

Austin Water Consumption Forecasting

Summary : The main aim of this work is to analyze the water consumption of Austin and find out the major factor Affecting it . Consumption of water in residential areas is increasing and irrigation , climate change and population are major factors. For this we merge three datasets to analyze this problem thoroughly. Weather conditions along with population and water consumption in different landscapes are combined together on the basis of months (2012-1 to 2020-12). LSTM based approach is used to predict the future usage of water in specific areas.

Discussion: Experiments are performed on publicly available datasets after pre-processing and fixing one variable at a time to co-relate it to water consumption graphically. Dataset generation , pre processing , experiment results and conclusion is Explained below

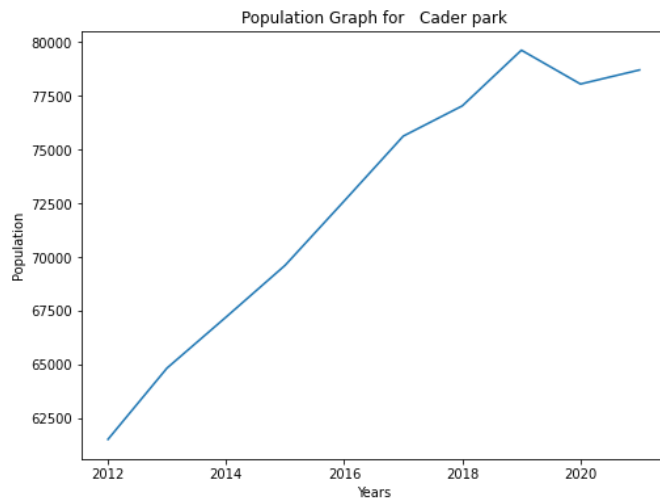
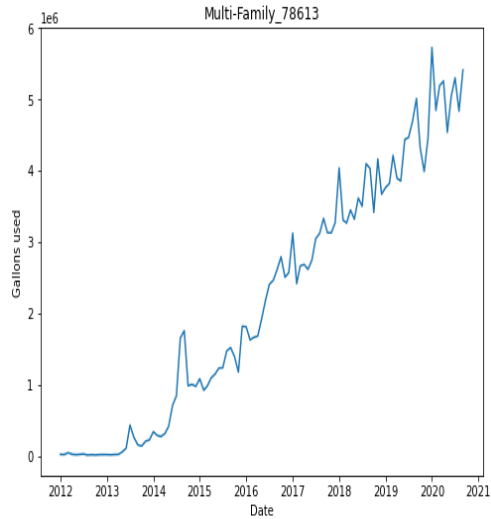
Dataset Details: To evaluate the water consumption in different areas of Austin, we merged the data of water consumption and weather conditions on the basis of date then grouped on the basis of the area's zip code. The information of sun rise and sun set is used to find the daytime of any area. Humidity , daytime , temp from the weather dataset is averaged for each month.

	datetime	humidity	temp	Day_time	Postal Code	Customer Class	Total Gallons
0	2012-01-01	63.570968	12.409677	626.553763	78613	Irrigation - Multi-Family	11000
1	2012-01-01	63.570968	12.409677	626.553763	78613	Multi-Family	23000
2	2012-01-01	63.570968	12.409677	626.553763	78617	Residential	19840800
3	2012-01-01	63.570968	12.409677	626.553763	78617	Multi-Family	2477000
4	2012-01-01	63.570968	12.409677	626.553763	78652	Irrigation - Residential	38500

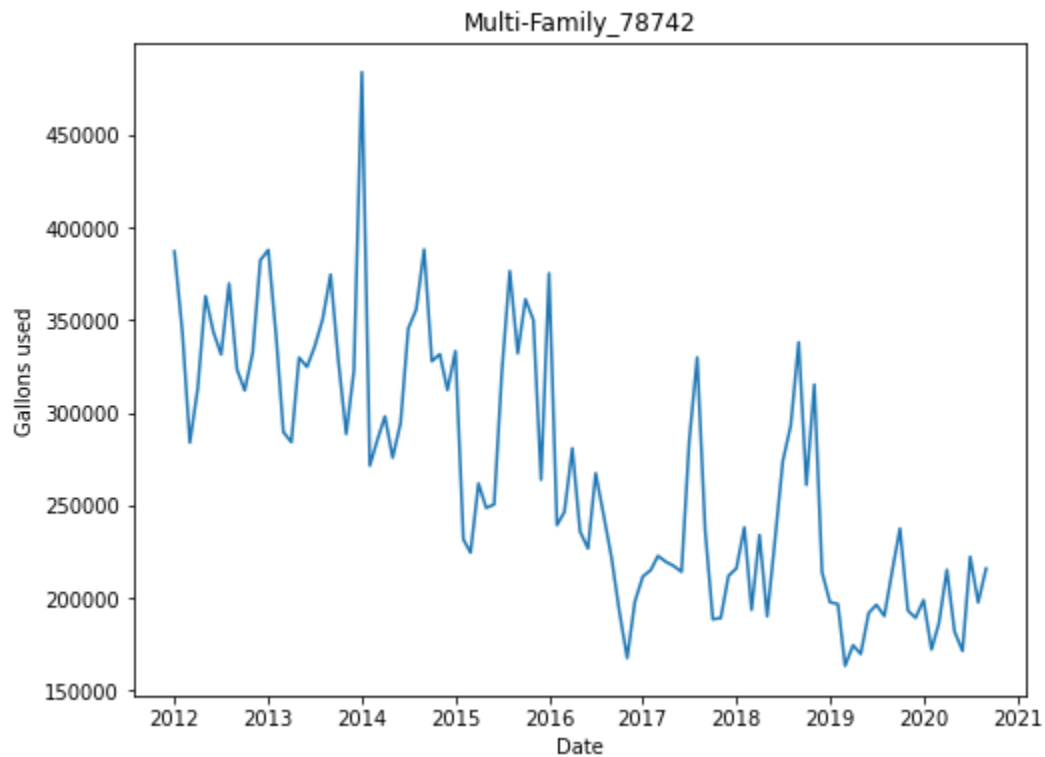
Experiments:

Experiment 1 is performed to check if population has any effect on water consumption. Austin is considered the second fastest growing city in the U.S. To prove this point we are taking the example of Cedar Park. Its population increased rapidly in the previous 10 years and a major reason for the increase is job opportunities and an entertainment center. Graph below represents the change of population from 2012 to 2021 for Cedar park.

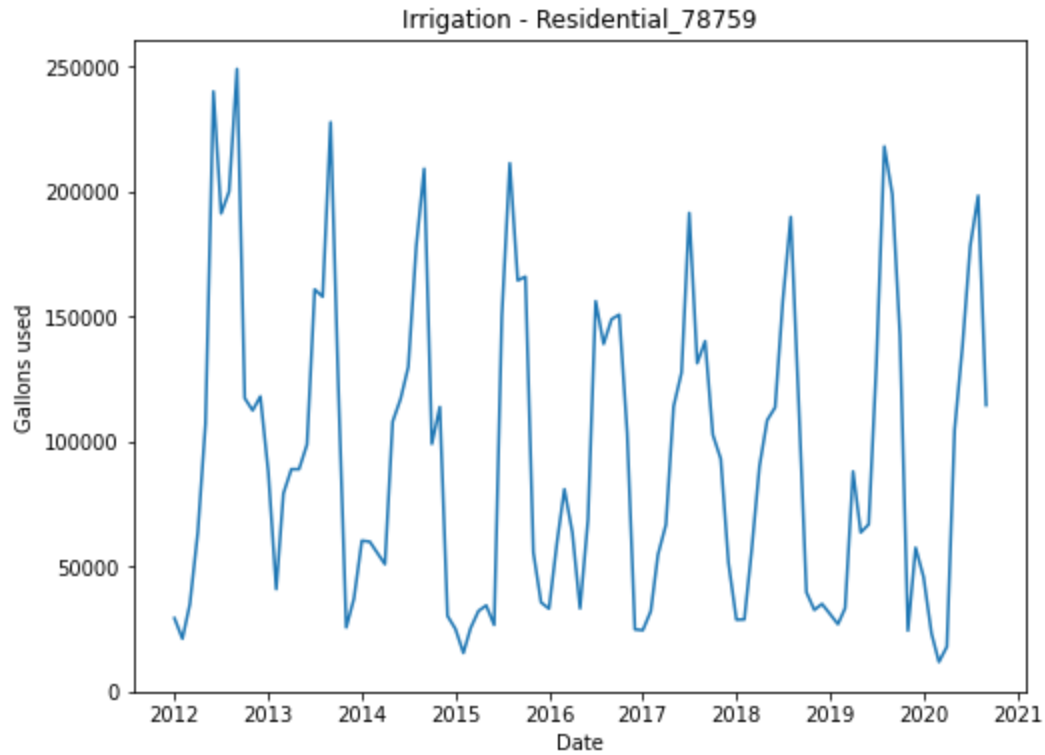
(Data-source : [Census.gov](https://www.census.gov))



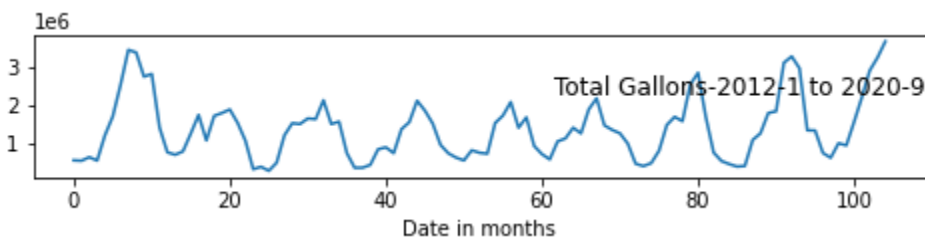
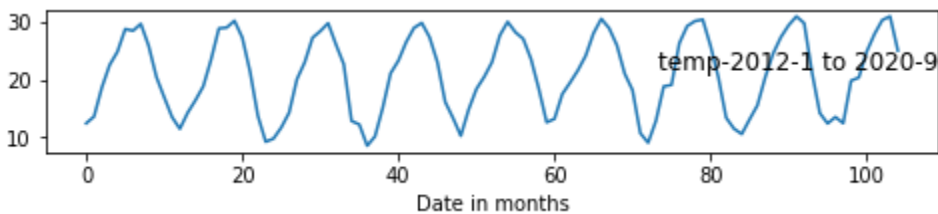
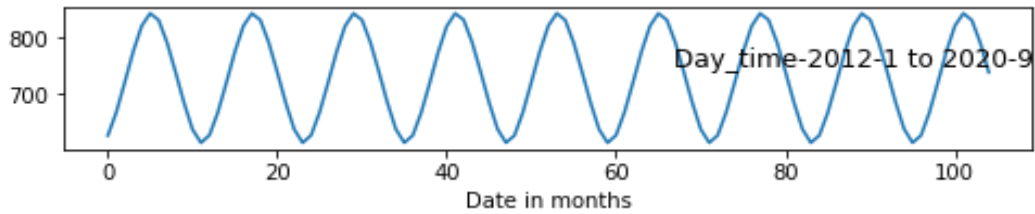
Similarly take the example of 78742. Its population decreased significantly in 2018 to onward due to lack of earning opportunities.



Experiment 2: Specific months showing more water consumption than the rest. After analyzing the dataset of the previous 10 years we deduce a pattern in water consumption in many areas of Austin. The least water usage is in January or February.

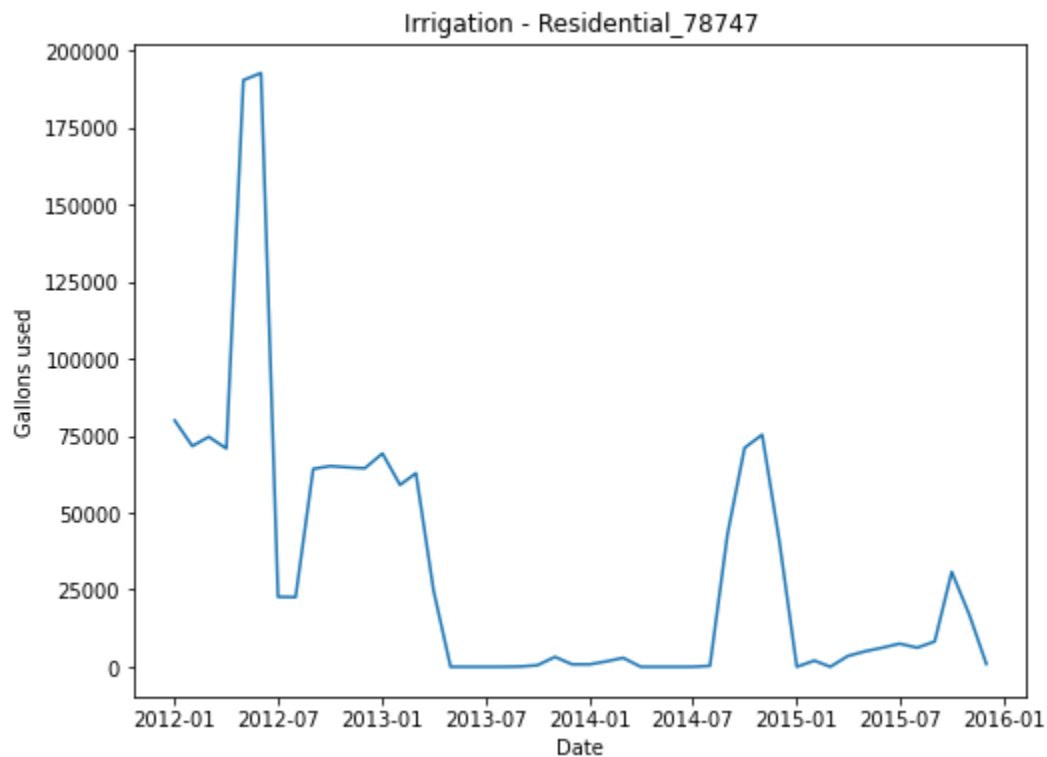


June and July are showing more water consumption as compared to other months. Temperature and day-time can be a major factor for this type of change.



Experiment 3 : Irrigation effect on water consumption

Automatic irrigation systems can reduce the consumption or wastage of water. A lot of water gets wasted on gardens and crops due to unattended use of water supplies. The Automatic irrigation system is gaining attention in Austin due to its feature to automatically detect the need of water for plants and soil. This initiative has a strong impact on water usage. Areas with good irrigation system have almost constant for more than 5 years.

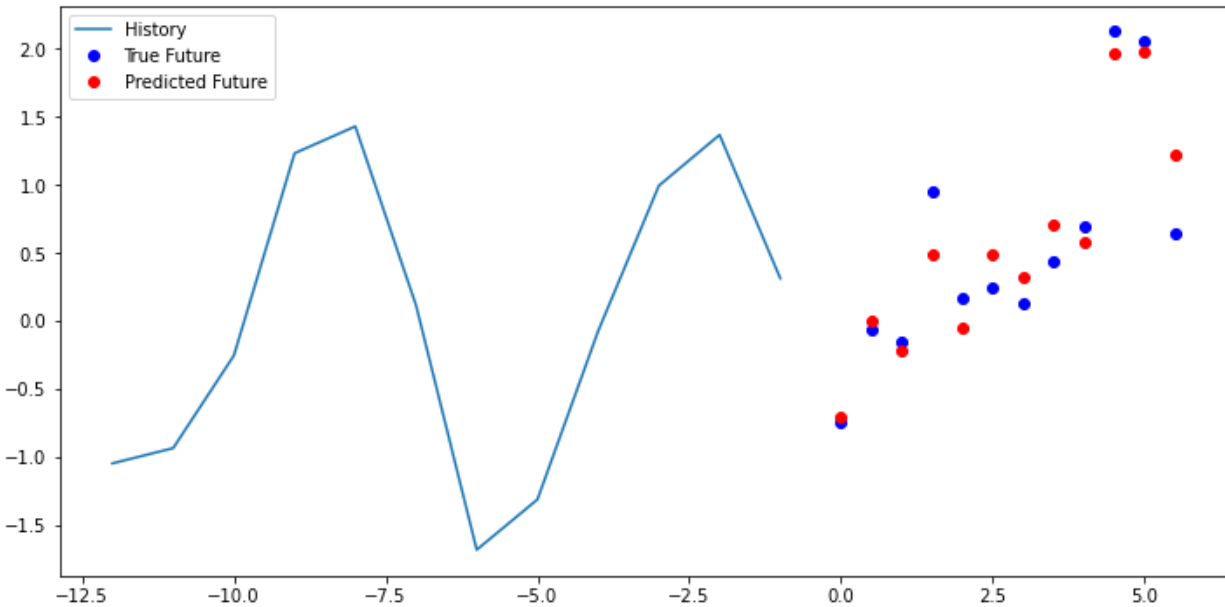


Experiment4: Prediction for next 12 months

LSTM is a machine learning based model which works well with time series data for prediction and classification, since there can be lags of unknown duration between important events in a time series. There is no vanishing gradient issue due to its both long and short term memory. We first transferred our data into continuous time-series by grouping it into customers and postal code classes. For experimentation purposes we are using one random zip code and Customer Class.

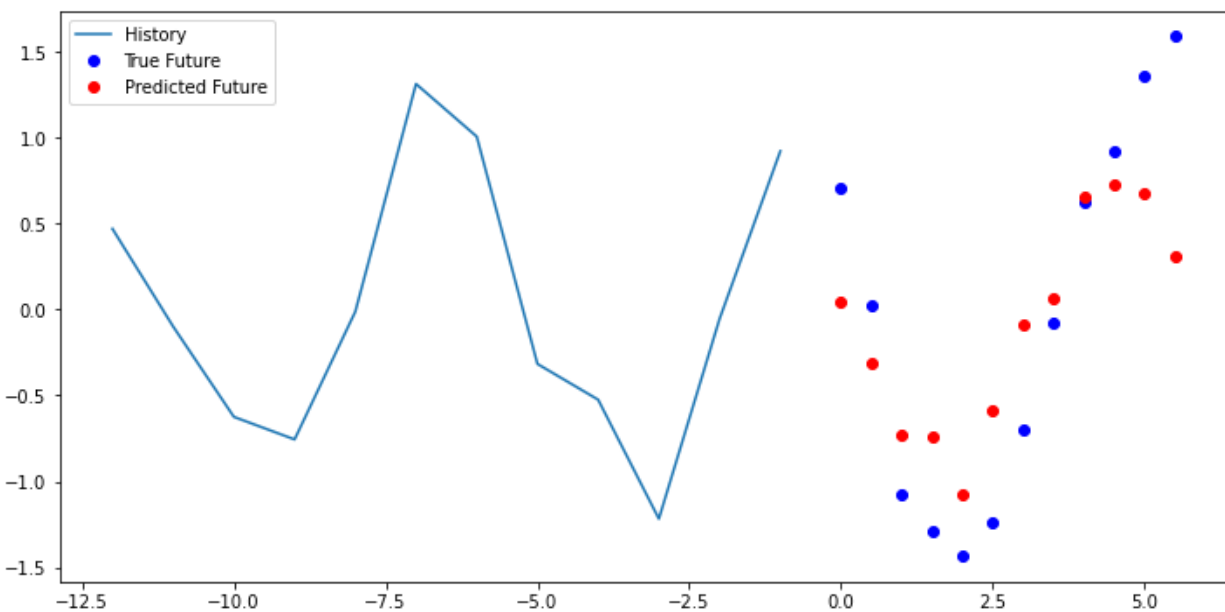
We tried to predict the water consumption of one zip area with one customer class using LSTM.(zip: 78701 , Customer : Irrigation - Multi-Family)

There were 105 entities for that. 93 is used in training and remaining for validation



Experiment 5: Total Water usage of city

Last experiment is performed by combining the data on monthly bases and summing all the water usage in every area to find the total usage of data. There were some missing values and the dataset was also very small so results are average (not so good, not so bad) . Dataset need improvement for better prediction using time series deep learning model as those models are data driven and more data mostly results in good performance.



Conclusion: Climate change and population is affecting Austin's water consumption. Austin is the second most fastest growing population among U.S countries with alot of

immirages due to good earning opportunities which is increasing residential customer demand exponentially. Austin is suffering from stage 1 water restriction and this encourages the need of study of different factors affecting the usage and precautions to reduce the risk of water unavailability. Some statistical analysis in this report concludes that Residential areas are consuming most of the water which can be reduced by proper irrigation systems.