Michigan Outdoor Recreation Summary

Outdoor recreation is important to many in Michigan and Michigan has many opportunities for outdoor recreation. Frequently, outdoor recreation is an economic driver supporting local businesses and providing employment. Michigan has Great Lakes and many other rivers and bodies of water. All but the southern portion of the Lower Peninsula is heavily forested with a lot of public land. Residents in the more populated southern Michigan also have access to public parks. Michigan residents participate in many forms of outdoor recreation including atving, boating, camping, fishing, hiking, kayaking, rving, hunting, skiing, and snowmobiling.

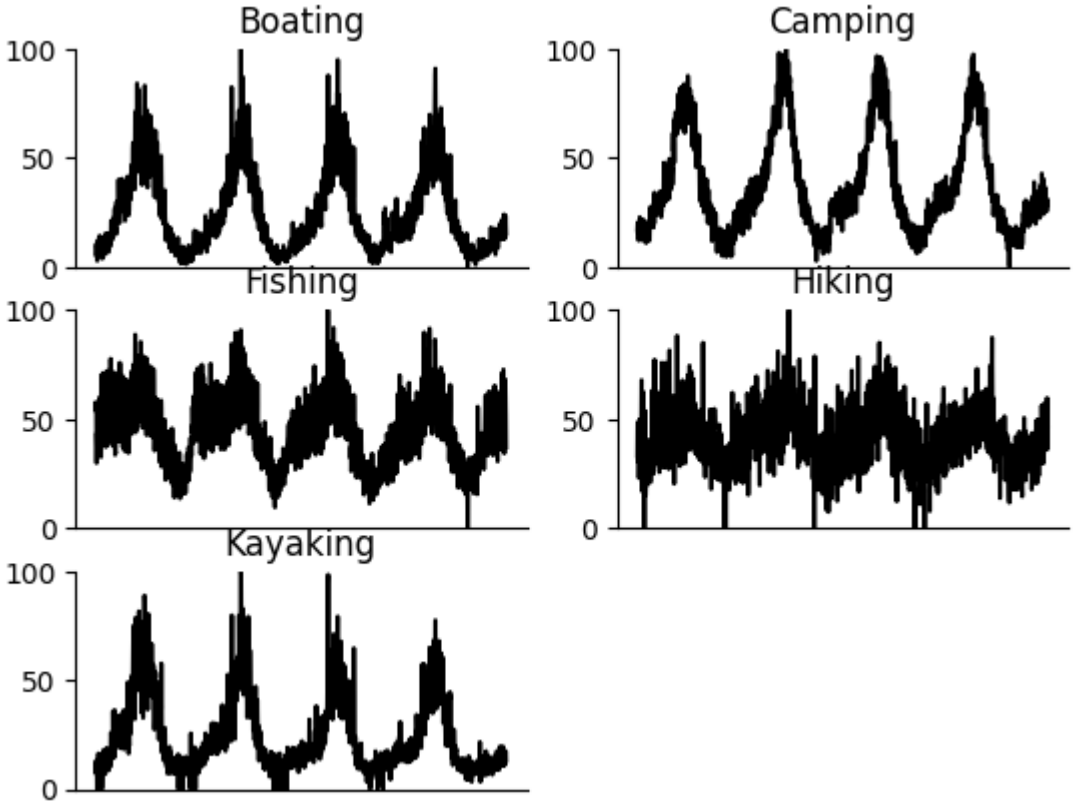
Given the importance of Michigan outdoor recreation, I decided to investigate trends in search interest for these ten activities. Google provides search interest data for just about any search term through Google trends. I access Google trends using the pytrends python package. For search terms, I use the base word and present participle form (i.e. atv and atving). I use data for years after 2020. My general assumption is that when a term is being searched more then there is more interest in that form of outdoor recreation in general.

This is a companion project to my Northern Michigan Search Interest Project. A lot of the interest for places in Northern Michigan is due to outdoor recreation and outdoor recreation based tourism. The Northern Michigan project forecasts monthly search interest for three months for over 200 Northern Michigan places. The goal of this project is to forecast daily search interest for outdoor recreation for two weeks.

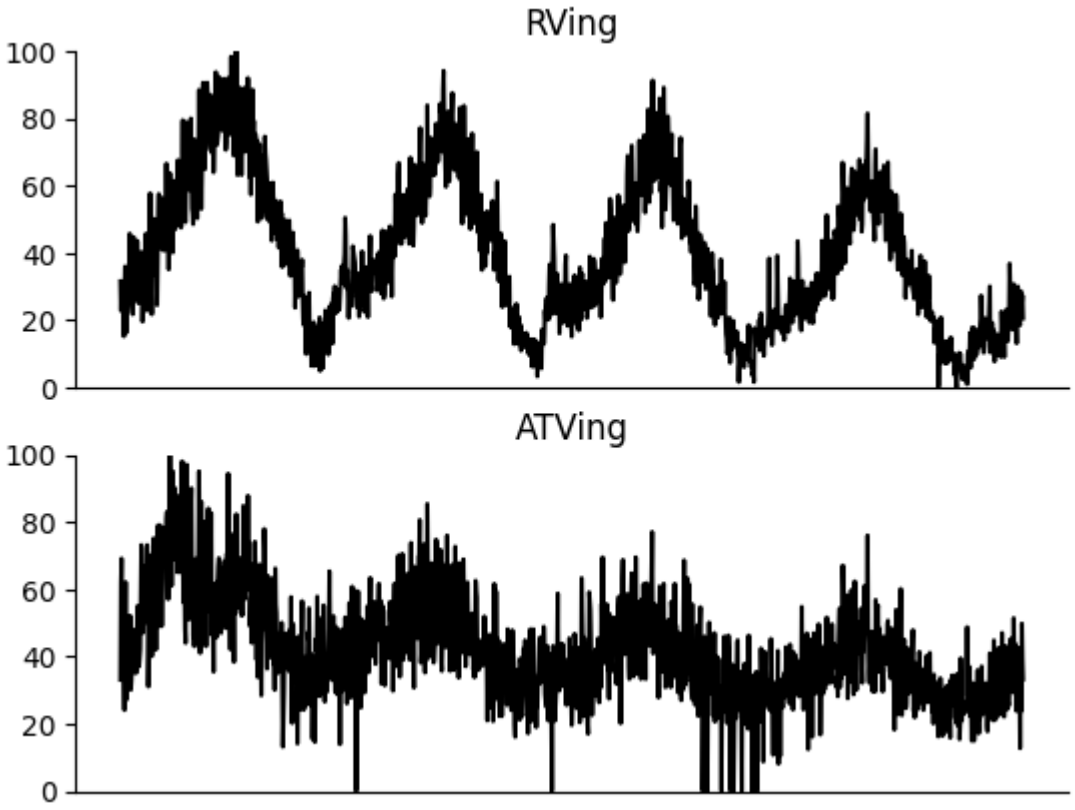
Past Trends

Outdoor recreation has experienced quite a few changes in the last few years. During the COVID-19 pandemic of 2020, there was both renewed interest in outdoor recreation and restricted access to engage in those activities far from home due to lockdowns. There was also considerable government money provided to the public that was used to buy various outdoor recreation related products. Since 2020, some forms of outdoor recreation have declined in interest while others have stayed the same.

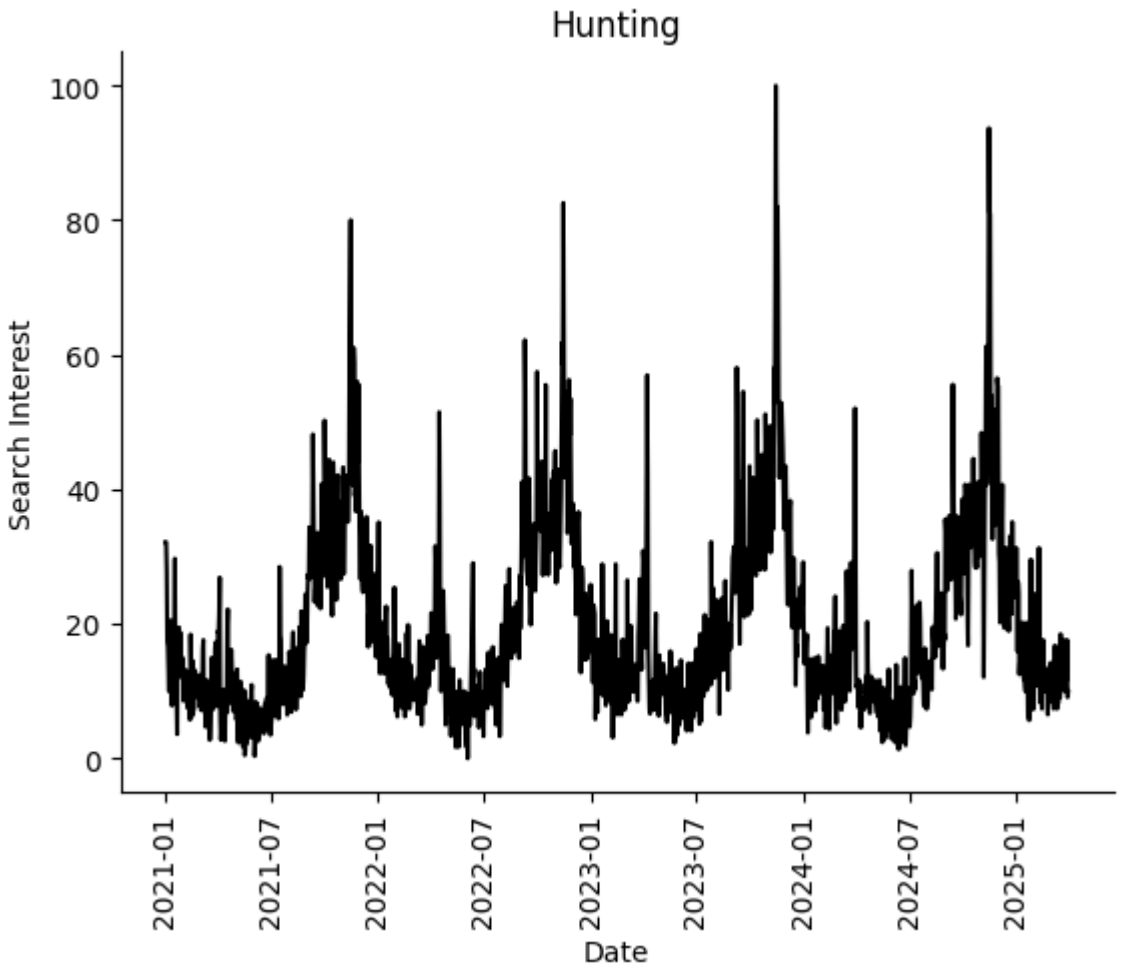
Search interest for many forms of outdoor recreation have stayed relatively similar since the pandemic: boating, camping, fishing, hiking, and kayaking. Note that these activities are both popular and all, except for perhaps boating, shouldn't require huge financial expenditures to engage in.



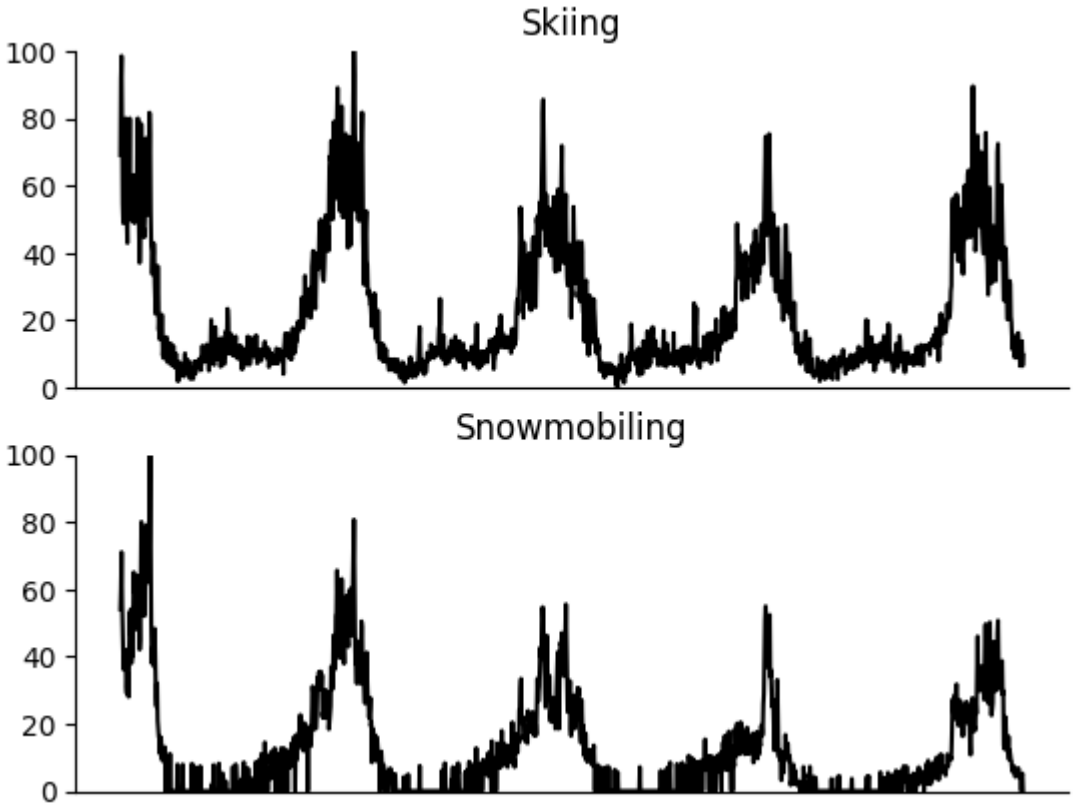
Two forms of outdoor recreation have decreased since 2020, specifically RVing and ATVing. These items require large ticket purchases which made them popular during and after the COVID-19 pandemic. Popularity for these outdoor activities have declined perhaps with the availability of free government money.



One form of outdoor recreation has increased in popularity in recent years, at least slightly--hunting. The Michigan Department of Natural Resources has gone to considerable lengths to promote deer hunting in recent years further liberalizing deer hunting regulations. This is due to what some feel is an overpopulation of the deer herd and reduced hunter harvest.



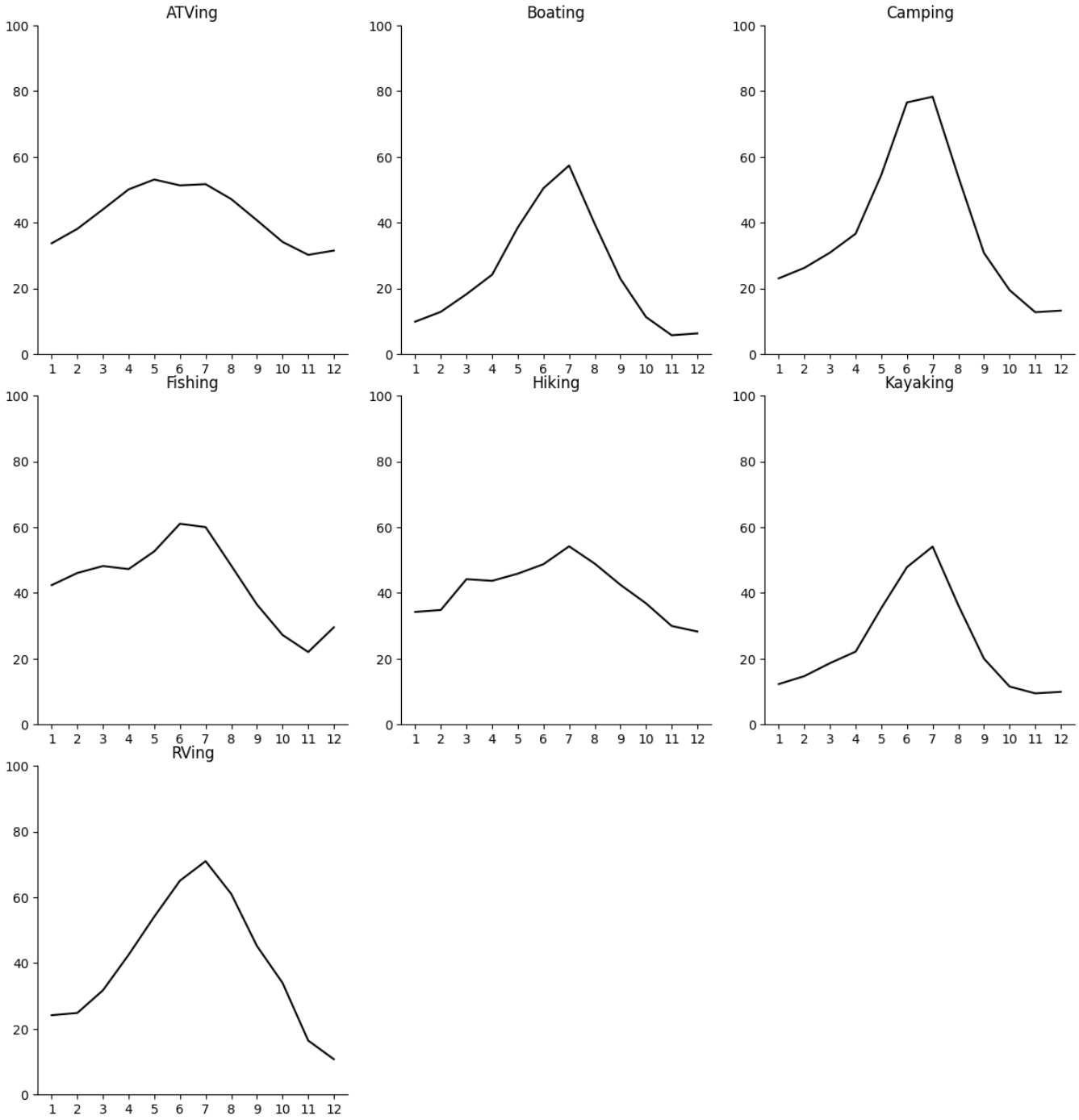
Finally, two forms of outdoor recreation are highly dependent on annual weather, specifically skiing and snowmobiling. Generally, these outdoor sports appear to be declining, in general. This is especially the case for snowmobiling which, like atving, requires a large ticket purchase to participate in. During the winter 2023/2024, there was very little snowfall. This led to much lower search interest, especially when you exclude the spikes related to the few weeks with considerable snow.



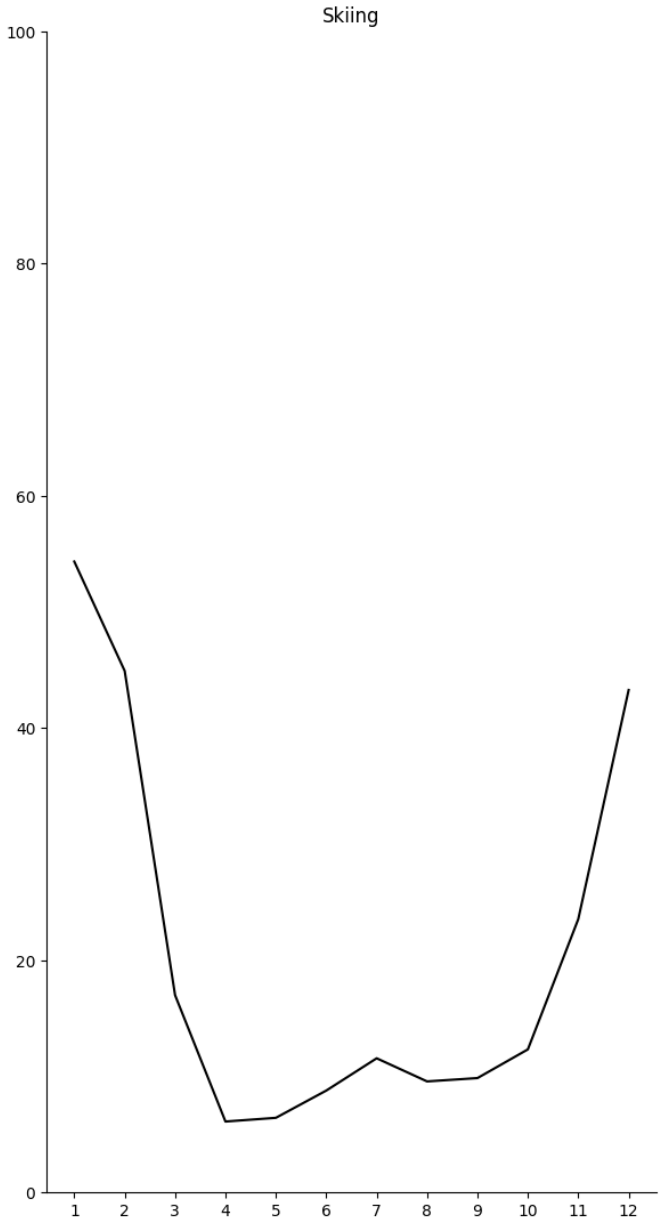
Seasonality

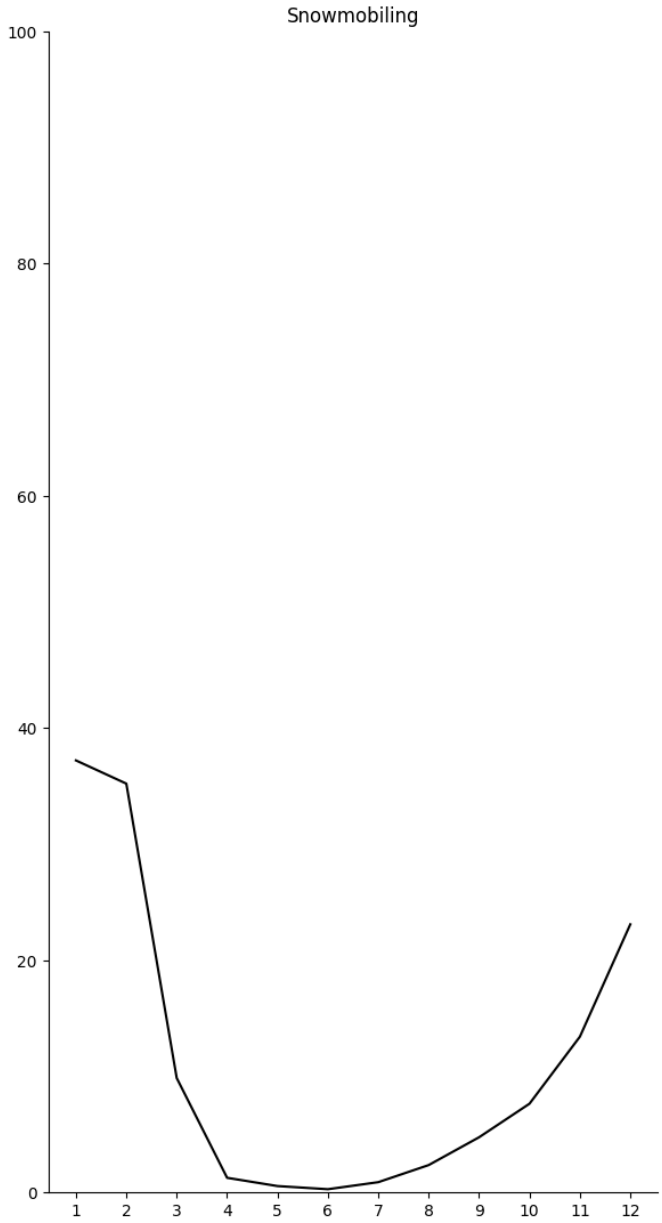
Given a quick look at the charts above, it's obvious that search interest for all forms of outdoor recreation follow a cyclical pattern due to seasonality. This means that search interest for outdoor recreation increases during certain times of the calendar, expecially certain times of year.

Most forms of outdoor recreation are popular during the summer: atving, boating, camping, fishing, hiking, kayaking, and rving. Warm weather months are more comfortable outdoors. Note that fishing also has a smaller peak of search interest during the winter due to ice fishing. ATVing and hiking show more interest year around. However, boating, camping, kayaking, and RVing show very prononounced search interest during the summer. In the charts below, numbers 1-12 refer to months January to December.

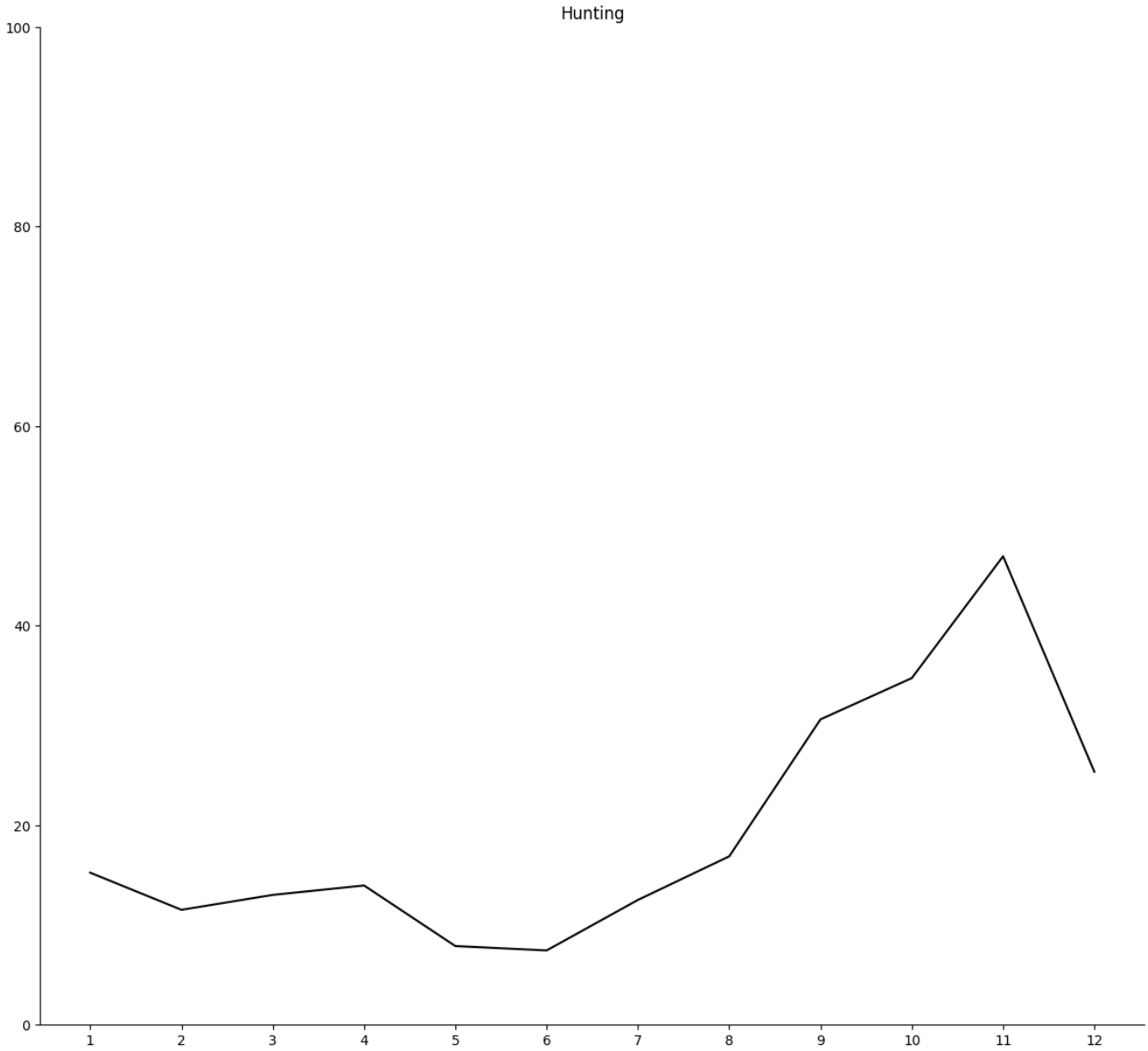


Two forms of outdoor recreation are most popular durign the winter: skiing and snowmobiling. Both of these activities require snow which mostly occurs from January to March in Michigan. However, some search interest should be expected November and December when some snowfall occurs and people prepare for the season.

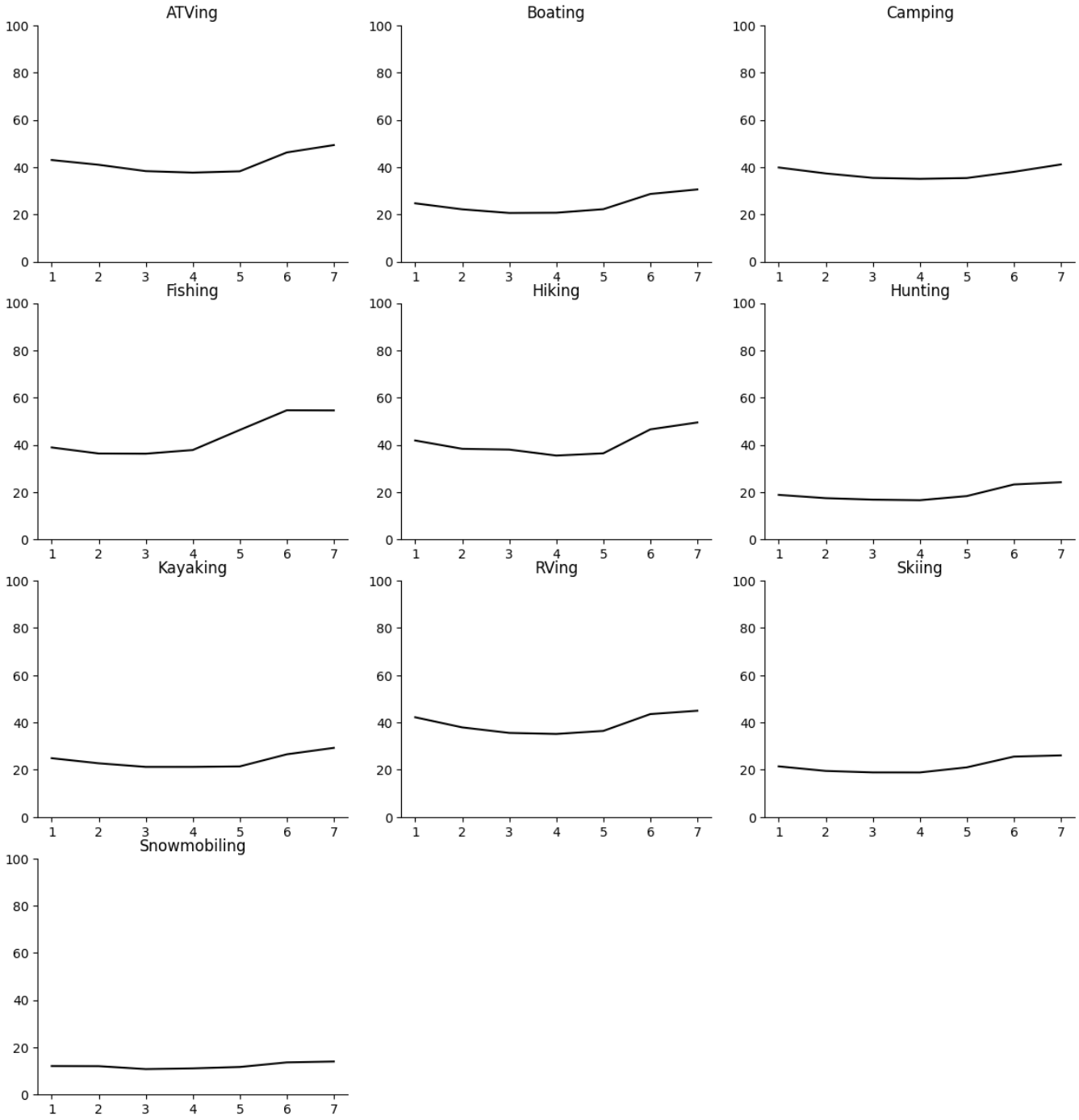




Finally, hunting is most popular in the fall during hunting season and, secondarily, in the spring during turkey hunting season. Note that firearm deer season is in November.



Given that we are using daily data, we can also look at search interest within each week. In the charts below, Sunday is Day 1 and Saturday is Day 7. For every form of outdoor recreation, search interest increases at the end of the week. Some forms of outdoor recreation exhibit this pattern more than others. Search interest increases near the weekend because more people have time off to engage in extra-curricular activities and are making their plans.



Weather

Weather is a key driver of interest in outdoor recreation. Generally, when weather is more comfortable people are more interested in being outdoors. However, in some cases, less comfortable weather might be more desirable for a specific sport.

A lot of the relationship between outdoor recreation and weather is seasonal as, in Michigan, average weather changes the most due to seasonal fluctuations. This can be seen in the large seasonality in search interest above, which is mostly driven by weather patterns.

Search interest is also driven by unseasonal weather. For instance, a winter with exceptionally little snow may have limited interest in snow sports. A cold rainy weekend may have limited interest in boating.

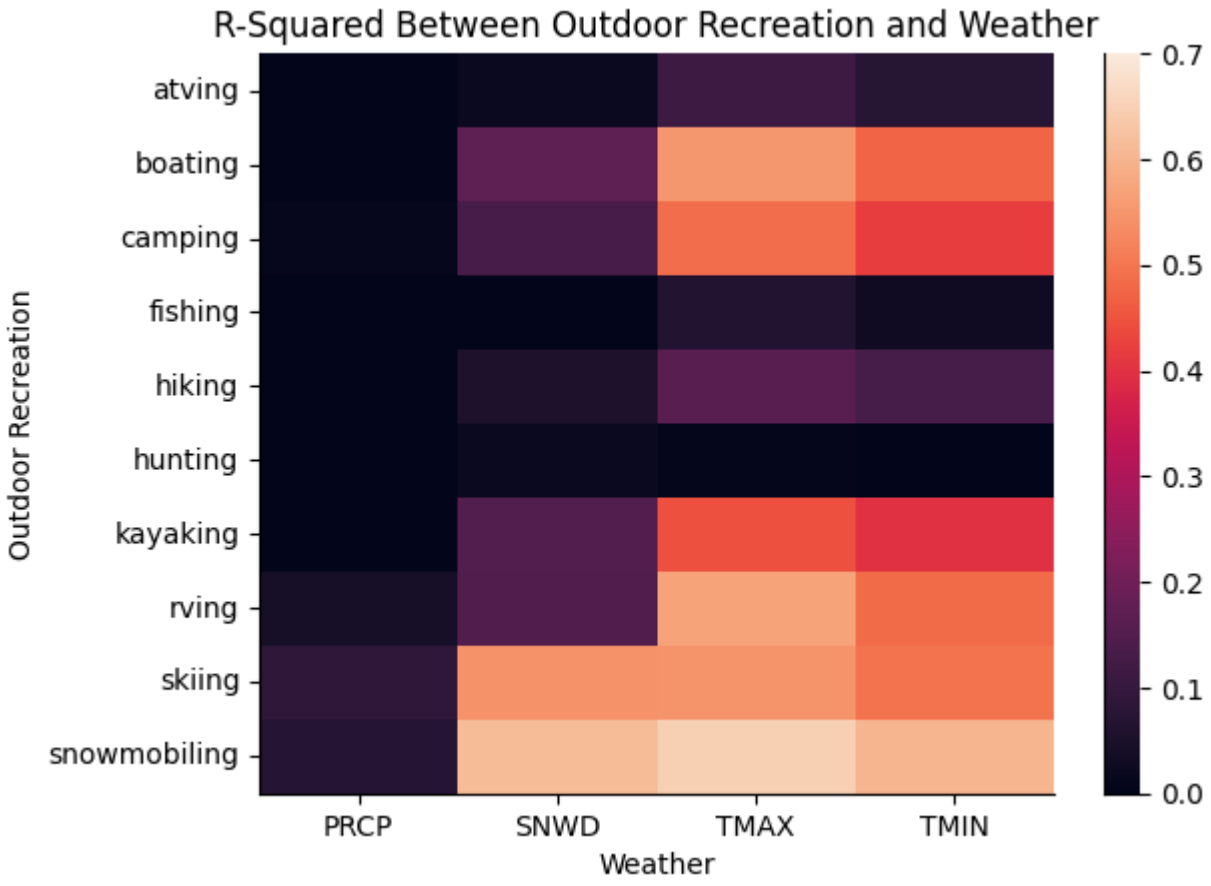
However, there may be limits to what extent daily weather captures the real impact on interest in outdoor recreation. For instance, people may be searching for camping due to favorable weather this weekend or next month, not necessarily the same day they are searching. Further, a rainy day may cause people to sit at home and search for kayaks more despite not actually engaging in kayaking on a rainy day. Despite the limitations of daily weather data capturing the true influence on interest, it is still a valuable predictor.

The chart below shows the R-Squared between search interest for various forms of outdoor recreation and average weather accross Michigan. R-Squared is a statistical measure between 0 and 1 with numbers near 1 showing a high association between two variables where most of the variation in search interest is explained by the weather variable..

Precipitation shows the lowest R-Squared with all forms of outdoor recreation. This is partly because precipitation has the lowest seasonal variation. Precipitation also tends to vary the most accross Michigan with precipitation in one place not necessarily impacting where a person lives or where the person intends to engage in outdoor recreation. This also suggests that a lot of search interest is not related to people engaging in that activity on the same day, as many would not want to engage in these activities while it's raining.

Snow depth only shows a high R-Squared with skiing and snowmobiling which are popular during times of high snow depth.

Temperature generally shows the highest R-Squared with outdoor recreation, especially for boating, camping, kayaking, rving, skiing, and snowmobiling. This is partly because temperature shows a high degree of seasonal variation. Temperature R-Squared is still relatively low for atving, fishing, hiking, and hunting. Fishing occurs during both summer and winter and temperature preferences are opposite for the two different seasons. Hunting occurs in the fall and spring and, consequently, is least popular in both hot and cold temperatures. ATVing and hiking tend to occur year around often in spite of temperatures.



Forecasting Search Interest

I created two different models to forecast search interest for outdoor recreation.

My first approach is more traditional and relies heavily on decomposition of the time series variation. First I account for aspects of the data such as trend, seasonality, and inacuracy of the data (note that Google trends data is generally inacurate specifically suffering from sampling error every time you pull the data). In this project, I account for these aspects in the data series using a Hankel matrix.

Once I account for trend, seasonality, and inacuracy, I account for the remaining variation, or what is known as residual variation. For this stage, I use a Vector Autoregressive model (VAR) with exogenous covariates. The VAR is essentially a linear regression which allows input from lagged values of the same series (so yesterday's value of camping influence todays values), other series (so yesterday's value of hiking can influence today's values of camping), and contempraneous weather variables. Which variables were chosen was based on statistical significance tests.

This method was chosen to model for three forms of outdoor recreation: ATVing, boating, and camping. For more information on this method, please see Installment 6 for this project.

https://dataandoutdoors.com/michigan-outdoor-recreation-search-interest-installment-6/

For forecasting the other seven forms of outdoor recreation, I chose the Long Short Term Memory (LSTM) model. This approach makes no attempt to manually segment time series variation and instead uses a neural network to learn patterns in the data. The LSTM considers not only the data values at one specific time, but jointly considers the recent sequence of the data values. It also considers a state which is update accross time, such that the model can be presented with the exact same information and make different predictions based on this state. For more information on this method, please see Installment 7 for this project.

https://dataandoutdoors.com/michigan-outdoor-recreation-installment-7/

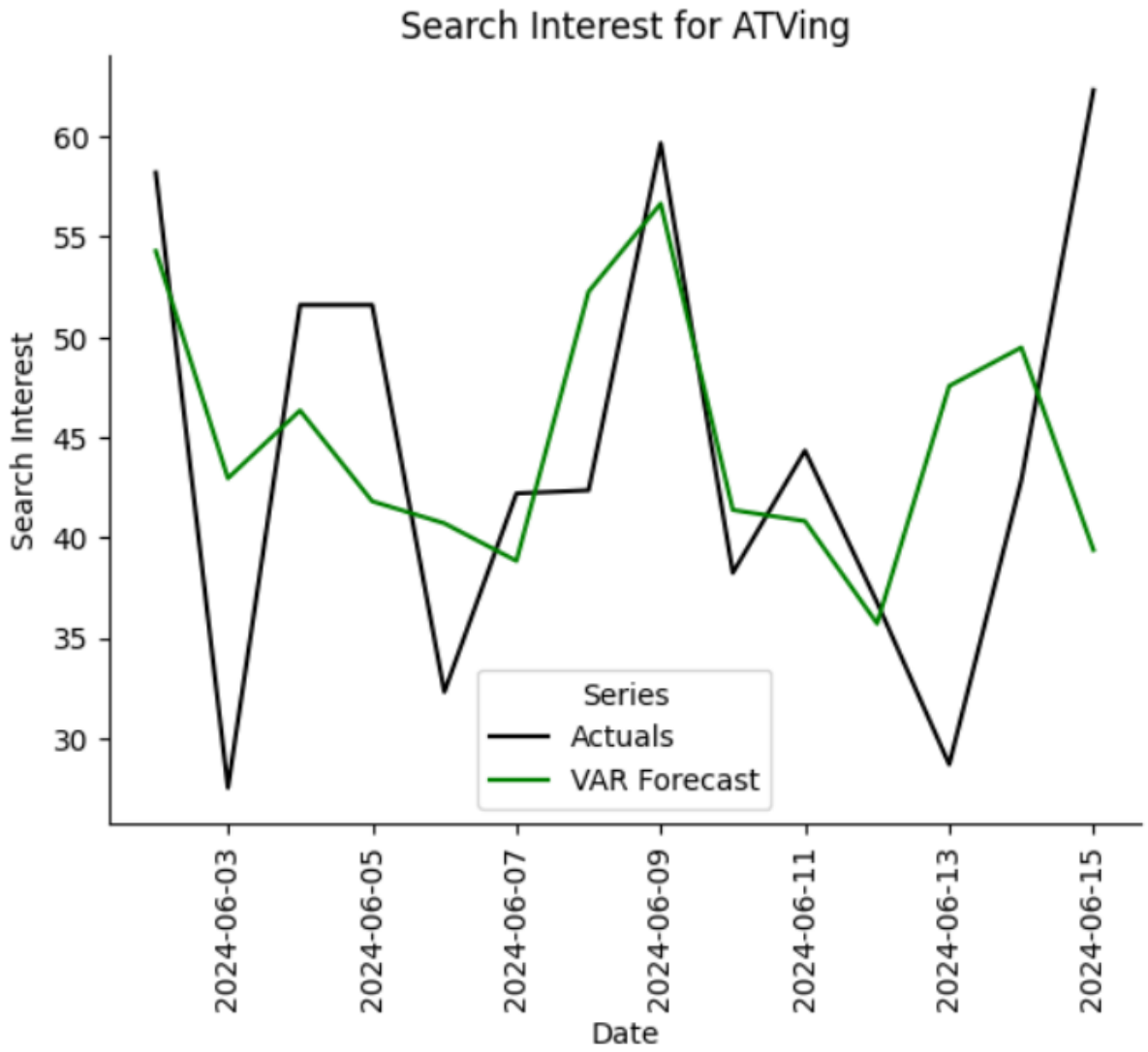
Example Forecasts

For illustrative purposes, I'm providing the following example forecasts for the 10 forms of outdoor recreation. These forecasts are given for various 14 day periods in 2024. The results of a single forecast should not be considered representative of the model performance in all periods. In each case, the chosen model was based on average prediction performance over a considerable period of time. Please see the link below for Installment 9 where this evaluation was performed. Nonetheless, these examples provide a graphical representation of how a forecast might look. In the future, these forecasts can be provided on a frequent basis.

https://dataandoutdoors.com/michigan-outdoor-recreation-installment-9/

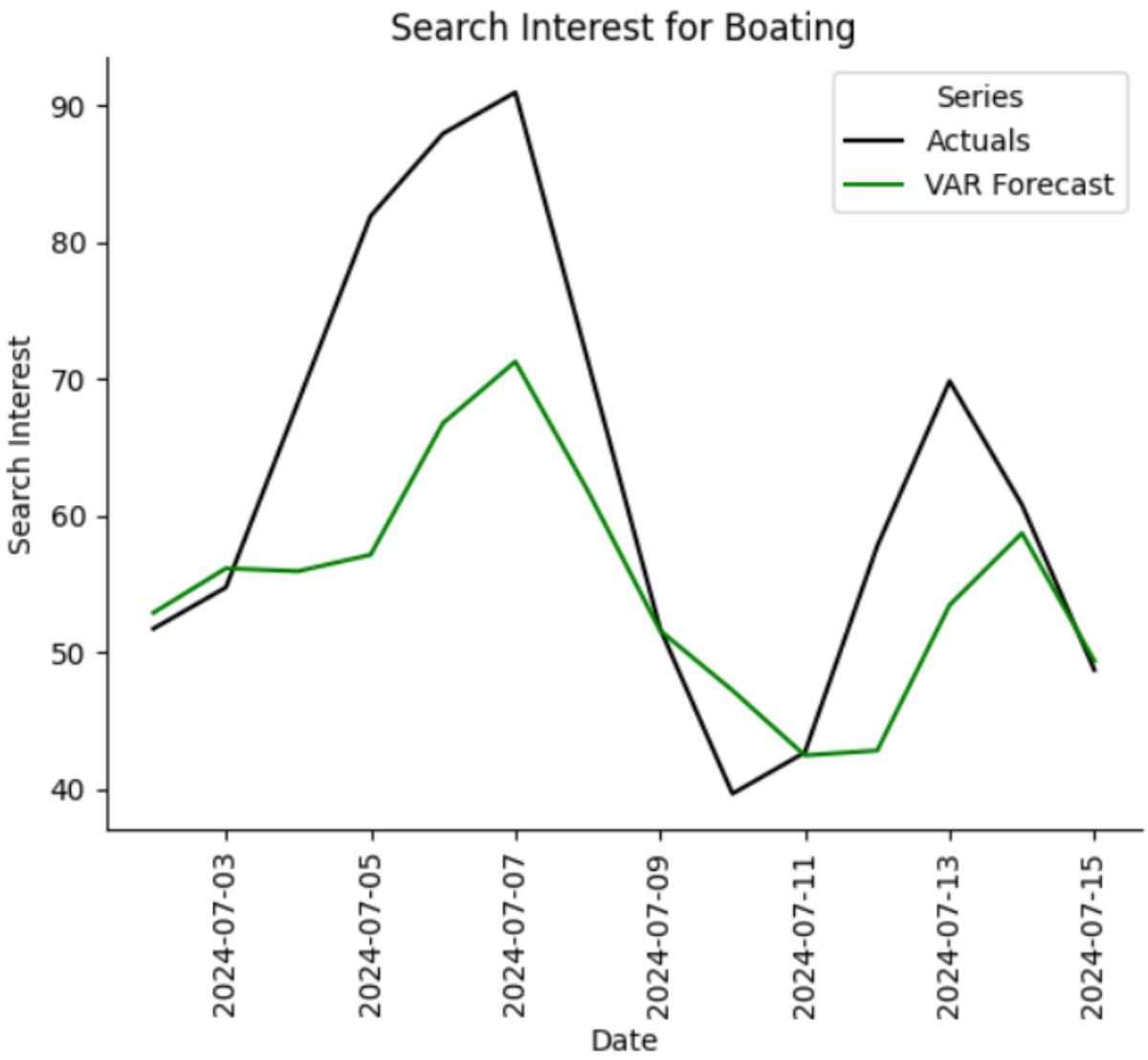
ATVing

For ATVing, I forecast the first week of June 2024. The actual series is highly variant. However, the Hankel/VAR model captures the general level of search interest and the peak seen on June 9. This model considers trend and seasonality in addition to the lagged values of ATVing, fishing, and kayaking. Weather is not considered by the model.



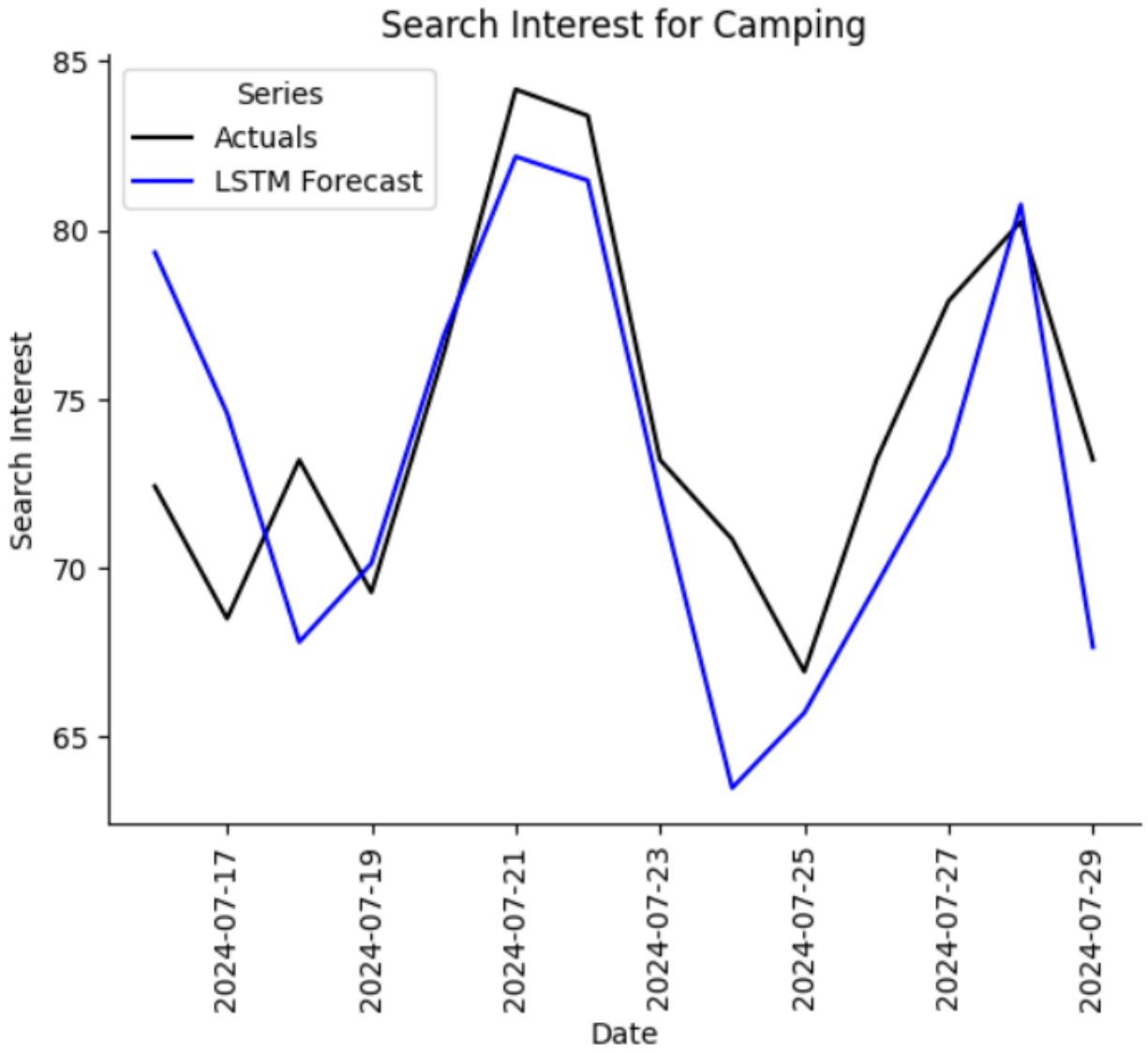
Boating

For boating, I forecast the first week of July 2024, which includes the 4th of July holiday. The model for boating is the Hankel/VAR model. This model considers trend and seasonality along with lagged boating, lagged kayaking, and the weather variables for maximum temperature and precipitation. The model captures the general fluctuation of boating during this time period, but not to the correct amplitude. Unlike the LSTM model, the boating model does not include variables for holidays.



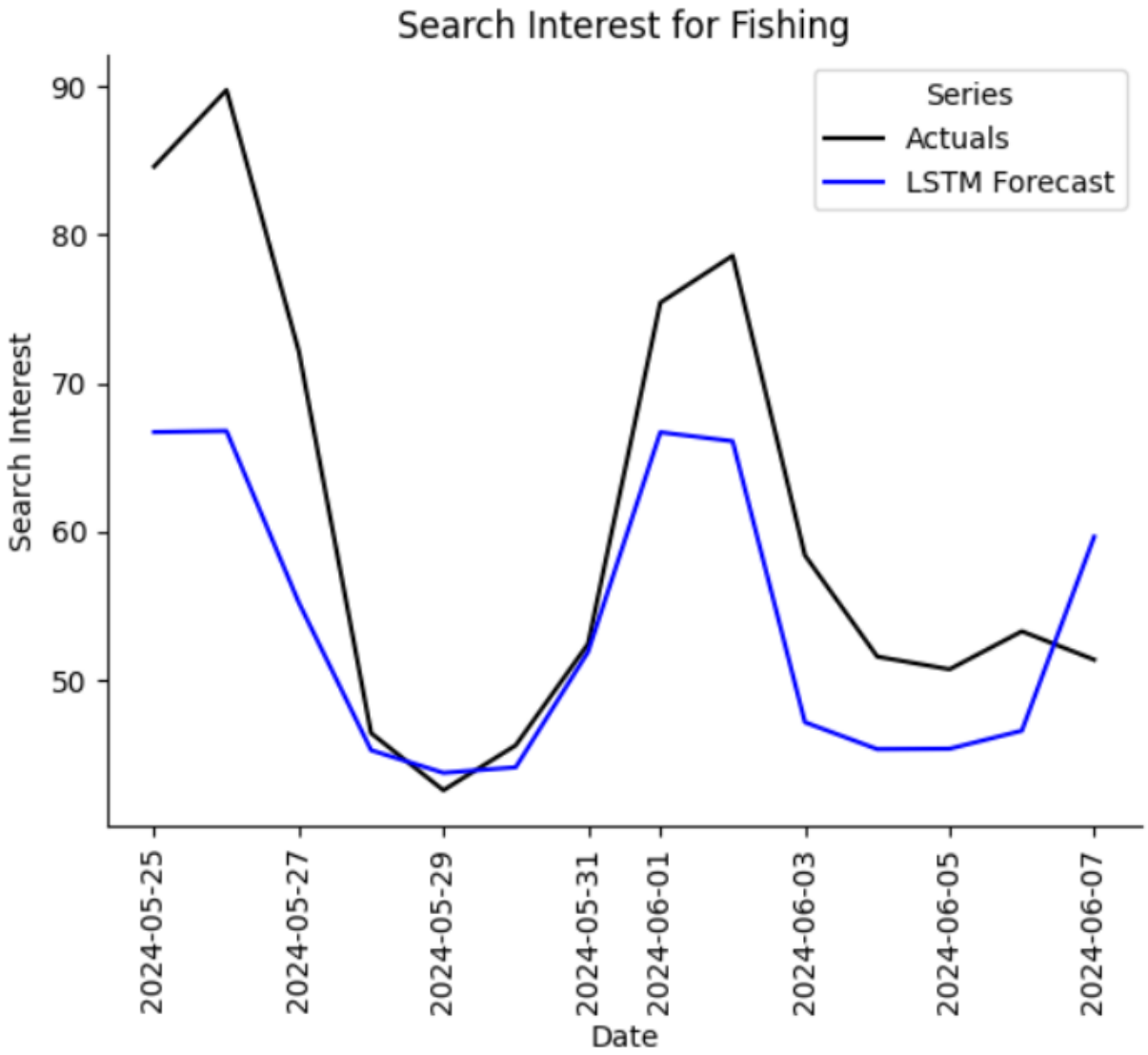
Camping

For camping I forecast the second half of July 2024. The LSTM model is chosen for camping. The forecast accurately captures the actuals, particularly after the first few days of the forecast.



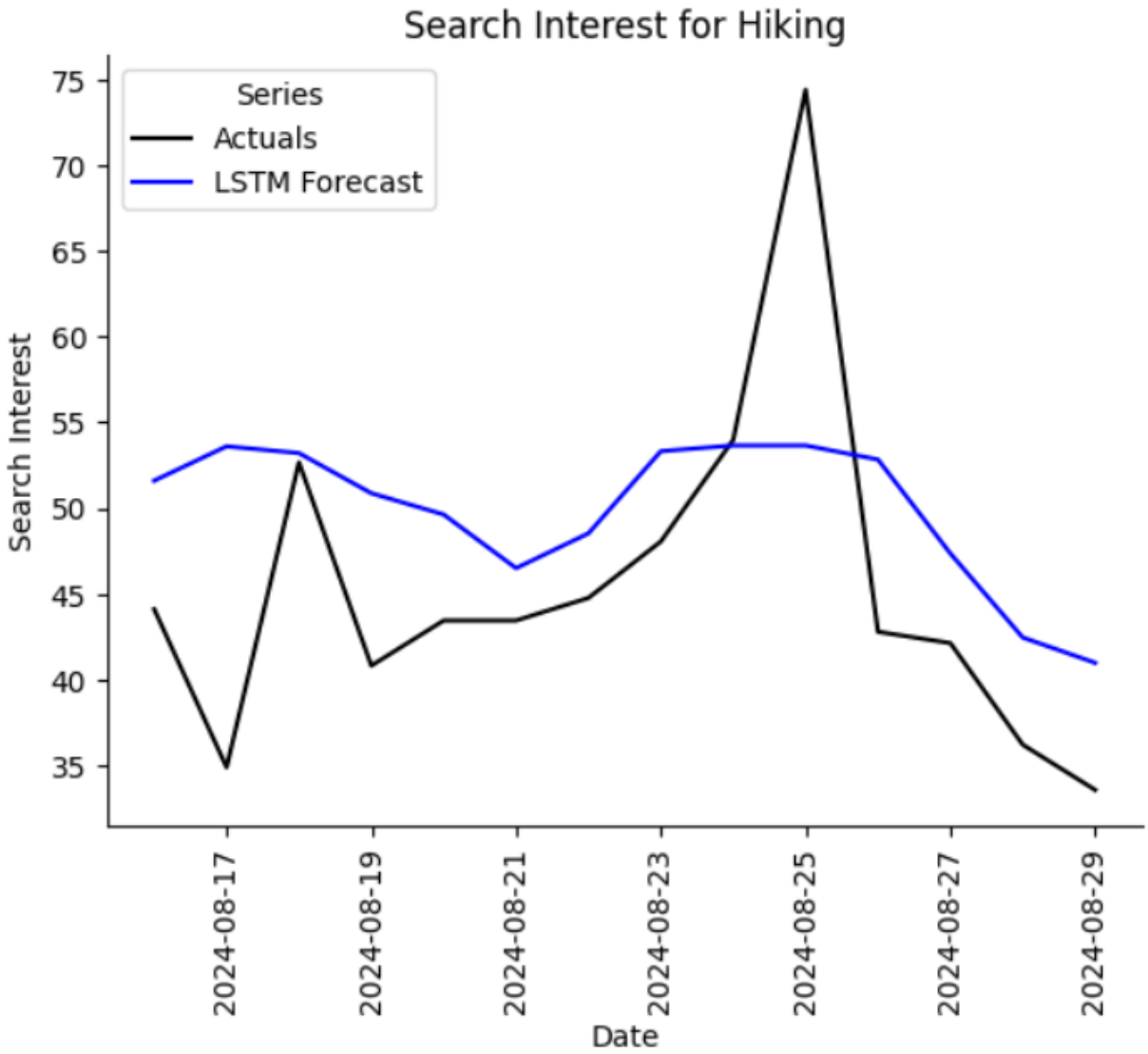
Fishing

For fishing I look at a forecast starting before Memorial Day and the start of bass fishing season 2024. The LSTM model is chosen for fishing. The model captures the general variation of the actuals without capturing the full amplitude of the peaks, despite accounting for the holiday weekend.



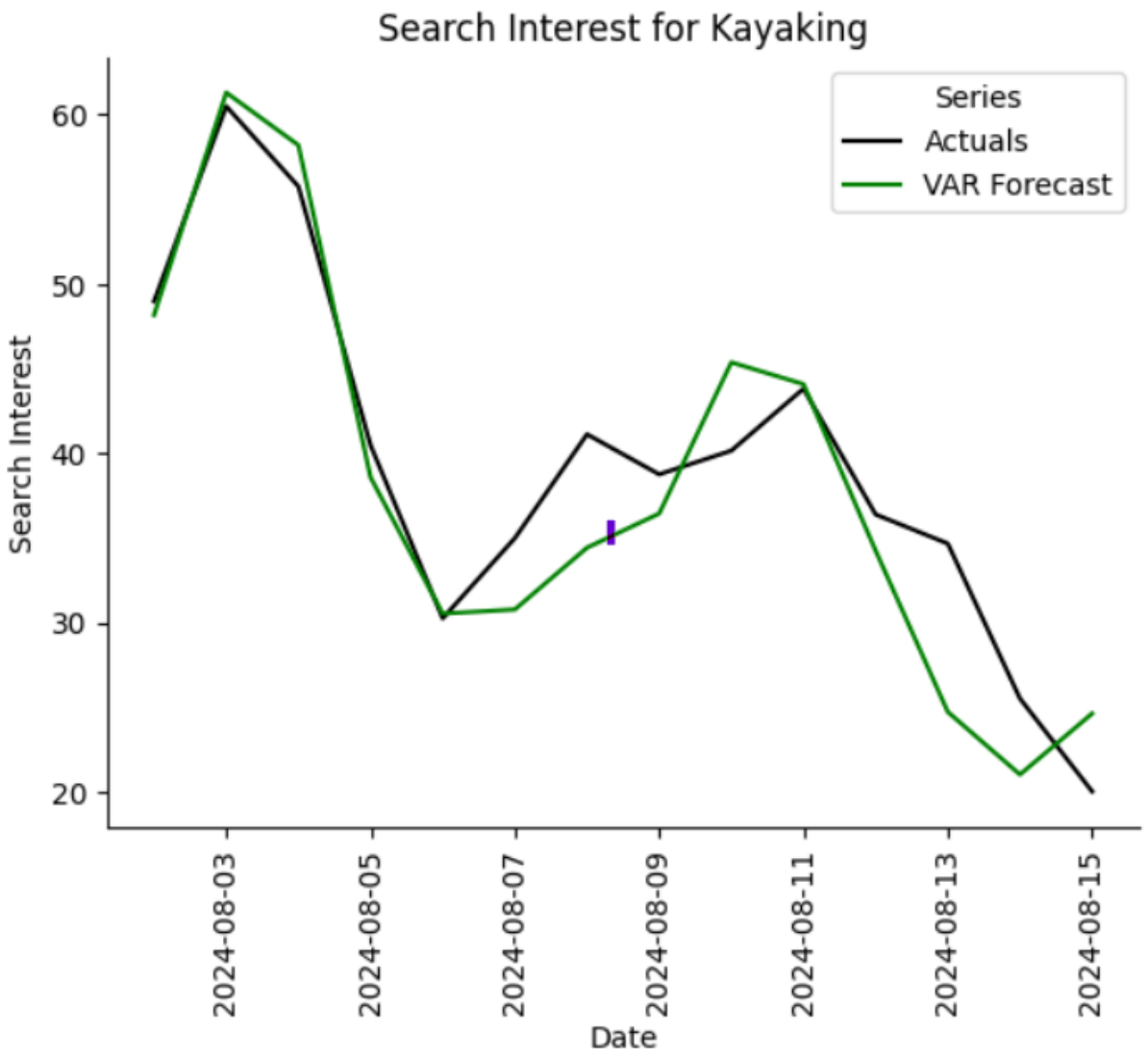
Hiking

Hiking is forecasted starting July 15. The LSTM model is chosen for hiking. For this time period, the model captures the general level of search interest but not much of the variation.



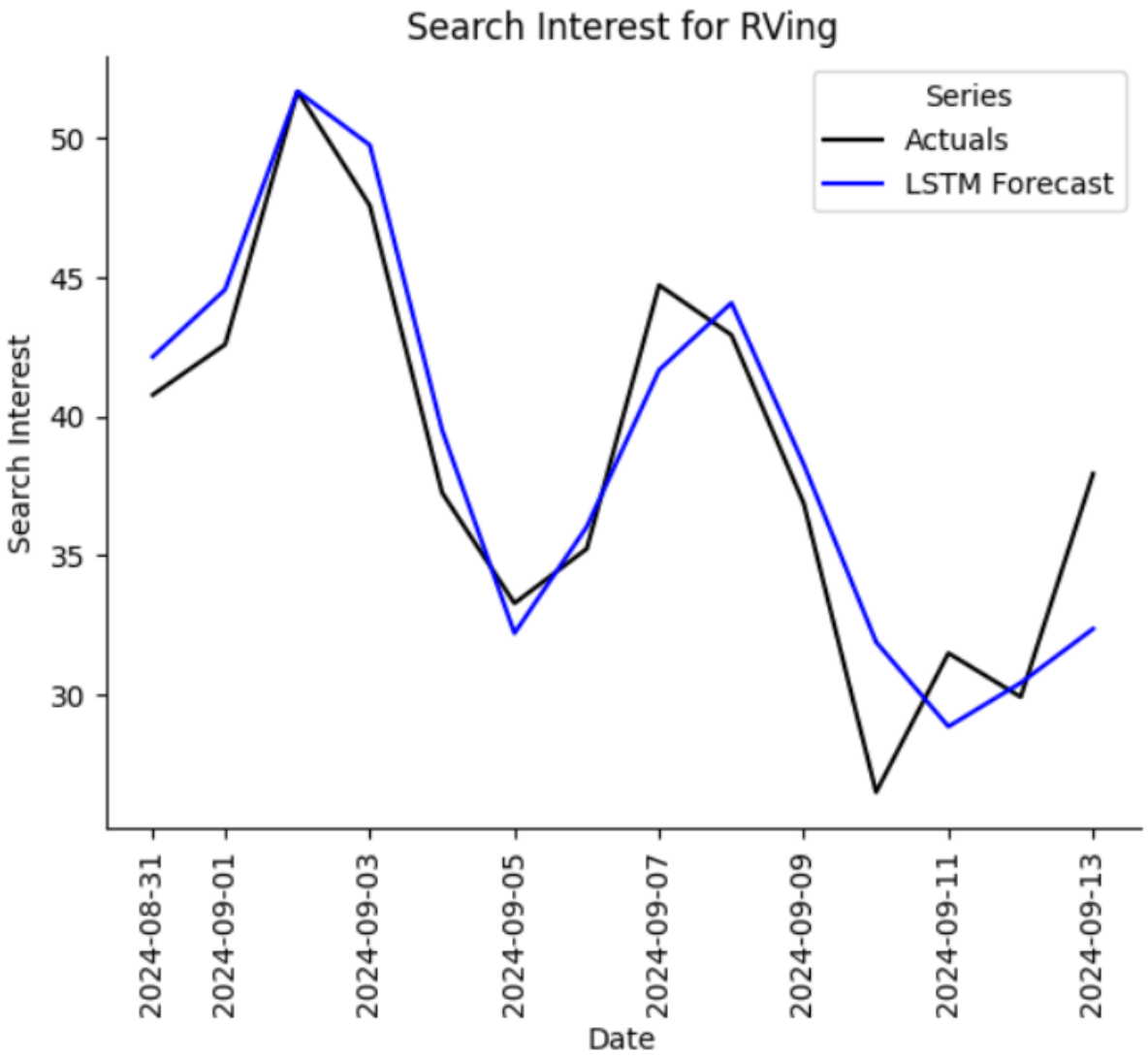
Kayaking

I provide a forecast for kayaking starting August 1, 2024. The VAR network is chosen for kayaking which accounts for trend and seasonality in addition to the weather variable precipitation. This model is very close to actuals during this time period.



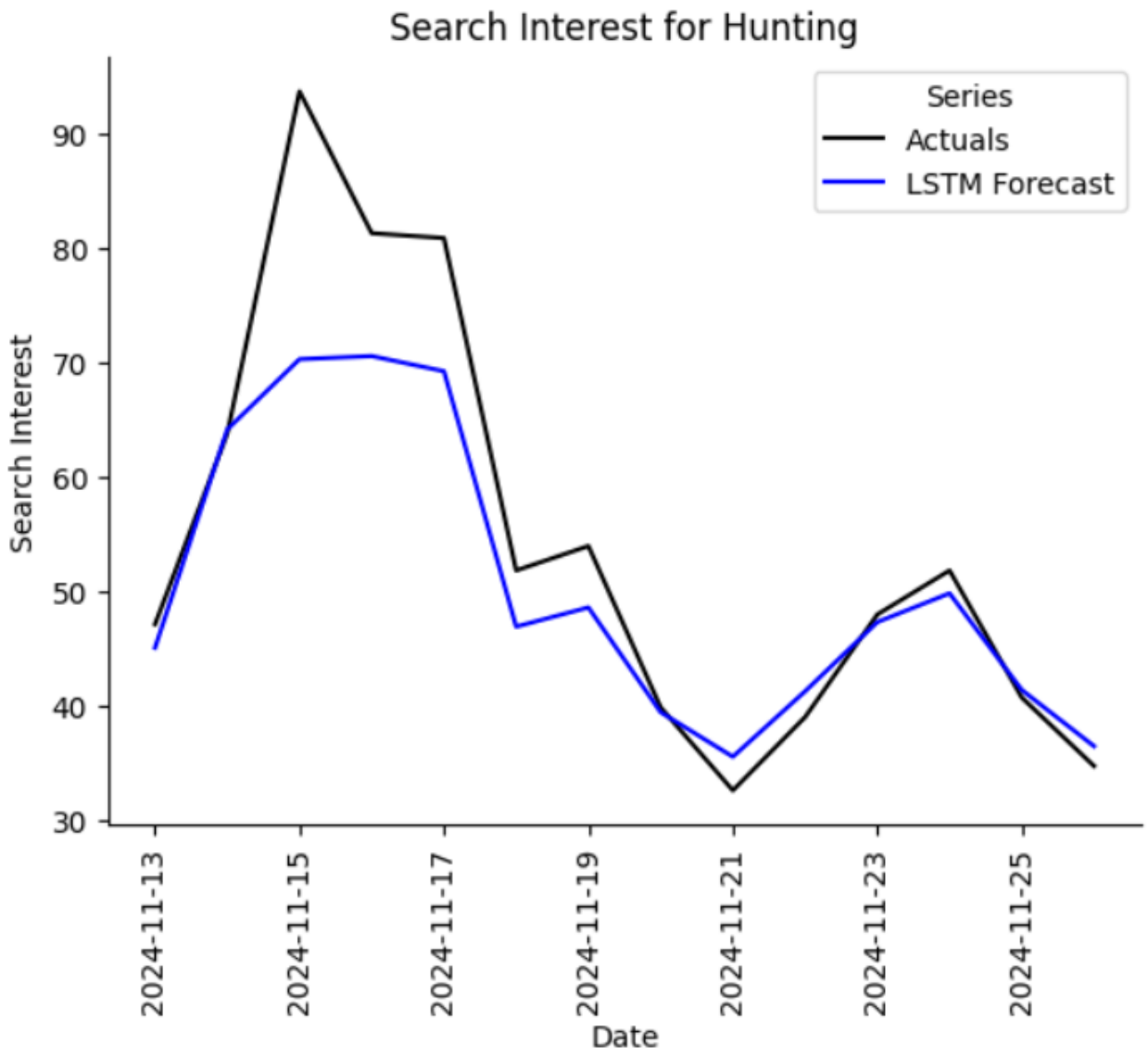
RVing

My forecast for RVing is over Labor Day weekend 2024. The LSTM model is chosen for RVing and the model forecast is close to actuals during this time period.



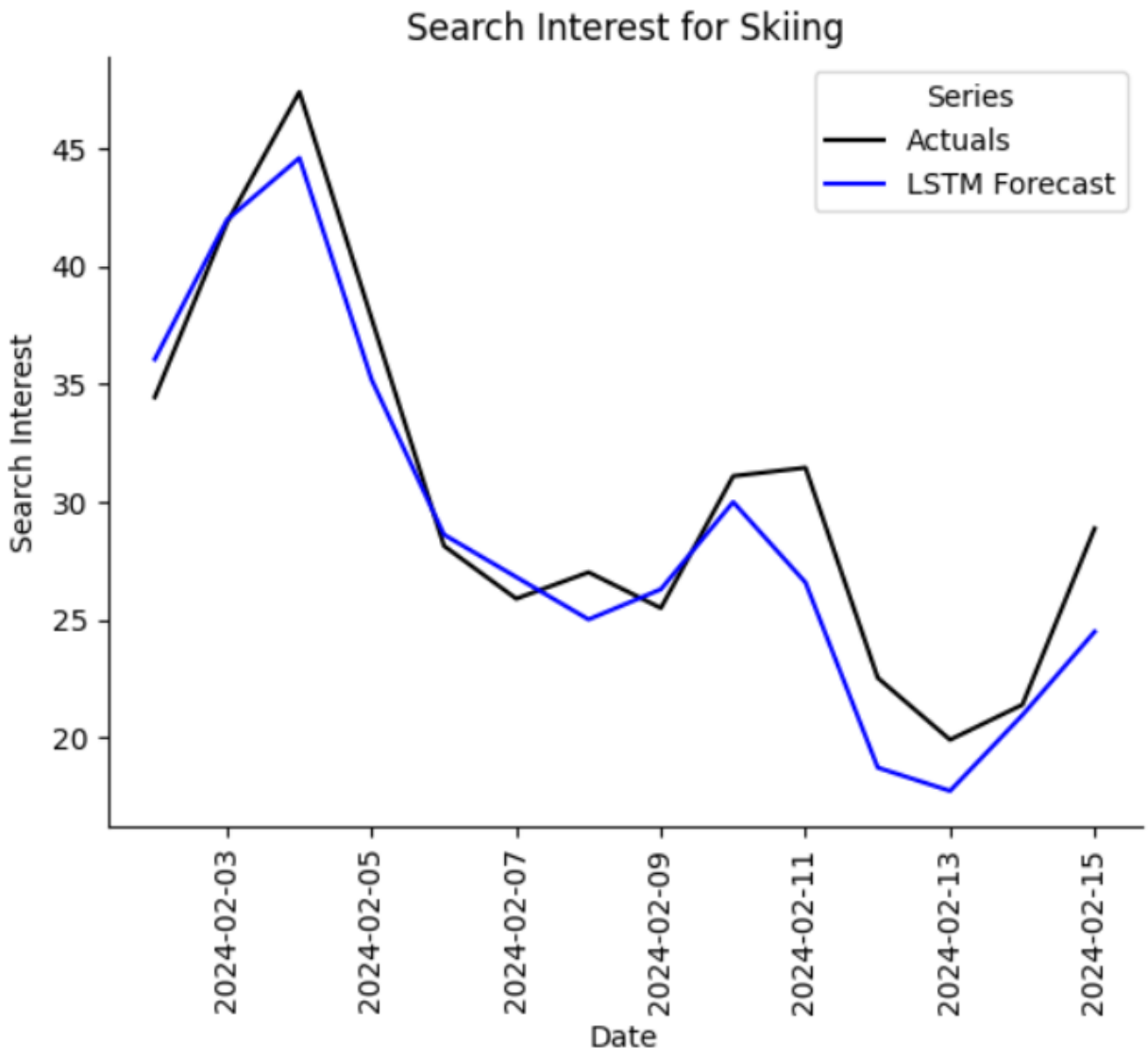
Hunting

I provide a forecast for hunting over November 15, 2024, which was the opening of firearms deer season in Michigan. The LSTM model is chosen for hunting. It captures the general variation of the data, but not the amplitude of the search interest during the opening weekend of season despite having a variable for this weekend.



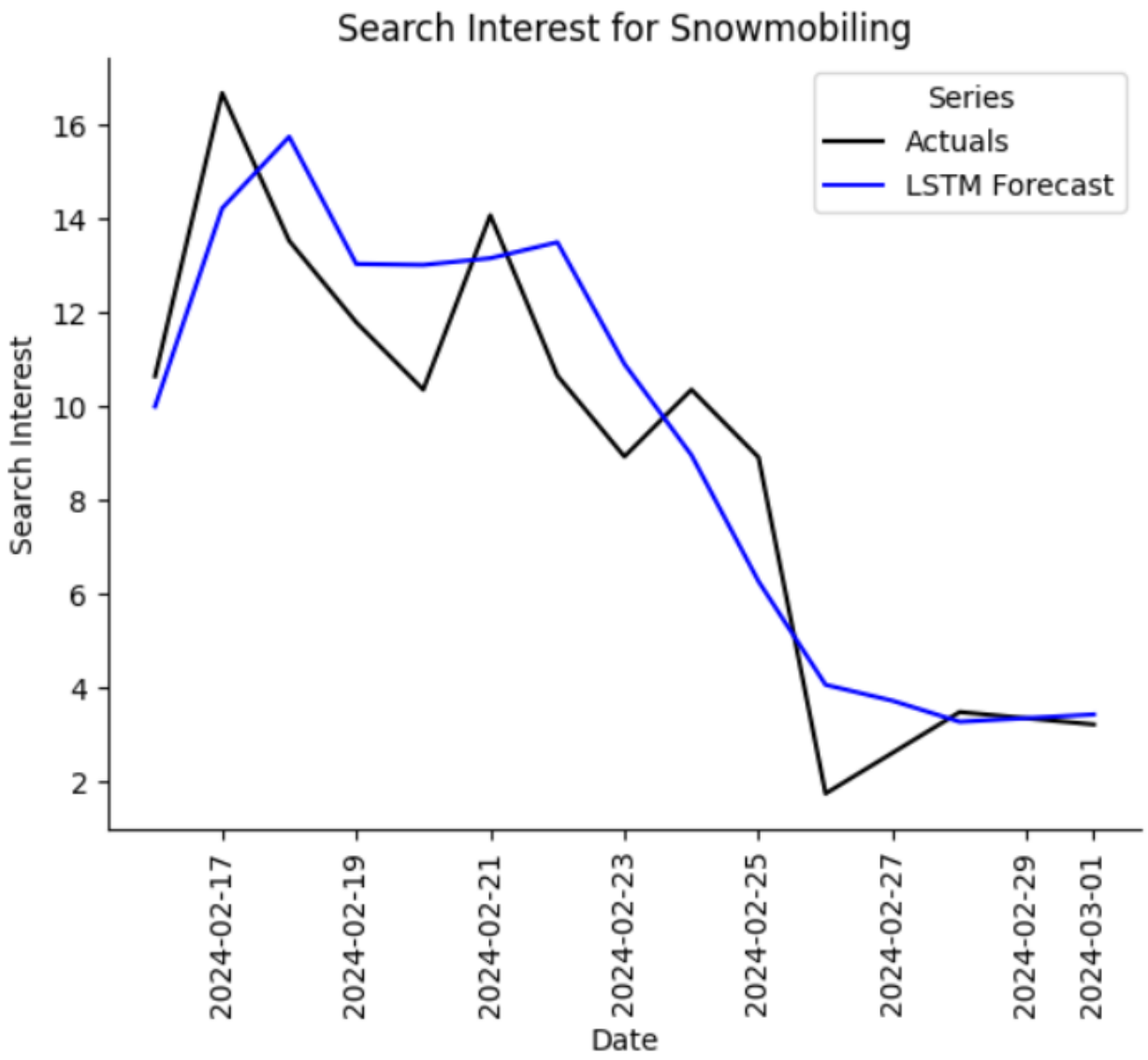
Skiing

I provide a forecast for skiing starting February 1, 2024. The LSTM model is chosen for skiing. It fits this series well during this period. There was limited snowfall in 2024 leading to diminishing snow and search interest as February went on.



Snowmobiling

I provide a forecast for snowmobiling starting February 15, 2024. The LSTM model is chosen for snowmobiling. It fits this series well during this period. There was limited snowfall in 2024 leading to diminishing snow and search interest as February went on.



Conclusion

Outdoor recreation is important to many people in Michigan. This project investigates past trends in Google search interest for outdoor recreation and uses this past data to create short term forecasts.

Unsurpringingly, interest in outdoor recreation hasn't increased much since 2021. During the pandemic, there was a renewed interest in outdoor activities due to social distancing requirements. Both RVing and ATVing have shown a decline in interest since 2021. While hunting shows some increase in search interest, much of this is likely driven by hype surrounding a decline in actual game harvest and attemtps to reverse it. It's encouraging that the other seven forms of search interest have stayed relatively the same over the past several years.

Outdoor recreation is highly seasonal, with most activities showing the most interst in pleasant summer months while others like hunting, skiing, and snowmobiling occuring in the times of year suitable to that

specific sport. ATVing and hiking show the least seasonality suggesting that these are ways Michiganders get outdoors irregardless of the time of year. Search interest also increases near the end of the week showing people making plans for the weekend.

Weather has a profound impact on outdoor recreation, especially as related to season or time of year. There is evidence that unseasonal weather trends also impact search interest, such that weather different from typical for that time of year. That's expecially true for snow sports where lack of snow can decrease search interest. However, this impact is definitely overshadowed by time of year.

I've developed statistical and machine learning models for each of the 10 forms of outdoor recreation for use in forecasting. Starting some time next year, I plan to start using these models to provide short term forecasts for each form of search interest.