More space for the festival

Mathematics Day for Lower Secondary 2017

MATHEMATICS DAY FOR LOWER SECONDARY 2017

During the day you will be working on a major open problem with a group of three to four students. The intention is that by the end of the day you will have written a paper as a result of your work. Below, you find a checklist with issues to keep in mind.

Method	*Check*
First read the entire assignment and consider the following: - Approach - Division of tasks - Availability computer - Time planning (make one!), keep in mind that the final assignment will take the most time.	
Work together: regularly discuss whether you are still on the right path and whether your planning is still accurate; do not forget to plan in some time at the end of the day to write a coherent report.	
Do not be satisfied too easily. Try different variants/ methods/ strategies within the assignments and include these in your report.	
Always justify your choices with arguments and describe your work method.	
Write a real report, not merely a list of answers to the questions; ensure that it is a logical entity.	
Make sure that your report can be read as an independent entity without the jury needing to look at the assignments. The report consists of a table of contents, an introduction, then the FINAL ASSIGNMENT (the letter, with maps) with in the APPENDIX the results of the entry assignments.	
Remember to number the pages.	
Mention the names of the team members and the school on the cover sheet.	

The assessment

This assignment is not about the “one correct answer”; there isn‘t merely one; several assignments have multiple options. In the assessment the following aspects are taken into account:

- whether your work method has been described clearly;
- whether the choices and results have been substantiated;
- how you have dealt with the assignment, whether you have worked systematically, and whether the use of math and calculations is correct, useful and clear;
- how the final assignment have been executed; the FINAL ASSIGNMENT outweighs the entry assignments in the assessment!
- whether the report/paper is a coherent entity that can be read as an independent piece without the use of the assignment;
- whether you used your creativity.

Have fun and good luck!

Introduction

The Netherlands are becoming more and more a festival country: a lot of festivals are held in summer, from Lowlands to "De Parade".
Existing sites are often temporarily transformed into festival grounds for a festival. That means there must be electricity available, there are podiums to be built, the soil should be reinforced, there should be toilets, catering, chill spots, etcetera.
Every year, the number of people attending the festivals is also increasing. That means larger "renovations" and thus: more costs. Afterwards, generally, the site is restored to its original state. All of this costs a lot of money!
In this task you will figure out how to do it cheaply, while taking into account both the wishes of the owner of the grounds (the local authority) and the wishes of the festival organizers.

Exploration of the problem

We begin to explore the problem by first looking at a schematic example of a park used temporarily for a festival.

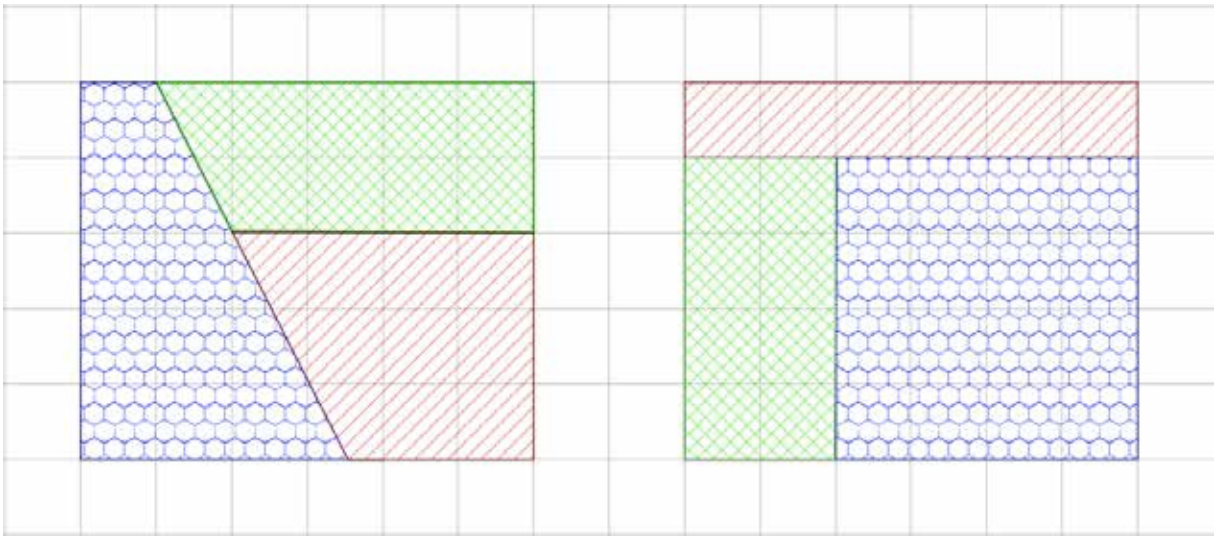


figure 1: current layout

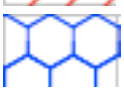
figure 2: desired layout

Figure 1 shows the current classification of an area of 500 x 600 meters. The total area of this area is 300.000 m^2.

The use of colours and shading indicates the intended use for each part of the area, so from that you know which activities can take place there.

 is **rest area**

 is **playground area**

 is **festival area**

You can using the schematic maps in figures 1 and 2 to calculate how many m^2 are used for rest area, playground area and festival area in the current layouts and in the desired layouts.

Task 1
Calculate the decrease in m^2 from the current layout to the desired layout for the rest area, the increase in m^2 of the festival area and calculate the increase or decrease in m^2 for the playground area.

The following costs are related to the redevelopment (in euros per square meter):

to / from	rest area	playground area	festival area
rest area	-	25	30
playground area	20	-	50
festival area	20	20	-

For example, from this table of costs you can read that changing rest area into festival area costs € 30,= per m^2.

Now, for each piece of land, you can calculate how much it costs to change the layout of Figure 1 to Figure 2, the so-called "redevelopment costs".
Using Figures 1 and 2, and the table of costs, you can draw a *cost card*. In a cost card the whole area is divided in sections in such a way that for each section it is clear how high the costs per square meter are to change from the current to the desired situation. These redevelopment costs per square meter are presented in each section of the map.

Task 2
a) Design such a cost card for the redevelopment of the area, as shown in Figures 1 and 2.
b) Calculate the total costs of the redevelopment of Figure 1 to Figure 2.

Figure 1 and Figure 2 show the current and desired new layouts. Often, however, the desired layout is not yet completely determined.
In the next task, you can determine new layouts for the area in Figure 1. The three zones (rest area, playground area and festival area) each have the same surface area as in Figure 2, but they may be placed differently within the area.

Task 3

a) Think of at least two new layouts for the area in Figure 1. Consider the following restrictions:

- The new surface areas for the three destinations are similar to those in Figure 2;
- The shape and the place of the three sub-areas may be different than in Figure 2;
- The new layouts should be cheaper than those in Figure 2. This means that the redevelopment costs should be lower than the costs you calculated in task 2

Draw maps of your new 'desirable' layouts and draw the associated cost cards as well. Calculate the total costs of the proposed redevelopments.

b) Briefly describe the method you use to come to a cheaper variant.

c) Explain whether one of your variants is the cheapest solution.

More space for the festival!

In the exploration of the problem you worked with not very realistic maps. In reality, the areas are never nicely bounded by straight lines. In the final task, we therefore assume a more realistic map.
Figure 3 shows a map of a large municipal park, which is bounded on one side by a river. It is crossed by two paved trails. In the park you will find the following destinations: a pond, a playground, forest, rest area and festival area.

Annually, a festival is organized in the park. The festival organizers have asked the local authority to expand the area for festivals, so there may be more visitors. They would prefer at least twice as large an area.

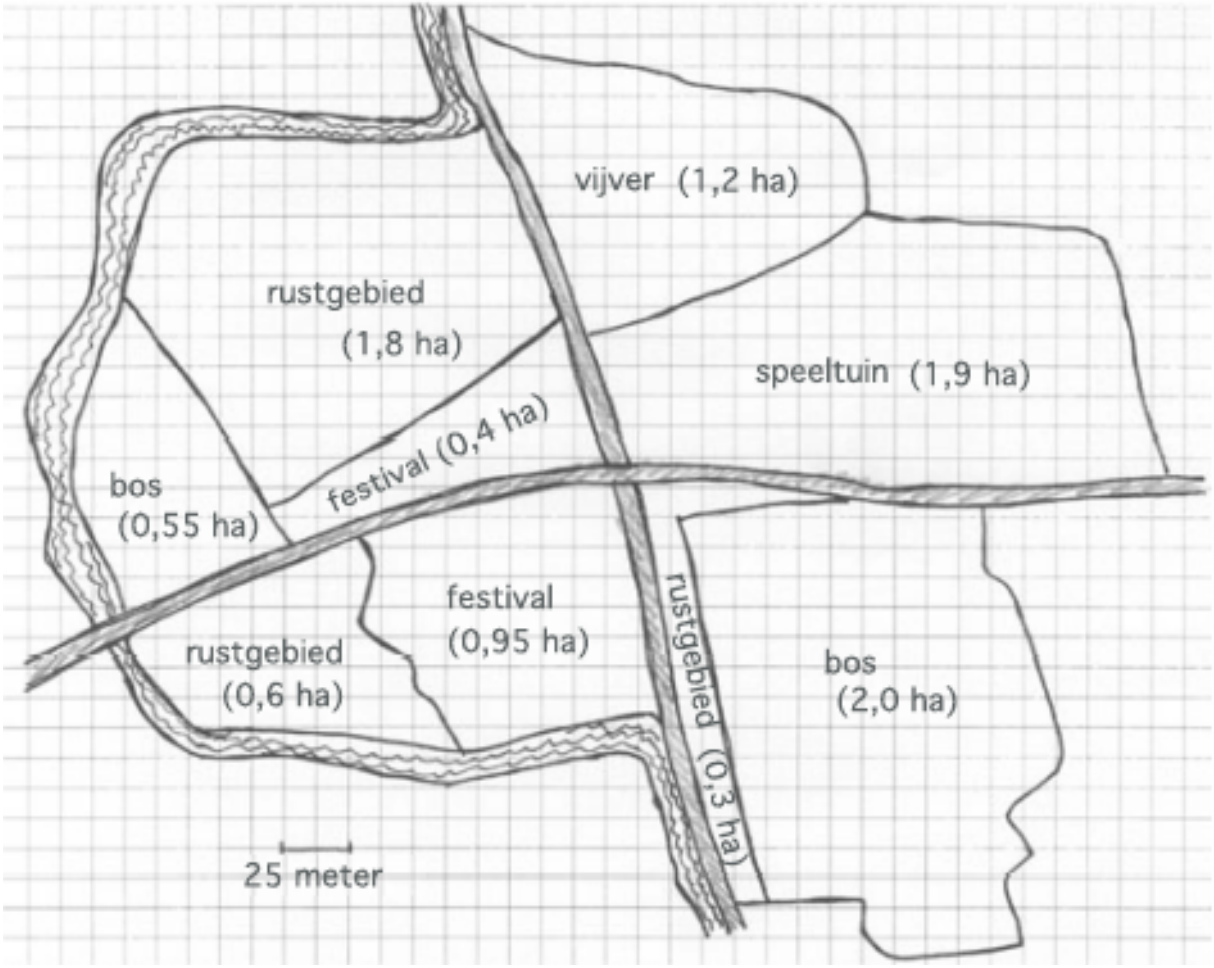


Figure 3

ha = 10.000 m^2 rustgebied = rest area bos = forest speeltuin = playground vijver = pond

The local authority has already received complaints about noise in the rest area, and there is a petition by an action group, "Preserve the forest!"

The local authority is willing to agree to an extension of the festival area, but the festival organization will have to come up with a good plan!

The local authority requires the following:
- All uses that the park has now should remain;
- The interests of other visitors to the park should be taken into account;
- The pond remains the same (in the same place), or becomes larger;
- Rest area must be (at least partly) adjacent to the pond;
- The costs should be taken into account.

The associated cost table is listed below. As you can see, the costs of redevelopment of this park are different than the costs in tasks 1, 2 and 3.

Cost table (in euros per square meter)

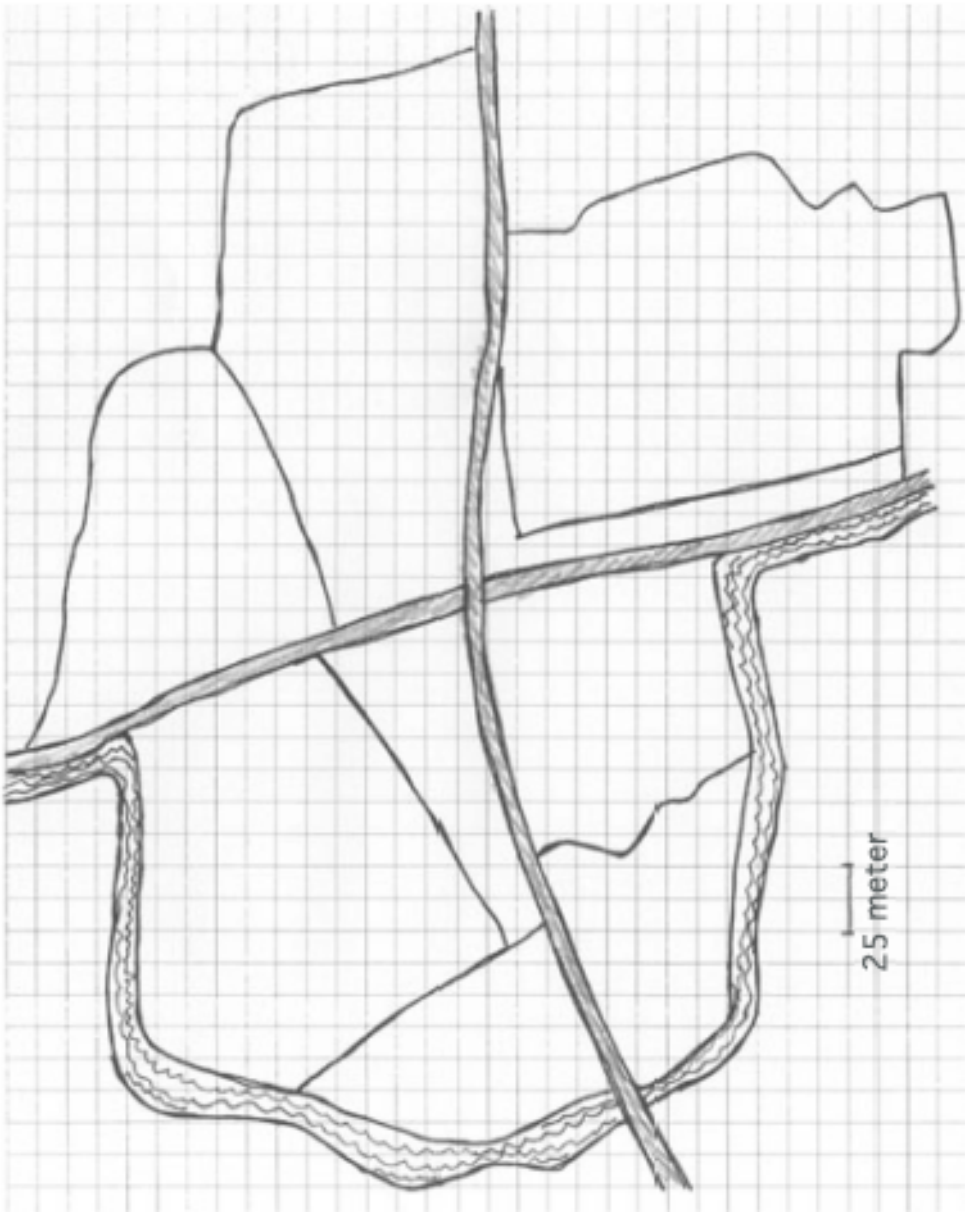
from \ to	rest area	forest	playground	festival area	pond
rest area	-	150	40	50	100
forest	100	-	120	140	140
playground	30	160	-	60	110
festival area	40	150	30	-	120
pond	-	-	-	-	-

The festival organization is invited to offer a plan to the local authority in which they create more space for organizing a festival in the park. In this plan it should be clear how the various uses are spread around the park and how much it costs; of course, all requirements of the local authority must also be taken into account.

In redeveloping, the festival organization will not only have to consider the requirements of the local authority, but they also have to make choices themselves:
- keep one use in one area, or separate this into different sections?
- which uses will be adjacent to each other, or not?
- what inconvenience might occur when certain uses are adjacent to each other, and how do you deal with that?
- .....

FINAL TASK

Your team writes a letter on behalf of the festival organization to the local authority, which includes the plan of the festival organizers.
The festival organizers want as much festival space as possible in the park, but whether this will be approved by the local authority depends on whether the requirements of the local authority are satisfied, whether it is not too expensive, and whether the park is still attractive to other visitors.
Present a redevelopment plan in the letter with a map of the redeveloped park, a cost card, and the corresponding total costs. (You can do this using the blank map in the appendix). Of course, you are free to come up with other requirements and principles in your remodelling plan. Justify the choices you made, so make clear why you made certain choices.


25 meter