Homework 5: Network analysis

In this assignment, you will perform a hypothetical consulting project on water system interconnections. Physical interconnections allow water systems to transfer water from one to another subject to specific agreed upon terms. Though many systems in North Carolina are interconnected, the majority are not. You have been contracted by NC Department of Environmental Quality to consult on the broader interconnection context in North Carolina and how to do address a couple of specific situations that have arisen.

A pdf of the report should be uploaded to Canvas, and should include a link to your code on Github (repository can be public or private; if private, add me as a collaborator - my github username is arelkhattabi). Feel free to use Quarto, Markdown, Canva, or any other software to create your report.

You should describe your findings in a well-written report to NC Department of Environmental Quality (complete sentences, please 🙂).

Question 1

Make a map showing the water systems that are interconnected, water systems that are not connected, and the network of interconnections [1 point].

Question 2

Transform the interconnections layer into a graph (network with nodes and edges). Map the network (nodes and edges) [2 point].

Question 3

Compute degree centrality and between centrality measures for the interconnections network. Map your measures and interpret/discuss your findings. [2 point]

Question 4

OWASA (the water system that serves Chapel Hill & Carrboro) needs to buy water. Cary has excess capacity that it is willing to sell. The cost of water depends on distance. Let’s assume it costs What is the shortest path between Chapel Hill and Cary? What cities does the water need to pass through to get from Cary to Chapel Hill? Now assume, that OWASA is thinking of instead getting water from Raleigh. How far does water have to travel? What cities does the water have to go to? [2 points]

Question 5

The Town of Liberty is in trouble and needs to augment its water supply. One option it is considering is to connect to a system that is already interconnected. What are its options? Which is the closest option? What would some of the challenges for the Town of Liberty in implementing this option? [3 points]

*You may find it useful to adapt code from* [*https://www.r-bloggers.com/2019/09/spatial-networks-in-r-with-sf-and-tidygraph/*](https://www.r-bloggers.com/2019/09/spatial-networks-in-r-with-sf-and-tidygraph/)

*It may be helpful to you if you make maps in leaflet to explore. For the report, please include maps created in ggplot.*

Extra Credit

Where are there regional clusters of unconnected systems? Associate each system with a county and bring in census data. Summarize the number of connected vs unconnected systems in each county. Are there any associations between county characteristics and the number of connected/unconnected systems? [2 points]