A resectorization of fire brigades in the north of Portugal

Sectorization: division of a region into smaller regions.

Resectorization: to achieve another division of a region according to some new conditions but avoiding substantial changes, maintaining some degree of similarity between the solutions.

Capacity of each fire brigade (c_i):

$$c_i = 0.5 g_1 A_i + 0.3 g_2 V_i + 0.2 E_i$$

A_i - number of ambulances in brigade i
V_i - number of fighting vehicles in brigade i
E_i - adimensional number of firefighters in brigade i
g_1, g_2 - constant parameters

Demand of each subregion (s_j):

$$s_j = 0.6 P_j + 0.4 Q_j$$

P_j - adimensional population in subregion j
Q_j - adimensional area of subregion j

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Sectors must be:

Balanced

Minimise the standard deviation of the percentage of the occupation of fire brigade j

$$\min \sqrt{\frac{\sum_{i=1}^{M}(k_i-\overline{k})^2}{N}}$$

$k_i = \frac{\sum_{j=1}^{N} s_{ij}}{c_i}$ - percentage of used capacity of brigade i

$\overline{k}$ - average of k_i

s_{ij} - demand of subregion j if j is assigned to the brigade i and zero otherwise

Compact

Minimise the distance between fire brigades and subregions, weighted by the demand of each subregion

$$\min \sum_{i=1}^{M} \sum_{j=1}^{N} d_{ij} s_j$$

d_{ij} is the distance between brigade i and subregion j

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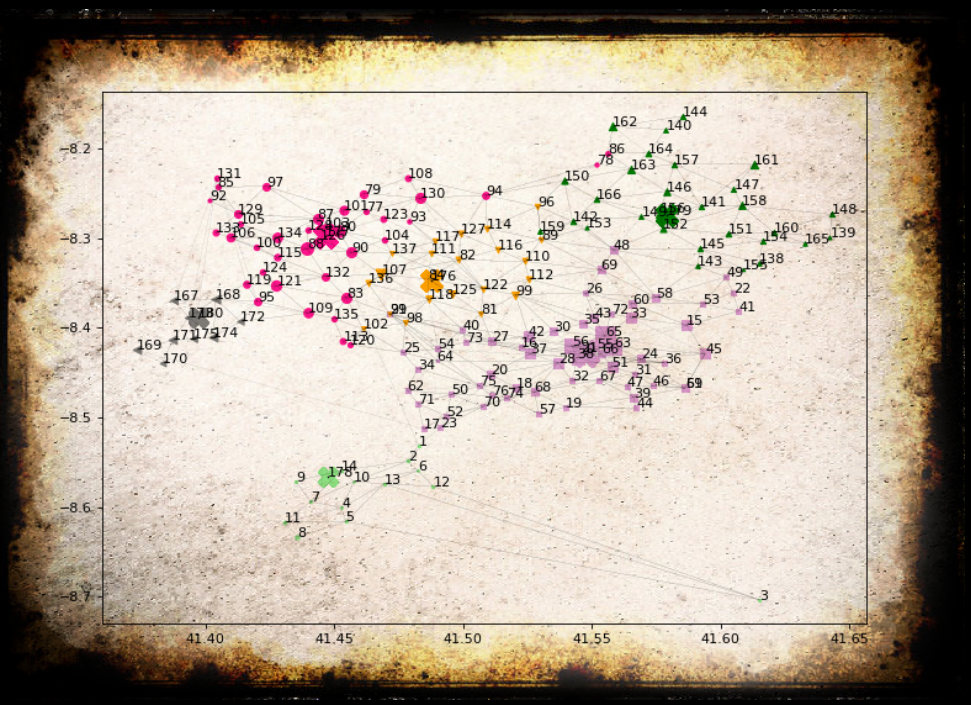

Current sectorization has 0.284 equilibrium and 0.035 of compactness

The optimal resectorization has 0.053 of of equilibrium and 0.037 of compactness with a similarity of 70.3%

Contributions:

Optimise Sectorization and Minimise Rescue Time