MAT 210
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Predicted Effects of Roundabouts and Road Connections on Main Street Traffic in Davidson, NC

The Town of Davidson is implementing three traffic infrastructure improvements to alleviate rush hour traffic on Main Street. These changes include:

1. A roundabout at the intersection of Griffith Street and Beaty/Sloan Street
2. A roundabout at the intersection of Potts Street and South Main Street.
3. A new road connection linking Potts Street and Sloan Street

Problem/Goal

Main Street frequently experiences congestion during rush hour (5–6 PM), causing short trips to take longer than expected. The new features aim to improve traffic flow and provide an alternative route through the connection of Potts St and Sloan St. Our goal was to determine the effects that new construction will have on Main Street traffic during rush hour. We determined the best way to represent traffic conditions is the average time it takes for a car to travel through the Main St. system.

Our Model:

We set up a discrete-event simulation in Python to represent Main Street traffic. This ‘gameboard’ does the following:

- Cars enter the system according to a Poisson process based on the data we gather, and move through each segment
- Each road segment is represented as an array, with positions on the road that cars can occupy
- Each second, cars move up at approximately a 10mph speed if there is room for them to fit ahead
- Cars proceed through intersections when permitted, such as during a green light or when it is their turn at a stop sign
- The car’s total commute time is logged after it exits the system

We ran two versions of this model: pre and post-construction (all 3 improvements implemented).

Results:

Graphs showing the average travel time across 100 simulation runs are provided on page 3. Overall, we noticed a **10%** reduction in the average time each vehicle would take to reach its destination in the system. Most of that reduction was achieved through the reduction in the Griffith → South Main Street route because cars traveled through the Potts-Sloan connection, but other routes were also positively impacted. The one negatively impacted route (Main North → Main South) was negative because we modeled the driver's tendency to avoid traffic and stoplights. Instead of Main, cars traveled on Beaty St. and the Potts-Sloan connection..

Our team considers this result conservative, recognizing the limitations of the various assumptions and simplifications made. The most important is the lack of dynamic light cycles that can adapt to cars waiting and not traveling through the current lights. Even with the model's restrictions, the difference in the model's times can be considered significant. Also, the commute time will likely be decreased even more when cars are moving faster than 10mph.

Strengths:

- Easily Customizable - The system can be easily adjusted or expanded if more data is collected, or more is required of it
- It models the whole Main St. system
- Accounts for random chance through the Poisson process
- Accuracy – The original model accurately reflects current traffic trends.

Weaknesses:

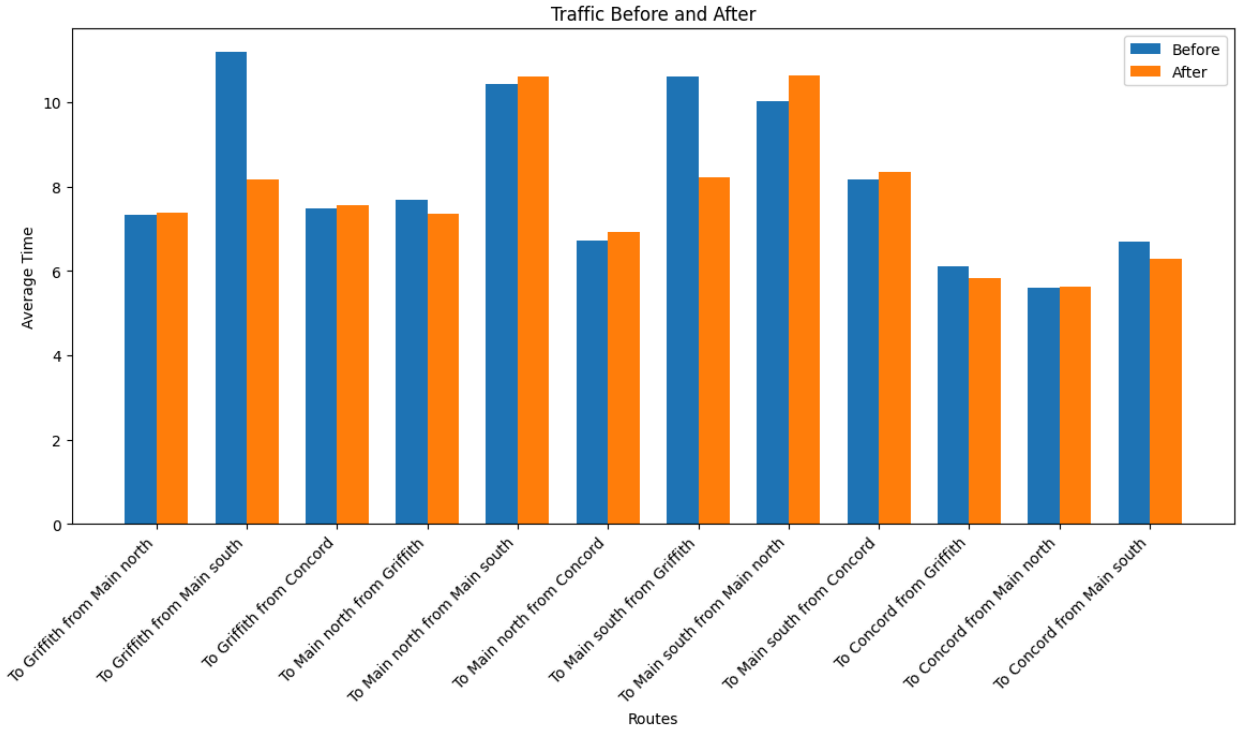
- A car's speed is locked at approximately 10 mph
- Fixed stoplight times that don't change when traffic flow is changed
- Doesn't account for differences in driver behavior
- Several assumptions were made to simplify our model

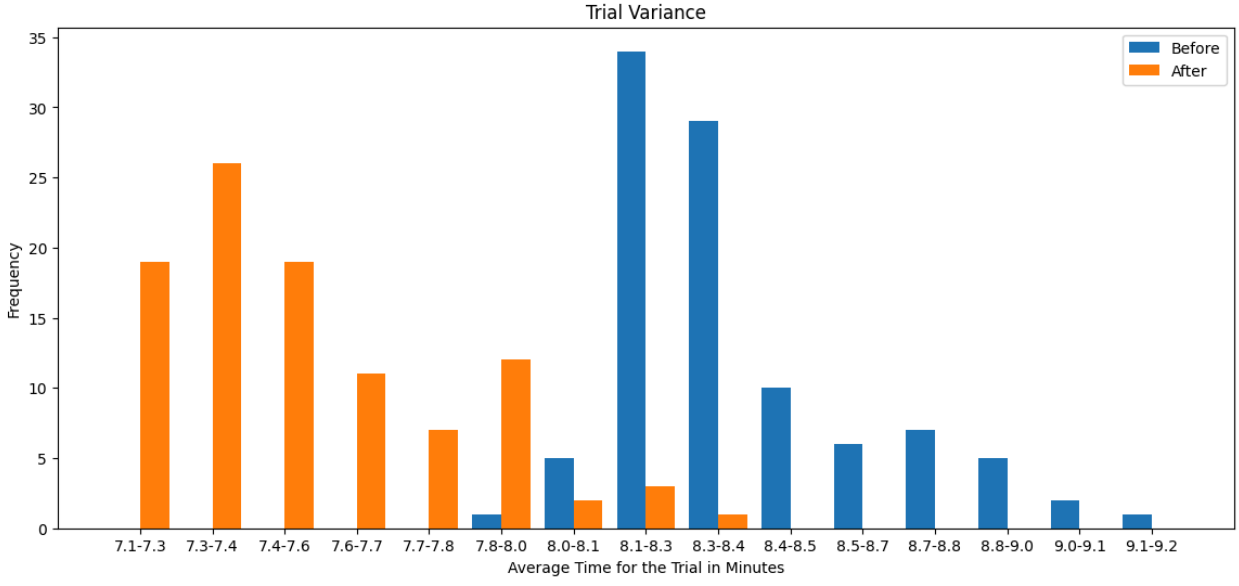
Conclusion + Recommendation:

We recommend continuing with the project as it will likely reduce travel times moving through Davidson by at least 10%, if not more. More information is available in the full paper, which can be requested from Dr. Chartier or by email at jadurcan@davidson.edu.

Field work and our model noted that a left turn lane onto Concord from Main Street could also lessen traffic through the system, as many cars are left waiting behind left turners, backing up the whole system.

It is also worth considering that more cars will be incentivized to travel through Beaty Street, a residential area.


Traffic Before and After
Before
After
Average Time
0
2
4
6
8
10
To Griffith from Main north
To Griffith from Main south
To Griffith from Concord
To Main north from Griffith
To Main north from Main south
To Main north from Concord
To Main south from Griffith
To Main south from Main north
To Main south from Concord
To Concord from Griffith
To Concord from Main north
To Concord from Main south
Routes


Trial Variance
Before
After
Frequency
0
5
10
15
20
25
30
35
7.1-7.3
7.3-7.4
7.4-7.6
7.6-7.7
7.7-7.8
7.8-8.0
8.0-8.1
8.1-8.3
8.3-8.4
8.4-8.5
8.5-8.7
8.7-8.8
8.8-9.0
9.0-9.1
9.1-9.2
Average Time for the Trial in Minutes