Coursera IBM Data Science - Capstone Project: Location Value Calculation for Pharmacies in the City of Zurich

This Notebook is for Marketing Leaders and Investors of the Pharmacy Business.

Introduction

Success for pharmacies depends much on their location. The location is the most important factor for the creation of revenue. Here I try to quantify the location value of pharmacies at the City of Zurich. The location value for is among other factors determined by:

- The locations of competitors like other Pharmacies and stores that also sell Parfumes and Cosmetics.
- The locations of enablers like drugstores and cosmetic stores and luxury stores. Foursquare can help analysing location datas for Zurich, because using it not only provides Coordinates of locations, it also helps to visualize the situation on a map. The report and the tool helps to analyze and to understand the current situation for Pharmacies in the City of Zurich. But is is also a useful for future developments. Where should I open a Pharmacy? Where should I close a Pharmacy. Are there Marketing instruments to make situation better? Should we - as a chain - cooperate with competitor or even buy them? Should we sell stores of focus on other products we sell beside drugs? And so on. One important basis for decision makers are facts, we can identify with the help of Foursquare.

Audience

This report is useful for the marketing leaders in Pharmacy chains, for risk managers and for all investors of the Pharmacy business. For leaders and decission makers.

Description of the used data

Foursquare let me help finding places and informations wich are hard to find manually. But with python, some libraries and the great visualizing tool folio I can present the results to everybody. Also I use request for Foursquare Pharmacies and other locations/stores that have an influence on the Pharmacy revenue. I selected

- Pharmacy
- Perfume Shop
- Medical Supply Store
- Doctor s Office
- Health Beauty Service
- Drugstore
- Cosmetics Shop

I say that all these locations have an impact on the revenue of a Pharmcy in the city. It would be interesting to talk to experts and identify more criteria with impact on city pharmacies.

In [1]:
```
import folium
import json
import requests
import pandas as pd
import math
import matplotlib.pyplot as plt
import pyarrow.feather as feather # pip install pyarrow
import numpy as np
import copy
import time
import random
```

In [2]:
```
# Function definitions

def fnc_distance(lat1,lng1,lat2,lng2):

    int_lat1 = lat1
    int_lng1 = lng1
    int_lat2 = lat2
    int_lng2 = lng2

    "distance in meters between two points. Input format is lat1,lng1,lat2,lng2"

    R           =6371000                    # radius of Earth in meters
    phi_1       =math.radians(int_lat1)
    phi_2       =math.radians(int_lat2)
    delta_phi   =math.radians(int_lat2-int_lat1)
    delta_lambda=math.radians(int_lng2-int_lng1)
    a           =math.sin(delta_phi/2.0)**2+math.cos(phi_1)*math.cos(phi_2)*math.sin(del
    c           =2*math.atan2(math.sqrt(a),math.sqrt(1-a))
    return (R*c)

def fnc_force(dist,sign):

    int_distance = abs(dist) # meters
    int_sign     = sign      # +1 or -1

    "calculating the force, here in a linear model. Input is distance in meters, sign is

    int_reach    = 400 # shops further away than 400 meters have no (zero) influence on
    int_force    = (int_reach - int_distance ) / int_reach #  (700 minus dist)/700
    if int_force <= 0:
        int_force =0
    return (int_force*int_sign)

def fnc_positionvalueof (lat, lng):

    int_lat=lat
    int_lng=lng

    sum_force     = 0
    for indB in nearby_venues_dotcolor_fix.index:               # all colored objects he
        latB      = nearby_venues_dotcolor_fix['lat'][indB]
        lngB      = nearby_venues_dotcolor_fix['lng'][indB]
        force     =  0
        sign      = +1
        if nearby_venues_dotcolor_fix['dotcolor'][indB] in ['yellow', 'red']:
            sign  = -1
        distance  = fnc_distance(lat, lng, latB, lngB)
        force     = fnc_force(distance, sign)
        sum_force = sum_force + force

    return (sum_force)

def get_category_type(row):

    try:
        categories_list = row['categories']
    except:
        categories_list = row['venue.categories']

    if len(categories_list) == 0:
        return None
    else:
```

In [3]:
```
# Definitions:
min_lat    = 47.355   # Below, lower border
max_lat    = 47.385   # Top, upper border
min_lng    =  8.515   # Left border
max_lng    =  8.560   # Right border
stp_lat    =  0.0002  # 0.001 = 35 seconds, 0.0005 = 1 min, 15 seconds; 0.0003=3 Minutes

# Calculations:
cnt_lat    = (min_lat + max_lat) /2 # Center Latutude = Average Latitude
cnt_lng    = (min_lng + max_lng) /2 # Center Longitude= Average Longitude
dif_lat    = max_lat - min_lat      # diff lat 0.08800000000000097        0.0880
dif_lng    = max_lng - min_lng      # diff lng 0.0625                     0.0625
cal_radius = fnc_distance(cnt_lat,cnt_lng,min_lat,min_lng)  # in Meters
meters_wide= abs(int(round(fnc_distance(min_lat,0,max_lat,0),0)))  # in Meters
meters_high= abs(int(round(fnc_distance(0,min_lng,0,max_lng),0)))  # in Meters
meters_lat = abs(int(round(fnc_distance(cnt_lat,cnt_lng,cnt_lat+1,cnt_lng  ),0)))
meters_lng = abs(int(round(fnc_distance(cnt_lat,cnt_lng,cnt_lat  ,cnt_lng+1),0)))
latlng_prop= meters_lat/meters_lng  # 1.476536357359
stp_lng    =  stp_lat * latlng_prop                 # 0.001476536357359112
grid_lat   = fnc_distance (cnt_lat,cnt_lng, cnt_lat+stp_lat ,cnt_lng        ) # result i
grid_lng   = fnc_distance (cnt_lat,cnt_lng, cnt_lat         ,cnt_lng+stp_lng) # result i
grid_diff  = abs(grid_lat - grid_lng)


print('The Zurich Rectangle is', meters_wide, 'Meters wide and', meters_high,'Meters hig
print('1 Latitude has a Length of             :', meters_lat,'Meters')
print('1 Longitude has a Length of            :', meters_lng,'Meters')
print('Latitude per Longitude Meter Proportion:', latlng_prop)
print('Grid in Meters Latitude                :', round(grid_lat,3))
print('Grid in Meters Longitude               :', round(grid_lng,3))
print('Grid Difference Lat Lng in Millimeters :', round(grid_diff*1000,3))
print('step stp_lat                           :', round(stp_lat,6))
```

```
The Zurich Rectangle is 3336 Meters wide and 5004 Meters high.
1 Latitude has a Length of             : 111195 Meters
1 Longitude has a Length of            : 75308 Meters
Latitude per Longitude Meter Proportion: 1.476536357359112
Grid in Meters Latitude                : 22.239
Grid in Meters Longitude               : 22.239
Grid Difference Lat Lng in Millimeters : 0.021
step stp_lat                           : 0.0002
Step stp_lng                           : 0.000295
```

Show a map of Zurich:

In [4]:
```
locationmap = folium.Map(location=[cnt_lat, cnt_lng], zoom_start=13) # a lower number sh
folium.CircleMarker([min_lat, max_lng], popup='<i>Corner</i>', tooltip='Corner Bottom Ri
folium.CircleMarker([max_lat, max_lng], popup='<i>Corner</i>', tooltip='Corner Top Right
folium.CircleMarker([min_lat, min_lng], popup='<i>Corner</i>', tooltip='Corner Bottom Le
folium.CircleMarker([max_lat, min_lng], popup='<i>Corner</i>', tooltip='Corner Top Left'
```

Out[4]:

In [5]:
```
CLIENT_ID = 'ZIVV2XBGULB4IKC2SFA33OT2WXMMAYEUNEMKP5NBZCSWL12U' # your Foursquare ID
CLIENT_SECRET = 'IAIN5OB2CYZ44STUMX0PDCKIMRTJ4OX3NUKEPA0O1U0XSY2M' # your Foursquare Sec
VERSION = '20190425' # Foursquare API version 20190425 20180605
```

```
Foursquare access is defined.
```

Foursquare has maybe 200 sort of locations defined. I select here the important ones for the project and I give them colors:

- Red is for locations with a negative impact on Pharmacies
- Yellow is for Pharmacies
- Green is for locations with a positive impact on Pharmacies -

In [6]:
```
data = [
    ['4bf58dd8d48988d10f951735', 'Pharmacy'             ,'yellow'],
    ['52f2ab2ebcbc57f1066b8b23', 'Perfume Shop'         ,'red'   ],
    ['58daa1558bbb0b01f18ec206', 'Medical Supply Store' ,'red'   ],
    ['4bf58dd8d48988d177941735', 'Doctor s Office'      ,'green' ],
    ['54541900498ea6ccd0202697', 'Health Beauty Service','green' ],
    ['5745c2e4498e11e7bccabdbd', 'Drugstore'            ,'green' ],
    ['4bf58dd8d48988d10c951735', 'Cosmetics Shop'       ,'green' ],
]

# Create the pandas DataFrame
df_stores = pd.DataFrame(data, columns = ['categoryId', 'categoryname', 'dotcolor'])
```

Out[6]:

	categoryId	categoryname	dotcolor
0	4bf58dd8d48988d10f951735	Pharmacy	yellow
1	52f2ab2ebcbc57f1066b8b23	Perfume Shop	red
2	58daa1558bbb0b01f18ec206	Medical Supply Store	red
3	4bf58dd8d48988d177941735	Doctor s Office	green
4	54541900498ea6ccd0202697	Health Beauty Service	green
5	5745c2e4498e11e7bccabdbd	Drugstore	green
6	4bf58dd8d48988d10c951735	Cosmetics Shop	green

I build a string with all the interesting Foursquare Id's:

In [7]:
```
# Creating an empty Dataframe with column names only
venues_total = pd.DataFrame(columns=['name', 'address', 'city', 'categories', 'lat', 'ln
```

I build the URL and use the string from above.

In [8]:
```
LIMIT      = 999    # limit of number of venues returned by Foursquare API
radius     = abs(round(cal_radius + 2000,0)) # define radius
url        = "https://api.foursquare.com/v2/venues/explore?"
url = url + '&client_id='    + CLIENT_ID
url = url + '&client_secret='+ CLIENT_SECRET
url = url + '&v='            + VERSION
url = url + '&ll='           + str(cnt_lat) +','+ str(cnt_lng)
url = url + '&radius='       + str(radius)
url = url + '&limit='        + str(LIMIT)
# url = url + '&categoryId='   + categoryId

url

for index, row in df_stores.iterrows():

    time.sleep((random.random()*1))
    url_send = url + '&categoryId='   + row['categoryId']
    dic_results = requests.get(url_send).json()  # This basically returns a Python dicti
    #results.keys()                          # dict_keys(['meta', 'response'])

    venues = dic_results['response']['groups'][0]['items']
    nearby_venues = pd.json_normalize(venues)
    # nearby_venues.head()

    # filter columns
    filtered_columns = ['venue.name', 'venue.location.address','venue.location.city', 'v
    nearby_venues =nearby_venues.loc[:, filtered_columns]

    # filter the category for each row
    nearby_venues['venue.categories'] = nearby_venues.apply(get_category_type, axis=1)

    # clean columns
    nearby_venues.columns = [col.split(".")[-1] for col in nearby_venues.columns]

    print(len(nearby_venues['name'])) # must be smaller than 50

    # venues_total = venues_total + nearby_venues
    venues_total = venues_total.append(nearby_venues, ignore_index=True)
```

```
22
7
8
19
36
4
40
```

In [9]:
```
# nearby_venues.head(100)
```

Out[9]:

	name	address	city	categories	lat	lng
0	Bahnhof Apotheke	Bahnhofplatz 15	Zürich	Pharmacy	47.377142	8.539919
1	Bellevue Apotheke	Theaterstrasse 14	Zürich	Pharmacy	47.366755	8.545925
2	Victoria Apotheke	Bahnhofstr. 71	Zürich	Pharmacy	47.374796	8.538618
3	Rosen Apotheke	Niederdorfstrasse 11	Zürich	Pharmacy	47.373329	8.543857
4	Sun Store Apotheke	Löwenstrasse 31-35	Zürich	Pharmacy	47.375423	8.536251
...	...	...	...	...	...	...
131	qosms Body & Soul Spa	Röschibachstrasse 71	Zürich	Health & Beauty Service	47.393456	8.528175
132	exurbe cosmetics	Zollikerstrasse 249	Zürich	Cosmetics Shop	47.347696	8.566541
133	SEPHORA ZURICH LETZI	Baslerstrasse 50	Zürich	Perfume Shop	47.386464	8.499441
134	Health Beauty Lifestyle AG	Schaffhauserstrasse 276	Zürich	Cosmetics Shop	47.404640	8.548776
135	Silendi Cosmetic	Limmattalstrasse 130	Zürich	Cosmetics Shop	47.400486	8.503647

136 rows × 6 columns

Do not read this. I just try to understand the JSON Data structure.

referralId e-0-4b8ff66ef964a520926c33e3-0 reasons.count 0 reasons.items [{'summary': 'This spot is popular', 'type': '... venue.id 4b8ff66ef964a520926c33e3 venue.name Bahnhof Apotheke venue.location.address Bahnhofplatz 15 venue.location.lat 47.3771 venue.location.lng 8.53992 venue.location.labeledLatLngs [{'label': 'display', 'lat': 47.37714158545192... venue.location.distance 278 venue.location.postalCode 8001 venue.location.cc CH venue.location.city Zürich venue.location.state Zürich venue.location.country Schweiz venue.location.formattedAddress [Bahnhofplatz 15, 8001 Zürich, Schweiz] venue.categories [{'id': '4bf58dd8d48988d10f951735', 'name': 'P... venue.photos.count 0 venue.photos.groups [] venue.venuePage.id NaN venue.location.crossStreet NaN Name: 0, dtype: object Bahnhof Apotheke [{'id': '4bf58dd8d48988d10f951735', 'name': 'Pharmacy', 'pluralName': 'Pharmacies', 'shortName': 'Pharmacy', 'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/pharmacy_' (https://ss3.4sqi.net/img/categories_v2/shops/pharmacy_'), 'suffix': '.png'}, 'primary': True}]

I add the colors to the results.

In [10]:
```
List = []
for index, row in venues_total.iterrows():
    #print (row )
    #category = row["venue.categories"][0]['name']
    category  = row['categories']
    if "Pharmacy" in category:
        dotcolor ='yellow'
    elif 'Cosmetics Shop' in category:
        dotcolor ='red'
    elif 'Perfume Shop' in category:
        dotcolor ='red'
    else:
        dotcolor ='green'
    #print (dotcolor,'\t' ,category)
    List.append(dotcolor)
    #print ('Done')
```

Then I add the newly created List with colors (dotcolor) as Column to the Dataframe. Again:

- yellow for pharmacie
- green for positive influence:
- red for negative influence: Perfume Shop, Cosmetics Shop

In [11]:
```
print('number of items in list:'    , len(List))
```

```
number of items in list: 136
number of rows in dataframe: 136
```

In [12]:
```
# Add column
nearby_venues_dotcolor = venues_total
nearby_venues_dotcolor['dotcolor'] = List

nearby_venues_dotcolor_fix = nearby_venues_dotcolor.apply(copy.deepcopy)
```

Out[12]:

	name	address	city	categories	lat	lng	dotcolor
0	Bahnhof Apotheke	Bahnhofplatz 15	Zürich	Pharmacy	47.377142	8.539919	yellow
1	Bellevue Apotheke	Theaterstrasse 14	Zürich	Pharmacy	47.366755	8.545925	yellow
2	Victoria Apotheke	Bahnhofstr. 71	Zürich	Pharmacy	47.374796	8.538618	yellow
3	Rosen Apotheke	Niederdorfstrasse 11	Zürich	Pharmacy	47.373329	8.543857	yellow
4	Sun Store Apotheke	Löwenstrasse 31-35	Zürich	Pharmacy	47.375423	8.536251	yellow
...	...	...	...	...	...	...	...
131	qosms Body & Soul Spa	Röschibachstrasse 71	Zürich	Health & Beauty Service	47.393456	8.528175	green
132	exurbe cosmetics	Zollikerstrasse 249	Zürich	Cosmetics Shop	47.347696	8.566541	red
133	SEPHORA ZURICH LETZI	Baslerstrasse 50	Zürich	Perfume Shop	47.386464	8.499441	red
134	Health Beauty Lifestyle AG	Schaffhauserstrasse 276	Zürich	Cosmetics Shop	47.404640	8.548776	red
135	Silendi Cosmetic	Limmattalstrasse 130	Zürich	Cosmetics Shop	47.400486	8.503647	red

136 rows × 7 columns

In [13]:
```
print('number of rows in dataframe nearby_venues_dotcolor including dublicates:', nearby
nearby_venues_dotcolor_fix.to_excel(r'nearby_venues_dotcolor1.xlsx', index = False)

nearby_venues_dotcolor_fix.drop_duplicates(keep='first',inplace=True)  # keep='first'

print('number of rows in dataframe nearby_venues_dotcolor without dublicates:', nearby_v

nearby_venues_dotcolor_fix.to_excel(r'nearby_venues_dotcolor2.xlsx', index = False)
```

```
number of rows in dataframe nearby_venues_dotcolor including dublicates: 136
number of rows in dataframe nearby_venues_dotcolor without dublicates: 131
```

In [14]:
```
# save as file pyarrow needs numpy
# pip install pyarrow
import pyarrow.feather as feather
feather.write_feather(nearby_venues_dotcolor_fix, 'C:\\Users\\x\\Desktop\\projects\\Cour
# nearby_venues_dotcolor.to_csv("C:\\Users\\x\\Desktop\\projects\\Coursera_Capstone\\scr
```

In [15]:

Out[15]:

	name	address	city	categories	lat	lng	dotcolor
0	Bahnhof Apotheke	Bahnhofplatz 15	Zürich	Pharmacy	47.377142	8.539919	yellow
1	Bellevue Apotheke	Theaterstrasse 14	Zürich	Pharmacy	47.366755	8.545925	yellow
2	Victoria Apotheke	Bahnhofstr. 71	Zürich	Pharmacy	47.374796	8.538618	yellow
3	Rosen Apotheke	Niederdorfstrasse 11	Zürich	Pharmacy	47.373329	8.543857	yellow
4	Sun Store Apotheke	Löwenstrasse 31-35	Zürich	Pharmacy	47.375423	8.536251	yellow
...	...	...	...	...	...	...	...
129	J.brand cosmetics gmbh	Seefeldstrasse 204	Zürich	Cosmetics Shop	47.353518	8.558353	red
130	Swiss Dental Center	Heinrichstrasse 239	Zürich	Cosmetics Shop	47.389165	8.521518	red
132	exurbe cosmetics	Zollikerstrasse 249	Zürich	Cosmetics Shop	47.347696	8.566541	red
134	Health Beauty Lifestyle AG	Schaffhauserstrasse 276	Zürich	Cosmetics Shop	47.404640	8.548776	red
135	Silendi Cosmetic	Limmattalstrasse 130	Zürich	Cosmetics Shop	47.400486	8.503647	red

131 rows × 7 columns

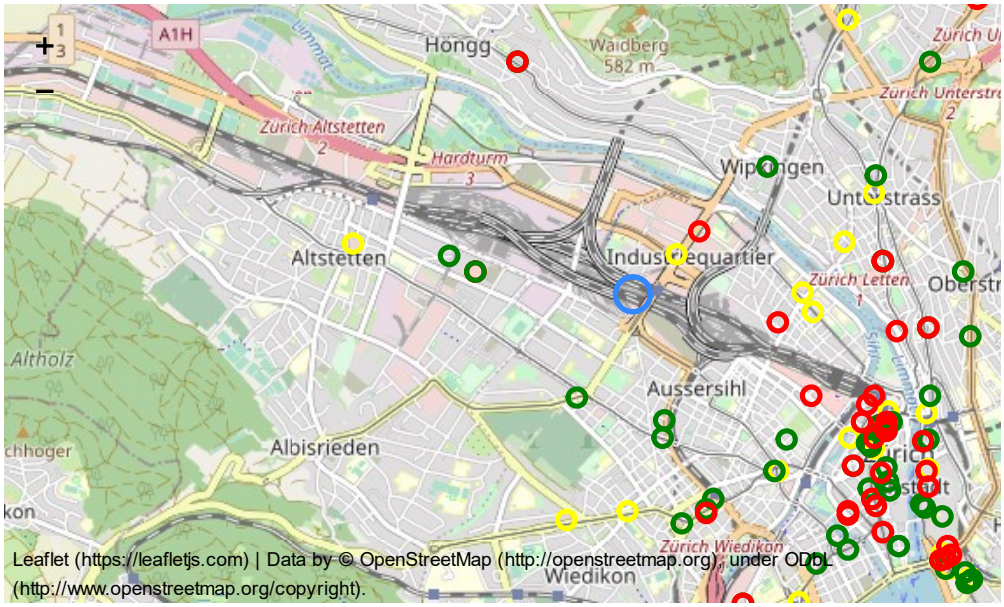
In [16]:
```
# .drop(['B', 'C'], axis=1)
for col in nearby_venues_dotcolor_fix.columns:
    print(col)
#nearby_venues_dotcolor.drop(columns=['venue.id', 'referralId', 'reasons.count'], axis=1
```

```
name
address
city
categories
lat
lng
dotcolor
```

Here I create the Map of Zurich with the colored locations:

In [17]:
```
# for lat, lng, label in result['Latitude'], result['Longitude'], result['Neighbourhood'
# label = folium.Popup(label, parse_html=True)
for ind in nearby_venues_dotcolor_fix.index:

    popupname = nearby_venues_dotcolor_fix['categories'][ind] +' '+ nearby_venues_dotcol

    folium.CircleMarker(
        [nearby_venues_dotcolor_fix['lat'][ind], nearby_venues_dotcolor_fix['lng'][ind]]
        radius=5,
        popup=popupname,
        color=nearby_venues_dotcolor_fix['dotcolor'][ind],
        fill=False,
        fill_color=nearby_venues_dotcolor_fix['dotcolor'][ind],
        fill_opacity=0,
        parse_html=False).add_to(locationmap)

folium.CircleMarker([min_lat, max_lng], popup='<i>Corner</i>', tooltip='Corner Bottom Ri
folium.CircleMarker([max_lat, max_lng], popup='<i>Corner</i>', tooltip='Corner Top Right
folium.CircleMarker([min_lat, min_lng], popup='<i>Corner</i>', tooltip='Corner Bottom Le
folium.CircleMarker([max_lat, min_lng], popup='<i>Corner</i>', tooltip='Corner Top Left'
```

Out[17]:



Calculate the distance between two lon/lat coordnate pairs

For each pharmacy (yellow dot), we calculate distances to other points. We us Newtons Law to calculate the force out of the distance. Here, force can be negative, eg. for close competitors or positive for enables like doctor offices. For each pharmacy we calculate the sum of forces.

In [18]:
```
list = []
for ind1 in nearby_venues_dotcolor_fix.index:
    lat1     = nearby_venues_dotcolor_fix['lat'][ind1]
    lng1     = nearby_venues_dotcolor_fix['lng'][ind1]
    sum_force=0

    for ind2 in nearby_venues_dotcolor_fix.index:
        lat2 = nearby_venues_dotcolor_fix['lat'][ind2]
        lng2 = nearby_venues_dotcolor_fix['lng'][ind2]
        sign = 0

        ################################################
        if   nearby_venues_dotcolor_fix['dotcolor'][ind2] == 'red':
            sign = -1
        elif nearby_venues_dotcolor_fix['dotcolor'][ind2] == 'yellow':            # Othe
            sign = -1
        else:
            sign = +1
        ################################################

        distance  = fnc_distance(lat1,lng1,lat2,lng2)
        force     = fnc_force(distance, sign)
        sum_force = sum_force + force

    list.append(sum_force)

nearby_venues_dotcolor_fix['force'] = list
print ('Done')
```

```
Done
```

Now we have an enhanced table with a force column.

In [19]:
```

```

Out[19]:

	name	address	city	categories	lat	lng	dotcolor	force
0	Bahnhof Apotheke	Bahnhofplatz 15	Zürich	Pharmacy	47.377142	8.539919	yellow	-6.562144
1	Bellevue Apotheke	Theaterstrasse 14	Zürich	Pharmacy	47.366755	8.545925	yellow	-1.100178
2	Victoria Apotheke	Bahnhofstr. 71	Zürich	Pharmacy	47.374796	8.538618	yellow	-3.957979
3	Rosen Apotheke	Niederdorfstrasse 11	Zürich	Pharmacy	47.373329	8.543857	yellow	-1.180184
4	Sun Store Apotheke	Löwenstrasse 31-35	Zürich	Pharmacy	47.375423	8.536251	yellow	-3.864038
...	...	...	...	...	...	...	...	...
129	J.brand cosmetics gmbh	Seefeldstrasse 204	Zürich	Cosmetics Shop	47.353518	8.558353	red	-1.000000
130	Swiss Dental Center	Heinrichstrasse 239	Zürich	Cosmetics Shop	47.389165	8.521518	red	-1.388125
132	exurbe cosmetics	Zollikerstrasse 249	Zürich	Cosmetics Shop	47.347696	8.566541	red	-1.000000
134	Health Beauty Lifestyle AG	Schaffhauserstrasse 276	Zürich	Cosmetics Shop	47.404640	8.548776	red	-1.000000
135	Silendi Cosmetic	Limmattalstrasse 130	Zürich	Cosmetics Shop	47.400486	8.503647	red	1.000000

131 rows × 8 columns

In [20]:
```
# Copy Table
```

We are only intersted in the location value of pharmacies. We sort the pharmacies so that the pharmacies with the best force are at the top.

In [21]:
```
# Eliminate red and green
indexNames = nearby_venues_sorted[ nearby_venues_sorted['dotcolor'] == 'red'   ].index
nearby_venues_sorted.drop(indexNames , inplace=True)

indexNames = nearby_venues_sorted[ nearby_venues_sorted['dotcolor'] == 'green' ].index
nearby_venues_sorted.drop(indexNames , inplace=True)
```

In [22]:
```
# Sort yellow (Rest)
```

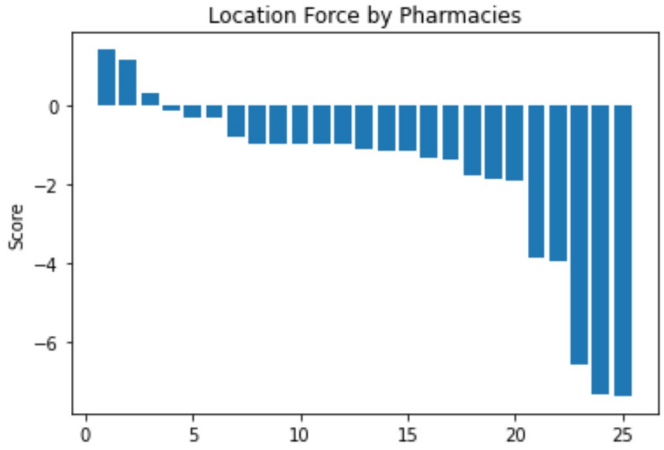
In [23]:
```
nearby_venues_sorted = nearby_venues_sorted.sort_values(by ='force', ascending=False)
```

Out[23]:

	name	address	city	categories	lat	lng	dotcolor	force
17	TopPharm Apotheke & Drogerie Höschgasse	Höschgasse 50	Zürich	Pharmacy	47.357833	8.554642	yellow	1.400480
10	Dr. Andres Apotheke Stadelhofen	Goethestrasse 22	Zürich	Pharmacy	47.366116	8.548078	yellow	1.127280
8	Berg-Apotheke	NaN	Zürich	Pharmacy	47.373271	8.529176	yellow	0.318340
13	Anrig Drogerie Naturathek	Forchstrasse 26	Zürich	Pharmacy	47.363991	8.556103	yellow	-0.135609
9	Topwell Apotheke-Drogerie	Tessinerplatz 10	Zürich	Pharmacy	47.364583	8.531195	yellow	-0.301005
19	Apotheke Schaffhauserplatz	Seminarstrasse 1	Zürich	Pharmacy	47.391778	8.538677	yellow	-0.309384
20	Vision hair	Nordstrasse 89	Zürich	Pharmacy	47.388483	8.535689	yellow	-0.790753
12	DROPA Apotheke & Post Hottingen	Freiestrasse 55, Beim Hottingerplatz	Zürich	Pharmacy	47.369764	8.555808	yellow	-1.000000
94	Drogama Apotheke Drogerie	NaN	Zürich	Pharmacy	47.370014	8.508480	yellow	-1.000000
21	Wehntal Apotheke	NaN	NaN	Pharmacy	47.403184	8.536066	yellow	-1.000000
16	Bären-Apotheke	Kalkbreitestrasse 131	Zürich	Pharmacy	47.370567	8.514387	yellow	-1.000000
95	Neumarkt Apotheke Drogerie	Altstetterstrasse 145, Neumarkt Altstetten	Zürich	Pharmacy	47.388364	8.487370	yellow	-1.000000
1	Bellevue Apotheke	Theaterstrasse 14	Zürich	Pharmacy	47.366755	8.545925	yellow	-1.100178
11	TopPharm Leonhards-Apotheke	Stampfenbachstrasse 7	Zürich	Pharmacy	47.377046	8.543790	yellow	-1.149204
3	Rosen Apotheke	Niederdorfstrasse 11	Zürich	Pharmacy	47.373329	8.543857	yellow	-1.180184
15	Coop Vitality	Kalanderplatz 1	Zürich	Pharmacy	47.358388	8.523170	yellow	-1.334641
18	apodoc	NaN	NaN	Pharmacy	47.387632	8.519185	yellow	-1.388125
5	Odeon Apotheke	Limmatquai 2, Bellevueplatz	Zürich	Pharmacy	47.367740	8.545305	yellow	-1.798875
93	DROPA Drogerie Apotheke Limmatplatz	Limmatplatz 7	Zürich	Pharmacy	47.385119	8.531566	yellow	-1.886747
14	TopPharm Limmatplatz Apotheke	Limmatstrasse 119	Zürich	Pharmacy	47.383865	8.532567	yellow	-1.933191
4	Sun Store Apotheke	Löwenstrasse 31-35	Zürich	Pharmacy	47.375423	8.536251	yellow	-3.864038
2	Victoria Apotheke	Bahnhofstr. 71	Zürich	Pharmacy	47.374796	8.538618	yellow	-3.957979
0	Bahnhof Apotheke	Bahnhofplatz 15	Zürich	Pharmacy	47.377142	8.539919	yellow	-6.562144
6	Coop Vitality Zürich Bahnhofstrasse	Bahnhofstrasse 81	Zürich	Pharmacy	47.375954	8.539052	yellow	-7.323256
7	Amavita Apotheke	Bahnhofstrasse 108	Zürich	Pharmacy	47.376265	8.539795	yellow	-7.367706

In [24]:
```
# Replace NaN by ''
nearby_venues_sorted.address = nearby_venues_sorted.address.fillna('NA')  # https://foru

labels = nearby_venues_sorted['name'] .tolist() # Labels must be unique for creating a b
force  = nearby_venues_sorted['force'].tolist()

temp =0
for i in labels:
    print (temp+1,'\t', i)
    labels[temp] = temp+1 #    i[:2];
    #labels[temp] = i[:10] #    i[:2];
    #print (temp+1,'\t', labels[temp], '\t', i)
    temp = temp + 1

# draw barchart
width   = 0.8
fig, ax = plt.subplots()
ax.bar(labels, force, width )
ax.set_ylabel('Score')
ax.set_title('Location Force by Pharmacies')
plt.show()
```

```
1       TopPharm Apotheke & Drogerie Höschgasse
2       Dr. Andres Apotheke Stadelhofen
3       Berg-Apotheke
4       Anrig Drogerie Naturathek
5       Topwell Apotheke-Drogerie
6       Apotheke Schaffhauserplatz
7       Vision hair
8       DROPA Apotheke & Post Hottingen
9       Drogama Apotheke Drogerie
10      Wehntal Apotheke
11      Bären-Apotheke
12      Neumarkt Apotheke Drogerie
13      Bellevue Apotheke
14      TopPharm Leonhards-Apotheke
15      Rosen Apotheke
16      Coop Vitality
17      apodoc
18      Odeon Apotheke
19      DROPA Drogerie Apotheke Limmatplatz
20      TopPharm Limmatplatz Apotheke
21      Sun Store Apotheke
22      Victoria Apotheke
23      Bahnhof Apotheke
24      Coop Vitality Zürich Bahnhofstrasse
25      Amavita Apotheke
```

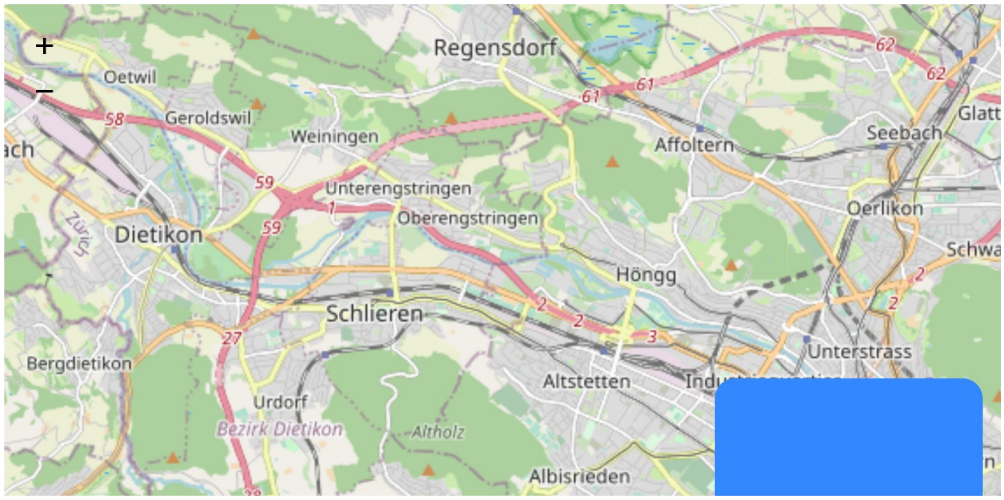


In [25]:

```
The following calculation may take 6 Minutes, 30 Seconds
```

In [26]:
```
data_length               = 0
data_high                 = 0
folium_tooltip            = 'Click me!'
filename_excel_dfr_matrix = 'dfr_matrix.xlsx'

########################################
dic_matrix = {'data_high':[], 'data_length':[], 'lat':[], 'lng':[], 'myforce':[], 'googl
dfr_matrix = pd.DataFrame(dic_matrix)
########################################

m = folium.Map(
    location  =[cnt_lat, cnt_lng],
    zoom_start=12,
)

lng = min_lng
while lng <= max_lng:

    lat       = min_lat
    data_high = 0
    while lat <= max_lat:

        myforce       = fnc_positionvalueof(lat,lng)
        if myforce <-2:
            myforce =-2
        ############################################################
        matrix_googlemaps = str(lat) + ', ' + str(lng) # 47.367296, 8.544618 Google Form
        matrix_new_row = {
                    'data_high'         :data_high      ,
                    'data_length'       :data_length    ,
                    'lat'               :round(lat,4)   ,
                    'lng'               :round(lng,4)   ,
                    'myforce'           :myforce        ,
                    'googlemaps'        :matrix_googlemaps  }
        dfr_matrix = dfr_matrix.append(matrix_new_row, ignore_index=True)
        ############################################################

        folium.CircleMarker([lat, lng], popup='<i>I am here</i>', tooltip=folium_tooltip
        lat         = lat+stp_lat
        data_high   = data_high + 1

    lng         = lng+stp_lng
    data_length = data_length + 1
dfr_matrix.to_excel(r'dfr_matrix.xlsx', index = False)

#folium.Marker([max_lat, min_lng], popup='<i>Corner</i>', tooltip='Top Left'    ).add_to
#folium.Marker([max_lat, max_lng], popup='<i>Corner</i>', tooltip='Top Right'   ).add_to
#folium.Marker([min_lat, min_lng], popup='<i>Corner</i>', tooltip='Bottom Left' ).add_to
#folium.Marker([min_lat, max_lng], popup='<i>Corner</i>', tooltip='Bottom Right').add_to

m
```

Out[26]:



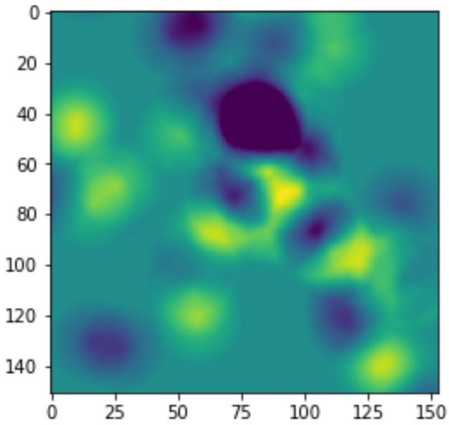
In [27]:
```
# create array, matrix for uniform data. Zero is top left.

filename_excel_dfr_matrix = 'dfr_matrix.xlsx'
df                        = pd.read_excel(filename_excel_dfr_matrix )
high                      = df['data_high'  ].max()
length                    = df['data_length'].max()
df2                       = df.pivot(index='lat', columns='lng',values='myforce')

df2.sort_index(ascending=False, inplace=True)

uniform_data = df2
```

Out[27]:

lng	8.5150	8.5153	8.5156	8.5159	8.5162	8.5165	8.5168	8.5171	8.5174	8.5177
lat										
47.3850	0.0	0.0	-0.003501	-0.040363	-0.075352	-0.108248	-0.138809	-0.166780	-0.191891	-0.213869
47.3848	0.0	0.0	0.000000	0.000000	-0.030759	-0.062089	-0.091097	-0.117555	-0.141225	-0.161873
47.3846	0.0	0.0	0.000000	0.000000	0.000000	-0.014955	-0.042534	-0.067613	-0.089983	-0.109443
47.3844	0.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	-0.017063	-0.038258	-0.056649
47.3842	0.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	-0.003551
...	...	...	...	...	...	...	...	...	...	...
47.3558	0.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	-0.018967	-0.042989
47.3556	0.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
47.3554	0.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
47.3552	0.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
47.3550	0.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

151 rows × 153 columns

In [28]:
```
# https://www.techtrekking.com/heatmap-using-matplotlib-and-seaborn-data-visualization-u
from matplotlib import pyplot as plt
import numpy as np

plt.imshow(uniform_data)
plt.savefig('heatmap-01.png')
```



In [29]:
```
import seaborn as sns
#import numpy as np
plt.rcParams['figure.figsize'] = (20.0, 10.0)
plt.rcParams['font.family'] = "serif"
```

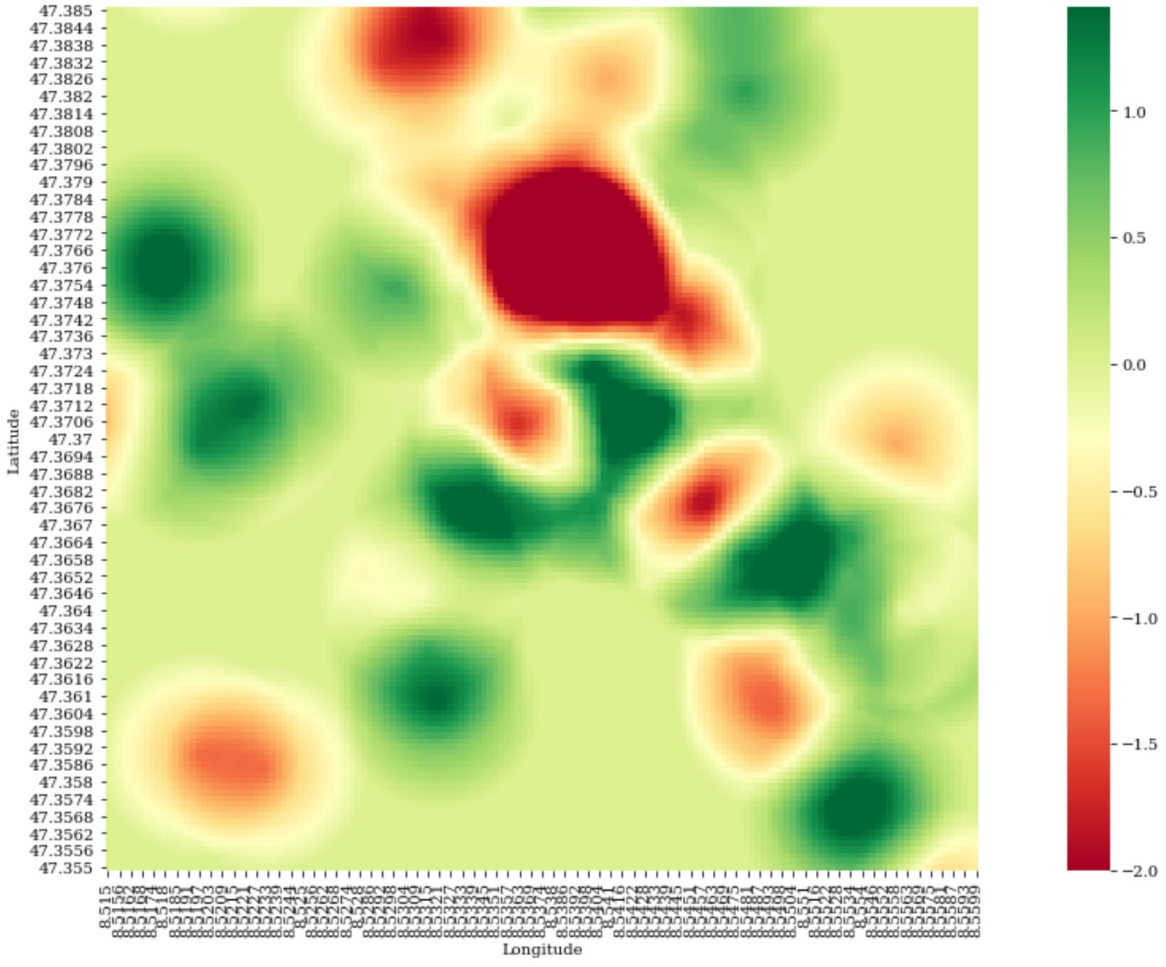
Out[29]:

lng / lat	8.5150	8.5153	8.5156	8.5159	8.5162	8.5165	8.5168	8.5171	8.5174	8.5177
47.3850	0.0	0.0	-0.003501	-0.040363	-0.075352	-0.108248	-0.138809	-0.166780	-0.191891	-0.213869
47.3848	0.0	0.0	0.000000	0.000000	-0.030759	-0.062089	-0.091097	-0.117555	-0.141225	-0.161873
47.3846	0.0	0.0	0.000000	0.000000	0.000000	-0.014955	-0.042534	-0.067613	-0.089983	-0.109443
47.3844	0.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	-0.017063	-0.038258	-0.056649
47.3842	0.0	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	-0.003551

5 rows × 153 columns

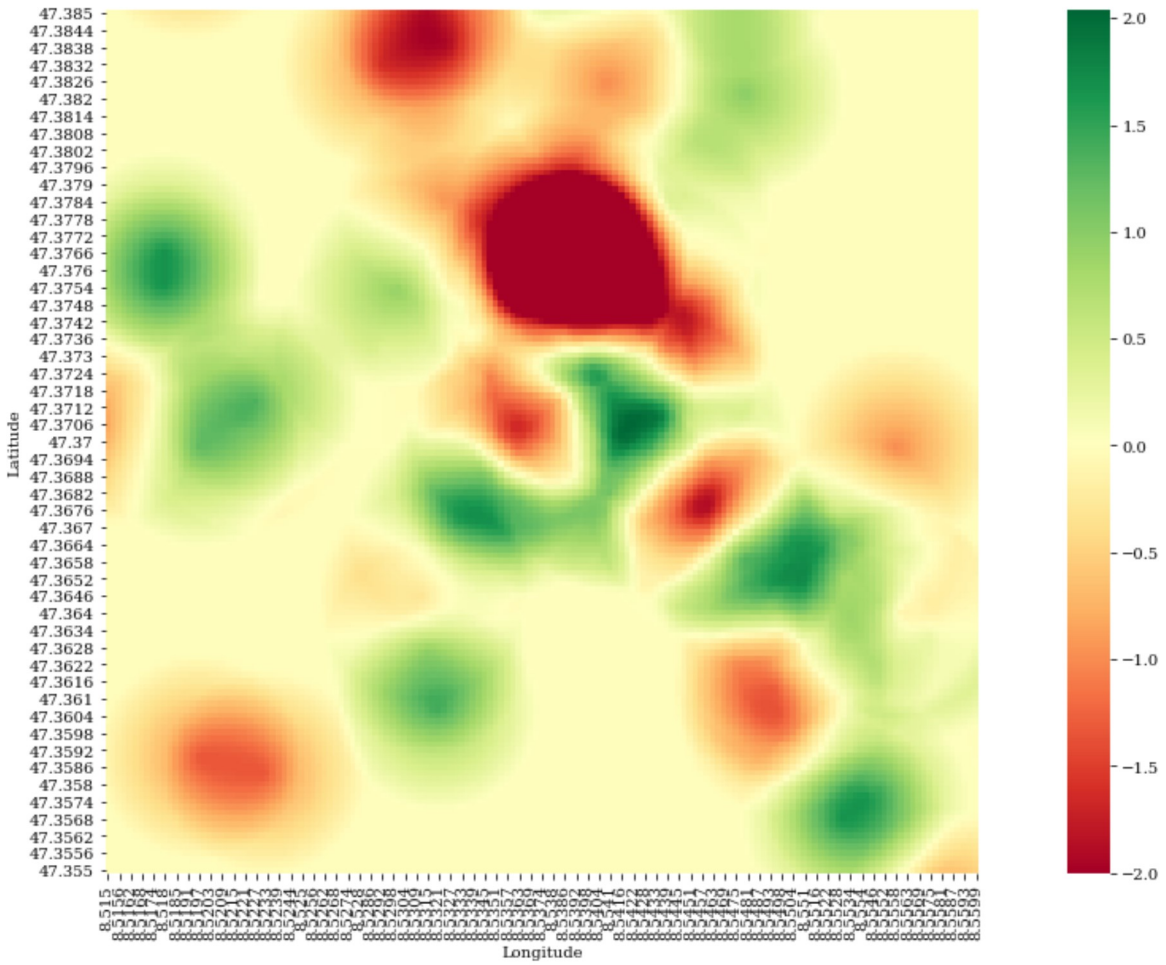
In [30]:
```
sns.heatmap(df2,
            robust=True,
            square=True,
            cmap  ='RdYlGn',
)
plt.xlabel('Longitude')
```

Out[30]: Text(502.0000000000001, 0.5, 'Latitude')



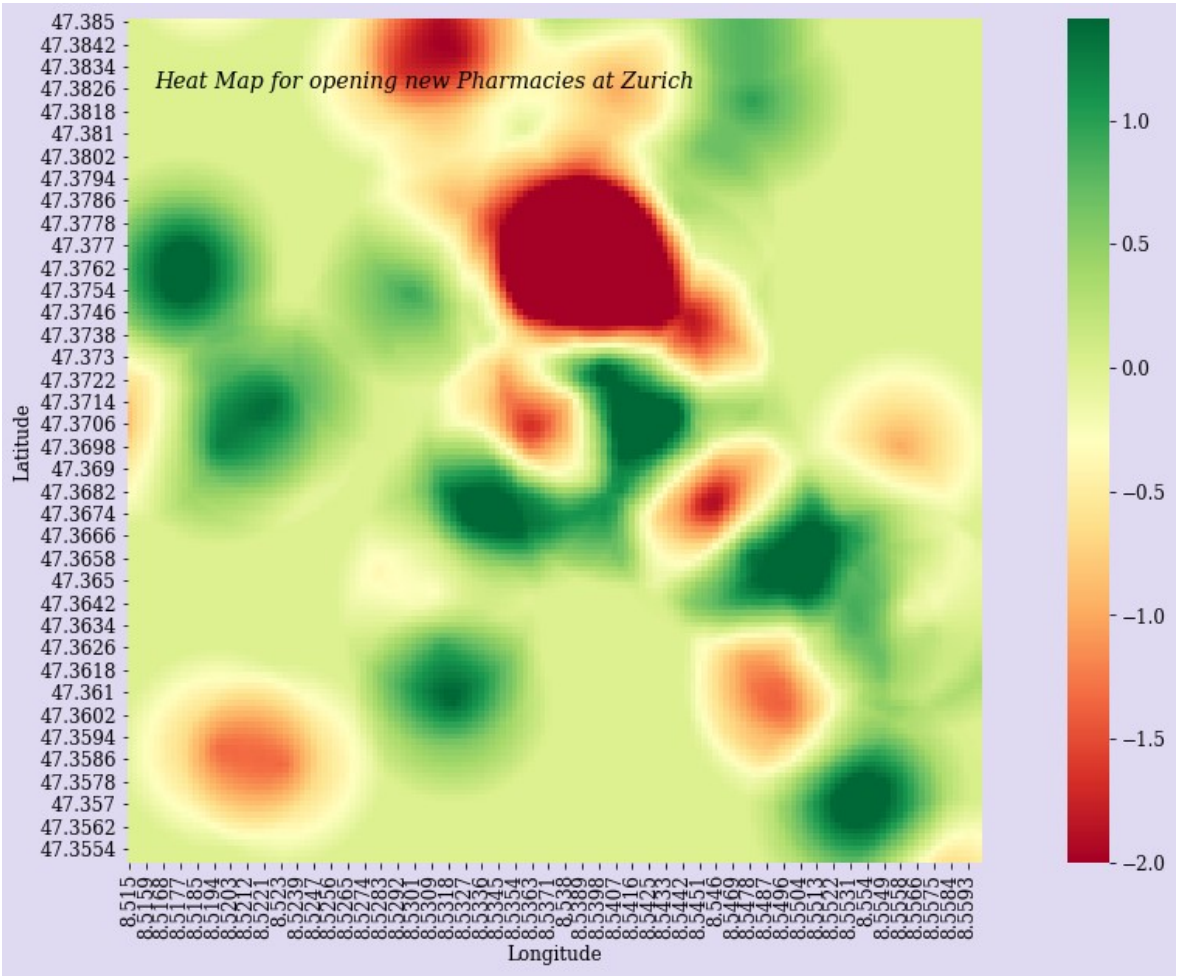
In [31]:
```
sns.heatmap(df2,
            cmap='RdYlGn',
            square=True
           )
plt.xlabel('Longitude')
```

Out[31]:
```
Text(502.0000000000001, 0.5, 'Latitude')
```



In [32]:
```
# Finalize
plt.rcParams['font.size'] = 12
bg_color = (0.88,0.85,0.95)
plt.rcParams['figure.facecolor'] = bg_color
plt.rcParams['axes.facecolor']   = bg_color
fig, ax = plt.subplots(1)
p = sns.heatmap(df2,
                robust=True,
                cmap='RdYlGn',
                annot=False,
                fmt=".1f",
                annot_kws={'size':12},
                square=True,
                ax=ax)
plt.xlabel('Longitude')
plt.ylabel('Latitude')
#ax.set_ylim((0,15))
```

Out[32]: Text(5, 12.3, 'Heat Map for opening new Pharmacies at Zurich')



In [33]:

In [ ]: