

TORONTO APARTMENT PRICES

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GUIDING QUESTIONS

1. Can we predict a Toronto apartment's rental price by knowing the businesses around it?
2. What makes one apartment more valuable than another with the same number of rooms?

DATA SOURCE

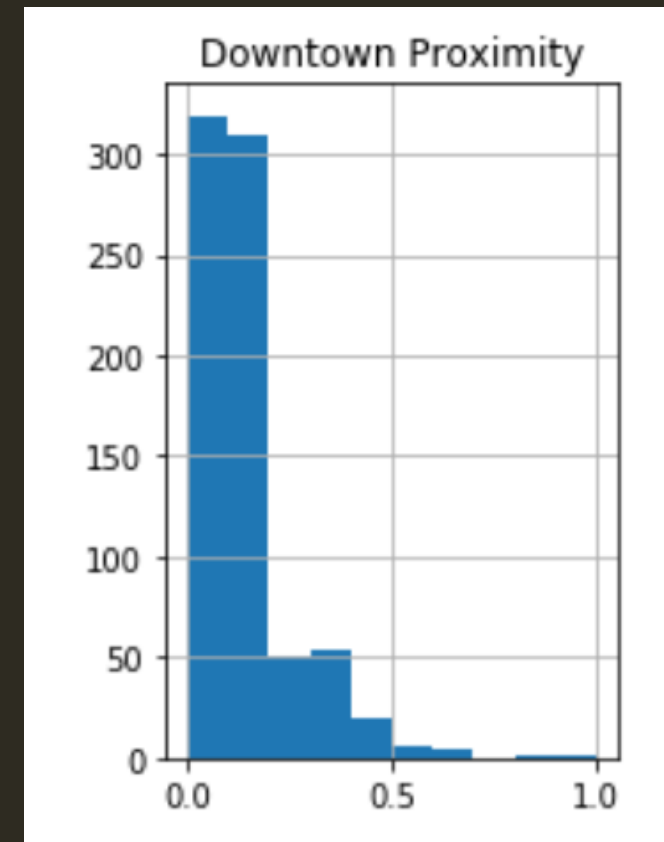
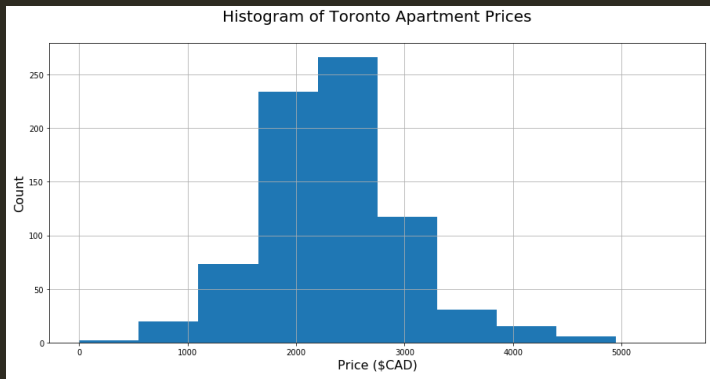
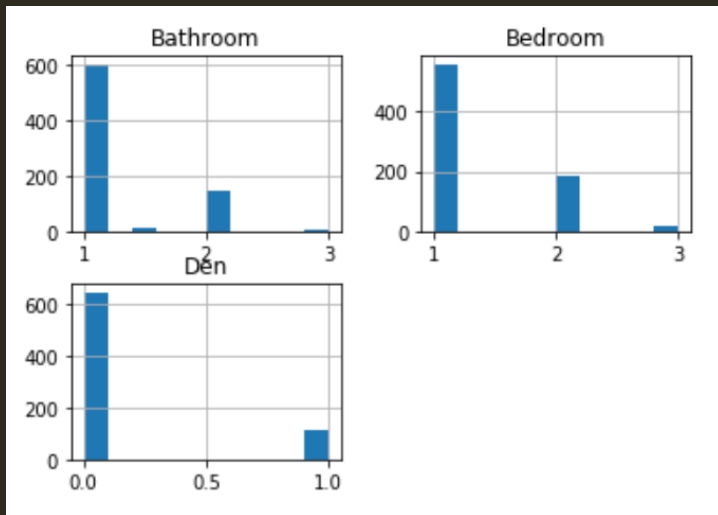
1. Toronto Apartment data from Kaggle

	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

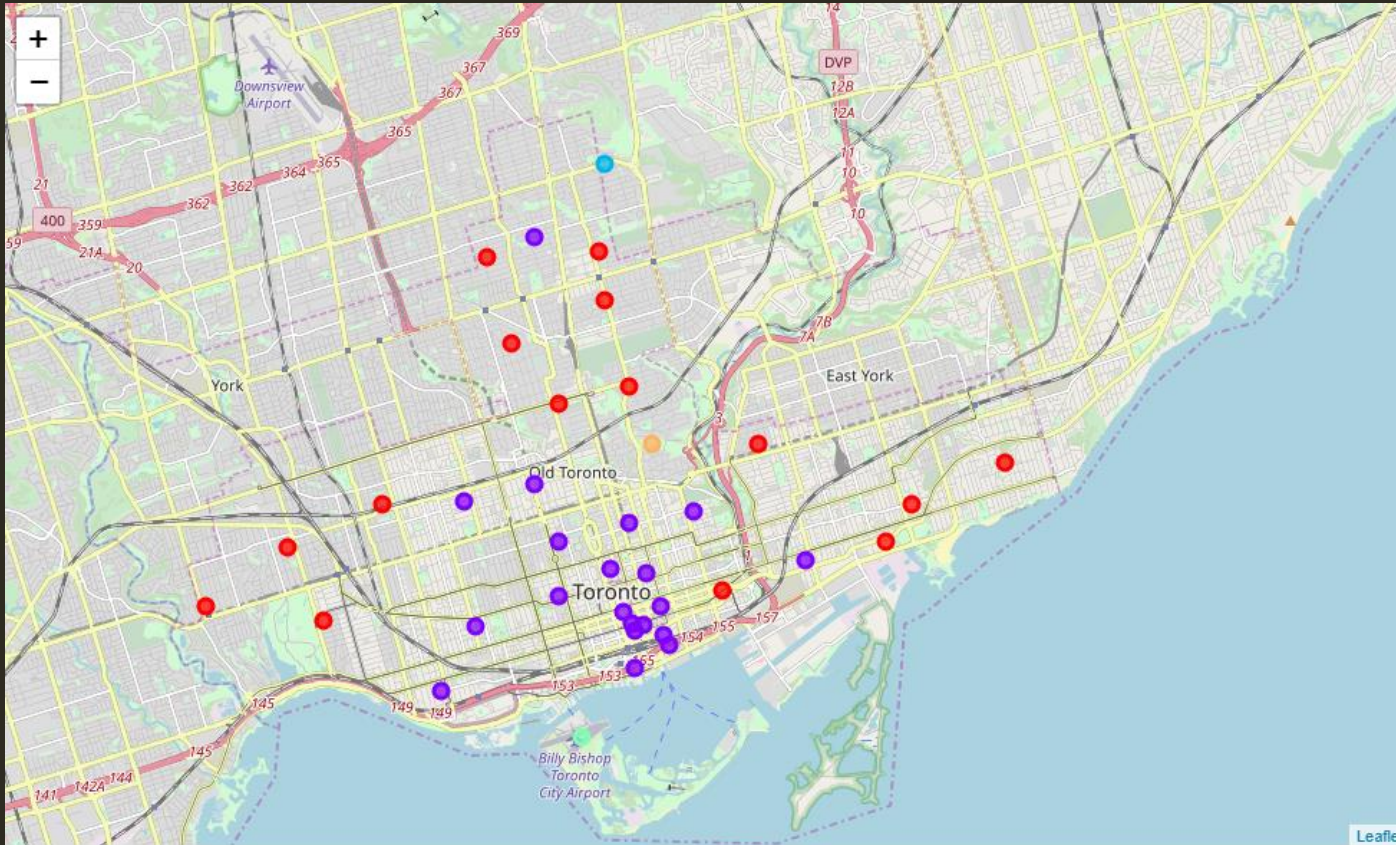
2. Nearby Venue data from Foursquare API

	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 DATA FROM KAGGLE

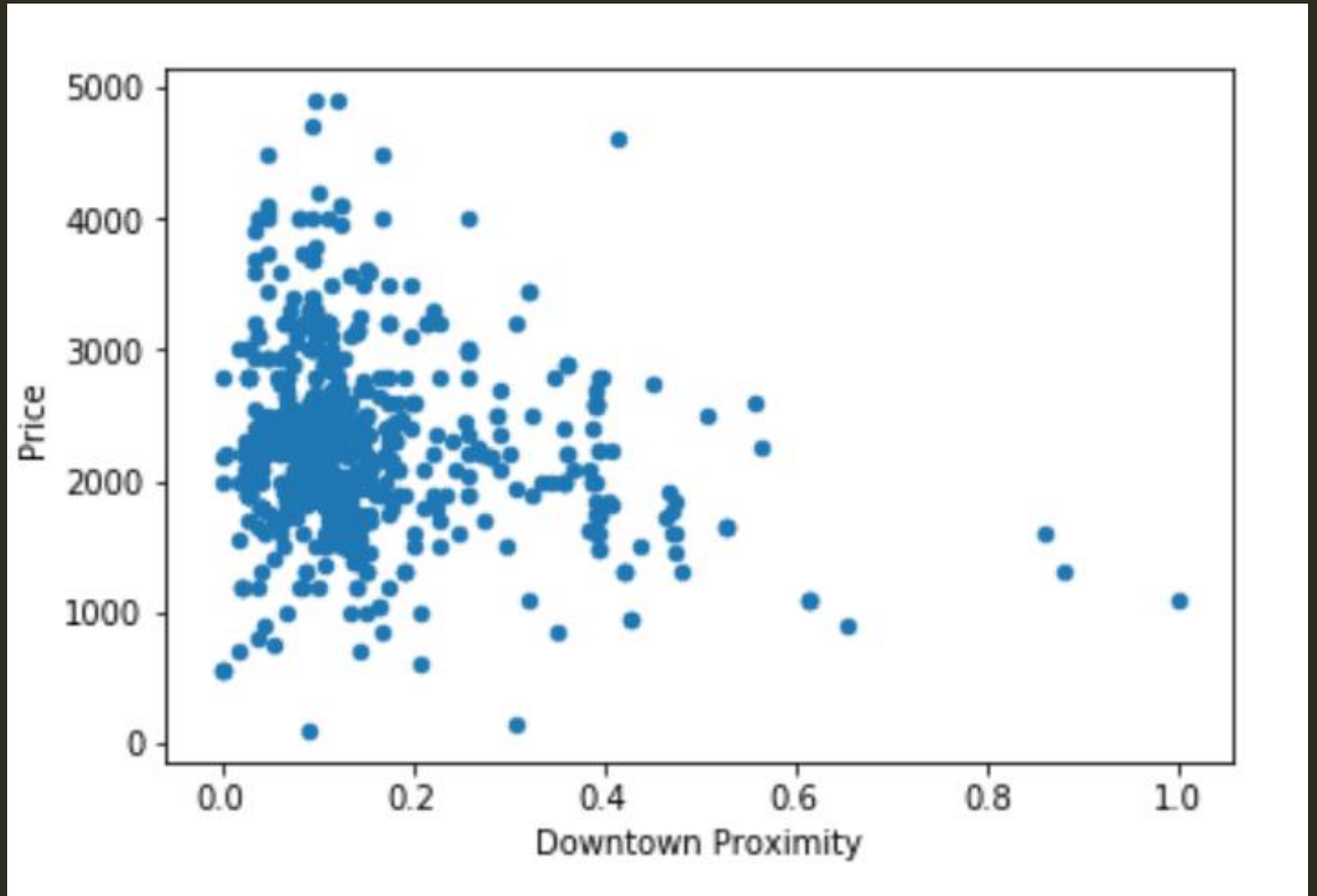


K-MEANS CLUSTERING TORONTO NEIGHBOURHOODS



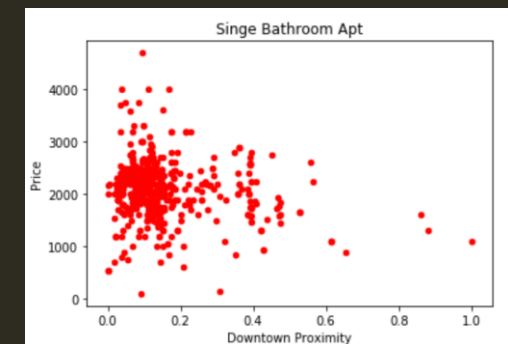
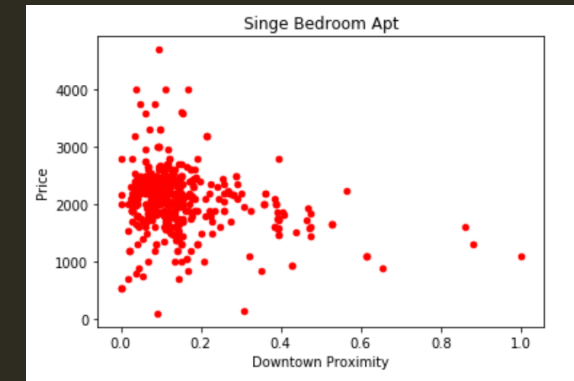
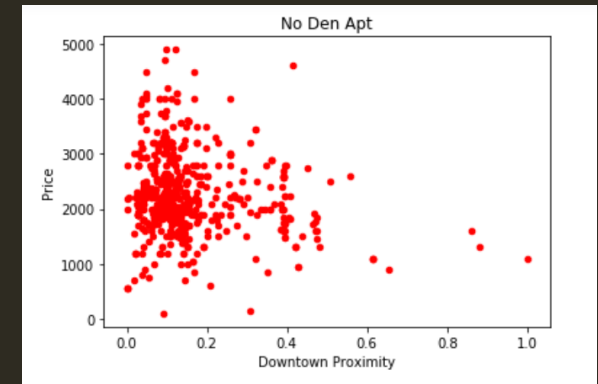
DOWNTOWN PROXIMITY VS. PRICE

1. No or unclear linear trend
2. Very hard to differentiate data points close to downtown
3. Not a very good indicator of apartment price by itself.



ROOM INFORMATION VS PRICE

1. Even introducing the number of bathrooms, bedrooms, and dens doesn't give a clear trend in downtown Toronto Apartment price.
2. Need to introduce additional data to predict the price of an apartment in downtown Toronto
3. Use the nearby venues from the FourSquare API in addition to this data to try and predict the price



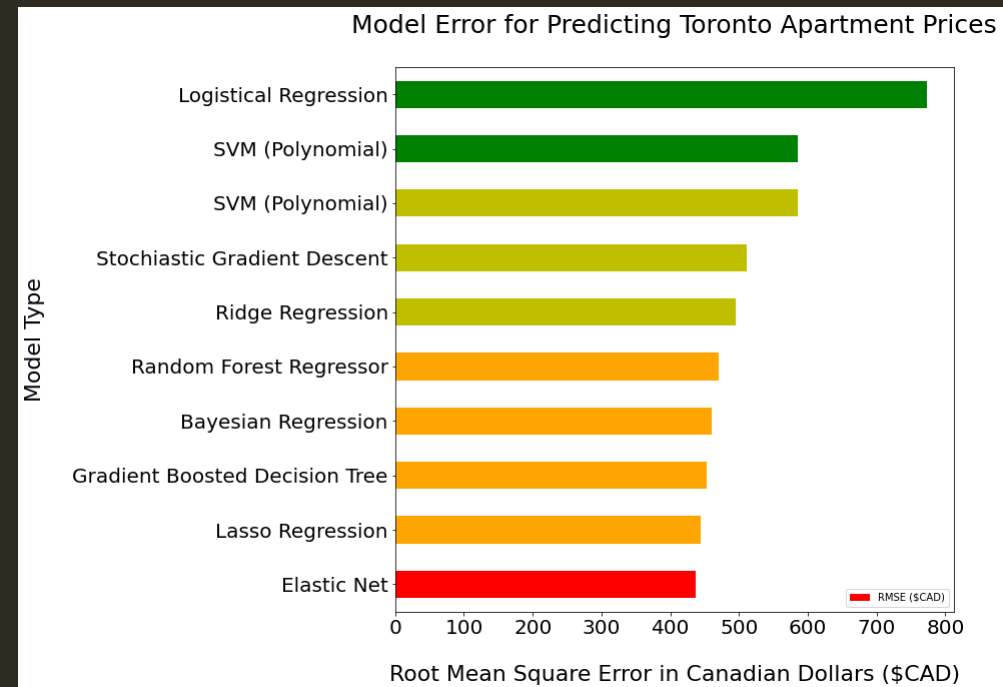
BENCHMARK MACHINE LEARNING MODELS

1. Data is split 60/20/20 - 60% Train, 20% Test, 20% Validation
2. Feed nearby business and apartment information to different model.
3. Perform Hyperparameter tuning.
4. Evaluate models for Root Mean Square Error (RMSE) of price prediction in Canadian dollars (CAD)

INITIAL MACHINE LEARNING RESULTS

Elastic Net model works best with lowest error and highest correlation

	Model	R ² :	RMSE (\$CAD)
0	Ridge Regression	0.489726	495.749341
1	Lasso Regression	0.589330	444.740927
2	Elastic Net	0.603796	436.837514
3	Stochiastic Gradient Descent	0.456028	511.857057
4	Bayesian Regression	0.558986	460.878995
5	Logistical Regression	0.274510	773.433500
6	SVM (Polynomial)	0.288845	585.251440
7	SVM (Polynomial)	0.288845	585.251440
8	Gradient Boosted Decision Tree	0.573604	453.176234
9	Random Forest Regressor	0.540273	470.555195

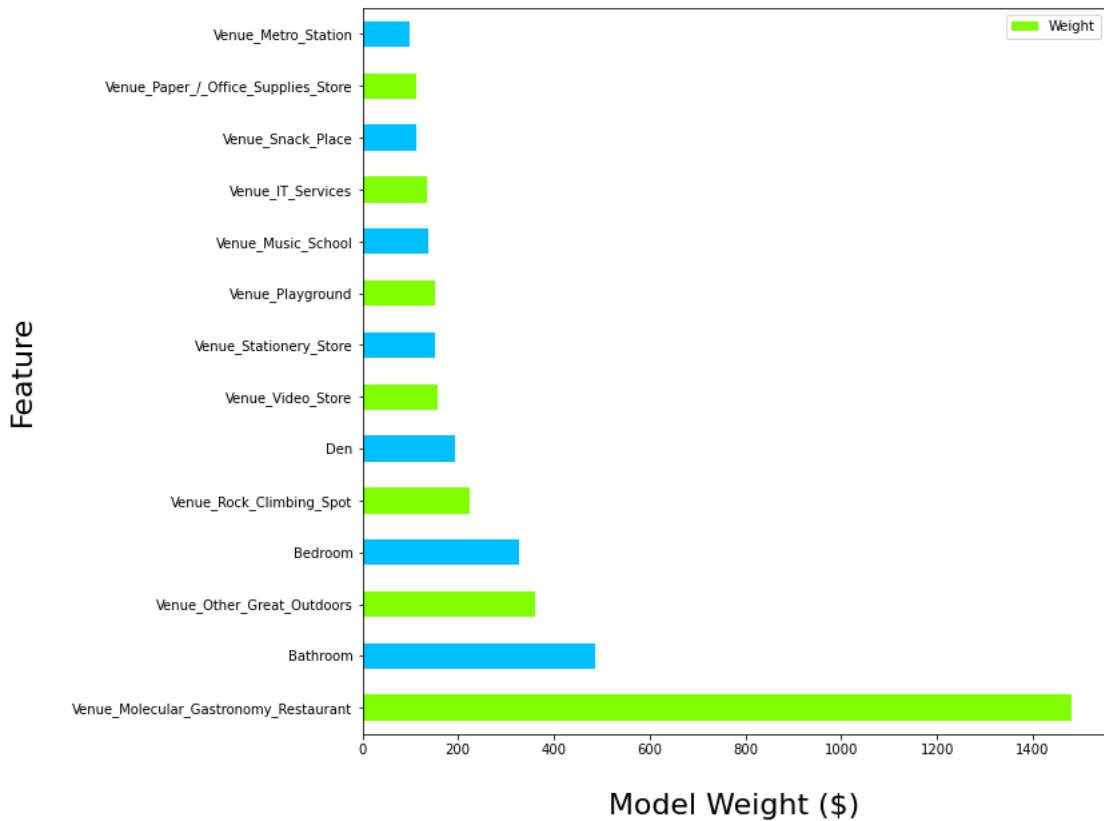


PERFORM MODEL TUNING

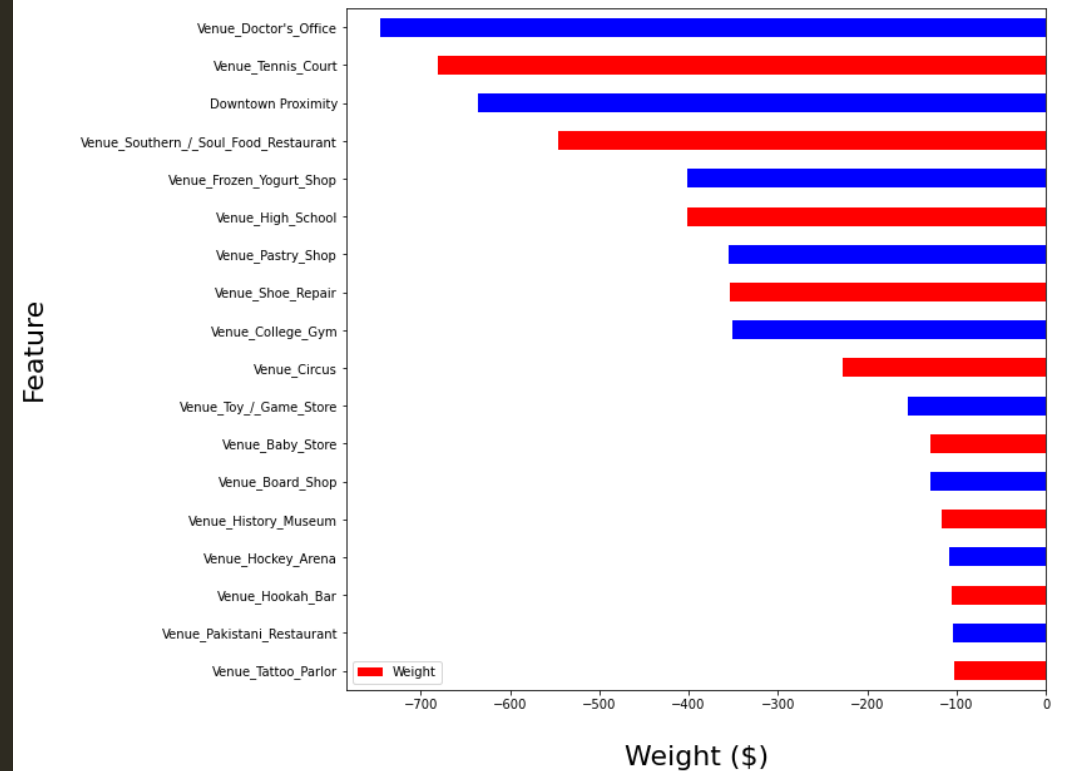
1. We tune the hyperparameters of the Elastic Net Model to perform better on the test set
2. After tuning we reduce its error on the test set predictions from \$436 to \$291.
3. \$145 more accurate on average!

EXTRACT FEATURES

Biggest Price Contributors from Toronto Apartment Features



Biggest Price Detractors from Toronto Apartment Features



SUMMARY

More Expensive Apartments Have...

- More Dens
- More Bathrooms
- More Bedrooms
- Outdoors Activities Nearby: Parks, Golf, Playgrounds and Rock Climbing
- Wine Stores
- Closer to new age restaurants – Molecular Gastronomy

Cheaper Apartments Are...

- Far from Downtown
- High Schools, Toy Stores, Game Stores and Arcades Nearby
- Tattoo Parlors and Hookah Bars
- Ethnic restaurants

RECOMMENDATIONS BASED ON RESULTS

For Apartment Building developers

- Develop apartments in neighborhoods with lots of parks, nature, outdoor activities, and as close to downtown as possible.
- Such units will have the highest price when these conditions are met and they are not surrounded by tattoo parlors, hookah bars and certain ethnic restaurants
- Such units will have the highest price when these conditions are met and they have wine parlors, new style food restaurants (molecular gastronomy), and are close to a doctor's office.

RECOMMENDATIONS BASED ON RESULTS

For Apartment owners

- Prices can be driven higher by investing in more green space, parks, playgrounds, and outdoor activities in the neighborhood.

For Tenants

- Price will be lowest if you live further from downtown.
- Look for apartments close to high schools, or without green space nearby, you can find apartments with a similar number of rooms for a lower rental price.