Copernicus Master in Digital Earth

Student: Emanuel Goulart Farias

Student number: 12413874

Methods in Spatial Analysis

Assignment 1: Network Analysis

Task 1

Using the *OSM Tourism attractions,* it is possible to infer many different attractions that are present in Salzburg. Exploring the data is possible to create a full network analysis. For the task 1, my point of interest is Mirabellplatz.

> Note: The *OSM Tourism attractions in EU* layer file has many attributes, making it a large file layer that consumes more ESRI credits with each operation. In order to avoid running out of ESRI credits, I filtered the dataset by selecting *cityID* equals to *Salzburg*. Even though I am missing many attributes with cityID blank, I opted for this approach to complete the tasks. To sum up, my result dataset OSM Tourism in EU filtered by Salzburg has 76 entries.

Starting with *Calculate Travel Cost tool*, I was able to create isolines for walking time distances of 5 min, 10 min, 15 min, and 20 min. Based on these isolines, I could determine the virtual area extension that would cover possible walking distances. Here is the map with my isolines:

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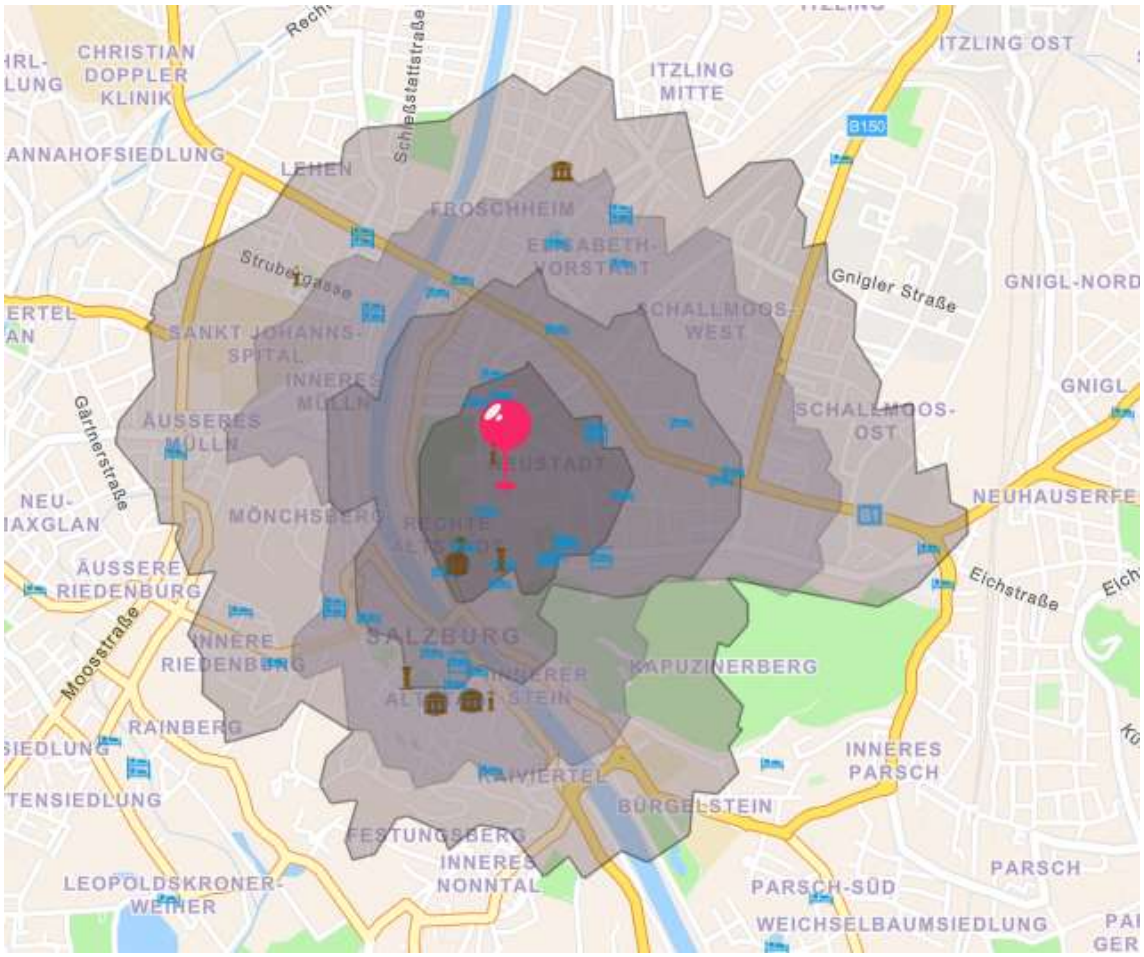

Figure 1- Isolines for walking distance time.

A rough visual inspection shows that between the 15-minute isoline and the 20-minute isoline, there were not many relative differences in the number of tourism attractions. Based on this, I decided to create another layer. It will create a route from the intersection of n-attractions at a given walking distance time, analyzing for 5 minutes and 15 minutes. Using the tool Find Closest, I could find the closest features of the OSM dataset that are within a reachable 15-minute walking distance from Mirabellplatz. It generates a layer that is shown below:

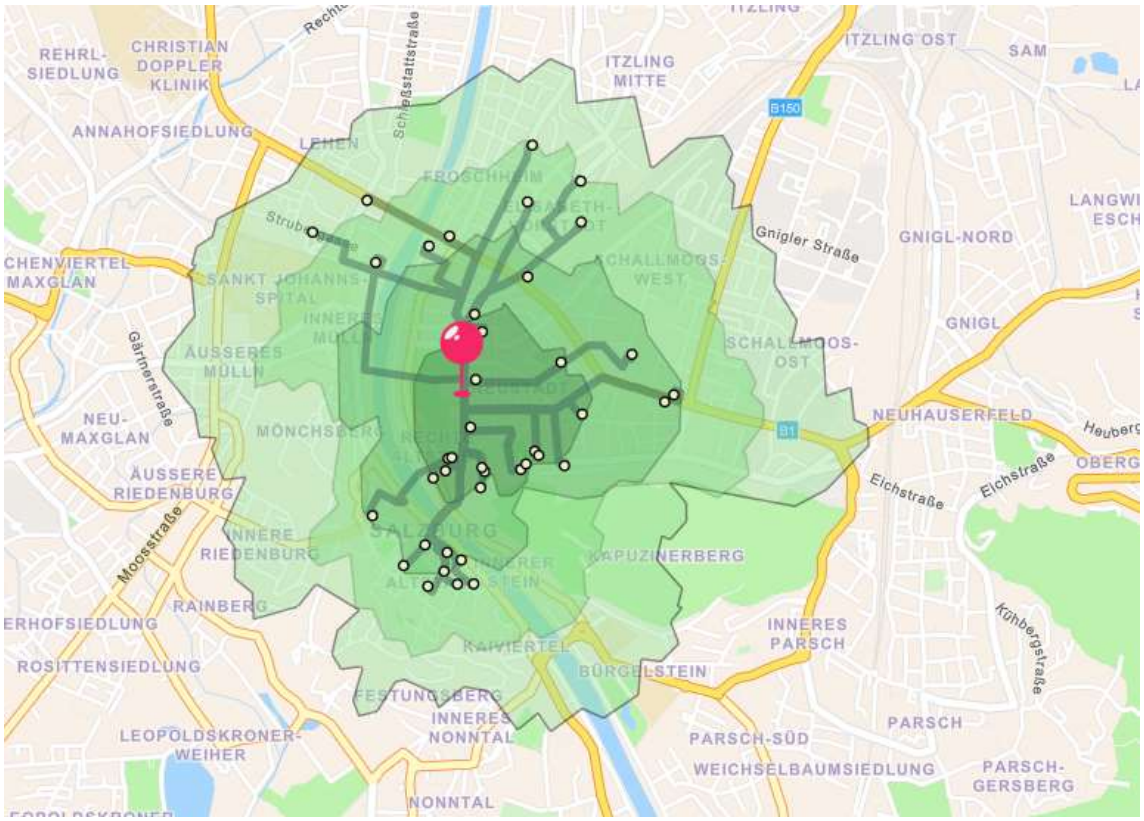

Figure 2 – Analysing tourist attractions at fifteen minutes walking distance from Mirabellplatz.

The statistical analysis of the routes is shown in the image bellow and synthetized over the table.

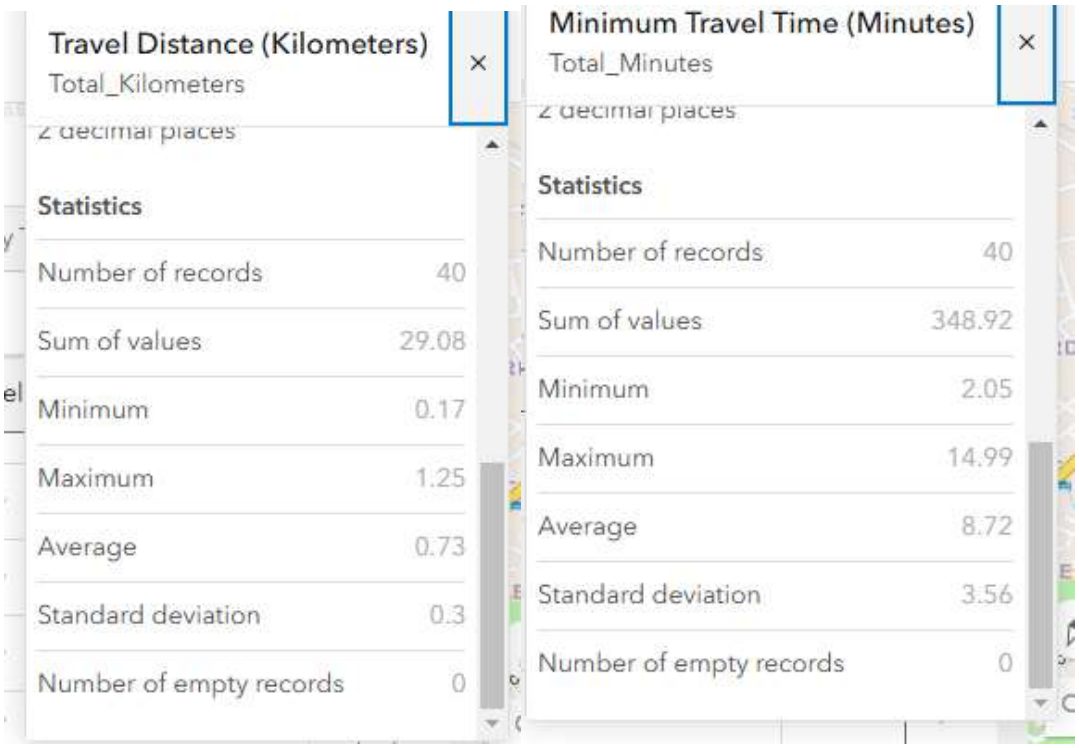

Figure 3 - Statistics from tourisms attractions near from Mirabellplatz.

Travel Distance in Kilometers	**Minumum Travel Time (Minutes)**
Number of records	Number of records
40	40
Sum of values	Sum of values
29.08	348.92
Minimum	Minimum
0.17	2.05
Maximum	Maximum
1.25	14.99
Average	Average
0.73	8.72
Standard deviation	Standard deviation
0.3	3.56

The Analysis found it fourty attractions in a fifteen minutes walking distance time, with minimum distance of 170 meters from Mirabellplatz and a maximum distance of 1250 meters. The average distance is approximately 750 meters.

The average of walking time around 40 diferent attractions is 8 minutes from Mirabellplatz, which shows off the **walk-friendly city of Salzburg**. In a radius of 1000 meters there is more than thirty touristics attractions, this compacteness attribute of the city contributes for a sightseeing easily reachable.

TASK 2

Filtering the OSM Tourism attractions in the EU layer file with the attribute `tourisms` equal to `museum`, I could apply the tool *Find Attributes by Location* and extract only the museums that intersect a buffer of 5 kilometres around Mirabellplatz.

Having solved my main dataset, I applied the tool *Find Closest* in order to find the five closest museums reachable by walking and by driving distance time. This operation generated two new layers, which are shown below:

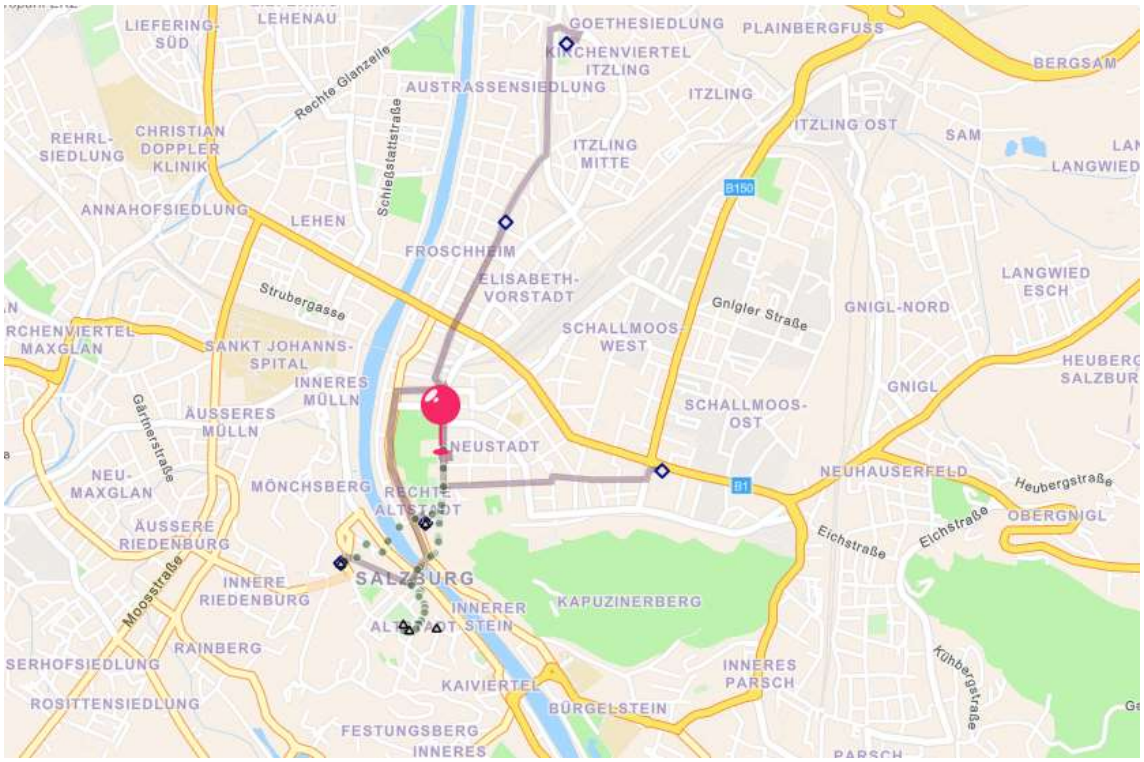

Figure 4 - Closest Museums with a Walking and Driving time.

The five closest museums within walking distance are labelled with triangles. It shows a tendency for the algorithm to choose the walking distance route towards the outskirts of Salzburg, which aligns with routes mainly accessed by walking or cycling. When the tool selected for driving time distances, the museums of the Old Town were not picked up, indicating that the closest routes for driving distances are different from walking distances.

TASK 3

Note:

> On the development of this Assignment, I was able to identify a method to slice my *OSM Tourisms attractions in Europe*, using the tool *find by attribute or locations* and selecting the environment to only analysis attributes inside my window view. Therefore, I sliced my OSM source data for a buffer of 5 kilometers around Mirabellplatz. This increase the coast-efficiency of my operations due to decrease my OSM dataset to 563 attractions. It is an improvement and, in opposition of the task 1 executed, it does not lost data where *city_id* is *blank*. Preserving a better and richest dataset.

Using the *OSM Tourisms attractions in Europe,* I filtered the attribute *tourism* equals *hotels*, and applied the *find closest* to find it the twenty closest hotels at a walking distance from Getreidegasse. The hotels are shown bellow:

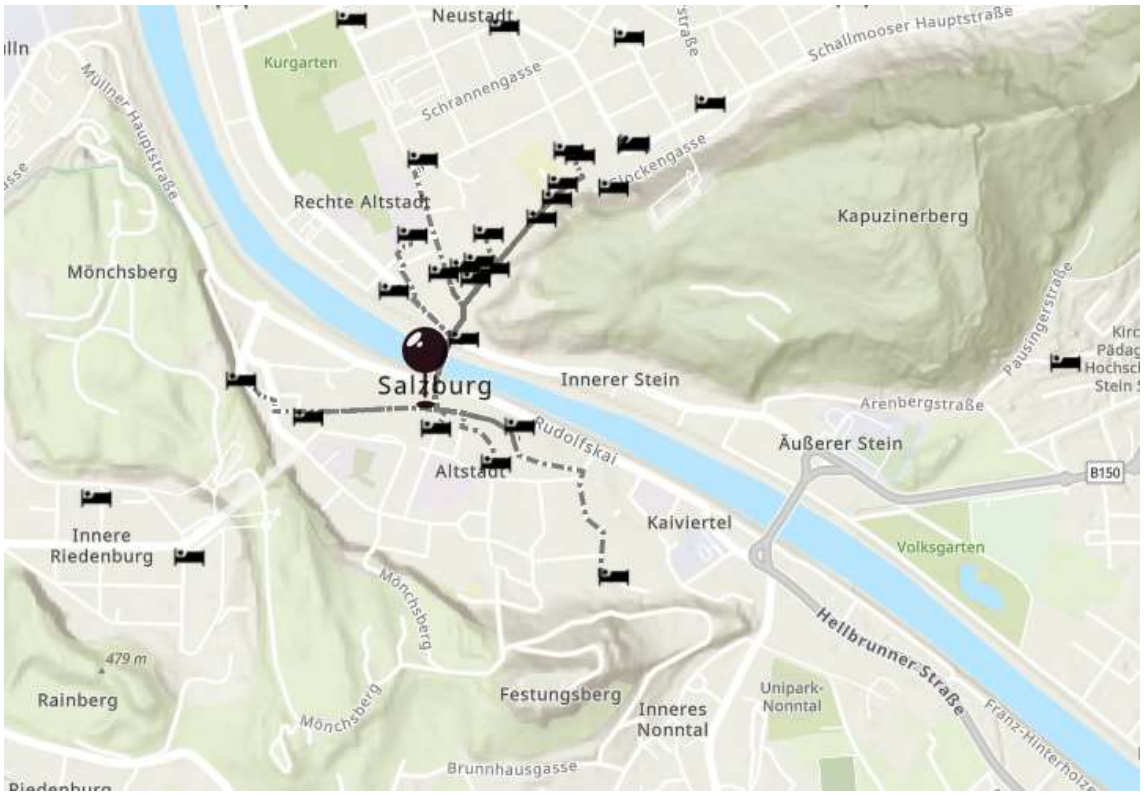

Figure 5 - 20 closest hotels from Getreidegasse at a walking distance time.

The statistics are summarized in the table below:

Travel Distance in Kilometers	**Time of Travel in Minutes**
Number of records	Number of records
20	
Sum of values	Sum of values
7.69	92.26
Minimum	Minimum
0.08	0.96
Maximum	Maximum
0.65	7.79
Average	Average
0.38	4.61
Standard deviation	Standard deviation
0.15	1.85

At a walking distance, the twenty closest hotels are on average 380 meters away, with a 4-minute walk. The maximum distance is no more than 700 meters, which corresponds to an 8-minute walk. As a well-centralized street in Salzburg, Getreidegasse offers interesting infrastructure for tourism, being well-served with hotels in the city center within a reachable walking distance. Spatially, the old town and the surroundings of Mirabellplatz are populated with many hotels, regionalizing the tourism aspect of the city.

TASK 4

To complete task 4, I used my OSM dataset, filtered for museums and already clipped to a 5-kilometer Salzburg buffer. My kindergarten choice was at Griesgasse 8. Utilizing the tool Find Closest, I calculated the closest museum within a walking distance of 10 minutes, which resulted in 9 possibilities around that kindergarten. By calculating the route with the tool Plan Route and setting no time constraints, I created three additional layers for 1 vehicle, 2 vehicles, and 3 vehicles, respectively. I had to enforce each route to distribute the maximum number of stops per vehicle equally, so for routes with 2 vehicles and 3 vehicles, I chose a maximum of 5 and 3 stops, respectively.

The image below shows a decision route that creates a circular path starting at Mirabellplatz for the first stop and then goes down to the old city, connecting each museum route and finishing at the kindergarten. The total route takes 31 minutes to complete by walking from start to finish.

Figure 6 - Walking route for one vehicle.

When using two vehicles I got the following representation:

Figure 7 - Walking route for two vehicles.

It is possible to see how the use of an additional vehicle splits the route. The first part is covered in yellow, with the museums more to the northwest of the image, and the red line shows an aggregation of the route in the old city, covering more museums that are close to each other but further from the kindergarten.

The three vehicles each reach three museums, showing a spatial aggregation for the routes. One route covers the other side of the river, the second covers the closest museums, and the third aggregates the further museums and covers them. The longest route takes 24 minutes to complete and is assigned in grey. The shortest route takes 15 minutes and is colored in green, while the blue route takes 18 minutes to complete.

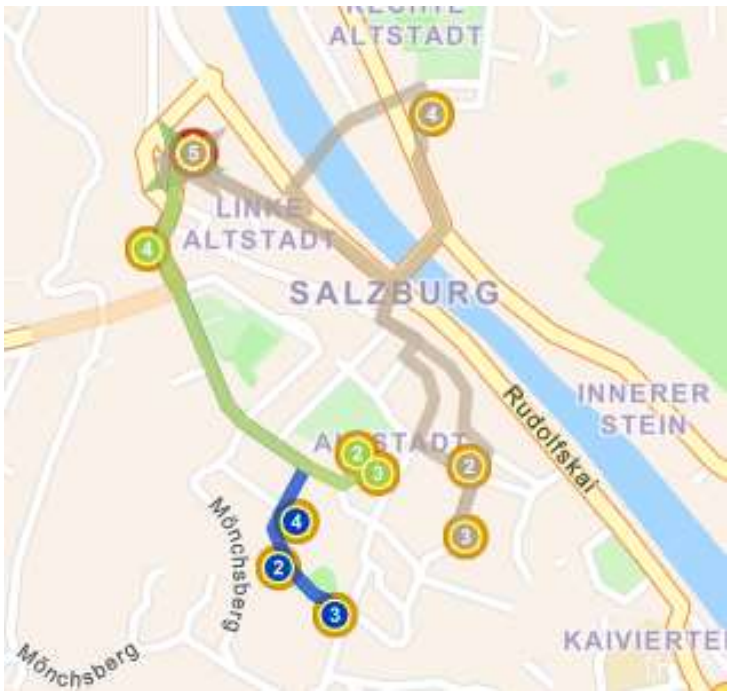

Figure 8 - Three vehicles walking route.