



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?

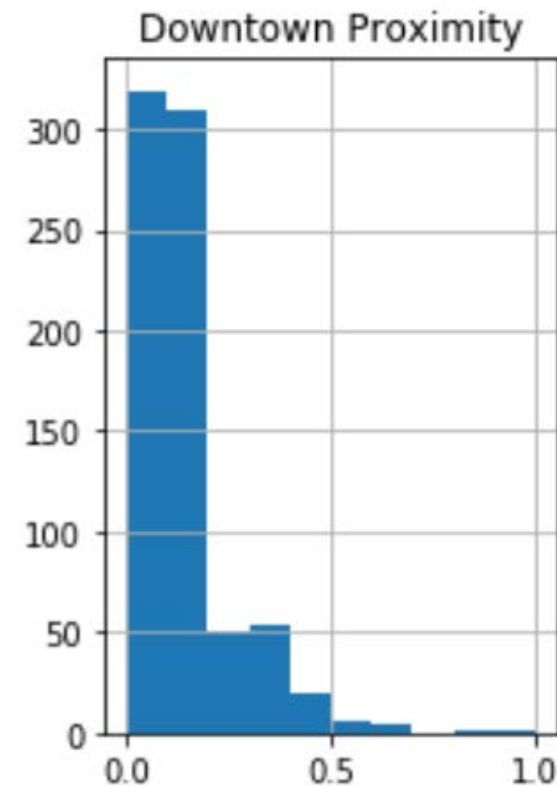
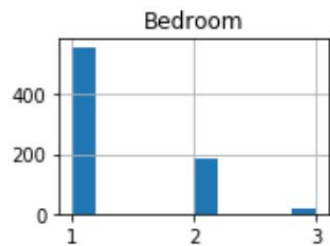
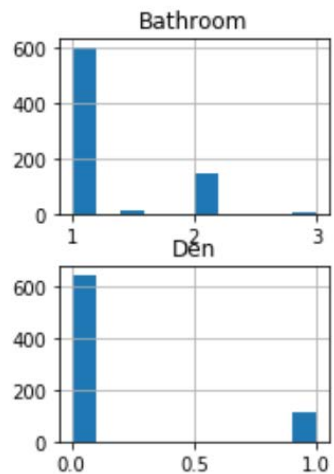
Data

- 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

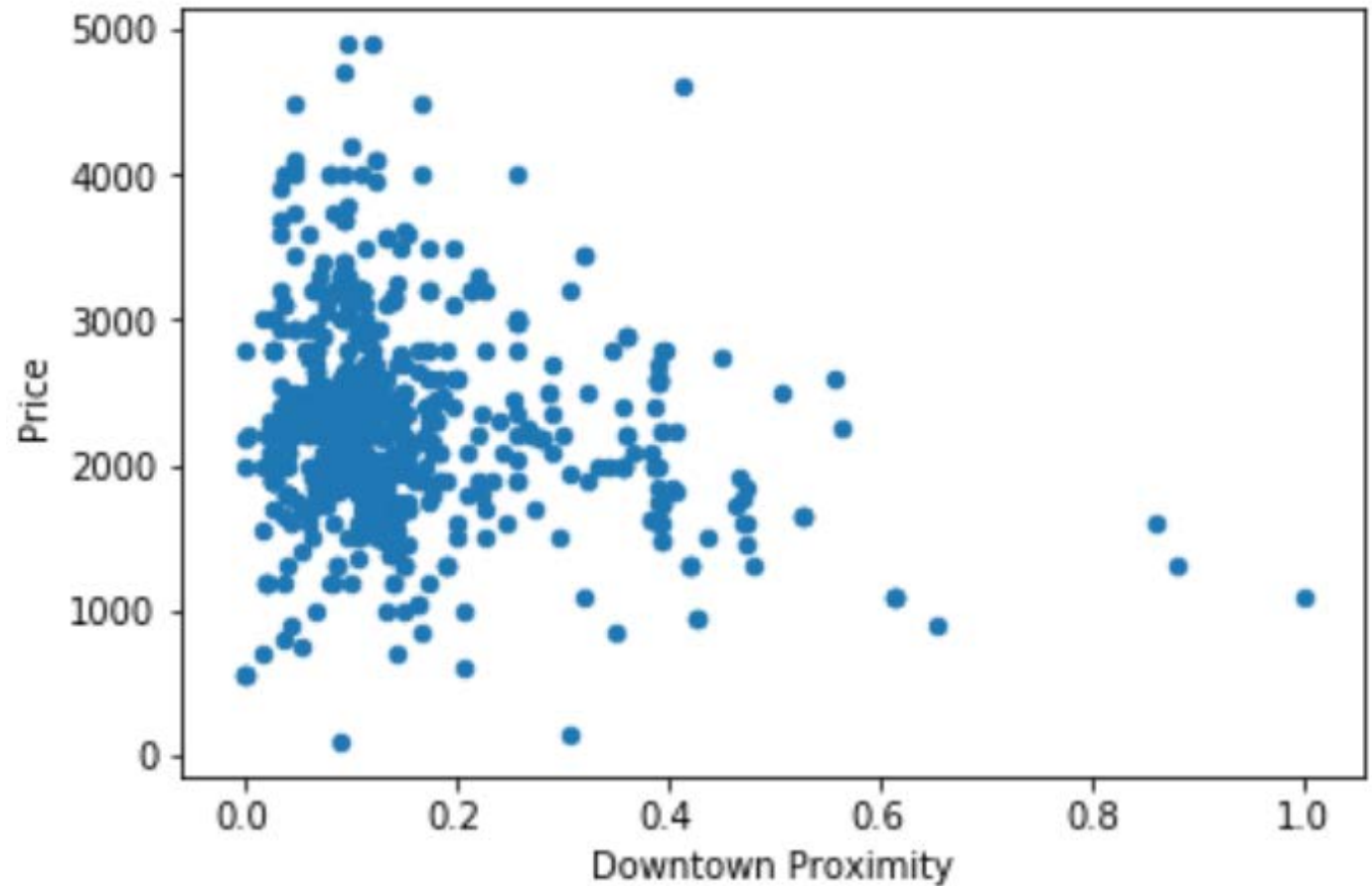
	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Downtown Toronto	43.643051	-79.391643	The Second City	43.645633	-79.391225	Comedy Club
1	Downtown Toronto	43.643051	-79.391643	WestJet Flight Deck	43.641038	-79.389092	Baseball Stadium
2	Downtown 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

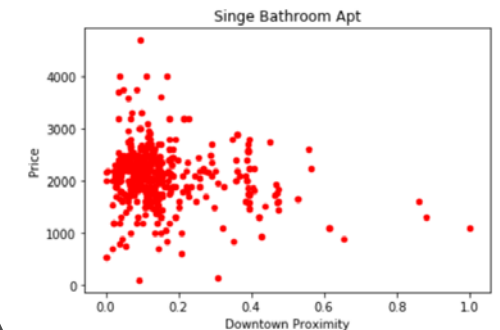
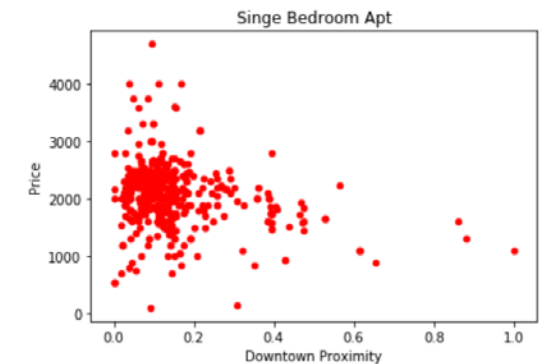
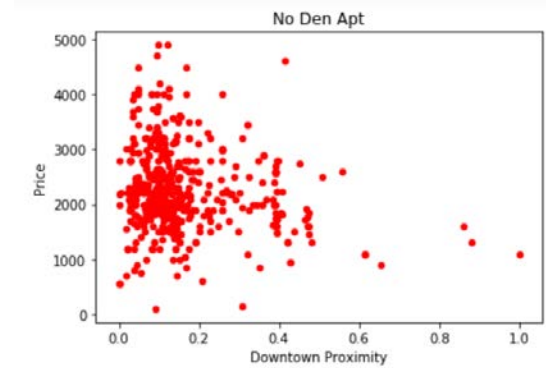
Downtown Proximity vs. Price

- 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

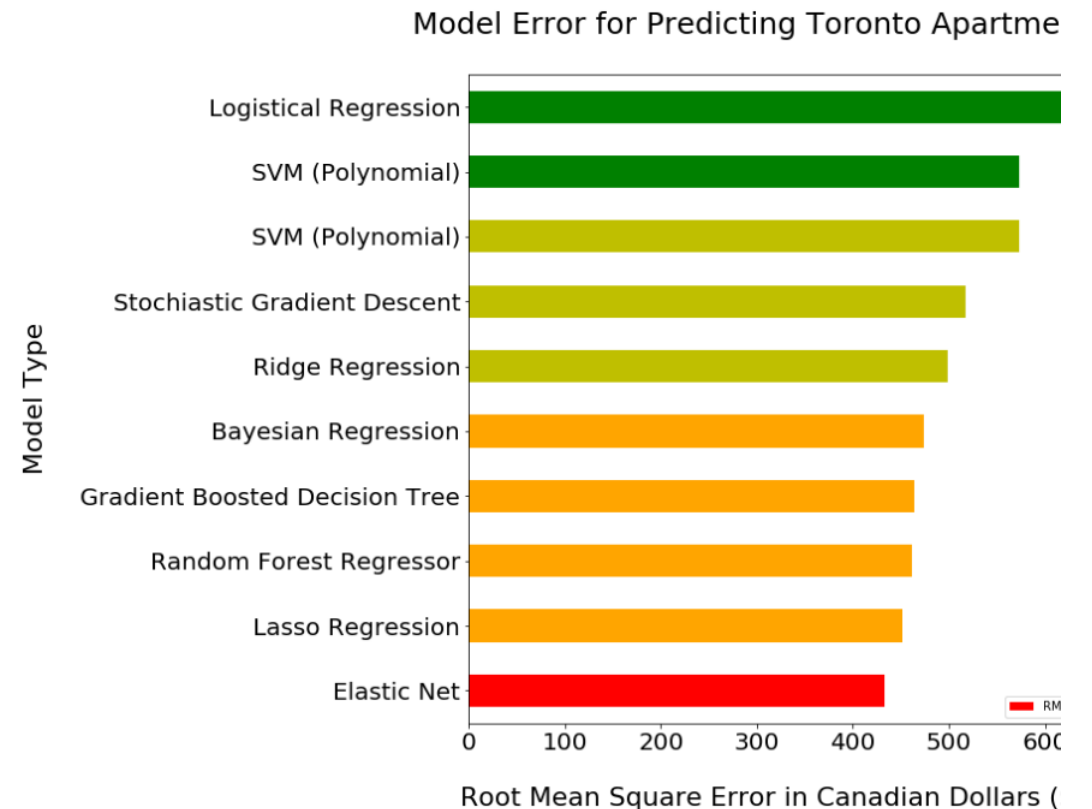




Benchmarking Machine Learning Models

- 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



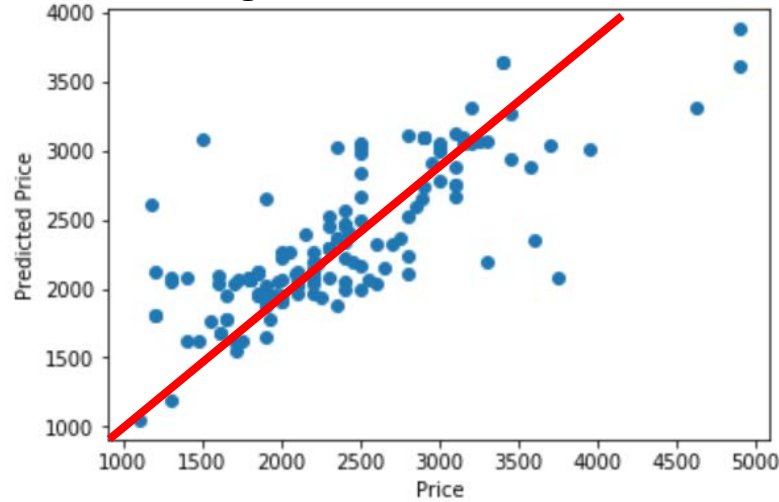
Initial Machine Learning Results

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

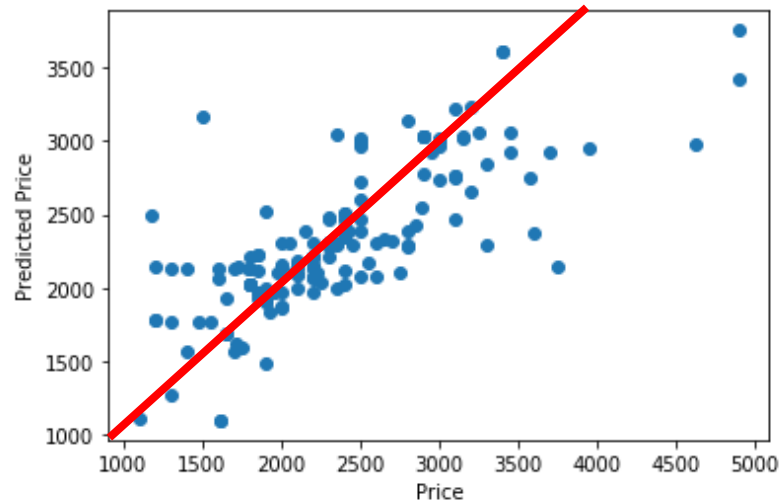
LEGEND

- Perfect Prediction line
- Model Prediction

Original Model Predictions

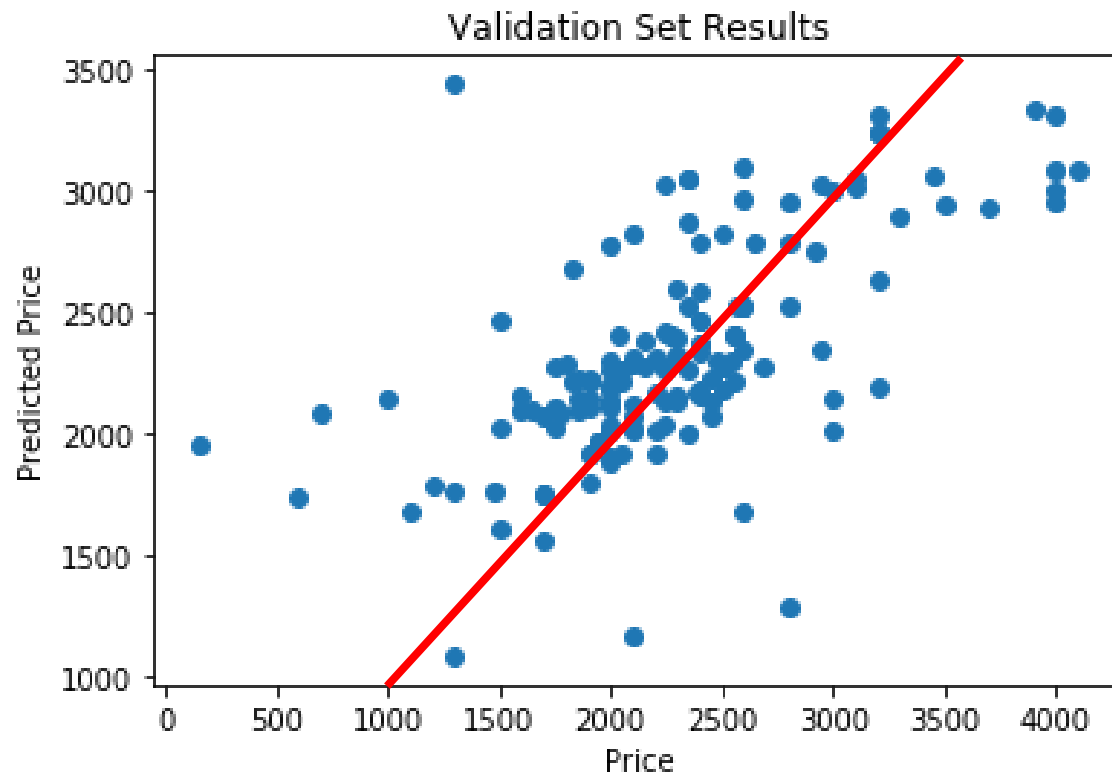


Tuned Model Predictions



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!



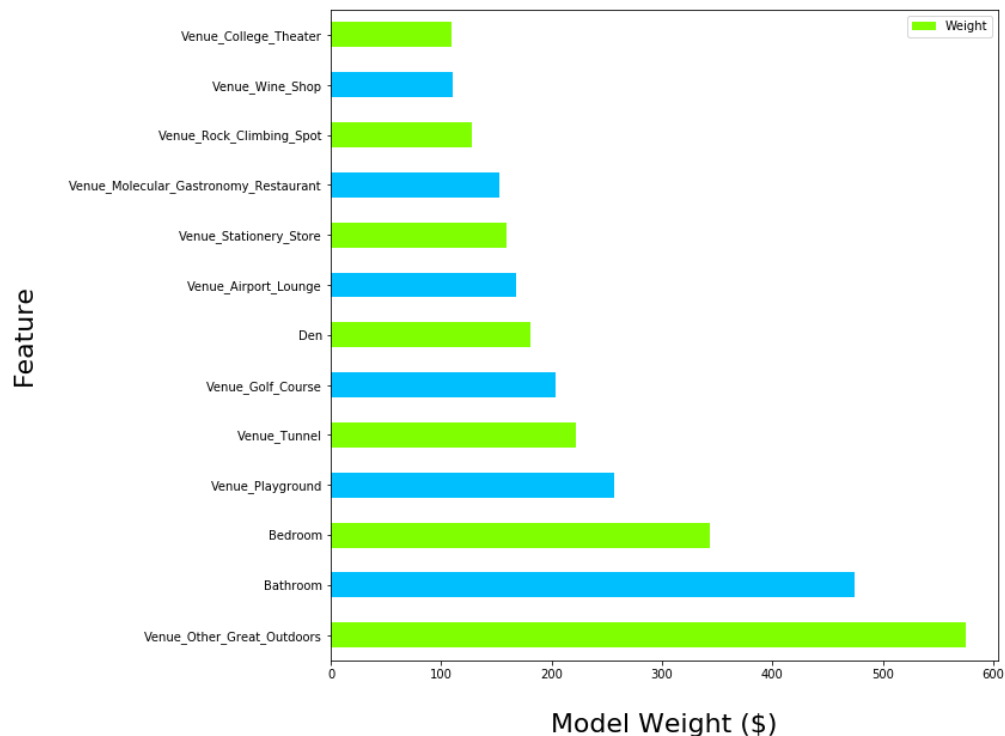
- Root Mean Square Error (RMSE): \$341
- Overall Accuracy: 74%
- Test Set Accuracy was 86%

Validation Set Performance

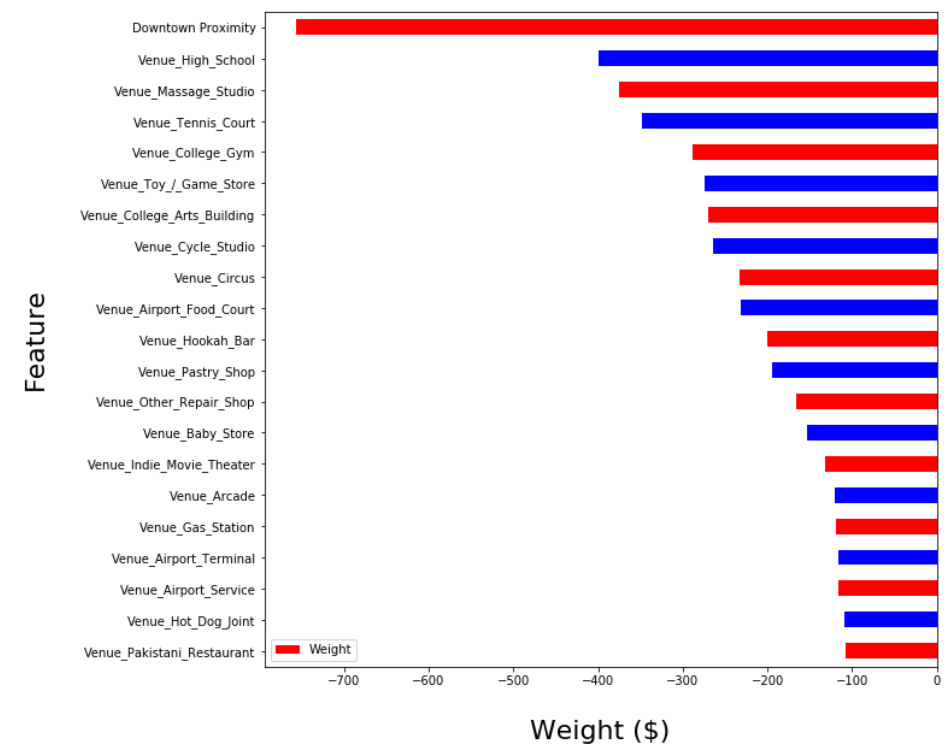
Extracting the Most Important Features

Pull out the most important features from the elastic net

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

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.