Computational Models and Algorithms for Dynamic Resource Distribution

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The distribution of resources over geographic area is a key issue that can be found in many different fields and industries. For example, when given limited resources to build a certain amount of hospitals over a specific area, one may want to know the optimal distribution and positioning of the hospitals so that everyone in that area has equal access. I researched a mathematical model to find ways to do this. I explored an array of solutions starting with one-dimensional dynamic programming algorithms, and working up to a two-dimensional k clustering solution. This solution considers varying amounts of population in the sample area to split the area into contiguous zones with equal area, in which people are assigned to a center representing the limited resource such that that is the closest center to them. This model could be used to assess distribution of critical resources such as hospitals, fire stations, schools, military establishments, police stations, courts, cellular network towers, etc. In addition, one use of this type of model is political redistricting of an area. Gerrymandering in the United States has created partisan districts; this algorithm could redistrict fairly. The results were analyzed using data from the 2010 Census for various states. The algorithm gave potential solutions for multiple states, each of which was more compact and contiguous than the original districts. I concluded that this model could be used to distribute resources equitably and to address the growing problem of gerrymandering in a fair way.

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