Facility Location Problem (FLP) - Women's Healthcare Access

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Algorithm

In developing our formula, we consider several crucial factors in determining the priority of district allocation for hospitals. These factors include the existing number of healthcare facilities in each district, the population of women residing in each district, the presence of schools as an indicator of family-oriented districts, the identification of isolated areas, and the consideration of social-economic factors. By analyzing these criteria, we can create a ranking system that highlights districts in greater need of hospitals, facilitating informed decision-making for optimal allocation and improved healthcare accessibility.

The factors considered to find Facility Location (distance metrics)

- The average distance of the individual's address to the GP and other amenities
- Number of schools nearby
- Transportation accessibility
- Isolated area index
- Socio-economic status
  - Income
  - Education
  - Immigration status
- Demography
  - Ratio of women - Ratio of households with children

Quantifying Index formula

1. $(\text{dist GP} + \text{dist supermarket}) \times (\text{dist kindergarten} + \text{dist school}) + \frac{1}{\#\text{schools}}$
2. $ (\text{low income households \%}) + (\text{ppl with lowest 40\% income}) + \frac{1}{\text{employment rate}} + \frac{1}{\text{avg. income per person}} \\$
3. $(\text{low education \%}) \times (\text{non-western immigration \%})$
4. $(\text{percentage of women}) + (\text{percentage of households with children})$

Result and Analysis

We ranked the Wijks (neighbourhoods) using the metrics. The top 5 Wijks are where the new health care facility should be built, as shown in figure 1.

Result: Top 5 Wijks

Scalability of the Algorithm

The algorithm developed for optimizing the placement of healthcare facilities for women in Amsterdam shows promising scalability potential. While Amsterdam currently has a relatively balanced male-female population, the algorithm's focus on the female population ensures its efficiency even in areas where the gender ratio is less ideal, such as those with a higher proportion of males.

By including the type of facility in the analysis, the algorithm can provide better predictions on where additional facilities are needed and what specific types of healthcare services are required, such as maternal care and gynecology. This granularity allows for more targeted planning and resource allocation, ensuring that the healthcare needs of women are adequately addressed.

Conclusions:

- **Adaptability to Other Cities:** The developed algorithm exhibits easy adaptability to other cities. By customizing the relevant parameters and input data for each city, the algorithm can be readily applied to optimize healthcare facility placement in various urban settings, accommodating the unique characteristics and needs of each location.

- **Collective City Analysis:** The scalability of the algorithm extends beyond individual cities. It can be scaled up to compute for multiple cities collectively, providing a comprehensive approach to addressing women's healthcare accessibility on a broader scale. This capability opens opportunities for regional or national-level planning and decision-making.

Scope of Improvement:

- **Integration with Transportation Apps:** To further enhance the algorithm's effectiveness, integrating it with transportation apps, such as 9292, would allow for a more comprehensive consideration of transport accessibility. In addition to transportation options, factoring in the time required to travel between locations would provide a more accurate assessment of accessibility and inform facility placement decisions.

- **Consideration of Existing Women's Healthcare Facilities:** To improve the quantifying index, it is essential to incorporate information about existing healthcare facilities that specifically cater to women's healthcare needs. By taking into account the availability and distribution of such facilities, the algorithm can better identify areas that lack sufficient coverage and allocate resources accordingly.

Overall, the scalability of the algorithm, coupled with potential improvements in data integration, can significantly contribute to optimizing healthcare facility placement for women, not only in Amsterdam but also in other cities, fostering better accessibility and quality of care.

Code

The algorithm is implemented in Python using Pandas. We provide the code file within the submitted folder, and it can be executed using Jupyter Notebook. Moreover, to generate plots, we used seaborn, *matplotlib* and *folium* Python libraries are used. We have provided a separate Jupyter Notebook file. The files generate 'amsterdam-data.csv', which is an intermediate dataset with enhanced information on top of CBS data, and 'data.csv', the file with the final ranking based on the quantifying metrics.