Green Fund HACK-A-THON

Startup Session

November 16th, 2020

Sponsored by:

UNC GREENSBORO Bryan School of Business and Economics

UNC GREENSBORO Department of Computer Science

UNC GREENSBORO GreenFund

Background and Funding

- The UNCG Green Fund awarded funds to

analyze smart-meter data and create an online dashboard to browse results

- Project consisted of two parts:
  - Summer 2020
    - Download, clean, and analyze data
    - Write reports for Facilities Operations and the Green Fund
  - Fall 2020
    - Create an interactive dashboard to display results
    - Host competition

Background and Preliminary Work

Work already done:

- Collection of smart-meter data
  - Hourly observations of the meter reading in nearly 81 meters on campus.
- Collection of weather data
  - North Carolina Climate Office.
  - Hourly observations for average temperature, dewpoint temperature, relative humidity, atmospheric pressure, wind speed, and precipitation.
- Collection of classroom occupancy data
  - Office of the registrar.
- Data Cleaning
- **Used linear models to predict hourly energy consumption**

Hack-a-thon

Create a dashboard that…

- **Displays data and results from prior work.**
  - Web-Dashboard
  - Interactive

- Benefits:
  - Helps UNCG Facilities Operations make decisions.
  - Is accessible to the public about UNCG energy consumption.
  - Is the basis for more advanced data and modeling projects.

Setup

Github Repository:

https://github.com/UNCG-DAISY/Green_Hackathon-Fall2020

The repository contains the following structure:

- /data – Datasets for the dashboard.
- /documentation - All related documentation for the Hackathon.
- /src – Python scripts showing how to download new data and model the data.

Setup : Data

./data/

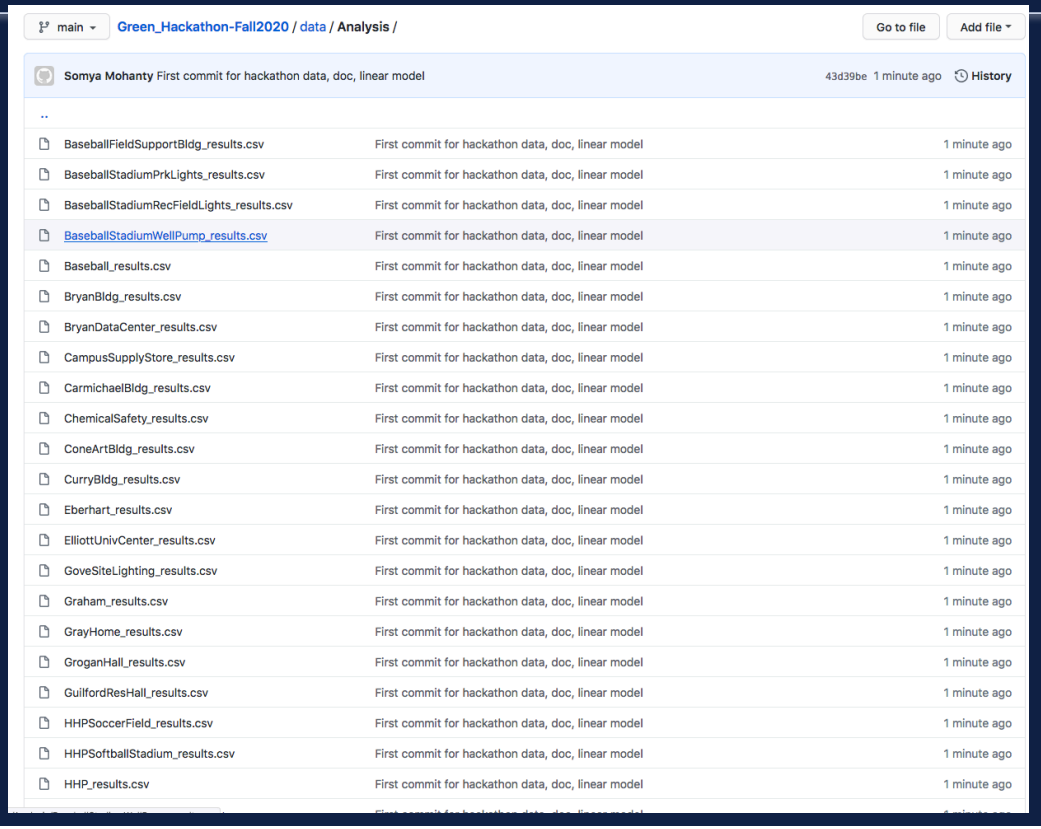
- **./data/Analysis/ - Merged and modeled data from meters, weather, and occupancy.**

- This data is what you are using for dashboard.

- Each file contains raw observed data and predicted data for different meters of the buildings.

Setup : Data

./data/Analysis/



main ▾ Green_Hackathon-Fall2020 / data / Analysis / Go to file Add file ▾

Somya Mohanty First commit for hackathon data, doc, linear model 43d39be 1 minute ago History

..

BaseballFieldSupportBldg_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
BaseballStadiumPrkLights_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
BaseballStadiumRecFieldLights_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
BaseballStadiumWellPump_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
Baseball_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
BryanBldg_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
BryanDataCenter_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
CampusSupplyStore_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
CarmichaelBldg_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
ChemicalSafety_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
ConeArtBldg_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
CurryBldg_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
Eberhart_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
ElliottUnivCenter_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
GoveSiteLighting_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
Graham_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
GrayHome_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
GroganHall_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
GuilfordResHall_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
HHPSoccerField_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
HHPSoftballStadium_results.csv	First commit for hackathon data, doc, linear model	1 minute ago
HHP_results.csv	First commit for hackathon data, doc, linear model	1 minute ago

Data: Meter Data Format

Example:
`./data/Analysis/Baseball_results.csv`

- **Actual** – Recorded Value
- **Predicted** – Value from Linear Model
- **Obs_ci_lower** – Lower confidence interval of prediction
- **Obs_ci_upper** – Upper confidence interval of prediction
- **Datetime**

	A	B	C	D	E
1	Actual	Predicted	obs_ci_lower	obs_ci_upper	Datetime
2	127	192.3790244	138.6748549	246.083194	2015-06-01 00:00:00-04:00
3	125	188.5778336	134.8745653	242.2811018	2015-06-01 01:00:00-04:00
4	140	189.8234206	136.1206239	243.5262173	2015-06-01 02:00:00-04:00
5	165	187.9042847	134.2015212	241.6070482	2015-06-01 03:00:00-04:00
6	206	196.2703393	142.5675739	249.9731048	2015-06-01 04:00:00-04:00
7	272	213.3199761	159.6162249	267.0237274	2015-06-01 05:00:00-04:00
8	272	222.9797303	169.2758228	276.6836377	2015-06-01 06:00:00-04:00
9	263	234.6066667	180.9022479	288.3110856	2015-06-01 07:00:00-04:00
10	266	254.7411219	201.0364786	308.4457651	2015-06-01 08:00:00-04:00
11	284	274.3643936	220.6608314	328.0679558	2015-06-01 09:00:00-04:00
12	299	289.6183209	235.913328	343.3233137	2015-06-01 10:00:00-04:00
13	301	300.8565731	247.1482747	354.5648716	2015-06-01 11:00:00-04:00
14	294	301.6438047	247.9328363	355.354773	2015-06-01 12:00:00-04:00

Setup : Model

The prediction was done using a linear regression model. (Ordinary Least Squares - OLS)

- The code to do this (for reference) is available in `Model_Update.py`

Setup Coding:

- Requirements:
  - Web-Interface,
  - Interactive,
  - Responsive (Ability to switch between mobile and desktop browser)
- Suggested:
  - Python
  - Plotly - https://plotly.com/
  - Dash - https://plotly.com/dash

Tasks and Rubric

You will be graded out of **100** points:

- **Tasks (60 points)**
  - Were you able to complete all tasks?
- **Style and Appearance (15 points)**
  - Correct labels, spelling, grammar
  - UNCG brand guide, “funded by the UNCG Green Fund”
- **Usability (10 points)**
- **Programs and Documentation (15 points)**
  - Proper Github repository etiquette and documentation of all your code.

Task 1 (40 points)

Create a real-time interactive plot of energy consumption and prediction.

- **Subtask 1: static plot of gathered data**
  - Horizontal axis is time, vertical axis is energy consumption
  - User chooses:
    1) which meter (or meters) to plot
    2) what time range to plot
    3) what unit of time to use (‘total consumption’ or ‘average hourly consumption’)

Task 1 Continued

Seven possibilities for graphs:

Horizontal Axis - Hour (e.g. 1:00AM Jan 1, 2015 - 3:00PM Sep 2, 2020)
- **Vertical Axis -** Hourly Energy Consumption

Horizontal Axis - Day (e.g. Jan 1, 2015 - Sep 2, 2020)
- **Vertical Axis -** Total consumption (for each day)
- **OR**
- **Vertical Axis -** Average hourly consumption (by day)

Horizontal Axis - Week (e.g. first week of 2020 - twentieth week of 2020)
- **Vertical Axis -** Total consumption (for each week)
- **OR**
- **Vertical Axis -** Average hourly consumption (by week)

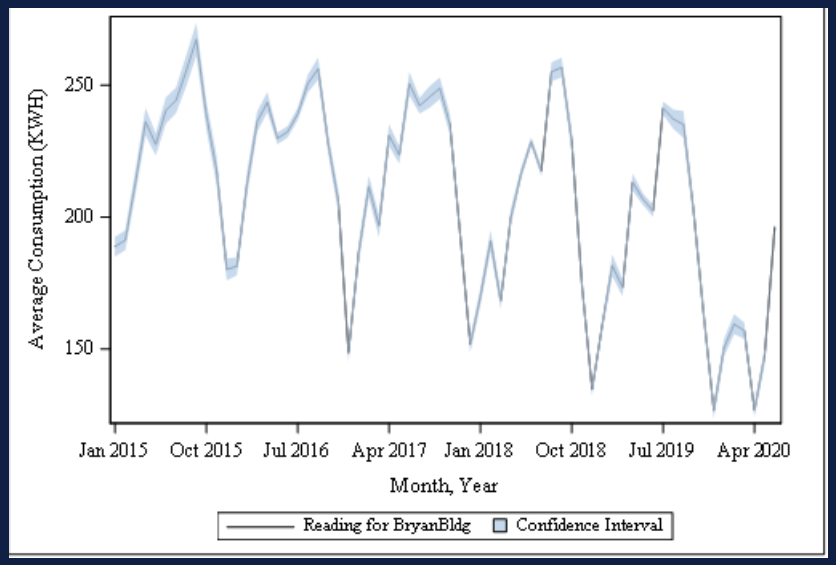
Horizontal Axis - Month (e.g. Jan 2019 - Dec 2020)
- **Vertical Axis -** Total consumption (for each month)
- **OR**
- **Vertical Axis -** Average hourly consumption (by month)

Task 1 Continued

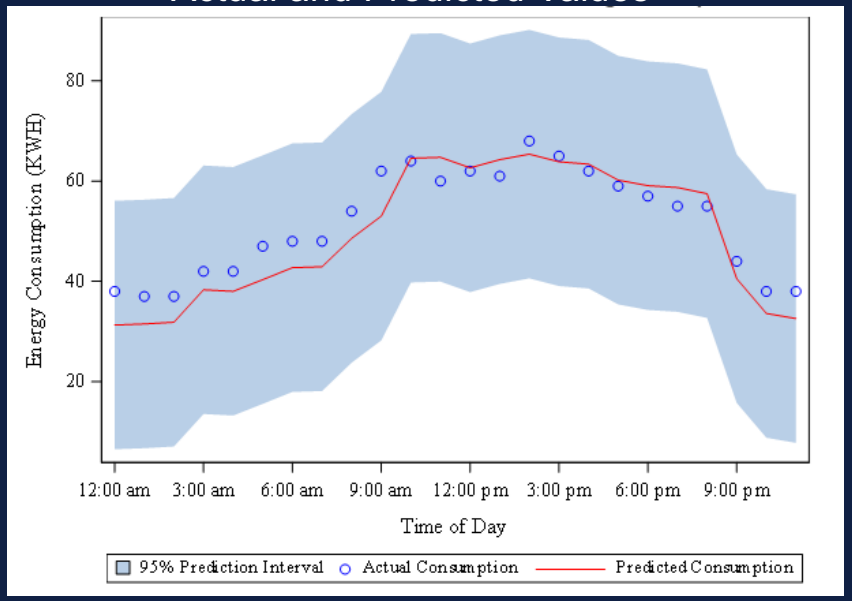
- **Subtask 2: Predictive Plot**
  - For each graph option, give the user the option to plot predicted values
  - Predicted values are summed up or averaged out depending on the actual values plotted
  - For example: average hourly consumption by month is plotted alongside average predicted hourly consumption by month.
  - For **only** hourly energy consumption, the graph must allow the user to plot the prediction intervals.

Task 1 Continued Examples

Average Hourly Consumption by Month



Actual and Predicted Values

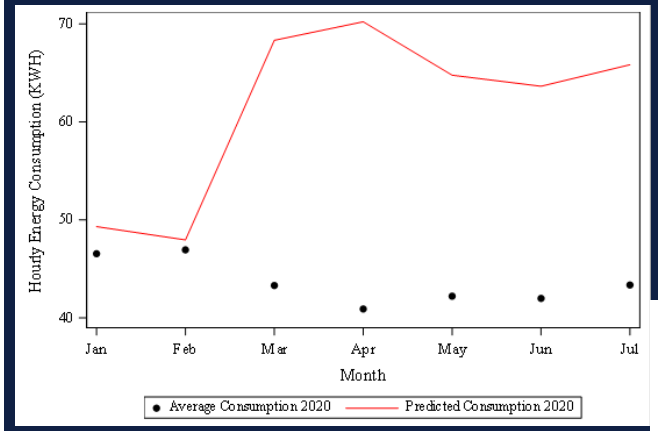


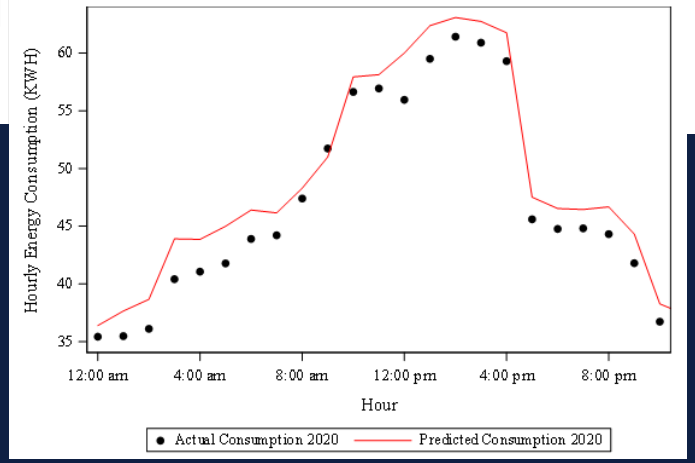
Task 2 (20 points)

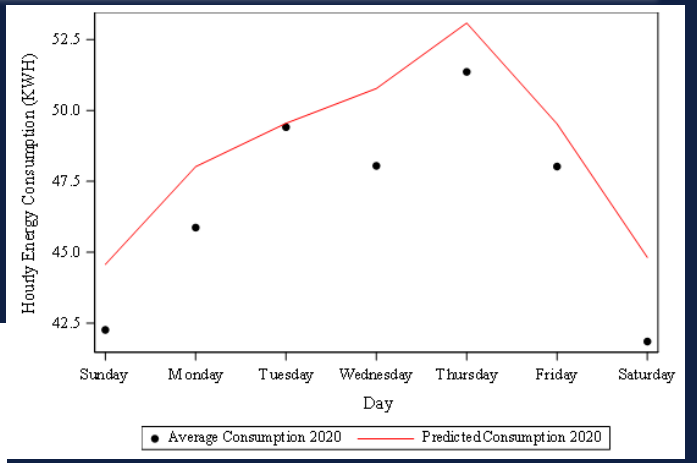
Create a reactive (interactive) plot of average predictions by group.

- These graphs will compare actual average consumption to predicted average consumption.
- The user will choose:
  - Time Category (hour of day, day of week, week of year, month)
  - Meter to plot
  - Time range of data to include in calculations (can *only* include 2020 and beyond)

Task 2 Examples







Style and Appearance (15 points)

- Follow the UNCG Brand Guide as best as possible.
  - https://uc.uncg.edu/uncg-brand-guide/
  - - Use university colors where applicable.
- Include the phrase “funded by the UNCG Green Fund” on the front page.
- Use logos of Bryan School and Computer Science.
- The dashboard must be appropriately labeled (including the axis and plot description), including spelling and capitalization.
  - - Clearly communicate what the output is.
  - - Labels for meters are provided under “Meter Names and Labels.xlsx”

Usability (10 points)

- How easy will the dashboard be to use and understand?
  - For Facilities Operations staff?
  - For students?
  - For community members?
- Providing ‘help’ options or explanations of graphs/options could help in this category.

Programs and Documentation (15 points)

- Code should be flexible, commented, and well-documented.
- Must submit brief documentation (e.g. .text document)
- Clear documentation will be useful if …
  - Code breaks
  - Future students or projects expand on your dashboard

Rules

- All code and elements of your project must be created during the event.
  - You may incorporate preexisting material that is freely available to the public (e.g. stack overflow questions, documentation). But provide references.
- You may **not** communicate with other teams or seek the help of anyone not on your team.
- You may ask questions to Dr. Mohanty and Will Queen about the data and instructions **only**.
  - We will not give you feedback on how the dashboard looks, how many points we would give you, etc.

Deadlines and Prizes

- Final materials due **November 23 at 11:59PM**
  - Dr. Mohanty, sdmohant@uncg.edu
  - Will Queen, jwqueen@uncg.edu
- Presentations will be on **December 2 from 3:00-5:00PM**
  - If all team members cannot make this time, we will make accommodations

1st place - $1,000

2nd place - $600

3rd place - $400

Questions

UNC GREENSBORO