Experiment - best temperature and cooling rate for the hill climber algorithm

Introduction

In order to connect the 150 houses to 5 batteries with minimal costs, we make use of a so called hill climber. This hill climber algorithm takes a current configuration of the district and starts off by attempting to swap two houses, if this is ineffective it attempts to move multiple houses to a different battery and move another to their first battery. To determine whether a change will be accepted, it uses simulated annealing. When the new costs are lower than the older ones, it accepts it immediately. But when the new costs are higher, then it generates an acceptance probability of this value by considering the current *temperature*. If this probability is higher than a random chosen float between 1 and 0, it accepts this configuration. After each iteration, the process cools down, the temperature is multiplied by the *cooling rate*. Once the temperature drops beneath one, the hill climber stops. But what are the ideal temperature and cooling rate settings to find the lowest costs configurations?

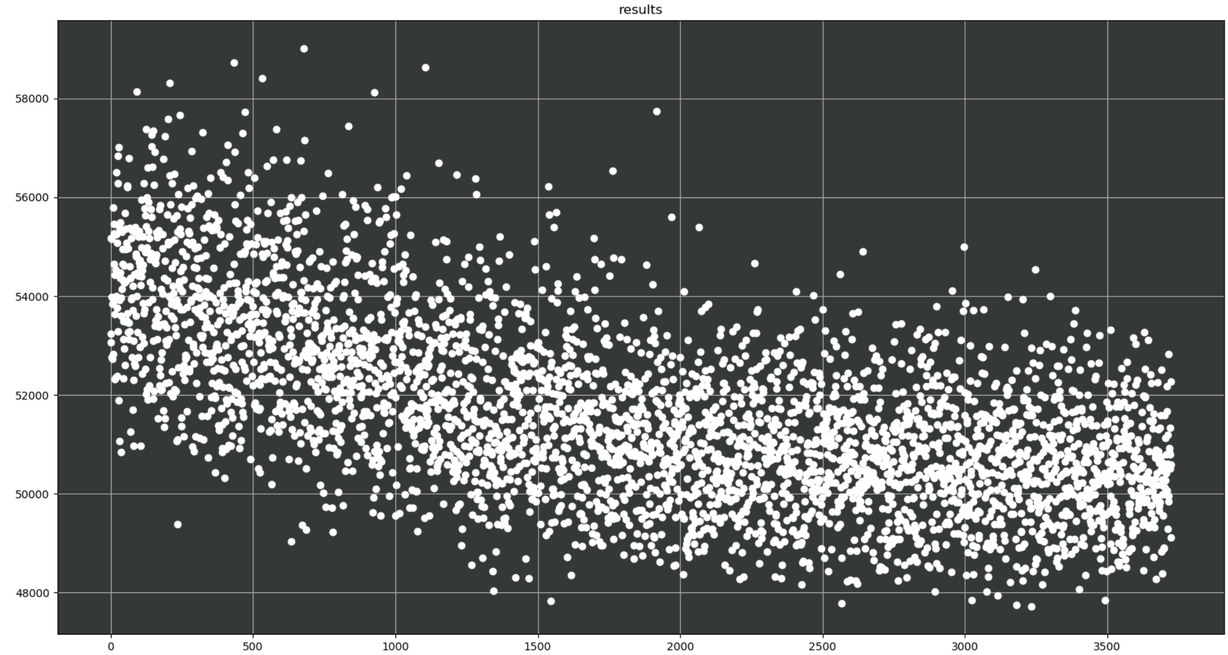
Methods

To find out, we used district 2, which beforehand got its houses connected to its batteries by the greedy algorithm. We set its standard cooling rate to 0.95. Then, we let the hill climber run 25 iterations over temperatures between 20 and 3000, increasing with steps of 20. This is a total number of 3750 iterations. Once we determine a good temperature value from this first experiment, we let the hill climber run with this temperature for again 25 iteration over cooling rates between 0.8 and 1.0, increasing with steps of 0.01.

Results

Experiment 1 – the temperature (see next page)

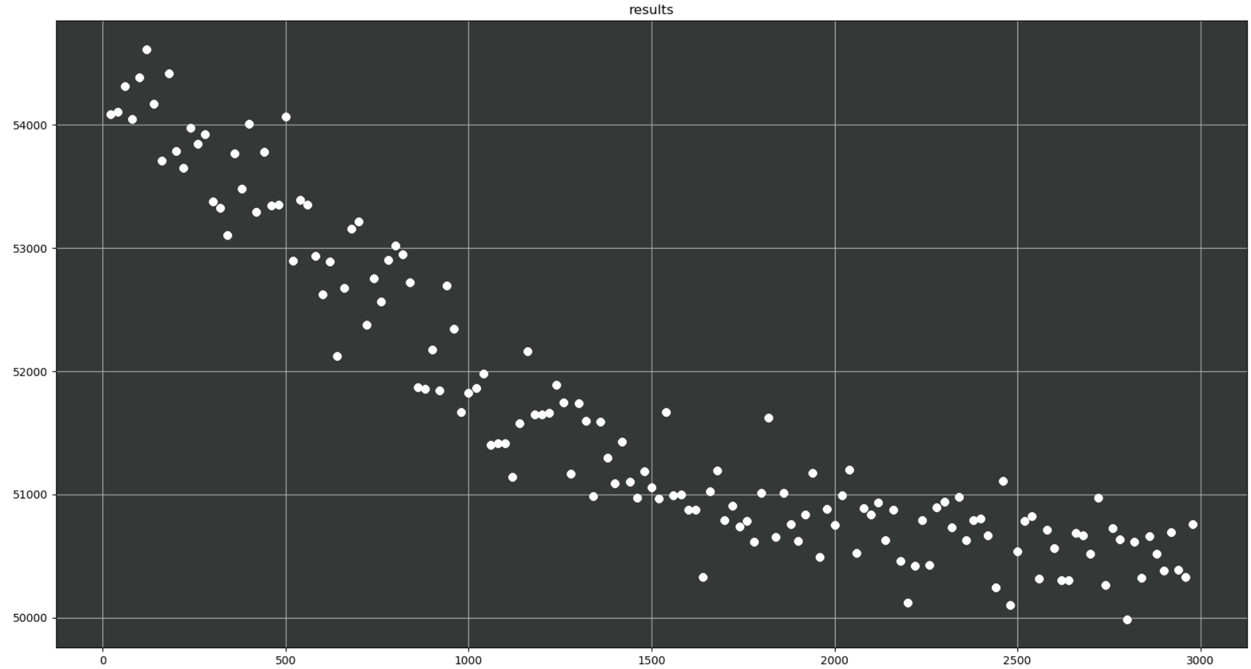
All iterations



Costs

Temperature

Means of iterations per temperature

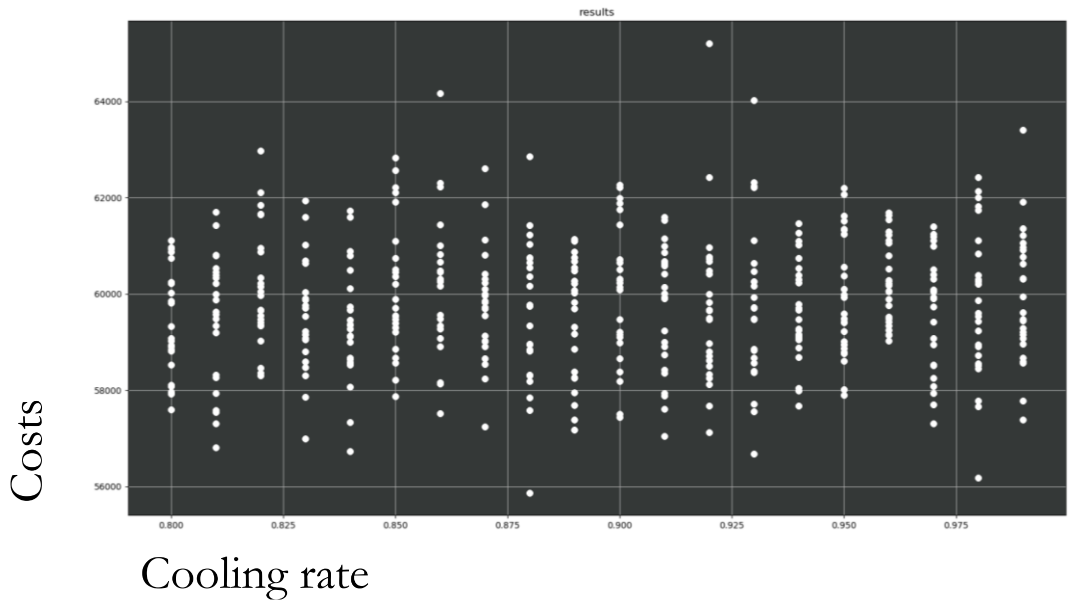


Costs

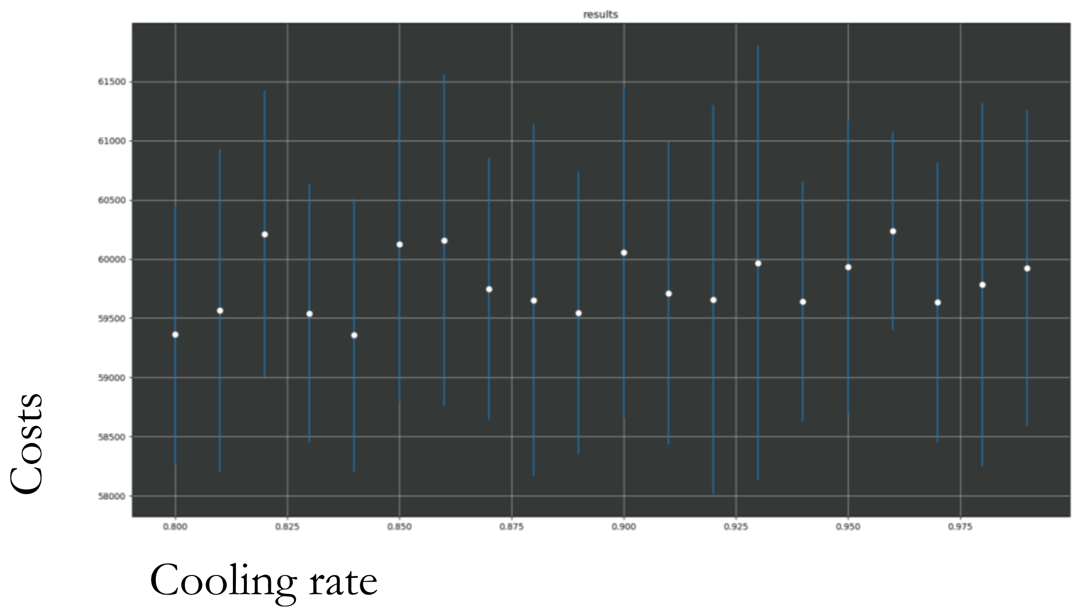
Temperature

Experiment 2 – the cooling rate

All iterations



Means of iterations per cooling rate, with standard deviation



Conclusion

Temperature shows a clear decline with the increase of the temperature. Around the temperature of 1500, the decline slows down. Because the running time increases when the temperature increases, it is more effective to use a low temperature that still has a lot of effect. Therefore the value of 1500 was picked to further test with the cooling rate. But the cooling rate experiment did not give a clear output. The means are distributed in a small range, almost on a line with each other. We cannot derive a good cooling rate value from these results.

Discussion

This experiment is somewhat problematic because it first finds a good temperature value and then alter looks for a good cooling rate value, while actually, the effectiveness of these two settings ties together. In the future it would be interesting to iterate on different temperature and cooling rate cooling rate combinations.