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Understanding Water Consumption and Energy Trends in New York City

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Understanding Water Consumption and Energy Trends in New York City

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Abstract

In this study, we will be using the NYC Open Data website to examine publicly available data sets on water and energy consumption in New York City. In particular, we will use various scientific programming and machine learning modules in Python to analyze and visualize trends in water and energy usage within the five boroughs.

Introduction

As the human population continues to grow rapidly around the world, the increasing demand on water and other resources is of great concern. The availability of water and other resources is extremely critical to humans. Our goal for this project is two-fold:

1. We will analyze NYC water consumption trends and create a model to predict future water consumption.
2. We will analyze recent Energy Star Rating trends for municipal buildings over 10,000 square feet.

All of the data used in this project is publicly available.

Methodology

We use linear regression models to help model future water consumption trends in NYC as a quadratic function. We also plot a histogram of Energy Star Rating differences between 2011 and 2012 (the most recent data available) for municipal buildings over 10,000 square feet. In both cases we use various Python modules, including numpy, matplotlib, pandas, and SciKit Learn to manipulate the data and generate our results/graphs.

References

NYC Open Data
<https://data.cityofnewyork.us>

One Water NYC: 2018 Water Demand Management Plan
<http://www.nyc.gov/html/dep/pdf/conservation/2018-water-demand-management-plan.pdf>

Energy Star Ratings
<https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/interpret-your-results/what>

Linear Regression in Python using SciKit Learn
<https://medium.com/@contactsunny/linear-regression-in-python-using-scikit-learn-f0f7b125a204>

Results

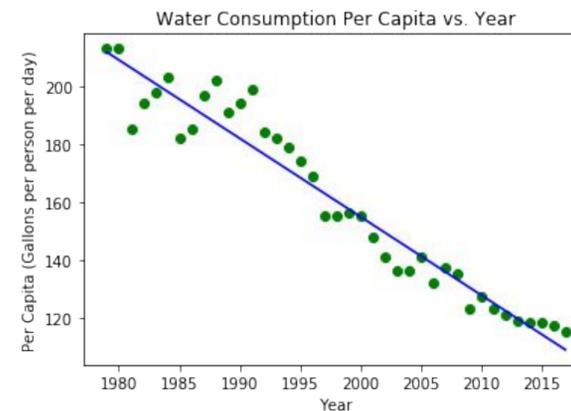


Figure 1 - Linear regression model for per capita water consumption over time.

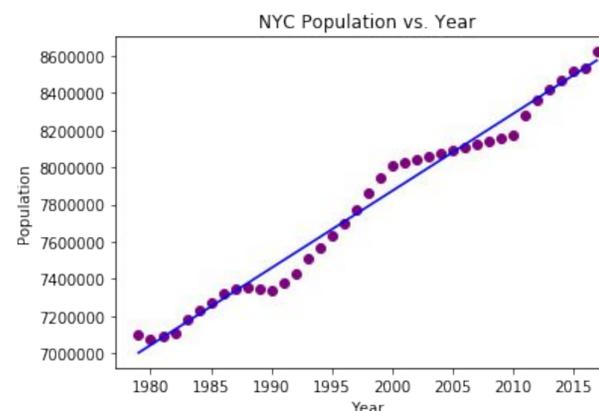


Figure 2 - Linear regression model for NYC population over time.

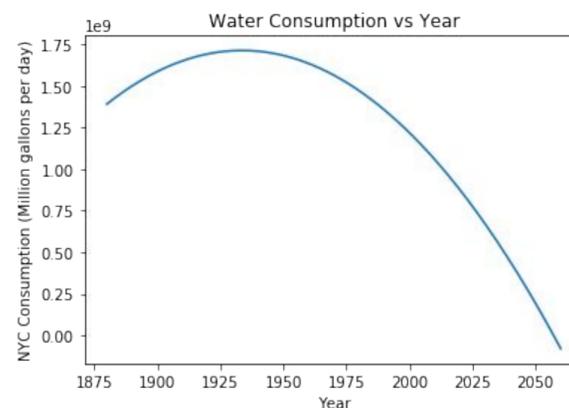


Figure 3 - Quadratic model for NYC water consumption over time.

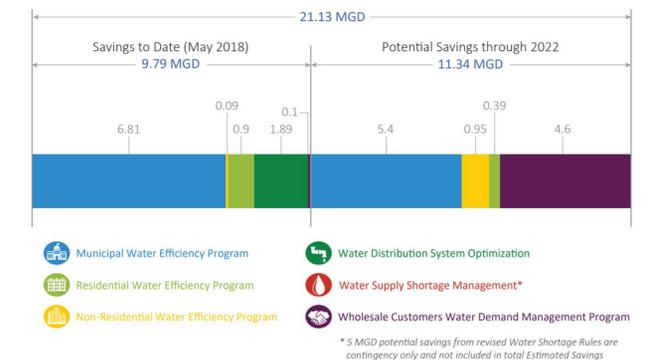


Figure 4 - Demand Management Strategies: Savings to Date and Potential Savings through 2022. (from One Water NYC: 2018 Water Demand Management Plan)

Histogram of Difference Between 2012 and 2011 Energy Star Ratings

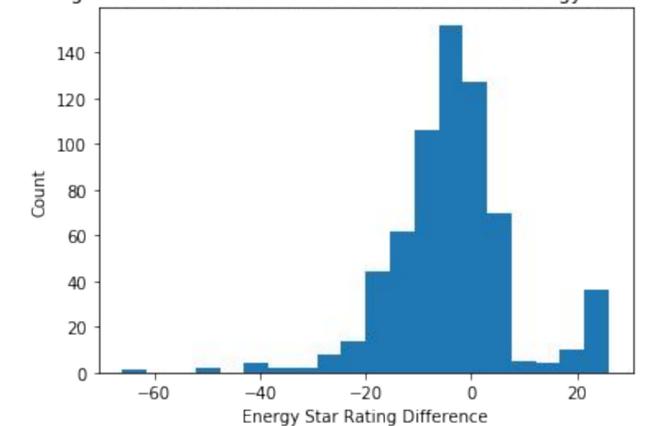


Figure 5 - Histogram of Energy Star Rating differences.

Discussion and Conclusion

Figures 1 and 2 show linear regression models for water consumption per capita and NYC population with respect to time from 1979 to 2017. The product of these models gives Figure 3, a quadratic model for water consumption over time. Figure 4 shows that NYC has projected water future water savings despite an increasing population. Figure 5 shows that many large municipal buildings have shown a decrease in their Energy Star Rating from 2011 to 2012.

Since the linear regression model for water consumption per capita has a negative slope, the model will eventually go to 0. We can compute the year where the model equals the minimum amount of water that a person must consume to survive (0.5 gallons). Beyond this year, the model does not apply. In particular, this model cannot be used to make any meaningful predictions beyond the year 2053.

Future work: Additional research using open data sets may give more information on how water and other resources are consumed within NYC at a finer level.