Guideline for Calculation Population and Dwelling Densities

This script calculates population and private dwelling densities around the centroid of each dissemination area (DA) for a selected Canadian province using the census data. It uses spatial processing and data from Statistics Canada accessed via the cancensus package.

It is worth mentioning that, since we do not have coordinates of population and dwelling variables, we assumed a uniform distribution of these variables across each DA.

1. Data Sources

- **Census Data**: The script retrieves population and private dwelling counts at the DA level from the Canadian Census using the cancensus API. To use the cancensus package, you need a valid API key, which you can obtain by signing up on the CensusMapper website. (https://censusmapper.ca/users/sign_up)

2: Data Download

Using the get_census() function from the cancensus package, the script downloads census data for a chosen province and chosen year, including:

- Total population (for 2021: v_CA21_1)

- Total private dwellings (for 2021: v_CA21_4)

3: Buffer Creation

The script specified the centroid of each DA polygon and then generates a 1 km radius buffer around each centroid. These buffers represent the spatial zone around each DA that will be used to calculate density.

4: Partial Spatial Intersections and calculation of densities

For each buffer, the script identifies all DA polygons that intersect it. Since a DA might only partially fall within a buffer, the script calculates the proportion of each intersecting DA's area that lies within the buffer. It then proportionally attributes population and dwelling counts based on this fraction, and finally the total population and dwellings within each 1-km buffer are divided by the buffer area (in square kilometers) to produce population and private dwelling density measures. The following example clarifies how the method works:

If the entire DA fell within the 1km buffer, then all of the dwellings in that DA would be added to the numerator for calculating dwelling density. If only 30% of a DA fell within the buffer, we assumed that 30% of its dwellings fell inside the buffer. So, for example, in a very simple scenario where only 2 DAs fell inside the buffer (one completely and one partially, we would make a calculation like this:

- *DA 1 (1000 dwellings, 100% in buffer) = Add 1000 dwellings to buffer*

- *DA 2 (500 dwellings, 20% of area in buffer) = Add 100 dwellings to buffer*

- *Then, calculate dwelling density by = 1100 dwellings / Area of Buffer*