

# Determining the Positions of Road Inspectors

## RWS Project - Group 1

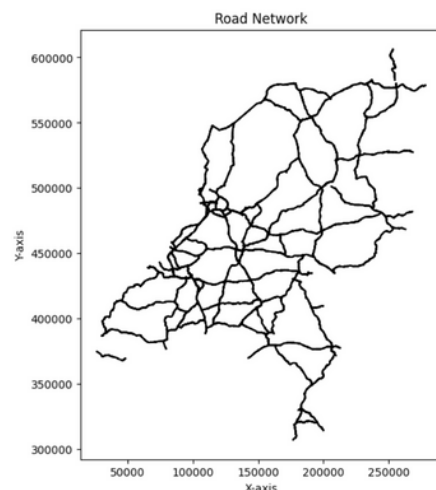
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### Introduction

A road inspector is dispatched when an accident happens on one of the Rijkswegen of the Netherlands. To ensure a fast average response time, these inspectors should be spread out over the road network smartly, considering where accidents are more likely to happen.

### Provided Data

Two datasets were provided to use in the solution, the first being a shapefile of the Rijkswegen road network on which the inspector should be placed (right). The other is a table containing all recorded accidents between July 31st, 2019, and December 31, 2019 (excerpt shown on bottom image).



Y	Id	Y	Type	Y	Starttime_new	Y	Endtime_new	Y	Vld_prim	Y	Primaire	Y	Primaire	Y	Primaire
0	A-ALL-IM19087676NLD_1		vehicle_obstruction		2019-08-28 12:11:32		2019-12-11 11:32:28		A1		4.97		52.35		
3	A-ALL-IM19087677NLD_1		vehicle_obstruction		2019-08-28 12:11:32		2019-12-11 11:32:28		A9		4.72		52.51		
5	A-ALL-IM19087678NLD_1		vehicle_obstruction		2019-08-28 12:11:32		2019-12-11 11:32:28		A9		4.74		52.61		
7	A-ALL-IM19087679NLD_1		vehicle_obstruction		2019-08-28 12:11:32		2019-12-11 11:32:28		A35		6.82		52.2		
174938	A-ALL-IM19087680NLD_1		vehicle_obstruction		2019-08-28 12:11:32		2019-12-11 11:32:28		A4		4.35		52.04		

### Data Preperation

The accident data includes some incorrect or impossible entries. The following faulty data was removed:

- Accidents with no duration or with durations longer than 1 day
- Accidents that occurred on roads outside of the given network
- Accidents that occurred outside the Netherlands

The data can now be filtered by date, day of the week, time of day, and type of accident. This way the optimal inspector placement can be analyzed for any desired subset.

Once the subset has been created, it is turned into a probability density function, which is used for the algorithm network.

### Algorithm Requirements

Using feedback from the project supervisors and logical assumptions, the following list of desired functions and used assumptions are created:

- We want to be able to place a certain number of inspectors
- We only want to place inspectors at highway exits
- The "accident risk" of an area should influence the placement
- The travel speed of inspectors is assumed to be 100 km/h
- Every type of incident requires only one inspector

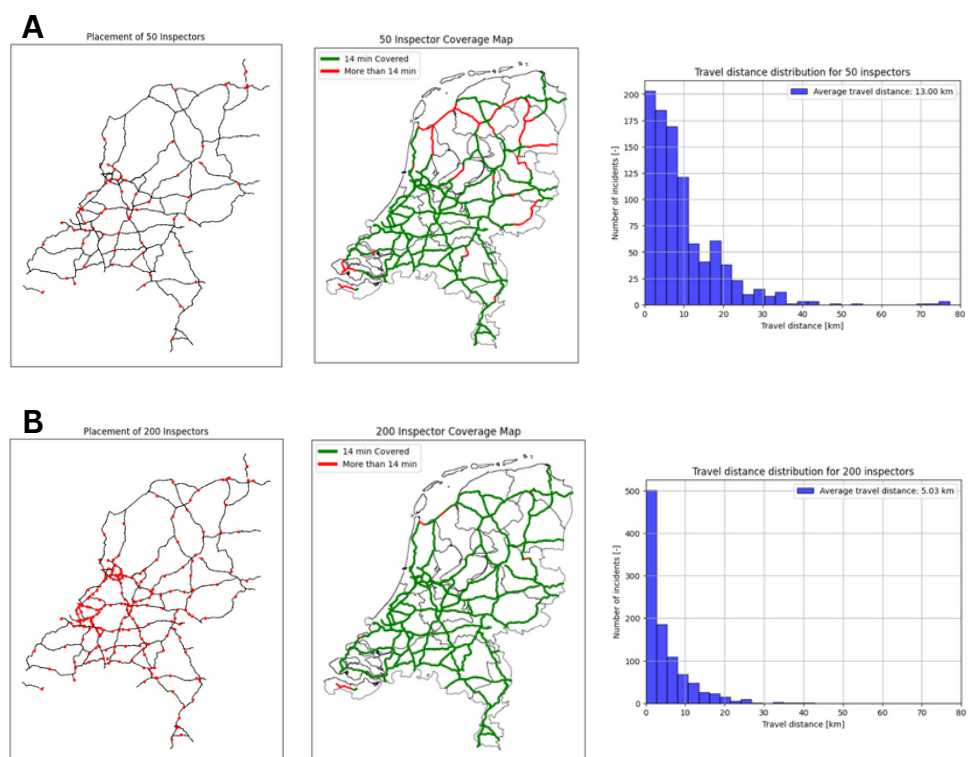
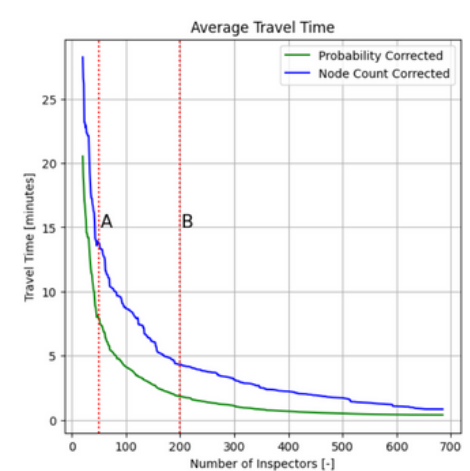
### Final Methodology

The final workflow of the placement process is as follows:

- Filter the accident data to a desired subset.
- Construct a probability density function from the subset.
- Construct a graph of the network, giving all nodes an accident occurrence probability based on a probability density function.
- Find the closest highway exit for each node, and assign that exit the sum of the probabilities of all its connected nodes.
- Run the algorithm
  - Place inspectors at all exits.
  - Look at the inspector with the lowest probability sum, and combine it with its closest neighbouring inspector.
  - If the desired number of inspectors is not yet reached, go back to step 5.b. If it is reached, the algorithm is finished.

### Results

Calculating the average travel time for all numbers of inspectors using the entire accident dataset gives us the graph on the right. It shows an inverse exponential function of the decrease in average travel time. To show the results for a single desired number of inspectors we have sampled three different points below



The speed of the algorithm is quite good, taking around 2 minutes for 100 inspectors. Calculating the Average travel time graph shown at the top of this chapter only takes around 6 minutes. This means that iterating with different variable values can be performed quickly.

Although we can create the graphs shown above, more extensive testing is needed to get a more qualitative score of the placement results. A simulation of a day of accident would give a better picture of how the placement performs if, for example, two accidents occur at the same time.