Data Science Capstone Assessment

Neil Mackin, July 2020

Exploring distribution of private pharmacies in Sweden

Introduction

The COVID-19 pandemic, aside from its immediate effects, has led to uncertainty over the healthcare of vulnerable people, especially the elderly and those with pre-existing conditions. Many of these people now face a dilemma when it comes to accessing their healthcare needs since they may feel that visiting a hospital or clinic could expose them to avoidable risks; this is especially the case where existing services are stretched and may be experienced even in countries with socialised healthcare provision. There may be a gap in the market for both public and private pharmacies to do more in local communities to ensure provision of basic medicines and equipment and for all people, but especially at-risk groups.

I will look at data across Sweden by municipality. There are 290 municipalities and the relevant data will be:

- Population per municipality, from Sweden's national statistics database
- Area of the municipality, to create a view of population density; it is the total population that is important but population density may give a good measure of average travel distance to reach services
- Average age per municipality
- Pharmacies across Sweden by municipality from Foursquare

The main metrics to consider will be:

1. pharmacies per capita by municipality
2. pharmacies per capita by average age
3. pharmacy 'density' versus population density

From this will be possible to present recommendations to private companies to show in which Swedish municipalities there may be opportunities for new private pharmacies.

Data

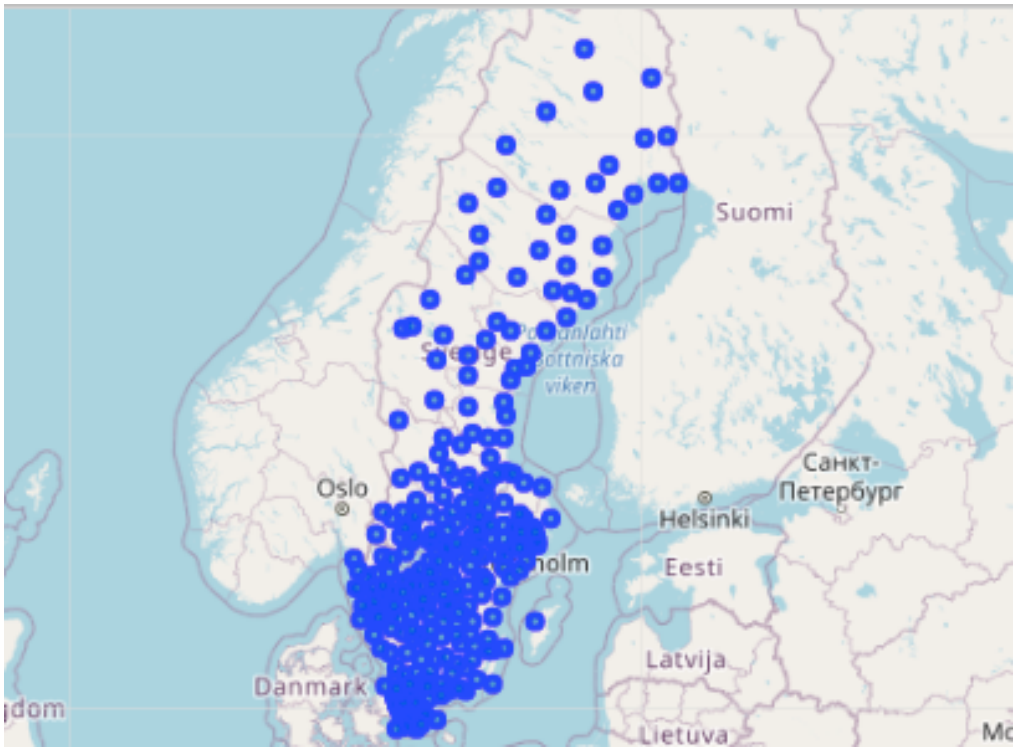
I have used:

1. List of municipalities and demographic data from ‘Statistics Sweden’ at scb.se, most of which is provided in a useful table in the relevant Wikipedia page, linked to in the Python code. Average age by municipality is directly from the Statistics Sweden site.
2. Latitude and Longitude information for the ‘seat’ or administrative centre of each municipality using the geolocation function in Python’s geopy library.
3. Count of pharmacies listed in Foursquare within a radius of 10km from the administrative seat of each municipality; note this is intended as a proxy for the general availability of pharmacies within the municipality. Search keyword is “apotek”.

Methodology

First a data frame was constructed with a list of Sweden’s 290 municipalities. This was looped through the geopy geolocator function to produce the latitude and longitude for the specific locations of the ‘seat’ of the municipality. For each of these 290 locations, a Foursquare query was used to create a list of pharmacies within 10km of the seat. The relevant variable is simply a count of the locations found.

Data with average age of the population within each municipality was merged with the existing dataframe, using the Municipality code as an identifier. Finally, non-required data was dropped so the final variables included were: Code, Municipality name, Municipality seat, County, Population, Land area, Population density and Average age. The correlation between each of these factors was calculated in Python using the correlation function in the sklearn library.



Map of Sweden showing location of all municipality administrative seats (2019)

There were two approaches taken with the aim of finding potentially under-served communities across Sweden.

- With the hypothesis that older members of the population will find it more important to have accessible healthcare options, including pharmacies. Average population age, of each municipality as well as Total municipality population (i.e. potential market) was compared with the pharmacy count in each municipality
- The list of municipalities with zero pharmacies (excluded from the first analysis) listed in Foursquare within a 10km radius of the municipal seat were compared with average age.

The aim of this approach was both to (1) Find correlations between the factors assessed that would help to plan for future placement of pharmacies or other healthcare services and (2) identify individual or groups of locations that seem to be under-served.

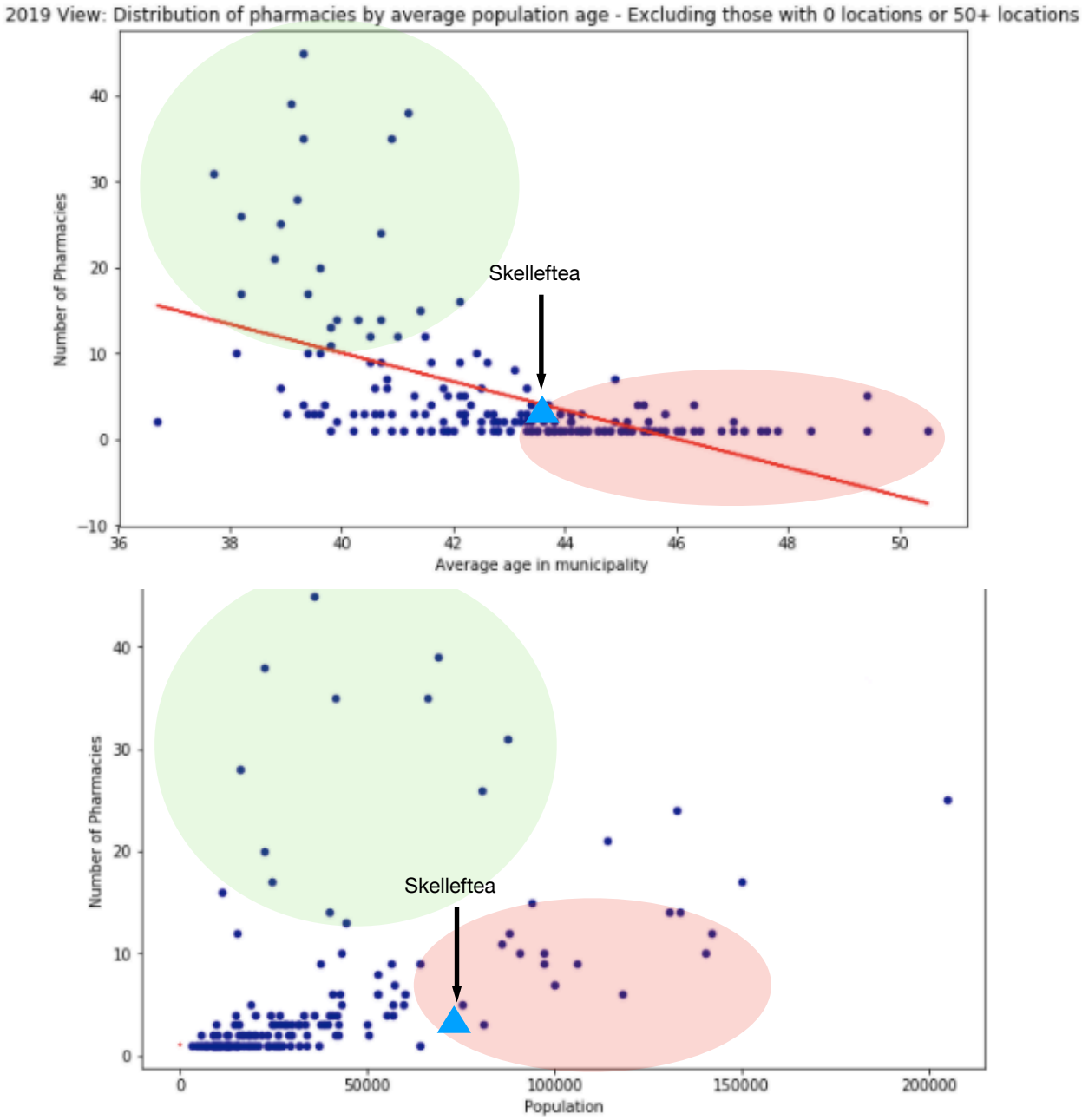
Results

Two scatter graphs were plotted that exclude both the municipalities where a return of >50 pharmacies was found in Foursquare. This is because, for those locations (mostly in Stockholm County), the Foursquare API would not be able to provide an accurate count due to 50 being the limit of returned results. These places were also very unlikely to be under-served in the final analysis.

The graphs are:

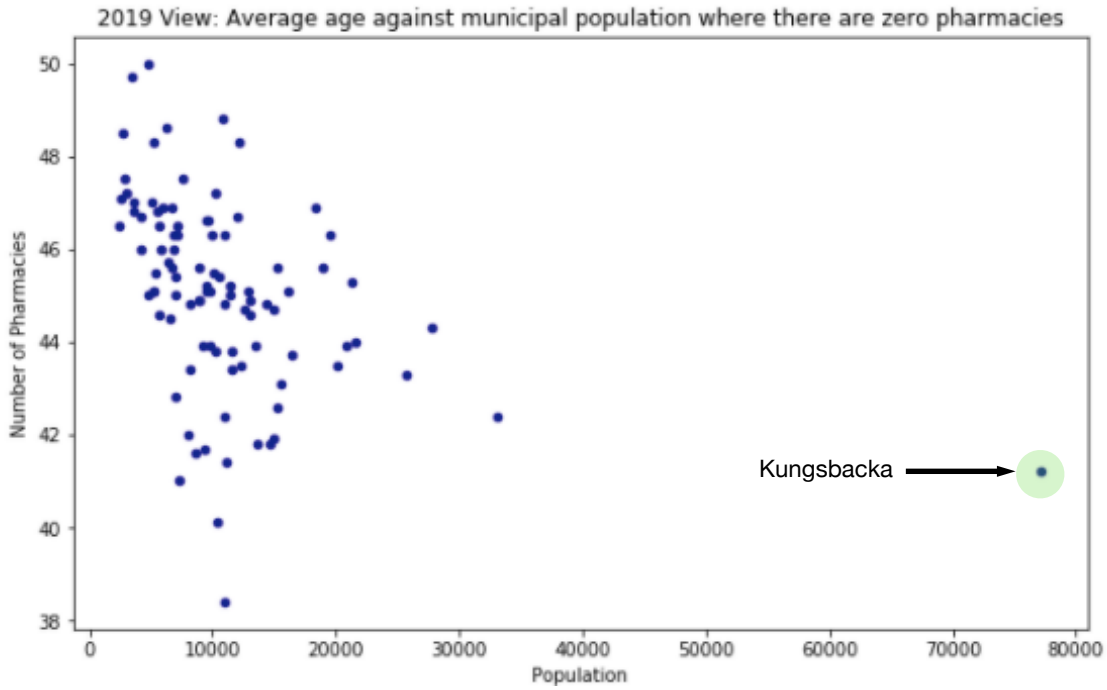
1. Distribution of pharmacies compared with Average municipality population age
2. Distribution of pharmacies compared with Total municipal population

We are looking for locations with both a relatively high population age and also a relatively high total population with respect to the number of pharmacies available according to the Foursquare data.



Each graph shows two areas: (1) The green area where population\age is low but number of pharmacies is high and (2) The red area where population\age is high but number of pharmacies is low. a combination of both high average age and total population should represent a high need of local healthcare services, including pharmacies. As an example I have picked the one potential overlap of the two graphs. This is the municipality of Skelleftea where population is relatively high, (71,927) and average population age is also relatively high (43.6). However, there were only 3 pharmacies available in this municipality.

A third scatter graph considers only the locations where a Pharmacy count of zero was returned by the Foursquare API and considers the combination of age and population. Again, both high age and high population would be considered an indication of increased need. Here the number of pharmacies is held constant (at zero) so it is easy to see these two factors together.



From the group with zero pharmacies there is one clear outlier, which is Kungsbacka, with a population of 77,211 and average age of 41.2.

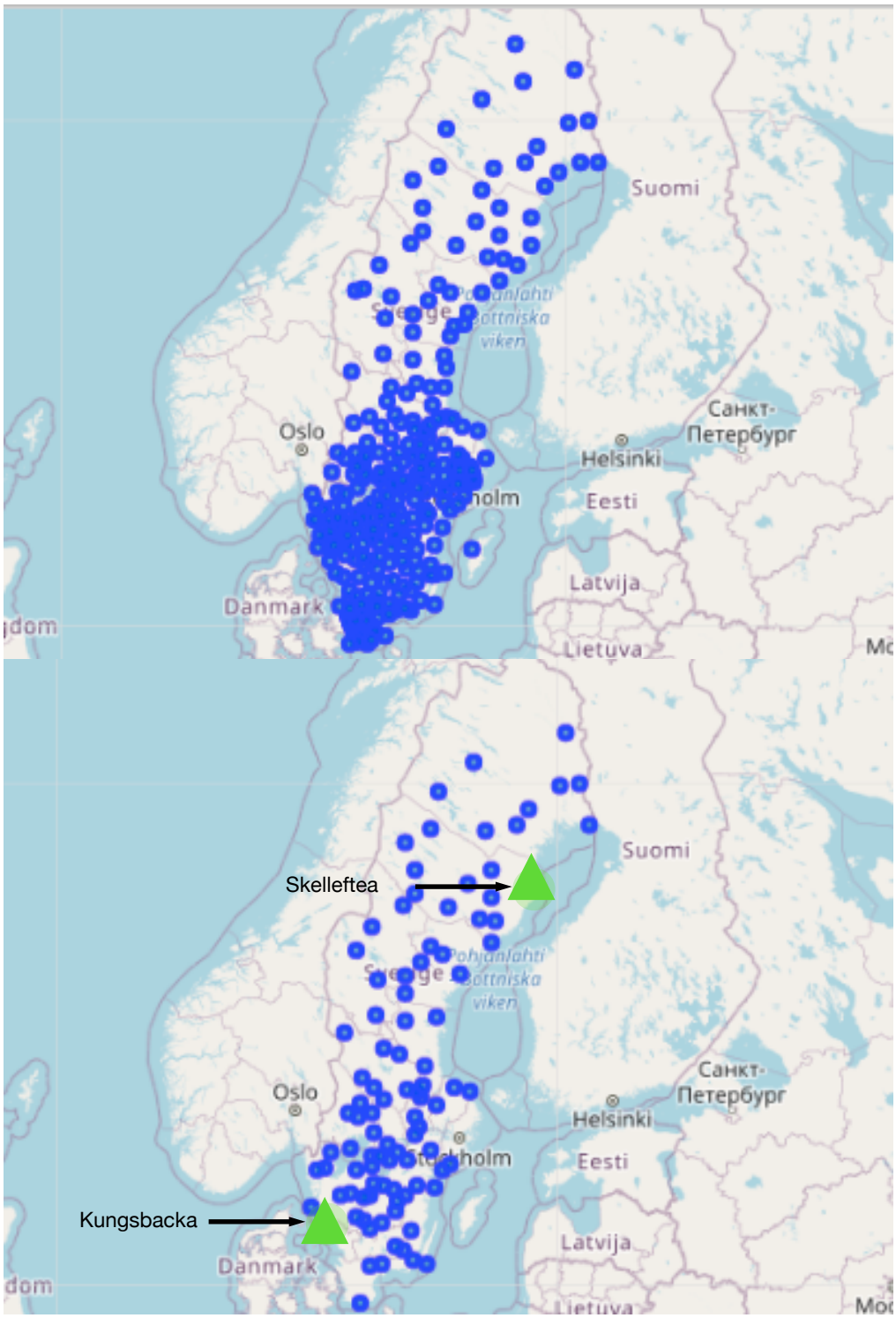
Discussion

This analysis is a good start to considering where opportunities for private pharmaceutical services could both benefit the Swedish population and be commercially successful. Indeed, mining the extensive Swedish statistics should be an excellent way to discover where resources are lacking in many areas. There are quite a few limitations and areas for improvement to this analysis:

First, the focus on age is based directly on the ongoing COVID-19 pandemic. However, although health challenges in general may indeed increase with age, the next pandemic could be worse for a different demographic. It also seems that we are not looking at a mix of ages across municipalities across varied geographies; the range of average ages covers 36.7 to 50.5 and there are moderate negative correlations between age and both pharmacy count and total municipality population (-0.53 and -0.52 respectively). Land area and latitude also have a moderate correlation. What this shows is not (necessarily) that there are fewer pharmacies provided for older people. It is more likely to reflect that older people are more likely to live in the northern municipalities that are larger and less densely populated. Since we have only looked in a 10km radius for pharmacies, the count may be lower in such municipalities. An improvement would therefore be able to search for the full list (>50 pharmacies) and to limit it to the boundaries of a specific municipality. It may also be that: (1) Foursquare does not capture all of the relevant locations and (2) The specific search term “apotek” does not find all of the entries in Foursquare that provide these services.

This analysis also not establish that there is actually a requirement for older people to have increased and closer access to pharmaceutical services. It also does not look at how existing services are provided. For example: what size are the existing pharmacy locations and are they linked to clinics or hospitals? Are home visit or medicine delivery services available? Finally, we have only looked at existing provision. There is no view of where standards of health are lowest or which location would be best from a commercial point of view.

The maps below show again the locations of all Swedish municipality seats. Beneath that is the map of under-served locations, highlighting two initial potential locations for a private pharmacy for further research. The recommendation is to proceed with this.



Sweden maps showing location of all municipality administrative seats and the under-served communities with two municipalities highlighted as potential development opportunities.

Conclusion

Skelleftea and Kungsbacka Municipalities in Sweden are potential locations to develop local-oriented private pharmacies. This is based on the availability of existing suppliers of pharmaceutical services in the area, plus the average age of the population. More research would also be required.