Abstract

Proposal 1:

The paper will present an application of Voronoi Diagram on improving power distribution efficiency in US by delimitating a geographically optimal scope of power supply for each power plant by constructing a weighted 2D Voronoi Diagram considering factor that might influence the scope, such as the capacity of the power plants (the maximum electric output a generator can produce).

The scope of power supply of a power plant is defined as the region where the power plant will be the main the power source for all demand points (residential site, industrial site, etc.) within the scope. Delimiting an appropriate scope of power supply is crucial for power delivery and energy efficiency, because the longer the distance of transmission, the higher the losses and costs would be. Thus, for any individual demand point, ideally, it should be included to a power plant’s scope of power supply that to which it is closer than to any other power plant in Euclidean distance. Voronoi Diagram, a partitioning algorithm, is applied to achieve that purpose. Each power plant is considered as a “site”, and the scope of power supply is the “cell” obtained as the result of partition. However, in reality, power plants have various capacities. To achieve optimal energy efficiency by avoiding potential power overloading or surplus, power plants with larger capacities will be supplying a larger region (here we assume electricity demand does not much vary across regions) by a weighted Voronoi Diagram.

The dataset consists of data of 28,500 power plants from 164, including over 8000 within the U.S.: https://www.kaggle.com/eshaan90/global-power-plant-database. The data

attributes include the location (by latitude and longitude), capacity (in megawatt), and the major fuel type of each power plant.

Proposal 2:

The paper will represent an application of Voronoi Diagram on estimating precipitation in Pennsylvania by data collected by over 90 stations within the state by given period of time.

Accurately measuring precipitation over a region is a crucial component of climatic analysis. Since it is infeasible to collect data on every inch of land, an efficient method to calculate the precipitation over an area from data collected by finite independent stations is demanded. The core problem is to figure out that what's the most reasonable area in which the precipitation on every unit of land could be represented by the data collected by a station (in other words, for each unit of land, we would like to know the data from which station is closest to represent its actual precipitation). Intuitively, the precipitation on a unit of area should be most similar to the precipitation from the closest station. Thus, Voronoi Diagram's nature of capturing proximity can be very useful in the scenario. Specifically, each station can be seen as a Voronoi site, and the Voronoi cell of the site represents the (presumably most reasonable) region in which the precipitation on every unit of land can be represented by the data from the station (i.e., the site). Then, we are able to calculate the average precipitation over the state -- the weighted average, i.e., the sum of product of data from each "site" and the proportion of the "cell" area (data at site1*cell1 area/state area + data at site2*cell2 area/state area …).

Data set: https://waterdata.usgs.gov/pa/nwis/current/?type=precip&group_key=county_cd, which includes the location of stations within Pennsylvania and the precipitation measured from each station in a period of time.