NIHR | Applied Research Collaboration South West Peninsula

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Module 5 : Geographic Modelling & Visualisation
Session 5B : Combinatorial Optimisation for Geospatial Problems
Elliott Coyne

“ahiti Nui Mare'are'a”

HSMA 5

#hsma5isalive

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Facility Location Problems

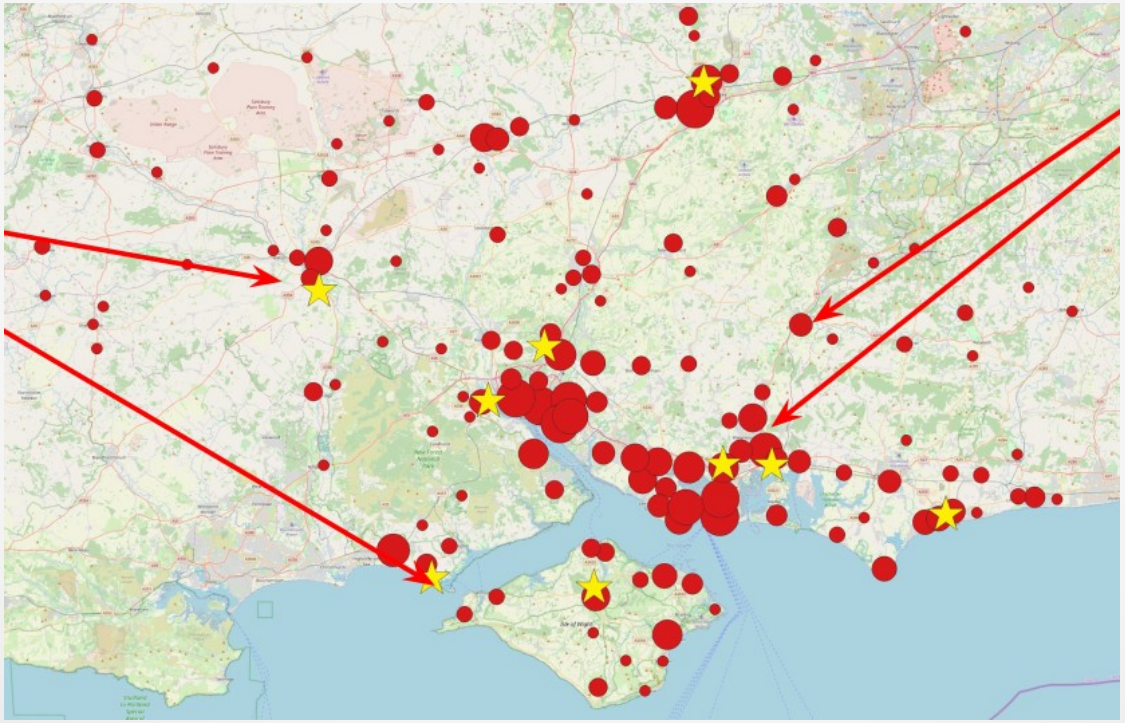
One job of budding Data Scientists is to help their organisations in making decisions when it comes to deciding about the locations for services.

Real life healthcare examples may include reviewing (and rationalising) existing service locations.

Understanding how to approach these problems will then given you data to use with maps. Great for Modules **5C - QGIS** and **5D – GeoPandas**.

Example...

Location of Dialysis treatment centres (i.e., hospitals)



Home ‘location’ of patients using dialysis service (size represents density)

Real Work Examples

Any examples to share with the group?

Feel free to put them in the chat...

Location Modelling

Other health examples include...

- A city hospital providing ophthalmology services needs support to decide where to locate 5 mobile clinics most equitably for users.
- A public health team and sexual health service provider organisation need support in reducing the number of locations for outpatient clinics in a region whilst still offering equitable access.
- NHS England want to support in centralising hyperacute stroke care across England, to maximise equity, quality and patient outcomes.

When Size Matter

Small problems in health

- best supported using using a combination of simple mapping and analysis

Medium/ large scale applications in health

- interwoven with mathematical and computational optimisation and are possibly *multi-objective* in nature
- You should view this as decision support not just optimisation.

Data Requirements

For these types of problems, you'll usually encounter…

Travel times/ distances – From different areas/ locations to existing/ proposed services or facilities

Demand (aggregated) – Total numbers of service users originating from different locations

Demand (granular) – Details of individual service users and their origin (i.e., home address); these are required to calculate Max or 95th percentile travel times/ distances

Facility details – generally including their name, location and possibly other details.

What We'll Cover….

During this session you'll be shown a live demo of the following steps. You'll then work in your groups to tackle a different problem, using similar steps for yourselves.

- Library Imports
- Data Imports
- Representing a Solution
- Constructing a Random Solution
- Evaluating a Solution
- Small Problem: Enumerating all Possible Combinations
- Bruteforce Solution
- Graphical Representation of Bruteforce Solution
- Medium to Large: Using random restarts (Demo Only)

What You'll Need...

Please open the following Jupyter Notebooks:

- *Code Along...*
- *Group Exercise...*

Other Possibilities

Use of…

- Evolutionary Algorithm – *See demo*
- Full Genetic Algorithm