



BUS SYSTEMS ANALYSIS

The **INSTITUTE** for
Public Policy & Economic Development
at Wilkes University

A collaboration among Geisinger Commonwealth School of Medicine, Johnson College, Keystone College, King's College, Lackawanna College, Luzerne County Community College, Marywood University, Misericordia University, Penn State Scranton, Penn State Wilkes-Barre, The Wright Center for Graduate Medical Education, University of Scranton & Wilkes University

Turning Information into Insight

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Turning Information into Insight

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Introduction

In 2017 The Institute for Public Policy & Economic Development published a report entitled “An Analysis of Public Transit Demand in Lackawanna and Luzerne County.” The report investigated the capacity for public transit in the Scranton-Wilkes-Barre area using the Transit Score method. This score is calculated by examining the factors of population density, job density, and the number of households without a vehicle. Thus, the scope of the investigation was focused upon the potential demand for transit across the region.

The report included a comparison of transit usage among 20 cities that were found to have similar qualities to the Scranton-Wilkes-Barre area based on The Institute’s annual Pillars of a Strong Community report. The statistic used to represent transit usage was trips per capita, a measure of the ratio of unlinked trips to total population.

Nine cities with higher transit trips per capita values than the Scranton-Wilkes-Barre area were chosen for comparison in this investigation. This analysis set out to compare transit systems in those cities with the systems found locally. Because they share at least some economic or demographic similarities to Lackawanna and Luzerne Counties as a region, they could provide useful information on what characteristics are found in transit systems that serve similar metro areas successfully, and what aspects of those systems might influence ridership.

Research Methods

Each of the nine comparison regions were identified as having some economic or demographic similarities to the Lackawanna-Luzerne County region. The metropolitan regions are:

- Spokane, WA
- Duluth, MN
- Erie, PA
- Binghamton, NY
- Laredo, TX
- Santa Rosa, CA
- Roanoke, VA
- Utica, NY
- York, PA

Data was collected from the publicly available bus schedules of the urban areas selected for comparison. The variables that will be analyzed here include the number of routes, the start and end time of routes, the frequency of busses, and the days of service of busses. In the analysis below, these characteristics were correlated with trips per capita. Scatter plots of these correlations include linear trendlines as a reference. Utility of this correlation analysis is limited by the small number of cases analyzed, but is demonstrative in showing areas where and how transit characteristics and usage differ between regions. More sophisticated statistical methods were not used due to this limitation.

Only fixed-route bus service was considered. As the focus of this analysis is on regular bus service, bus routes that operate only on weekends or evenings, special-purpose routes with irregular schedules or extended routes with unusually long headways were excluded. Furthermore, Luzerne County Transportation Authority’s night service was not considered, as the data on routes was collected prior to the start of the night service program in Fall 2018.

The number of routes data point was calculated using the total number of routes published on each transit service’s website. This introduces some irregularity as some services may, for instance, consider a

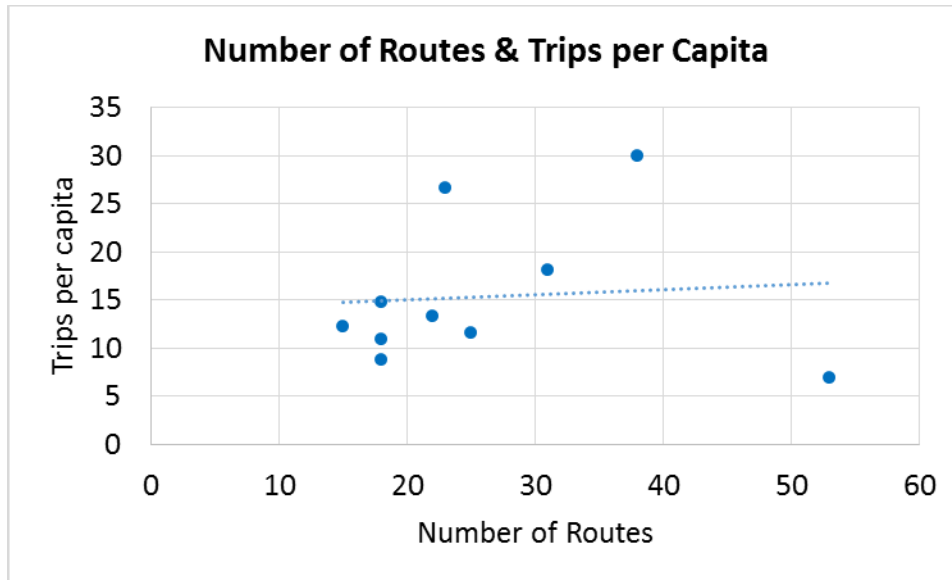
shortened weekend version as a separate route, while others may not. In addition, this number also incorporates routes purposefully excluded from the calculation of other variables. In the process of collecting data on the start and end times of bus routes, the earliest and latest times for each route were selected. In many cases, this means the times in which the first bus leaves the transit center in the morning and the last bus makes its final stop at night. For frequency of routes, the peak AM and PM frequency were chosen for all routes. These often corresponded to a morning or evening rush hour. Frequency was defined as the minimum headway, in minutes, between scheduled buses on routes during AM and PM hours. For days of service, the amount of days each route operates was recorded. Finally, the population, square mileage, and population density data were taken from the U.S. census bureau data for urbanized areas. The trips per capita scores correspond to these urbanized areas, not to be confused with metropolitan areas, which are designated by the census as areas of dense urban population and the surrounding contiguous census tracts that make up the outlying areas. The Scranton urbanized area includes Wilkes-Barre but does not include Hazleton, and as such data from Hazleton Public Transit was not included in this analysis.

Number of Routes

Area	Trips per capita	# of routes	Square Miles	Population
Spokane	30.1	38	164	387,847
Duluth	26.7	23	70	120,378
Erie	18.2	31	82	196,611
Binghamton	14.8	18	74	158,084
Laredo	13.4	22	66	235,730
Santa Rosa	12.3	15	98	308,231
Roanoke	11.6	25	124	210,111
Utica	11	18	62	117,328
York	8.8	18	132	232,045
Scranton	6.9	53	171	381,502

The Scranton urbanized area has notably more routes than any other area mentioned. Its population and area are much greater than every other city than Spokane, but its difference with Spokane may be explained by the fact that the Scranton area includes the urban cores of both Scranton and Wilkes-Barre which both feature independent transit systems operating separately in a separate hub and spoke format, necessitating many branching routes.

The relationship with number of routes appeared to be insignificant as far as trips per capita goes: more routes do not appear to strongly correlate with ridership among the urban areas analyzed. Further, it is evident that the number of routes does clearly scale as population increases, which is similarly related to the geographic dimensions of the area.

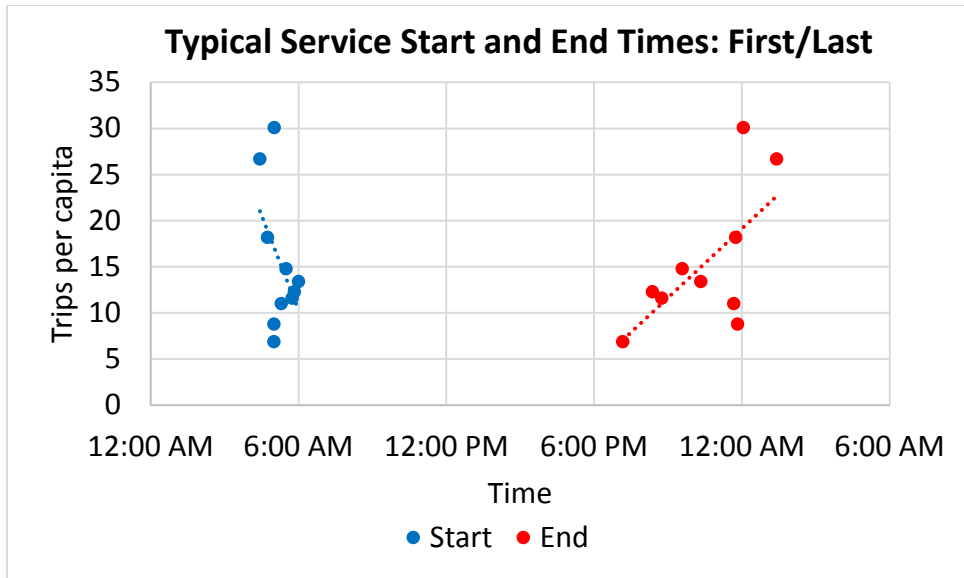


Start and End Times

For each transit service, the earliest and latest times of any one regular weekday route were recorded for the purpose of comparison. The extreme early times were mostly centered on the hour of 5 AM, but there was more variation among extreme end times.

Area	Trips per capita	Earliest Start	Latest End
Spokane	30.1	5:01 AM	12:04 AM
Duluth	26.7	4:26 AM	1:25 AM
Erie	18.2	4:45 AM	11:45 PM
Binghamton	14.8	5:30 AM	9:35 PM
Laredo	13.4	6:00 AM	10:20 PM
Santa Rosa	12.3	5:50 AM	8:22 PM
Roanoke	11.6	5:45 AM	8:45 PM
Utica	11	5:18 AM	11:40 PM
York	8.8	5:00 AM	11:50 PM
Scranton	6.9	5:00 AM	7:10 PM

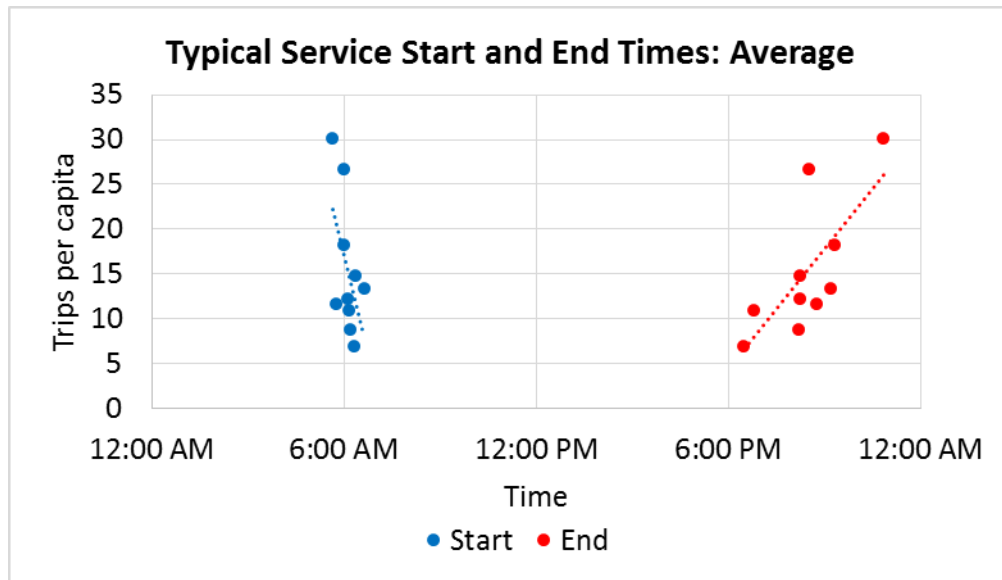
There was a more evident relationship between the latest end time offered by a transit service and ridership, as shown on the chart. Scranton, the urbanized area with lowest trips per capita, had the earliest end time at 7:10 PM, while the cities with the most ridership by far both had end times after midnight; Duluth and Spokane end at 1:25 and 12:04 AM respectively.



The following table provides the average start and end time of each regular weekday route. The average start time among all transit services was 6:06 AM. The average end time, which contained a much larger degree of variability, was 8:26 PM. The earliest and latest end times correspond to the lowest and highest trips per capita among all services. The Scranton area again had the earliest end time, averaging 6:28 PM. Utica was similar, but most other systems had a systemwide average end of service in the 8 or 9PM hour.

Area	Trips per capita	Avg. Start Time	Average End Time
Spokane	30.1	5:38 AM	10:49 PM
Duluth	26.7	5:59 AM	8:28 PM
Erie	18.2	6:00 AM	9:18 PM
Binghamton	14.8	6:22 AM	8:12 PM
Laredo	13.4	6:37 AM	9:10 PM
Santa Rosa	12.3	6:06 AM	8:12 PM
Roanoke	11.6	5:45 AM	8:45 PM
Utica	11	6:09 AM	6:46 PM
York	8.8	6:10 AM	8:10 PM
Scranton	6.9	6:19 AM	6:28 PM

There is an apparent correlation between average end of service time and trips per capita. As the graphs also indicate, there is a clear trend between earlier start times and later end times and higher trips per capita. The end time relationship appears strong, as opposed to that of start times, although this is not surprising due to the lack of variability in start times.

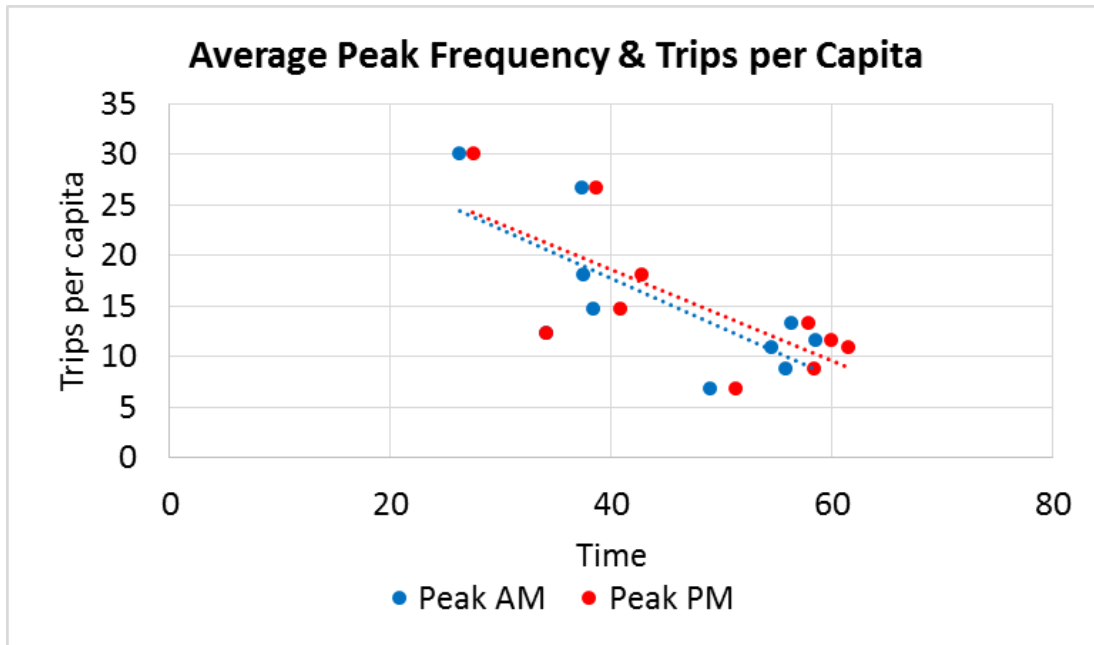


Frequency

Ridership evidently trends to decrease as frequency of busses decreases. In addition, in all cases AM frequency is slightly higher than PM frequency.

Area	Trips per capita	Avg. AM Frequency (min.)	Avg. PM Frequency (min.)
Spokane	30.1	26	28
Duluth	26.7	37	39
Erie	18.2	37	43
Binghamton	14.8	38	41
Laredo	13.4	56	58
Santa Rosa	12.3	34	34
Roanoke	11.6	59	60
Utica	11	55	62
York	8.8	56	58
Scranton	6.9	49	51

Frequency is another variable that literature indicates is highly correlated with transit usage¹. Transit riders typically seek assurance that they will not need to wait excessively long periods for a bus, and could be particularly important in attracting “choice” riders – those who have access to other forms of transportation but who choose to utilize transit. This is an especially important factor with the needs of commuters in mind. The relationships between frequency and trips per capita were found to indicate notable correlations. The four urban areas with the highest trips per capita all had AM frequencies, PM frequencies, or both, that were better than 40 minutes. The Scranton/Wilkes-Barre area averaged 50 minutes, still better than some of its peer cities.



Days of Service

Area	Trips per capita	Average Days of Service
Spokane	30.1	6.70
Duluth	26.7	6.17
Erie	18.2	6.19
Binghamton	14.8	6.50
Laredo	13.4	6.77
Santa Rosa	12.3	7.00
Roanoke	11.6	6.00
Utica	11	5.83
York	8.8	6.39
Scranton	6.9	5.91

In Lackawanna and Luzerne Counties, weekend bus service is limited. A positive but weak correlation was found between days of service and ridership among the transit services analyzed. It is difficult to quantify an effects weekend service has on overall ridership based on this analysis, especially in terms of the utility of transit to commuters. However, several of the urban areas with lower trips per capita, including Roanoke, Utica, and Scranton, averaged less than 6.5 days of service per week across all routes.

Conclusions & Recommendations

The data put forward in this report followed a comprehensive survey of bus schedules for the transit services selected for analysis. Several notable relationships were found between the variables studied and the dependent variable of trips per capita, these being both the first/last and average end times of routes provided by a transit service, as well as the average peak AM and PM frequency. These findings corroborate the ideas present in much of the literature regarding the wants and needs of transit users that cite frequency as one of users' main concerns. Additionally, the findings of this analysis do not indicate a causal relationship between later end times of routes and higher ridership, but this relationship warrants further investigation, especially in the context of the needs of commuters and businesses whose employees work later or irregular shifts and face transportation challenges.

Given the reality of significant limitations on funding available for bus service in Lackawanna and Luzerne, the analysis on total number of routes makes it clear that simply adding more routes to serve more communities may not be the most effective way to increase transit utilization. Prior research by The Institute has also provided evidence in support of this concept.

Instead, it is likely more important to work to expand service frequency and operating hours along key routes and corridors. One strategy to implement this may be to modify the spoke-and-hub approach used for service planning. One city with higher transit ridership per capita, Duluth, Minnesota, aligns parts of several branching routes over the same key corridors at staggered intervals to provide headways as low as 10 to 20 minutes in the urban core.

Evening service is also an important consideration. Progress is already being made in this area, as LCTA has established several night service routes. However, this service does not extend to Lackawanna County, and does not cover the entirety of LCTA's Luzerne County service area at the time of this publication.

Transit operators already face significant challenges in stretching limited resources to provide the best possible coverage, and there is the possibility that resources available for transit in Pennsylvania could be further diminished. As a result, it will be important for all stakeholders to collaborate in order to find creative ways to enhance service frequency and hours where necessary. Public-private partnerships could be an avenue to achieve better service even when state or federal funding is uncertain.

¹ What makes transit successful? Walkable neighborhoods and fast, frequent service. (2016, July 12). Retrieved July 25, 2018, from <http://transitcenter.org/2016/07/12/what-makes-transit-successful-whos-on-board/>



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