

**Compare and Contrast Two Cities
(Manhattan, NY, and Downtown Toronto)**

To Assist Foreign Travelers

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PROBLEM & BACKGROUND

Downtown Toronto Canada and Manhattan New York USA are considered two major tourist spots with lots of multicultural venues. Both are considered financial hubs and with many restaurants, coffee shops, theaters, and other attractions such as CN Tower in Toronto. It will be interesting to compare the different venues such as restaurants, hotel accommodations, tourist attractions such as Broadway shows and many other Tourist spots.

Number of Tourists from various parts of the world (Australia, Europe, Asia) when they visit different cities in different countries, they wanted to see different attractions, different food and so forth. They would not like to spend time and money on two different cities for similar experience. Hence, a comparison of Downtown Toronto and Manhattan New York will be valuable for tourist who are travelling from far away so that they can enjoy best of both and feel happy that their time and money are spent wisely.

DATA DESCRIPTION

We have explored Manhattan venues in Week3 module hands on lab using Foursquare API. In addition, through the peer graded assignment for Week3, we analyzed Downtown Toronto using Foursquare API as well. Hence, we have obtained Data frames for both Downtown Toronto and Manhattan New York. From the Jupyter notebook for Toronto and Manhattan. Exported these files to CSV files and named them **DT_Toronto.csv** and **Manhattan_NY.csv**.

METHODOLOGY

Using the CSV files mentioned in the Data description: DT_Toronto.csv and Manhattan_NY.csv which has the names of the neighborhood (Borough) and location information (latitude and longitude) and used the geolocator library and Folium map to display the neighborhood of Manhattan and Downtown Toronto. This is to analyze the number of Boroughs and how far are they to each other.

Using the function getNearbyVenues and foursquare API to explore the locations of Boroughs and Venues within 1000 meters radius from the location of Manhattan and Downtown Toronto. First, the venues for Manhattan were explored. Using groupby, count, and nlargest functions to display the first 50 venues in descending order (based on total number of venues). Similarly, explored and displayed the first 50 venues in descending order for Downtown Toronto. After that, created a Data Frame to capture the venues and the counts to compare Manhattan and Downtown Toronto. Exported the data to a csv file named: **Venu_Comparison.csv**. This csv file provided the necessary comparison data between Manhattan and Downtown Toronto.

RESULTS

Map of the Boroughs for Manhattan:

2. Read CSV file for Manhattan obtained from Module3 and display Manhattan map

```
In [183]: manhattan_data=pd.read_csv("Manhattan_NY.csv") #obtained from Module3 lab
manhattan_data.head()
```

Out[183]:

Unnamed: 0	Borough	Neighborhood	Latitude	Longitude
0	Manhattan	Marble Hill	40.878551	-73.910880
1	Manhattan	Chinatown	40.713618	-73.994279
2	Manhattan	Washington Heights	40.851903	-73.938900
3	Manhattan	Inwood	40.867884	-73.927210
4	Manhattan	Hamilton Heights	40.823804	-73.949885

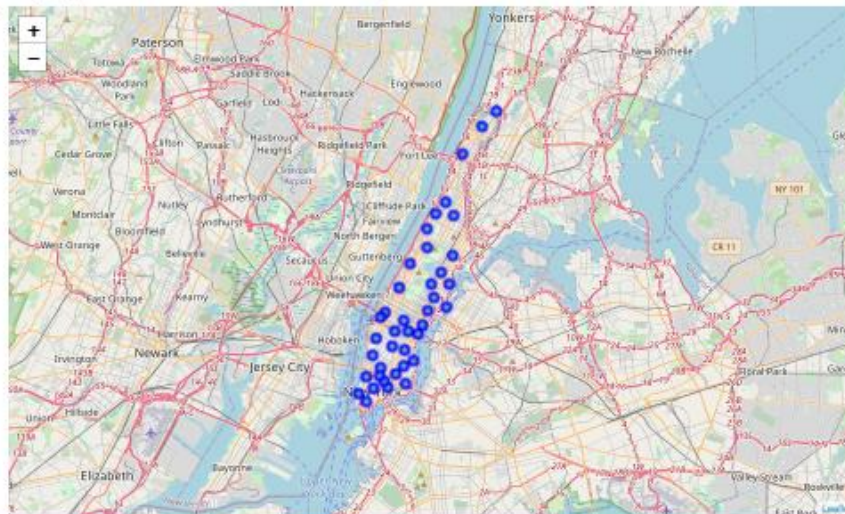
```
In [184]: print("Number of Boroughs in Manhattan", manhattan_data.shape[0])
```

Number of Boroughs in Manhattan 48

```
In [185]: address = "Manhattan, NY"
geolocator = Nominatim(user_agent="ny_explorer")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geographical coordinate of Manhattan are {}, {}'.format(latitude, longitude))
# create map of Manhattan using latitude and longitude values
map_manhattan = folium.Map(location=[latitude, longitude], zoom_start=11)
# add markers to map
for lat, lng, label in zip(manhattan_data['Latitude'], manhattan_data['Longitude'], manhattan_data['Neighborhood']):
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3185cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_manhattan)
map_manhattan
```

The geographical coordinate of Manhattan are 40.7896239, -73.9598939.

Out[185]:



Map of the Boroughs for Downtown Toronto:

3. Read CSV file for Downtown_Toronto from Module3 and display Downtown Toronto map

```
In [185]: DT_Toronto=pd.read_csv("DT_Toronto.csv")
DT_Toronto.head()
```

```
Out[185]:
```

	Unnamed: 0	Postal Code	Borough	Neighborhood	Latitude	Longitude
0	0	M5A	Downtown Toronto	Hogwood Park, Harbourfront	43.654280	-79.380838
1	1	M5B	Downtown Toronto	Garden District, Nyreson	43.657182	-79.379257
2	2	M5C	Downtown Toronto	St. James Town	43.651404	-79.379418
3	3	M5E	Downtown Toronto	Berney Park	43.644771	-79.373508
4	4	M5G	Downtown Toronto	Central Bay Street	43.657052	-79.387383

```
In [187]: print("Number of Boroughs in Downtown Toronto", DT_Toronto.shape[0])
```

Number of Boroughs in Downtown Toronto 17

```
In [188]: address = "Downtown, Toronto"
geolocator = Nominatim(user_agent="Toronto")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print("The geographical coordinate of Downtown Toronto are {}, {}".format(latitude, longitude))
# create map of Manhattan using Latitude and Longitude values
map_Toronto = folium.Map(location=[latitude, longitude], zoom_start=11)
for lat, lng, label in zip(DT_Toronto['Latitude'], DT_Toronto['Longitude'], DT_Toronto['Neighborhood']):
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_Toronto)
map_Toronto
```

The geographical coordinate of Downtown Toronto are 43.6541737, -79.38081152653639.



Explore the Neighborhoods in Manhattan and Downtown Toronto within 1000m radius

Define Foursquare Credentials and Version

```
In [189]: # CLIENT_ID = 'CRUHL5K6GYMZDBS3TMR53YDM4MNLNFJ815IU04DNFU25PUU3' # your Foursquare ID
CLIENT_SECRET = 'PYIP94CTXDHTK2CT454CWAIZDFPBL24IOLNV5IM1ADK54' # your Foursquare Secret
ACCESS_TOKEN = 'OHMPFPTTNGXBLCKIG5M3154W2K3MDI3CMH2EGLLQYTC18' # your Foursquare Access Token
VERSION = '20210515'
LIMIT = 100
print('Your credentials:')
print('CLIENT_ID: ' + CLIENT_ID)
print('CLIENT_SECRET: ' + CLIENT_SECRET)

Your credentials:
CLIENT_ID: CRUHL5K6GYMZDBS3TMR53YDM4MNLNFJ815IU04DNFU25PUU3
CLIENT_SECRET: PYIP94CTXDHTK2CT454CWAIZDFPBL24IOLNV5IM1ADK54
```

Now, let's get the top 100 venues that are in Manhattan and Downtown Toronto within a radius of 500 meters.

4. Explore Neighborhoods in Manhattan and Downtown Toronto Using Foursquare

Let's create a function to repeat the same process to all the neighborhoods in Manhattan

```
In [213]: # def getNearbyVenues(names, latitudes, longitudes, radius=1000):

venues_list=[]
for name, lat, lng in zip(names, latitudes, longitudes):
    print(name)

    # create the API request URL
    url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={}&radius={}&limit={}'
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION,
    lat,
    lng,
    radius,
    LIMIT)

    # make the GET request
    results = requests.get(url).json()["response"]["groups"][0]["items"]

    # return only relevant information for each nearby venue
    venues_list.append([
        name,
        lat,
        lng,
        v['venue']['name'],
        v['venue']['location']['lat'],
        v['venue']['location']['lng'],
        v['venue']['categories'][0]['name'] for v in results])

nearby_venues = pd.DataFrame([item for venue_list in venues_list for item in venue_list])
nearby_venues.columns = ['Neighborhood',
                        'Neighborhood Latitude',
                        'Neighborhood Longitude',
                        'Venue',
                        'Venue Latitude',
                        'Venue Longitude',
                        'Venue Category']

return(nearby_venues)

<----->
Yoga Studio 22
Restaurant 21
Furniture / Home Store 20
Playground 20
Salad Place 20
Vegetarian / Vegan Restaurant 20
Boutique 19
Name: Venue, dtype: int64
```

Let's find out how many unique categories can be curated from all the returned venues

```
In [205]: # print('There are {} unique categories in Manhattan.'.format(len(manhattan_venues['Venue Category'].unique())))

There are 329 unique categories in Manhattan.
```

Explore the Neighborhoods in Manhattan:

Let's Check the top 50 popular Venues based on Venue Category in Manhattan

```
In [216]: #List1= manhattan_venues.groupby(["Venue Category"])[["Venue"].count().nlargest(50)]
df=manhattan_venues.groupby(["Venue Category"])[["Venue"].count().nlargest(n=50)]
df
```

```
Out[216]: Venue Category
Coffee Shop          169
Italian Restaurant   138
Park                 111
Pizza Place          109
Café                 107
American Restaurant   95
Bakery               92
Gym / Fitness Center  77
Hotel                73
Mexican Restaurant    70
Cocktail Bar         68
Bar                  65
Gym                  62
Wine Shop            60
Grocery Store        54
Japanese Restaurant   54
Sushi Restaurant      54
Wine Bar              54
French Restaurant     51
Seafood Restaurant    49
Sandwich Place        47
Ice Cream Shop        46
Spa                   43
Chinese Restaurant    40
Juice Bar             40
Art Gallery           36
Cosmetics Shop        36
Indian Restaurant     35
Burger Joint          34
Mediterranean Restaurant 34
Theater              34
Bagel Shop            33
Deli / Bodega         33
Dessert Shop          33
New American Restaurant 33
Bookstore             32
Gourmet Shop          32
Salon / Barbershop    32
Yoga Studio           32
Vegetarian / Vegan Restaurant 31
Thai Restaurant       30
Salad Place           29
Korean Restaurant     27
Plaza                 26
Asian Restaurant      25
Lounge                25
Playground            25
Clothing Store        23
Greek Restaurant      22
Spanish Restaurant    22
Name: Venue, dtype: int64
```

Let's find out how many unique categories can be ourated from all the returned venues

```
In [217]: # print('There are {} unqiues categories in Manhattan.'.format(len(manhattan_venues['Venue Category'].unique())))
```

There are 387 unqiues categories in Manhattan.

Explore the Neighborhoods in Downtown Toronto:

```
In [208]: DT_Toronto_venues.shape
Out[208]: (1090, 7)

In [209]: print('There are {} uniques categories in DT Toronto.'.format(len(DT_Toronto_venues['Venue Category'].unique())))
There are 283 uniques categories in DT Toronto.
```

Top 50 Venue Categories in Downtown Toronto in Descending order

```
In [211]: dFT=DT_Toronto_venues.groupby(["Venue Category"])["Venue"].count().nlargest(n=50)
dFT

Out[211]: Venue Category
Coffee Shop          111
Café                  59
Restaurant            35
Hotel                 34
Japanese Restaurant  28
Italian Restaurant   24
Bakery                20
Park                  20
Clothing Store        17
SeaFood Restaurant    17
Gym                   15
Pizza Place           15
Steakhouse            14
Sushi Restaurant      14
Thai Restaurant       14
American Restaurant   13
Beer Bar              13
Deli / Bodega         13
Gastropub             13
Burger Joint          12
Cocktail Bar          12
Salad Place           12
Vegetarian / Vegan Restaurant 12
Bar                   11
Sandwich Place        11
Theater               11
Breakfast Spot        10
Grocery Store         10
Pub                   10
Art Gallery           9
Asian Restaurant      9
Bookstore             9
Cosmetics Shop        9
Bank                  8
Concert Hall          8
Department Store      8
Plaza                 8
Sporting Goods Shop   8
Wine Bar              8
Bubble Tea Shop       7
Burrito Place         7
Diner                 7
Fast Food Restaurant  7
French Restaurant     7
Gym / Fitness Center  7
New American Restaurant 7
Pharmacy              7
Dessert Shop          6
Farmers Market        6
Lounge                6
Name: Venue, dtype: int64
```

Combine Venue data for both Manhattan and Downton Toronto for comparison

Create a DataFrame to compare the Venues by category between Manhattan and Downtown Toronto

```
In [212]: dict={"Manhattan":df,"Downtown_Toronto":dfT}
          pdf=pd.DataFrame(dict)
          df_sorted= pdf.sort_values("Downtown_Toronto", ascending=False)

          df_sorted.to_csv("Venue_Comparison.csv")
          df_sorted
```

Out[212]:

	Manhattan	Downtown Toronto
Coffee Shop	140.0	111.0
Cafe	80.0	59.0
Restaurant	21.0	35.0
Hotel	68.0	34.0
Japanese Restaurant	38.0	28.0
Italian Restaurant	123.0	24.0
Bakery	78.0	20.0
Park	70.0	20.0
Clothing Store	40.0	17.0
Seafood Restaurant	35.0	17.0
Pizza Place	79.0	15.0
Gym	53.0	15.0
Steakhouse	22.0	14.0
South Restaurant	44.0	14.0
Thai Restaurant	32.0	14.0
Del / Bodega	37.0	13.0
American Restaurant	77.0	13.0
Gastropub	NaN	13.0
Beer Bar	NaN	13.0
Vegetarian / Vegan Restaurant	20.0	12.0
Cocktail Bar	58.0	12.0
Burger Joint	33.0	12.0
Salad Place	20.0	12.0
Theater	22.0	11.0
Bar	63.0	11.0
Sandwich Place	43.0	11.0
Pub	NaN	10.0
Grocery Store	32.0	10.0
Breakfast Spot	NaN	10.0
Cosmetics Shop	32.0	9.0
Bookstore	28.0	9.0
Aran Restaurant	NaN	9.0
Art Gallery	27.0	9.0
Sporting Goods Shop	NaN	8.0
Bank	NaN	8.0
Place	NaN	8.0

Venue_Comparison.csv file was created:

	Manhattan	Downtown_Toronto
Coffee Shop	169	132
Caf��	107	96
Japanese Restaurant	54	45
Park	111	41
Hotel	73	37
Restaurant		37
Theater	34	32
Italian Restaurant	130	27
Vegetarian / Vegan Restaurant	31	26
Gastropub		26
Pizza Place	109	25
Cosmetics Shop	36	24
Seafood Restaurant	49	22
Bakery	92	22
Sushi Restaurant	54	21
Gym	62	20
Thai Restaurant	30	20
Art Gallery	36	19
Plaza	26	17
Pub		17
Beer Bar		17
Grocery Store	54	17
American Restaurant	95	16
Sandwich Place	47	15
Bookstore	32	15
Concert Hall		15
Korean Restaurant	27	14
Diner		14
Yoga Studio	32	13
Farmers Market		12
Mexican Restaurant	70	12
Bar	65	11
Tea Room		11
Steakhouse		11
Creperie		11
Gym / Fitness Center	77	10
Clothing Store	23	10
Monument / Landmark		10
French Restaurant	51	10
Bistro		9
Burrito Place		9
Furniture / Home Store		9
Cocktail Bar	68	9
Neighborhood		9
Museum		9
Middle Eastern Restaurant		9
Ramen Restaurant		9
Dance Studio		8
Bubble Tea Shop		8
Breakfast Spot		8
Asian Restaurant	25	
Bagel Shop	33	
Burger Joint	34	
Chinese Restaurant	40	
Deli / Bodega	33	
Dessert Shop	33	
Gourmet Shop	32	
Greek Restaurant	22	
Ice Cream Shop	46	
Indian Restaurant	35	
Juice Bar	40	
Lounge	25	
Mediterranean Restaurant	34	
New American Restaurant	33	
Playground	25	
Salad Place	29	
Salon / Barbershop	32	
Spa	43	
Spanish Restaurant	22	
Wine Bar	54	
Wine Shop	60	

KMEANS clustering (Manhattan)

```
In [237]: # set number of clusters
kclusters = 5

manhattan_grouped_clustering = manhattan_grouped.drop('Neighborhood', 1)

# run k-means clustering
kmeans = KMeans(n_clusters=kclusters, random_state=0).fit(manhattan_grouped_clustering)

# check cluster labels generated for each row in the dataframe
kmeans.labels_[0:10]
```

```
Out[237]: array([2, 1, 1, 1, 3, 0, 3, 3, 1, 0, 3])
```

Let's create a new dataframe that includes the cluster as well as the top 10 venues for each neighborhood.

```
In [238]: # add clustering labels
neighborhoods_venues_sorted.insert(0, 'Cluster Labels', kmeans.labels_)

manhattan_merged = manhattan_data

# merge manhattan_grouped with manhattan_data to add latitude/longitude for each neighborhood
manhattan_merged = manhattan_merged.join(neighborhoods_venues_sorted.set_index('Neighborhood'), on='Neighborhood')

#manhattan_merged.head() # check the last columns!
```

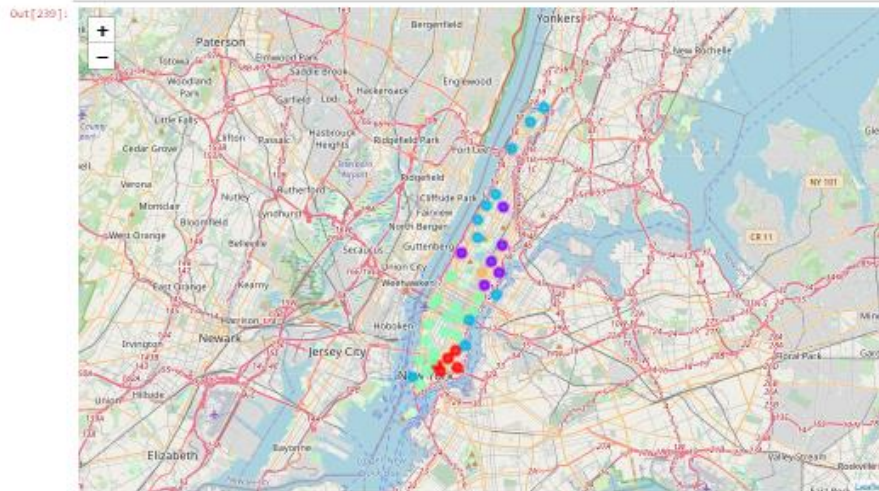
Finally, let's visualize the resulting clusters

```
In [239]: # create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [1 + x + (1*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(manhattan_merged['latitude'], manhattan_merged['longitude'], manhattan_merged['Neighborhood'],
                                manhattan_merged['Cluster Labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=5,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_clusters)

map_clusters
```



KMEANS clustering (Downtown Toronto)

```
In [241]: # set number of clusters
kclusters = 5

DT_grouped_clustering = DT_grouped.drop('Neighborhood', 1)

# run k-means clustering
kmeansDT = KMeans(n_clusters=kclusters, random_state=0).fit(DT_grouped_clustering)

# check cluster labels generated for each row in the dataframe
kmeansDT.labels_[0:10]

Out[241]: array([1, 4, 0, 3, 0, 0, 0, 0, 0, 0])

In [243]: # add clustering labels
#DTneighborhoods_venues_sorted.insert(0, 'Cluster labels', kmeansDT.labels_)

DT_merged = DT_Toronto

# merge manhattan_grouped with manhattan data to add latitude/longitude for each neighborhood
DT_merged = DT_merged.join(DTneighborhoods_venues_sorted.set_index('Neighborhood'), on='Neighborhood')

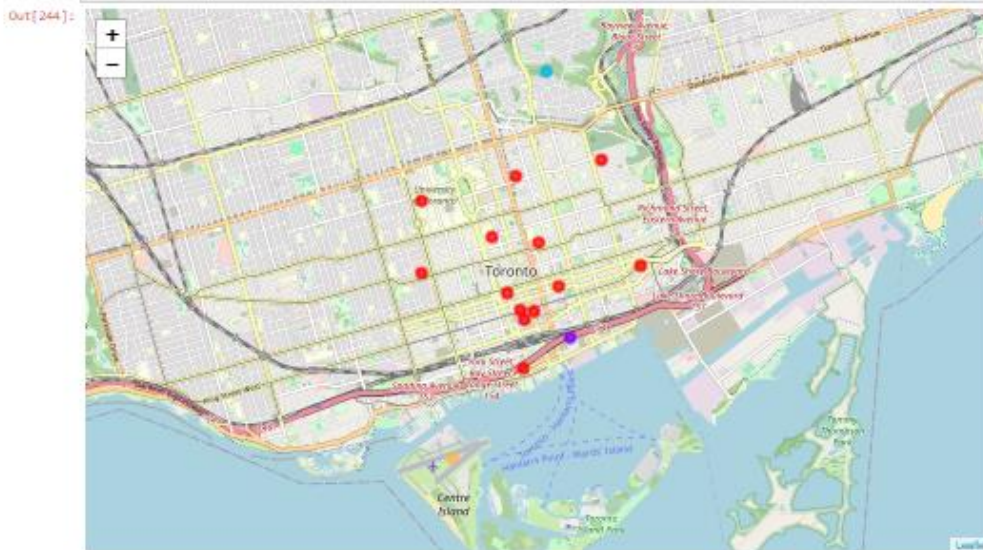
#DT_merged.head() # check the last columns!

In [244]: # create map
DTmap_clusters = folium.Map(location=[latitudeI, longitudeI], zoom_start=11)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [1 + x + (1*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

# add markers to the map
markers.colors = []
for lat, lon, poi, cluster in zip(DT_merged['latitude'], DT_merged['longitude'], DT_merged['Neighborhood'], DT_merged['Cluster labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=5,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(DTmap_clusters)

DTmap_clusters
```



DISCUSSION

From the maps for Manhattan and Downtown Toronto, number of Boroughs in Manhattan are 40 and situated close to each other whereas Downtown Toronto has only 17 Boroughs and they are spread wider than Manhattan. Although both Manhattan and Downtown Toronto have remarkably similar venues, Manhattan has much higher number of venues except for the number of Coffee shops. For example: Manhattan has 130 Italian restaurant, 109 Pizza places, 111 parks, 65 bars, 73 hotels, and 36 art galleries etc. in comparison Downtown Toronto has only 27 Italian restaurants, 25 Pizza places, 37 hotels, 11 bars, and 19 art galleries, respectively. Also, based on the exploration of venues, there are number of more venues in Manhattan, but appearing in Downtown Toronto, and it may be since the neighborhoods are far apart in Downtown. The number of venues may slightly vary based on the radius of exploration. Smaller radius will result in lower number of venues particularly for Downtown Toronto, since the neighborhoods are spread wider.

Both places have ample number of Coffee shops. One of the key observations is that Downtown Toronto has an airport whereas Manhattan does not have an airport. It is interesting to notice within 1000 meters radius of Manhattan there are large number of Greek, Indian, Mediterranean, Spanish restaurants whereas Downtown Toronto does not have those restaurants withing 1000 meters but may have those restaurants in the suburbs such Marcom or Scarborough.

Conclusion

Based on the above observations, it is recommended to rent a vehicle in Downtown Toronto, since the neighborhoods and venues are more spread. In Manhattan it may be walkable. Also, Downtown Toronto seems to have less hotels. Moreover, no restaurants for Indian, Greek, Spanish etc. Hence, tourists from these countries may consider visiting Manhattan.

One of the conveniences of Downtown Toronto is that the airport is situated in Downtown. Hence, it will be easier to stay closer to the airport and explore the area. Manhattan may be much crowded due to the large number of venues. People who wanted to shop, Manhattan is the place to be, since there are much more departmental stores.

Although Manhattan has more Theaters, Downtown Toronto has more concert halls which may be something the music lovers need to consider.

For families with children, there are plenty of parks in Manhattan than Downtown Toronto.

In conclusion, both Manhattan and Downtown Toronto have similar venues and hence, tourist could pick and choose different venues in different cities instead of visiting the same venues in both places. Tourists need to book the hotels much earlier in Downtown Toronto than in Manhattan, since Downtown Toronto has only half the number of hotels compared to Manhattan.