Case *Advanced Analytics for a Better World*

Optimization of the design of residential towers

This case consists of three parts:

1. In Appendix A, you will find a rather vague (but that is reality) description of the case. The assignment is to carefully read this description, and to prepare questions (including which data you need) for the mock interview we will have on **September 26, 2024**. I (Dick den Hertog) will play the role of the real estate developer, and you the role of the 'optimization consultant'.

   - *No need to submit the questions; this part of the assignment does not count for the grade.*

2. On September 27, 2024, I will give you a detailed description of the case, and you are asked to develop a mathematical optimization model for it.

   - *Deadline for submission: midnight October 3, 2024.*
   - *This part counts for 10% of final grade.*

3. On October 4, 2024, I will provide the 'correct' optimization model, and the data. You are asked to implement the model, and to write a short report (at most 5 pages, excluding appendices). This report is meant for the commissioner, the real estate developer.

   - *Deadline for submission: midnight October 14, 2024.*
   - *This part counts for 15% of final grade.*

Appendix A. Introduction to the case

In the Netherlands, there is a housing shortage. The Dutch government estimates the housing shortage at 390,000 units at this moment. Together with market parties, the government has the ambition to add 100,000 dwellings per year till 2030. However, this aspiration has not been met in recent years. In public debate, several causes are cited for the failure of meeting the production ambition and reducing the housing shortage: labor shortage, lengthy public law proceedings, and less feasible building plans. With respect to the last reason, plans will not be realized as long there is no feasible business case. Reasons why it is difficult to develop feasible plans are: increase of interest rates, increase of building costs and increase in legislation which have impact on revenues and costs. Residential developers already have to deal with the first two developments for many years. The last reason, namely the increasing level of legislation is a more recent phenomenon. The Dutch government and municipalities try to solve the affordability problem by stimulating production and by increasing the regulations on affordability. That means that a project must meet additional exploitation criteria by national legislation and municipal agreements when the building is in use. Since July 2024 national legislation introduces an additional rental sector next to the social and the free market sector, namely the middle rental sector (with a maximum rent of €1157.95 in 2024). Based on the residential value determined by the government (WOZ value) and the properties of an apartment, this apartment is categorized in one of these three sectors. In addition, the government set the ambition that approximately 67% new residential development must be affordable (within the social or middle sector).

Adjacent to the national regulation, municipalities will set obligations for developments to meet the production and affordability requirements. These requirements can be, e.g., on a number of affordable houses in a project, additional sustainability standards and minimal surface area for the different sectors. As the problem becomes more complex, it can be questionable whether existing techniques and development process can generate a feasible design or enough feasible options to meet design criteria. Feasibility is tested during the whole development process. In the current situation, the development process is often an iterative process in which knowledge from different disciplines is used: a real estate advisor describes a program that is salable, an architect draws up a spatial plan based on the program so that a cost expert can estimate the costs. The result is a first feasibility study.

Residential real estate developers are professional entities involved in the process of developing residential real estate, they are responsible for transferring raw land or existing properties into residential assets that are affordable by the citizens and profitable for the real estate companies. There are many choices for the design (e.g. the sizes of the apartments, for which sector), and also many restrictions that have to satisfied. The assignment is to develop an optimization model to optimize the design of the residential towers.