Starting a bike rental business

Finding good locations near larger European airports

Introduction

Background

Travelling in Europe often involves going to – and waiting at – airports. Often you have to wait for a connecting flight, or because you worry about traffic jams on the way to the airport, or simply in fear of getting lost in a foreign country on your way to the airport. Thus, often you may have to wait for several hours at airports.

Airports often have very similar (and boring) venues. There are about 1.6 billion passengers at the 90-100 busiest airports in Europe. Thus, much time is not well spent.

However, if you have arrived at an airport near a city you do not know very well, it may be risky to travel to the city center to seek time well spent. It may also be challenging to travel outside the ariport on your own, not at least due to lots of different languages in Europe.

If the city center is close to the airport, or if there is a train station at the airport, this risk may be lower. You may also want to travel to possible interesting venues near the airport. Recent technological developments may also have made e-scooters and e-bikes (hereafter «bikes») more attractive. (For instance, AI functionality in maps, and self-driving e-scooters that can drive to a charging station themselves.)

New forms of micro travel, and other forms of innovative travel (selv-driving transportation), will undoubtedly become important within a number of years. Experience from running an bike rental business may give you lots of data that can be useful in such other businesses later on. Thus, it could be worthwile to run bike rental businesses, even if one would not make a profit in the short run. For instance, within a few years (in the long run) small adjustments to trains and adding small boxes to bikes could be used in combination to find new and improved parcel delivery systems. Starting a bike rental business could also improve the image of businesses that are not perceived as environmentally friendly.

Problem

The core question is: Are there good locations for starting new bike rental venues near larger European cities? This will be the case if you are likely to get many people to use such services, either travelling to and from the airport to the city, or travelling to venues nearby the airport. Where are you likely to find many such passengers interested in travelling environmentally friendly, and interested in travelling to interesting venues outside, and not spend hours waiting at airports getting bored?

This projects aims to identify larger European airports that could be good locations, and also airport that probably are not viable for bike rental businesses.

Who might be interested

This could be of interest to businesses considering starting bike rental businesses. It could also be interesting for people who like to make short trips to new cities, and who do not like spending lots of time waiting at airports and who like to try new things.

Data acquisition and cleaning

Data sources, and whether the data is representative

Below I will discuss what data is needed to solve the business problem.

We need data about airports, cities, trains, bike rental businesses and venues near airports. Data about airport and the cities they serve is coming from Wikipedia. Foursquare data will be important to get information about trains, bike rental businesses and venues near airports. Some information about countries and regions will be gathered from the internet pages of the European union.

Generally speaking, this data should be representative. However, a possible question is whether countries with early smart phone use, and many English-speaking tourists may have registered a larger share of venues. Another question could be how the exact locations are set for the airports, since an airport covers a relatively large area.

Data and «Data cleaning»

A table of larger European airports were scraped from Wikipedia[1] and put into a data frame. Some columns had to be cleaned and converted to numbers. For one airport, three countries were listed. This was reduced to one country. This and another airport was registered as serving three cities. This was also adjusted, in order to avoid problems later. A few airports from countres far east in Europe were removed (for instance, it could result in misleading results for Russia as only parts of the country was included). Thus, 92 airports were left to study.

Regional classification was added to the data frame. One such classification was the UN classification in the UN immigration table (see the Visualization module). Other classifications were added as well, such as EU membership[2], whether it is an older or newer member state, and a classification of Scandinavia/the Nordic region.
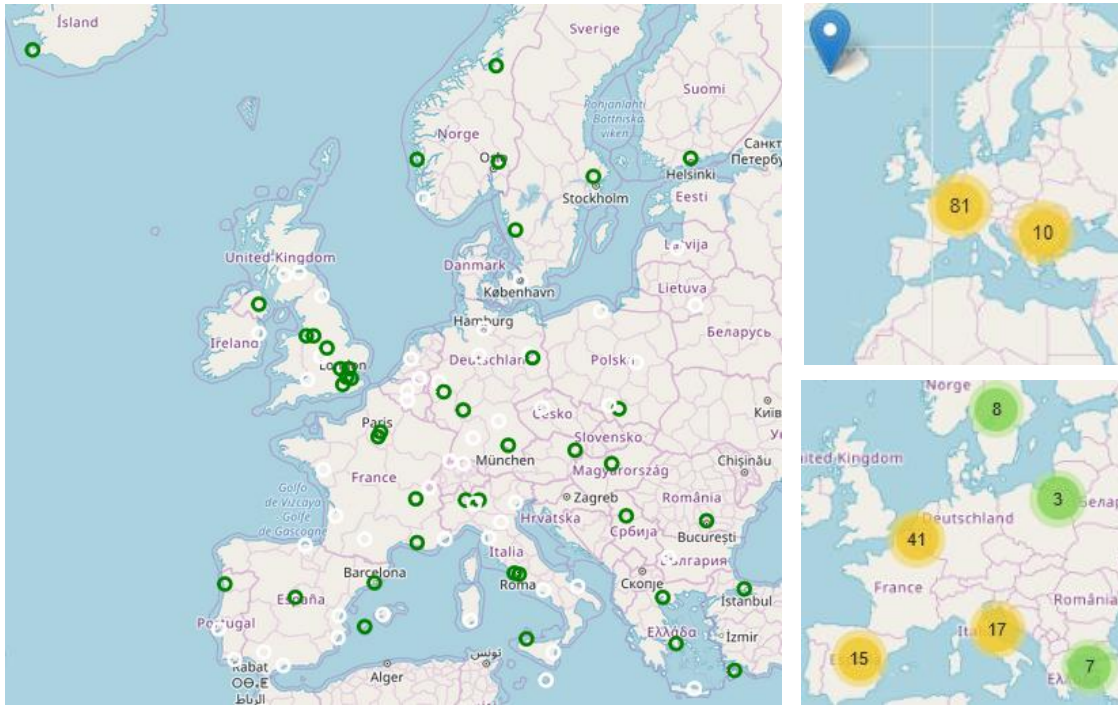
The names of airports and cities were then used to find their locations. However, a number of the airports were not found. A few times the API also returned error(s) than could indicate that the stability is not perfect. Using a more detailed address did not help, this caused even more missing values. In order to remedy this, a number of airports names were «corrected» (this included removing names of historical figures airports are named after, and just keep city and country). A few queries returnes results that were somewhat surprising. For instance, when searching for Athens, this returned a location somewhere in USA. It was easy to find such errors by visualizing the location data with folium maps.

To check that the data cleaning had been successful, a Folium map with Circle Markers were used to chatch errors such as Nominatim returning airport or city locations in wrong countries, see below (left). Any red circles (more than 200 km from the airport to the city) would mean something was wrong (green: less than 12 km to city, white: more than 12 km). In addition, a Folium map with MarkerCluster was used to verify that all 92 airports were plotted (below, right x 2).

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[1] https://en.wikipedia.org/wiki/List_of_the_busiest_airports_in_Europe
[2] https://europa.eu/european-union/about-eu/countries_en#28members Such lists are also available many other places.

The location data were added to the table. Having such structured data, we could now collect lots of more data. First, we collected information about distance from city to airport by using Geopy. We also added regions the countries belong to, based on the regional division in the UN Immigration dataset (see the Visualization module). We also added other regional information, about EU membership status, the Nordic region and the BeNeLux[3] countries.

Foursquare was then used to acquire information about train stations, bike rentals, and possible interesting venues near the airports.

To find the Foursquare venues, the category Ids were used to collect aggregate data. Given that there are many different languages used in Europe, it seemed doubtful whether it would be a good idea to use furter detail (such as the name of the venue). Thus, aggregate data was used.

Feature selection
The following details were selected: Country, Airport name, city served, the location of these places and their distance. The number of passengers in 2017, 2018, and the change from 2017 to 2018. The largest cities were also marked. Additional regional information (whether an EU member stated and similar information) was also added.

From Foursquare the venue Ids were used for rail transportation (train stations, metro stations and similar), and for bike rental businesses. For possible venues to visit, selected venues were chosen (beaches, museums and gyms). The point of this was to find venues that are not traditional «airport venues» (that is, we would exclude among others restaurants and gift shops). If all of the venues, or most of the venues, had been chosen, it may also have resulted in problems with the API (rate limits).

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[3] Belgium, the Netherlands, Luxembourg

Methodoogy

Below we will use the data we have gathered and see if we can detect airports that may be particularly interesting for starting a rental business. First, we will perform initial exploration of the gatherede data. In this process we will also use Seaborn to visualize data and see if we can gain insights as to what properties could be of particular interest for studying later in this notebook. Visualizing the data will thus be very important for learning more about the 92 airports and their attractiveness for bike rental facilities.

As mentioned above, we only look at selected venue categories. The range was set to 3 km from the airport. Venues chosen are such that promotes a healthy lifestyle (gyms, bike trials, beaches) or provides a cultural experience (museums), and not restaurants and bakeries. (Searching for all venues at 92 airports might also cause API challenges, either that values above a set LIMIT are discarded or that there would be too many API calls).

There are many languages in EU/Europe (24 official languages in the EU, and 60 more unofficial/ used in parts of countries). Because of this, we have chosen not to work with venues on a detailed level, only aggregate: Working with venue names may be confusing when the names are in foreing languages.

Based on the results of visualization and other exploration, we will go deeper into the importance of venue counts, distance to city, competing rental services, trains and a few other categories. We will also use weights/ calculate a total score. As it turns out, the data does not seem to easily facilitate using machine learning in a stricter sense. However, we use it in a broader sense, by using Seaborn et cetera.

Exploratory Data Analysis

Division into regions. Regions and the number of airports.

By calculating the sum of the passengers, we see that these 92 European airports have more than 1.5 billion passengers.

The table below shows the distribution of airports in different regions in Europe. As can be seen from the table, Northern, Southern and Western Europe have about the same number of airports. Eastern Europe have far fewer airports, and even fewer that the sparsely populated Nordic region. However, one may note that a few Eastern European airports were removed from the selection (see the Data part above). Still, there is a substantial difference. (From the Notebook one can see that the Eastern European airports are growing faster, so perhaps it is some form of «catching up».)
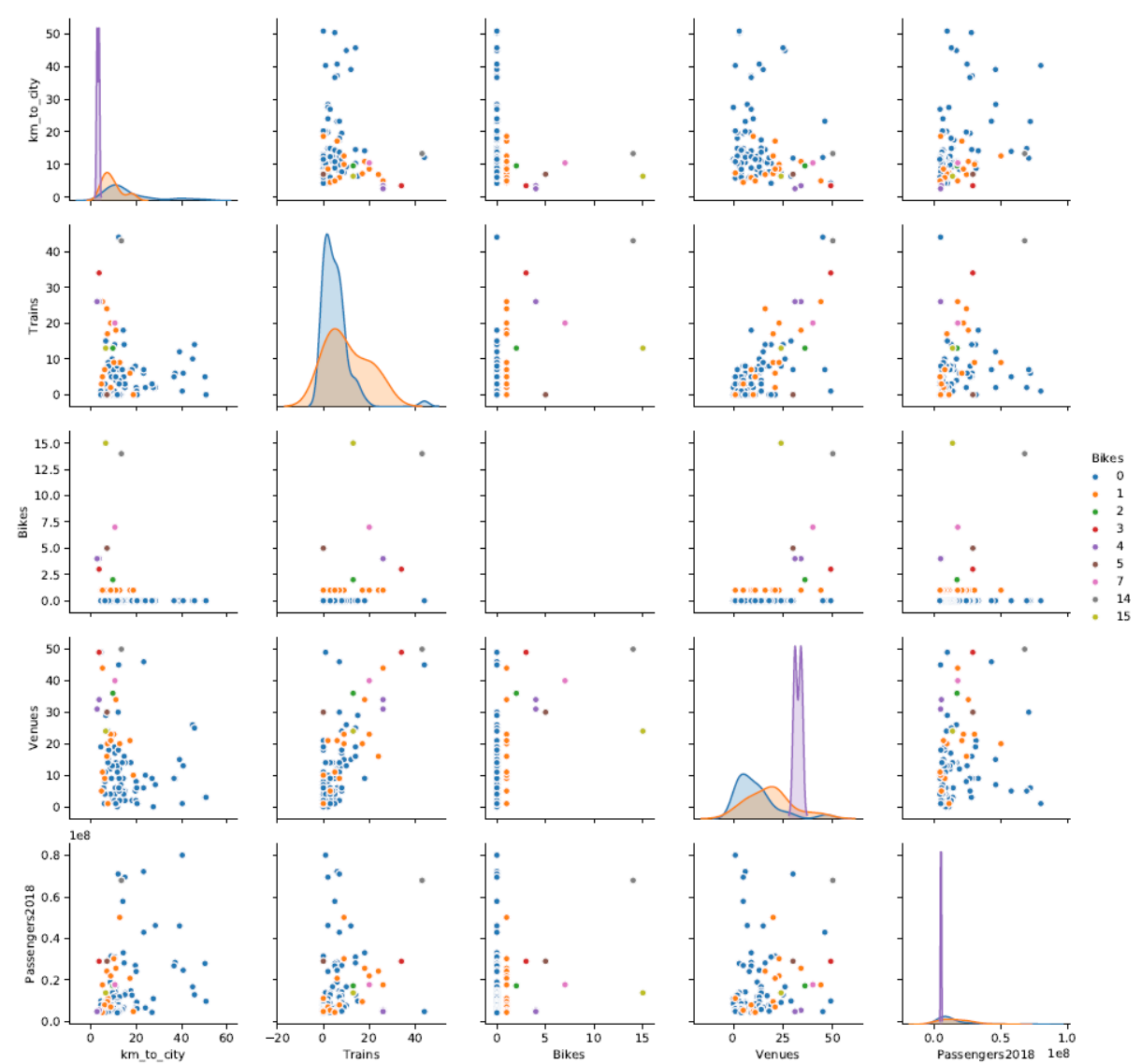
EE	8
NE	26
SE	32
WE	26
EUmember	83
EUold	72
EUnew	11
EEA_all	88
Nordic	9
BeNeLux	4

The table may indicate that the UN classification fits better to the purposes of this project, than the EU membership status.

The fact that the sparsely populated Nordic region has quite a few busy airports, may also make it interesting to look closer at this region (which is part of Northern Europe).
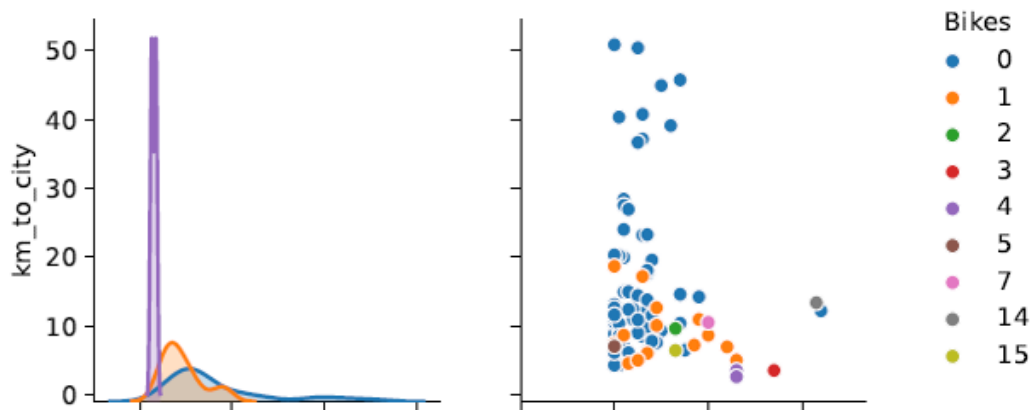
Overview of features – jointplot

To get an overview of the different relationships and get some information on how they might be correlated, a Seaborn jointplot was used:
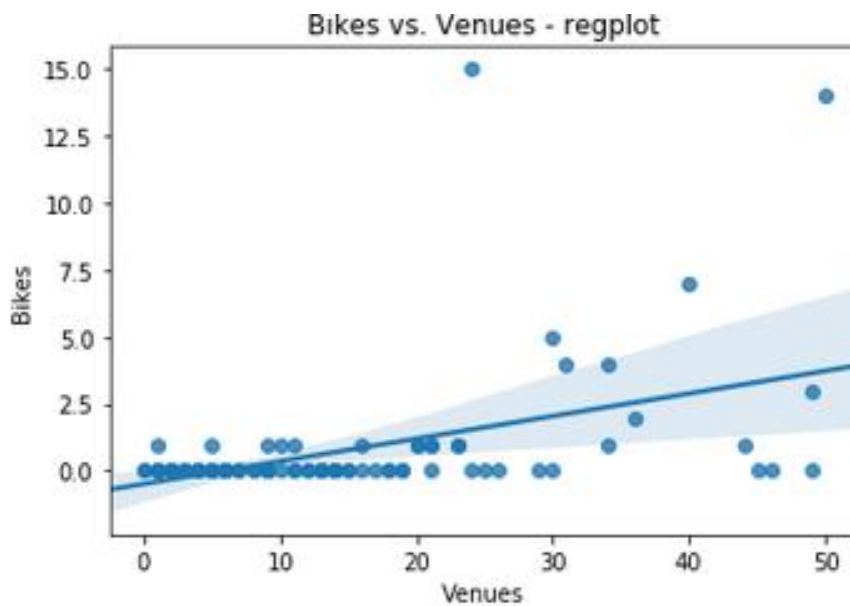

This jointplot gives an overview of how the variables may be correlated. A few things we can see from the jointplot:

1. Bikes vs. distance: We can see that airports situated very far from the city have only blue dots, that is, do not have any bike rental services.
2. Bikes vs. venues: Airports with many venues seem to have bikes more often.
3. Bikes vs. venues / Trains vs. venues: Bike rental may seem to be immature
4. Venues vs. distance: Airports that far from the city seem to have fewer venues nearby
5. Other: For several features, it seems unclear if anything useful can be found

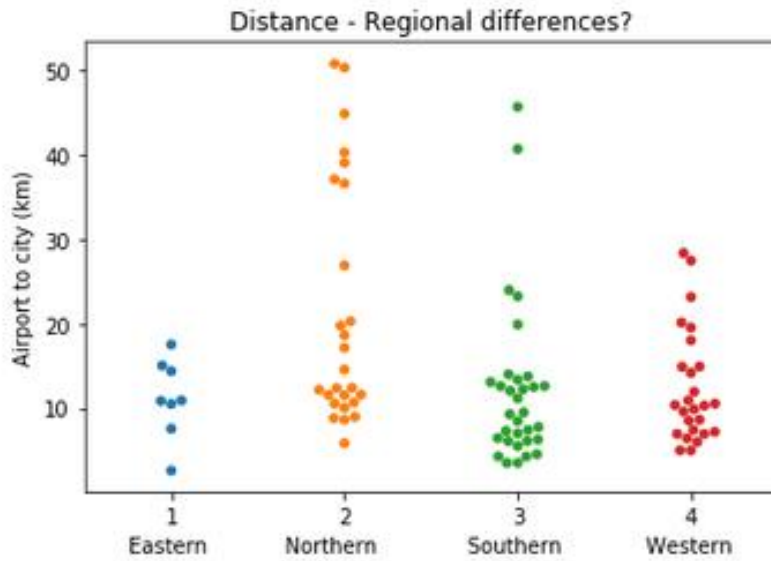Excerpt from the jointplot above, that shows no. 1 more clearly:

By using only one plot (instead of the 25 above), we can gain more information. For example, by using a sns reglot we can also get a regression line that shows that only airports with many venues nearby have more than one bike rental venues (no. 2). We can also confirm number 4 by using a kde plot, see below under «Venues».

After exploration of the data, it is my view that visualization should be the main form to present the data in this project. Thus, the perspective had to be somewhat modified from what was originally planned (using non-visualization machine learning more).

More about distance from airports to cities

Another question is whether there are regional differences. Indeed, there seem to be substantial differences: None of the airports in Eastern Europe are situated far from the city. In Northern Europe, quite a few are situated far from the airport.

The distance between the airport and city seem to be important. Thus it should be studied more. Below there are box plots of the distance for all airports that have bike rental venue(s) (first box plot), and airports without bike rentals (right):

As can be seen, box plots give lots of useful information, including information about bottom 25 %, median, 75 %, and outliers. Such information cannot be easily read from the joinplot above.

We can se from the top of the blue box that 75 % of airports with bike rentals are situated slightly more than 10 kilometres from the city (or less). By using the quantile function, we find that 80 % are within 10.83 km.

Bike rentals

If you want to start a rental business, it may be better to start a place where there are no bike rental competitors. First, we create a list of the largest airports without bike rental services, that are situated within 11 km from the city (80 % quantile rounded up to 11 km). There are 27 matching airports, and Southern Europe is the region with the most of them (EE: 3, NE: 5, SE:12, WE: 7). These are the top 10 airports:

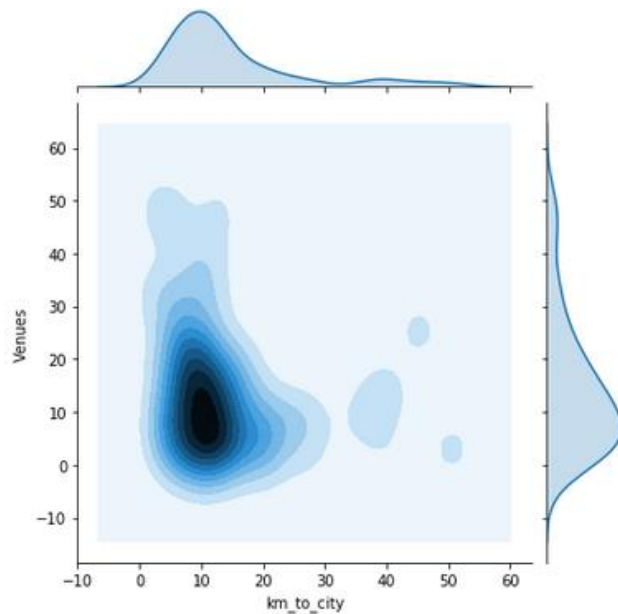|	Country	Airport	Passengers2018	Bikes	CityXL	EE	NE	SE	WE
0	Ireland	Dublin Airport	31497526	0	False	0	1	0	0
1	Switzerland	Zurich Airport	31113488	0	False	0	0	0	1
2	Spain	Málaga Airport	19021704	0	False	0	0	1	0
3	Czech Republic	Václav Havel Airport Prague	16797006	0	False	1	0	0	0
4	United Kingdom	Edinburgh Airport	14291811	0	False	0	1	0	0
5	Spain	Alicante Airport	13981320	0	False	0	0	1	0
6	United Kingdom	Birmingham Airport	12454642	0	False	0	1	0	0
7	Germany	Stuttgart Airport	11798090	0	False	0	0	0	1
8	Italy	Catania-Fontanarossa Airport	9933318	0	False	0	0	1	0
9	Italy	Naples Airport	9932029	0	False	0	0	1	0

The Nordic region has no airports on the list. The reason for that is that only one airport is situated less than 11 km from the city, and this airport (Copenhagen) already has a bike rental venue:

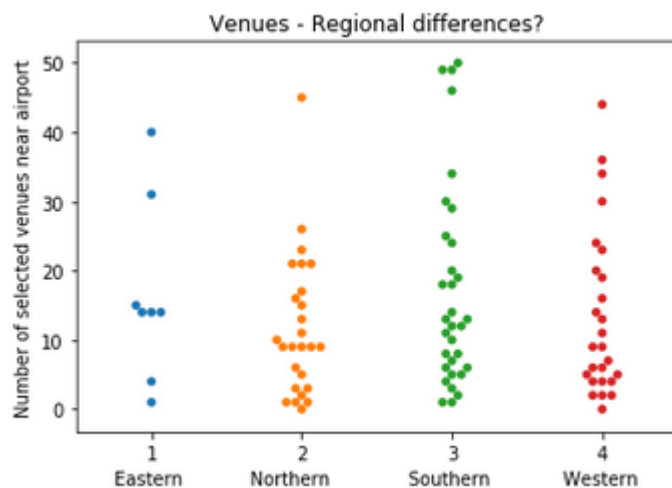|	Country	City	Airport	Passengers2018	km_to_city	Venues	Bikes	Trains
13	Denmark	Copenhagen	Copenhagen Airport	30298531	10.029	23	1	9
16	Norway	Oslo	Oslo Airport, Gardermoen	28518584	37.119	9	0	6
20	Sweden	Stockholm	Stockholm Arlanda Airport	26845419	36.631	9	0	6
26	Finland	Helsinki	Helsinki Airport	20848838	17.154	21	1	6
48	Iceland	Reykjavík	Keflavík International Airport	9804388	50.824	3	0	0
64	Sweden	Gothenburg	Göteborg Landvetter Airport	6807976	19.773	2	0	0
71	Norway	Bergen	Bergen Airport, Flesland	6306623	12.396	5	0	4
89	Norway	Trondheim	Trondheim Airport Værnes	4441791	26.905	9	0	3
91	Norway	Stavanger	Stavanger Airport Sola	4262476	11.576	11	0	0

Venues

There relationsship between the number of venues and the distance to the city can be shown as follows:

From this, one can see that venues far from the city have fewer venues, but there does not seem to be a strong correlation.

From this swarmplot we see that only 1 airport in Northern Europe has lots of selected venues near the airport. If you are stuck at an airport and go out for a walk (or a bike ride), the chances of finding selected venues nearby are higher in Southern Europe than in Northern Europe.

There are 26 airports with venues, within 11 km for the city, and who do not have bike rental venues. From the quantile function, we see that half of the airports have 11 or more selected venues nearby.

The top five airports are these:

	Country	Airport	Venues
0	Italy	Catania-Fontanarossa Airport	49
1	Italy	Naples Airport	29
2	Italy	Linate Airport	24
3	Ireland	Dublin Airport	21
4	Greece	Heraklion International Airport	19

We now have a shorter list of airports that have quite a few selected venues nearby, is situated not very far from the city, and that has no registered bike rental services. At these airports, we may consider connecting with local businesses, and establish extra charging stations in the local area, in order to support extensive travel near the airport.

Trains

After analyzing the data, we find that 81 % of the European airports have train stations (rail passenger transportation venues) within 3 km from the airport. 13 of 15 (86 %) airports with bike rentals have also train stations. One could ask if inflexible train stations with few stops complement and promotes use of bike rentals. However, the difference is not large. More importantly, it might also be a third factor, such as a busy airport having room for lots of services, that trains and bikes could have in common.

As mentioned on the first page of this report, we think that the presence of trains is favorable for a bike rental business, but only a little blit. Below, extra points is given to airports with trains.

Other

By using geopy.distance, we found that the airport furthest north (Iceland) is 3187 km futher north than the airport furthest south. Airports far to the north will have more light in summer, and can then be used almost 24 hours of the day. However, the winter may be long and with little daylight. All in all, we think that it is preferable to run a bike rental business more to the south than Iceland. A little minus will be given to airports with latitude > 55.

Weighted total score

We will now give each airport a score, indicating the level of attractiveness for establishing a bike rental service near the airport. (Originally, this was intended to be done using more machine learning. However, the data is small and fragmented, so it will be done manually.)

In order to do this, we calculated z scores. For distance from airport to city, a low number (negative z score) is attractive. For such values, we multiplied by (-1) in order to be able to produce one single number showing how attractive the airport is.

Then we use weights, to make sure that the factors we think are most important have the largest impact on the total score. We used the following:

```
# Weights and direction - enter into dictionary: ..[feature] = (weight, direction)
we = {}
we["km"]= (10,-1)      # 10: on a scale from 1 to 10. -1 because high value reduces attractiveness
we["P18"]= (3,1)       # The more passengers at the airport, the better
we["change"] = (3,1)   # We think that airports with passenger growth are better
we["bikes"] = (5,-1)   # Competitors may be bad for business. Later: increase score btw 0 and 1
we["trains"] = (1,1)   # Unclear how stations are counted, reduce difference btw high and low values later
we["venues"] = (3,1)   # For venues total score. (Could be higher for local travel near airports)
```

For bikes and trains, we made an additional adjustments, to increase the difference between 0 and 1, and to reduce the difference between 1 and many (say: 20). This was done by using power/square. Airports without bike venues was also assigned a value of 1 (while all airports with bike venues would have (-1)* the z score (after using square)). The airport furtherst north would get minus 3 points, and airports with a latitude above 55 would get between 0 and 3 minus points. Airports near one of the largest European cities would get 2 extra points. The weights could be easily changed. By using this, we calculated a total score for all 92 airports. The 10 most attractive airports to start a bike rental nearby was the following:

	Country	City	Airport	Total
0	Italy	Catania	Catania-Fontanarossa Airport	23.419600
1	Lithuania	Vilnius	Vilnius Airport	22.247250
2	Italy	Naples, Italy	Naples Airport	21.933812
3	Netherlands	Amsterdam	Amsterdam Airport Schiphol	20.513531
4	United Kingdom	London	London City Airport	17.524448
5	Portugal	Lisbon	Lisbon Airport	16.044158
6	Poland	Katowice	Katowice Airport	15.205696
7	Greece	Heraklion	Heraklion International Airport	14.894000
8	Spain	Madrid	Madrid–Barajas Airport	14.813876
9	Spain	Valencia	Valencia Airport	14.551335

We also grouped the airports by country (based on the total score, which is based on the top 30 airports). That resulted in the following:
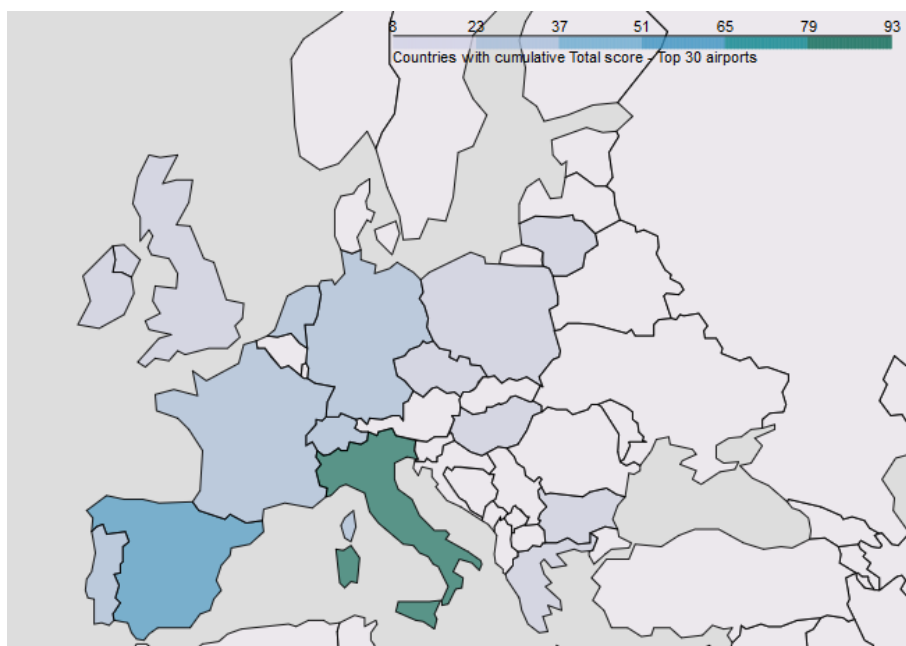
Country	Total	Passengers2018	Venues	Bikes	Trains	All	EE	NE	SE	WE	Nordic	BeNeLux	Iata	Inga
Italy	92.404974	85631359	177	0	46	6	0	0	6	0	0	0	251.28325	78.92302
Spain	51.779531	91063376	31	0	21	4	0	0	4	0	0	0	154.09210	-14.43617
France	30.206762	47893571	17	0	21	3	0	0	0	3	0	0	143.48456	8.28409
Germany	23.524852	81308359	18	0	9	2	0	0	0	2	0	0	98.71309	17.71840
Netherlands	32.415931	77237125	44	0	8	2	0	0	0	2	0	2	103.77751	10.11538
Portugal	25.432789	40970830	61	3	41	2	0	0	2	0	0	0	80.01933	-17.81055
Switzerland	25.163238	48790523	63	1	40	2	0	0	0	2	0	0	93.70312	14.65949
Bulgaria	12.071584	6962040	15	0	9	1	1	0	0	0	0	0	42.69557	23.41422
Czech Republic	10.895501	16797006	14	0	4	1	1	0	0	0	0	0	50.10204	14.27057
Greece	14.894000	7974887	19	0	0	1	0	0	1	0	0	0	35.33703	25.18094
Hungary	9.287931	14867491	14	0	7	1	1	0	0	0	0	0	47.43527	19.25351
Ireland	14.053000	31497526	21	0	0	1	0	1	0	0	0	0	53.42876	-6.25456
Lithuania	22.247250	4922949	1	0	3	1	0	1	0	0	0	0	54.63484	25.29031
Malta	12.866800	6808177	8	0	0	1	0	0	1	0	0	0	35.84739	14.49227
Poland	15.205696	4838149	31	4	26	1	1	0	0	0	0	0	50.23804	19.03379
United Kingdom	17.524448	4820292	45	0	44	1	0	1	0	0	0	0	51.50427	0.04748

We can see that Italy, Spain, France, Germany, Netherlands, Portugal, Switzerland all have at least two airports each that could be attractive to start a rental business. We can also see that Portugal, Switzerland and Poland are on the list, even though there are airports that have bike rental venues already.

We can see that Southern Europe («SE») is the region with most of the attractive airports. The Nordic region is the only one with no airports among the top 30 airports (see also above under «Venue).

We would now like to visualize our findings: First we will show the countries with the highest total score (based on the top 30 airports). Finally, we will plot all 30 airports with different colors/sizes/markers indicating which ones are lower or higher on the top 30 list.

We have now analyzed 92 airports and have found a number of airports that could be attractive for starting a rental business. As can be seen above, there are substantial differences between larger European airports and the viability for bike rental businesses nearby. Of course, this is a very simplified study. For instance, the weights can be refined more. There are also a number of other factors that might be taken into account. Presumably, lots of such data may be available via other sources (for instance, at various "open data" sites in a number of the countries and on EU sites. However, this could be very challenging, not at least due to all the different languages in Europe.

This ends our analysis.

Results and discussion

Our analysis shows that there are substantial differences in airline travel in Europe. For instance does air travel seem to be quite more frequent in the Nordic region than in Eastern Europe. However, the growth rate of the latter is higher.

We have seen that 80 % of European aiports with bike rental venues are situated less than 10.8 km from the city center. This is a bit further from the city than what I guessed before I started this project. Technological developments that can be expected the next few years, such as better batteries and scooters that can return themselves to charging stations, may increase the range even further.

Still, a number of the European airports are situated very far from the city. Given that there are no bike rental venues found near these airports. These airports also seem to have less venues nearby. Thus, starting a bike rental business near such airports may not be a bad idea.

Based on the data, it may seem difficult to find many factors that clearly separates airports with rental facilities from those that do not have that. There may be other factors not included in the data, such at local initiative (either promoting bike rental or prohibiting it), that determine whether there is a rental facility nearby. An important finding of the analysis may be that there are not many clear distinctions.

However,the data point to a number of aiports that could be attractive for starting such business. Italy and Spain seem to be among the countries that are of particular interest.

Many large airports still do not seem to have any such services, not even airports that are close to the city centre and who probably have . It may be a good time to start such rental business these days, an so get a first mover advantage. Given the limitations of the available data, by starting such business (or buying one established business), one could also gain valuable information about how such services are used.

Conclusion and future directions

Airline travel is very popular in Europe, with almost all European countries having at least one larger airport. The aim of this project has been to use data to see if there may be business possibilities for e-bike services near larger European airports. The majority of the larger European airport do not have bike rental venues nearby.

We have seen that an airport closer to a city is more likely to have bike rental facilities. Airports far away from cities do not have bike rental facilities. At the same time, it is hard to find other factors that are strongly linked to rental businesses at airports.

By using Foursquare data, and other data, we can see that there seem to be quite a few airports that could be attractive locations for starting rental businesses nearby.

There may be "noise" in the data, and local regulations and other factors not contained in our data sets may be important. Thus, some of the locations may, after further studies, turn out not to be good places to start such a business. Therefore, it is advised to study this further.

Still, the chances of finding good locations to start bike rental business seem to still be good. Things are happening pretty fast in this field, and it may be well worth to move fast, and gain experience and gather data from one or a couple of locations. We would in particular recommend Italy, Spain, France, Germany, and the Netherlands.

During this project, I have seen that there seem to be quite a lot of «open data» available. For instance: location data for bike roads in a larger geographical area, and location data for all businesses over a given size in a country. If this would develop futher, and become a bit more user friendly and avaiable in English, it could add a lot to a future analysis.