Transit Signal Priority Analysis:

Route 54 and Route 84

Chelsey Palmateer **Mentor: Gary A. Davis**

This project was supported by the University of Minnesota's Undergraduate Research Opportunities Program.

Signal priority and preemption devices have long been used by emergency vehicles to prevent or mitigate delays in emergency response due to the presence of signalized intersections. Preemption devices cancel he cycle and immediately switch to the requested phase; in contrast priority devices simply extend the length of the desired phase within the cycle at the expense of shortened lengths for the other phases. In an attempt to incentivize transit options and increase ridership many transit options have been provided with signal priority as well.

Traditional signal priority devices request that priority be granted when a vehicle is within a certain distance of the intersection which is beneficial for buses traveling through the intersection without stopping including those making far-side stops which need to pass through the intersection before they stop to drop off or pick up passengers . However, much of the benefit of a priority device is lost if the bus is making a near-side stop at the intersection, where the bus stop is immediately before the intersection. In such cases the bus often requests priority before it is needed and as a result the granted request may expire before it may be used.

Due to the large percentage of near-side stops in Minnesota and the increasing desire to have priority options for buses; researchers at the University of Minnesota have developed a new type of priority device which allows transit vehicles to wait until they are prepared to travel through the intersection before requesting priority. This study is intended to provide a basic evaluation of whether or not two specific Metro Transit bus routes might benefit from the use of such a devices over the traditional model.

Evaluation of the two bus routes is based on the percentage of overall stops which are near-side for each route as well as a demonstration that the near-side stop generally consumes more time than the far-side stop, even without the use of a priority device that provides unequal advantage to the far-side stop. Note that this type of demonstration could only be provided at stops where both a near and a far side stop occur at the same intersection and timing data was available, as this was accomplished by modeling the time spent at existing stops.

Modeling Procedure

Time at far-side stops were modeled to fit the following parameters:

$$T = Ax_b + Bx_a + C\alpha + D$$

x_b: *number of passengers boarding*

x_a: *number of passengers alighting*

α: 1 *if there is any passenger movement*

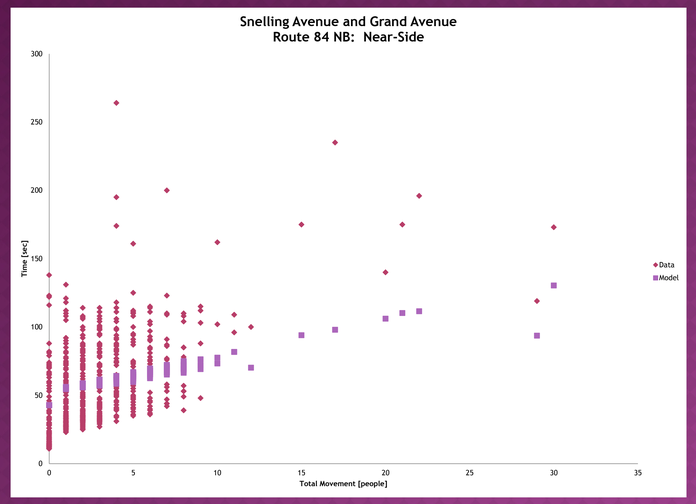
0 *otherwise*

Where A is the time it takes for a passenger to board, B is the time it takes for a passenger to alight, C is the time which results from the bus needing to stop in order to allow for passenger movement, as stopping and restarting take time, and D is representative of the average time necessary to cross the intersection, which accounts for delay due to the intersection. These parameters are held constant in the near-side time model, while an additional parameter E is optimized to represent the difference in the time spent at the intersection due to the type of stop being near-side rather than far-side.

$$T = Ax_b + Bx_a + C\alpha + D + E$$

Comparison of Representative Near-Side and Far-Side Stops which Occur at the Same Intersection

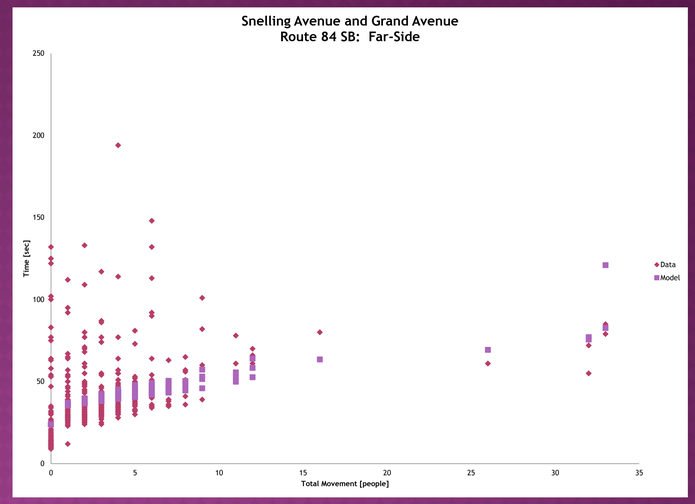
Snelling Ave. & Grand Ave.



$$T = 2.71x_b + 1.29x_a + 10.47\alpha + 23.80 + 19.04$$

Route 84
154 existing stops

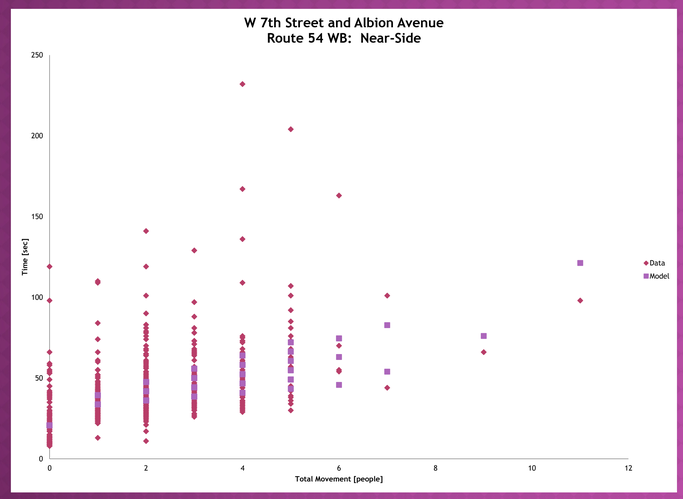
72.7% Near-side
14.3% Far-Side
13.0% Other



$$T = 2.71x_b + 1.29x_a + 10.47\alpha + 23.80$$

Route 84 buses would likely benefit from the use of a signal priority device which allows flexibility in the timing of the priority request. This is due to the significant percentage of near-side stops as well as the demonstrated discrepancy between the time required to make a near-side stop and the time required to make a far-side stop at the intersection of Snelling Avenue and Grand Avenue.

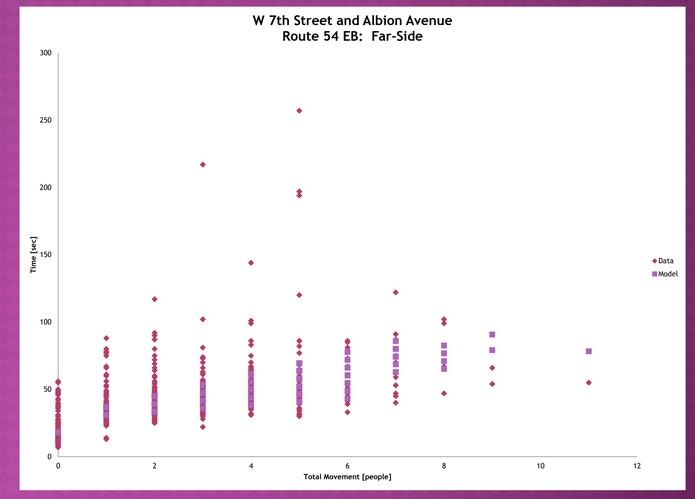
W 7th St. & Albion Ave.



$$T = 8.18x_b + 2.43x_a + 10.43\alpha + 18.14 + 2.64$$

Route 54
61 existing stops

44.3% Near-side
31.1% Far-Side
24.6% Other



$$T = 8.18x_b + 2.43x_a + 10.43\alpha + 18.14$$

Route 54 buses would likely benefit from the use of a signal priority device which allows flexibility in the timing of the priority request. This is due to the significant percentage of near-side stops as well as the demonstrated discrepancy between the time required to make a near-side stop and the time required to make a far-side stop at the intersection of W 7th Street and Albion Avenue. However, the benefit will likely not be as pronounced as for Route 84, due to the lower percentage of near-side stops for Route 54 than Route 84.