



Forecasting Water Demand in Dublin



Summary

- Our project looks at quantifying the impact of air temperature on the water demand for the Greater Dublin Area (GDA) water supply.
- We used publicly available data from Uisce Éireann Water & Met Éireann between the years 2014-2022.
- A relationship was found between an increase in water demand during both periods of high and low temperatures.
- We developed a method of estimating the impact that the air temperature has on water demands.

Hypothesis

- If there is a relationship between air temperature and demand, then we can use this relationship to predict future water demand based on Met Éireann's forecasts.

Methodology

In order to develop a method of predicting future water demand we carried out the following steps.

- We created a graph, which had over 3,200 data points, showing the relationship between demand and temperature.
- We added a polynomial trend line to this graph which showed us when the demand rose above the expected range.
- Using the data we graphed the year on year variation in demand, the month on month variation in demand, and the day to day variation in demand.
- We standardised the data points to remove the impact of the year on year, month on month, and day on day variation on our results.
- Using the polynomial on our graphed data we generated three lines which mimicked the shape of the trend line.
- We found the equations and boundaries of each of these lines which we used to get our results.
- We created graphs showing the actual weather vs what was forecasted.

Results

Our key findings were as follows:

- When air temperatures fell below 8.3 °C water demands would rise.
- When air temperatures rose above 19.0 °C water demands would rise.
- Between 8.3 °C and 19.0 °C demands would stay within the expected range.
- We found that the temperature range between the 5th & 95th percentile was between 5.5 °C and 22 °C.
- By applying our equations along with a +/- 9 MI/day range we were able to establish results which were 73% accurate.
- We noted that during public holidays and the weekends that accompany them the demand is significantly lower.

Conclusion

Water is an important & limited resource which needs to be protected. With population growth and climate change causing more extreme weather events it is more important now than ever to be able to manage our water resources in a sustainable and efficient manner.

Analysis supports our hypothesis that a direct relationship between air temperature and water demand can be used to create a method to predict future water demand based on forecasted air temperatures.

Graphs

Graph 1: Variation in average daily demand per year between 2014-22

Graph 2: Variation in average daily demand across the week for years 2014-22

Graph 3: Variation in average daily demand for each month for the years 2014-22

Graph 4: Temperature and demand during summer heat wave 2022

Graph 5: Temperature and demand during Storm Emma in 2018

Graph 6: Frequency of maximum temperatures between 2014-22

Graph 7: Standardised data points on graph with predicted demand & range

