Energy Usage Analysis

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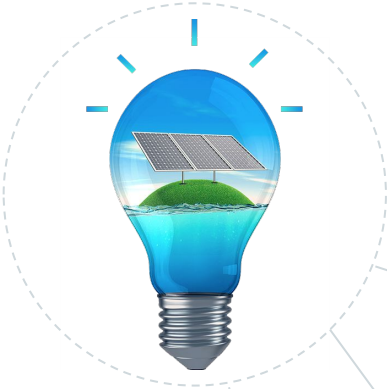
Objective

Predicting energy consumption

Using features like:

- Temperature
- Humidity
- Time of Day
- Wind Speed
- Visibility



1.
Overview

What does our data look like?
What features do we have?

Data

- Contains the total energy consumption of 9 rooms
  - Duration- 138 days (Jan 11 to May 27, 2016)
  - Measured every 10 minutes
- Room attributes-
  - Room Temperature- (15^{o} - 25^{o} C)
  - Humidity- (28 - 60%)
- External Factors-
  - Temperature (-5^{o} - 26o C)
  - Humidity (24- 100%)
  - Pressure (729 - 772 mm/Hg)
  - Wind Speed (0 - 14m/s)
  - Visibility (1 - 66 km)

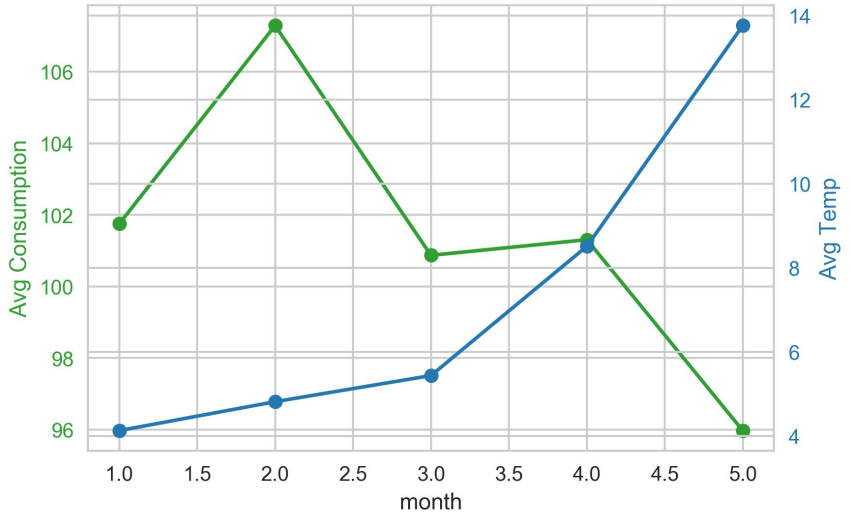
Features Added

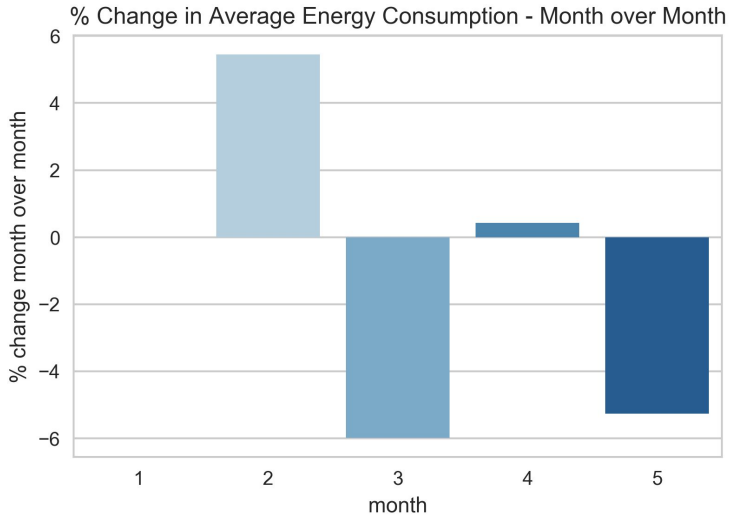
- Time attributes - Hour, Week, Month
- Mean room temperature and humidity (average across all rooms)
- Is Weekend- if a day is a weekend of not
- Is Day- if it is daytime or nighttime
  - Daytime considered to be from 6 AM to 6 PM
- Difference between Mean Room Temperature and External Temperature
- Time of day
  - Morning - (4 AM to 12 Noon)
  - Afternoon - (12 Noon to 3 PM)
  - Evening - (4 PM to 8PM)
  - Night - (8 PM to 4 AM)
- Is HDD (Heating Degree Day)
  - It is a metric that is used to determine whether a building/room is to be heated or not
  - Calculated as the number of degrees (in F) a day's average temperature is below 65^{o} F (18^{o} C)

2.
Trends

What treasures are hidden in the data?

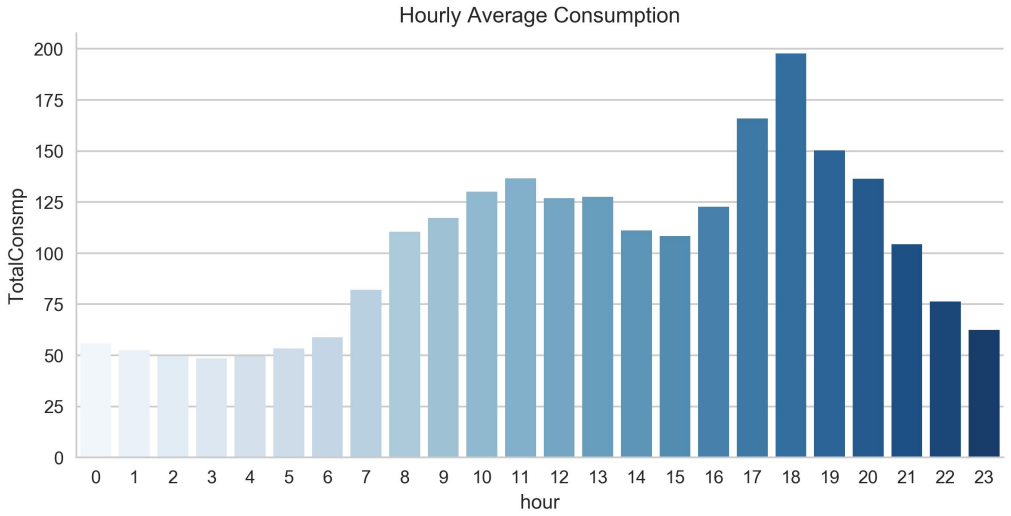
Monthly Consumptions

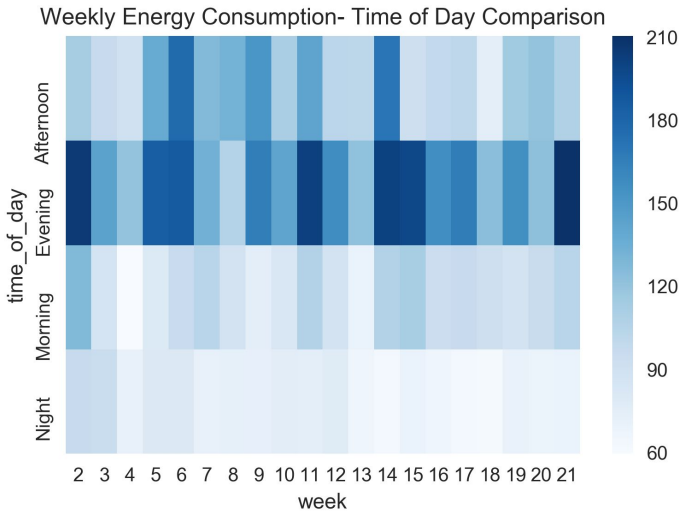




- Average Energy Consumption hits a high during February and is at its lowest during May
- Dips in energy consumption during season change (rising ext. temperatures)
  - Winter to Spring - March
  - Spring to Summer- May

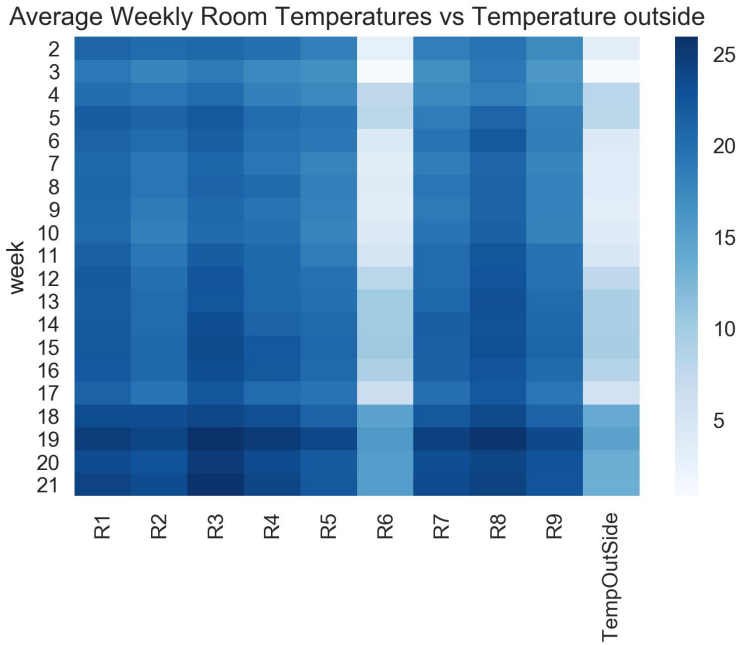
Time of Day Consumption

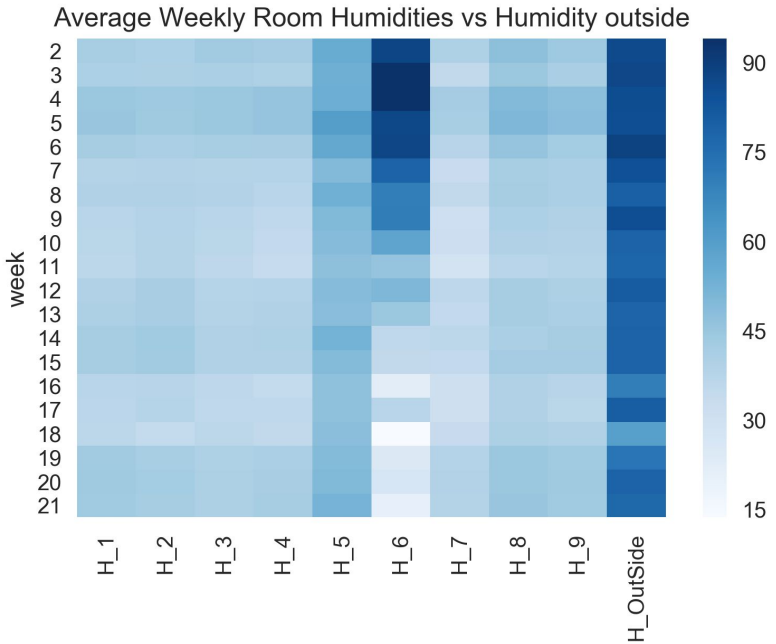




- Evenings have the highest energy consumption across all weeks
  - Driven by peaks at 5 and 6 PM
- Nights have the lowest energy consumption
  - Even then, first few weeks have slightly higher consumption- due to low external temperatures in weeks 2 and 3

Room Attributes





- Room 6 appears to be unoccupied - its temperature matches the external temperature
- Rooms 3 and 8 have a higher weekly room temperature average
- Humidity in room 5 is set higher than all the other rooms

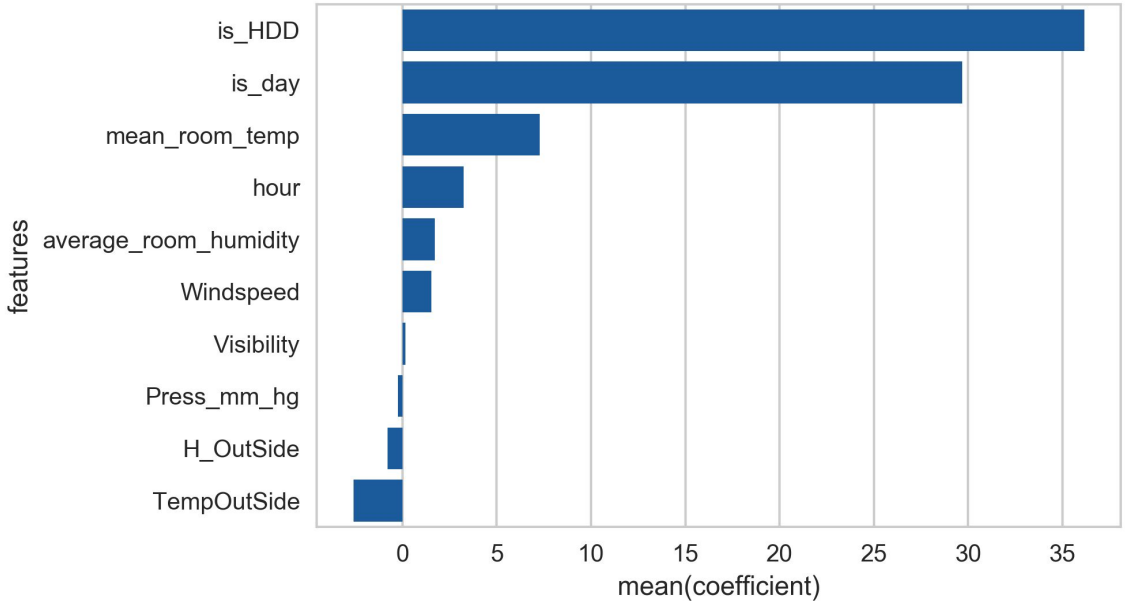
3.
Modeling

What factors affect energy consumption?

Modeling

- Regression analysis
  - Target variable- Total Consumption
- Train - test split- 80:20
- Baseline model- Linear Regression
  - Mean Squared Error - 9533
  - R^2 score- 0.08
- Best model- Random Forest Regressor
  - Test set Mean Squared Error- 4472
  - Test set R^2 score- 0.57
- We choose the Random Forest Regressor for predictions, since it performs better than other models on the test (holdout) set

Feature Importances



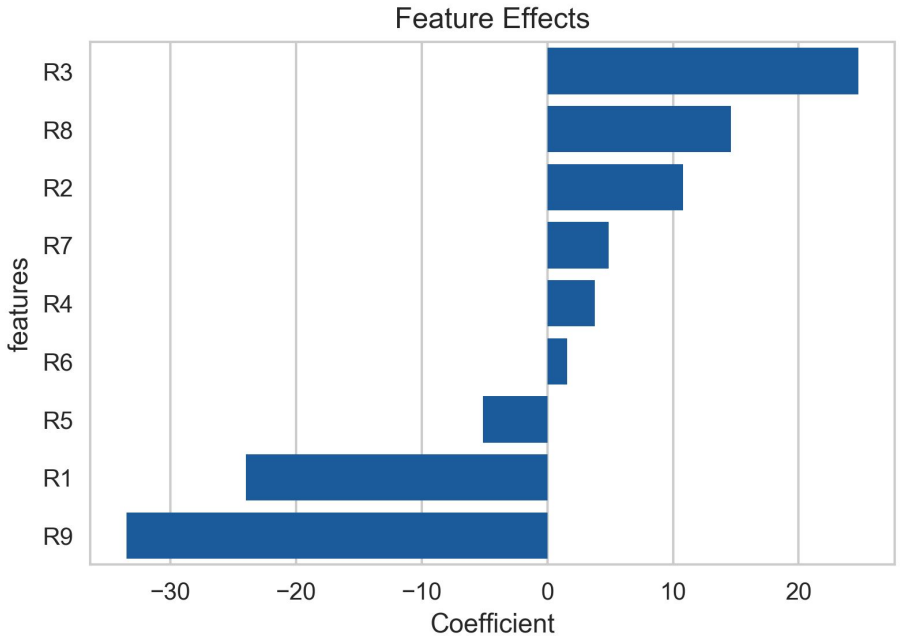
- From the linear regression coefficients, we can say that -
  - If a day is flagged as a heating degree day (HDD), the energy consumption is more
  - The greater the room temperatures, greater the energy consumption
  - Greater the external temperature, lower the energy consumption

Rooms Energy Consumption

Since we established that increasing room temperatures increases energy consumption, we perform Regression analysis of individual room temperatures with total energy consumption.

From the feature coefficients, we can see that-

- Rooms 3 and 8 consume more energy than all the rooms
- Rooms 1 and 9 uses the lesser energy
- Room 6 has little impact on the energy consumption (confirming that it is empty for the duration of the analysis)



Conclusion

- Energy consumption decreases with increase in external temperature
  - Dip in consumption is noticed during season changes
  - Since our data contained mostly Winter and Spring energy measurements
  - This could change during the peak of summer, when the daily average temperature could be much higher than 65° F (Cooling Degree Day)
- Rooms with higher temperatures consume more energy
- Humidity (external or internal) has little effect on energy consumption
- Much of the energy consumption happens during the Evenings and Afternoons
  - Energy consumption during nights is lower since most of the appliances are switched off at this time

Thanks!

Any questions?

The code is placed here- Energy Consumption Analysis

Alternate link- Code PDF file