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# AARHUS AND THE 15-MINUTE CITY

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**Indholdsfortegnelse**

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**Abstract**

This study focuses on evaluating the walkability of Aarhus municipality, Denmark, within the framework of a "15-minute city." The 15-minute city concept emphasizes convenient access to essential amenities within a 15-minute walk or bike ride, promoting healthier urban living. This study assess the percentage of Aarhus municipality's area within a 15-minute walk of key daily amenities: supermarkets, day-cares, and general practitioners.

The analysis indicates that 58% of the total city zone qualifies as a 15-minute city, with 79% of the area having access to supermarkets, 62% to general practitioners, and 86% to day-cares. While city-zoning discrepancies and availability limitations pose challenges, the study provides valuable insights for urban planning.

The findings pinpoint areas that may benefit from enhanced amenity provision, like Lisbjerg, a city development project without key amenities. Moreover, the map serves as a tool for broader analyses, such as examining housing prices' relationship with walkability and socioeconomic patterns within the 15-minute city framework, contributing to more liveable urban environments.

## Introduction

No matter which city you live in, you intuitively know that some neighbourhoods are more attractive than others. The area might have a special atmosphere that just feels a bit more pleasant than other places. Cosy neighbourhoods can happen when city-planning is done well, and an entire field of research is dedicated to quantifying what makes a city great to live in. And for a very good reason. Comfortable neighbourhoods do not just feel pleasant to be in, they can vastly improve the lives of its inhabitants. Urban planning has an immense impact on all aspects of citizens lives from obesity to loneliness (Frank et al., 2006; Lyu & Forsyth, 2022).

While most of us knows how important it is for our general health to be active every day, as a citizen of Aarhus, it is easy to take for granted how easy it is to move around on foot or by bike. “Walkability” is a buzzword amongst urban planners in car centric America, where city infrastructure is often designed for cars. This means that no matter the distance you are traveling, going by car is often the most practical choice. This is clearly reflected in the statistic from the American Community Survey, showing that only 0.6% of American workers bike to work (Burrows, 2019). In Denmark this number is much higher, with 17% of commuters using a bike as their mode of transportation (DTU, 2019). Walkability is often measured by examining whether a neighbourhood consists of properties with mixed purposes, such as housing, schools, and retail. With just a 5% increase in walkability, a 32% increase in physically active travel can be observed, along with a 0.23 point reduction in body mass index (Frank et al., 2006). Another study showed that people living more than 1 km away from a green space have higher odds of experiencing stress than citizens living less than 300 meters from a green space (Stigsdotter et al., 2010).

One framework that aims to help citizens, politicians and urban planners move towards healthier walkable cities is the “15-minute city”. The framework encompasses several factors, the most important being that cities should be walkable, have green spaces, proper public transport, and proper infrastructure of pavements and bike lanes. The central aspect is that citizens should be able to reach the most important daily amenities such as work, shopping, and parks within a 15-minute walk (C40, 2021). Several cities have adopted this framework and are seeing great results. As an example, Oklahoma City has focused intensely on improving the walkability of their city, and as a result they are seeing an influx of young, educated people moving to the city (Cornett, 2013).

The 15-minute framework does not provide clear cut requirements to signify whether a city can be described as a 15-minute city. Whether a city has “enough” greenspaces and “easy access” to public transport is difficult to quantify. One aspect of the 15-minute city that can be quantified and measured is the issue of travel time to daily amenities. This paper shows how spatial tools can be equipped to map where in a city the travel-time requirement of the 15-minute city is met.

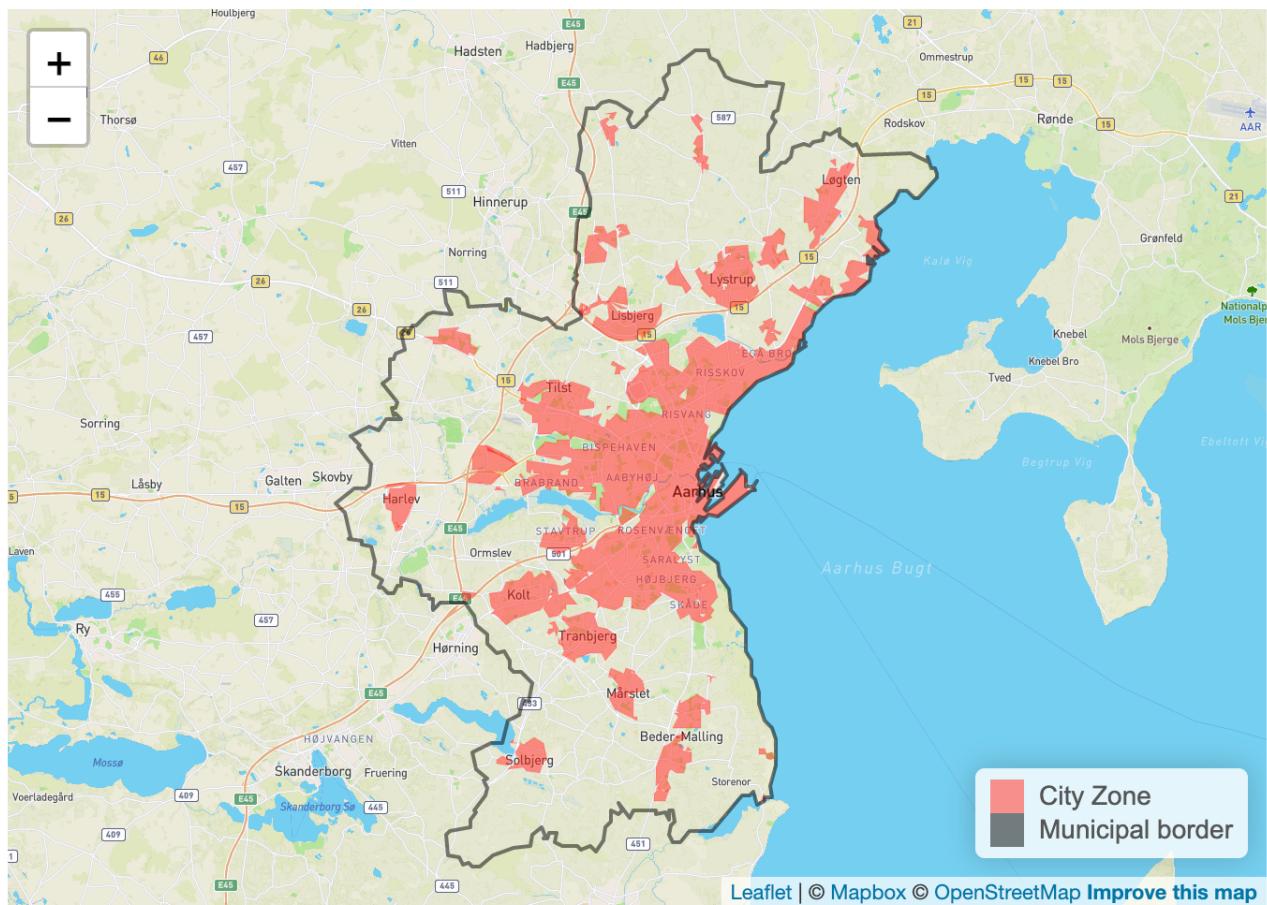
**Focus of this paper**

The central question in this paper is what percentage of the area in Aarhus municipality is within a 15-minute walk of a supermarket, day-care, and general practitioner. The percentage of Danes that visit a supermarket between 3 and 7 days a week is 56% making supermarkets evident to include in this analysis. With 773.541 families with children in Denmark and almost all children attending “børnehave” a day-care for 3–5-year-olds, the commute to a day-care is daily for many families (Danmarks Statistik, 2022; Vive, 2020). While a general practitioner might not be visited daily, easy access to healthcare is important. The government of Denmark does not have a 15-minute rule measuring distance to a doctor, but all citizens have the right to change their general practitioner if they move more than 15 km away from their current doctor. Within Copenhagen this limit is at 5 km (KL, 2018).

While a truly complete neighbourhood hosts a range of other amenities beyond these three, a complete analysis within the 15-minute framework is beyond the scope of this paper.

**Method**

In Denmark zoning is regulated by the local government into three distinct zones, “landzone”, “sommerhusområder” and “byzone”, that primarily consists of farmland, vacation houses and cities. The zoning primarily protects farmland and nature by preventing unregulated spreading of cities (Plan- og Landdistriktsstyrelsen, 2023). For the purpose of this paper the city-zones will denote the area of interest. Information on zoning in Denmark is available through Plandata.dk, maintained by the government organization “The Danish Agency for Planning and Rural Development”. Local governments decide the different zoning regulations for their municipality, and ensure the relevant data is available through the database. It is easy to get a sense of how well kept this database is – the “oldest” city zone in Aarhus municipality was updated on 12/05/2022.



**Figure 1 - City zones in Aarhus municipality.**

To measure what areas can reach the three important amenities the R package mapboxapi is used to calculate travel time with isochrones. A travel isochrone finds the area it is possible to travel from a point within a set time and travel mode. For this project, the isochrones are restricted to the area one can walk within 15 minutes. With the average walking speed of 5km/h 15 minutes of walking equates to 1,25 km distance travelled.

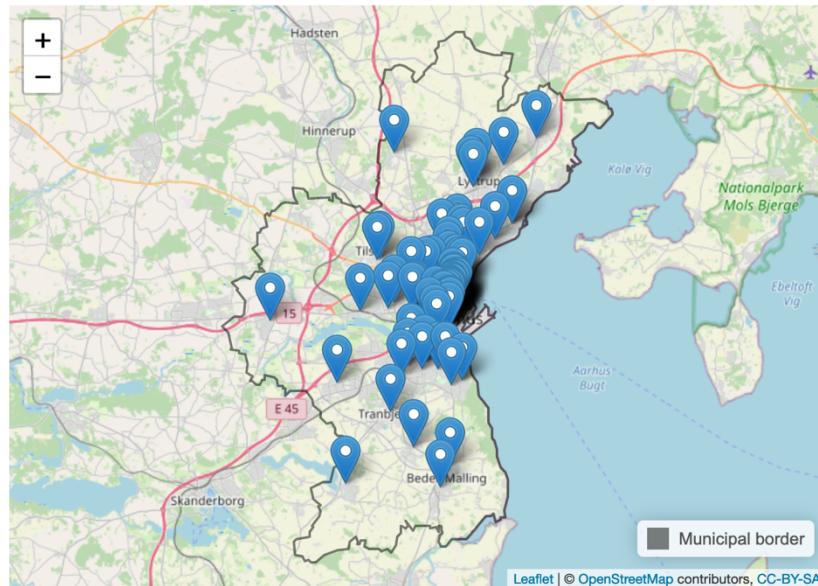
The location of day-cares and general practitioners are also available through government databases that are regularly updated. The Ministry of Children and Education maintains dagtilbudsregister.stil.dk that contains information on all institutions taking care of children aged 0 to 5. This paper only focuses on day-cares that accept 3–5-year-olds. The government organisation The Danish Patient Safety Authority maintains "Behandlingsstedsregistret", a database of all clinics in Denmark. This paper focuses only on general practitioners.

The locations of supermarkets were collected through search queries on google maps. The definition of a supermarket in this paper is:

- A shop owned by either Coop, Salling group or Dagrofa (spanning over 15 different supermarket chains)

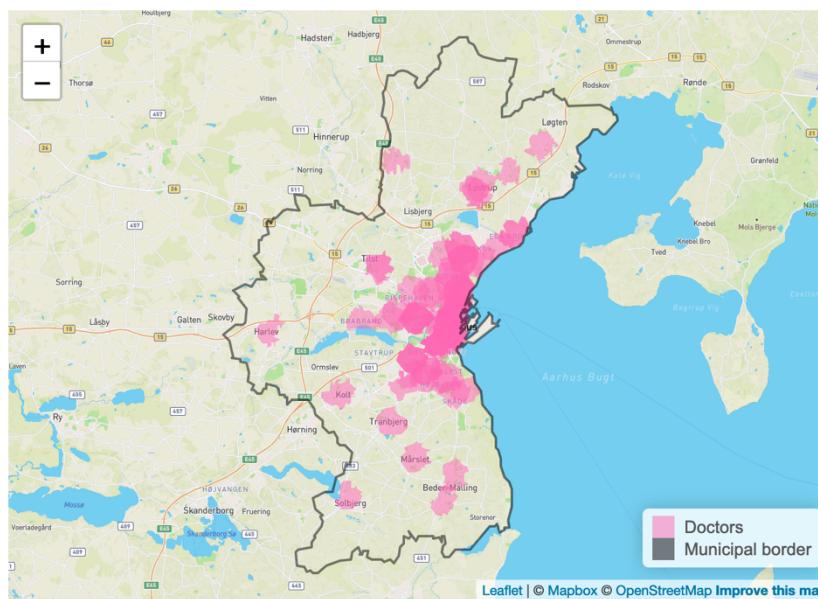
- A shop from either of the following supermarket chains: Rema1000, Løvbjerg or Lidl.

The following four maps visualizes the process of finding area in Aarhus municipality that is within a 15-minute walk from a doctor:



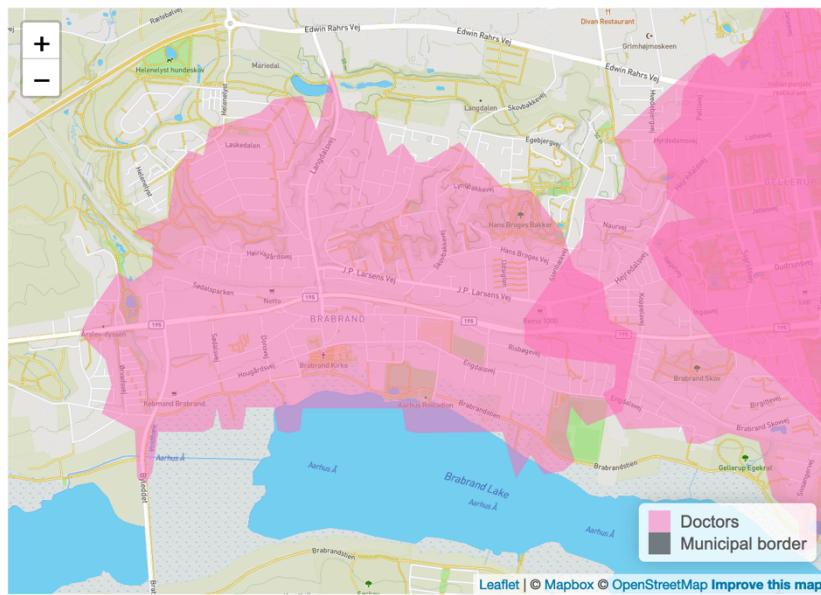
**Figure 2 - Doctors in Aarhus municipality.**

The coordinates of each clinic is found during the pre-processing stage. Each point marks a general practitioner's clinic.



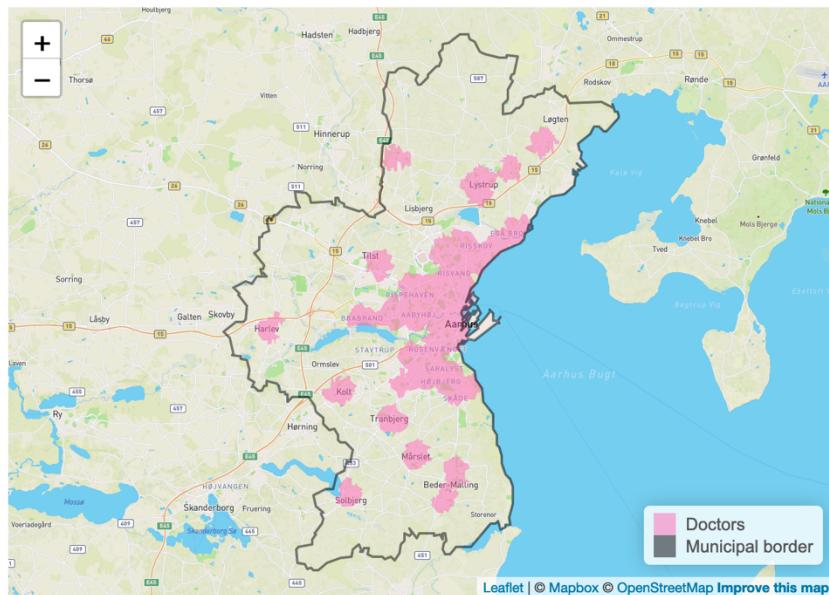
**Figure 3 - Isochrones around each clinic.**

A 15-minute isochrone is calculated around each point.



**Figure 4 - Overlapping isochrones.**

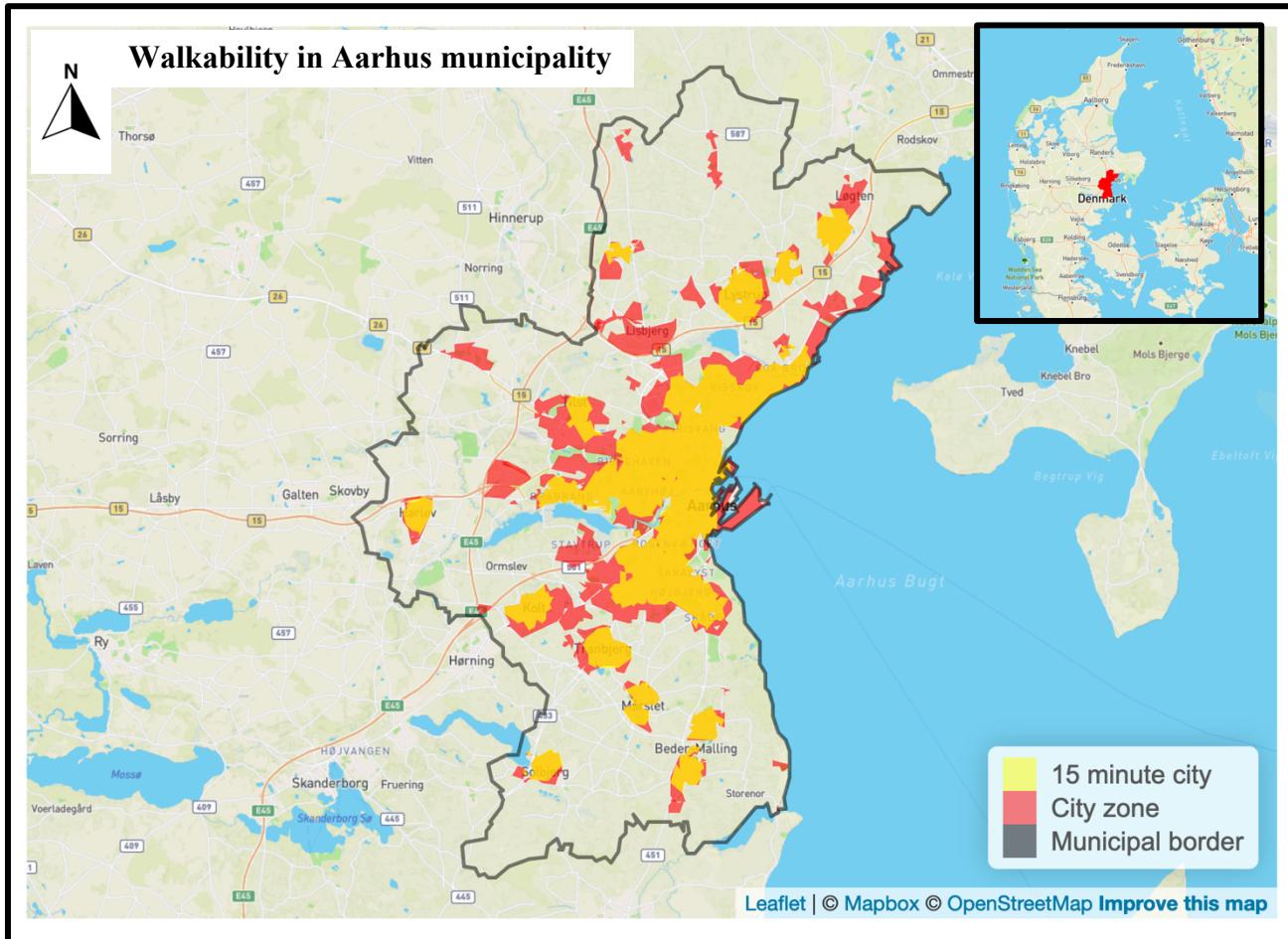
Closeup of isochrones, showing several overlapping.



**Figure 5 - Multipolygon for doctors.**

The isochrones are joined into one multipolygon, shown here on the map in pink. When this process is repeated for supermarkets and day-cares as well, the intersection of the three multipolygons can be found. The intersection of the three multipolygons results in a new multipolygon that only contains area where all three original multipolygons are present. The resulting area can be defined as a 15-minute city within the scope of this paper.

## Results



**Figure 6 - Map showing city zones and 15-minute zones.**

This final map shows the area in Aarhus municipality that qualify as a 15-minute city within the definition defined in this paper. Please note that an interactive map is available through GitHub, along with another interactive map showing all the multipolygons needed to make this map.

The 15-minute area covers 58% of the total city zone. Supermarkets are accessible within a 15-minute walk in 79% of the city zone area, whereas a doctor can only be reached within this timeframe in 62% of the city zone. Day-cares are the most reachable, with 86% of the city zone being within a 15-minute walk from a day-care.

## Evaluation

While the city-zones of Aarhus municipality largely correspond with where cities are located, the measure is not perfect for this use case. For instance, the large industrial harbour of Aarhus where no residential buildings are placed is within the city border, and small villages in the countryside are included in the farmland zone. This is bound to lower the quality of the analysis, as the city zone is

not a true reflection of actual cities. However, for the purpose of this paper, the city zone provides a great estimate of where people are actually residing.

This way of examining walkability has a couple of drawbacks. For instance, while you might live right next to a general practitioner, there is no guarantee that they are accepting new clients. While Aarhus is not a huge city worldwide, the inner city has a much higher density of people than the suburbs. Right now, 21/40 general practitioners in the city centre are not accepting new patients (sundhed.dk, 2023). Similarly, while you are guaranteed a spot in a day-care for your child, you are not guaranteed a spot close to your home (Aarhus kommune, 2023b).

While this map is not a complete review of whether the cities of Aarhus municipality are truly 15-minute cities, it serves as a starting point by highlighting areas that could use some attention. For instance, the city of Lisbjerg has neither supermarket nor a general practitioner. The municipality describes this area as “One of the largest city development projects in Denmark” (Aarhus kommune, 2023a). While the timeframe for completion is 65 years, it might be a good idea to get a supermarket in the city sometime before that. The map can also serve as an element in other analyses, e.g., looking at whether house prices are affected by walkability or whether specific socioeconomic groups tend to live within the 15-minute city.

#### Metadata

#### Data sources

Coordinates extracted for:	Maintained by	Url
Doctors' clinic	<i>The Danish Patient Safety Authority</i>	<a href="https://stps.dk/da/registrering/behandlingssted/dataudtraek-om-behandlingssteder/">https://stps.dk/da/registrering/behandlingssted/dataudtraek-om-behandlingssteder/</a>
Day-cares	<i>The Ministry of Children and Education</i>	<a href="https://dagtilbudsregister.stil.dk/">https://dagtilbudsregister.stil.dk/</a>
City Zones	<i>The Danish Agency for Planning and Rural Development</i>	<a href="https://kort.plandata.dk/spatialmap">https://kort.plandata.dk/spatialmap</a>
Municipality border	<i>The Danish Agency for Planning and Rural Development</i>	<a href="https://kort.plandata.dk/spatialmap">https://kort.plandata.dk/spatialmap</a>
Supermarket	<i>Collected by author</i>	<a href="https://www.google.com/maps/">https://www.google.com/maps/</a>

**GitHub repository**

The github repository is available at <https://github.com/AddiH/15-minute-city> under the MIT licence.  
 All .Rmd files also exist as a knitted .html file.

<b>File/folder name</b>	<b>Subfolder</b>	<b>Contents</b>
<i>Analysis.Rmd</i>		The main analysis, containing two interactive maps
<i>Rapport.pdf</i>		Project rapport
<i>data/</i>		
	<i>in/</i>	Raw data sources
	<i>isochrones/</i>	Isochrones around points
	<i>multipolygons/</i>	Multipolygons used for mapping
<i>src/</i>		Contains code used in the project

**Software metadata**

<b>Software metadata description</b>	<b>Details</b>
Current software version	<i>RStudio (2022.12.0+353)</i>
Permanent link to Github repository where you put your script or R project	<a href="https://github.com/AddiH/15-minute-city">https://github.com/AddiH/15-minute-city</a>
Legal Software License	<i>MIT License</i>
Computing platform / Operating System	<i>MacBook Pro (M1, 2020) running macOS Monterey version 12.5</i>
Installation requirements & dependencies for software not used in class	<i>All software used in this paper was also used in class.</i>
Support email for questions	<a href="mailto:202006712@post.au.dk">202006712@post.au.dk</a> or <a href="mailto:astrid.elmann@gmail.com">astrid.elmann@gmail.com</a>

**R packages**

Name	Citation	Version
<b>R</b>	<i>R Core Team (2019). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <a href="https://www.R-project.org/">https://www.R-project.org/</a>.</i>	4.1.2
<b>Rstudio</b>	<i>RStudio Team (2020). RStudio: Integrated Development for R. RStudio, PBC, Boston, MA URL <a href="http://www.rstudio.com/">http://www.rstudio.com/</a></i>	2022.12.0+353
<b>Tidyverse</b>	<i>Wickham et al., (2019). Welcome to the tidyverse. Journal of Open Source Software, 4(43), 1686, <a href="https://doi.org/10.21105/joss.01686">https://doi.org/10.21105/joss.01686</a></i>	1.3.1
<b>sf</b>	<i>Pebesma E, Bivand R (2023). Spatial Data Science: With applications in R. Chapman and Hall/CRC. doi:10.1201/9780429459016, <a href="https://r-spatial.org/book/">https://r-spatial.org/book/</a></i>	1.0.9
<b>leaflet</b>	<i><a href="https://leafletjs.com/">https://leafletjs.com/</a> 2010–2023 <u>Vladimir Agafonkin</u>. Maps © OpenStreetMap contributors.</i>  <i><a href="https://cran.r-project.org/web/packages/leaflet/index.html">https://cran.r-project.org/web/packages/leaflet/index.html</a></i>	2.1.1
<b>mapboxapi</b>	<i><a href="https://www.mapbox.com/about/maps/">https://www.mapbox.com/about/maps/</a> © Mapbox, © OpenStreetMap</i>  <i><a href="https://cran.r-project.org/web/packages/mapboxapi/index.html">https://cran.r-project.org/web/packages/mapboxapi/index.html</a></i>	0.5
<b>opencage</b>	<i>Geocoding services provided by OpenCage using data from OpenStreetMap contributors and others.</i>  <i><a href="https://cran.r-project.org/web/packages/opencage/index.html">https://cran.r-project.org/web/packages/opencage/index.html</a></i>	0.2.2

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