Hackathon 2024

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Trinity College Dublin

6th September 2024

Introduction

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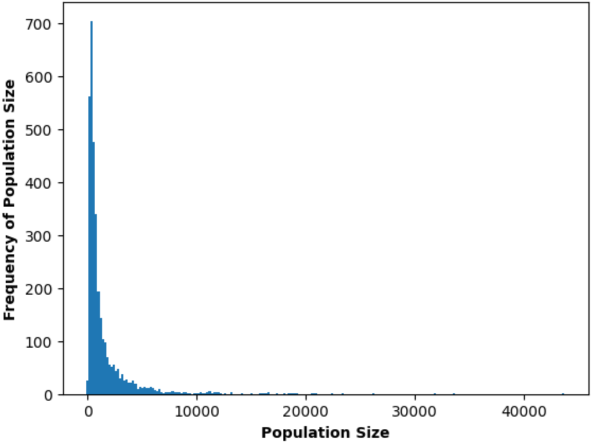
- Applying Diffusion to non local population density

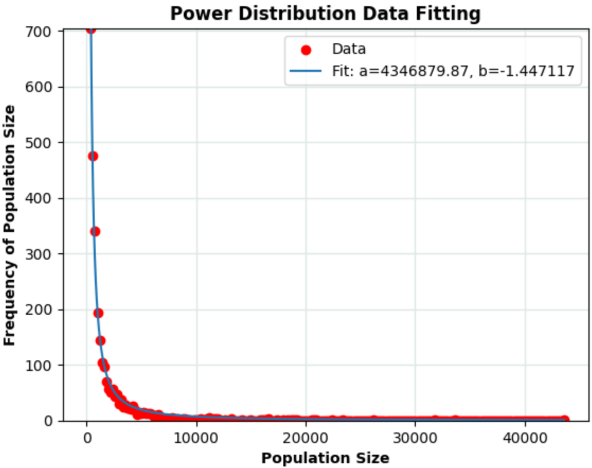
Population Distribution law

A histogram of the population data shows that most ED's have a small population



Population Distribution Law

Fitting a power law to the data, ax^b



Modelling Internal Population Migration Population

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- In DFT, interactions between electrons are represented as potential energy functionals. As the name would suggest, these functionals are often dependent on electron density.
- We decided to see if we could do something similar with population density. Take a look at the plots on the following slide.

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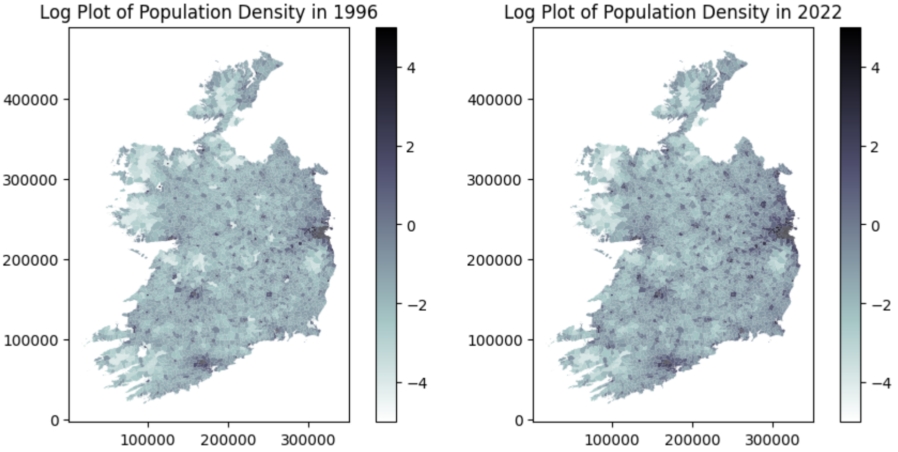

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- We used this idea of high population density being attractive to generate the following non-local potential matrix:

$$\rho_i = \frac{p_i}{A_i}$$

$$V_{ij}[\vec{p}, \vec{\rho}] = \beta \left(\frac{\rho_i - \rho_j}{p_j} \right) \left(\frac{\max(p_i, p_j)}{\min(\rho_i, \rho_j)} \right)$$

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- This matrix, when multiplied by the population vector, generates a $\Delta\vec{p}$ vector that has the condition that $\sum_i \Delta p_i = 0$, meaning that the total population doesn't change.

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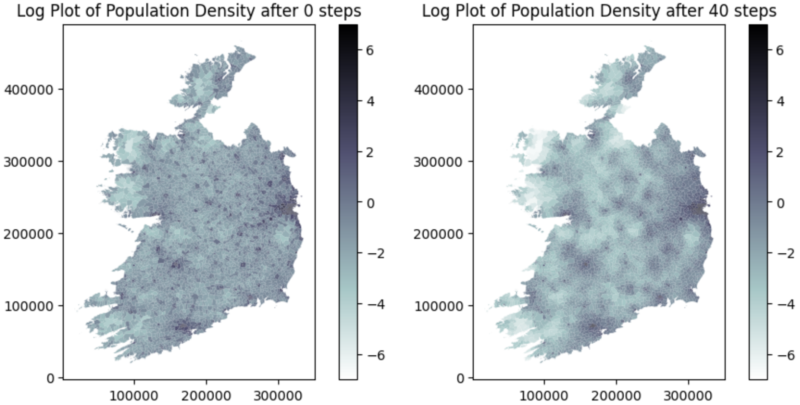

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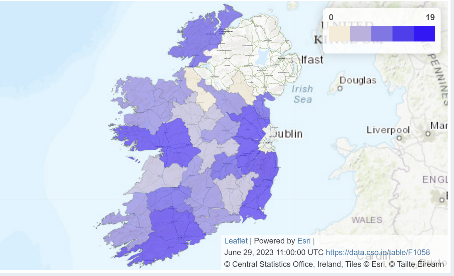

Figure: 2022 Census: pupulation movement out of Dublin by percentage

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- The highest percentage of people leaving Dublin were dispersing to nearby areas, as seen in the model
- The majority of people leaving Dublin for non surrounding areas were moving to other cities, i.e other areas of high population density

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- With this correlation matrix we can get a sense of what EDs are "topologically close".

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- We can then use this with Electoral census data to create a new non-local adjacency matrix by having EDs within a certain topological distance of each other be connected.
- This new adjacency matrix can then be used with a simple diffusion model to allow the flow of population density from lower to higher density.

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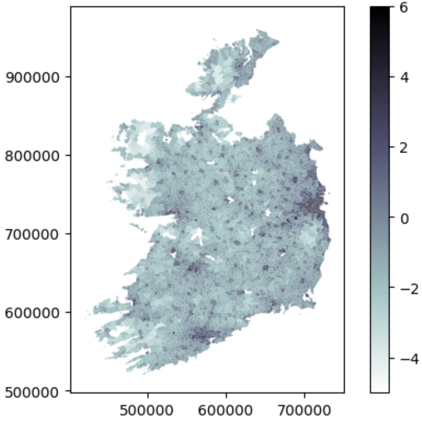

Thanks for Listening!