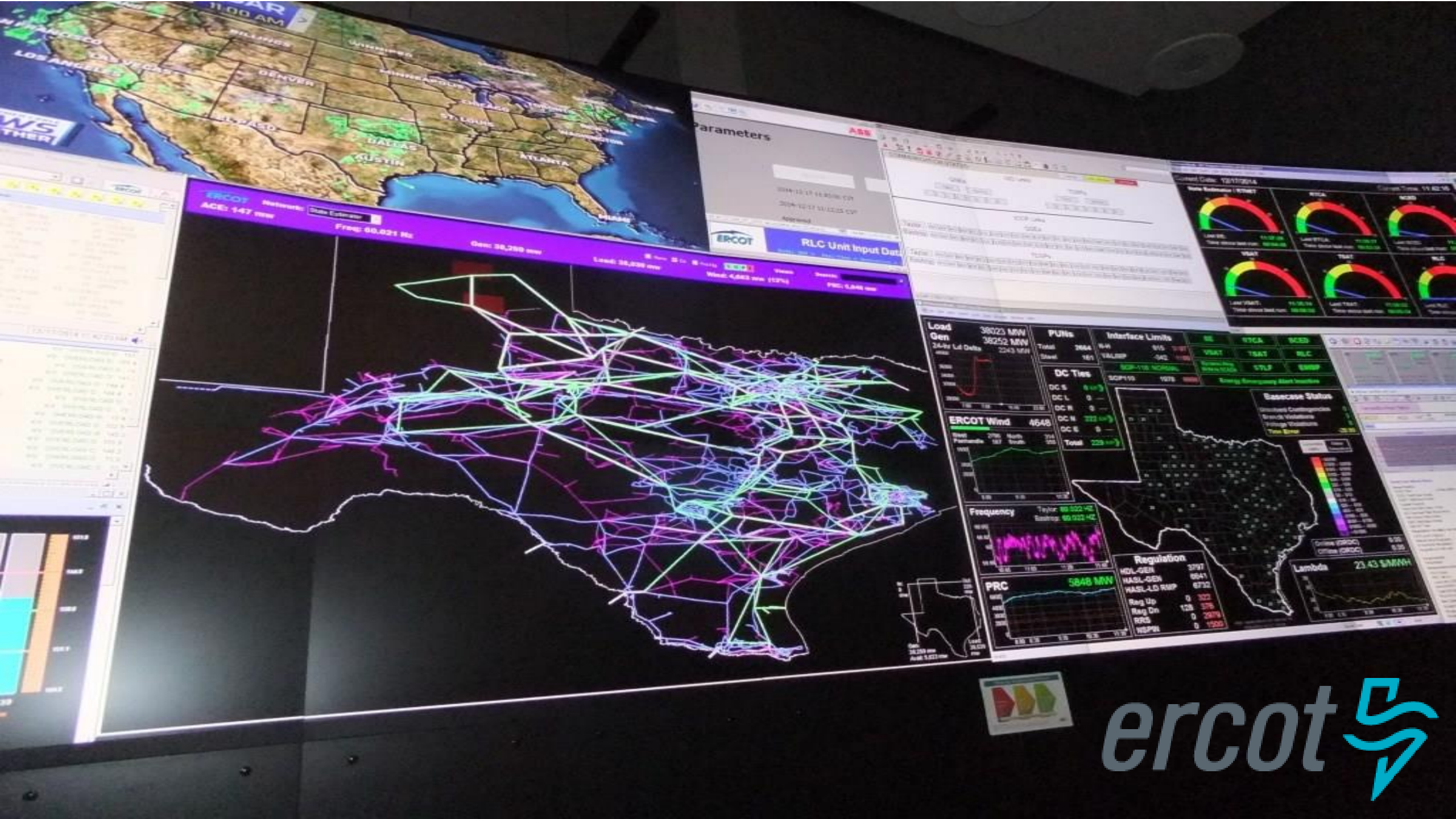


PREDICTING TEXAS ELECTRICITY SPOT PRICES

PAIGE BAILEY
CS 5310 – DATA MINING
MARCH 4, 2017





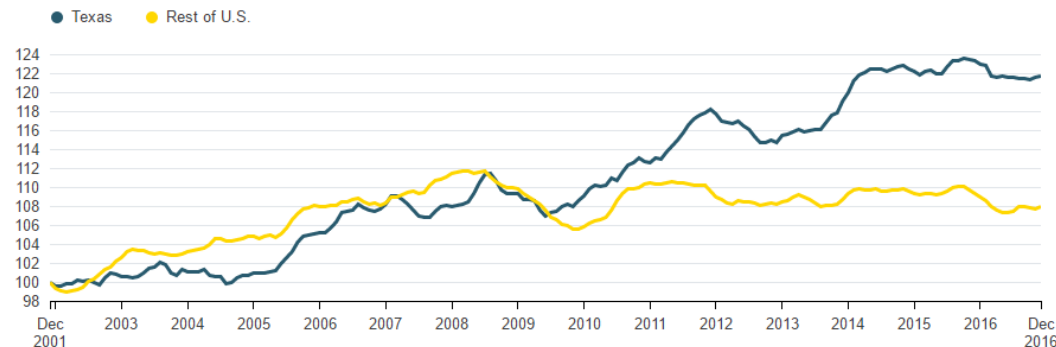
MOTIVATION

BRIEF

ERCOT: Narrow reserves boost real-time prices above \$700/MWh

Lone Star State

Texas' electricity demand kept growing after 2008, unlike the U.S. overall



Source: Energy Information Administration

Note: Trailing 12-month retail sales of electricity, indexed to 100 in December 2001.

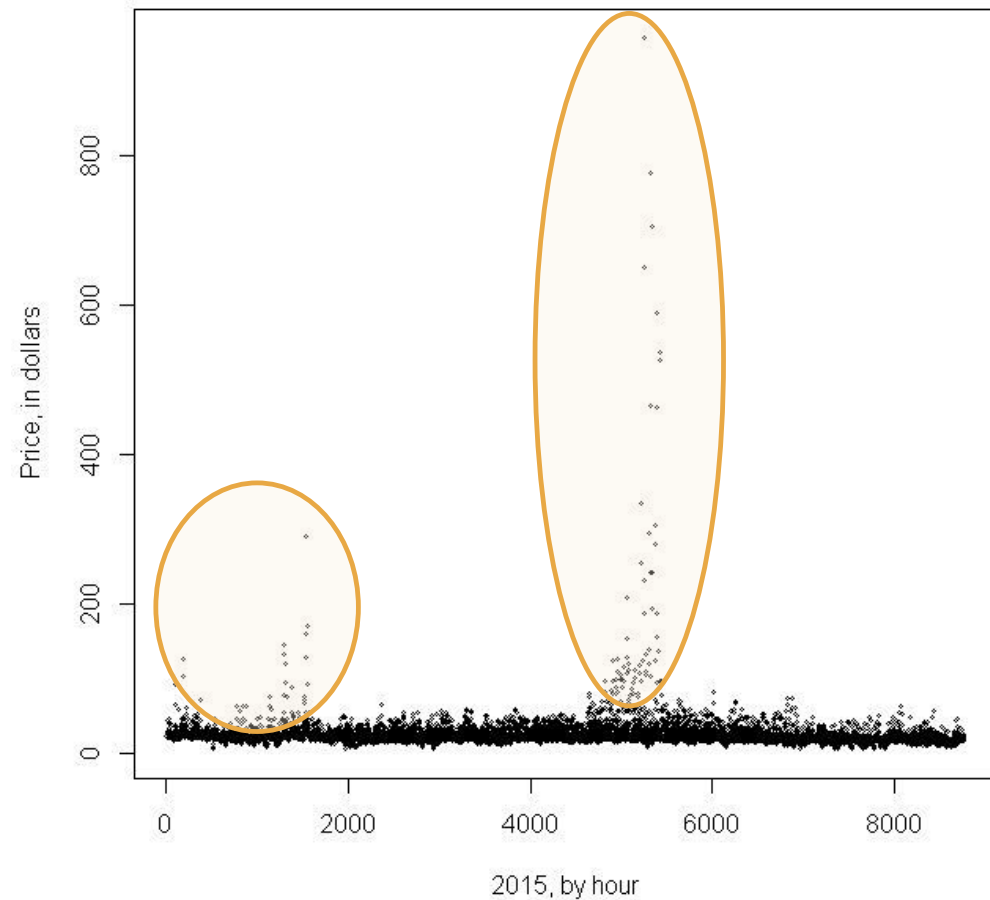
from the Houston Chronicle:

By late afternoon on February 22, 2017, temperatures around [Texas] had climbed into the 90s, and the demand for power surged. **In Houston, where midday wholesale power prices typically hover around \$25, the price spiked to \$4,000 per megawatt-hour** - a sign that the market was short of supply.

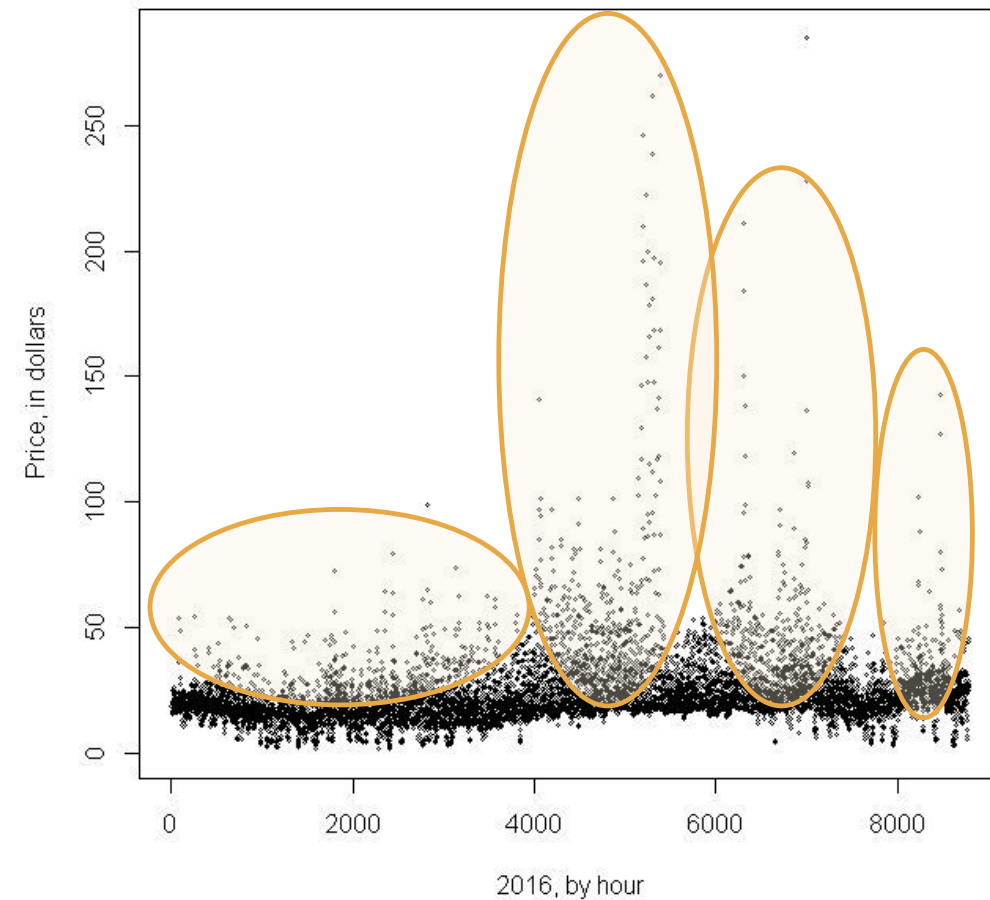
Houston has a capacity problem, and energy demand is only anticipated to increase.

VARIABILITY IN ELECTRICITY PRICES

ERCOT Spot Market Price - 2015



ERCOT Spot Market Price - 2016



- Do prices between Texas electricity hubs vary?
 - Time of day, season, month?
 - Do they follow the same general pattern, or differ?
- Do **weather patterns** in Houston (humidity, precipitation, temperature) impact price of electricity for the Houston hub?
- Does **wind speed** impact the price of electricity in West Texas (HB_WEST)?
- Which **factors or combination of factors** impact electricity prices in each of the hubs? Are those factors consistent?
- What are the **optimal times** to purchase electricity at each of the hubs? To sell?



RESEARCH QUESTIONS

DATA SOURCES

ERCOT

Real-Time Settlement Point Prices Display

SPP values include the 15 Minute Online Reserve Price Adders and the Real-Time Online Reliability Deployment Price Adders.

Operating Day: 03/03/2017 ▼

Oper Day	Interval Ending	HB_BUSAVG	HB_HOUSTON	HB_HUBAVG	HB_NORTH	HB_SOUTH	HB_WEST	LZ_AEN
03/03/2017	0015	14.64	14.64	14.64	14.64	14.64	14.64	14.64
03/03/2017	0030	14.53	14.53	14.53	14.53	14.53	14.53	14.53
03/03/2017	0045	14.49	14.49	14.49	14.49	14.49	14.49	14.49
03/03/2017	0100	14.33	14.33	14.33	14.33	14.33	14.33	14.33
03/03/2017	0115	14.11	14.11	14.11	14.11	14.11	14.11	14.11
03/03/2017	0130	14.02	14.02	14.02	14.02	14.02	14.02	14.02
03/03/2017	0145	13.96	13.96	13.96	13.96	13.96	13.96	13.96
03/03/2017	0200	14.08	14.08	14.08	14.08	14.08	14.08	14.08
03/03/2017	0215	14.00	14.00	14.00	14.00	14.00	14.00	14.00
03/03/2017	0230	13.90	13.90	13.90	13.90	13.90	13.90	13.90
03/03/2017	0245	14.13	14.13	14.13	14.13	14.13	14.13	14.13
03/03/2017	0300	14.44	14.44	14.44	14.44	14.44	14.44	14.44
03/03/2017	0315	14.35	14.35	14.35	14.35	14.35	14.35	14.35
03/03/2017	0330	14.34	14.34	14.34	14.34	14.34	14.34	14.34
03/03/2017	0345	14.07	14.07	14.07	14.07	14.07	14.07	14.07
03/03/2017	0400	14.07	14.07	14.07	14.07	14.07	14.07	14.07
03/03/2017	0415	14.63	14.63	14.63	14.63	14.63	14.63	14.63
03/03/2017	0430	14.82	14.82	14.82	14.82	14.82	14.82	14.82
03/03/2017	0445	15.01	15.01	15.01	15.01	15.01	15.01	15.01
03/03/2017	0500	15.06	15.06	15.06	15.06	15.06	15.06	15.06
03/03/2017	0515	15.51	15.51	15.51	15.51	15.51	15.51	15.51
03/03/2017	0530	15.72	15.72	15.72	15.72	15.72	15.72	15.72
03/03/2017	0545	16.16	16.16	16.16	16.16	16.16	16.16	16.16
03/03/2017	0600	16.71	16.71	16.71	16.71	16.71	16.71	16.71
03/03/2017	0615	17.73	17.73	17.73	17.73	17.73	17.73	17.73
03/03/2017	0630	18.98	18.98	18.98	18.98	18.98	18.98	18.98
03/03/2017	0645	20.20	20.20	20.20	20.20	20.20	20.20	20.20

MRCC CLI-MATE DATA

Hourly Data Between Two Dates

HOUSTON HOBBY AP (TX)

12918

Lat/Lon/Elev: 29.6381/-95.2819/44 ft

Date	Time	Temp (F)	RH (%)	Dewpt (F)	Wind Spd (mph)	Wind Direction (deg)	Peak Wind Gust(mph)	Atm Press (hPa)	Precip (in)	Wind Chill (F)	Heat Index (F)
2011-01-01	00:00	63	35	35	16	20	M	1009.03	M	NC	NC
2010-01-01	01:00	49	77	42	20	330	24	1024.27	M	NC	NC
2010-01-01	02:00	47	80	41	20	340	29	1024.94	M	40	NC

Time Range:

Sampling Rate:

Weather Prediction:

2010 – present

every 15 minutes / hourly

darksky (R package)

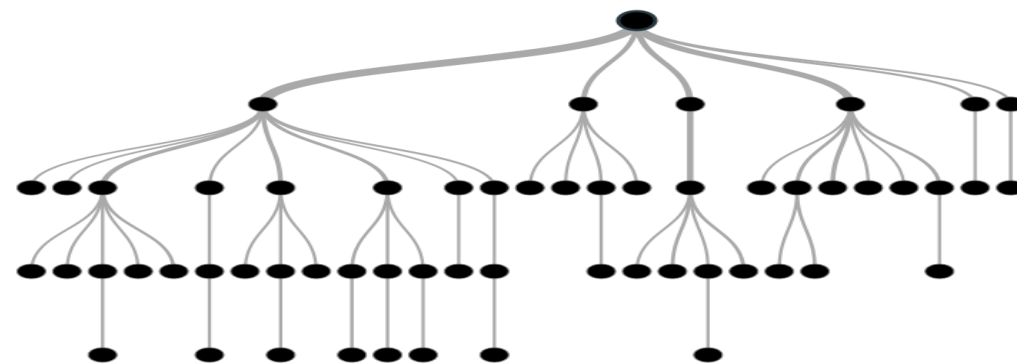
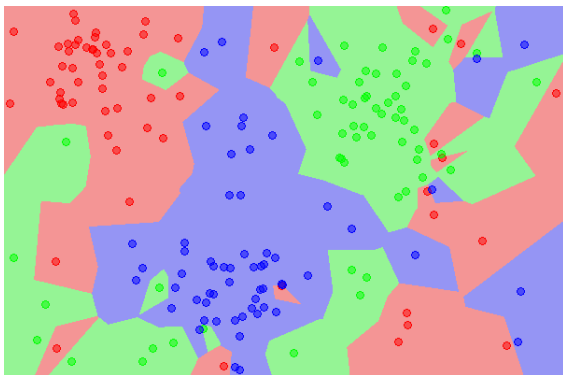
- Consistent date/time formats
- Derived column for z-scores
- Derive “class” column based on z-score
 - **SELL**: z-score greater than or equal to 1
 - **STAY**: z-score between -1 and 1
 - **BUY**: z-score greater than or equal to -1
- Single data frame for each hub
- Determine appropriate segmentation for weather
 - By month? By season?
 - By time of day, or hour?
 - Some combination?

DATA PREPARATION

DATA ANALYSIS

Data Acquisition

- Obtain developer credentials for **DarkSky**
- Install **darksky** package in R
- Download data from **ERCOT website** (2010-2016)
- Download data from **MRCC website** (2010-2016)
 - Houston, TX
 - Midland, TX
 - Dallas, TX
 - Austin, TX
 - Waco, TX



Algorithms to Test

- Both **numeric** and **nominal** features
- **Few examples** for some scenarios
- Algorithms to test
 - Nearest Neighbors (kNN)
 - Decision Tree



Data Cleaning



Test Model



Refine Model

NEXT STEPS

March 4th → April 28th

QUESTIONS / SUGGESTIONS?

