Predicting Energy Consumption for Power Systems Planning

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Introduction to Data Science

University of Utah

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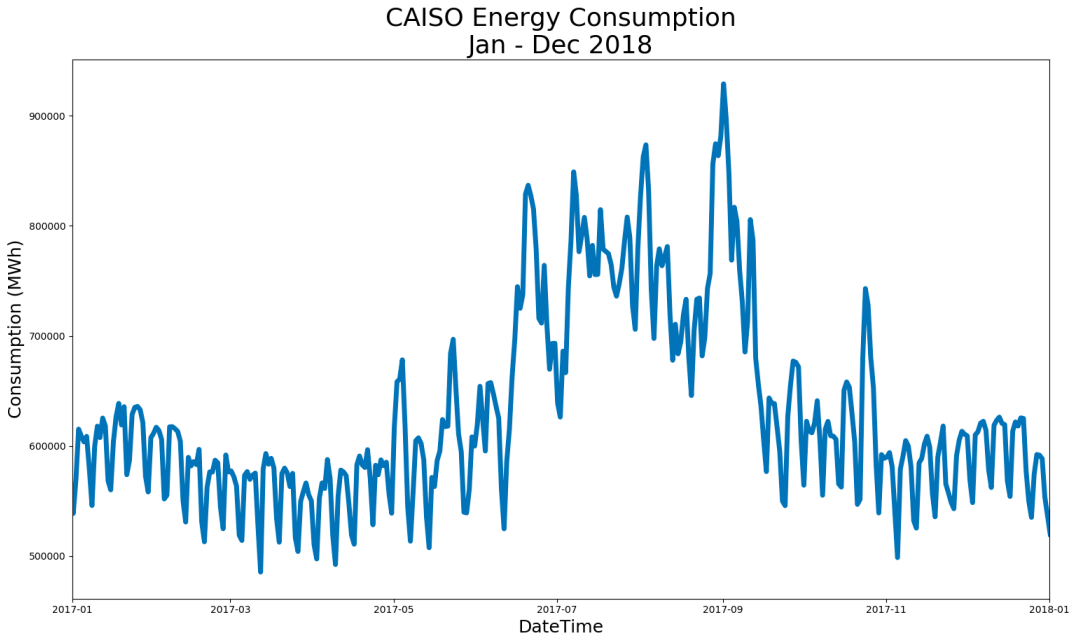
Why Forecast Energy Consumption?

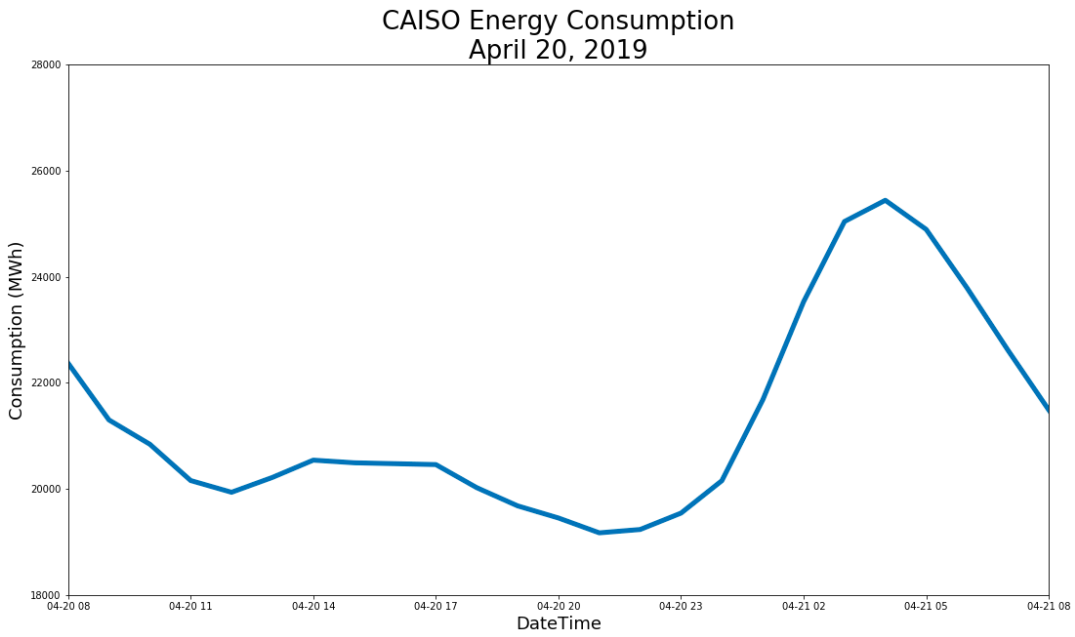
Long-Term (Annual Trends)

- Transmission Planning
- Generation Planning

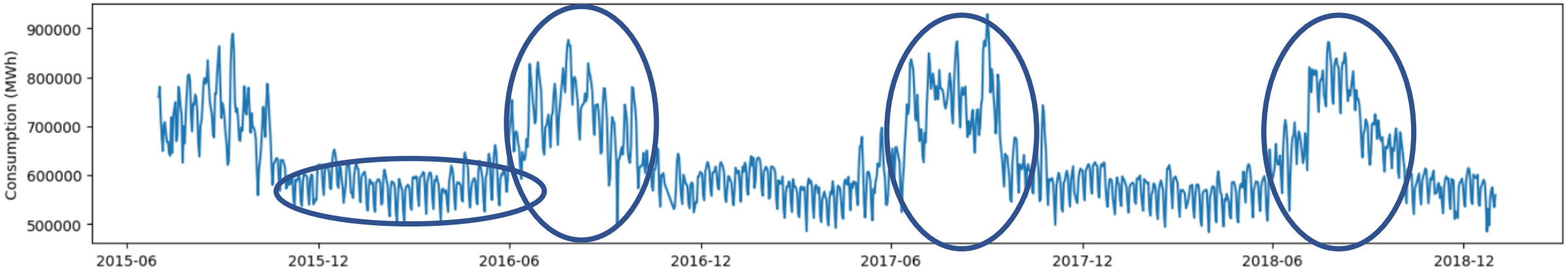
Day-Ahead Forecasting

- Dispatch Schedules
- Ancillary Services





What Influences Energy Consumption?

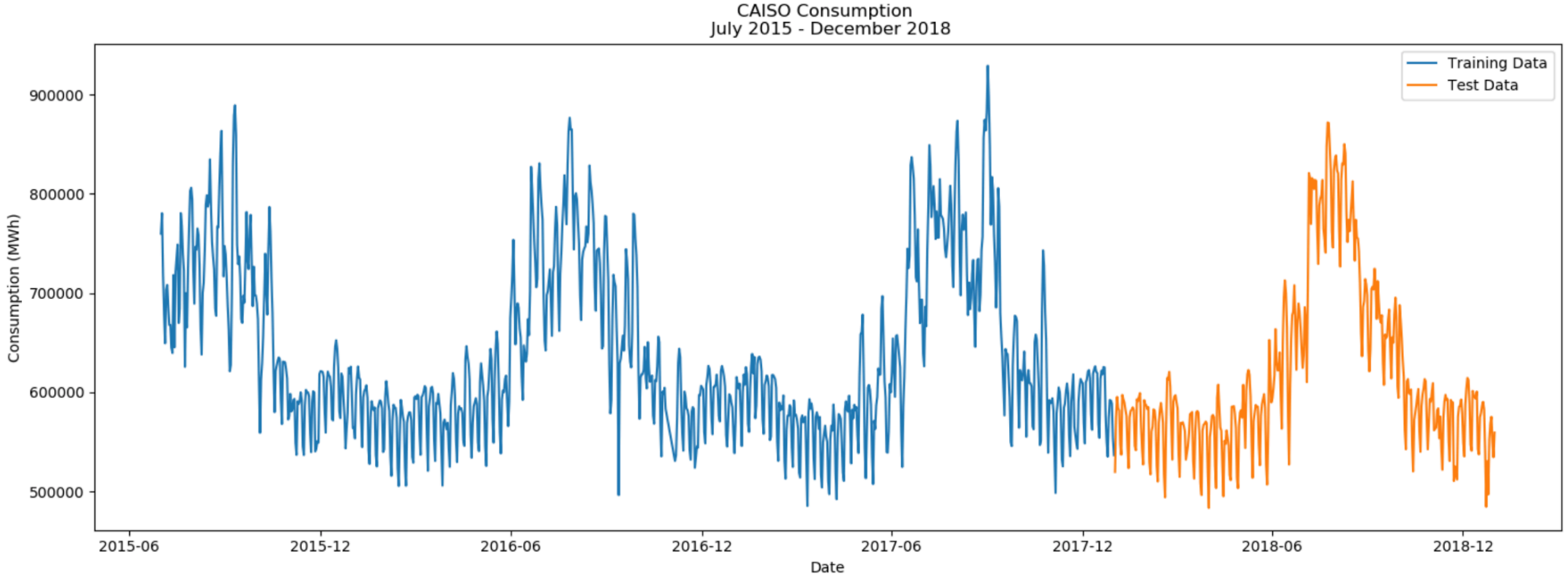


Short-Term Trends
- Day of the Week
- Weekend vs. Weekday
- Holidays

Seasonal Trends
- Weather
- Appliance Usage
- Distributed Renewables

Long-Term Trends
- Economic Factors
- Population Growth
- Renewable Integration

Machine Learning Approach

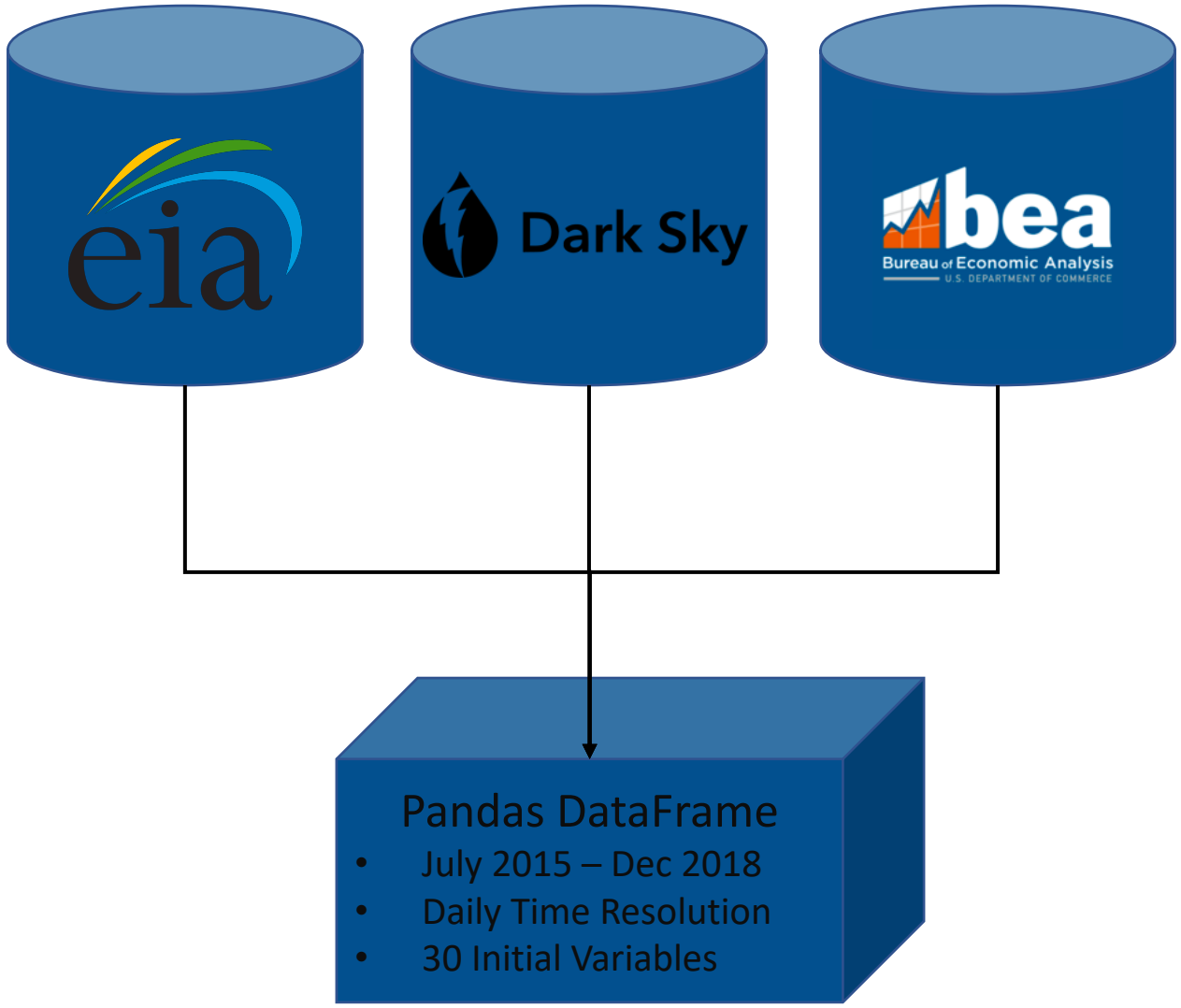


Objective: Use 2.5 years of historical weather, economic, and population data to predict energy consumption for the California ISO.

1. Linear Regression
2. Multi-Layer Perceptron (Neural Network) Regression

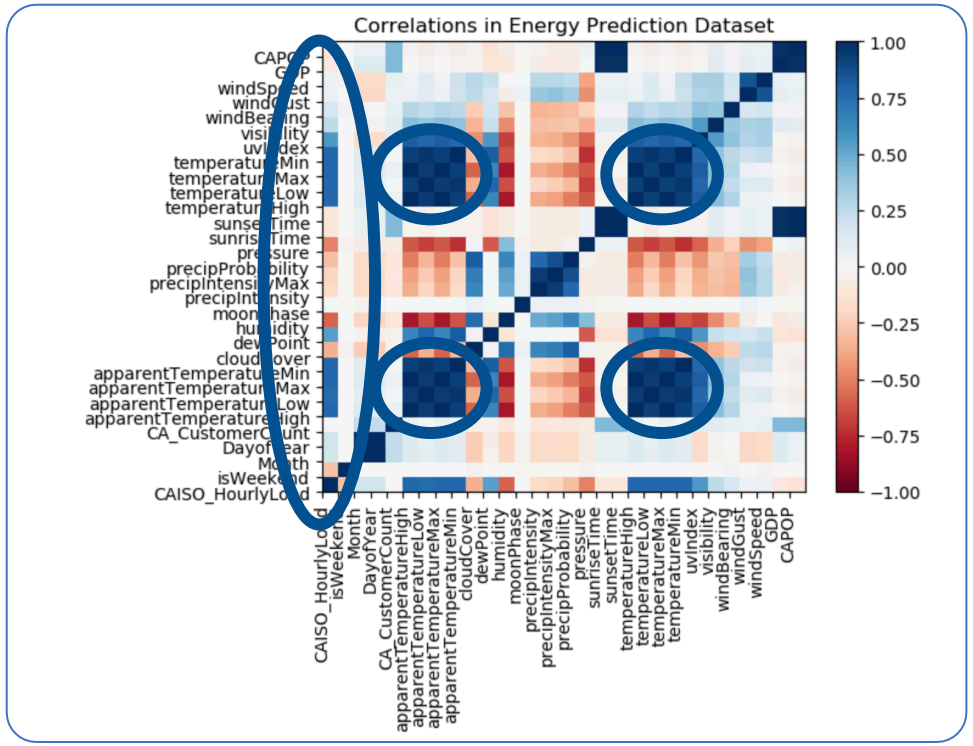
Data Import

- Energy Information Agency API
  - CAISO Hourly Energy Consumption
  - California Region Energy Consumption
  - Number of CAISO Power Customers
- Dark Sky API
  - Temperature
  - Dew Point
  - Pressure
  - Precipitation
  - Cloud Cover
  - Other Weather Parameters
- Bureau of Economic Analysis
  - California Population
  - U.S. Gross Domestic Product

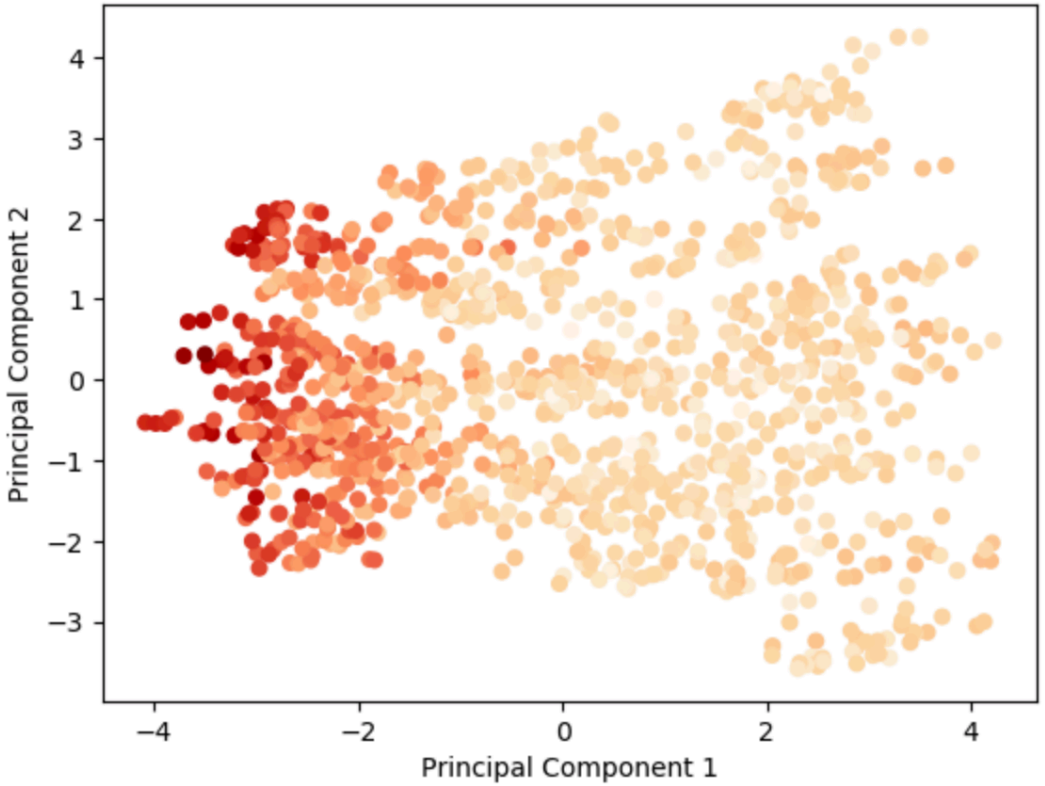


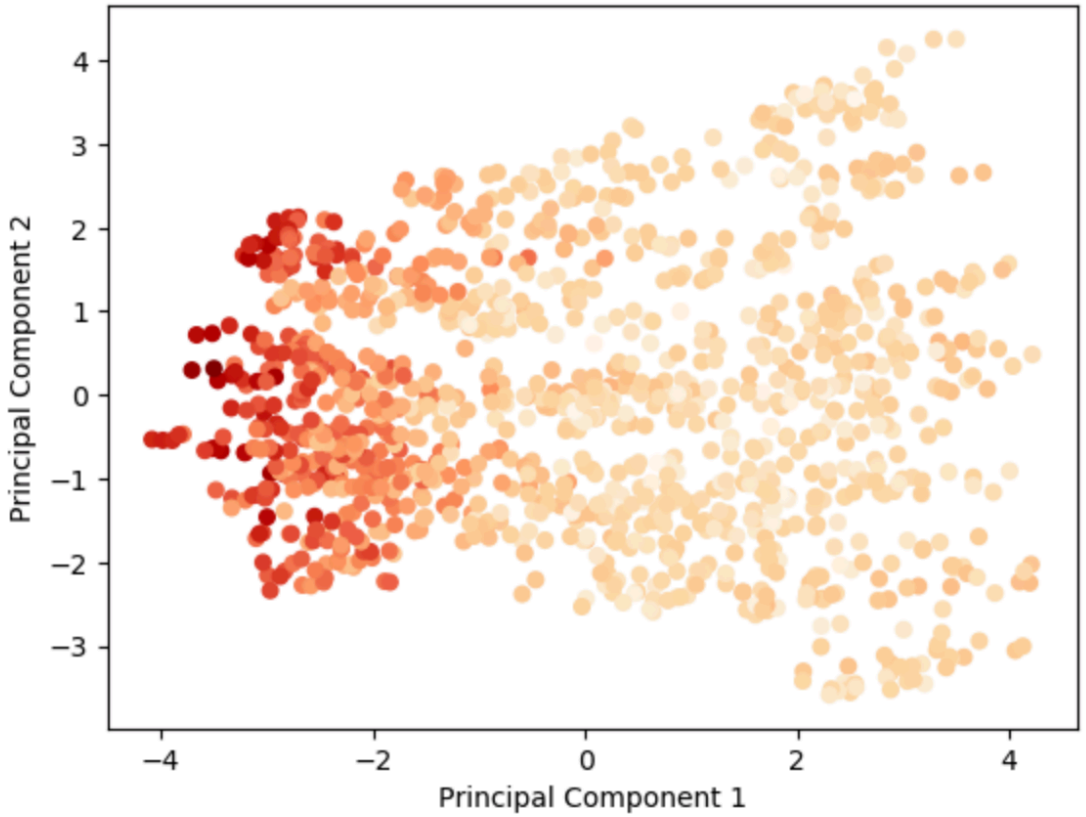
Dimension Reduction

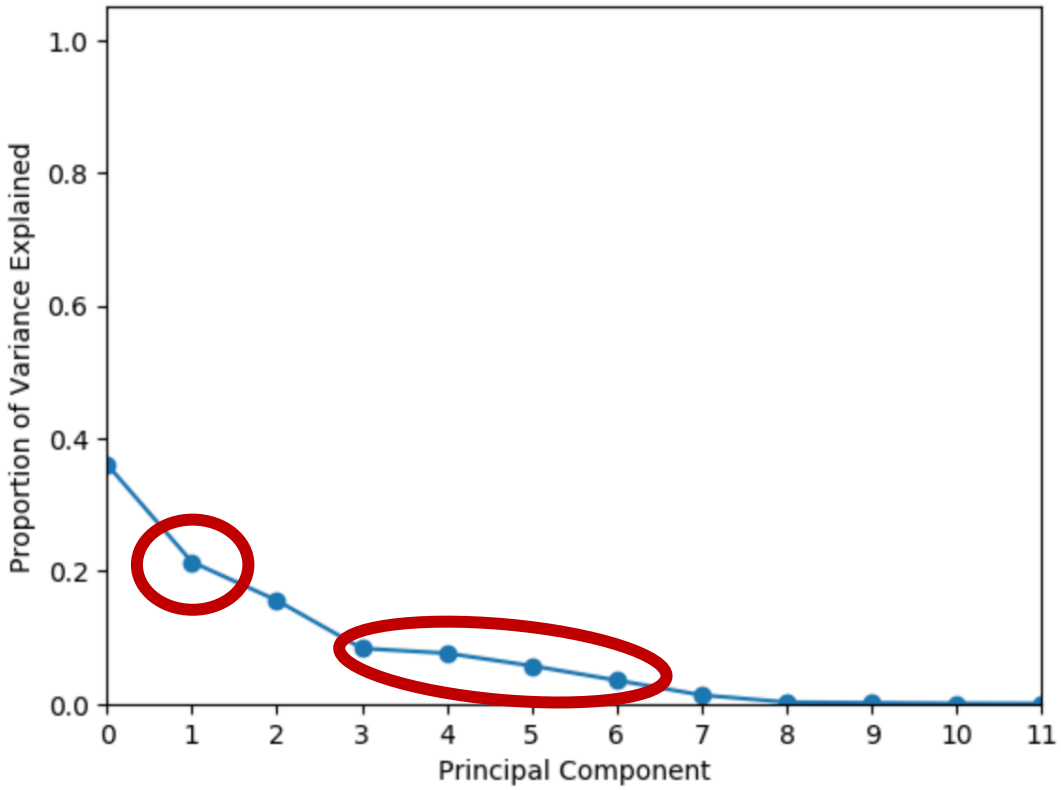
Empirical Deduction



Principal Component Analysis



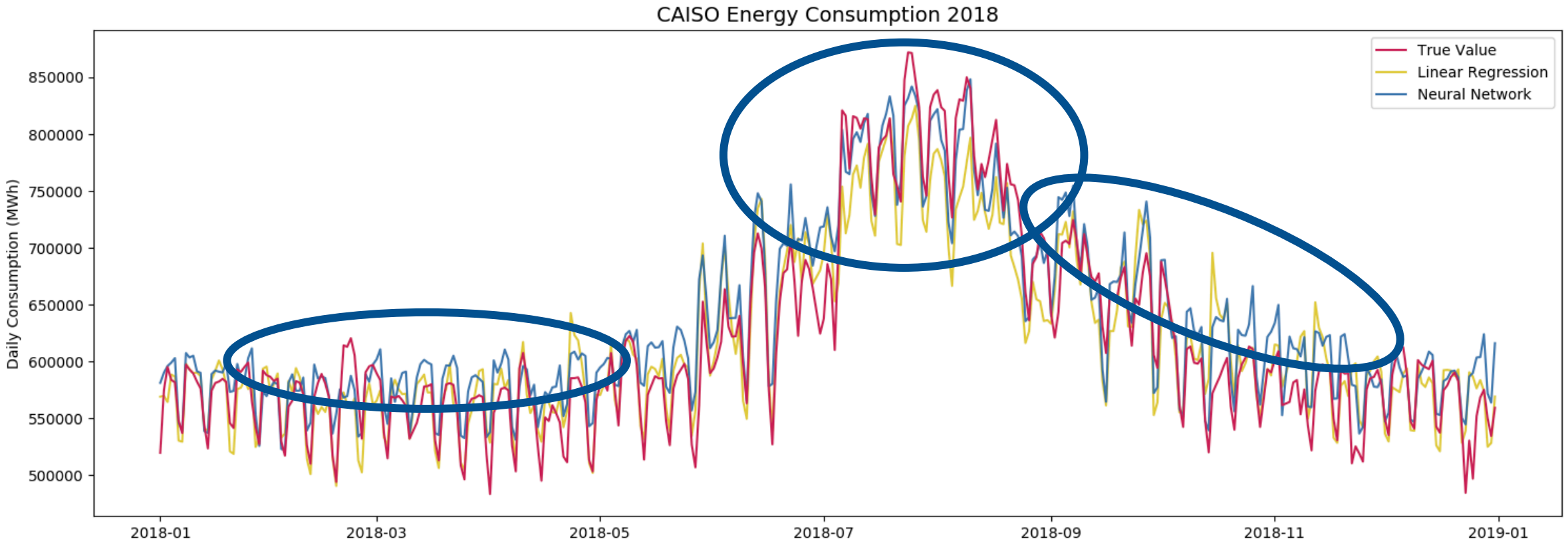




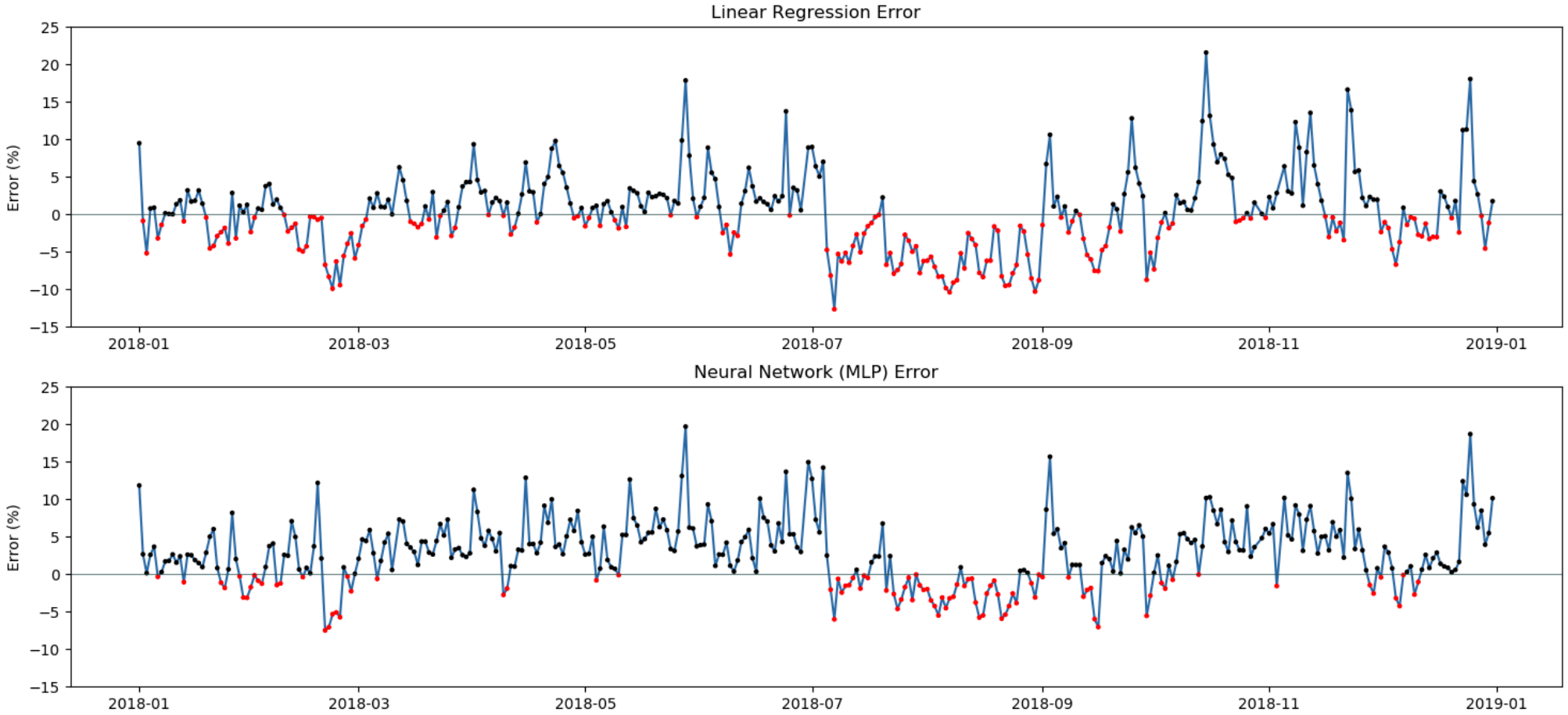
$$\max Var(z_1) = \frac{1}{n}\sum_{i=1}^{n}\left(\sum_{j=1}^{p}\phi_{j,1}X_{i,j}\right)^2$$

Principal Component Analysis

Energy Consumption Predictions



Model Comparison



- Neural Network showed 6.36% reduction in RMS error
- Linear regression much more straightforward to implement

Thank you.

Project Completed by John Muhs and Corbett Carrell for Introduction to Data Science Class (COMP 5360).

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