**Assessment of relation between pedestrian traffic and popular venues, Toronto**

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## 1. Business Problem

For a city, in order to control traffic flows and manage availability of public transport options and traffic regulation, it is helpful to be able to analyze and predict the flow of pedestrian traffic throughout a city. If there are hotspots where many people gather, certain precautions may be required in order to ensure public safety and / or manage traffic in other forms.

However, it is also good to know how pedestrian traffic changes with the availability of new venues. If, for example, new restaurants or cafés open in an area, how will the amount of foot-traffic change? It would be beneficial for the municipalities to know this upfront in order to account for increases.

That is the business problem this project is concerned with. For the city of Toronto, the pedestrian foot-traffic at peak hours at popular intersections is assessed, combined with information on close-by venues. A model will be extracted to predict foot-traffic based on the type of venues that are closest to the intersections.

The audience for this report is the department of traffic management of the city of Toronto. The insights aim to make better predictions of pedestrian traffic, thus helping with management issues.

## 2. Data

Two data sources are used to conduct this project. They are explained in the following.

*FourSquare Data*
FourSquare is a global location data repository that yields data on locations and venues. It is the foundation for many popular applications, such as uber. Contributions to FourSquare can be made by the general public, ensuring that the database keeps on growing and improving.

The FourSquare data that is used for this project is venue and location data, meaning that for a certain location (provided in latitude and longitude), venues are found that are within a certain radius around this location.
The parameters that need to be set are the radius around the location, the limit of number of venues to be returned, as well as the user specific FourSquare access tokens. All these are converted to a user and problem specific url, which is used to extract the venue data.

The venue data consists of the name of the venue, the location (latitude, longitude), the postal code, the category, the exact address, and information such as whether it is a popular

venue. The data is returned as an object and is unpacked into a dataframe to be able to work with the data. Hereby, the name, venue category and the latitude and longitude are the only parameters considered important. An extract of the returned object is shown.

```
In [22]: results_street_venues_test = requests.get(url).json()
         results_street_venues_test

Out[22]: {'meta': {'code': 200, 'requestId': '609d0082bfd44c277f4778e7'},
          'response': {'suggestedFilters': {'header': 'Tap to show:',
            'filters': [{'name': 'Open now', 'key': 'openNow'}]},
           'headerLocation': 'Financial District',
           'headerFullLocation': 'Financial District, Toronto',
           'headerLocationGranularity': 'neighborhood',
           'totalResults': 195,
           'suggestedBounds': {'ne': {'lat': 43.657653009000015,
             'lng': -79.36785315936936},
            'sw': {'lat': 43.63965299099999, 'lng': -79.39268284063064}},
           'groups': [{'type': 'Recommended Places',
             'name': 'recommended',
             'items': [{'reasons': {'count': 0,
                'items': [{'summary': 'This spot is popular',
                  'type': 'general',
                  'reasonName': 'globalInteractionReason'}]},
               'venue': {'id': '4ad4c05df964a52059f620e3',
                'name': 'Canoe',
                'location': {'address': '66 Wellington St West',
                 'crossStreet': 'at Bay Street',
                 'lat': 43.647452066183476,
                 'lng': -79.38132001815676,
                 'labeledLatLngs': [{'label': 'display',
                   'lat': 43.647452066183476,
                   'lng': -79.38132001815676}],
                'distance': 158,
                'postalCode': 'M5K 1H6',
                'cc': 'CA',
```

Image 1: snippet of FourSquare data export

*Pedestrian volume data*

The data on volume of pedestrians in the city of Toronto can be extracted from an Excel File that can be downloaded from the website of the city of Toronto (https://open.toronto.ca/dataset/traffic-signal-vehicle-and-pedestrian-volumes/). The data contains information on traffic volume at traffic lights from 2018.

The datafile is read into the project notebook and transformed into a dataframe for easier manipulation. The information contained in the data is the main street of the intersection, the first and (if applicable) second side street, the date when the traffic light was activated, the Latitude, the Longitude, the count date of traffic, the peak volume within 8 hours for vehicles and pedestrian separately.

An extract from the data is shown.

```
In [8]: df_data_0.head(10)
```

Out[8]:

| | TCS # | Main | Midblock Route | Side 1 Route | Side 2 Route | Activation Date | Latitude | Longitude | Count Date | 8 Peak Hr Vehicle Volume | 8 Peak Hr Pedestrian Volume |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2 | JARVIS ST | NaN | FRONT ST E | NaN | 11/15/1948 | 43.649418 | -79.371446 | 2017-06-21 | 15662 | 13535 |
| 1 | 3 | KING ST E | NaN | JARVIS ST | NaN | 08/23/1950 | 43.650461 | -79.371924 | 2016-09-17 | 12960 | 7333 |
| 2 | 4 | JARVIS ST | NaN | ADELAIDE ST E | NaN | 09/12/1958 | 43.651534 | -79.372360 | 2016-11-08 | 17770 | 7083 |
| 3 | 5 | JARVIS ST | NaN | RICHMOND ST E | NaN | 04/21/1962 | 43.652718 | -79.372824 | 2015-12-08 | 19678 | 4369 |
| 4 | 6 | JARVIS ST | NaN | QUEEN ST E | NaN | 08/24/1928 | 43.653704 | -79.373238 | 2016-09-17 | 14487 | 3368 |
| 5 | 7 | JARVIS ST | NaN | SHUTER ST | NaN | 11/18/1948 | 43.655357 | -79.373862 | 2016-11-08 | 15846 | 3747 |
| 6 | 8 | JARVIS ST | NaN | DUNDAS ST E | NaN | 06/21/1928 | 43.657052 | -79.374531 | 2017-06-27 | 17835 | 5858 |
| 7 | 9 | JARVIS ST | NaN | GERRARD ST E | NaN | 07/14/1941 | 43.660432 | -79.375854 | 2016-11-01 | 18196 | 6493 |
| 8 | 10 | JARVIS ST | NaN | CARLTON ST | NaN | 06/28/1928 | 43.662420 | -79.376708 | 2017-01-21 | 14222 | 6165 |
| 9 | 11 | JARVIS ST | NaN | WELLESLEY | NaN | [illegible] | [illegible] | [illegible] | 2016- | [illegible] | [illegible] |

Image 2: Pedestrian volume as extracted from Toronto data file