Project SEN124A:
The Best Office Settling Locations in the Randstad

Cities are many things to many people. But, at a minimum, cities provide the institutional context for employment and job growth. Larger cities result in greater numbers of employers and greater numbers of employees. And that's a good thing: large job markets run more effectively for all involved. But this market plays out over space, in the demand for urban land.

In the classic city, employers want to be in the central (business) district. There they can be a magnet to attract the greatest number of potential employees, and the greatest number of service companies which can help them grow their business. On the other hand employees want affordable housing and a reasonable commute time. Thus for employees there is a serious trade-off between time on the road and money spent on rent and mortgage.

Figure 1: Highways in the Netherlands (By T Houdijk, CC BY-SA 3.0, `https://commons.wikimedia.org/w/index.php?curid=3677106`).

We know how this works for the classic city – expensive, dense infrastructure in the center and affordable, low density housing at the outskirts of the city. The Randstad is an edge city; it is in fact the classic example of a 'polycentric urban region'. Every polycentric city is a little different; we don't really understand how they work. When you add more roads to the network you change the time geography of the city, making some parts of the city more accessible than others.

For this project we assume that a big international company with around 5000 employees will open two new office locations somewhere in the Randstad. It is your task to advise the company

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on the best suitable locations within the Randstad area to settle using a network based analysis.

Network Analysis

The network analysis consists of four parts. You are asked to investigate the most suitable two office locations for the company to settle using various network metrics.

Part 1: best location within the Randstad

Use the distance from potential employees within the Randstad together with other relevant network metrics to determine the best two locations to settle within the Randstad. You can assume that the number of employees from a certain city working at the company is proportional to the city population's share within the Randstad (city population divided by total population Randstad).

- investigate at least three different **network metrics** that quantify relevant information about the network and your choice for the best locations to settle. You need to argue yourself (i) why the metrics you have chosen are good network metrics and (ii) what properties you think are (most) relevant.

- you can assume that the Randstad consists at least of the following cities/locations: Zaanstad, Amsterdam, Haarlem, Schiphol, Leiden, Den Haag, Zoetemeer, Delft, Rotterdam, Spijkenisse, Dordrecht, Vlaardingen, Alphen aan de Rijn, Gouda, Woerden, Utrecht, Hilversum, Almere, Amersfoort. You may add more cities if you like. **Use the same network for all following parts.**

- For the distance between cities you can use Google maps (`http://maps.google.com`). Make sure that in your network representation you don't make a fully connected graph, but that you follow (more or less) major roads, i.e., Den Haag and Amsterdam are connected via Leiden, not directly.

Motivate your choice for the two best locations to settle with a network analysis. Generate at least one graph visualization to support your argument.

Tip: you might need to partition your network into two parts before you can do your analysis.

Part 2: best location within a city

In this second part, we are interested in deciding the best possible location *within a particular city* for the company to settle. Continue with **one of the cities** you have chosen in the previous questions and investigate the trade-off between settling in a central location close to a major train station or in a more peripheral location close to a highway.

Investigate the influence of travel time of the company's employees for two modalities: commuting via road or using public transport.

Tip: investigate the average commute time per employee to the central or peripheral location, assuming the number of employees from a certain city working at the company is proportional to the city population's share within the Randstad. Start with all employees using only one type modality and continue with a mix of modalities until you find the threshold where both locations are as suitable.

If you want you can add information to the model, either by using one of the resources given below or by other relevant information you found yourself (refer to the sources you use!).

Part 3: Interactions in Property Markets

In your network model you considered features of distance and proximity for locating your company. Now let's consider potential strategic interactions with others. Property values are strongly related to the location of these properties within a transportation network. One compelling model

of this phenomena is to use the PageRank values of the nodes (see section 14.3 of the course book). This presumes that everyone wants to be where everyone else thinks is a central location. This might be how many companies choose their location. Another compelling model is betweenness centrality. A job seeker who wished to keep their options open might live in a node with high betweenness (see section 3.A of the course book).

- Which **network properties** can you justify as having possible strategic significance for property networks?

- Calculate these properties for your model of the Randstad.

- Gather indications of office prices and/or rents for centrally located facilities at each of your nodes (using external literature sources).

- Which network properties seem to be best indicators of property values for private homes and retail properties? HINT: You may have to transform/scale your variables to achieve a reasonable fit to the data.

- Were these metrics a satisfactory fit, and why or why not?

- Relate this the outcome of your analysis of the previous questions. Would you change your recommendation for the two best office settling locations knowing that it is a strategically valuable (or non-valued) based on your analysis of this question? Motivate your answer.

Part 4: Strategic recommendation

Use your network analysis (from the questions above) to provide a strategic recommendations for the best two locations for the company to settle within the Randstad area.

Hints

Here are a few suggestions which may help you in analysing this network. First, we recognize that this is a challenging problem. Be creative! Second, be technically correct. Regardless of your answer, be sure that it follows proper network analysis procedures. Third, be consistent with your models. Fourth and finally, start simply. Make a simple model which explains the most obvious features of the problem. Consider what parts (and assumptions) of the model are least adequate, and improve from there.

Note: where necessary make assumptions, and make these explicit in your report.

Assignment

Provide a report of no more than 15 pages that answers the questions above. Explain how you did your analysis and illustrate your answers with graphs and figures.

You're allowed to provide an appendix to your document. This appendix is not counted in the 15 page limit. Here you can add any additional information, such as details about a particular analysis etc. Note that the main rapport should be understandable *without* reading the appendix.

Next to the report you also need to hand in all the code/models used in your analysis. You don't need to elaborately provide comments in your code.

Code & Models

Feel free to use whatever programming language or platform you want for answering your questions. We provide you with a starting NetworkX and Gephi model, but if you'd rather use excel, matlab or another package that is fine.

Practical Information

Form groups of four students for this assignment. You can register your group on BrightSpace. The deadline for handing in the assignment is **Wednesday April 10, 2024 at one minute before midnight (23:59)**. Reports must be handed in in pdf format via BrightSpace. The reports must include the name and student numbers of all group members. Code can be compressed (zipped) when handed in.

We expect a report according to normal academic standards, i.e., refer to sources (don't plagiarise) and use arguments for all statements.

Note that you have to pass both this assignment as well as the written exam in order to pass the course.

For questions contact Martijn Warnier (M.E.Warnier@tudelft.nl) or ask during the lectures or during the office hours (see Brightspace).

References & Other resources

Good sources for finding data are Wikipedia (for city sizes) (`https://en.wikipedia.org/wiki/Main_Page`), Google maps (`http://maps.google.com`), Dutch Railway (`https://www.ns.nl/en`), Public transport planner for the Netherlands (`https://9292.nl/en`).

1. Alonso, W. (1960). "A theory of the urban land market". Papers and Proceedings of the Regional Science Association 6(1): 149-157.

2. PBL (2016), "Cities in the Netherlands," Available online: `https://www.pbl.nl/sites/default/files/cms/publicaties/PBL-2016-Cities-in-the-Netherlands-2470.pdf`

3. Parr, J. (2004). "The Polycentric Urban Region: A Closer Inspection." Regional Studies 38(3): 231-240.

4. Randstad Monitor 2017 (2017). `https://www.nl-prov.eu/wp-content/uploads/2017/11/regio-randstad-monitor-2017.pdf`