

Examining the Patterns of Foreign Migration to Denmark

Appendix

Cultural Data Science

Spatial Analytics, 2024

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Appendix 1: Preprocessing and downloading data

The code for data preprocessing and analysis can be found on GitHub, link below:

https://github.com/JustinaRaz/Exam_Spatial_Analytics.git

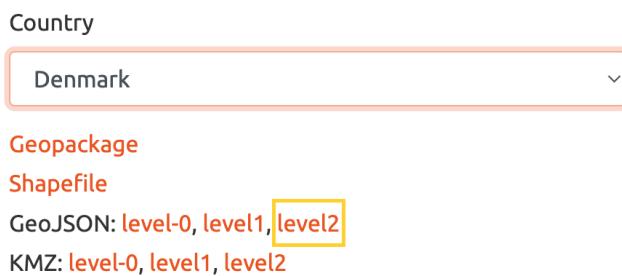
preprocessing_data.Rmd - contains code for data preprocessing.

The following steps were performed to preprocess data:

1. All of the data from Statistics Denmark was downloaded for each year separately, and loaded to R Studio.
2. All four datasets have been combined to one, and cleaned-up:
 - a. Observations that did not state the country of origin were removed.
 - b. For simplicity, observations that stated 2 countries being the countries of origin, were removed.
 - c. Country specifications, such as “North Macedonia”, were adjusted to “Macedonia”.

Downloading spatial data from GADM steps:

1. Go to https://gadm.org/download_country.html.
2. Select Denmark as a country.
3. Download the highlighted data:



4. Store data in the “data” folder inside the “Spatial Analytics” folder, which you can find on GitHub.

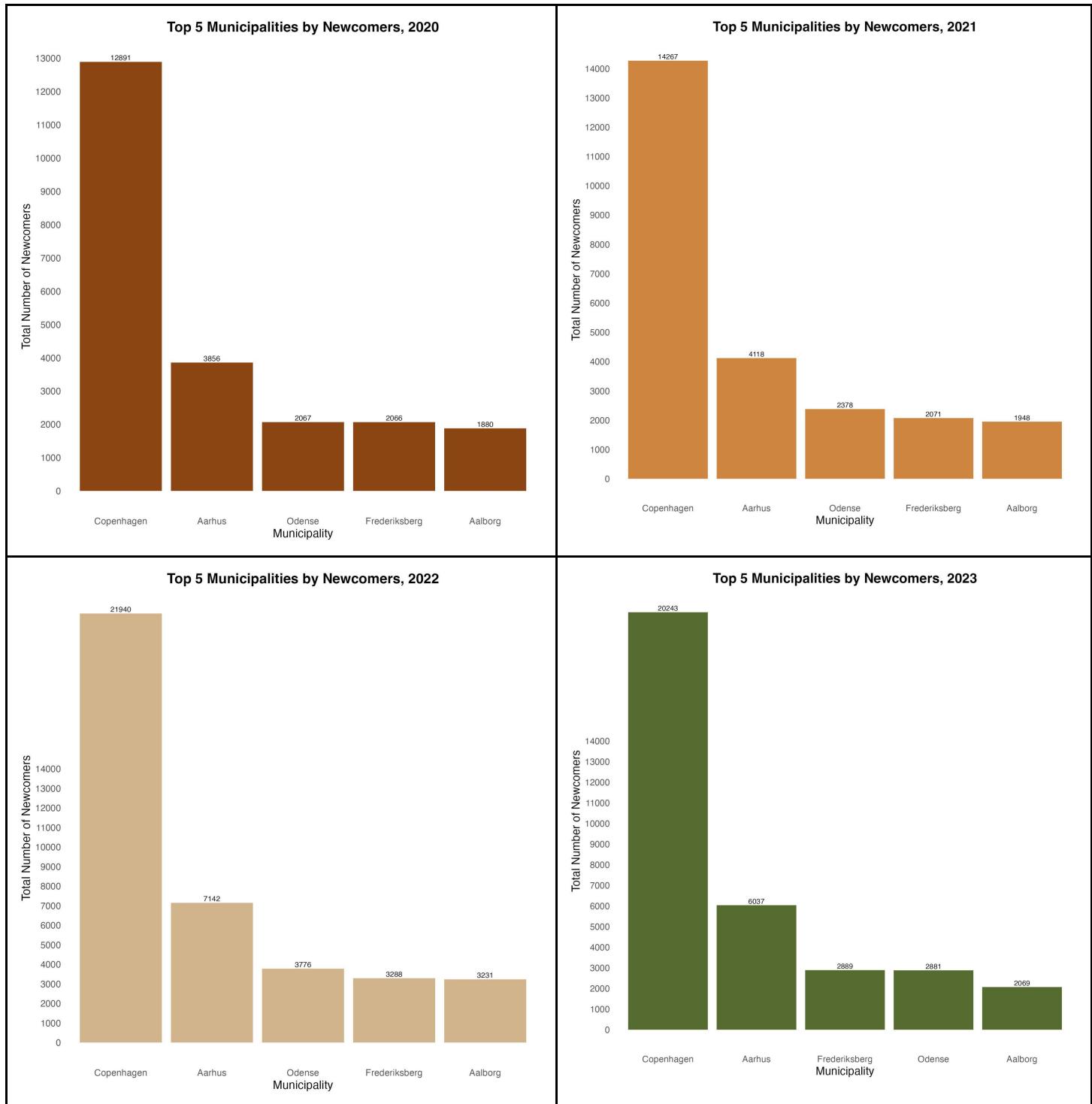
Downloading statistical data from Statistics Denmark steps:

1. Go to <https://www.statbank.dk/20004>.
2. Select ‘Immigration (yearly) by municipality, sex, age, country of origin and citizenship (2007-2023)’.
3. Aggregate Regions by municipalities, select all citizenships except Denmark, and choose a year of the data, for instance, 2020. Remember to log in to this page, which will allow you to download large tables with data.

4. Press ‘Show Table’. Then select the ‘Semicolon sep. (*.csv)’, mark ‘Codes in sep. columns’, unmark ‘Incl. Footnotes etc.’ and press Download.
5. Store downloaded dataset in folder ‘to_clean’. Rename to ‘2020.csv’.
6. Repeat the same steps for other datasets depending on a year.

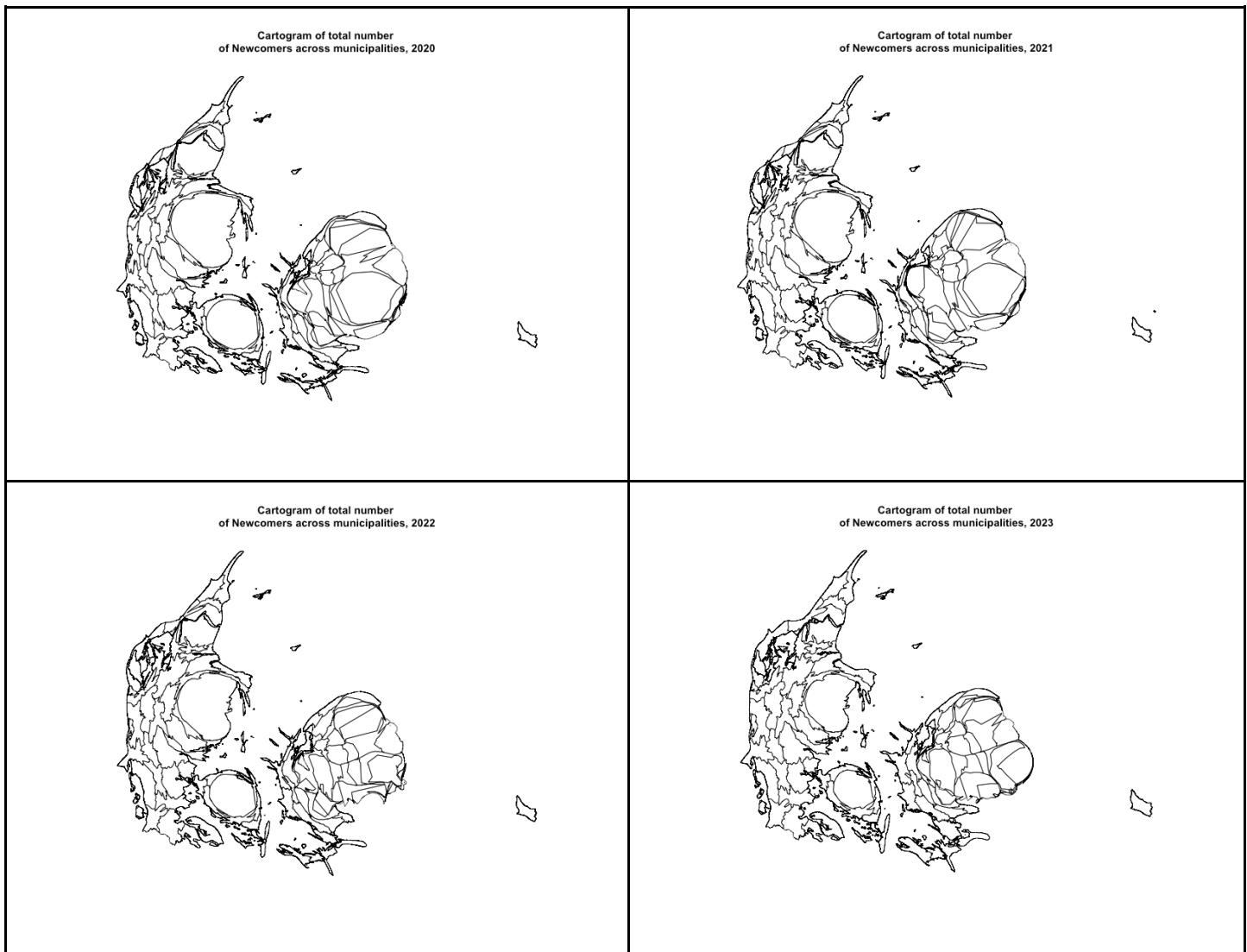
Appendix 2

Appendix 2.1: Histograms of top 5 municipalities, 2020 - 2023



The table above shows the top 5 municipalities according to the total number of newcomers for years 2020, 2021, 2022, and 2023.

Appendix 2.2: Cartograms, 2020 - 2023



The table above contains four cartograms of the total number of newcomers across municipalities. The result compliments the findings of plots in Appendix 2.1. It is clear from these cartograms which municipalities have welcomed the greatest numbers of newcomers.

Appendix 3: Percentages of newcomers across regions

Continent	Total Number of Newcomers	Percentage	Year of migration
Europe	33851	70.0	2020
Asia	8870	18.3	2020
America	4077	8.4	2020
Africa	1194	2.5	2020
Oceania	361	0.7	2020
Europe	43124	74.8	2021
Asia	9940	17.2	2021
America	3193	5.5	2021
Africa	1226	2.1	2021
Oceania	172	0.3	2021
Europe	77870	75.9	2022
Asia	15912	15.5	2022
America	6778	6.6	2022
Africa	1549	1.5	2022
Oceania	538	0.5	2022
Europe	50328	63.5	2023
Asia	18852	23.8	2023
America	7104	9.0	2023
Africa	2148	2.7	2023
Oceania	813	1.0	2023

The table above shows the total number and percentage of newcomers for each year across the different regions.

Appendix 4: Plots of neighborhoods

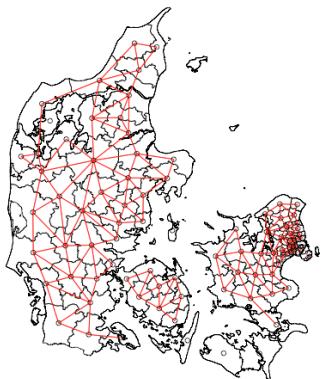
This appendix contains all plots for neighborhood definitions for each country of origin.

Ukraine:

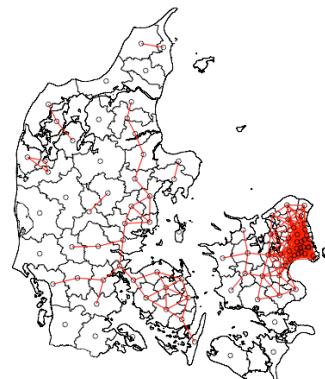


Romania:

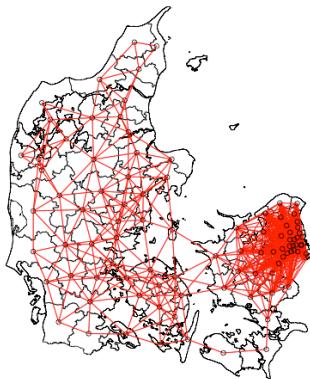
Queen Contiguity, Romania



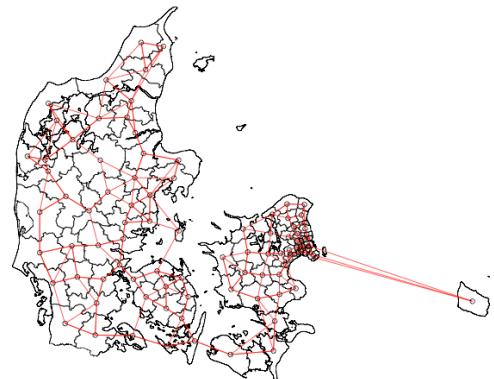
Distance of 25km, Romania



Distance of 50km, Romania

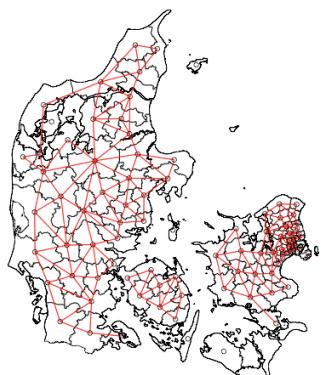


K-nearest neighbors (k=3), Romania

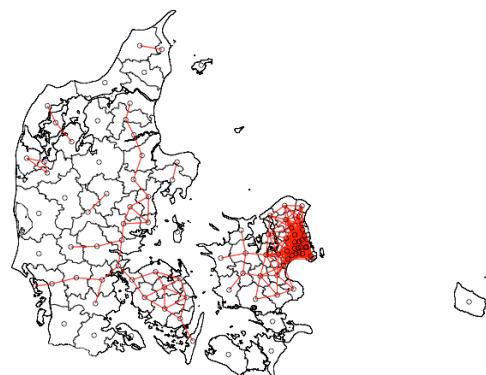


Germany:

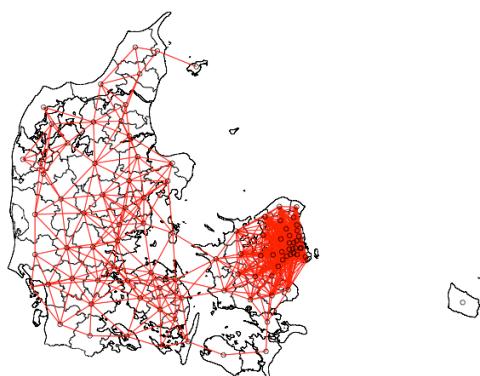
Queen Contiguity, Germany



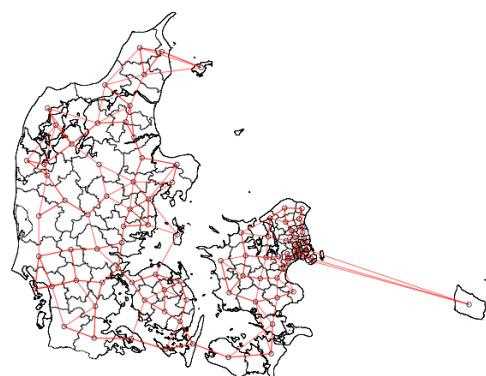
Distance of 25km, Germany



Distance of 50km, Germany

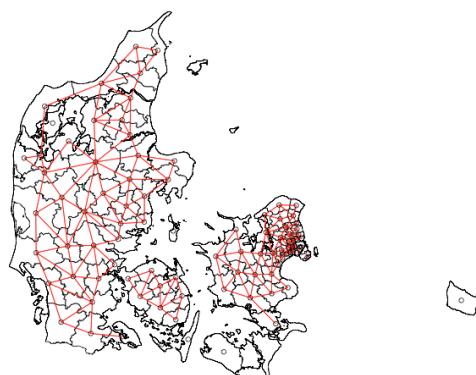


K-nearest neighbors ($k=3$), Germany

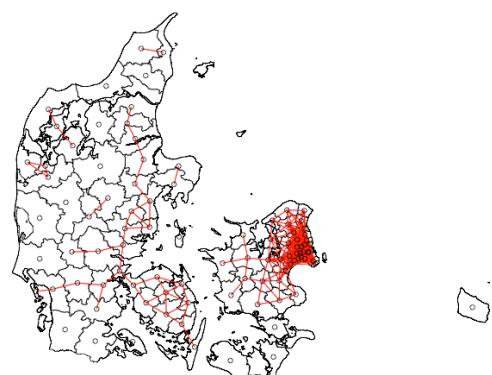


Poland:

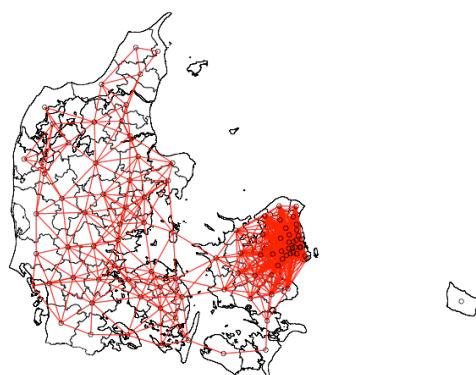
Queen Contiguity, Poland



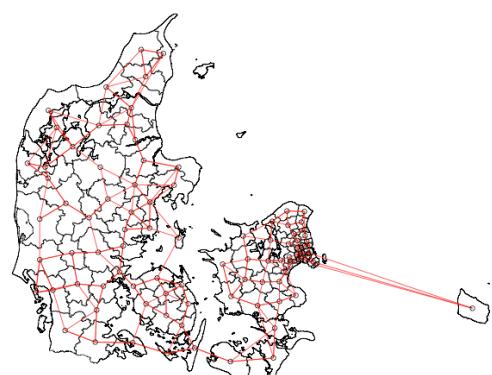
Distance of 25km, Poland



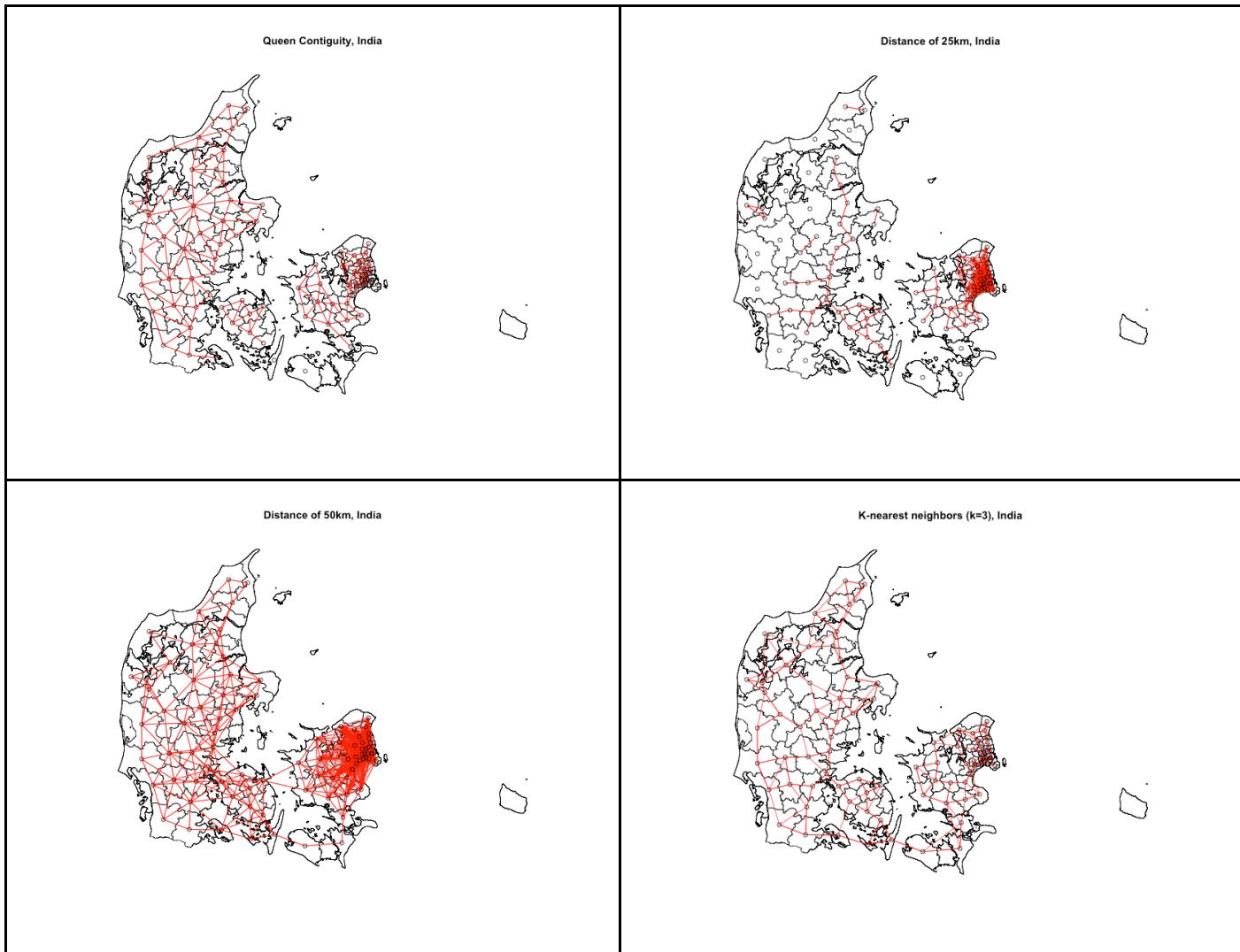
Distance of 50km, Poland



K-nearest neighbors (k=3), Poland

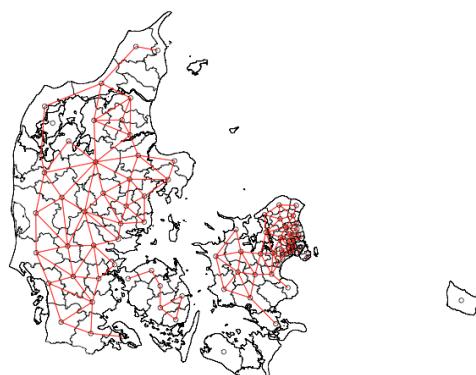


India:

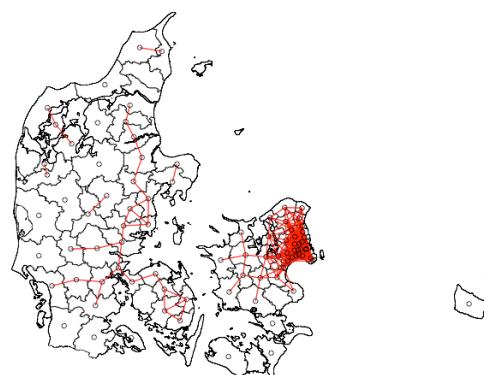


China:

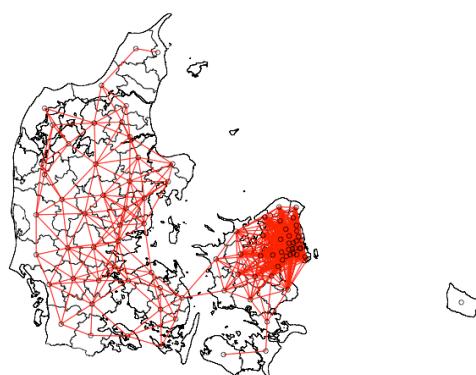
Queen Contiguity, China



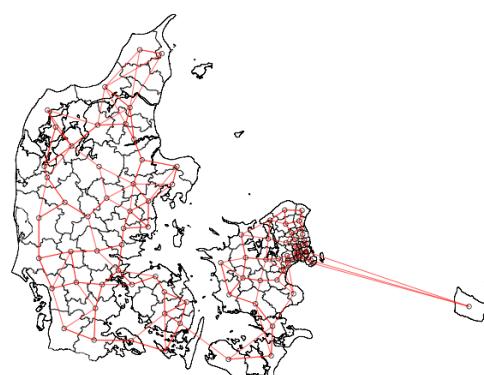
Distance of 25km, China



Distance of 50km, China

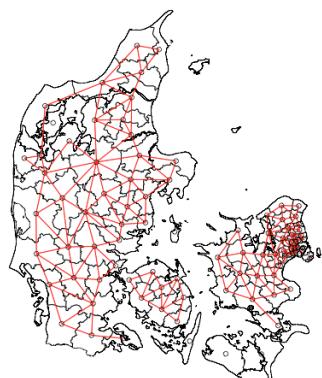


K-nearest neighbors (k=3), China

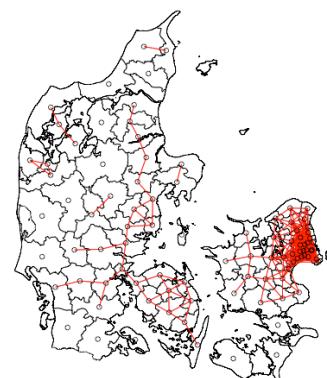


USA:

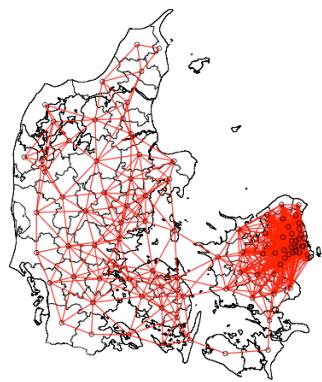
Queen Contiguity, USA



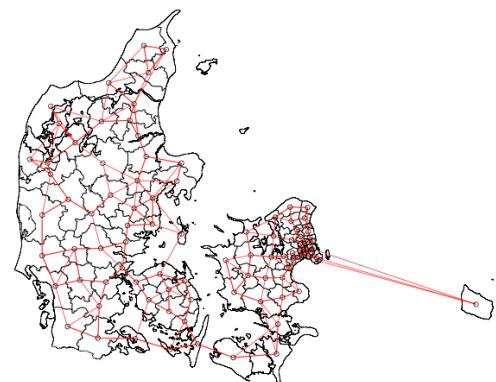
Distance of 25km, USA



Distance of 50km, USA

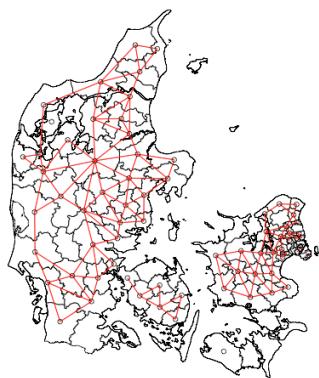


K-nearest neighbors (k=3), USA

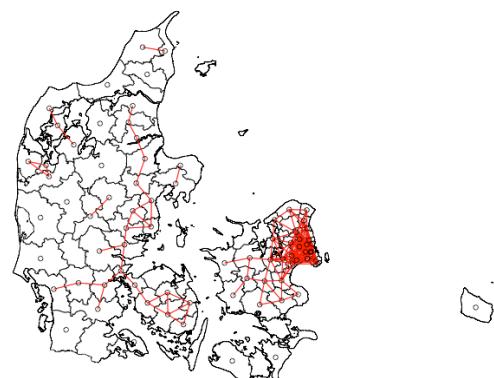


Eritrea:

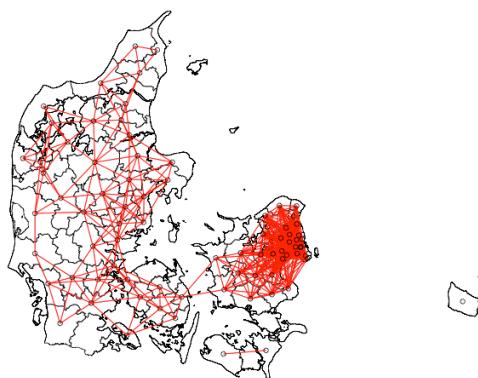
Queen Contiguity, Eritrea



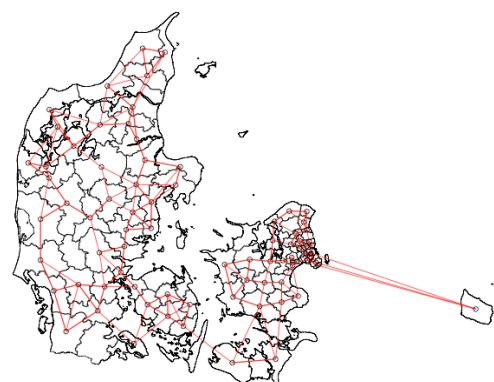
Distance of 25km, Eritrea



Distance of 50km, Eritrea

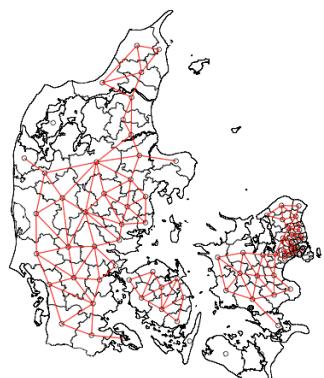


K-nearest neighbors (k=3), Eritrea

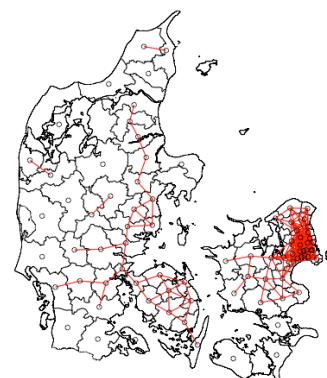


Australia:

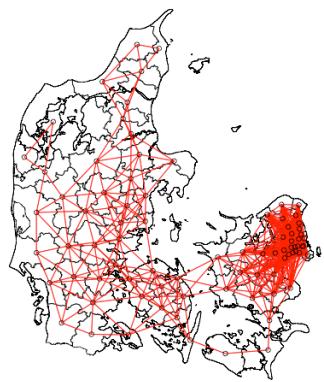
Queen Contiguity, Australia



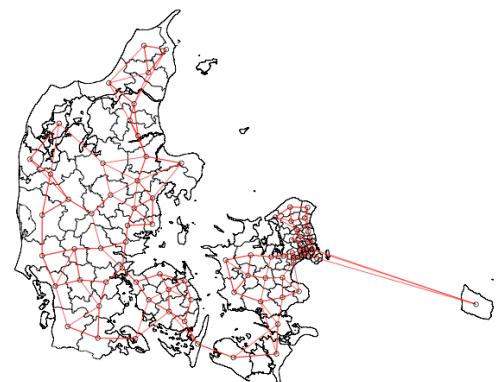
Distance of 25km, Australia



Distance of 50km, Australia



K-nearest neighbors (k=3), Australia



Appendix 5: ‘tmaps’ of total number of newcomers, 2020-2023

Figures below contain the total number of newcomers across municipalities for each country that was analyzed in the paper.

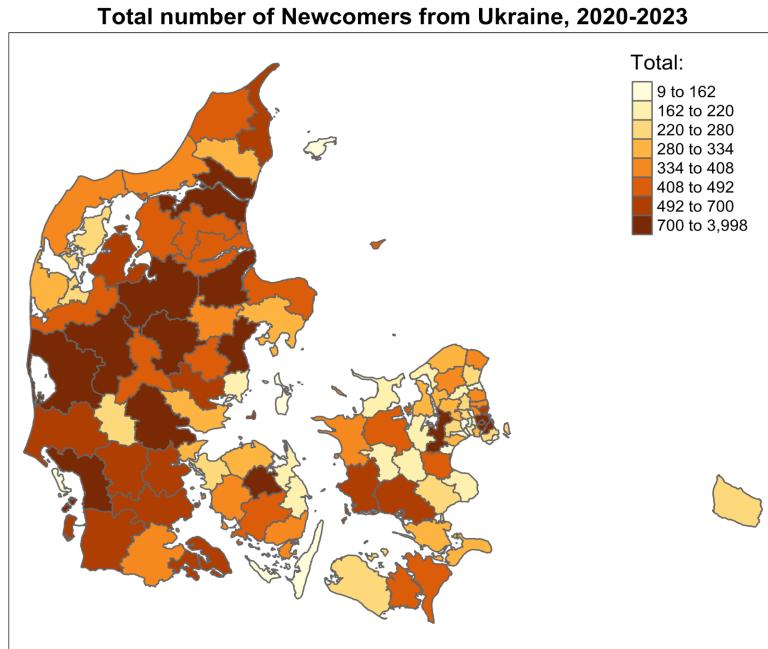


Figure 1: Total number of people from Ukraine across municipalities of Denmark.

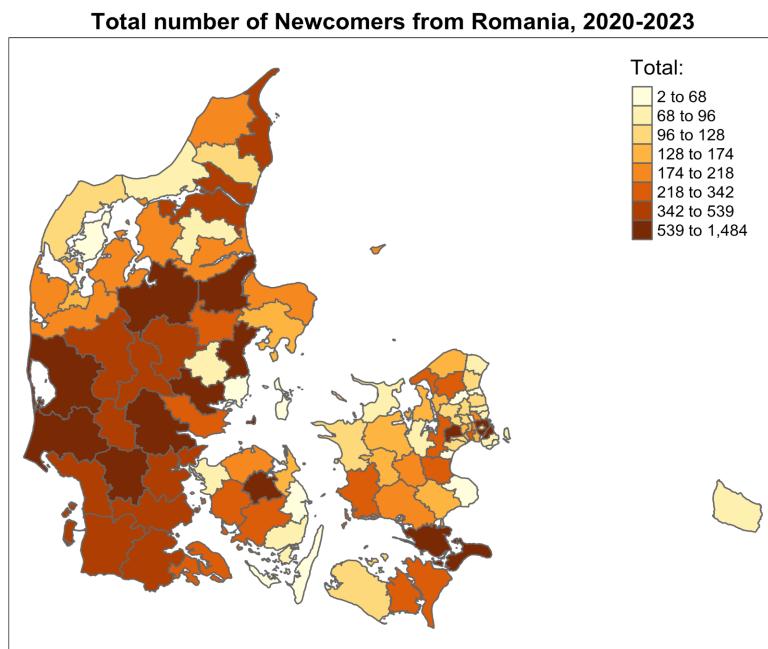


Figure 2: Total number of people from Romania across municipalities of Denmark.

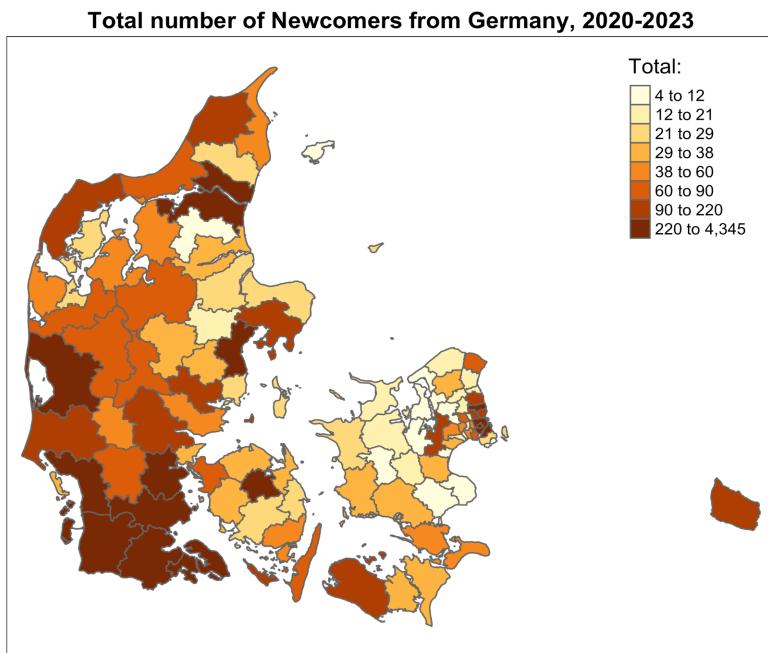


Figure 3: Total number of people from Germany across municipalities of Denmark.

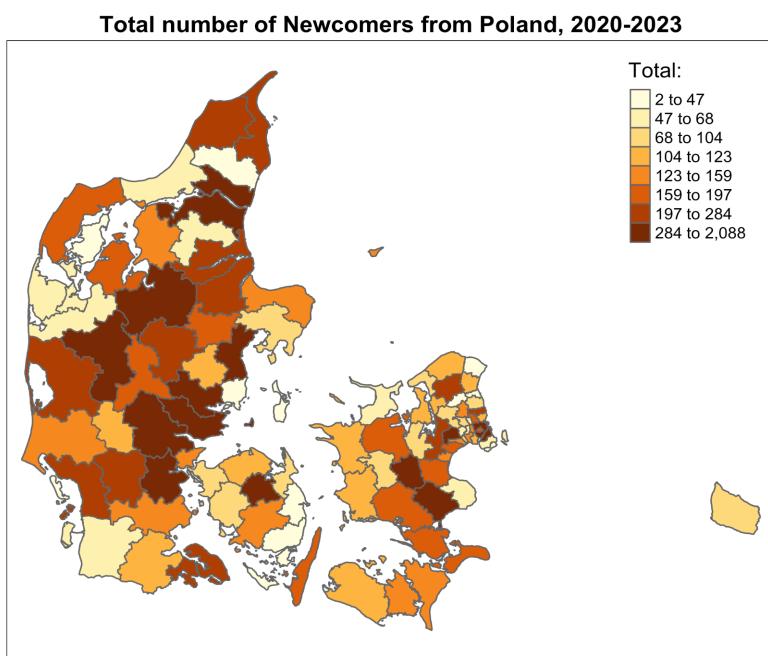


Figure 4: Total number of people from Poland across municipalities of Denmark.

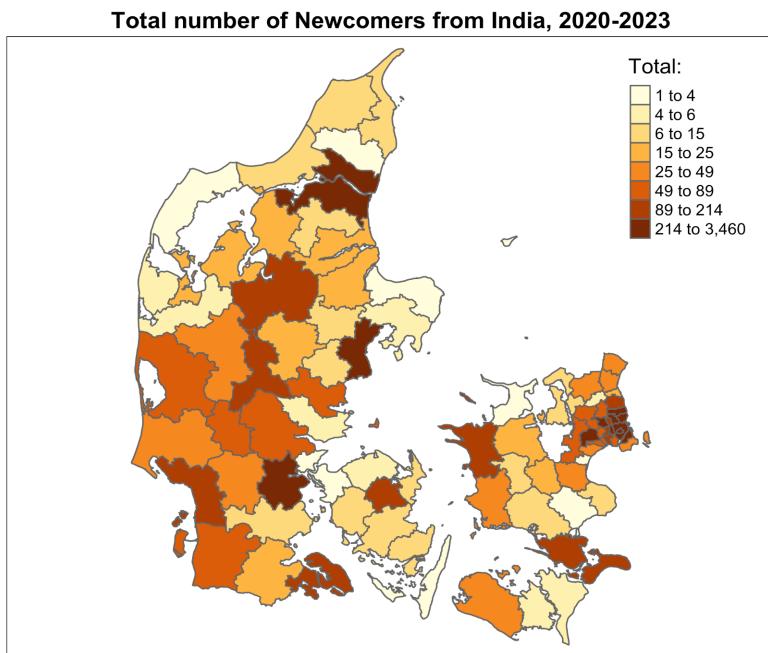


Figure 5: Total number of people from India across municipalities of Denmark.

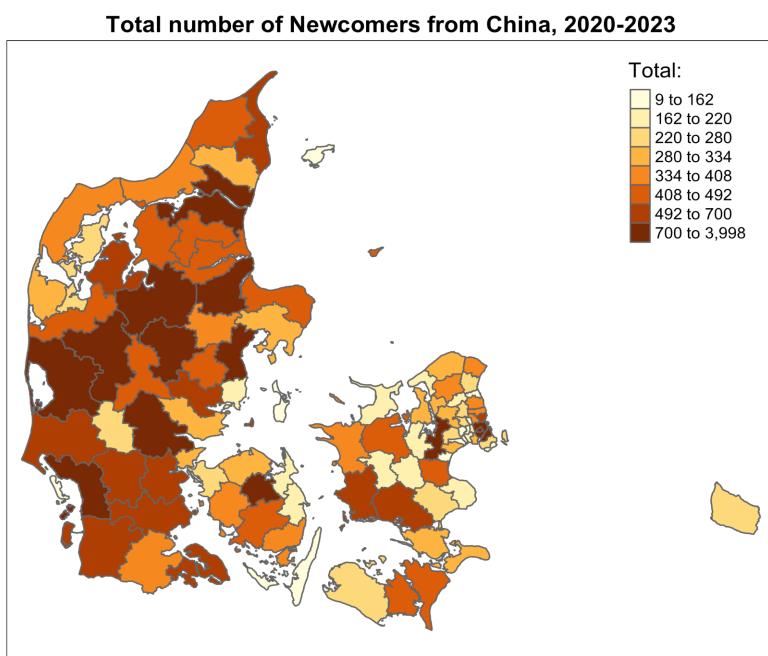


Figure 6: Total number of people from China across municipalities of Denmark.

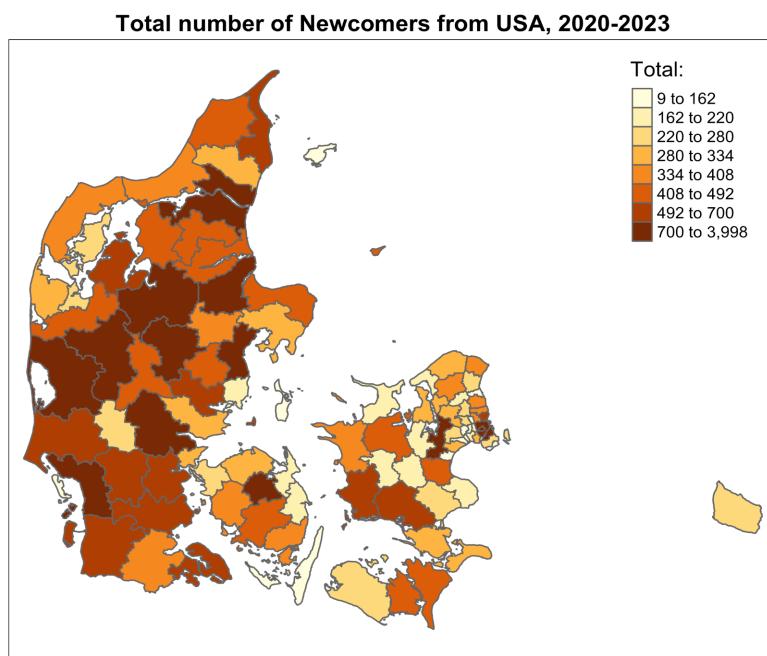


Figure 7: Total number of people from the USA across municipalities of Denmark.

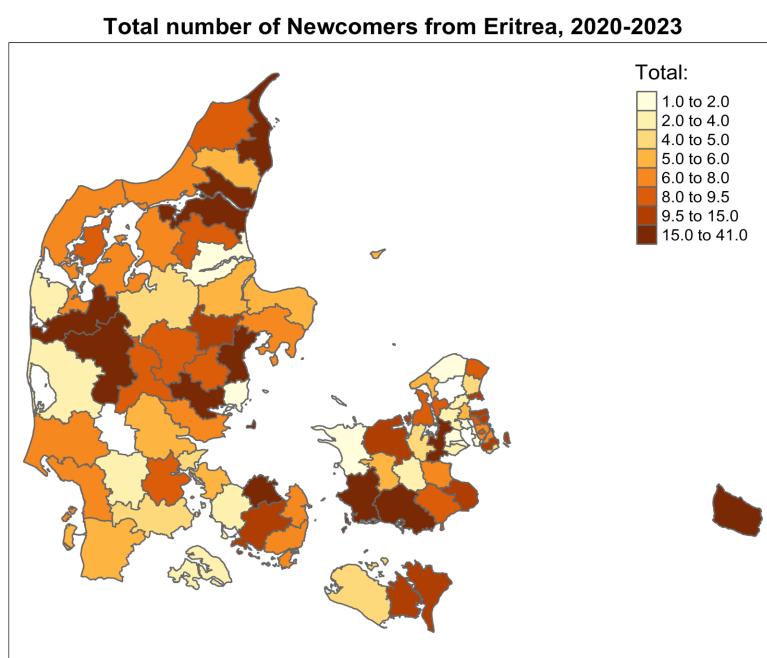


Figure 8: Total number of people from Eritrea across municipalities of Denmark.

Total number of Newcomers from Australia, 2020-2023

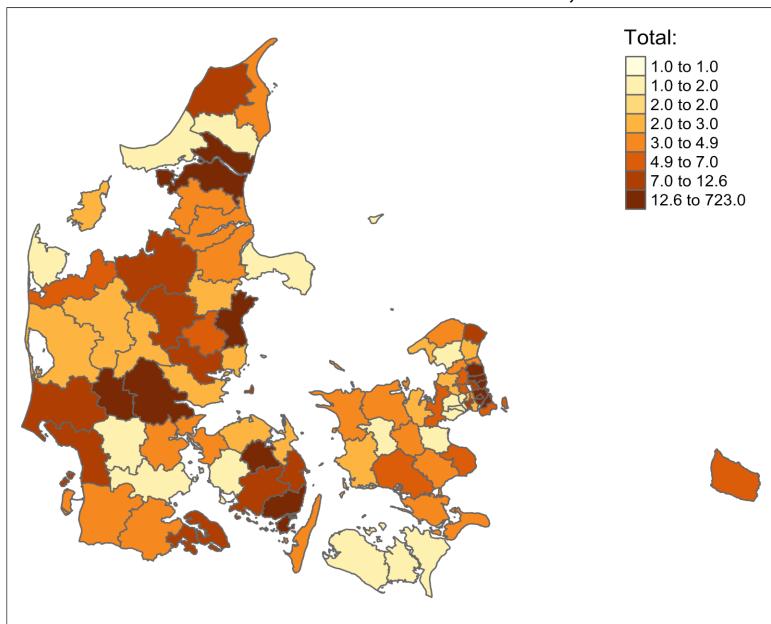


Figure 9: Total number of people from Australia across municipalities of Denmark.

Appendix 6: Software and Data metadata

Nr	Software metadata description	
S1	Current software version	<i>R 4.4.0, R Studio 2024.04.1 + 748</i>
S2	Permanent link to your code in your Github repository	<i>https://github.com/JustinaRaz/Exam_Spatial_Analytics.git</i>
S3	Legal Software License	<i>GNU GENERAL PUBLIC LICENSE, version 2.1</i>
S4	Computing platform / Operating System	<i>macOS Sonoma 14.2.1</i>
S5	Installation requirements & dependencies for software not used in class	-
S6	If available Link to software documentation for special software	-
S6	Support email for questions	-

Table 1: Software metadata

Nr	Metadata description	
D1	Data License	<p><i>License for data from Statistics Denmark, dst.dk: Creative Commons, CC 4.0 BY</i></p> <p><i>License for data from GADM: Creative Commons Attribution-ShareAlike 2.0</i></p>
D2	Dataset name: <i>gadm41_DNK_2.json</i> <i>2020.csv</i> <i>2021.csv</i> <i>2022.csv</i> <i>2023.csv</i>	<p><i>Data of a 'simple feature' class. Attributes that are needed for the analysis: 'NAME_2' for municipalities' names, 'geometry' for geometries of each municipality.</i></p> <p><i>Downloaded from Global Administrative Areas (GADM) database source: https://gadm.org/index.html.</i></p> <p><i>.csv type datasets, which contain information about 'municipality', 'n' number of people, 'origin' country.</i></p> <p><i>Downloaded from Statistics Denmark, source: https://www.statbank.dk/20004.</i></p>

Table 2: Data metadata