Wave Prediction: Building my own Surf Forecast

BrainStation Capstone Project

Subject Area Overview

Goal: Build my own surf forecast

Why Build my own Forecast?

Current surf forecasts vs. my surf forecast

Current Model: LOLA(*"Lots of Lousy Arithmetic"*)
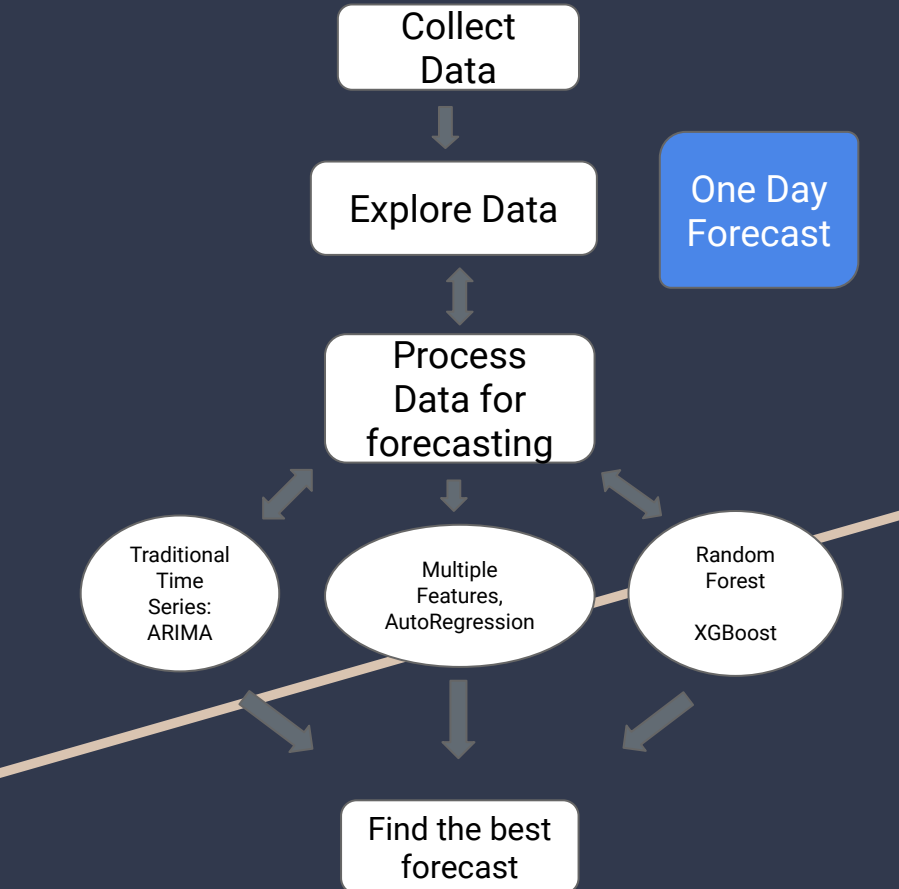
Lotus + ML

My Approach: Incorporate ML with Buoy data, focusing on a specific location.

Other Potential Impact...

	Surf (ft)	Rating	Primary Swell			Secondary Swell				Wind		Weather	Pressure	Probability
12am	8-10	POOR TO FAIR	12ft	11s	◤	2.9ft	13s	◥		22 kph 54	↗	☁ 9°c	995mb	100%
3am	8-10	POOR TO FAIR	10.9ft	11s	◤	3.5ft				21 kph 46	↑	🌦 9°c	996mb	100%
6am	8-10	POOR TO FAIR	7.9ft	11s	◤	6.4ft		◣		16 kph 38	↑	🌧 9°c	998mb	100%
9am	8-10	POOR TO FAIR	9.5ft	11s	◤	4.9ft	13s	◥		19 kph 43	↑	🌤 8°c	999mb	95%
Noon	8-10	POOR TO FAIR	8.8ft	10s	◤	5.8ft	14s	◥		22 kph 45	↗	🌤 8°c	1001mb	75%

Forecast: Wave Height and Wave Period

Approach

Collect Data

Explore Data

One Day Forecast

Process Data for forecasting

Traditional Time Series: ARIMA

Multiple Features, AutoRegression

Random Forest
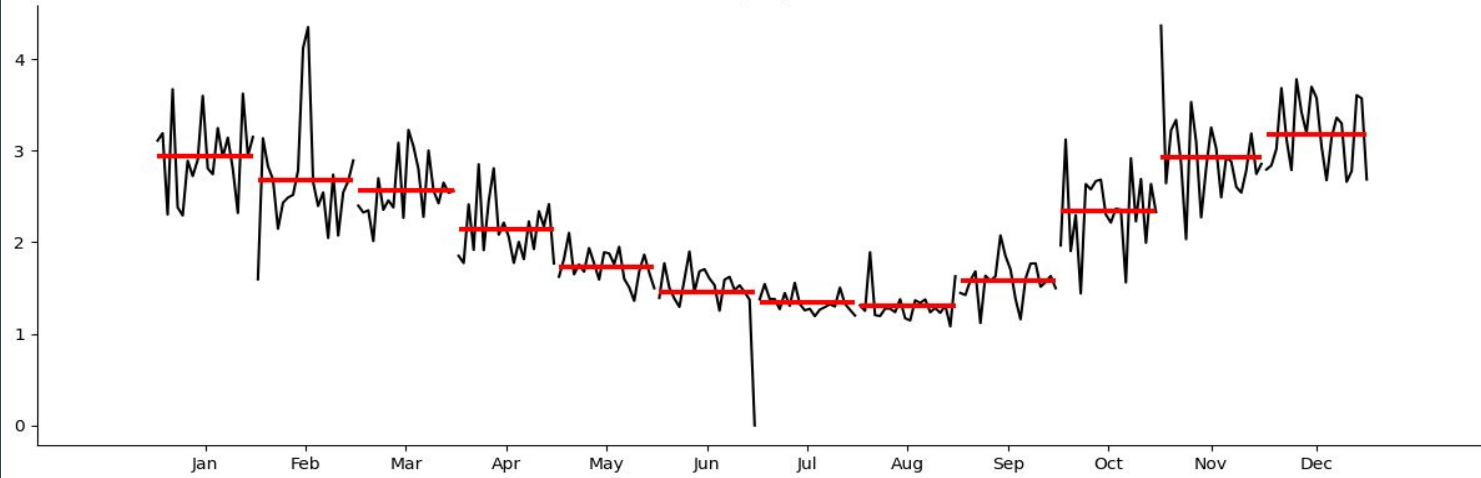
XGBoost

Find the best forecast

How Can the Relationship between Wave Height and Wave Period for forecasting be better understood?

Forecast Independent of each other.
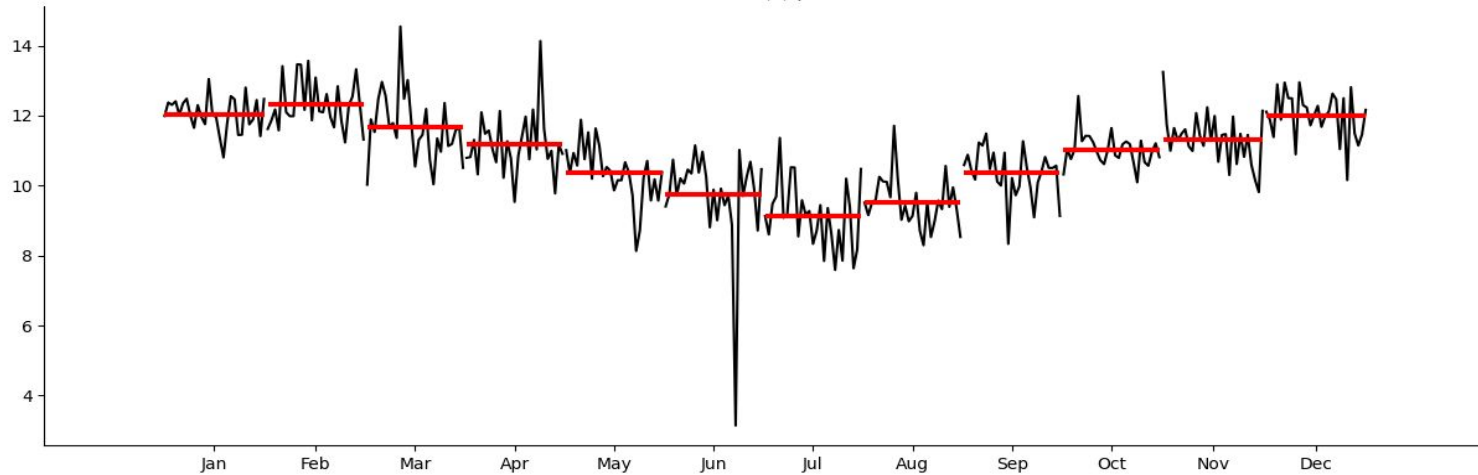Forecast for same day.

How will Forecast Be Evaluated?
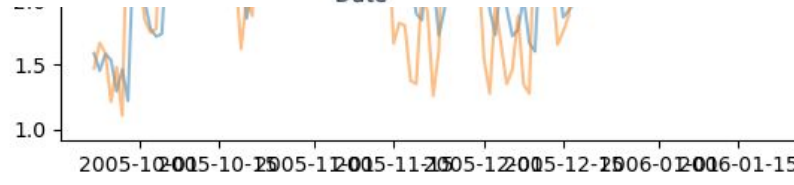
Change in Error
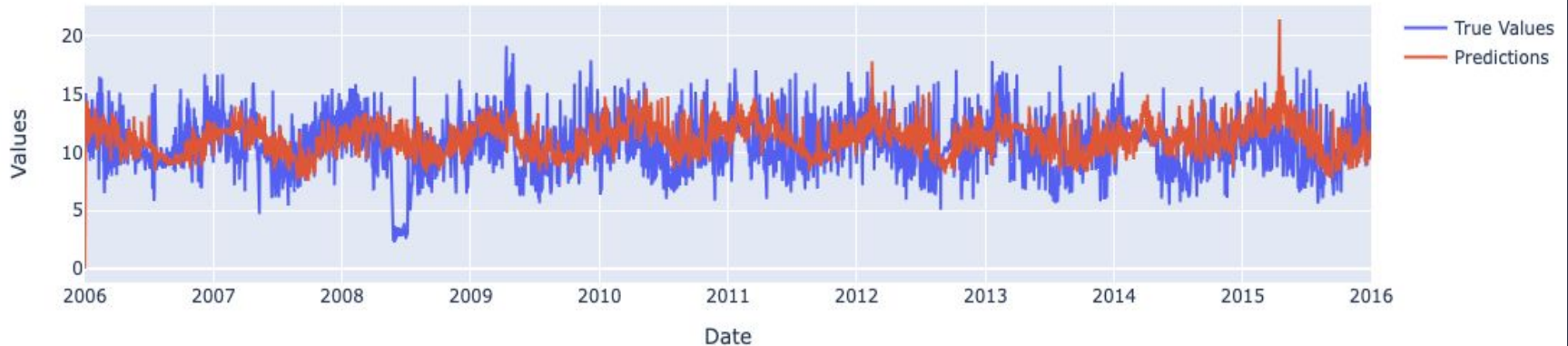
Wave Height per Month

Wave Period (s) per Month

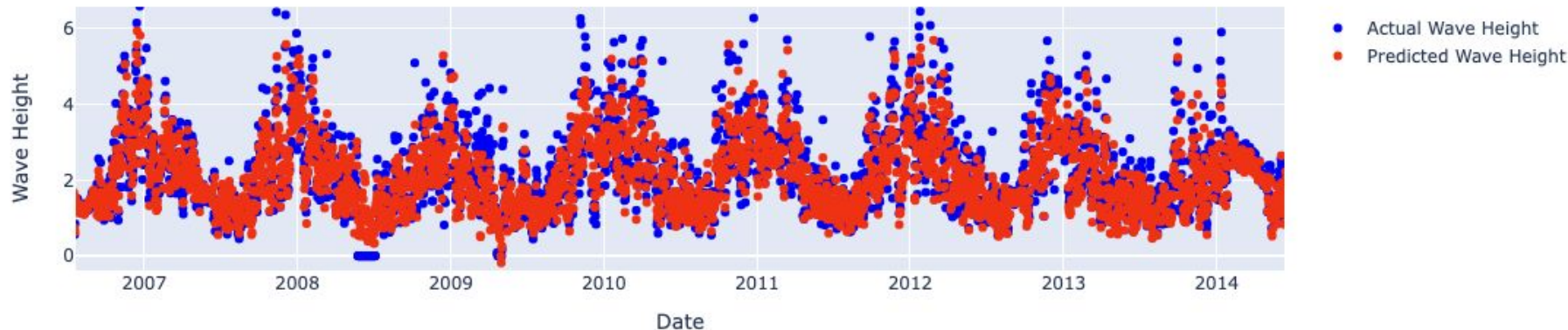# Traditional Statistical Method: ARIMA

Wave height (m) Predicted over time.
One Day Forecast

Can the forecast be more accurate by including other features?

Baseline Linear Regression
Predicted Wave Height over Time

Actual vs. Predicted Wave Height

Ensemble Learning
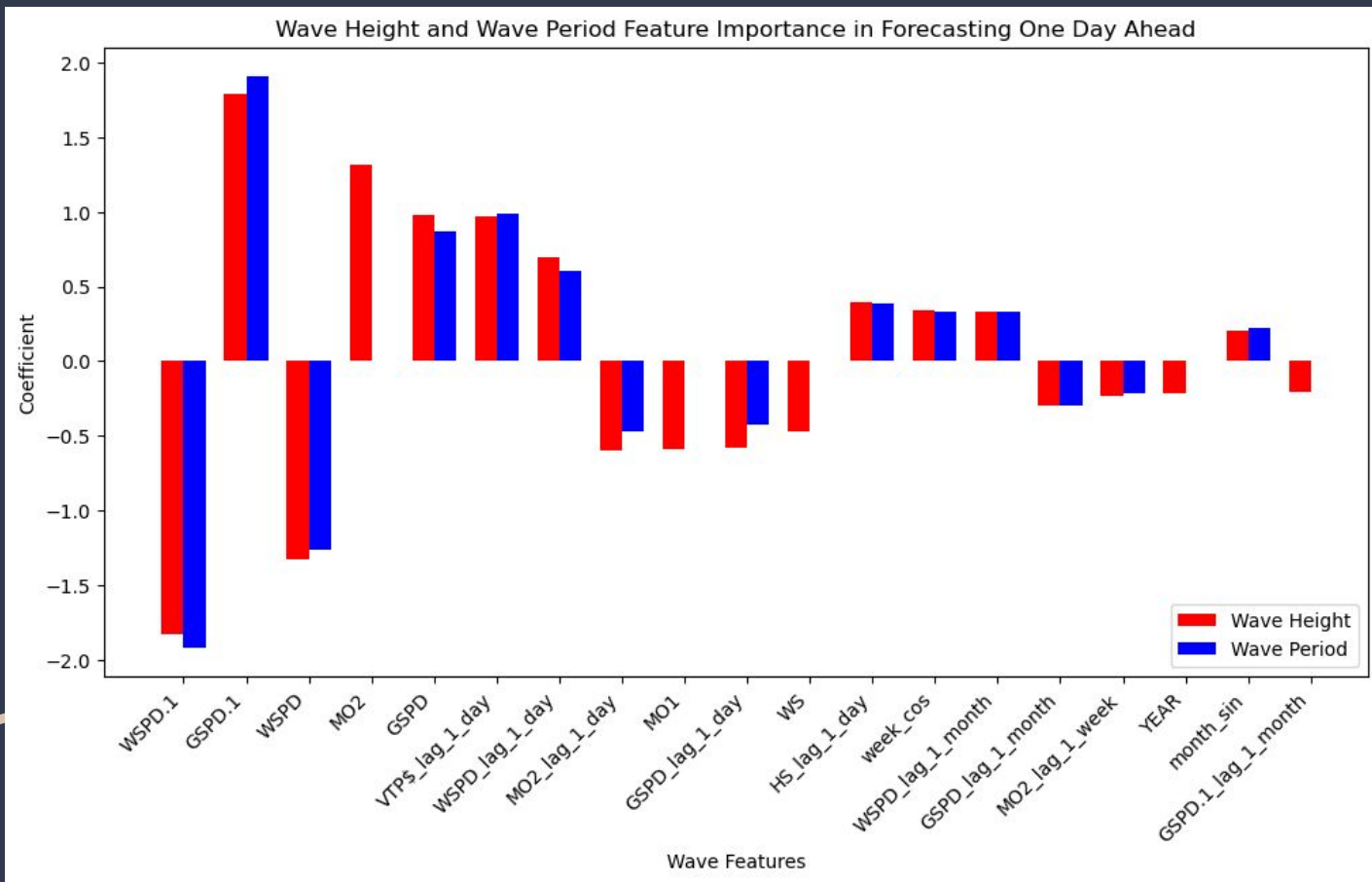# XGBoost and Random Forest

Wave Height and Wave Period Forecasted Independently:

Model	Wave Period (MSE)	Wave Period (MAE - seconds)	Wave Height (MSE)	Wave Height (MAE - meters)
Random Forest	2.90	1.25	0.015	0.067
XGBoost	2.80	1.22	0.017	0.071
Linear Regression	2.83	1.28	0.19	0.31
ARIMA	6.94	2.06	1.47	0.91

Wave Height and Wave Period Forecasted Simultaneously for same Day:

Model	Wave Period (MSE)	Wave Period (MAE - seconds)	Wave Height (MSE)	Wave Height (MAE - meters)
Random Forest	3.069	1.319	0.253	0.362
XGBoost	3.069	1.319	0.232	0.345
Linear Regression	3.043	1.343	0.307	0.391
ARIMA	6.94	2.06	1.47	0.91

Feature Importance

Wave Height and Wave Period Feature Importance in Forecasting One Day Ahead

Summary:

Wave height and wave period can be forecasted for the same day with average error in predictions:

Wave Height: 1.13 feet or 0.34 meters
    Wave Period: 1.32 seconds

Next Steps:

- Further Feature Analysis
- Forecast other components
- Explore Vector AutoRegression, Neural Networks
- Live forecasting