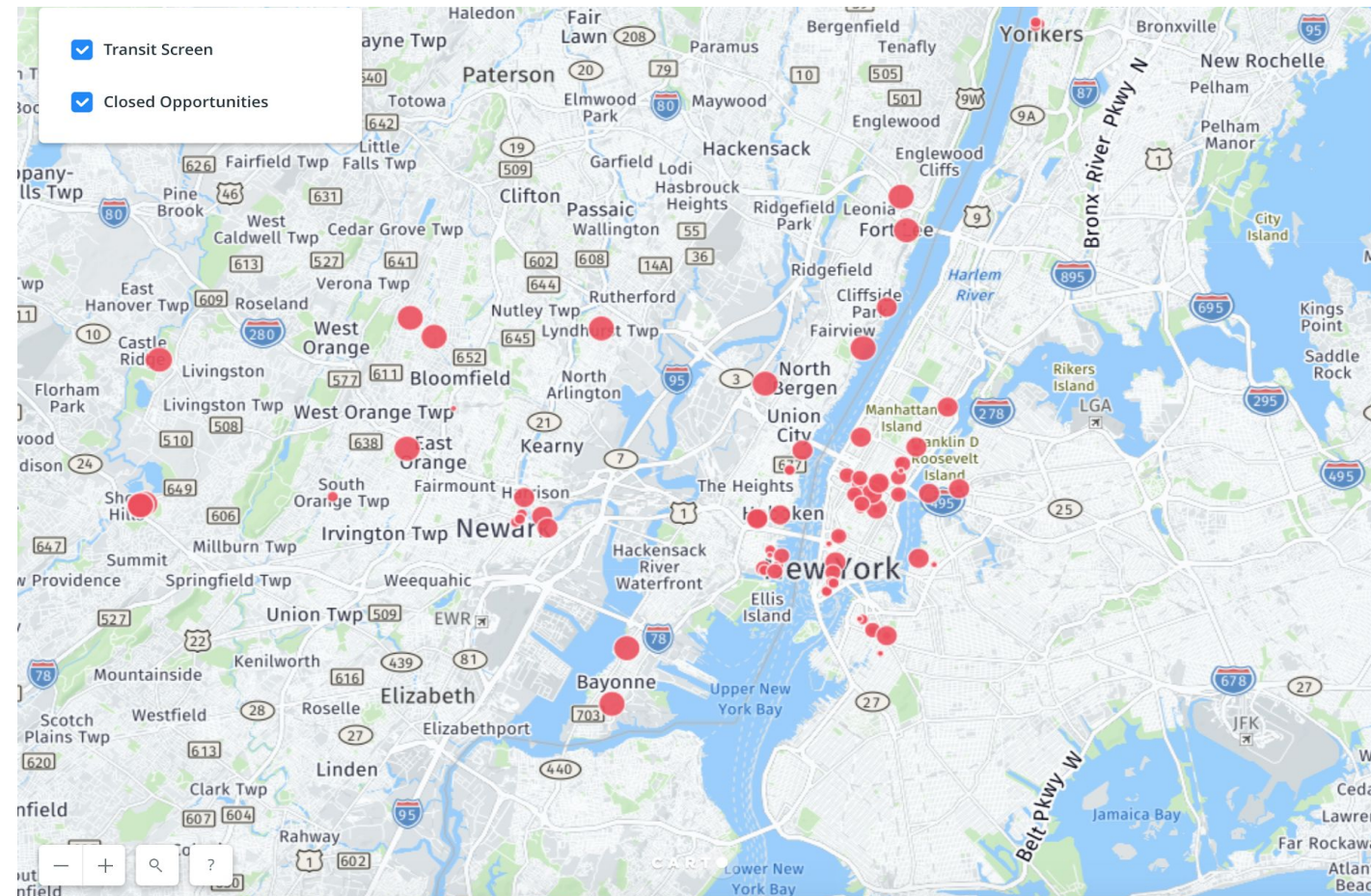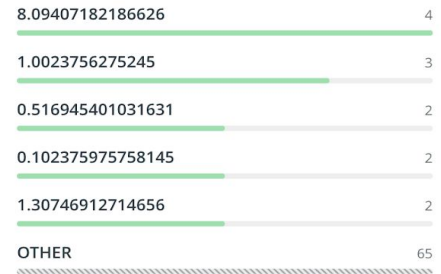
Visualizing Our Data: Proximity to TransitScreens
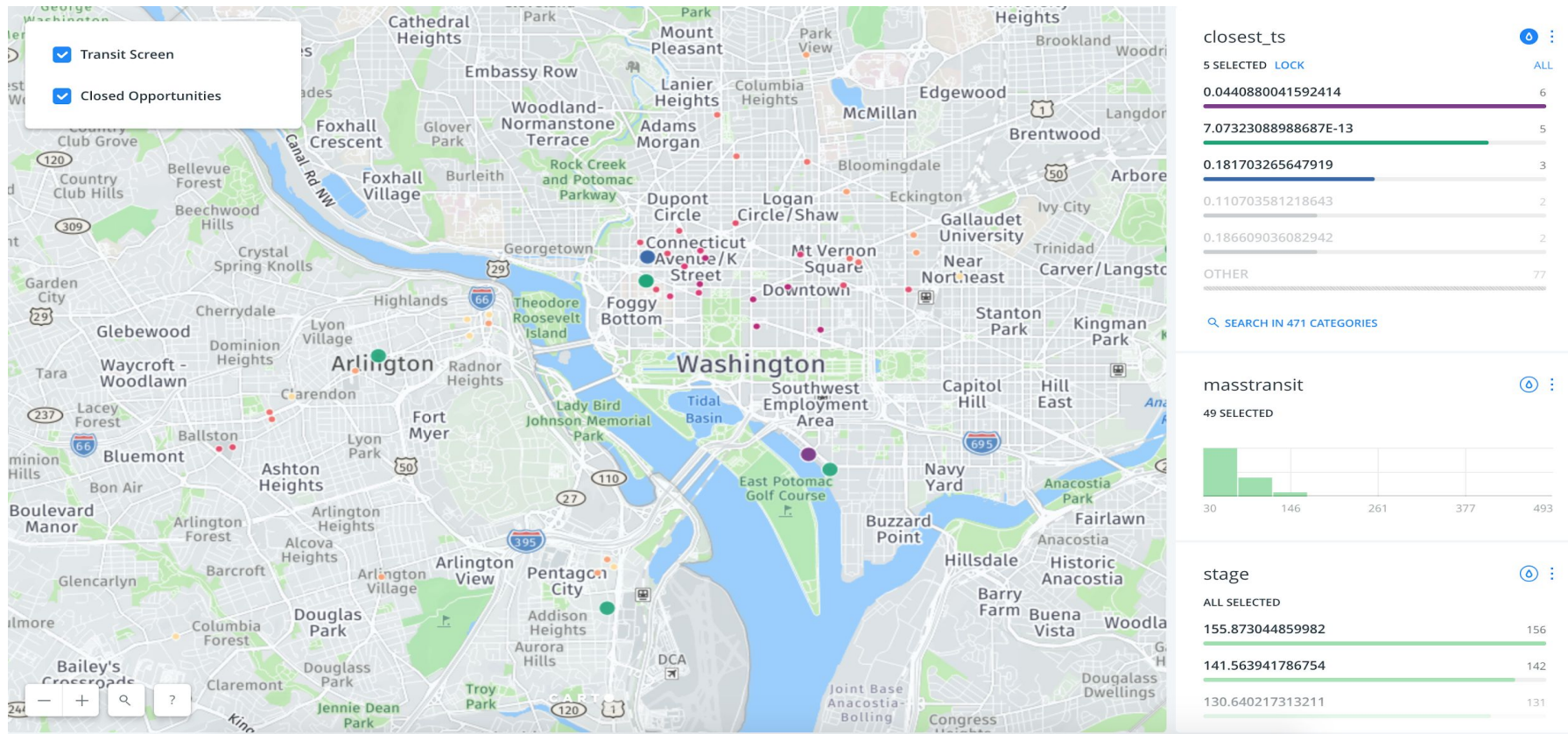
Visualizing Our Data: Mobility Score
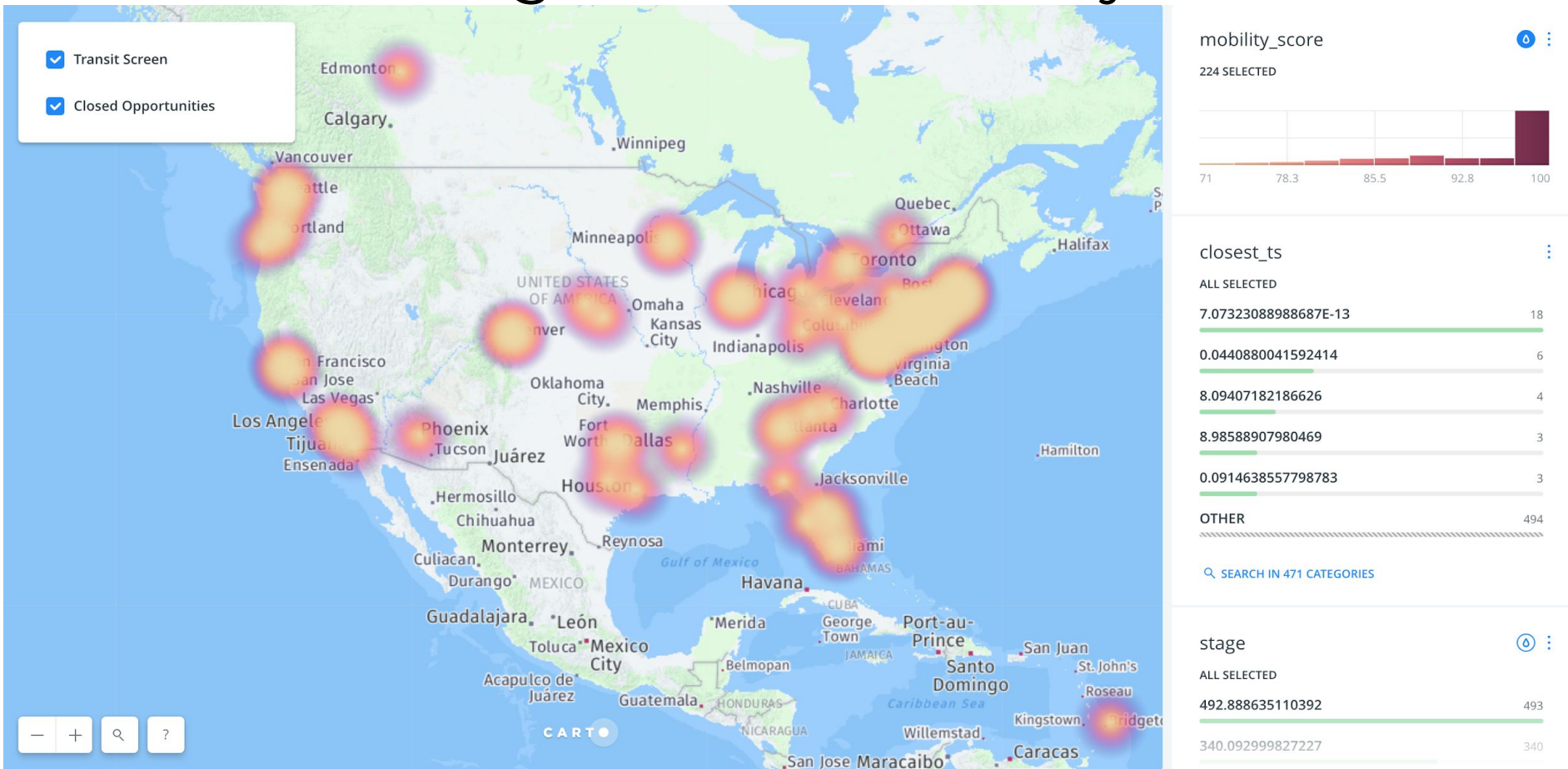
BUILDING THE ALGORITHM

Algorithm

1. AdaBoost Classifier
2. Gradient Boosting Classifier
3. Extreme Gradient Boost Classifier
4. Bagged Decision Tree Classifier
5. Random Forest Classifier
6. Extreme Trees Classifier
7. Logistic Regression

8. Neural Network

Interpretations

1. Boosting Methods (#1 - 3)
   a. Fitting weak learners and iterating through them to make them stronger
2. Ensemble Methods (#4 - 6)
   a. Using multiple algorithms to aggregate a prediction from all of them
3. Logistic Regression (#7)
   a. More classic method for classification, behaves in a similar fashion to linear regression, but it is a classification algorithm
4. Deep Learning Algorithm

And then. . .

- We got the highest accuracy score with our neural network
- The best models (ADABoost, Neural Network) performed at an 0.77 accuracy score (77%)
- All other models performed similarly in the 75 - 77% range

INTERPRETING OUR FINDINGS

About Feature Importances
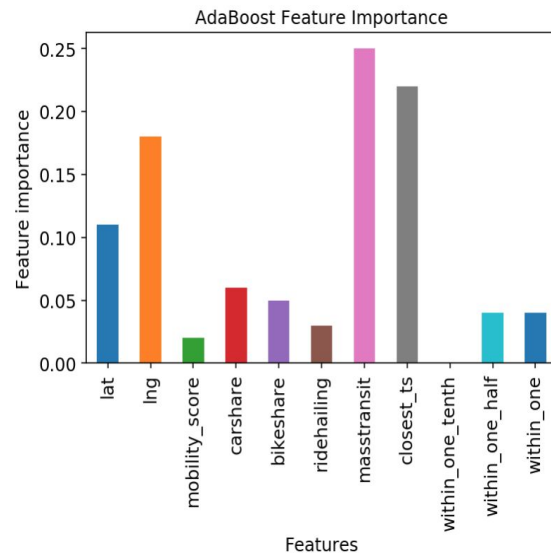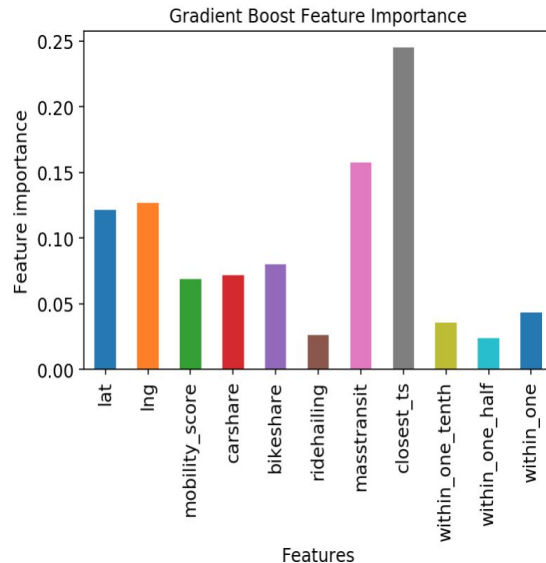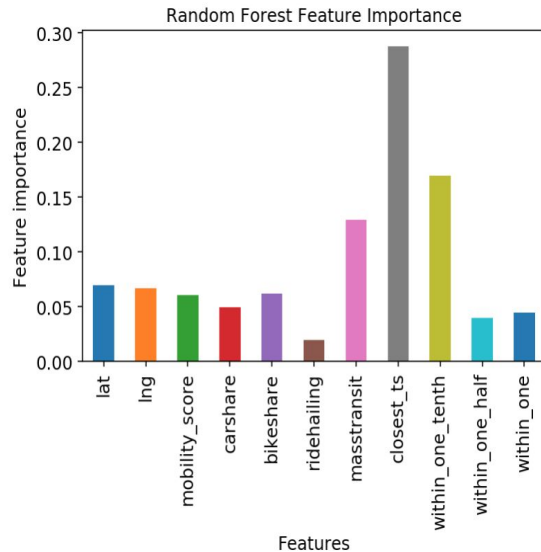
Across most of our models, the most influential features were **the closest TransitScreen** followed by **masstransit.**

SUMMARY: Proximity to TransitScreens and high mass transit scores are the best predictors for closing sales.

What we found are the following important features:

- Having a transitscreen close by
- Being close to mass transit

Therefore, any lead that in close proximity to another TransitScreen, or locations that have a higher mass transit score **seem to be the best predictors of a <u>successful sale</u>.**

Mass Transit also seems to be a better predictor than ride hailing, bike shares and Mobility Scores.

FINDING CUSTOMERS & CLOSING SALES

To Predict Successful Closings, Mass Transit is Tops

Shaw-Howard U 7 min walk

| YL | Huntington | 7 min |
| GR | Greenbelt | 12 min |

U Street/African Amer Civil War Memorial/Cardozo 7 min walk

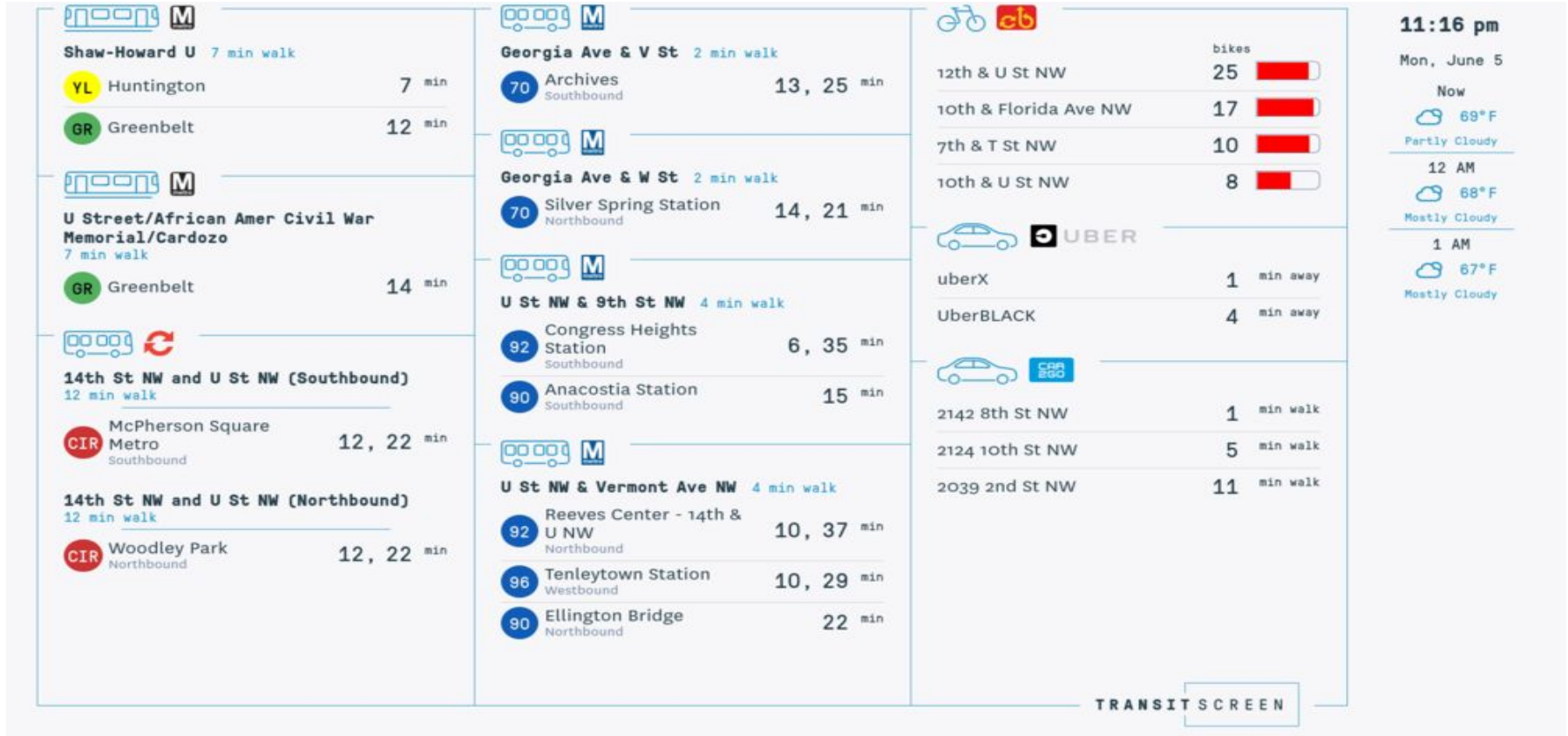| GR | Greenbelt | 14 min |

14th St NW and U St NW (Southbound) 12 min walk

| CIR | McPherson Square Metro · Southbound | 12, 22 min |

14th St NW and U St NW (Northbound) 12 min walk

| CIR | Woodley Park · Northbound | 12, 22 min |

Georgia Ave & V St 2 min walk

| 70 | Archives · Southbound | 13, 25 min |

Georgia Ave & W St 2 min walk

| 70 | Silver Spring Station · Northbound | 14, 21 min |

U St NW & 9th St NW 4 min walk

| 92 | Congress Heights Station · Southbound | 6, 35 min |
| 90 | Anacostia Station · Southbound | 15 min |

U St NW & Vermont Ave NW 4 min walk

92	Reeves Center - 14th & U NW · Northbound	10, 37 min
96	Tenleytown Station · Westbound	10, 29 min
90	Ellington Bridge · Northbound	22 min

bikes

12th & U St NW	25
10th & Florida Ave NW	17
7th & T St NW	10
10th & U St NW	8

UBER

| uberX | 1 min away |
| UberBLACK | 4 min away |

car2go

2142 8th St NW	1 min walk
2124 10th St NW	5 min walk
2039 2nd St NW	11 min walk

11:16 pm

Mon, June 5

Now — 69°F — Partly Cloudy

12 AM — 68°F — Mostly Cloudy

1 AM — 67°F — Mostly Cloudy

TRANSIT SCREEN

Beyond Mass Transit: Where to find customers?
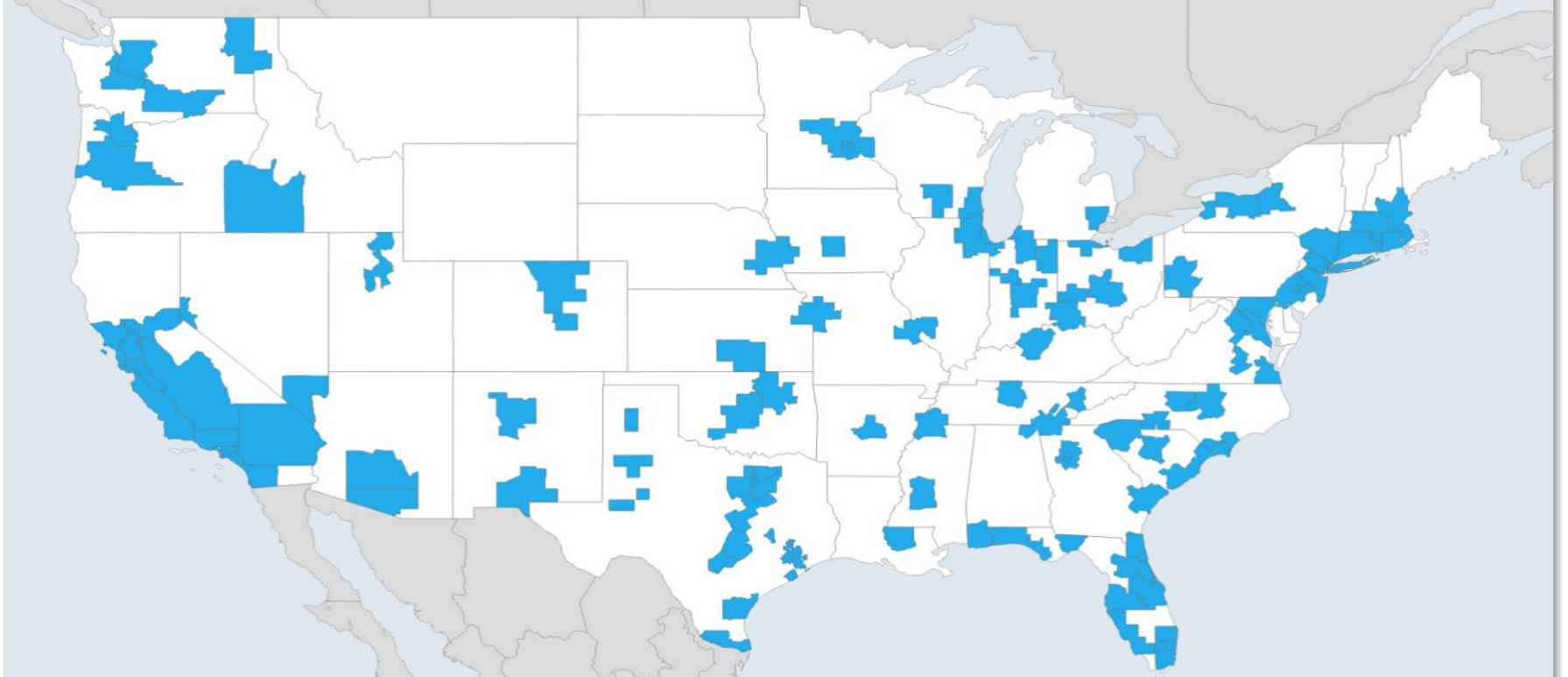
Finding More Customers: Top Multifamily Developers

| Rank (2017)	Rank (2016)	Company Name (P) = Public	Units Managed (as of Jan. 1, 2017)	% change 2016 to 2017	Corporate Officer	HQ City	HQ State
1	1	Greystar Real Estate Partners	415634	0%	Robert A. Faith	Charleston	SC
2	2	Lincoln Property Co.	184167	11%	Tim Byrne	Dallas	TX
3	3	Pinnacle Property Management Services	172000	28%	Rick L. Graf	Dallas	TX
4	6	FPI Management	103839	6%	Dennis Treadaway	Folsom	CA
5	5	WinnCompanies	100669	2%	Gilbert Winn	Boston	MA
6	9	MAA (P)	99393	25%	H. Eric Bolton Jr.	Memphis	TN
7	7	Alliance Residential Co	99364	13%	Bruce Ward and V. Jay Hiemenz	Phoenix	AZ
8	8	Apartment Management Consultants	86364	8%	Brenda Barrett	Cottonwood Heights	UT
9	4	Equity Residential (P)	78023	-29%	David J. Neithercut	Chicago	IL
10	10	AvalonBay Communities (P)	74049	0%	Timothy J. Naughton	Arlington	VA

- Focus on entire developer groups

- Focus on multifamily developers

- Focus on top 10 developers

Architectural Firm Billings Are 9 - 12 month precursor

Regional

Firm billings remain soft in Northeast, but continue to grow in all other regions

Graphs represent data from February 2017–February 2018 across the four regions. 50 represents the diffusion center. A score of 50 equals no change from the previous month. Above 50 shows increase; Below 50 shows decrease. 3-month moving average.

West: 57.6

Midwest: 54.5

South: 54.4

Northeast: 47.5
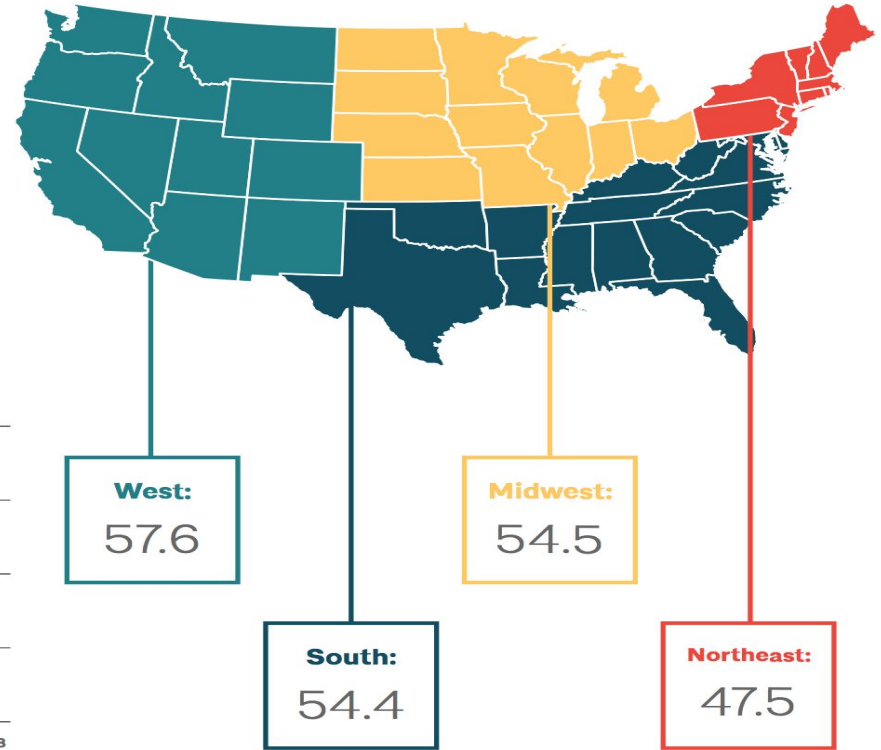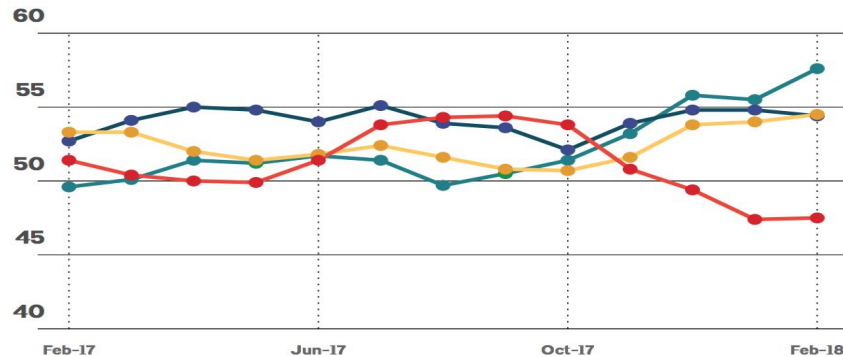
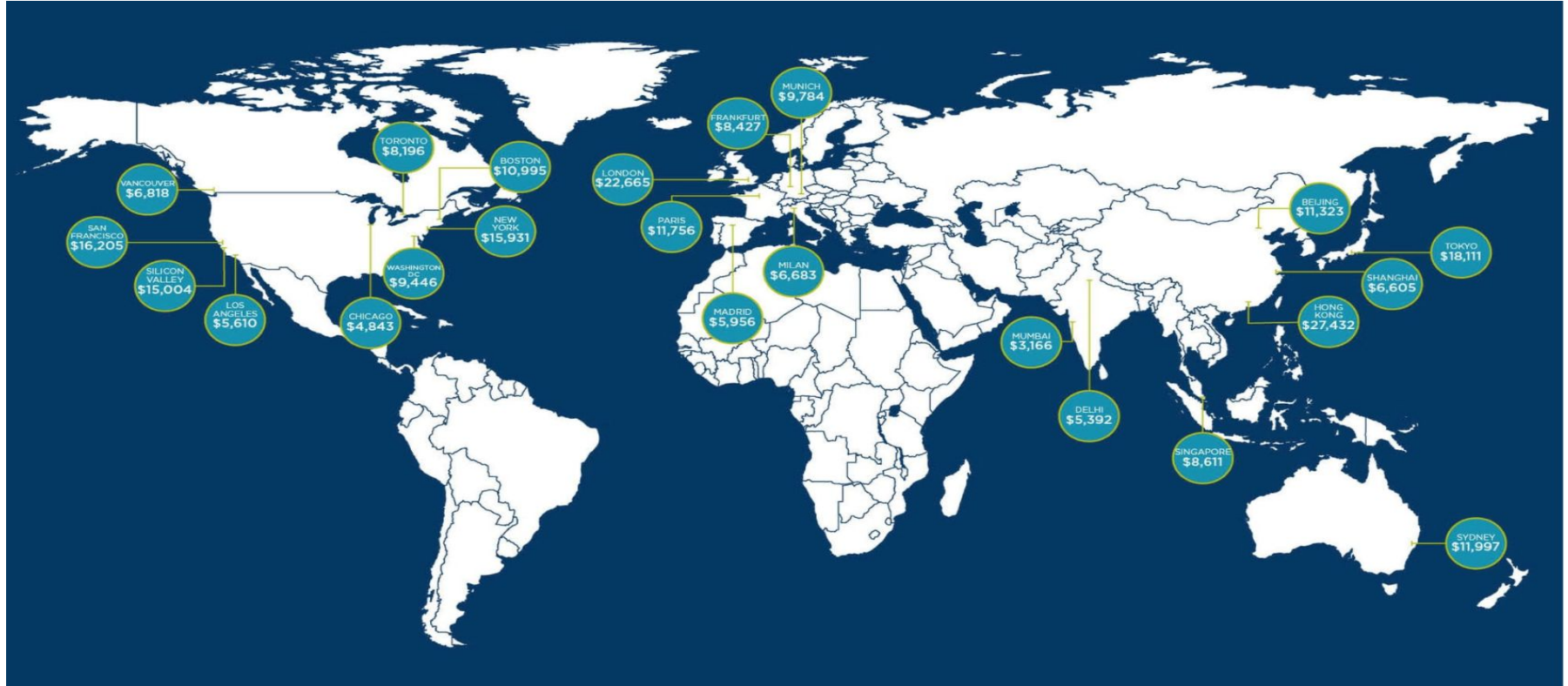# Look at Forecasted Completions

- Consult industry sources, like the Yardi Matrix to focus domestic efforts on residential offerings

Metros	Total Inventory as of 12/17	2018 Forecast Completions	2018 Completions % Change
National—All Markets	12,987,933	360,000	2.8%
Dallas	704,191	22,158	3.1%
Manhattan	543,945	21,768	4.0%
Denver	246,296	15,661	6.4%
Houston	623,369	14,334	2.3%
Miami	270,823	13,483	5.0%
Los Angeles	407,785	12,472	3.1%
Seattle	291,315	12,362	4.2%
Washington	505,144	11,249	2.2%
Atlanta	422,154	10,231	2.4%
San Antonio	185,509	9,385	5.1%
Austin	215,380	8,603	4.0%
Charlotte	160,683	8,165	5.1%
Chicago	328,954	8,018	2.4%
Nashville	122,069	7,562	6.2%
Phoenix	292,137	7,495	2.6%
Tampa	203,714	7,291	3.6%
Twin Cities	197,209	6,888	3.5%
Boston	213,065	6,887	3.2%
Orlando	201,532	6,450	3.2%
San Francisco	246,554	5,893	2.4%

Source: Yardi Matrix

Finding More Customers: Most expensive int'l cities

VANCOUVER $6,818 · SAN FRANCISCO $16,205 · SILICON VALLEY $15,004 · LOS ANGELES $5,610 · TORONTO $8,196 · BOSTON $10,995 · WASHINGTON DC $9,446 · CHICAGO $4,843 · NEW YORK $15,931 · LONDON $22,665 · PARIS $11,756 · FRANKFURT $8,427 · MUNICH $9,784 · MADRID $5,956 · MILAN $6,683 · MUMBAI $3,166 · DELHI $5,392 · BEIJING $11,323 · SHANGHAI $6,605 · TOKYO $18,111 · HONG KONG $27,432 · SINGAPORE $8,611 · SYDNEY $11,997

Occupancy costs (USD per workstation, 2017)

Most Expensive Commercial Rents Worldwide

HONG KONG: ($27,432)

LONDON WEST END: ($22,665)
TOKYO: ($18,111)
FAIRFIELD COUNTY: ($17,414)
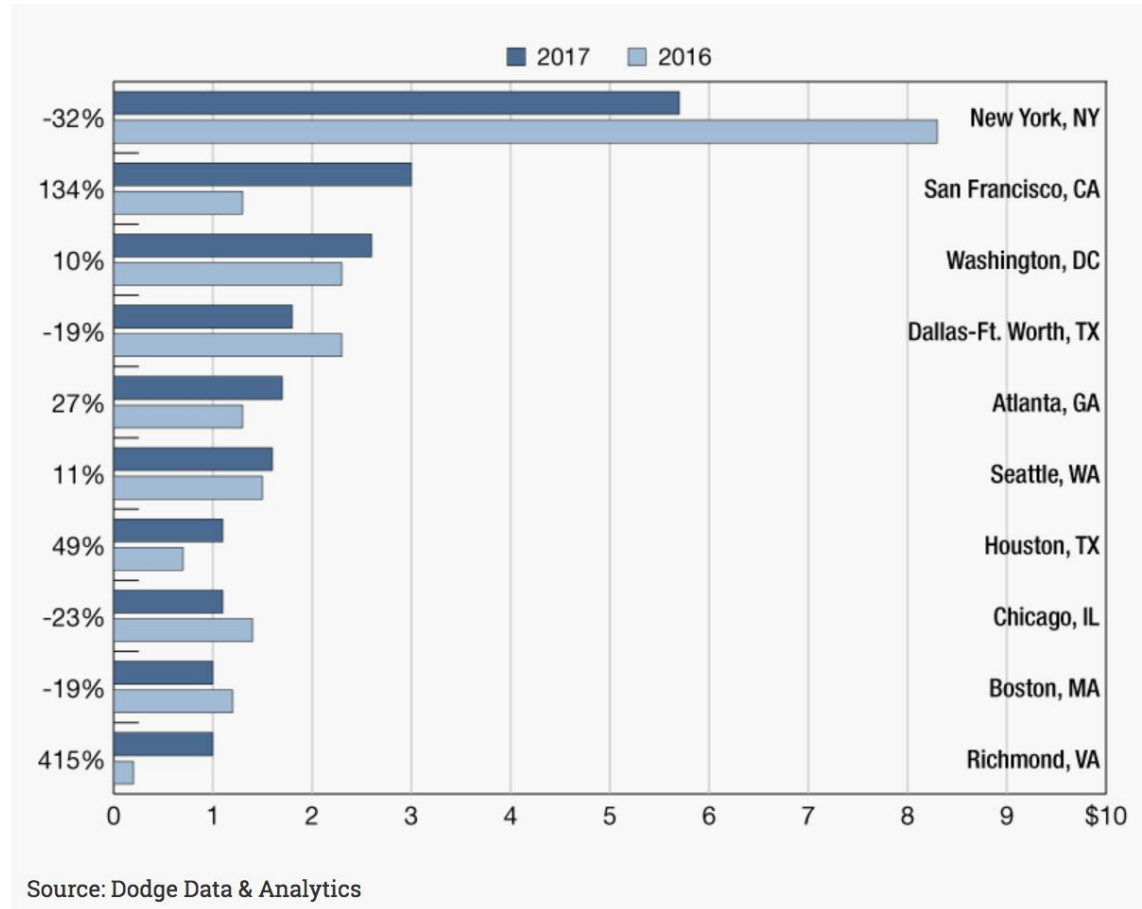SAN FRANCISCO: ($16,205)
NEW YORK: ($15,931)
SILICON VALLEY: ($15,004)
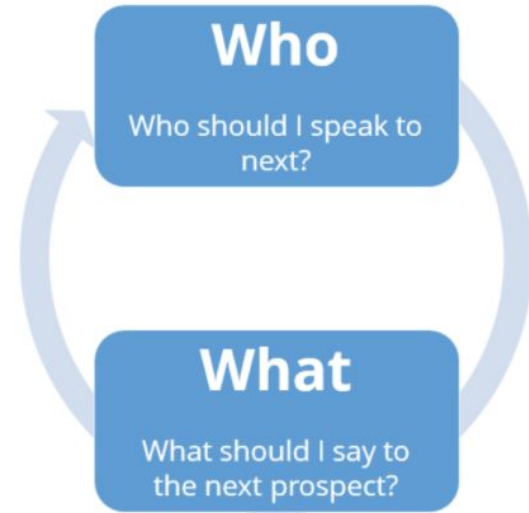GENEVA: ($13,424)
SYDNEY: ($11,997)
PARIS: ($11,756)

Focus commercial efforts in cities with most "construction starts"

OFFICE BUILDING CONSTRUCTION STARTS; $ IN BILLIONS

Legend: ■ 2017 ■ 2016

City	%
New York, NY	-32%
San Francisco, CA	134%
Washington, DC	10%
Dallas-Ft. Worth, TX	-19%
Atlanta, GA	27%
Seattle, WA	11%
Houston, TX	49%
Chicago, IL	-23%
Boston, MA	-19%
Richmond, VA	415%

Source: Dodge Data & Analytics

CUSTOMERS PERSONAS

So, who are the best prospects that will close?

Potential deals
Step 1
2
3
4
5
6
7
8
Deals closed

Time
Start

End

Number of customers
High

Low

Confidence
Low

High

Who
Who should I speak to next?

What
What should I say to the next prospect?
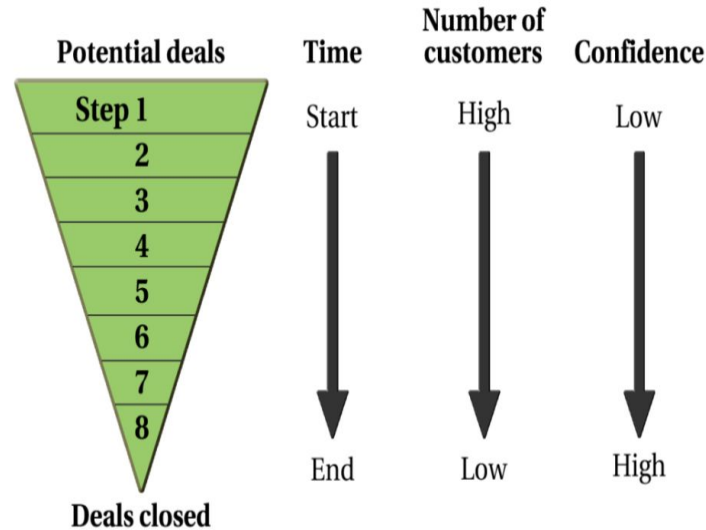
Dev L. Loper

Age: Timeless

Country: UK, Hong Kong, US, and rest of top 10 commercial development nations

Occupation: President of commercial development company

Leasy McAgentcy & MultiFamily McGee

Country/City: City with major mass transit system

Occupation: Multifamily development group owner

Company size: Top 10

Industry: Real estate development

Conclusions

- **When it comes to predicting opportunities that will close . . .** proximity to TransitScreens and mass transit are the best predictors of successful sales

- Focus on large commercial and residential development groups

Challenges and Recommendations

-Include open dates for leads so we can we can track the length of time to close

-Better data hygiene and standardization in data collection

-Include indicator for residential vs commercial leads and opportunities