Toronto Apartment Prices

by Bailey Duncan

Guiding Questions

Can we predict a Toronto apartment's rental price by knowing the businesses around it?

What makes one apartment more valuable than another with the same number of rooms?

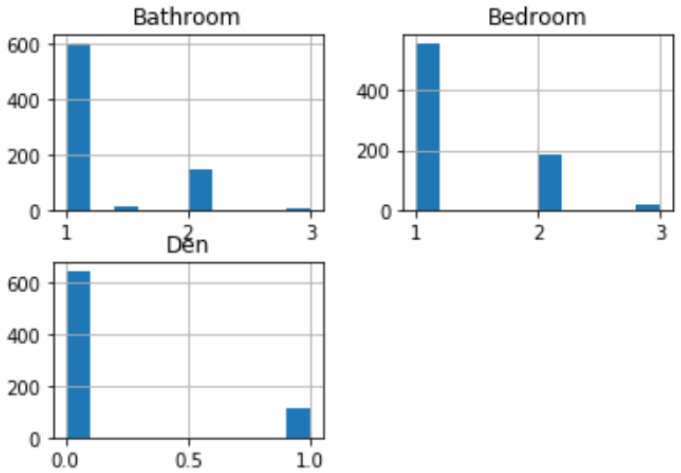
Data

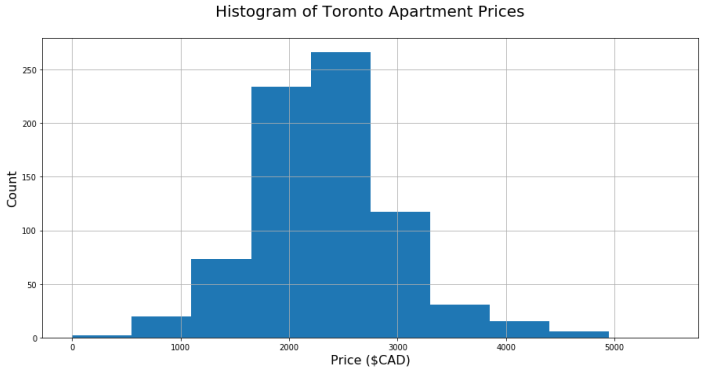
- Toronto Apartment Data from Kaggle:

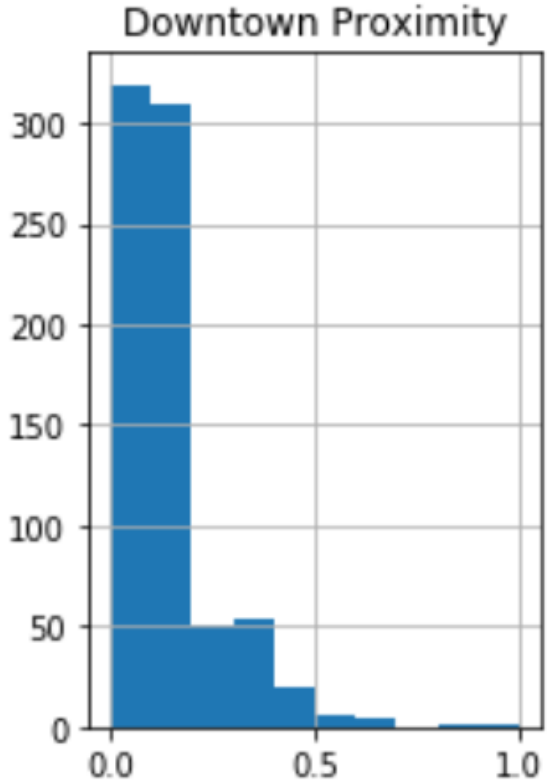
	Bedroom	Bathroom	Den	Address	Lat	Long	Price
0	2	2.0	0	3985 Grand Park Drive, 3985 Grand Park Dr, Mis...	43.581639	-79.648193	$2,450.00
1	1	1.0	1	361 Front St W, Toronto, ON M5V 3R5, Canada	43.643051	-79.391643	$2,150.00
2	1	1.0	0	89 McGill Street, Toronto, ON, M5B 0B1	43.660605	-79.378635	$1,950.00
3	2	2.0	0	10 York Street, Toronto, ON, M5J 0E1	43.641087	-79.381405	$2,900.00
4	1	1.0	0	80 St Patrick St, Toronto, ON M5T 2X6, Canada	43.652487	-79.389622	$1,800.00

- Nearby Venues for each Apartment from FourSquare API

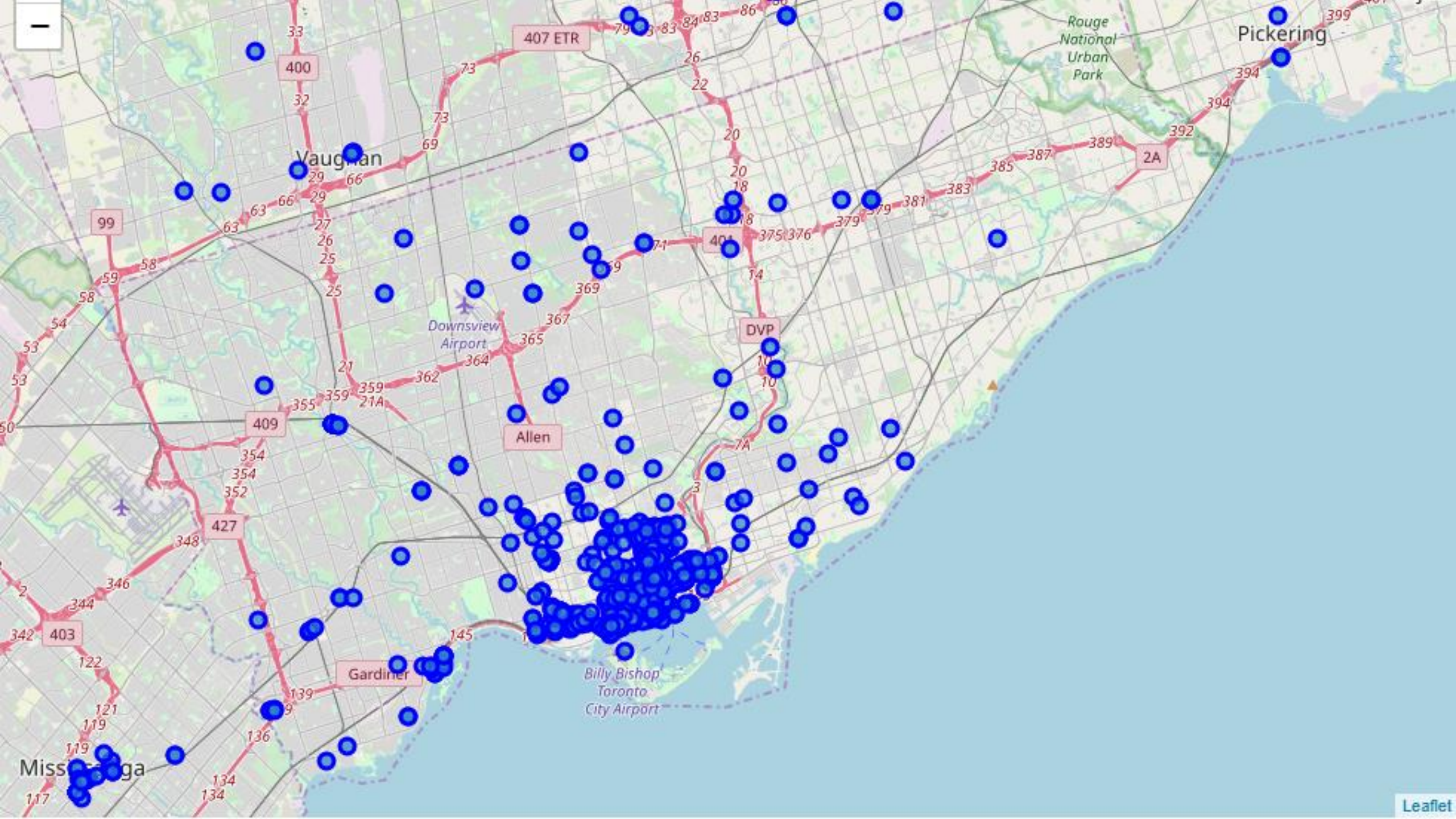
	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Downtown Toronto	43.643051	-79.391643	The Second City	43.645633	-79.391225	Comedy Club
1	Downtown Toronto	43.643051	-79.391643	WestJet Flight Deck	43.641038	-79.389092	Baseball Stadium
2	Downtown Toronto	43.643051	-79.391643	Akira Back	43.645376	-79.392063	Japanese Restaurant
3	Downtown Toronto	43.643051	-79.391643	Sky Pod	43.642561	-79.387038	Scenic Lookout
4	Downtown Toronto	43.643051	-79.391643	CN Tower	43.642536	-79.387182	Monument / Landmark







Exploring the Kaggle Data


Vaughan
Pickering
Rouge National Urban Park
Downsview Airport
Allen
DVP
Gardiner
Billy Bishop Toronto City Airport
407 ETR
400
404
2A
99
409
427
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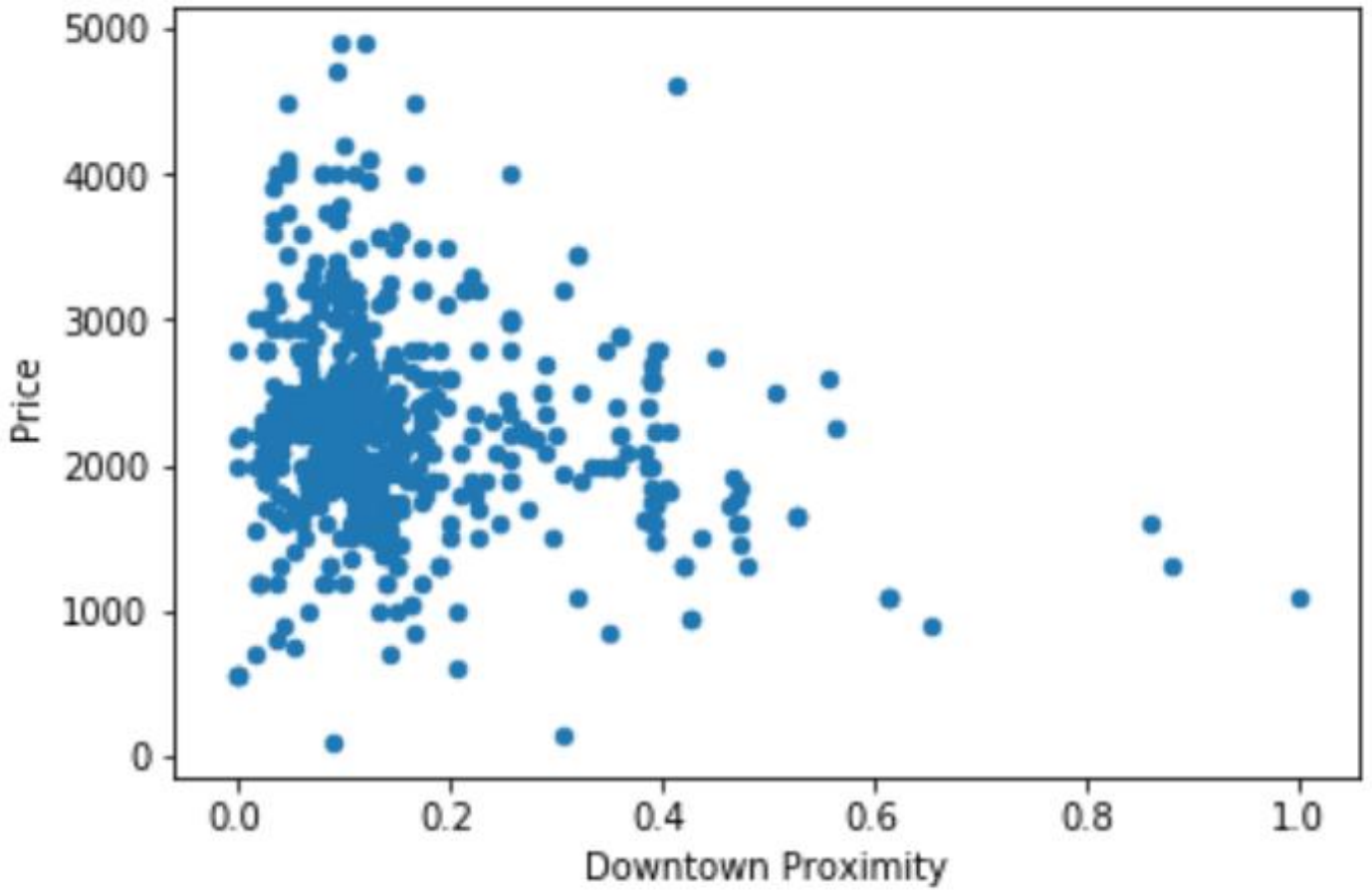
Leaflet

Downtown Proximity vs. Price

- Looking for good indicators of **apartment price**
- No linear trend we can see
- Very hard to differentiate data points close to downtown

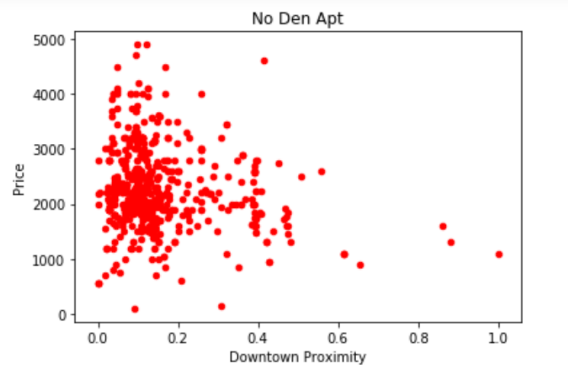


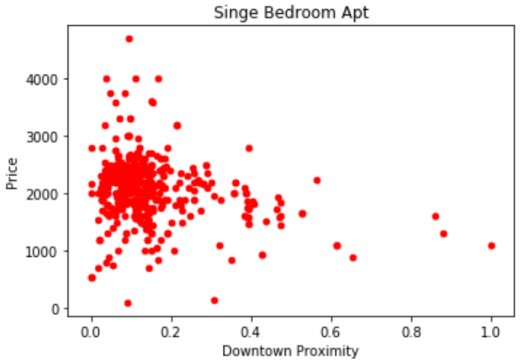
Introducing our Room Information

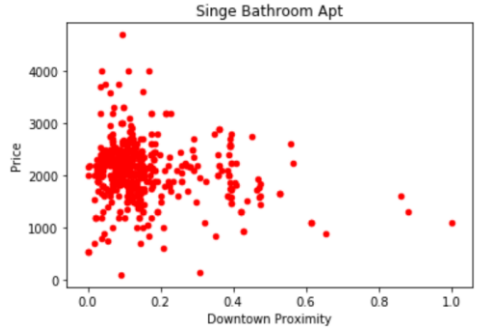
- Even introducing the number of bathrooms, bedrooms, and dens doesn't give a clear trend in downtown!

- This means we will need to introduce additional data to predict the price of an apartment in downtown Toronto

- We will use the nearby venues from the FourSquare API in addition to this data to try and predict the price



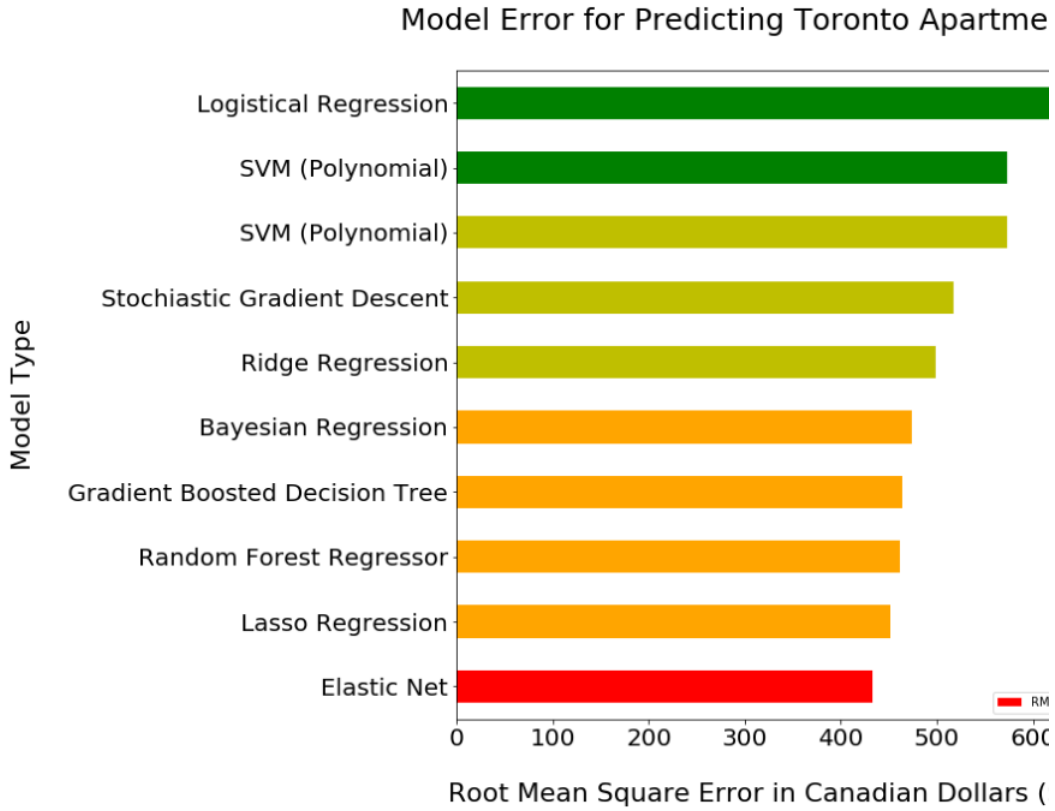




Benchmarking Machine Learning Models

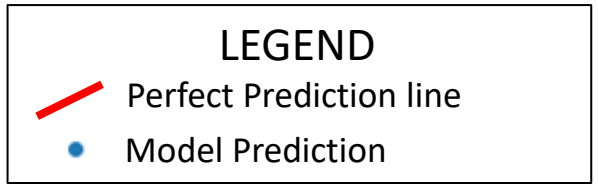
- Split the data into 3 sets: 60% **Train**, 20% **Test**, 20% **Validation**
- We'll feed the nearby businesses and apartment information into different models
- Each **regression model** will be used with little hyperparameter tuning
- They will be evaluated by comparing the Root Mean Square Error of the price prediction in Canadian Dollars ($CAD)

	Model	RMSE ($CAD)	R^2:
0	Ridge Regression	499.049896	0.482909
1	Lasso Regression	451.366499	0.577003
2	Elastic Net	432.773497	0.611134
3	Stochiastic Gradient Descent	517.736698	0.443459
4	Bayesian Regression	474.047566	0.533423
5	Logistical Regression	659.668326	0.359477
6	SVM (Polynomial)	572.831299	0.318709
7	SVM (Polynomial)	572.831299	0.318709
8	Gradient Boosted Decision Tree	463.807976	0.553362
9	Random Forest Regressor	461.173953	0.558421

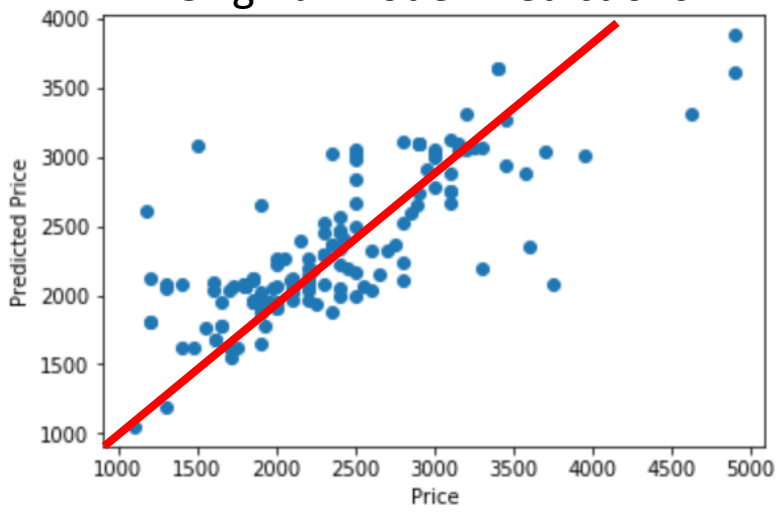


Initial Machine Learning Results

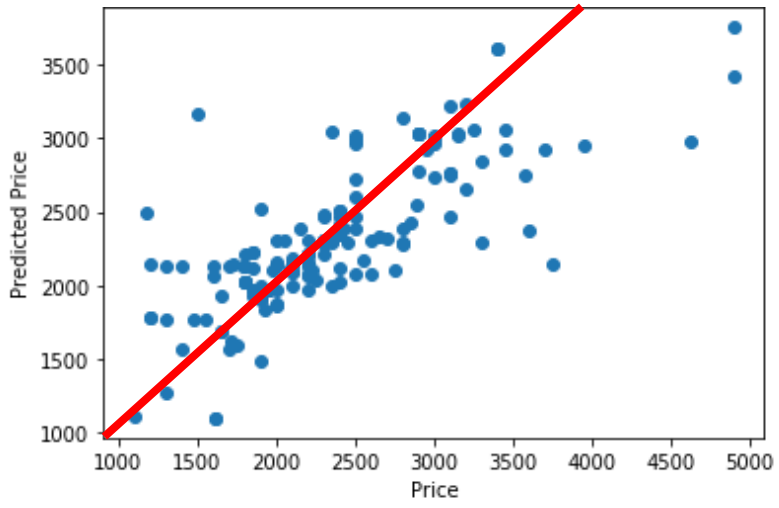
Elastic Net Model performs the best with the lowest error & highest correlation



Original Model Predictions

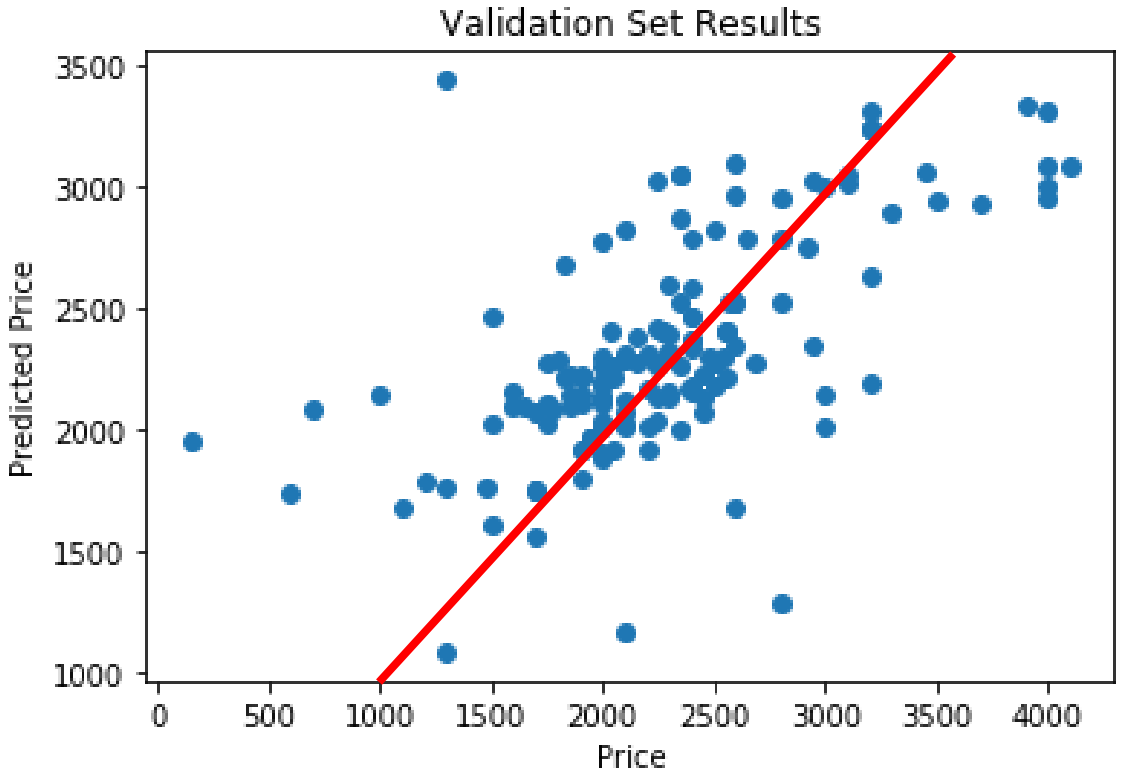


Tuned Model Predictions



Tuned Model Performance

- We tune the hyperparameters of the Elastic Net Model to perform better on the test set
- After tuning we reduce its error on the test set predictions from $432 to $299.
- $132 more accurate on average!

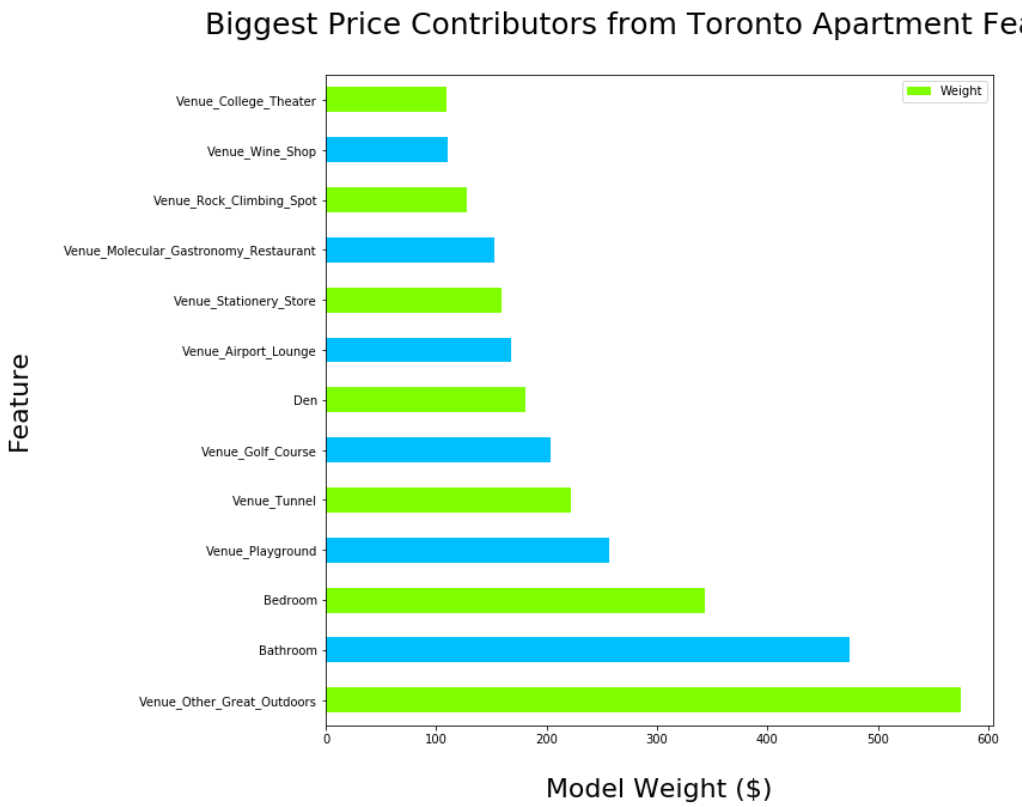


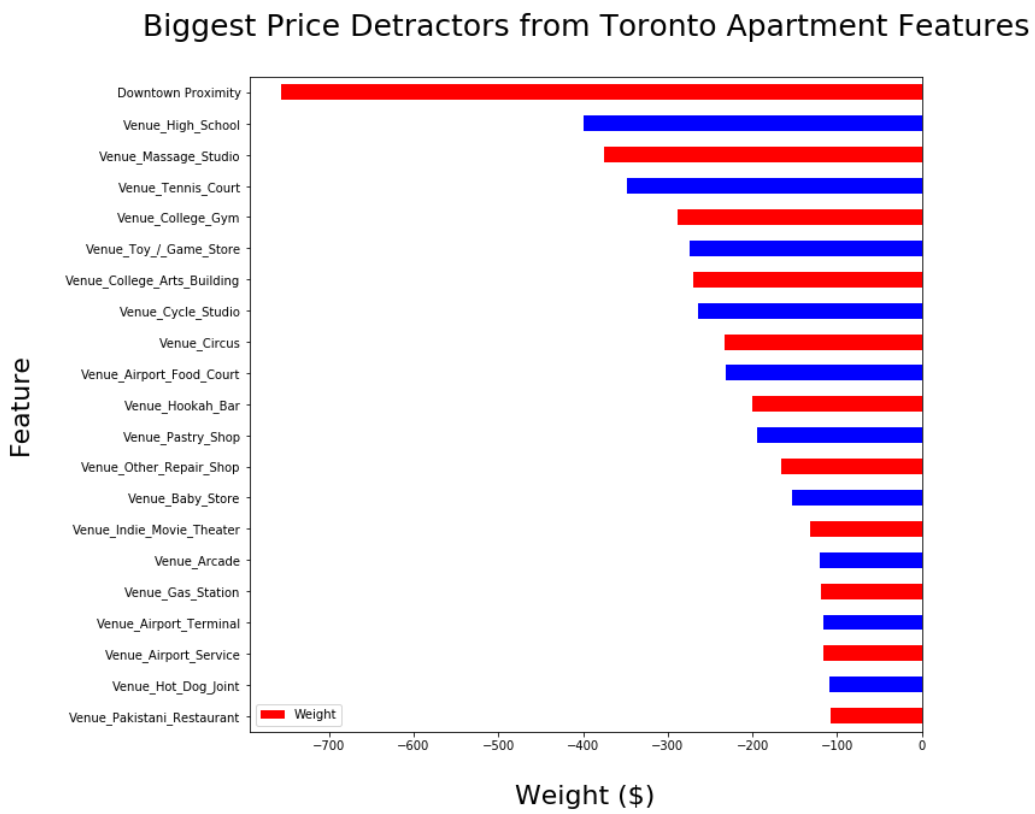
- Root Mean Square Error (RMSE): $341
- Overall Accuracy: 74%
- Test Set Accuracy was 86%

Validation Set Performance

Extracting the Most Important Features

Pull out the most important features from the elastic net





Summary

More Expensive Apartments Have…

- More Dens
- More Bathrooms
- More Bedrooms
- Outdoors Activities Nearby: Parks, Golf, Playgrounds and Rock Climbing
- Wine Stores

Cheaper Apartments Are…

- Far from Downtown
- Close to the Airport
- High Schools, Toy Stores, Game Stores and Arcades Nearby
- Hot Dog Stands
- Massage Studios

Recommendations Based on Results

Apartment Complex Owners can drive prices higher, and make higher demand by investing in amenities in the neighborhood like:

- Green space
- Parks
- Playgrounds
- Outdoor activities

Apartment Tenants can find apartments with similar number of rooms but lower price point by looking:

- further from downtown
- closer to the airport
- Close to high schools
- At Apartments without nearby green space, and parks

Apartment Building Developers should develop in neighborhoods with:

- Lots of parks, nature, outdoor activities
- As close to downtown as possible, but not near the airport
- The units will have the highest price when these conditions are met and they are not surrounded by car mechanics, hot dog stands, high schools, etc.