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

To Assist Foreign Travelers

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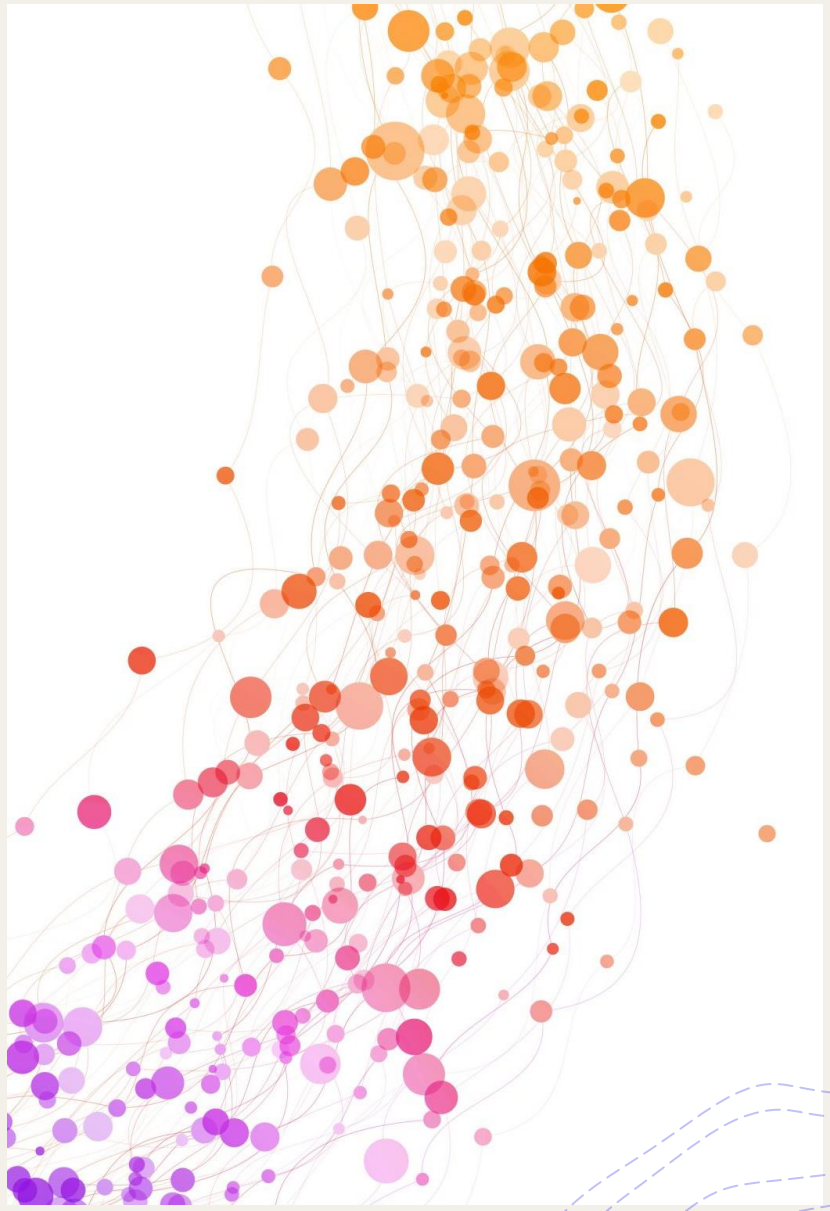


Problem and Background

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 Downton 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 Downton Toronto.

Results

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	0	Manhattan	Marble Hill	40.876551	-73.910660
1	1	Manhattan	Chinatown	40.715618	-73.994279
2	2	Manhattan	Washington Heights	40.851903	-73.936900
3	3	Manhattan	Inwood	40.867684	-73.921210
4	4	Manhattan	Hamilton Heights	40.823604	-73.949582

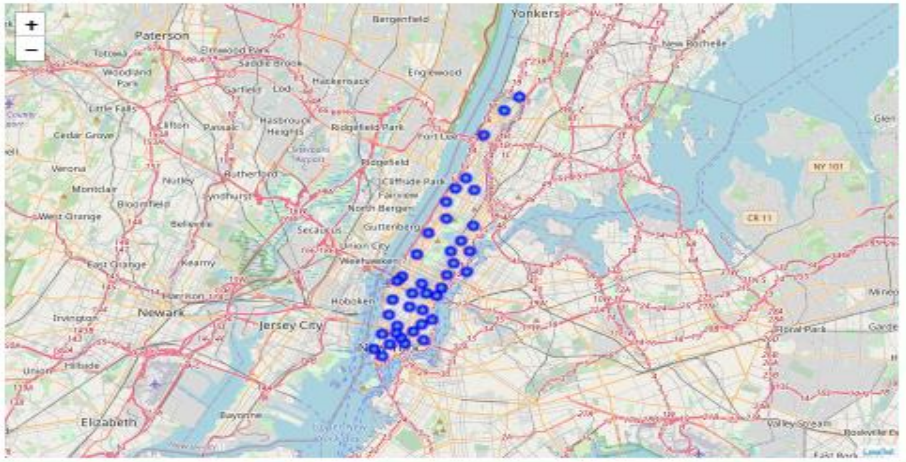
In [184]:
```
print("Number of Boroughs in Manhattan", manhattan_data.shape[0])
```

```
Number of Boroughs in Manhattan 40
```

In [185]:
```
address = 'Manhattan, NY'
geolocator = Nominatim(user_agent="ny_explorer")
location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geograpical 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='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_manhattan)
map_manhattan
```

```
The geograpical coordinate of Manhattan are 40.7896239, -73.9598939.
```

Out[185]:



Results-Continued

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

In [186]:
```
DT_Toronto=pd.read_csv("DT_Toronto.csv")
DT_Toronto.head()
```

Out[186]:

	Unnamed: 0	Postal Code	Borough	Neighborhood	Latitude	Longitude
0	0	M5A	Downtown Toronto	Regent Park, Harbourfront	43.654260	-79.360636
1	1	M5B	Downtown Toronto	Garden District, Ryerson	43.657162	-79.378937
2	2	M5C	Downtown Toronto	St. James Town	43.651494	-79.375418
3	3	M5E	Downtown Toronto	Berczy Park	43.644771	-79.373306
4	4	M5G	Downtown Toronto	Central Bay Street	43.657952	-79.387383

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

```
Number of Boroughs in Downtown Toronto 17
```

In [188]:
```
addressT = 'Downtown, Toronto'
geolocator = Nominatim(user_agent="Toronto")
locationT = geolocator.geocode(addressT)
latitudeT = locationT.latitude
longitudeT = locationT.longitude
print('The geograpical coordinate of Downtown Toronto are {}, {}.'.format(latitudeT, longitudeT))
# create map of Manhattan using latitude and longitude values
map_Toronto = folium.Map(location=[latitudeT, longitudeT], 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 geograpical coordinate of Downtown Toronto are 43.6541737, -79.38081162653639.
```

Out[188]:

Results-Continued

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

Define Foursquare Credentials and Version

In [189]:
```
CLIENT_ID = 'CRUHLSKWGYWZDBSJTWRS3YDM4MWLNFJB1SIUU4DNFU25PUU3' # your Foursquare ID
CLIENT_SECRET = 'PYIPPW4CTXDHTKZCT4S4CWAI2DFPBLL24IOLNV5IW1IADK54' # your Foursquare Secret
ACCESS_TOKEN = 'OHMFWEPTTNGXBLCMIG5MJ1S4W2K3MDI3CMIH2EGLLQYTTC1B' # your FourSquare Access Token
VERSION = '20210515'
LIMIT = 100
print('Your credentails:')
print('CLIENT_ID: ' + CLIENT_ID)
print('CLIENT_SECRET:' + CLIENT_SECRET)
```

```
Your credentails:
CLIENT_ID: CRUHLSKWGYWZDBSJTWRS3YDM4MWLNFJB1SIUU4DNFU25PUU3
CLIENT_SECRET:PYIPPW4CTXDHTKZCT4S4CWAI2DFPBLL24IOLNV5IW1IADK54
```

Now, let's get the top 100 venues that are in Manhattan and Downtown Toronto within a radius of 600 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)
```

Results-Continued

In [196]:
```
print(manhattan_venues.shape)
```

```
(3217, 7)
```

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

In [204]:
```
#list= manhattan_venues.groupby(["Venue Category"])["Venue"].count().nlargest(50)
df=manhattan_venues.groupby(["Venue Category"])["Venue"].count().nlargest(n=50)
df
```

Out[204]:

Venue Category	
Coffee Shop	140
Italian Restaurant	123
Café	88
Pizza Place	79
American Restaurant	77
Bakery	76
Park	70
Hotel	66
Bar	63
Cocktail Bar	56
Mexican Restaurant	55
Gym	53
Gym / Fitness Center	52
Wine Shop	48
French Restaurant	44
Sushi Restaurant	44
Chinese Restaurant	43
Sandwich Place	43
Clothing Store	40
Japanese Restaurant	38
Spa	38
Deli / Bodega	37
Wine Bar	36
Ice Cream Shop	35
Seafood Restaurant	35
Burger Joint	33
Cosmetics Shop	32
Grocery Store	32
Thai Restaurant	32
Dessert Shop	31
Mediterranean Restaurant	31
Korean Restaurant	28
Art Gallery	27
Bookstore	26
Indian Restaurant	25
New American Restaurant	25
Bagel Shop	24
Salon / Barbershop	23
Greek Restaurant	22
Juice Bar	22
Steakhouse	22
Theater	22
Vietnamese Restaurant	22
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 {} uniques categories in Manhattan.'.format(len(manhattan_venues['Venue Category'].unique())))
```

```
There are 329 uniques categories in Manhattan.
```

Results

```
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
```

Results-Continued

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
Café	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
Sushi Restaurant	44.0	14.0
Thai Restaurant	32.0	14.0
Deli / 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	83.0	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	26.0	9.0
Asian Restaurant	NaN	9.0
Art Gallery	27.0	9.0
Sporting Goods Shop	NaN	8.0
Bank	NaN	8.0
Plaza	NaN	8.0

Results

Venue_Comparison.csv file was created:

	Manhattan	Downtown_Toronto
Coffee Shop	169	132
CafÃ©	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

Results-Kmeans 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, 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

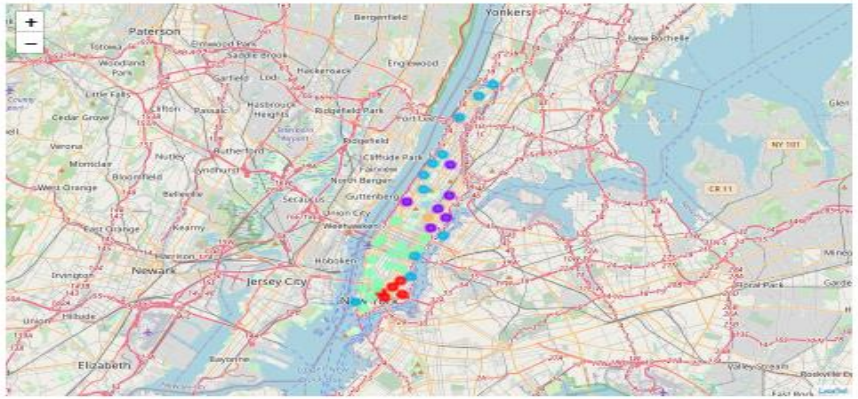
In [239]:
```
# create map
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=11)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [i + x + (i*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['Neighborhoo
    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
```

Out[239]:



Results-Kmeans 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=[latitudeT, longitudeT], zoom_start=11)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [i + x + (i*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['Clust
    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
```

Out[244]:

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.