Northern Michigan Search Interest Final Summary

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Here in Michigan, "going up North' is a popular trip, vacation, place to live, and retirement destination. Michigan's North is full of forests, lakes, rivers, and public land. Most of Michigan's Great Lakes shorline is north. Couple these natural resources and recreation opportunities with Michigan's history of a vibrant middle class, and Michigan's North has a reputation for providing normal people with their most enjoyable memories.

While not densely populated, Michigan's North contains over 200 cities, towns, and places. These range from cities like Traverse City (2021 population 15,599) and Marquette (2021 population 20,394) to small unincorporated settlements with a few houses and perhaps a convenience store. For this project, I look at Google search interest for these communities from 2017-2023. I provide three month forecasts for search interest using machine learning algorithms, classify different places by characteristics of their search interest, and investigate what is driving growing search interest for some places. While this is just a brief summary of the nine previous installments that I've published online, it will provide highlights from the many interesting results that were contained therein.

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How to Think About Northern Michigan Search Interest

Search interest is more meaningful when we have an idea of why people might be searching for different terms. For instance, if someone was searching for "trucks 2023" they might be interested in buying a new vehicle. There are any number of reasons why someone might search for a city or town in Northern Michigan. However, one key reason is the abundant natural resources and public access in the region. People are much more likely to search for "Mio" Michigan in hopes of rafting the Au Sable River and far more likely to search "Silicon Valley" California in hopes of founding a technology startup.

While natural resources and public access are the key attractive features of Northern Michigan, many businesses have sprung up to serve locals, numerous second residents, and visitors including bars, restaurants, grocery stores, hardware stores, surveyors, well drillers, and carpenters. In fact, Pure Michigan (https://www.michigan.org/industry/researchandreports) publishes spend reports related to tourism at the county-year level (currently as late as 2021).

As shown below, the overall yearly trend in total search interest and tourism spend track each other very closely. Search interest and tourism spend both have a large drop during 2020 due to the COVID-19 pandemic and a large compensatory increase in 2021.

Finally, search interest at the county-year level is moderately correlated with total spend (0.50). The highest correlations are for food and beverage, retail, and transportation spending. While the correlation with recreation is much lower (0.31), it's important to remember that people aren't engaging in outdoor recreation in cities and towns proper. Rather, these are places they go to have

their needs filled. In fact, recreation spend itself is most correlated with spend on food and beverage, retail, and transportation.

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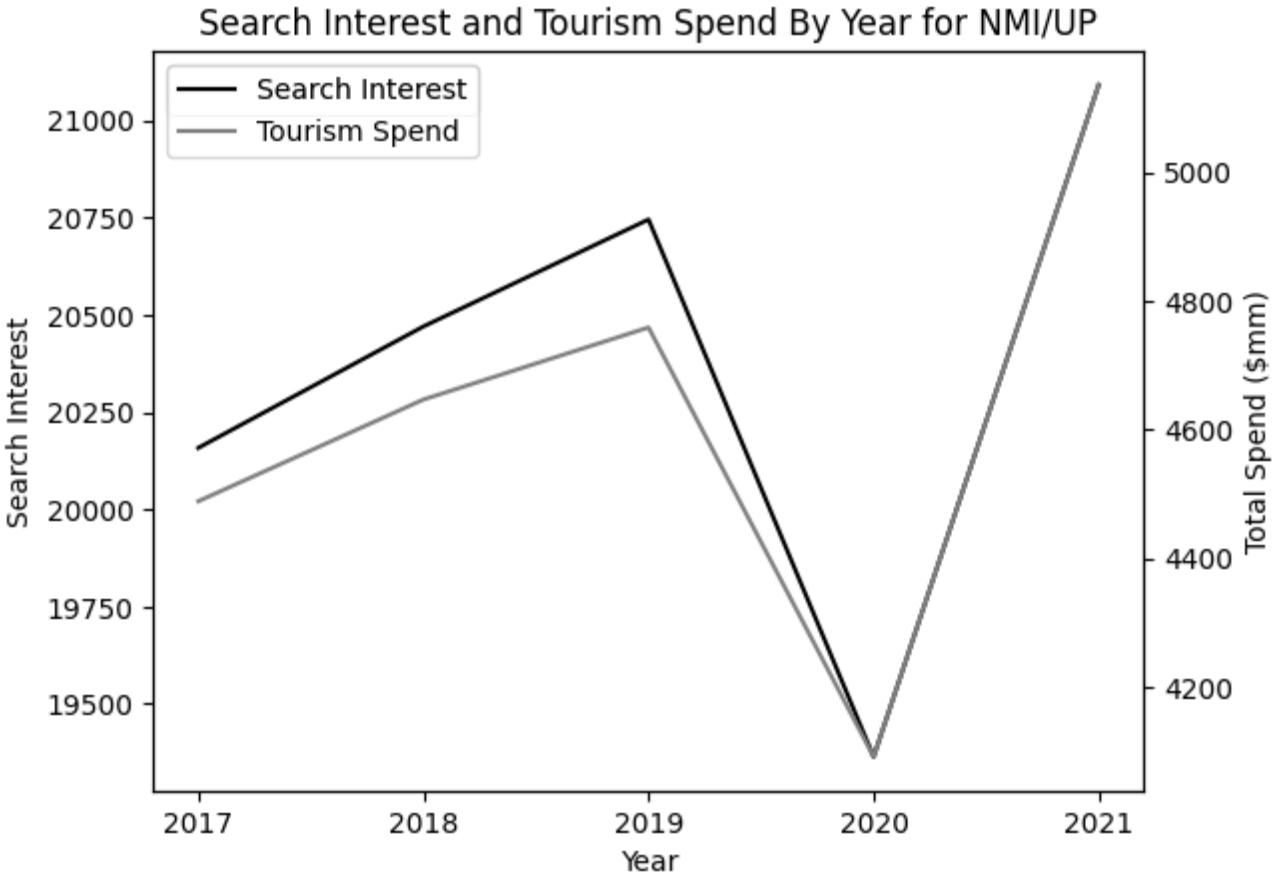

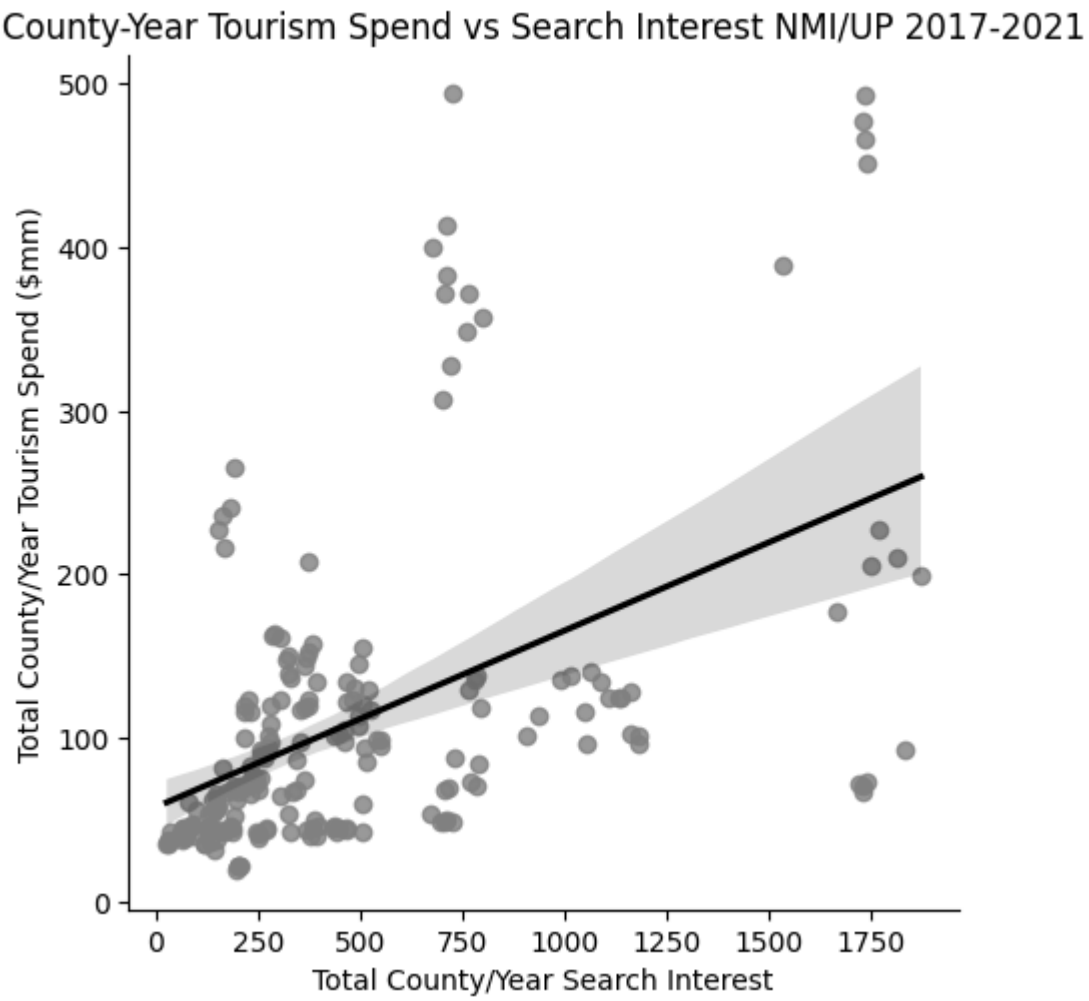

Table: Correlation Table, Search Interest & Various Forms/Total Tourism Spend

	Search Interest	Lodging	F&B	Retail	Recreation	Transport	Total
Search Interest	1.00	0.43	0.53	0.53	0.31	0.56	0.50
Lodging	0.43	1.00	0.92	0.91	0.58	0.85	0.94
F&B	0.53	0.92	1.00	0.98	0.63	0.95	0.97
Retail	0.53	0.91	0.98	1.00	0.62	0.94	0.96
Recreation	0.31	0.58	0.63	0.62	1.00	0.63	0.77
Transport	0.56	0.85	0.95	0.94	0.63	1.00	0.94
Total	0.50	0.94	0.97	0.96	0.77	0.94	1.00

Both tourism spend and search interest tell a valuable story about interest in Northern Michigan. Tourism spend gives some idea of the tangible economic benefit brought to local communities specifically from tourism. However, the monthly search interest results I provide are more up to date and provide short-term forecasts. I also include interest from non-tourists such as prospective second home owners and interest in free to use public lands. Finally, search interest is not sensitive to inflation or gas price increases. The disadvantage of Google search interest is not everyone searches on Google and frequent visitors likely don't web search places at all. Further, many searchers likely never visit the communities they research.

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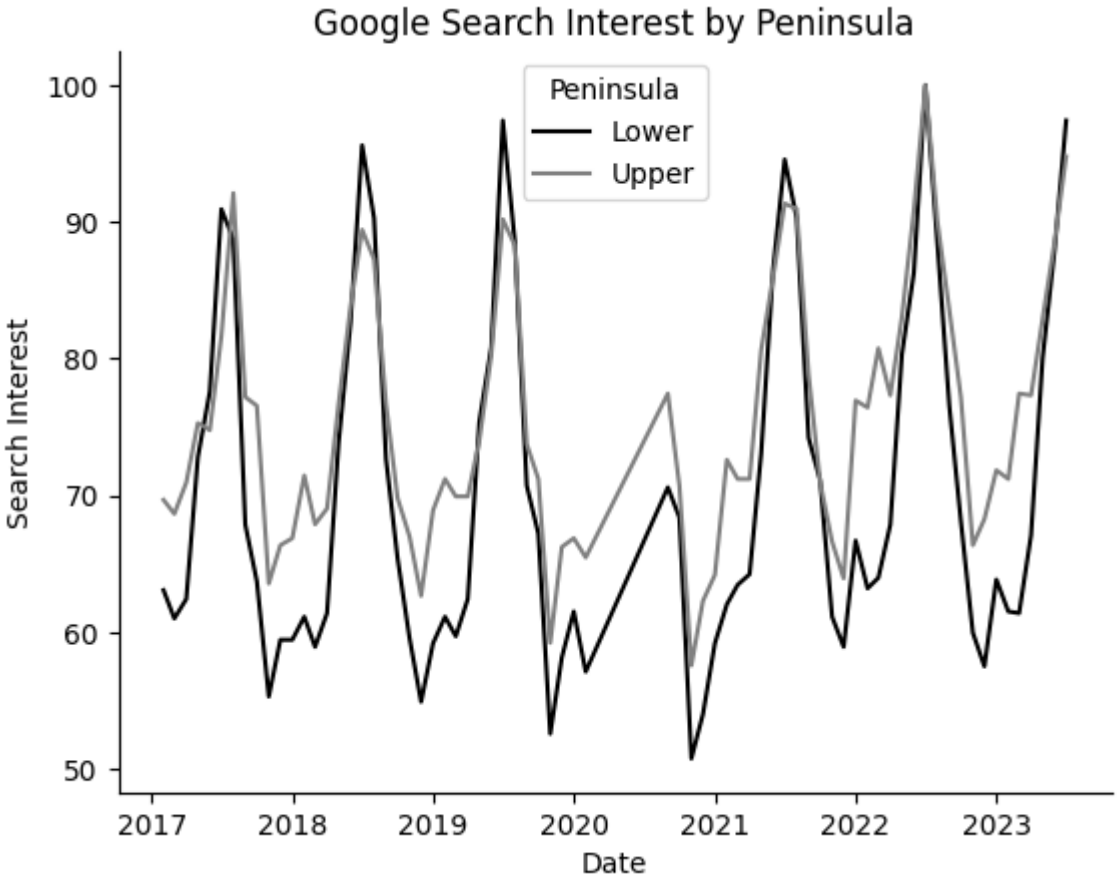
Search Interest Trends and Forecast

The figure below shows the aggregate search interest for 141 places in the Northern Lower Pensinsula and 71 places in the Upper Pensinsula from January 2017 to July 2023. Both series are normalized such that their maximum value is 100. There are three main features evident in these series:

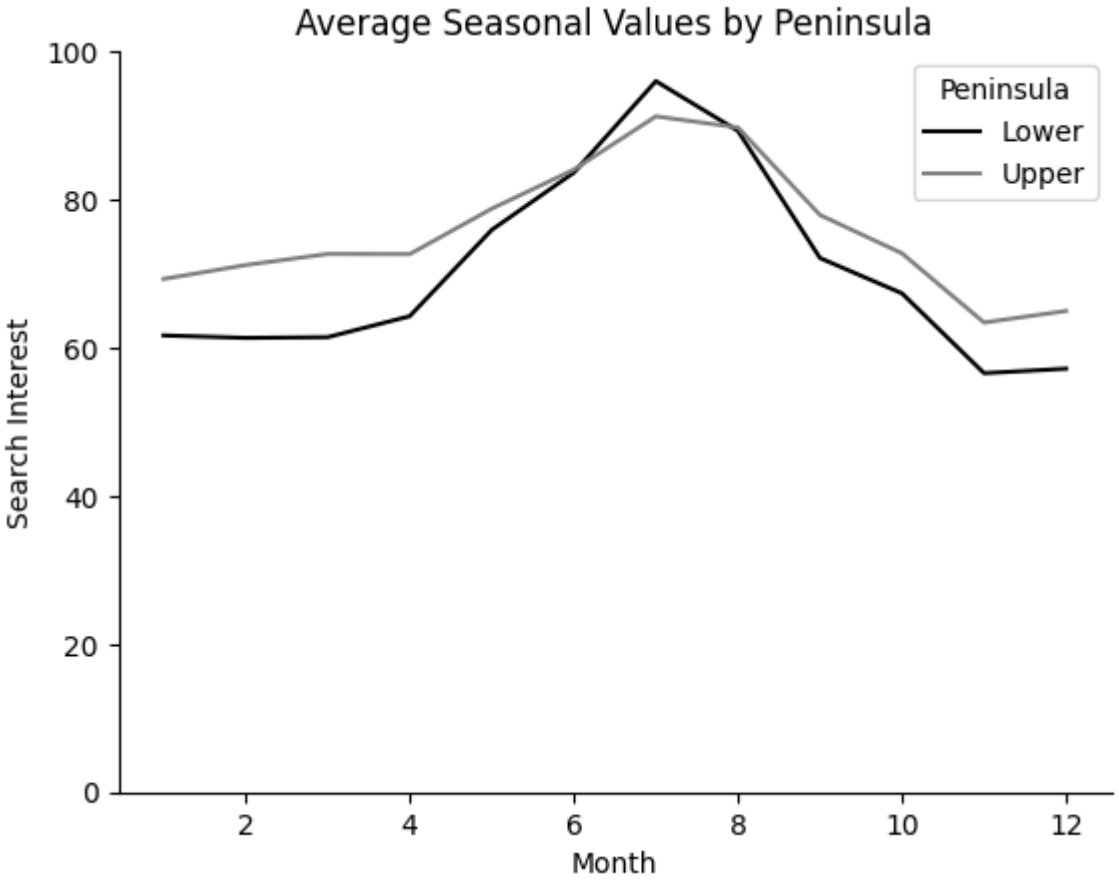
1. These series are highly seasonal moving upward during the summer months and downward during the colder months.
2. Both these series had large relative decreases during the COVID-19 pandemic of 2020.
3. The Upper Peninsula series is trending relatively upward, especially when viewing the low points of the series during the colder winter months.



As said above, the series for both peninsulas are highly seasonal. However, the seasonality is different between the Upper and Lower Peninsula. The figure below shows the average monthly search interest for each month. The Upper Pensinsula shows much less downward seasonality from December-April. This is no doubt due to winter outdoor recreational sports and the higher amount of snow and ice in the Upper Peninsula than the Lower Pensinsula.

The Lower Peninsula also shows a more obvious peak in search interest in July while the summer peak for search interest in the Upper Peninsula is more spread between July and August. Overall, many outdoor recreational activities especially boating, beach going, camping, and hiking are more pleasant during the warm summer months. No doubt the summer peak is accentuated by families taking vacations during the summer breaks of school children.

Another aspect of Upper Pensinsula seasonality is that there is also a lower decline in search interest for fall months compared to the Lower Peninsula. While summer recreation during school breaks may appeal to the most people, fall recreational opportunities such as viewing fall tree colors and hunting are popular in northern areas. This interest appears to be relatively more important for the Upper Peninsula than the Lower Pensinsula. However, this is at least partly the case because Lower Peninsula search interest is dominated by areas surrounding Traverse City. It's an area of future investigation to determine which areas of the Northern Lower Peninsula exhibit higher relative search interest during the fall and winter.



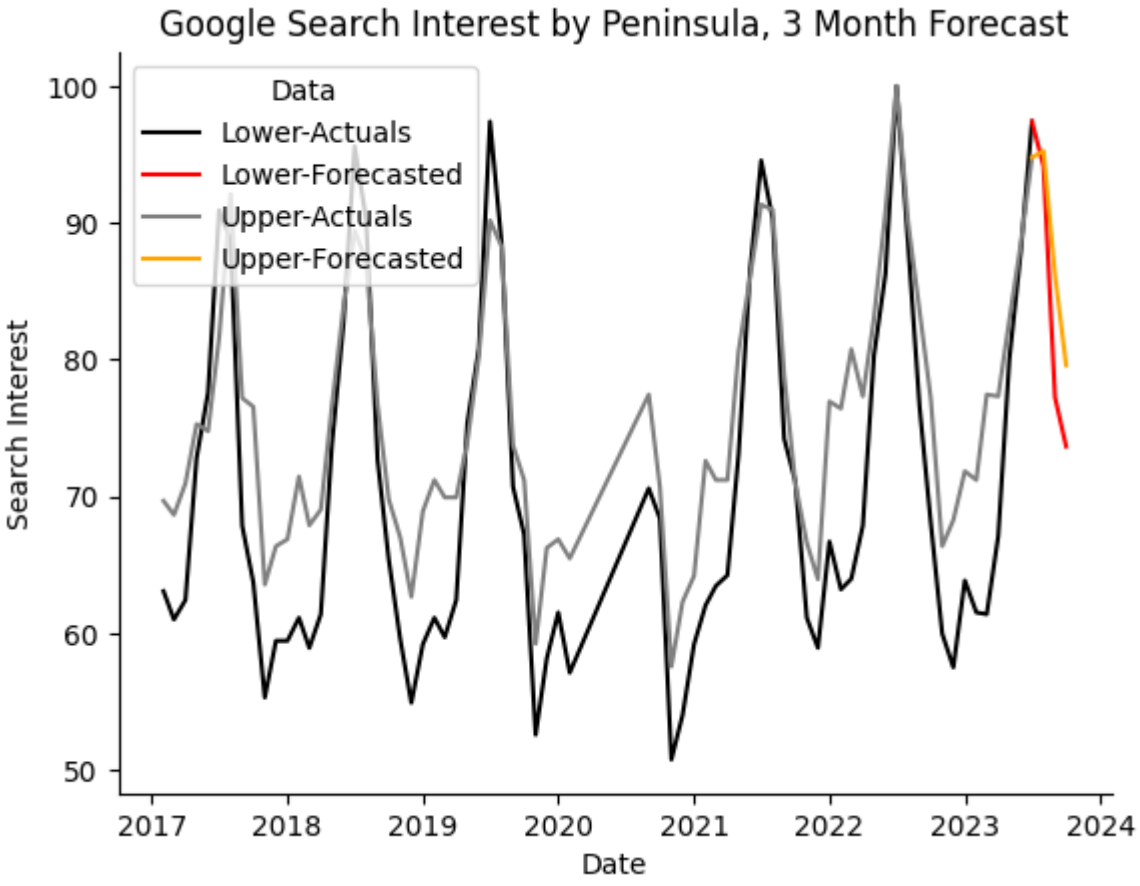
Based on previous trends, I create three month forecasts for each place. Forecasts are determined by the expected seasonal value for each place (based on month) shifted by the last actual for each place such that if the monthly value previous to the forecast is relatively high or low the forecast will be shifted higher or lower.

Further, the forecast will also be shifted based on whether the forecasted monthly temperatures, precipitation, and snowfall are atypical for that month based on the average values for previous years in my historical data. Historical search interest values for each place are compared to weather data at Houghton Lake for Lower Peninsula places and Sault Saint Marie for Upper Peninsula places. Weather forecasts are derived from accuweather.com monthly forecasts, weather.gov climate forecasts, and historical correlations in the data as determined by statistical models. Further, gasoline prices are considered as forecasted by a statistical model.

Note that it is obvious from the seasonal values that temperature changes throughout the year have an impact on search interest, but deviations of weather from historical averages determine the impact on unseasonal weather on residual search interest (after accounting for seasonality). Machine learning models determine the impact of weather being different from historical averages on the

residual search interest of each place along with the impact of changes in gas prices. For some places, these factors have no measurable impact on changes in search interest but for others the difference is measurable.

The impact of seasonal variation, last actuals, and the expected impact of unseasonable weather/gas prices are summed to create three month forecasts. The forecasts aggregated by peninsula created for August, September, and October 2023 are below.



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Place Level Search Interest Trends

To investigate how search interest differs between various Northern Michigan places I employed an unsupervised learning algorithm to cluster places by four characteristics:

1. Trend: The extent that search interest is trending upward or downward.
2. Seasonality: The extent that search interest varies due to repeated changes for each calendar month.
3. Weather, Warm Months: The extent that atypical weather patterns and gasoline prices influence search interest from May-October, based on r-squared.
4. Weather, Cold Months: The extent that atypical weather patterns and gasoline prices influence search interest from November-April, based on r-squared.

I chose five clusters from this algorithm that can be characterized as 'Low All', 'High Slope', 'High Seasonality', High Cold R-Squared', and 'High Warm R-Squared'. The table below shows the values for all four characteristics, in terms of standard deviations from the mean. For instance, the category

'Low All' has an average trend that is 0.96 standard deviations below the overall average. Places in this category are low for all four characteristics.

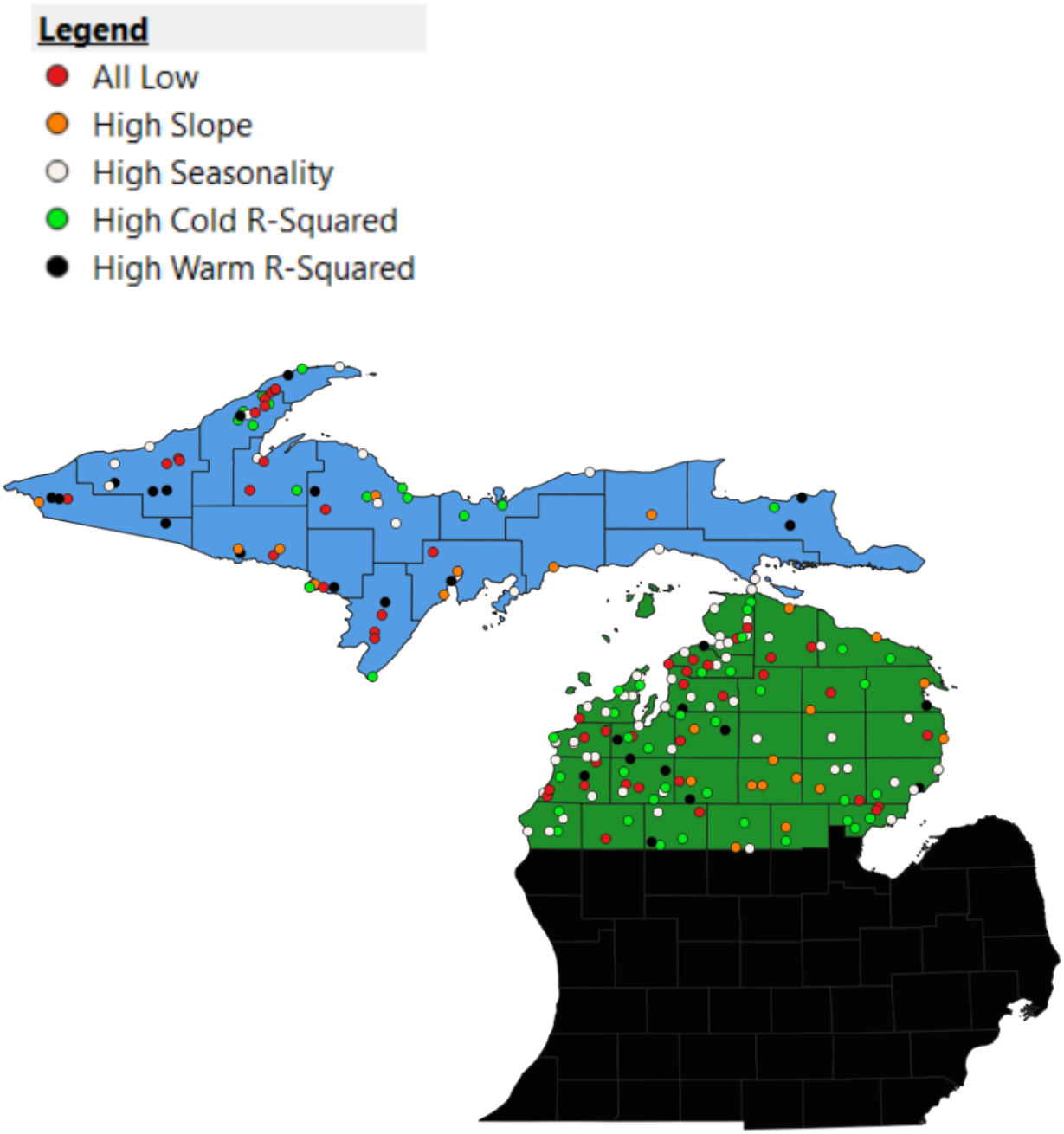
Places in the high slope category are trending upward the most on average in search interest. Those in the high seasonality category tend to have a higher proportion of variation explained by seasonality. Those in the High Cold R-Squared category have a high proportion of November-April search interest variation explained by atypical weather and gas prices. Similarly, places in the High Warm R-Squared category have a high percentage of May-October search interest explained by atypical weather and gas prices.

Cluster Number	Description	Slope Index	Seasonality Index	Warm R-Squared	Cold R-Squared
1	Low All	-0.96	-1.11	-0.16	-0.64
2	High Slope	1.92	0.26	-0.19	0.11
3	High Seasonality	0.16	0.85	-0.19	-0.68
4	High Cold R-Squared	-0.09	-0.00	-0.56	1.23
5	High Warm R-Squared	-0.06	-0.16	2.01	0.42

The map below shows the locations of the places in all five categories specified above. Places with a high slope index are trending upward in search interest and tend to be located in the eastern side of the Northern Lower Peninsula. Some are also located in the Upper Peninsula along Lake Michigan and the Wisconsin border. The eastern side of the Northern Lower Peninsula generally received less tourism spend. However, it is far less densely populated and the home to large amounts of public land. The areas along Lake Michigan and Wisconsin in the Upper Peninsula tend to be of moderate population density relative to the Upper Peninsula. While many people may be interested in Northern Michigan due to public land and less congestion, the most remote portions of the Upper Pensinsula may be more difficult to visit due to lack of basic services.

Unsurprisingly from the seasonality discussion, many of the high seasonality places are in the Lower Pensinsula with most of these seeing much interest in the summer months and much less interest in other times of the year. However, a few locations such as ski resorts have more interest in the winter.

Finally, many of the places where search interest is more explained by atypical weather patterns and gas prices are found in the western side of the Lower Pensinsula. This portion of Michigan is more densely populated than the rest of Northern Michigan and has many tourist areas and a large amount of tourism spend. There are also many Upper Pensinsula places with a larger amount of cold weather month dependence on atypical weather, especially along Lake Superior. The Upper Pensinsula is popular for winter outdoor activities.



Since areas in the North-Eastern portion of Michigan are receiving growing search interest, I looked to see where this search interest is coming from. While one may suspect that growing search interest for these areas is coming from areas in Lower Michigan such as Detroit, Grand Rapids, and Saginaw/Flint, this increased search interest is actually coming from within Northern Michigan: Traverse City area. The figure below shows search interest from many sources for an example city: Cheboygan, Michigan which is located in North-East Michigan.

Traverse City is in the North-Western portion of the Lower Pensinsula which is relatively densely populated compared to the rest of Northern Michigan and receives substantial tourism spend from down state and elsewhere. It seems many people in these areas are interested in other areas of Northern Michigan that also happen to have more public land while being less densely populated and somewhat less congested with tourists than where they are searching from.

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Search Interest for Cheboygan
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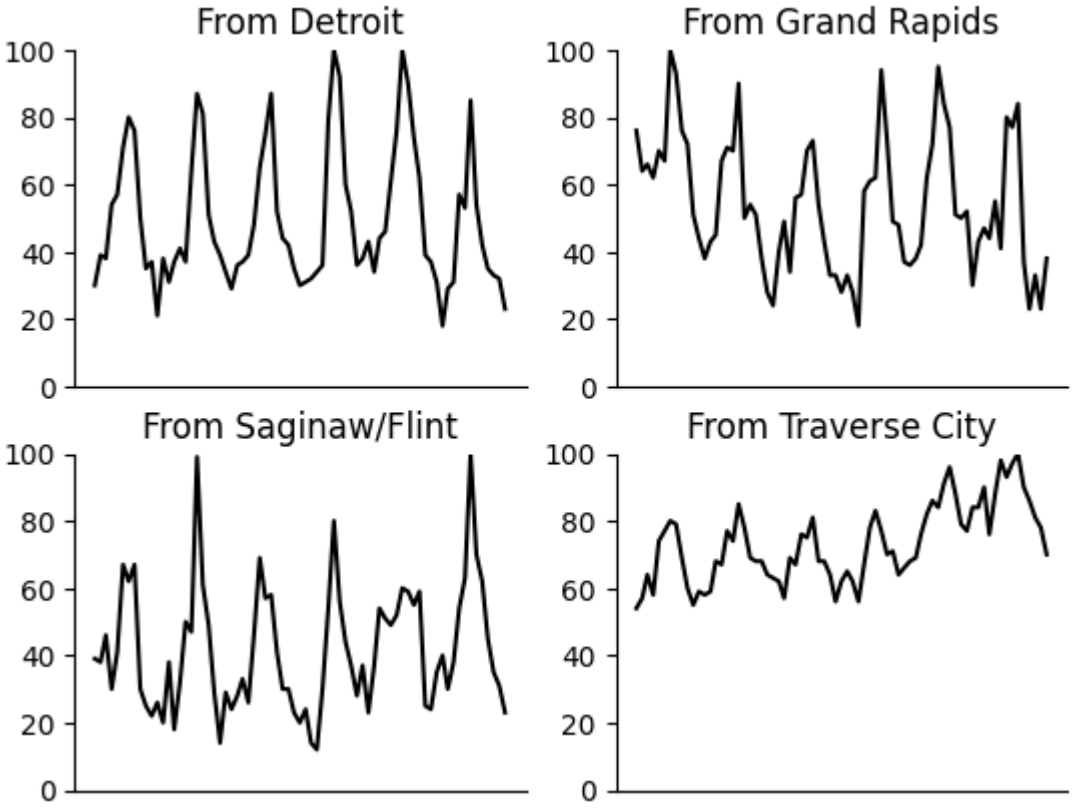
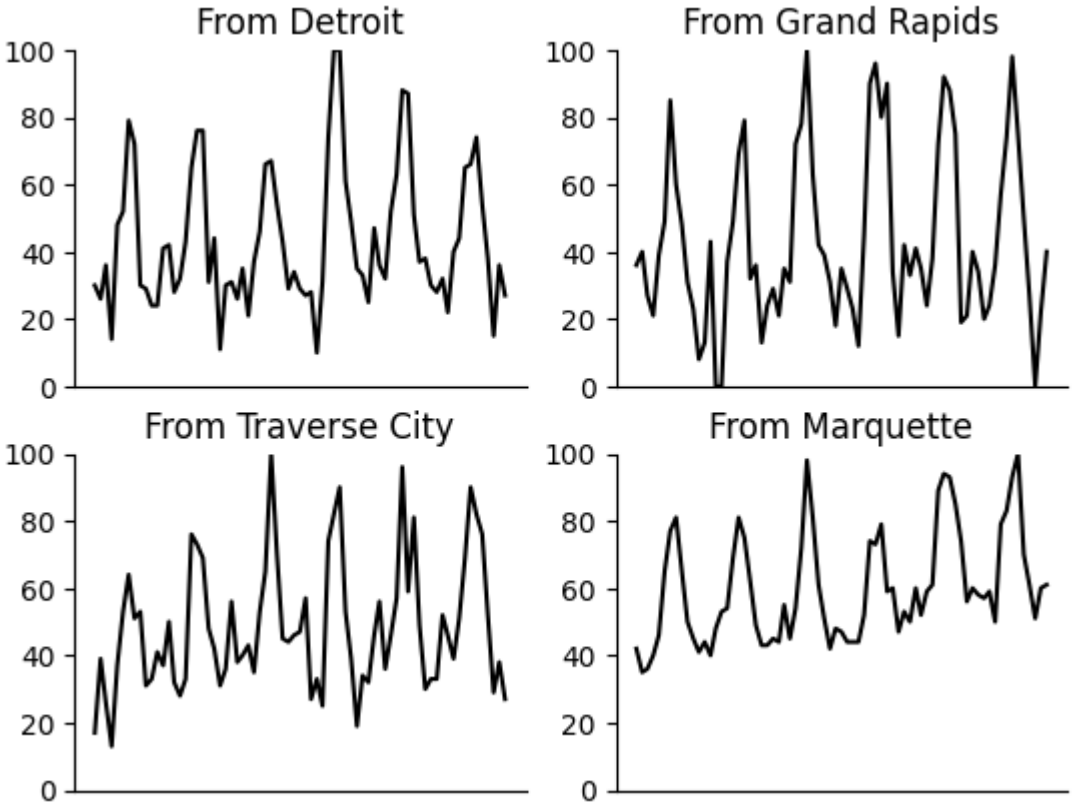


Similarly to Cheboygan, Manistique is also growing in search interest. Manistique is located in the Upper Peninsula along Lake Michigan. The figure below shows that search interest for Manistique is growing most obviously from Marquette, Michigan, while there is some increase from Traverse City. Like Traverse City, Marquette is one of the larger cities in Northern Michigan. However, Marquette is in the Upper Peninsula. As with Cheboygan, it appears that many of the places growing in search interest in Northern Michigan are growing from people in Northern Michigan population hubs not places in Southern Michigan.

`Search Interest for Manistique`



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Conclusions

A lot can be learned from search data especially when trends are combined with a basic understanding of why people are interested in various search terms. While Northern Michigan has long been a source for natural resource extraction such as lumber and mining, its poor agricultural potential and harsh climate have led to low population densities and an abundance of forests, clear lakes and rivers, and public lands. Most interest in Northern Michigan relates to outdoor recreation and natural resource tourism. Therefore, it's not surpising that search interest in Northern Michigan places is seasonal, but it's surprising that search interest can almost double between seasons. It's also surprising that the Upper Pensinsula shows the least seasonality, despite harsher seasonal weather fluctuations, until one considers the role of winter outdoor recreation opportunities in search interest.

Further, it's not surprising that destination tourist areas in the North-Western Lower Peninsula such as Traverse City have the highest search interest, but what is suprising is that the places growing in search interest the most are in the north-east of the Lower Peninsula or some areas in the Upper Pensinsula along Lake Michigan or Wisconsin. What is even more surprising is that search interest for these places is growing not from people down state but rather people from regional population centers like Traverse City and Marquette. This may be evidence of a form of congestion effect due to the fact that less densely populated and less heavily visited areas are getting more attention. But what is happening could be more accurately described as a trickle down effect as people from high popularity and high cost tourism areas are interested in taking their own resources to more remote locations.

Future directions for this project are to continue publishing monthly search interest forecasts while improving the quality of the analytics that accompany these forecasts.