FEEL THE BERNOULLI

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TACC
TEXAS ADVANCED COMPUTING CENTER
GOOD SYSTEMS
A UT Grand Challenge

Table of contents

01

Introduction

Background and motive

Prediction Applications

- Power providers and operators rely on consumption predictions to balance electricity supply and demand
- Accurate predictions act as the foundation for safe and reliable operation on the power grid
- Accurate predictions can help policymakers cut costs and prepare for future events

02

GOALS

Model capabilities and important questions

Goals

Predictive model using weather and water data

Primary

An analysis of solar usage

Secondary

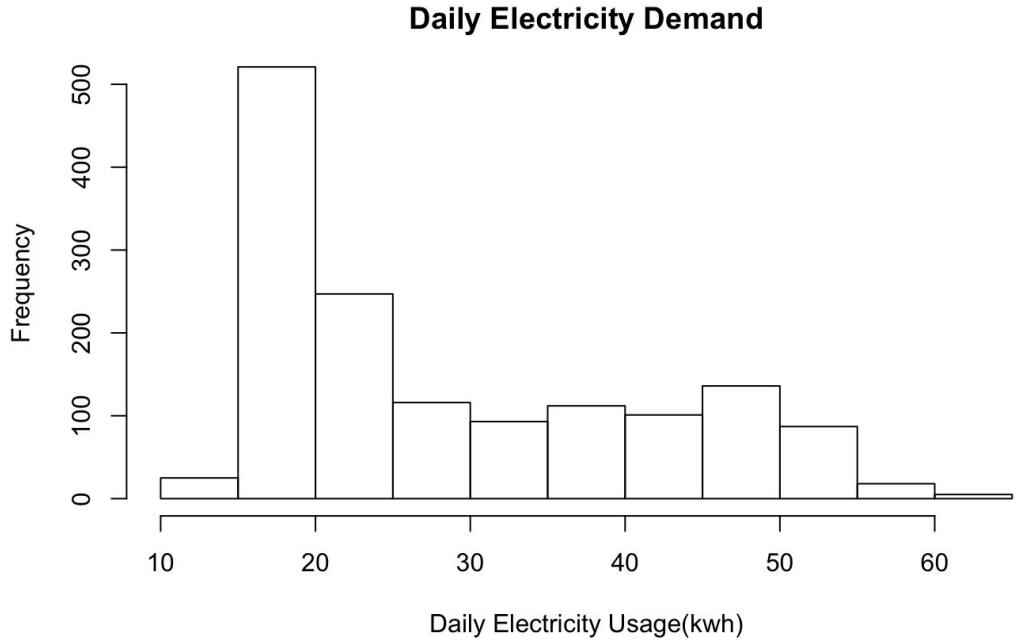
03

METHODS

Procedure and methods

DATA DESCRIPTION

The mean daily electricity usage is **28.79** kWh per household.



Methodology

Predictive Modelling

- LASSO regression for feature selection
- Principal Component Analysis (PCA) for dimension reduction
- K-Nearest Neighbours (KNN)
- Support Vector Machine (SVM)

Unsupervised Data Exploration

- Principal Component Analysis (PCA) for relation extraction

04

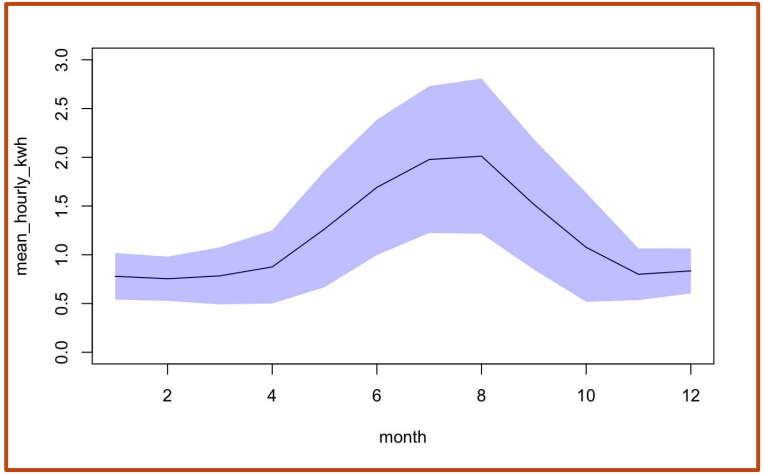
RESULTS

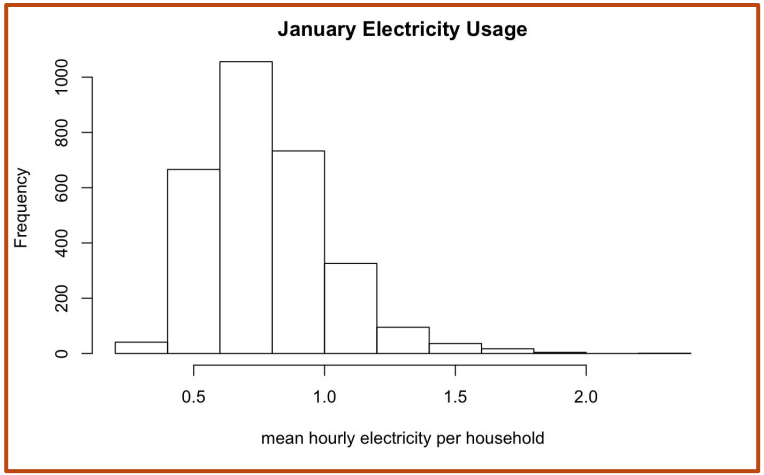
Results and implications

Data Exploration in Depth

- Households use **less** electricity during **winter**

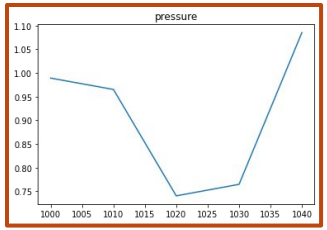
- In January, **83.8%** households used at most 1 kwh an hour

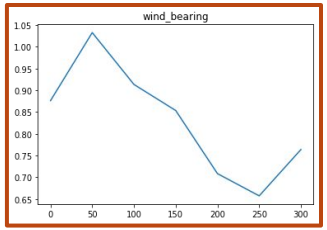


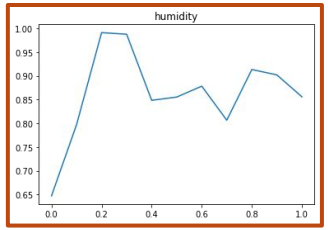


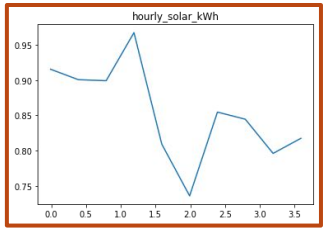
Model Comparison:

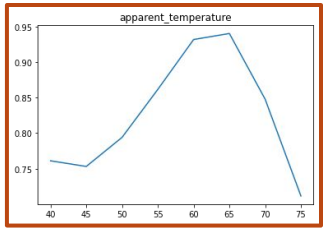
Training Data	Model	Mean Absolute Error (MAE)
January	Average over all household's electricity usage	0.36635
October - March (winter)	Lasso feature selection + principal component analysis (PC = 2) + KNN (K = 10)	0.34943
January	Lasso feature selection + principal component analysis (PC = 4) + KNN (K = 5)	0.33658
January	Lasso feature selection + principal component analysis (PC = 4) + support vector regression (kernel = 'rbf', C = 1000, gamma = 1)	0.29815











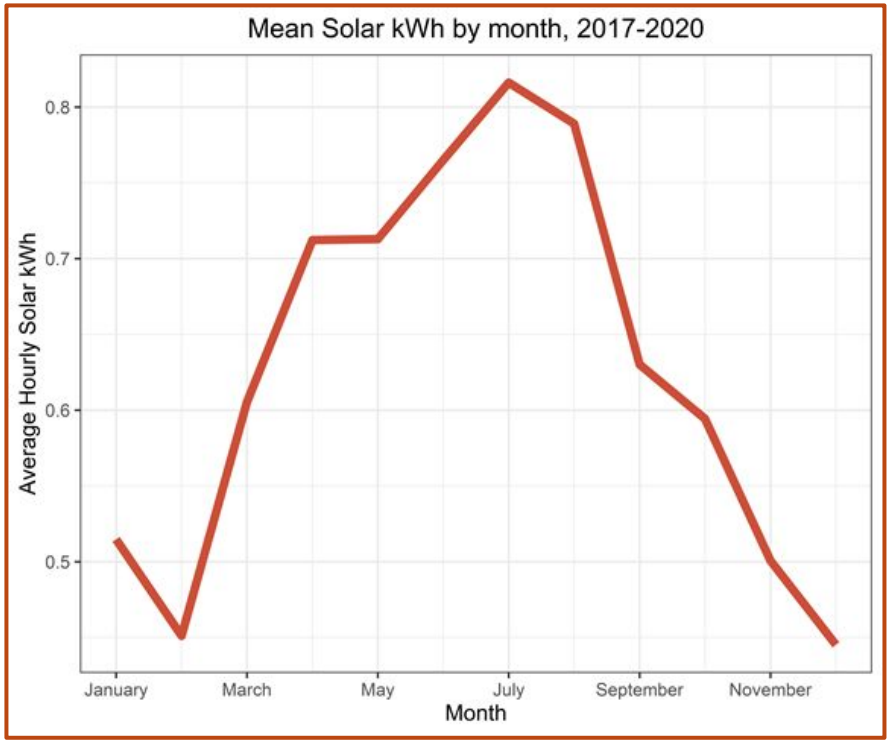
LOWER ENERGY DEMAND CORRESPONDS TO …

- Pressure level between 3020 to 3030
- Wind bearing between 200 - 300
- Lower humidity

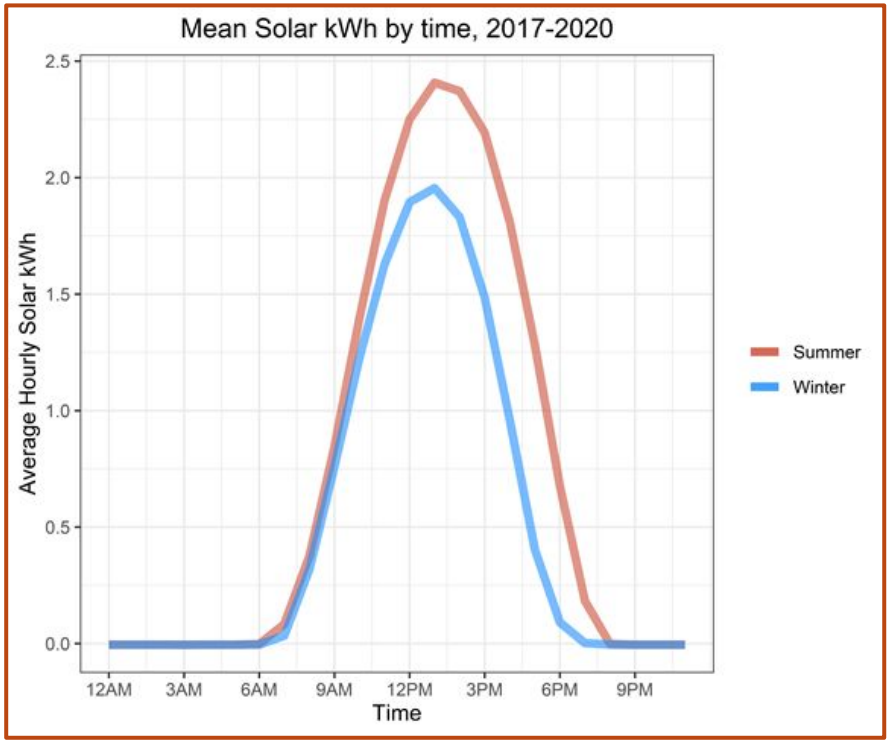
- When temperature is too low → power outage
- When the weather is good → solar energy compensates

Principal Component Analysis

	PC1	PC2	PC3	PC4
cloud cover	***0.516***	-0.123	0.291	***-0.603***
humidity	***0.588***	-0.203	-0.130	-0.165
apparent temperature	0.158	0.712	0.186	0.034
pressure	-0.389	-0.571	0.195	-0.196
wind bearing	-0.084	0.094	-0.881	-0.376
hourly solar kWh	***-0.452***	0.319	0.223	***-0.654***



This figure displays hourly solar kWh aggregated by month and averaged



Hourly solar kWh aggregated by hour of day and averaged; summer (April-September) versus winter (October-March)

Summary

Adaptive support vector machine model for prediction

Solar energy generation is dependent on seasonality

Future Directions

Adaptive model to each month

Behavioral studies of solar consumers

Electricity usage among solar consumers and nonconsumers

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