

Geographical Effects of Hub Changes at the Chippewa Valley Regional Airport

Introduction

The Chippewa Valley Regional Airport (CVRA, airport code EAU) serves the Wisconsin cities of Eau Claire and Chippewa Falls as well as the surrounding area. While most air traffic is made of general aviation (private) planes, there is also some scheduled commercial flight availability for the general public, along with occasional chartered flights to Laughlin, Nevada on Sun Country Airlines.

Scheduled service used to consist of Delta Connection service to the Minneapolis-St. Paul International airport (MSP), but Delta Air Lines announced that it would no longer serve Eau Claire. This opened up the bidding for an Essential Air Service (EAS) contract to other airlines. The EAS is a program by the federal government to subsidize commercial airline service to smaller cities, which may otherwise not be profitable enough for most airlines to be in these smaller markets.

In late 2009, it was announced that SkyWest airlines had been awarded the new EAS contract with its bid to provide United Express service to Chicago's O'Hare airport (ORD).

Passenger Destinations

Scheduled service to Chicago began March of 2010 (O'Brien, April 16, 2010), with Minneapolis service having ended completely the night prior. The primary purpose of this project is to examine patterns in passenger movement, especially changes in the patterns after the change in airline and hub service took place.

One interesting characteristic of CVRA is that it is located approximately 100 miles away from MSP, which is within driving distance. There is also a shuttle service from downtown Eau Claire direct to MSP. There are more airlines that fly from MSP, and prices can be cheaper as a result. Therefore, if people have a choice in their departure airport, and price is a major factor in deciding what that airport will be, destinations from Eau Claire can be quite volatile compared to a more isolated airport with steady destination needs.

Nearby Hub Impacts

Delta and United both have different sets of hubs. In addition to its Minneapolis hub, Delta also has hubs in Detroit, Memphis, New York (JFK), Atlanta, Cincinnati, and Salt Lake City. United has hubs in Chicago as well as Washington, Denver, Los Angeles, and San Francisco. This project shall examine how these hubs impact surrounding cities' ridership and if that may have an impact on ridership changes during the service switch.

Other Information and Trends

Finally, auxiliary data will be examined for this project. While it doesn't examine specific cities, it does look at overall trends in passengers flying from Eau Claire alongside national trends. This information shall include passenger ridership, cost per mile of a ticket, and average miles from Eau Claire to the final destination.

The Traditions and Approaches of Geography

The Four Geographical Traditions

Geographer William D. Pattison wrote to the *Journal of Geography* in 1990 a re-publication of "The Four Traditions of Geography." In his preface letter, he explained that he has seen different terms used improperly over time, and he wished to have a set of standard wordings to prevent this confusion and create a more unified vocabulary across the Geography Community. He also hoped that this would also be understandable for those outside of the field.

After Pattison's traditions interpretation was published, it received widespread acceptance. A few discussions took place, such as how earth science would be integrated and whether or not a movement tradition should be included, but the overall idea of having this link between the world of geography and the outside world has stayed the same, using much of the same concepts. Today, the four recognized geographical traditions include the spatial, area studies, man-land, and earth science traditions. This project will primarily utilize the former two traditions, as the latter two are not really related.

Spatial Tradition

According to Pattison's writing, early western culture had a very strong separation of events and the spatial setting in which they occurred. In the 17th century, the philosophy changed that *perhaps* there was a connection and the environment may have had some kind of actual effect on past happenings.

Of course, that's not to say that the spatial tradition has gone ignored throughout history, either. Humans have mapped spaces for centuries, such as various boundaries – which can include political boundaries, such as national borders, or physical boundaries, such as rivers or mountains. Greeks would record sailing information and map coastlines, perhaps for trade with others. This deeply rooted history very well could be the reason that geography and mapping are so synonymous today.

Area Studies Tradition

In Pattison's article, he points to Strabo as the creator of some of the oldest known works in area studies of geography, in this case made for officials in Rome during Augustus Caesar's rule. Area studies, Pattison explains, focuses on how a place is and what it "feels" like, rather than the precise location. While this was not really given much regard by professional geographers years ago (even if it was

acknowledged), it is well-established to the outside world as a major and recognizable part of geography.

The Geographical Approaches

In Peter Jackson's article, "Thinking Geographically," he addresses the fact that many Americans seem to have a distorted view on what geography is and what geographers actually do. While professional geographers examine all kinds of dynamic things and how they work together, most people have a view of geography as being more static and fact-oriented, such as the capitals of far-away places. Perhaps this stems from large amounts of time spent learning state capitals and names of countries and rivers in geography (or "social studies") classes in primary school.

To attempt to break away from that stereotype, Jackson came up with some geographical approaches, which can be used to explain what exactly professional geographers do. This project will primarily take advantage of the Proximity and Distance as well as Relational Thinking approaches, while the other approaches of Space and Place as well as Scale and Connection have a less active role.

Proximity and Distance

Jackson also brought up that distance is an important part to geography. However, distance has gotten to be a much more relative term than before. Rather than looking at measurable distances alone (that is, in miles or kilometers) one also needs to look at the *perceived* distance between two points. The Internet was brought up specifically, as communication via the Internet has been so easily accessible that distance is practically a non-issue for those with a connection.

Relational Thinking

The final approach Jackson writes about is relational thinking. That is, how one entity interacts with another geographically. Jackson especially emphasizes the comparison of the self and others, rather than a third-party observer between two other things.

The Concepts and Standards of Geography

While the actual concepts of geography may be a little more open-ended and informal, the National Geography Standards were created as a set of geographical ideas that should be understood by students nationwide as they graduate high school. While there are 18 concepts in total, they can be grouped into 6 different categories pretty easily. These categories of concepts include the world in spatial terms, places and regions, physical systems, human systems, environment and society, and the uses of geography. However, this project will not use the concepts of physical systems nor environment and society.

The World in Spatial Terms

In its most basic form, this concept can be used for taking a question, and seeing how it relates in space. From that, one can find patterns within data and then make observations and connections. The best way to do this is through maps, which can be used to display multiple datasets of different types at once, which is incredibly useful for finding patterns among multiple variables. One useful characteristic of maps is that they can be used as both an input and an output tool to communicate information.

Once data have been mapped and transformed into more useful information, it is easier to find spatial patterns within different subjects. When a pattern is noticed, one can research *why* these patterns may occur, and look for similar characteristics in other areas to predict trends in other areas.

Additionally, understanding space can be used for basic organization of things. For example, if one were to imagine major ethnic backgrounds across the US, they may start with South Americans in the southwestern part of the country into California, where Asian populations start to become very noticeable in places like Los Angeles up through Seattle. On the east coast, African-Americans commonly live east of Texas into the Carolinas, and different European backgrounds (such as Irish, Italian, German, Norwegian, and others) often run between New England and the Midwest. Even imagining a map of the US and following along with those different regions is very much thinking spatially.

Places and Regions

While space deals with more “hard” data and displaying it in a map, studying places and regions adds a more human touch to an area of interest. Starting at a worldwide view, one can break down different regions with similar traits. For example, taking a walk through a major city in one continent can have a totally different feel than walking through a city of a similar size in another continent.

Not only can the world be divided into regions, but also every region can be divided into sub-regions to a nearly infinite amount. For example, I live in North America, which is quite different culturally than most places in Africa or Asia. Specifically, I live in the United States, which is different than various countries in South America, though not too different from some parts of Canada. Within the United States, I live in Wisconsin, which has a noticeable difference from Florida (but at this point, it could easily be argued that Florida and Wisconsin have a lot more in common with each other than either would with most places overseas mentioned earlier). Within Wisconsin, I live in the western part of the state, in Eau Claire County, which is quite different from Milwaukee County. Within Eau Claire County, I live in the city Eau Claire, which is a lot different than one of the surrounding areas. Within the city of Eau Claire, I live in an apartment building near the intersection of Hastings Way and Birch Street, which is different than the neighborhoods of the south side of town or the college housing area. I could divide

my apartment building, or even my unit even further, but the differences become less and less noticeable, especially when compared to the original worldwide scale.

Of course, as a resident of Eau Claire, I would have more context to easily notice the differences of my area, where a resident of another continent would be more prone to categorize my neighborhood as being part of the United States or simply “North America” – similar to how an American may have trouble noticing many differences between the cities of Seville, Spain and Malaga, Spain. They both have similar traits, and at that small of a scale the differences between those cities and American cities would distract from the differences between the two Spanish cities.

On the other hand, as an American who has studied in Seville but visited Malaga for a day, I might be able to pick up on some more differences more easily than a total stranger to the country. I could notice the differences in architecture (which reflects the historic Arab influences in the case of Seville) and the way that Malaga seems to have a major tourism focus, especially with its beaches.

Human Systems

Just as the attributes of the physical system in geography affects itself within a region, so does the human system. People migrate around the earth, causing a mix of cultures and beliefs all over. Some people may group together, while others may have distinct groups in the same nationality. Some groups (ethnicities, countries, etc.) may have strong economic ties to one another, such as with consistent imports and exports. Others may be very close to each other spatially, but have enough conflict culturally that they are in long-term conflict or war with no end in sight. Some groups of people may go as far as to completely overtake another previously sovereign nation and gain control of that land and all that it has.

This is a great example where geography reaches other entirely different subjects. In this case, the human systems of geography can be understood even better using the help of sociology and anthropology, as the world of humanistic tendencies meshes with spatial attributes known to geographers.

The Uses of Geography

While it's great to know the basic concepts of geography, to go from a conceptual to a more applied idea is also a great idea. Knowing what spatial patterns exist is a great start to finding out why. Finding the “why” can be done through different types of research, depending on what the question is. Eventually, once the factors of a question are understood, they can be used in turn to find similar environments and predict where similar occurrences of a pattern may exist, which could be very important when there is some sort of a continuing effect on other places.

Related Traditions, Approaches, and Concepts

Space and Place

Every destination exists somewhere in space in relation to Eau Claire. While distance and population may be able to be used to predict some trends in destinations chosen, each destination has (and needs) something to draw people in from Eau Claire. This could be a business link between one or more companies, or a purely touristic attraction. For now, the data acquired works with more of a spatial analysis with different destinations shown.

Regions

Each airport (or group of nearby airports) has been given its own region based on where it is in relation to other airports. In this project, a passenger will be assumed to go somewhere in that region, and the airport was simply a way of getting there. Within each airport zone exists multiple counties, each with their own cities, and people could go to any of them once they arrive at that airport. While I have not yet analyzed this, my own experience working at the airport seems to show a consistent pattern in people generally flying within the Midwest and the New England area, with areas west of the Great Plains not being visited as often.

Proximity and Distance

These data will be used to determine how distance and proximity relates to passenger ridership, and will be a major factor used to determine any anomalies – that is, cities with significantly more or less passenger traffic than would be expected for a city of that distance (and population size). As with any movement-tracking research, distance is an integral part in ensuring a fair and accurate analysis for the purpose.

Data

Given the goal of the project to observe destination patterns with Eau Claire passengers, a variety of data will be used to determine airport locations, ridership, and population of the corresponding regions.

Bureau of Transportation Statistics – Passenger Movement Patterns

The Bureau of Transportation Statistics (BTS) has a dataset made of 10% of all domestic airline tickets sold in the United States per quarter, which goes back a number of years. This study shall include data from first quarter 2009 through first quarter 2011, which had to be filtered through in each file to extract only data representing passengers flying commercially in or out of the airport in Eau Claire.

These data include not only the origin and destination cities for each ticket, but other useful information such as the number of coupons (flight segments) in a ticket, the time period (quarter) in which the passenger flew, and city and state identifiers for the origin and destination. There is also information about the exact routing flown (especially useful with multiple connections), ticketing and operating

carrier information, number of passengers, and distance flown (both including connections and directly).

Other Acquired Data

Airports

A shapefile with all airports is used for the maps created in this project, and are also necessary for defining zones for each airport or airport group. A join was made with the BTS data to narrow the airports to only include those actually used in the data, ignoring smaller and non-commercial airports.

Census Blocks

In order to understand population trends in different custom-defined areas as will be explained later, census block data from the US Census Bureau will be utilized.

Derived Data

Airport Zones

Within any point in space, one airport will always be the closest. However, multiple airports may serve some areas, such as in Chicago or the Los Angeles metropolitan area. To account for this, airports within 40 miles (straight-line distance) of each other were merged into groups. After these groupings were made, the Thiessen Polygons tool was used to determine which airport(s) would serve any point in space by making different regions (see Figure 2).

As distance increases, one may assume that population must generally remain large enough to sustain frequent visitors to a region. For example, passengers from California are probably less likely to go to a smaller city like South Bend, Indiana, compared to passengers from the Midwest.

Each zone will include all counties that fall within, plus a proportionate fraction of county population that fall only partially within a zone. When the county populations are added together, a reasonable representation of that zone's population can be used. Of course, population is not spread evenly across a county. However, airports are generally located near the larger cities, where the population is greatest. These counties should lie fully within a zone, rather than getting split. Counties along the edge of airport zones are more likely to be less urbanized, and should have a relatively even population distribution, so splitting these counties should be acceptable for this purpose.

General Analysis Results

Using the raw data previously mentioned, other data can be calculated fairly quickly. Some data may be less geographical, such as ticket prices normalized for distance, how those ticket prices change over time, overall passenger ridership as

well as more spatial information such as how far away people fly, which cities are more commonly flown to after accounting for distance and population, etc. Some data may only be used for “side factoids” at the most, while others could be crucial information for the main question to be answered.

OBJ	MktCoupon	Year	Quarter	Origin *	OriginAptI	OriginCity	OriginCoun	OriginStat	OriginSt_1	OriginSt_2	OriginWac
555	3	2009	1	ANC	1	3291	US	2	AK	Alaska	1
556	3	2009	1	EAU	0	26070	US	55	WI	Wisconsin	45
572	1	2009	2	MSP	0	57970	US	27	MN	Minnesota	63
573	1	2009	2	EAU	0	26070	US	55	WI	Wisconsin	45
1124	2	2009	2	EWR	3	63760	US	34	NJ	New Jersey	21
1125	2	2009	2	EAU	0	26070	US	55	WI	Wisconsin	45
1753	2	2009	3	IAH	1	37320	US	48	TX	Texas	74

Dest *	DestAptInd	DestCityNu	DestCountry	DestStateF	DestState	DestStateN	DestWac	AirportGro
EAU	0	26070	US	55	WI	Wisconsin	45	ANC:SEA:MS
ANC	1	3291	US	2	AK	Alaska	1	EAU:MSP:SE
EAU	0	26070	US	55	WI	Wisconsin	45	MSP:EAU
MSP	0	57970	US	27	MN	Minnesota	63	EAU:MSP
EAU	0	26070	US	55	WI	Wisconsin	45	EWR:MSP:EA
EWR	3	63760	US	34	NJ	New Jersey	21	EAU:MSP:EW
EAU	0	26070	US	55	WI	Wisconsin	45	IAH:MSP:EAU

WacGroup	TkCarrierC	TkCarrierG	OpCarrierC	OpCarrierG	RPCarrier	TkCarrier	OpCarrier	BulkFare	Passengers	MktFare	MktDistanc	MktDista_1	MktMilesFl	NonStopMil
1.93.63.45	1	AS:AS:NW	1	AS:AS:NW	AS	99	99	0	1	0	2933	6	2933	2577
45.63.93.1	1	NW:AS:AS	1	NW:AS:AS	AS	99	99	0	1	0	2933	6	2933	2577
2.65625	0	NW	0	XJ	XJ	NW	XJ	0	1	0	85	1	85	85
45.63	0	NW	0	XJ	XJ	NW	XJ	0	1	0	85	1	85	85
0.919270833	1	CO:NW	1	CO:NW	CO	99	99	0	1	0	1093	3	1093	924
45.63.21	1	NW:CO	1	NW:CO	CO	99	99	0	1	0	1093	3	1093	924
74.63.45	1	CO:NW	1	CO:NW	CO	99	99	0	2	0	1119	3	1119	1048

Figure 1: Sample rows of raw data from the Bureau of Transportation Statistics, filtered to include only Eau Claire data.

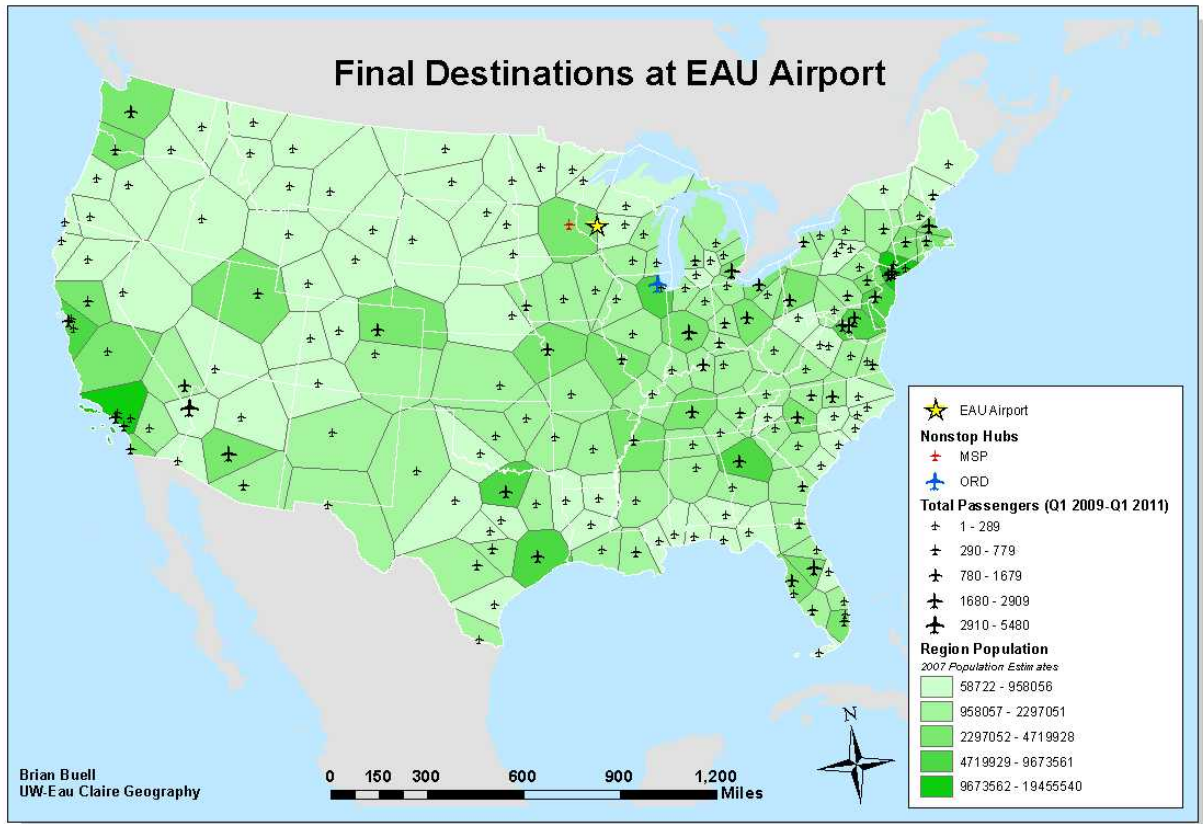


Figure 2: Origins and Final Destinations of passengers flying from Eau Claire, WI (EAU). Nearby airports were grouped together (such as Chicago's O'Hare and Midway airports) and regions were created to accompany these points

Results

After combining and analyzing the data in many different ways, a variety of different types of results were found. Effects of the switch from Delta Connection to United Express service were very apparent, both in spatial and non-spatial ways.

Non-spatial Results

In general, ridership went up during United Express service compared to Delta Connection as ticket prices dropped, excluding a price spike in the third quarter of 2010. Additionally, people started flying shorter distances after the switchover, compared to flying mostly longer distances where driving would be less practical. Because of the significant change in ridership between services, comparisons between the services shall use a region's ridership normalized by that service's overall ridership, rather than raw ridership data.

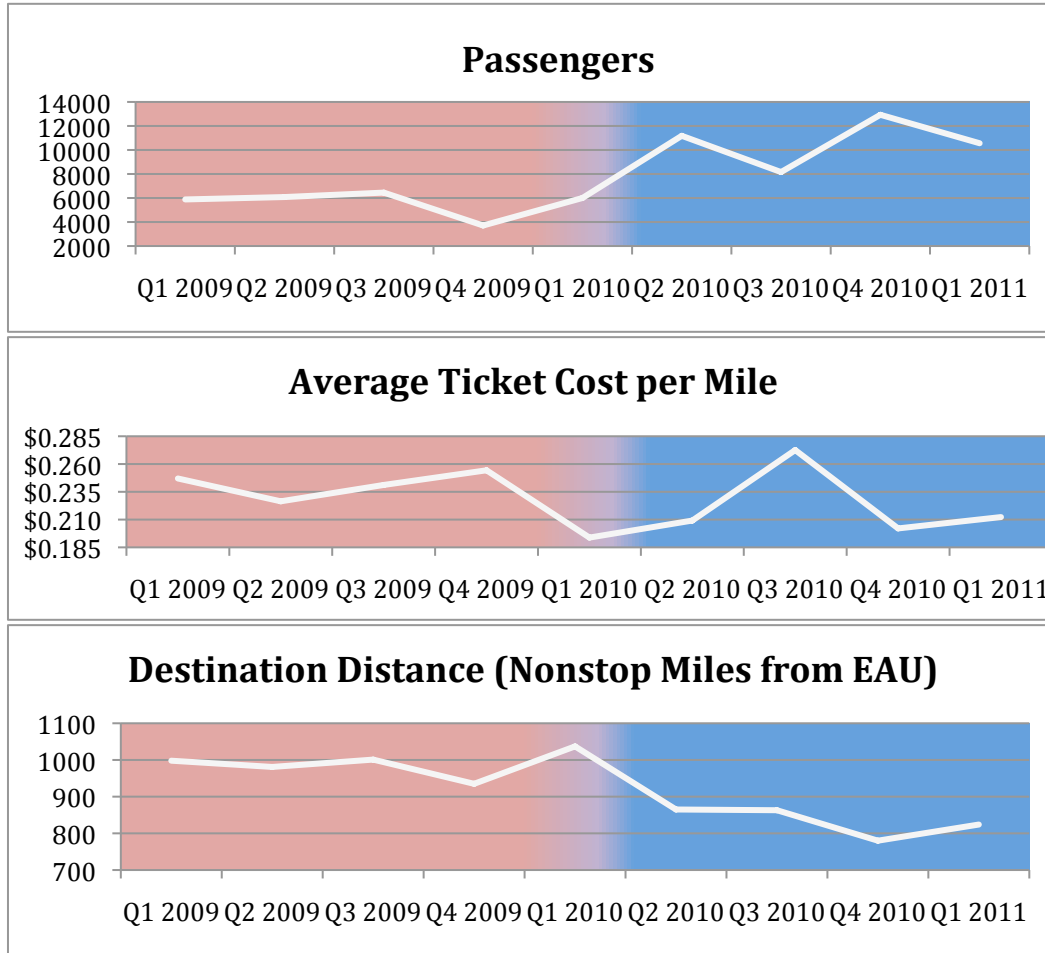


Figure 3: Ridership trends from EAU. Red background indicates Delta Connection service, while the blue half represents United Express service, with the area in between containing a mix of both services during the switch.

Top Destinations

During the entire time period studied, the top destinations were made of cities known for tourism or commerce. Out of approximately 70,810 passengers in total, the most popular destination was with the Sun Country charter flight to Laughlin, NV, with approximately 5,480 passengers. The Washington, DC and Baltimore, MD region followed closely (5,220), followed by Chicago, IL (4,850), New York, NY and Newark, NJ (3,620), Orlando, FL (2,610), and Boston, MA (2,330).

After the switch to United Express service, these top cities (excluding Laughlin, which is only accessible on the Sun Country charters in the first place) have all seen an increase in ridership greater than the increase in ridership brought on by the Chicago service. In other words, based on the results of these top cities, it would seem as though this switchover has caused an increase of ridership to larger cities compared to smaller ones.

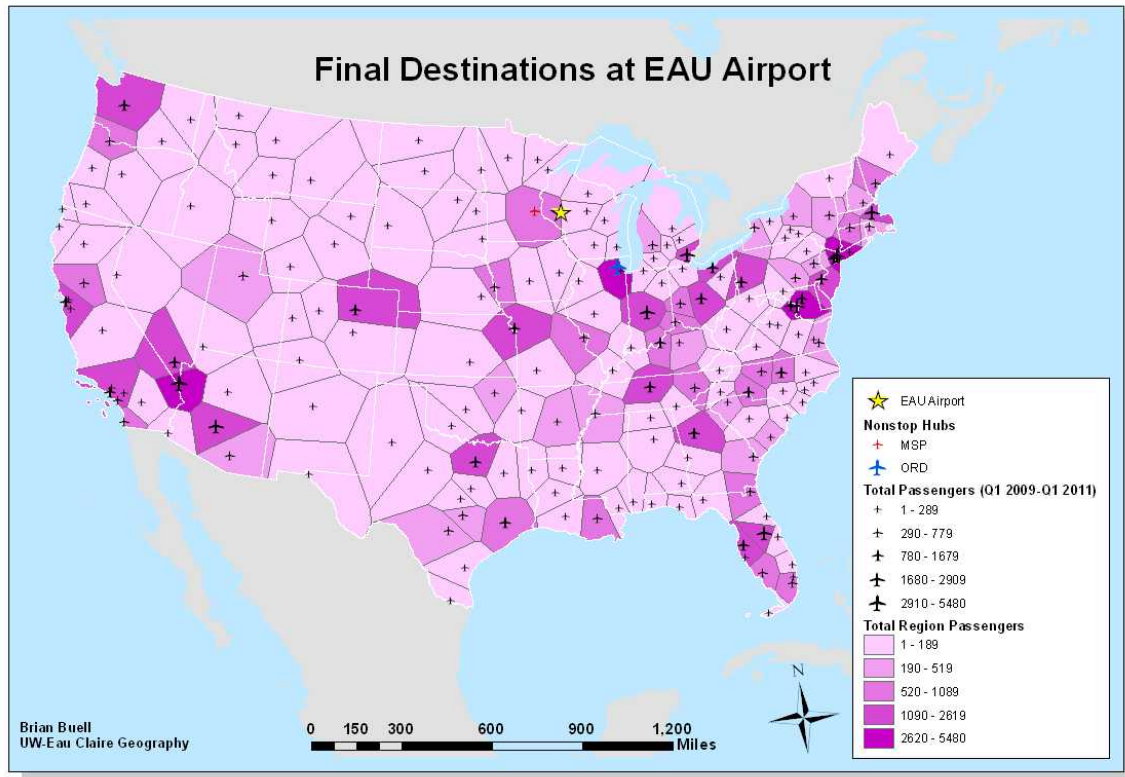


Figure 4: Map of all destination airports and corresponding regions displaying ridership during both services.

Top Destinations (Population Normalized)

When a region's population is taken into consideration, more regions are brought closer to the average level, rather than many extremely low and extremely high ratings. However, larger cities still have a dominating presence on the map. Additionally, cities known for tourism tend to show up more, as they have lower populations. In fact, the top four cities (Laughlin, NV; Orlando, FL; Key West, FL; and Las Vegas, NV) are very distinct cities for their tourism. Portland, ME also has a moderate tourism industry and showed up in seventh place. Other high-ranking cities when normalized for population include Indianapolis, IN; Baltimore, MD and Washington, DC; and Omaha, NE.

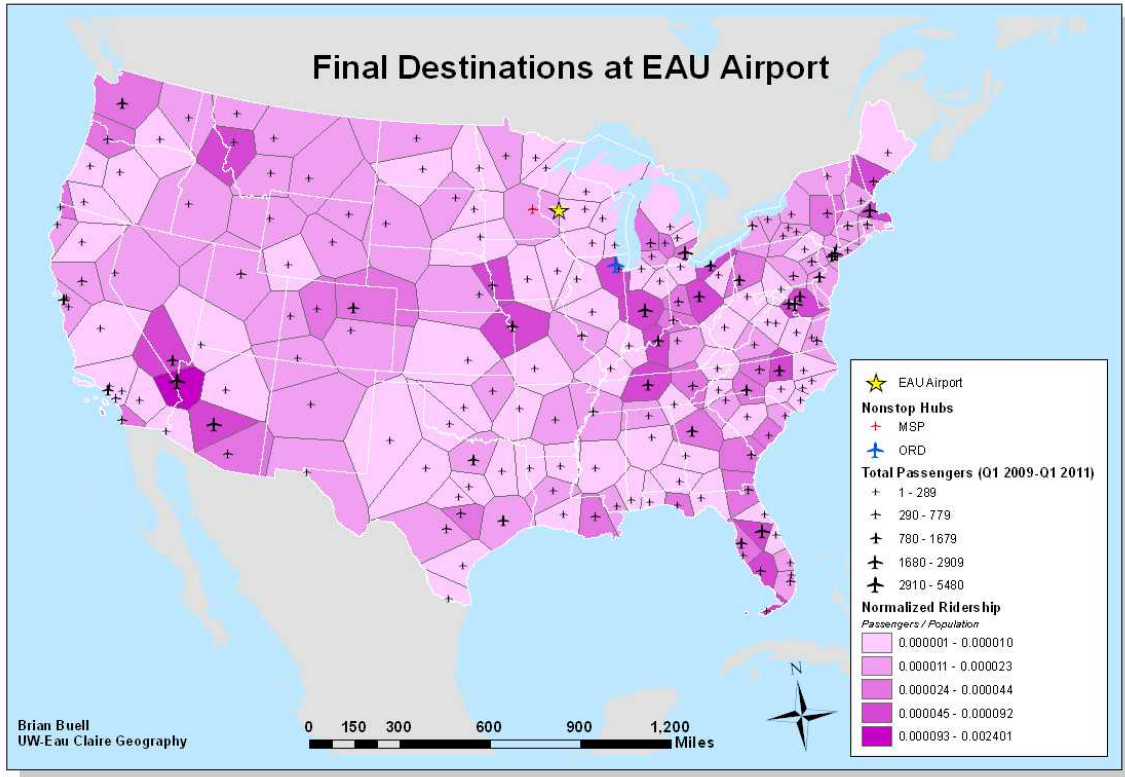


Figure 5: Ridership map normalized for population of a region

Distance's Effect on Ridership

At the beginning of this project, it was assumed that there would be a general trend of more people flying to cities somewhat close to Eau Claire. However, after running an analysis on the correlation of passenger ridership to a region's distance and population, it became quickly apparent that while ridership was closely correlated to population, there was actually very little connection between ridership and distance. Because of this, any analysis regarding distance was determined to be unnecessary and useless in these circumstances.

		Total Passengers	Distance	Population
TotalPassengers	Pearson Correlation	1	.031	.744**
	Sig. (2-tailed)		.690	.000
	N	172	172	172
Distance	Pearson Correlation	.031	1	.110
	Sig. (2-tailed)	.690		.150
	N	172	172	172
Population	Pearson Correlation	.744**	.110	1
	Sig. (2-tailed)	.000	.150	
	N	172	172	172

** . Correlation is significant at the 0.01 level (2-tailed).

Figure 6: Correlation of Passengers, Distance, and Population

Changes in Ridership Patterns Caused by Airline Changes

After the switch from Delta Connection to United Express service, a surprisingly distinct pattern emerged. In addition to top destinations gaining ridership, destinations in the eastern half generally had greater ridership, while the western half seemed to lose much of its strength. Within the data given during the quarters studied, some moderately-sized cities like Buffalo, NY; Allentown, PA; and Myrtle Beach, SC started to become a destination for Eau Claire passengers unlike during the Delta period, while other cities like Boise, ID and Panama City, FL no longer had any representation in the dataset (because the BTS dataset only accounts for 10% of tickets, it is possible that some people did fly to these destinations but did not get recorded).

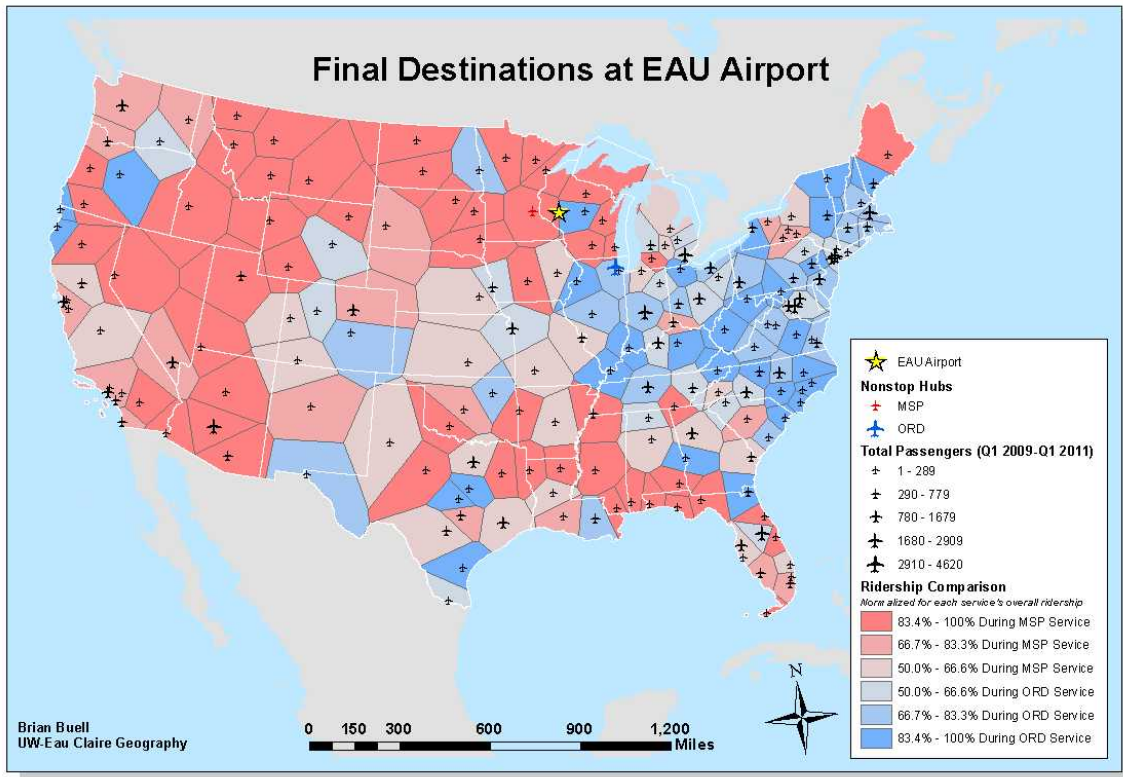


Figure 7: Regional changes in ridership between Delta Connection and United Express services

Next, the study area was grouped based on the closest Delta or United hub. Some spatial patterns are noticeable on the map, such as the United presence in the northeast, but there is not much of a connection between a region's ridership balance and its closest hub's main airline. This is likely because hub airports reach other airports well beyond these regions, especially when the hubs are pretty close to each other. Many cities can be (and are) served by many airlines to multiple hubs, not just the closest one.

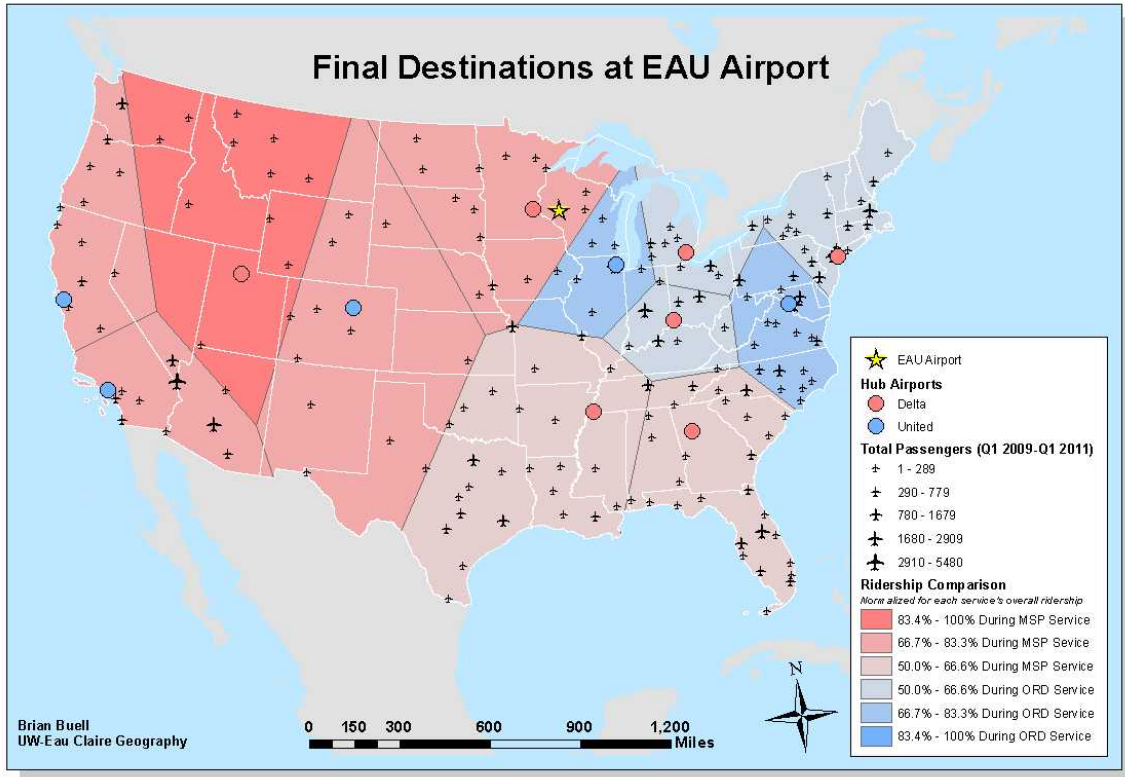


Figure 8: Ridership divided by hub regions

However, there does seem to be a noticeable connection when the study area is divided into the two cities with *nonstop* scheduled service to Eau Claire (that is, Minneapolis and Chicago). While there seemed to be an east-west divide in the previous maps, this seemed to be proven when the country was split into two halves.

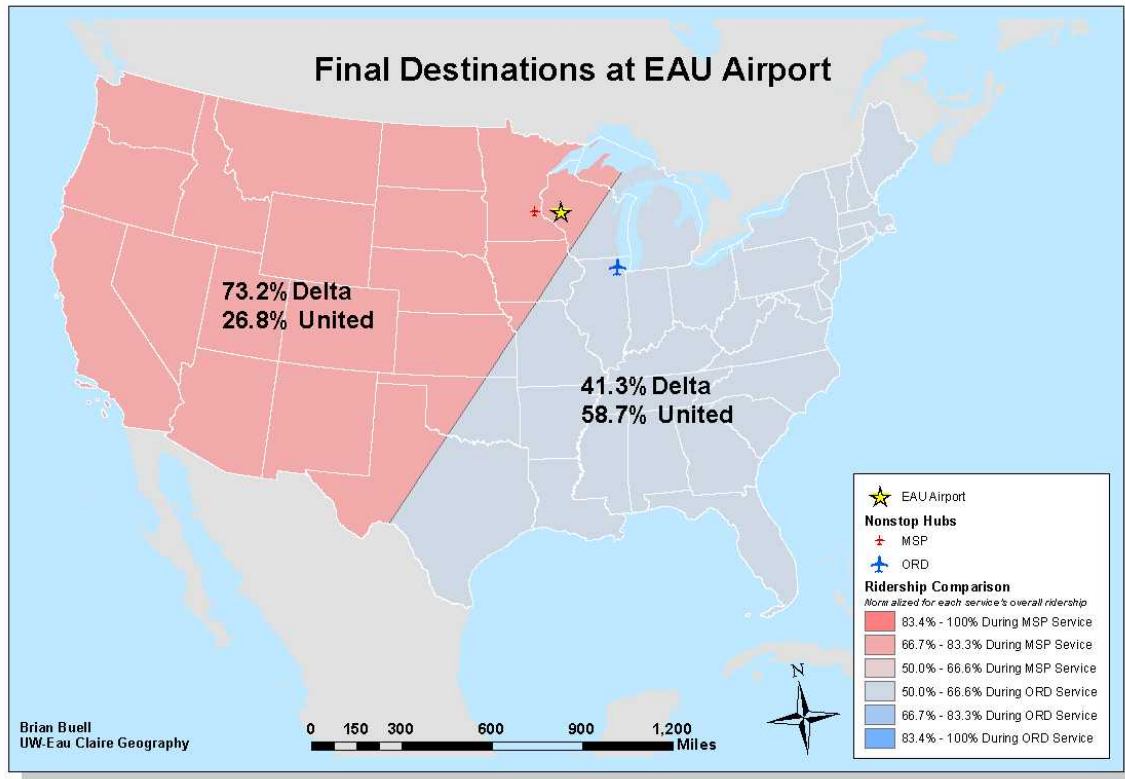


Figure 9: Ridership divided by nonstop service regions

Conclusion

After this project was completed, many patterns were very apparent. Starting with destinations, a very obvious trend exists between the population of a city and its resulting ridership, while distance seems to have a very minimal influence. When normalizing for a region's population and finding higher-than-expected ridership, one can see that tourism is a major driving factor, along with large financially oriented cities.

When examining the spatial effects of a change in service, one can see a general shift in ridership away from smaller cities, as many of the regions with lower populations (especially farther away) saw a decrease in ridership under United Express. A decrease in distance is also quite apparent. Additionally, an eastward shift in ridership is very apparent, with some exceptions scattered in. Hub locations outside of the nonstop hubs do not seem to have much of an impact on ridership in surrounding regions, likely because most cities are generally available through multiple hubs, including Minneapolis and Chicago. For example, Indianapolis has flights to both cities, but has seen an increase under United service even though it is closest to Cincinnati, another Delta hub. Additionally, a similar trend was found through the entire Cincinnati region overall.

Finally, non-spatial effects of the switch are very distinct. Ticket costs per mile have generally decreased, and ridership has increased, generally inversely following ticket prices quite closely.

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