

# Forecasting Campground Pressure using Time Series Analysis

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A wide-angle photograph of a mountainous landscape. In the foreground, dark evergreen trees are heavily laden with white snow. The middle ground shows a vast valley filled with a mix of snow and green vegetation, leading towards a range of majestic mountains. The sky above is a clear, vibrant blue. A bright sun is positioned in the upper left, its rays creating a starburst effect through the branches of a tree on the left side of the frame.

**330.9 million**



## The Problem

- Americans love their National Parks! But, maybe a little bit too much...
- 2016 and 2017 were the busiest years to date for the NPS with 330.9 Million visitors\*
- In response, the current administration has suggested a raise in entry fees for some of the most popular parks to as much as \$75.

\*<https://www.theguardian.com/environment/2018/nov/20/national-parks-america-overcrowding-crisis-tourism-visitation-solutions>

The background of the slide is a photograph of a sunset over a body of water. The sky is filled with streaks of orange, yellow, and blue. In the foreground, there are tall green reeds growing out of the water. A white rectangular box containing the text is centered over the middle ground of the image.

My goal is to use the NPS's reservation data to draw conclusions about the NPS's approach to park entry and campground reservation policies.



## The Recreation Information Database

- Recreation.gov is a trip planning and reservation service portal
- The RIDB is Recreation.gov's API, recently upgraded its data-sharing capability in March 2015
- Uses industry-standard Representational State Transfer application programming interface (RESTful API)
- Keeps historic public records of reservations



The background of the image is a wide-angle photograph of a mountainous landscape. In the foreground, there's a body of water with small ripples. The middle ground shows several mountain peaks covered in green forests. A bright, colorful rainbow arches across the sky from the upper right towards the center. The sky is filled with various shades of blue, white, and grey clouds.

**15,187,728**

From 2018 to 2014



# Methodology



## 1. The Data

What I had to do to make it usable

## 2. Modeling

What I observed from using time-series modeling

## 3. Analysis

What does it all mean?

## 01 The Data





## Filtering

- 6.20 GBs of raw data
- 2,784,270 campsite reservations in entire dataset
- Python datatype downcasting to optimize memory usage



## Aggregating

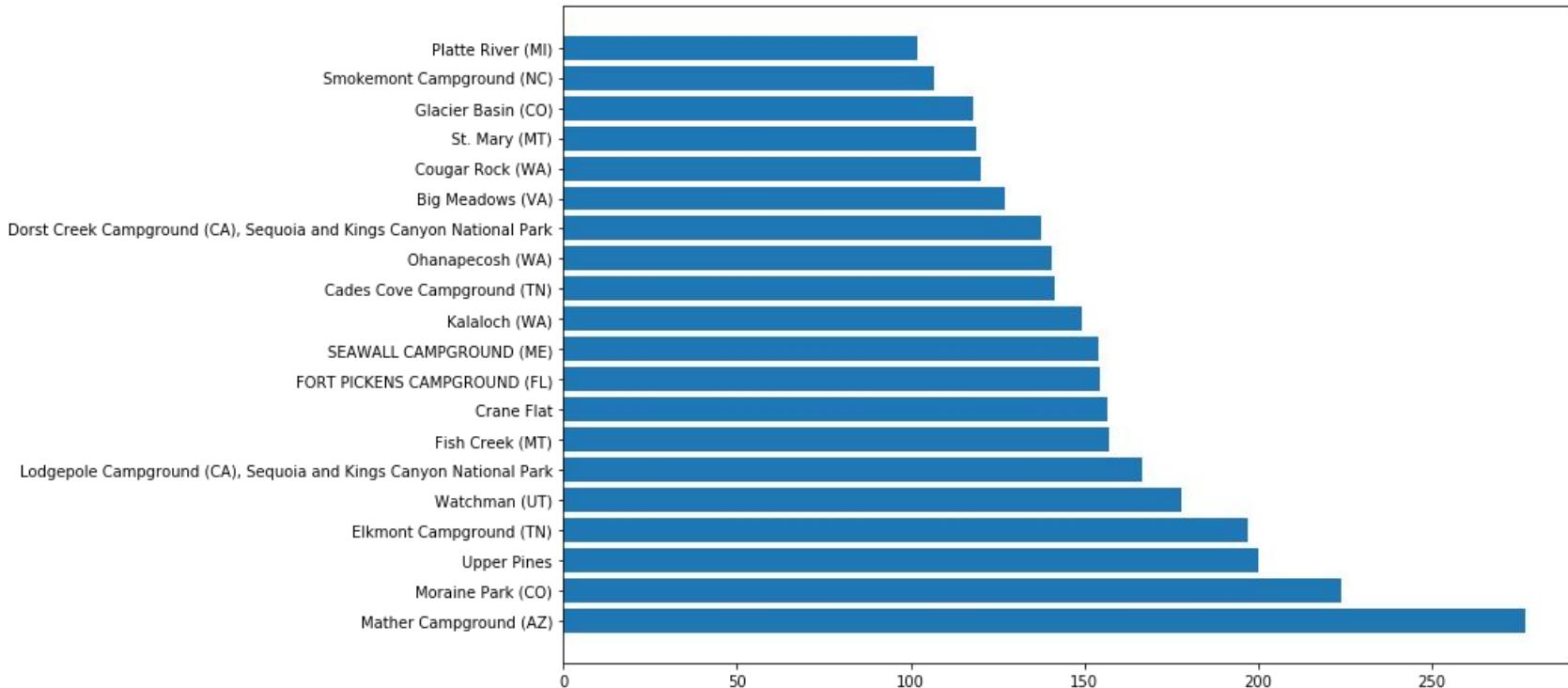
- Each reservation grouped by date
- Variables aggregated appropriately
- Deal with duplicate dates
- Making each entry uniform using API data



## Formatting

- Prepare the data for time-series modeling
- Converting the series to weekly data
- Separating by site

# Top 20 Campgrounds by Average Number of Sites Booked



# Which Campsites?



## Moraine Park

"Moraine Park Campground (8,160 feet) is located in Colorado's awe-inspiring Rocky Mountain National Park, near the Beaver Meadows Entrance on Highway 36. It is situated on the north side of Moraine Park, offering beautiful views of the vast park and the surrounding mountains."



## Mather Campground

"Mather Campground is located on the South Rim of Grand Canyon National Park in northern Arizona. Grand Canyon is one of the most inspiring landscapes on Earth and draws over five million visitors per year to its spectacular scenery."

# Which Campsites?



## Big Meadows

"Secluded in the thick trees and rolling hills of Shenandoah National Park, the Big Meadows Campground is the ideal spot for an outdoor family getaway."



## Elkmont

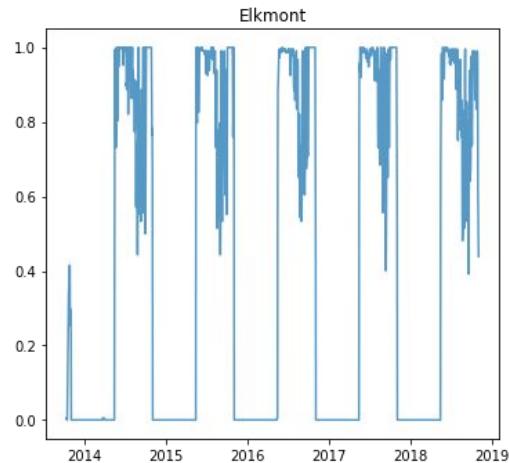
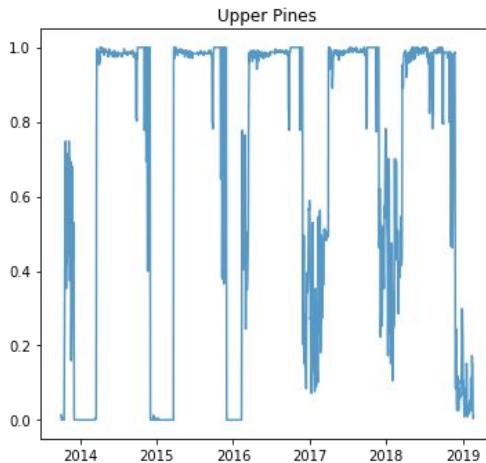
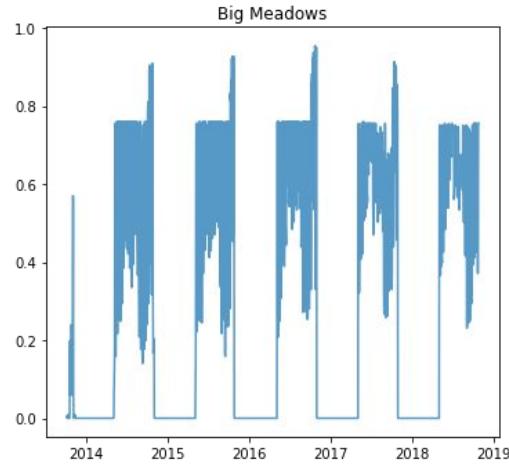
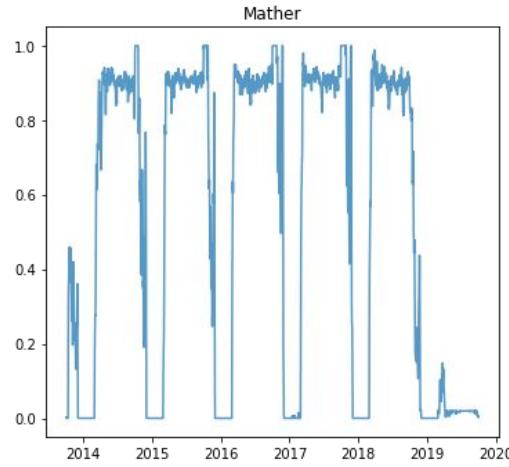
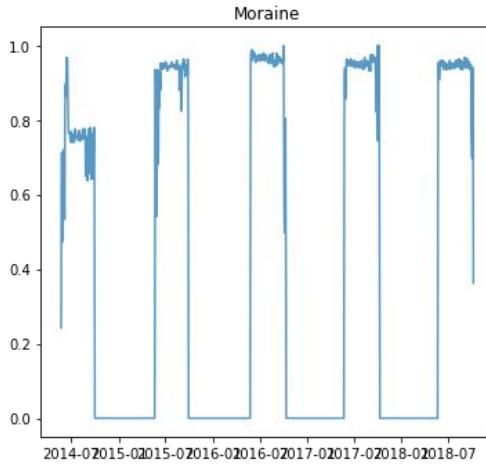
"Located eight miles from Gatlinburg, Tennessee, Elkmont Campground is the largest and busiest campground in Great Smoky Mountains National Park. At an elevation of 2,150 feet, the area enjoys a moderate climate, characterized by mild winters and hot, humid summers."

# Which Campsites?



## Upper Pines

"Upper Pines Campground is located in breathtaking Yosemite National Park in Central California's rugged Sierra Nevada Mountain Range at an elevation of 4,000 feet. The site is situated in the heart of Yosemite Valley, an awe-inspiring landscape containing many of the famous features for which Yosemite National Park is known."



## 02 Modeling



## Modeling Process

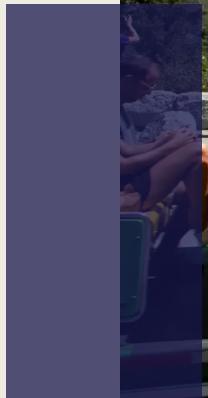
- Datasets were converted to a weekly time-series
- Stationarity evaluated Augmented Dickey-Fuller Test (ADF) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) Test
- Logarithmic Transformation was used set boundaries for predictions
- SARIMA or SARIMAX model was fit on each dataset
- Each forecast was then updated on half of the testing data

# How did the models perform?

|              | Model                   | RMSE   | MAE    |
|--------------|-------------------------|--------|--------|
| Moraine      | SARIMA(1,1,1)(0,1,0)52  | 4.20%  | 2.34%  |
| Mather       | SARIMA(3,1,2)(0,1,0)52  | 24.50% | 12.69% |
| Big Meadows  | SARIMA(1,1,1)(1,1,0)52  | 24.38% | 17.42% |
| Upper Pines* | SARIMAX(1,1,1)(2,1,0)52 | 13.39% | 10.77% |
| Elkmont      | SARIMA(2,1,1)(0,1,0)52  | 10.77% | 5.9%   |

\* Upper Pines was not transformed logarithmically

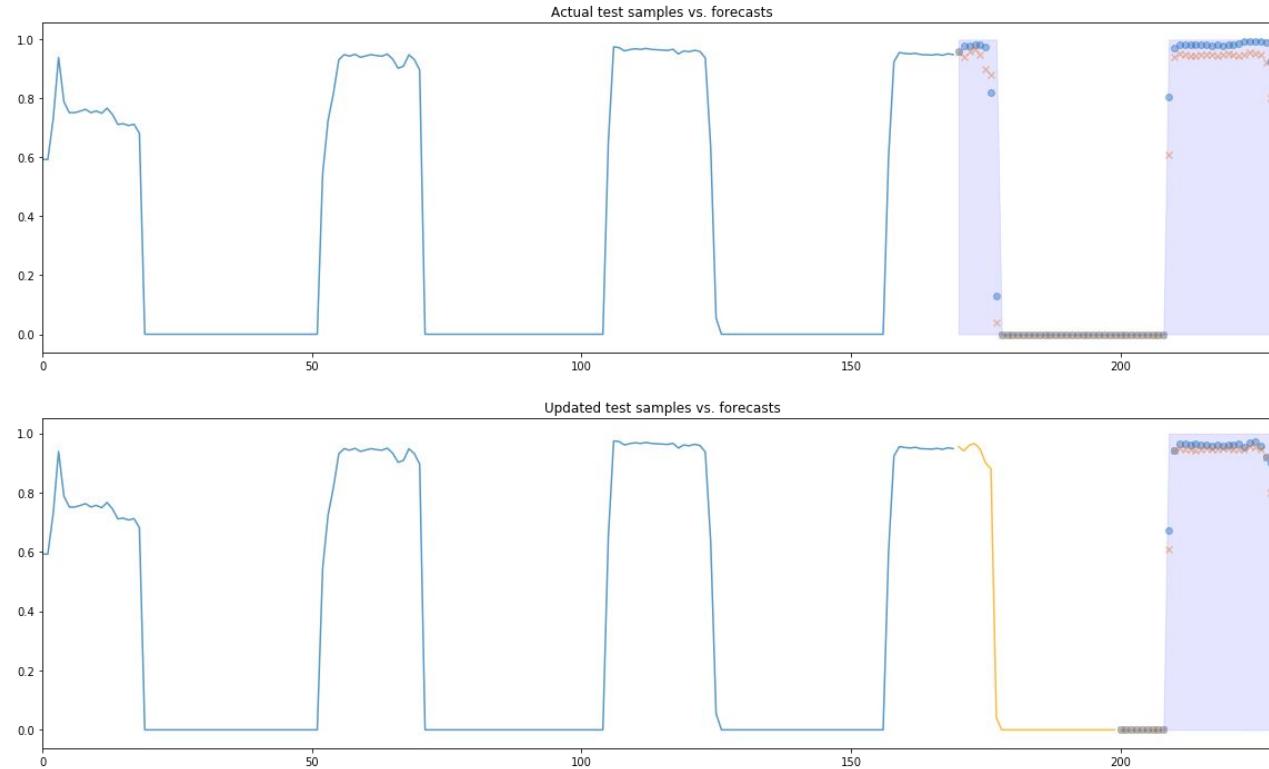
## 03 Analysis



# Moraine

Rocky Mountain National Park

60 Week Forecast plus Updated Forecast

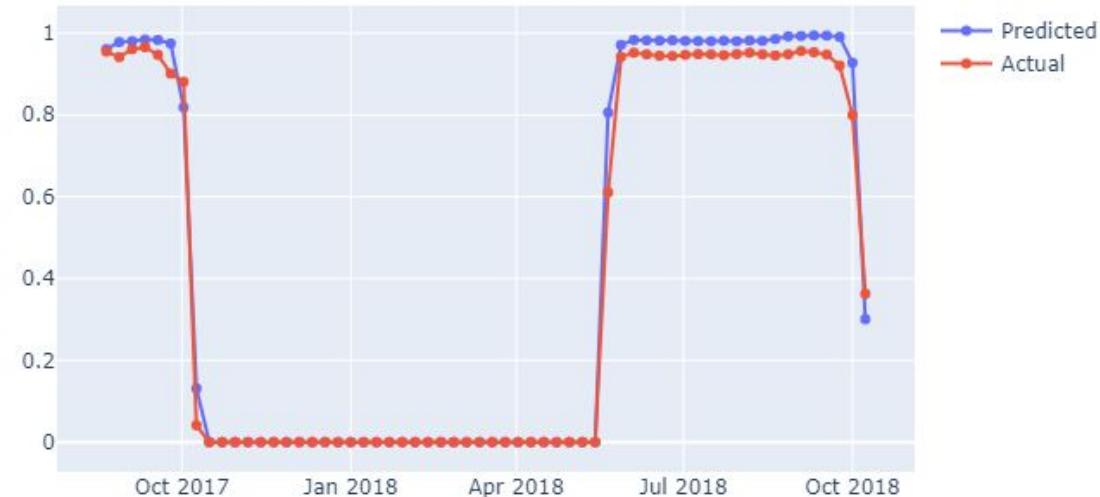


# Moraine

Rocky Mountain National Park

60 Week Forecast

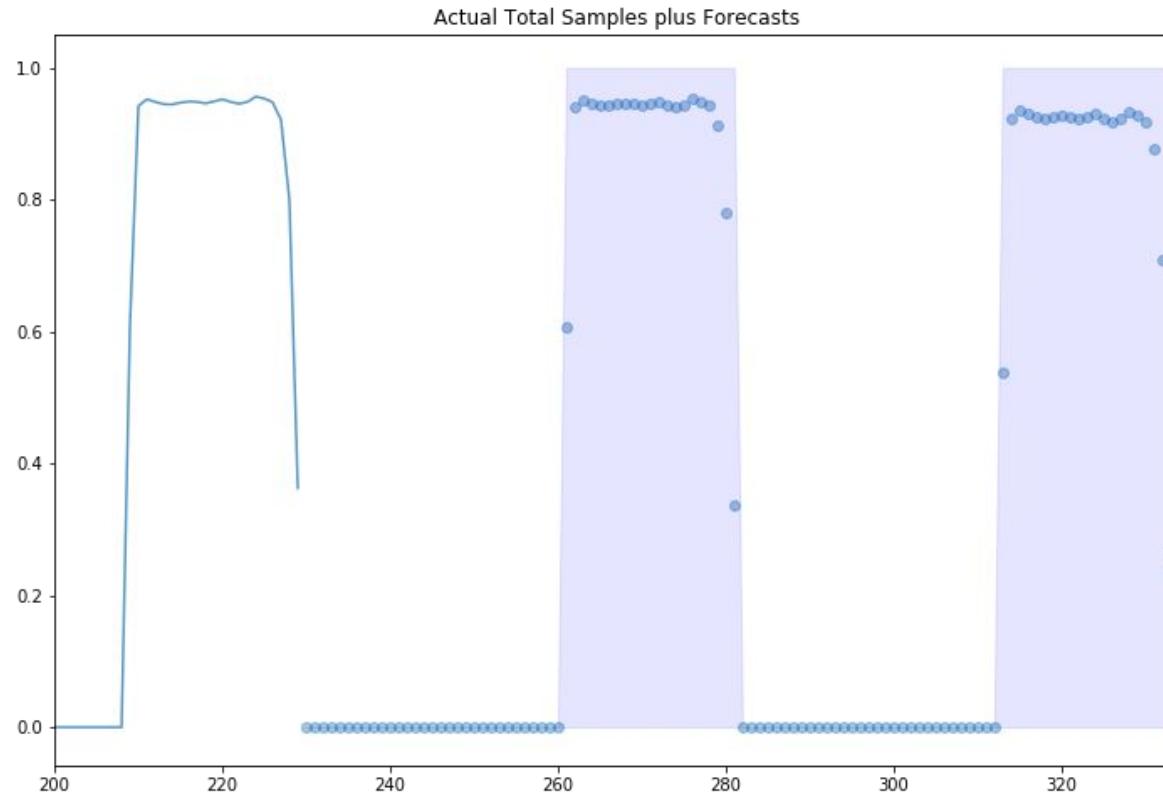
Actual vs. Forecasted Percentage of Sites Booked: Moraine



# Moraine

Rocky Mountain National Park

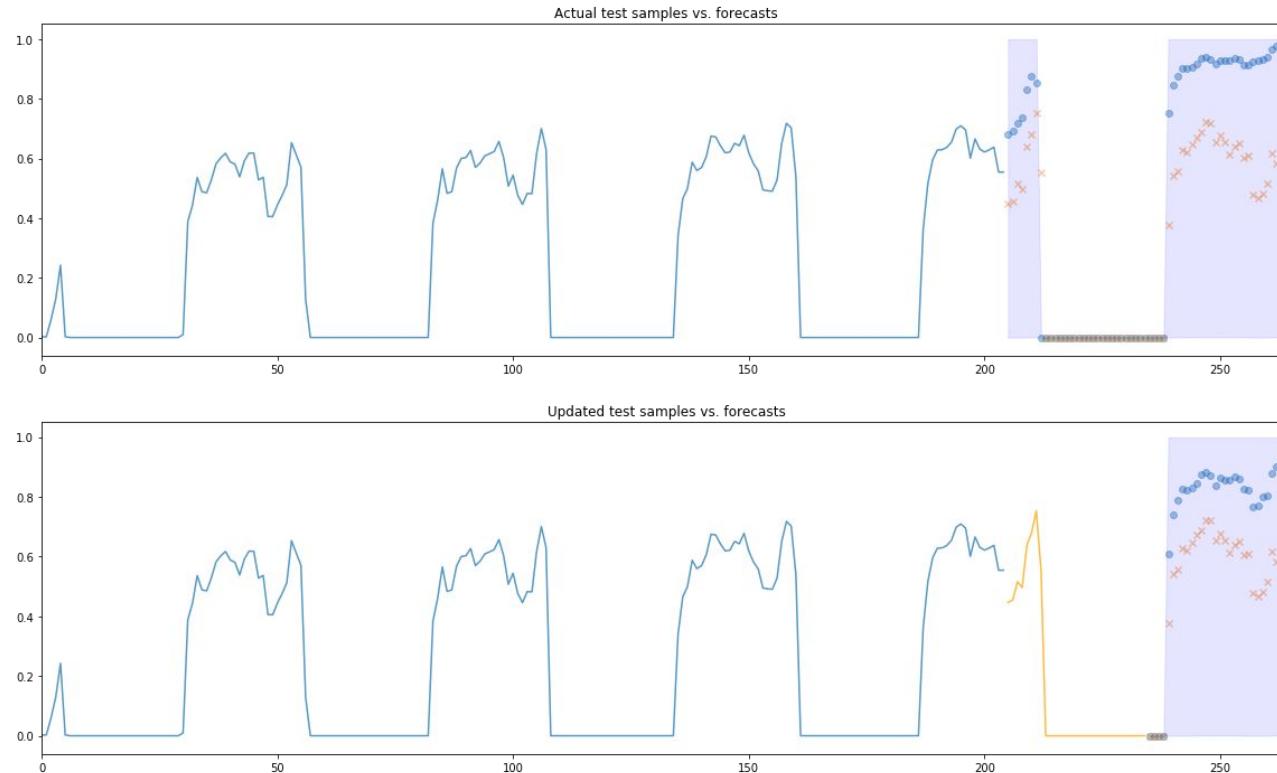
104 Week Forecast



# Big Meadows

Shenandoah National park

60 Week Forecast plus Updated Forecast



# Big Meadows

Shenandoah National park

60 Week Forecast

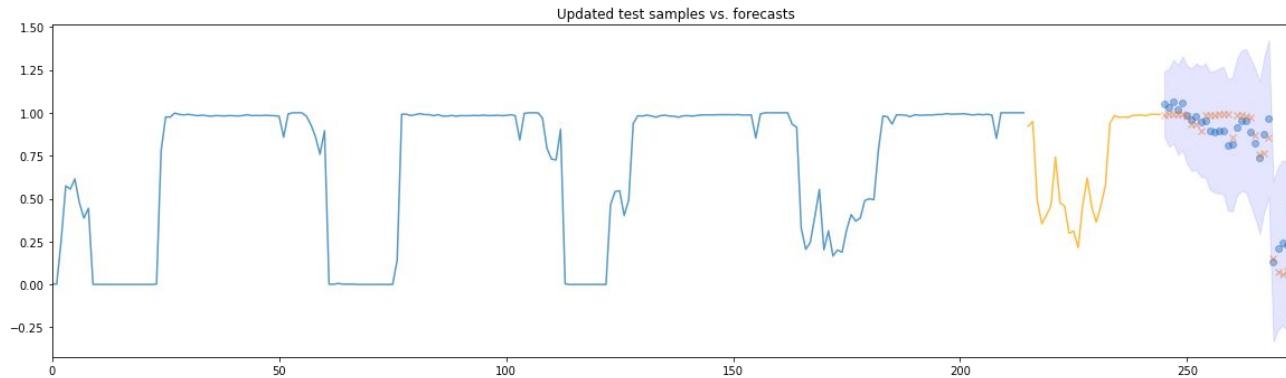
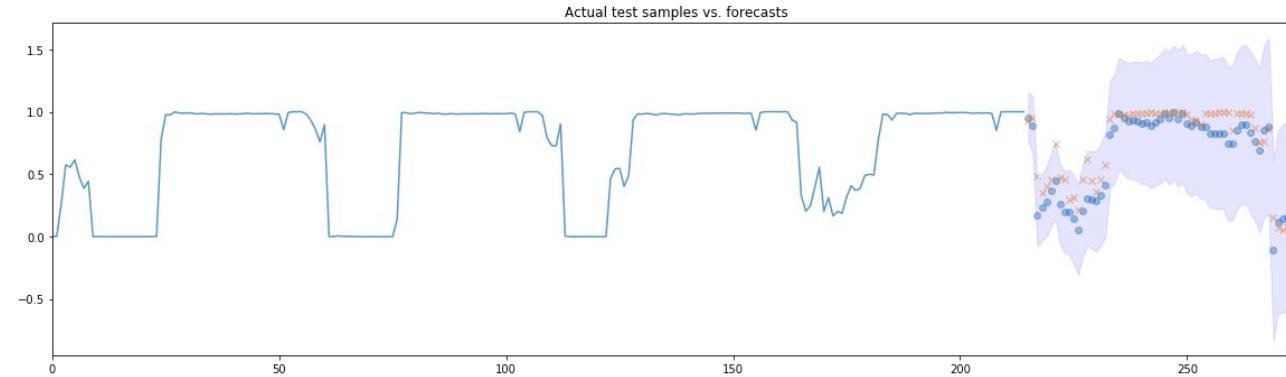
Actual vs. Forecasted Percentage of Sites Booked: Big Meadows



# Upper Pines

Yosemite National Park

60 Week Forecast plus Updated Forecast



# Upper Pines

Yosemite National Park

60 Week Forecast

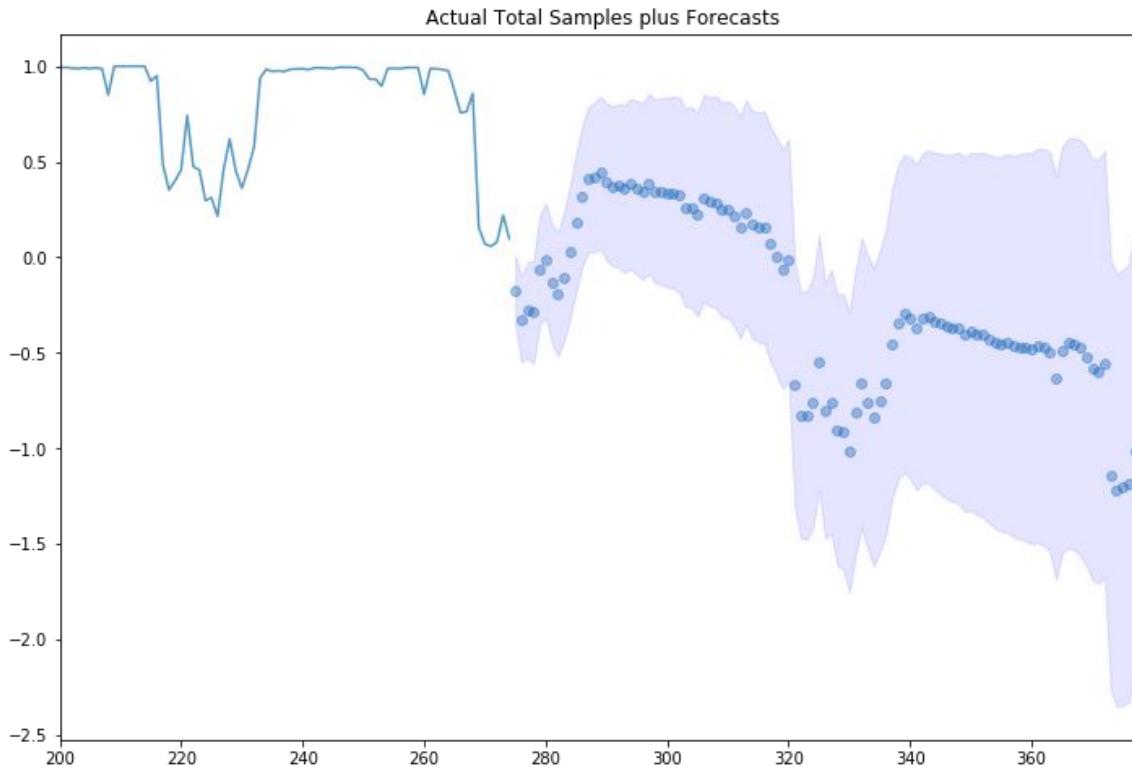
Actual vs. Forecasted Percentage of Sites Booked: Upper Pines



# Upper Pines

Yosemite National Park

104 Week Forecast



## What would I change?

- Another model combined with SARIMA could produce better results, had RNN and KNN time-series in the works
- Pay more attention to stationarity
- Deploy models to an easy-to-use platform, fitting five in a single notebook is cumbersome
- Integrate the saved data to the cloud (S3), share the aggregated dataset with the masses

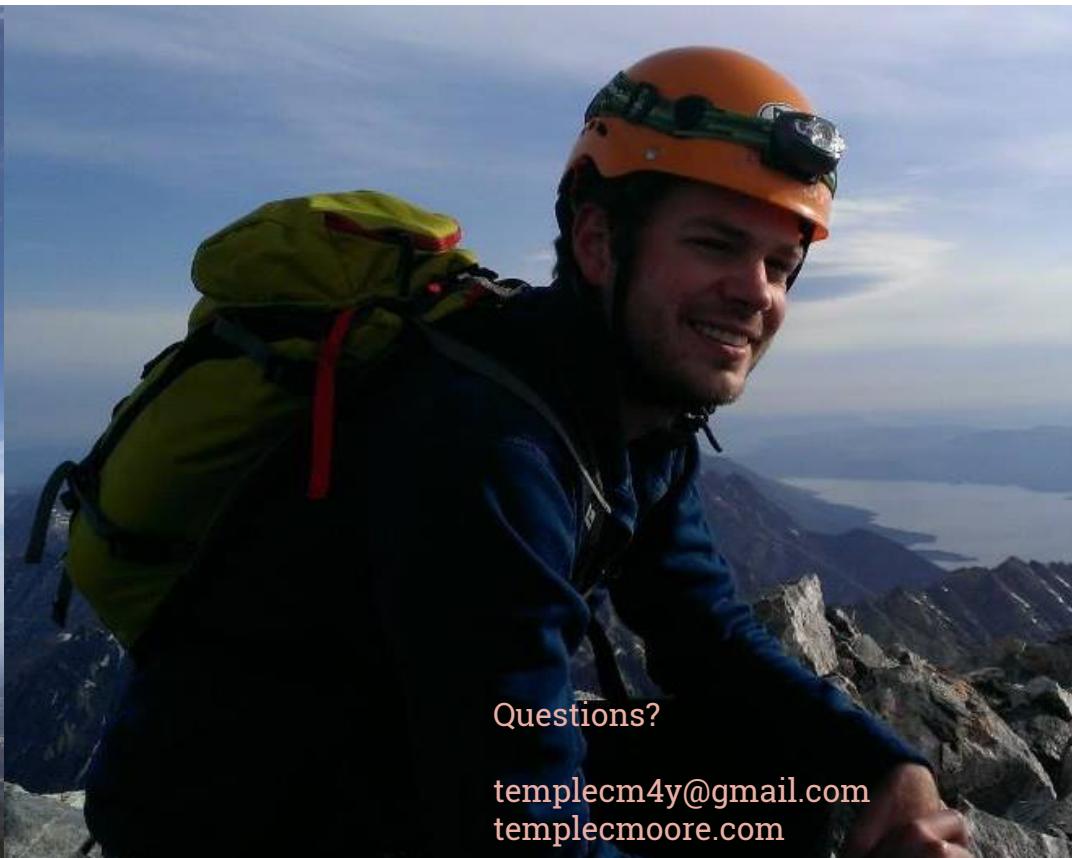




## CONCLUSIONS AND Recommendations

- With the exception of Big Meadows, I was able to accurately predict a 60 week forecast for each campground.
- These trends will continue under the services provided by the NPS.
- Higher park entry fee could slow down at-capacity or near capacity bookings for these campsites
- Congress and the Administration need to consider alternatives to slow down or limit the pressure put on these parks during their peak seasons.

# THANK YOU!



Questions?

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