# Bus Route 3 Simulation Report

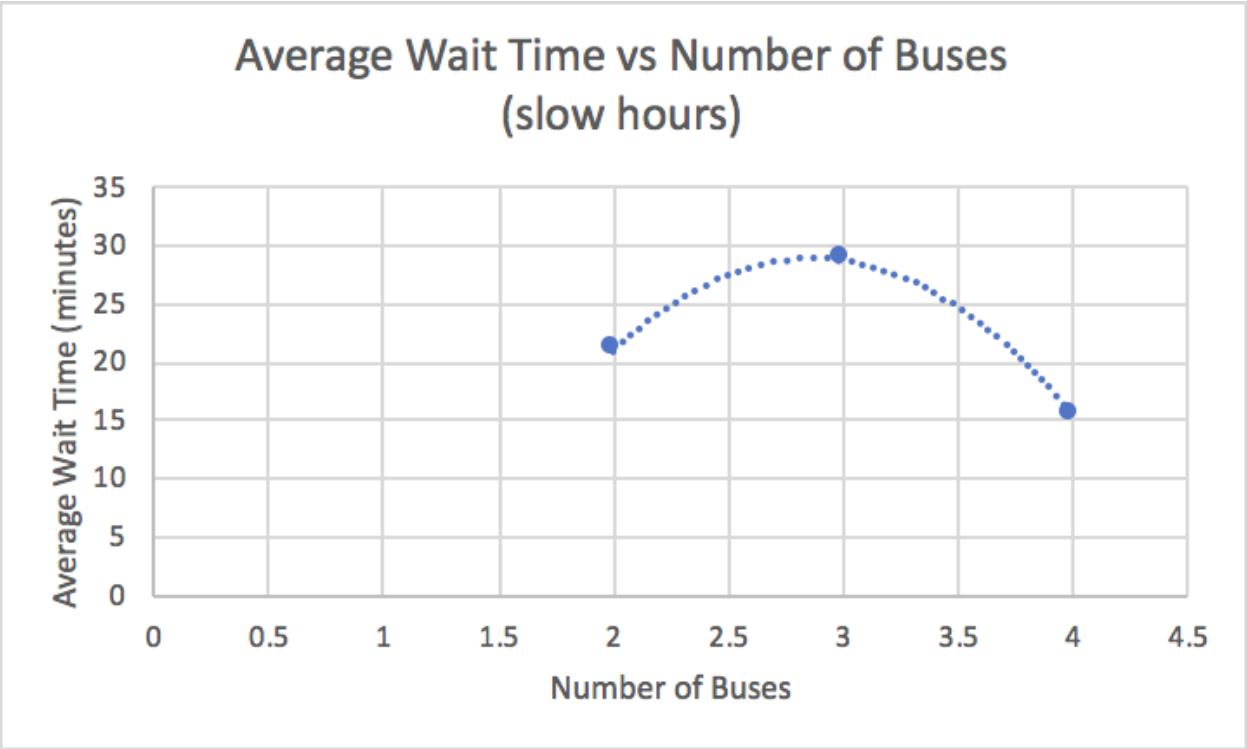
## *The why and how of Statistics Gathered:*

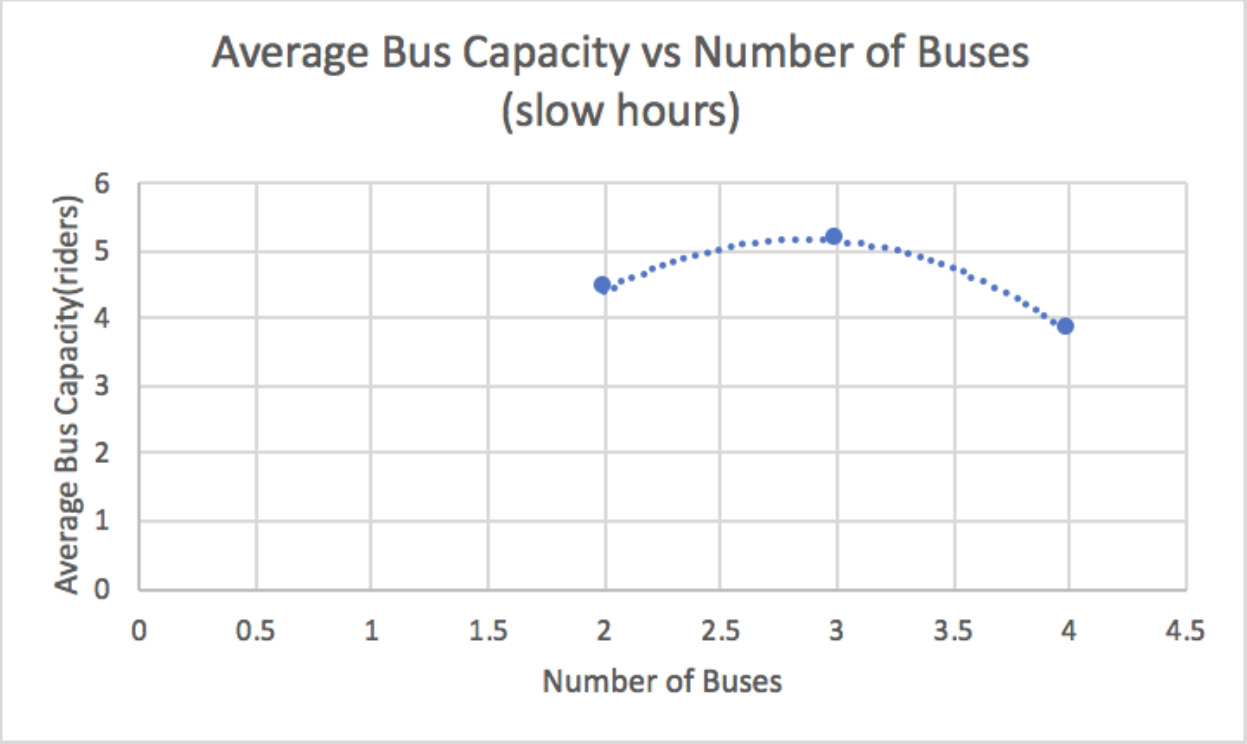
To gather our statistics in a clear and concise manner, first we first prioritized which characteristics of the bus riding experience are the most important for the riders experience and the company's best interest. It was decided that the average wait time is the most important statistic to gather for riders. In our own experience how long the trip is doesn't quite matter as much as the wait time, because once you board a bus you start to feel like you are making progress on your goal of travel. Secondly, the next most important statistic was average total trip time for riders. This is chosen because the average trip time across a city should take no more than an hour. Next, for the companies interest we first took into account that they want the lowest number of buses while still providing a high quality service and minimizing overcrowded buses. This correlates with a medium average bus capacity, and for the sake of this simulation we picked the target average capacity to be 80% of the max capacity for rush hour and 10% for slow hour. Also, we picked max bus stop queue length, this was selected because if a rider has to wait in a long line, it will be a dissatisfying experience for the rider. These four statistics set the foundation for our decision making process. Additional statistics that we gathered include max rider wait time and total number of riders for the duration of the experience.

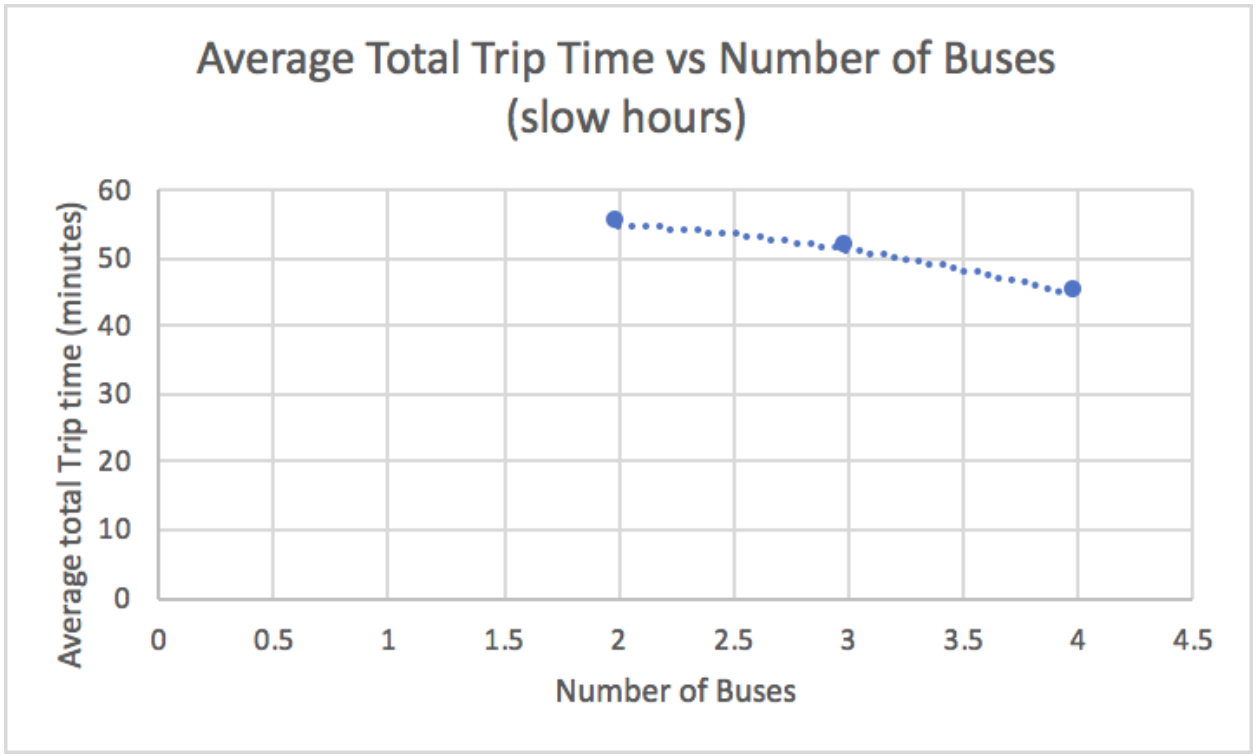
Next we ran our simulation for 8 hours at various loads to simulate 4 hours of real world bus service time. This incongruence is because the beginning statistics taken skews the data after the simulation reaches equilibrium. Running it longer will diminish the effects of the beginning of the simulation. During rush hour we thought 10 seconds would be the most realistic interarrival rate because our rider event only randomly generates 1 rider for a random bus stop out of 30 bus stops. During the slow hours we thought 180 seconds would be the most realistic slow interarrival rate, that is 1 rider at a random bus stop every 3 minutes. We found a range of the most efficient bus loads, then ran the simulation 5 times for each load and averaged each stat in excel. The averages were then graphed in order to be analyzed. The subsequent decision will come out of the data analysis.

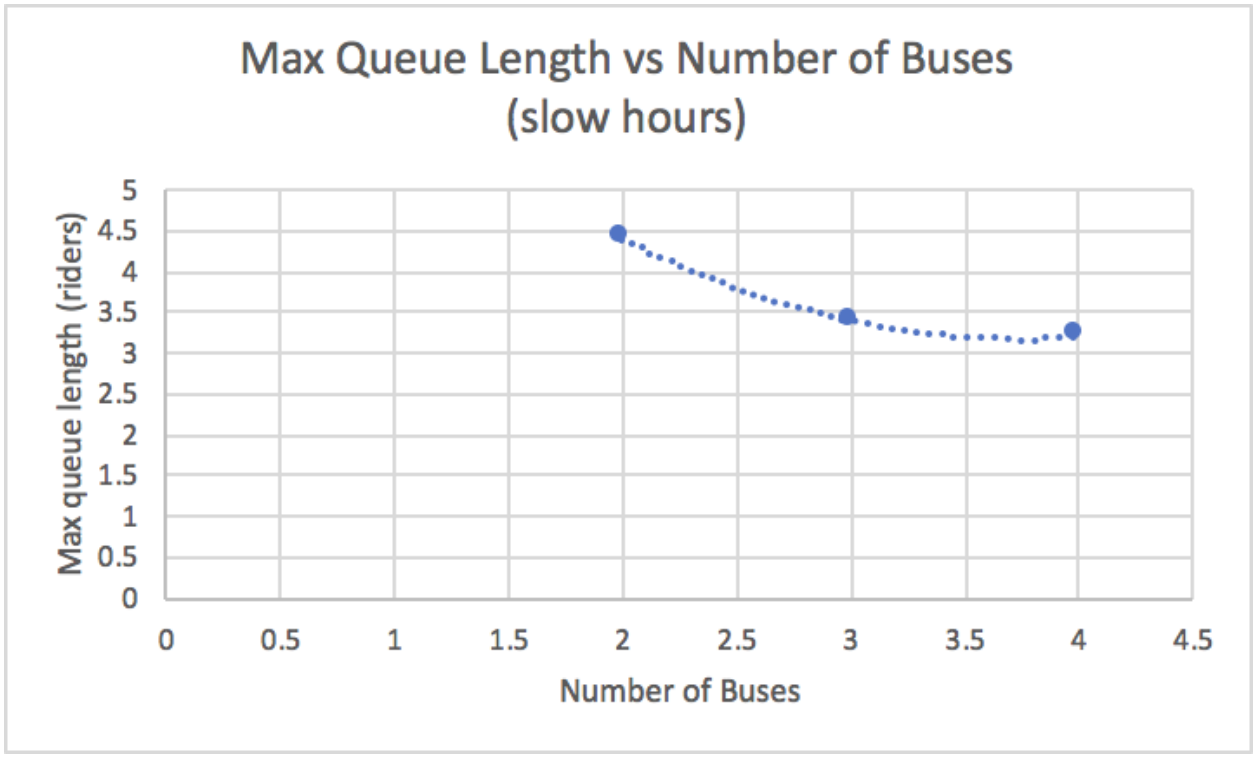
It must also be noted that due to various tests of running the simulation the express buses were not a help to the efficiency of our simulation. In both rush and slow hours the presence of an express bus made all the statistics worse off.

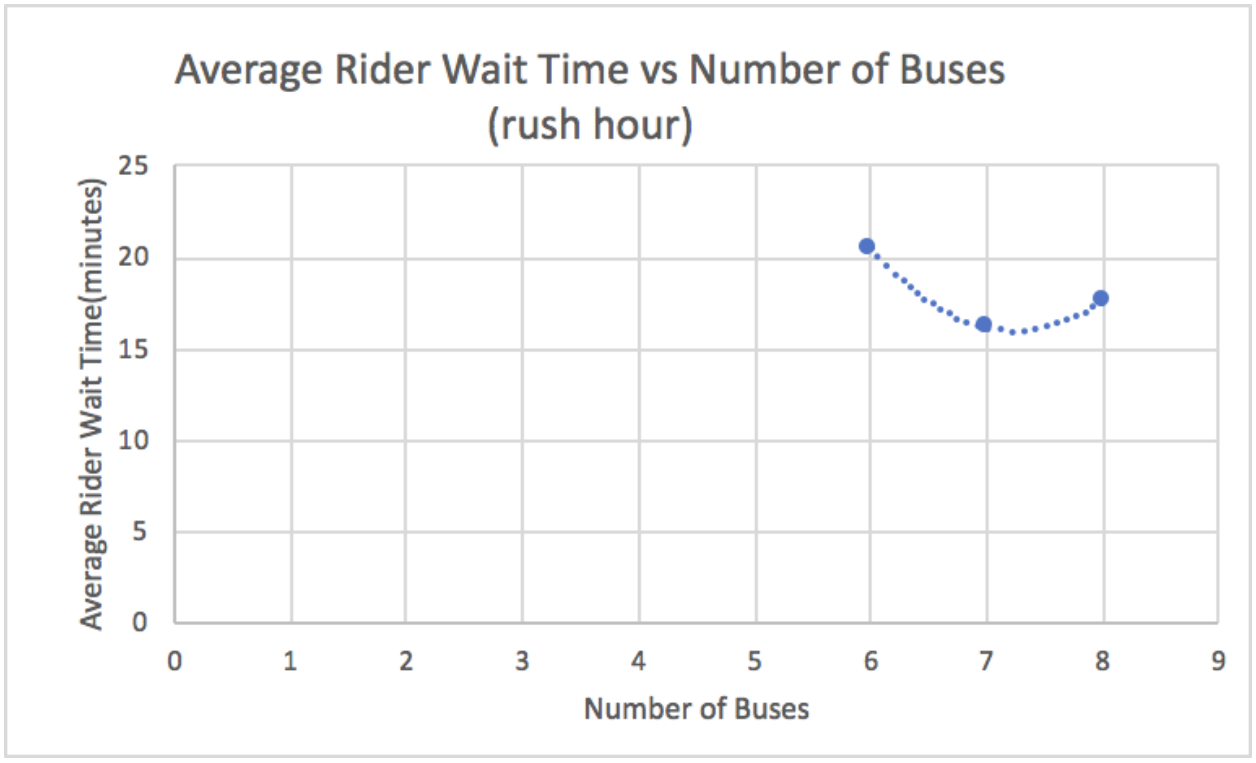
***Data and Analysis:***

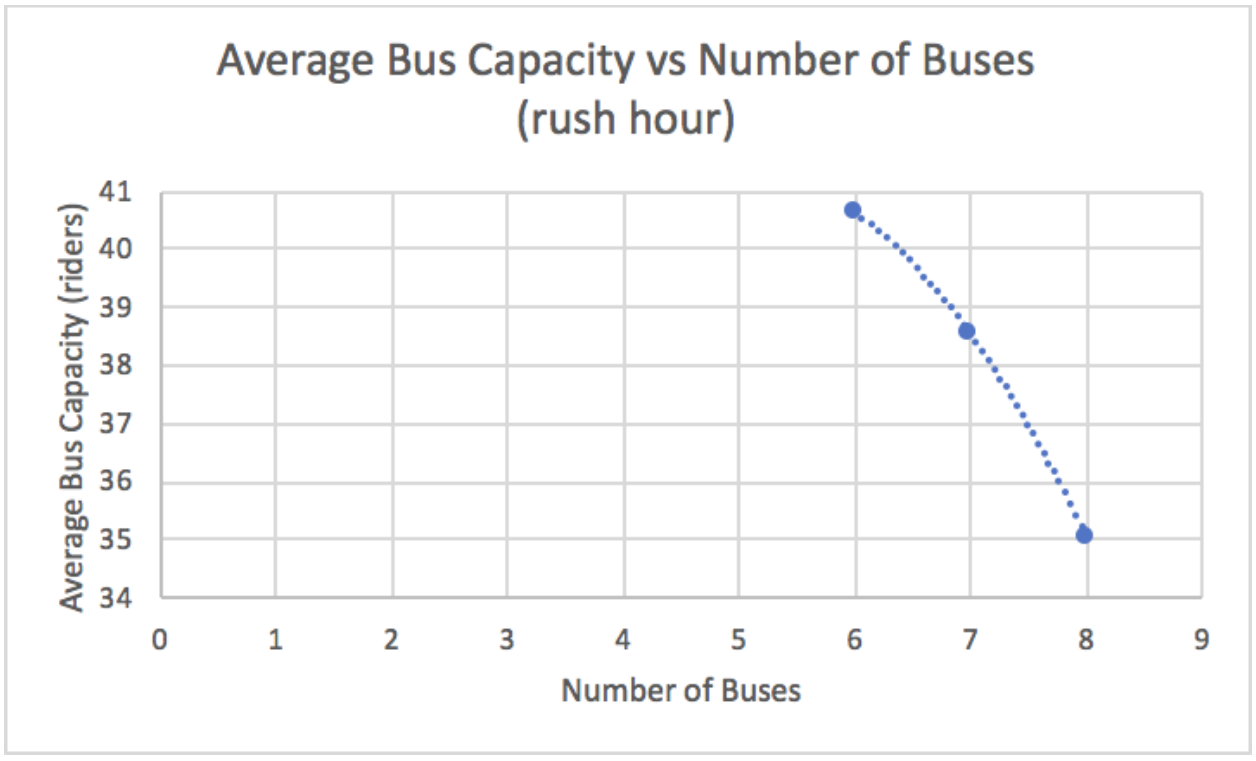


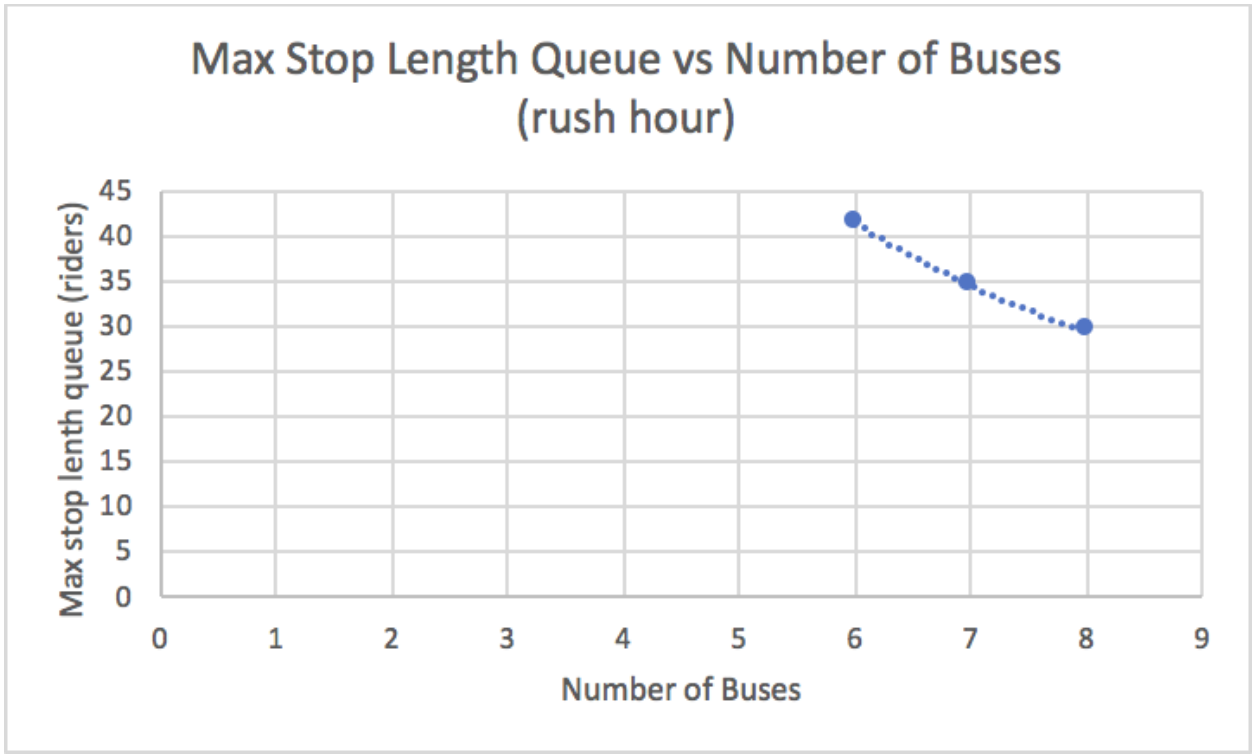



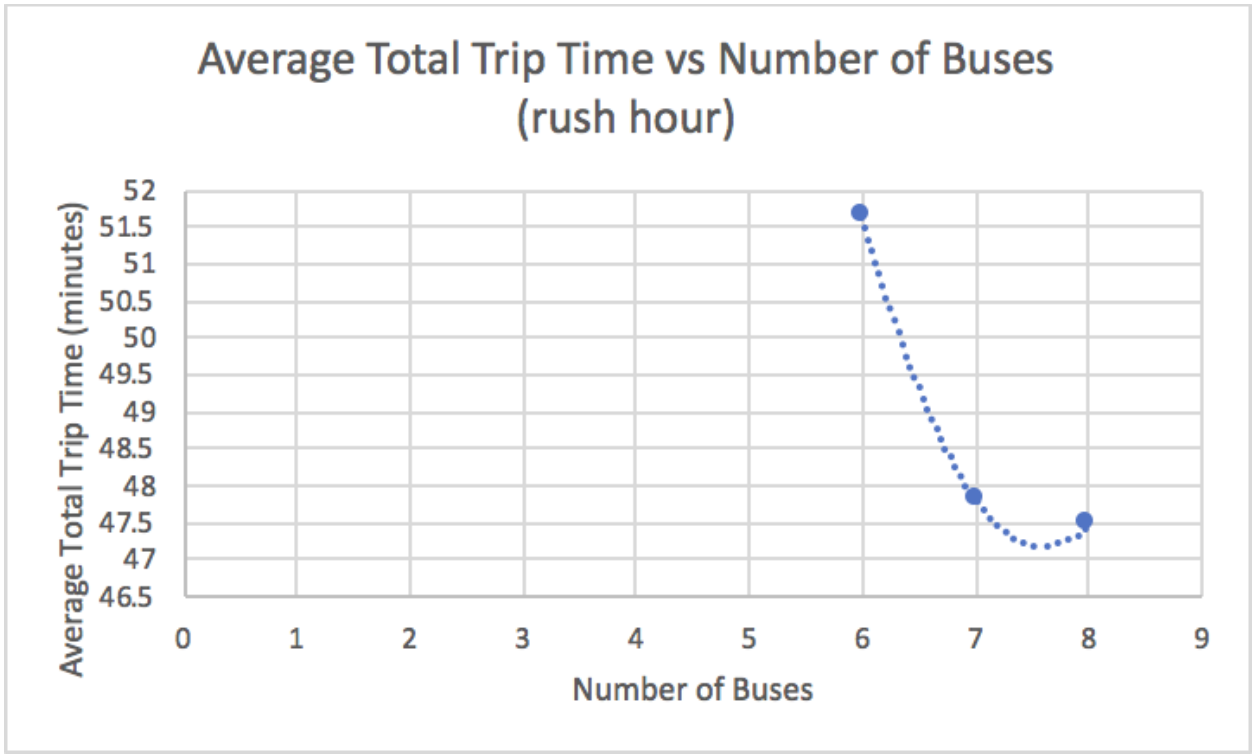

Average Total Trip Time vs Number of Buses
(slow hours)
Average total Trip time (minutes)
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Number of Buses


Max Queue Length vs Number of Buses
(slow hours)
Max queue length (riders)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
Number of Buses


Average Rider Wait Time vs Number of Buses
(rush hour)
Average Rider Wait Time(minutes)
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
Number of Buses


Average Bus Capacity vs Number of Buses
(rush hour)
Average Bus Capacity (riders)
41
40
39
38
37
36
35
34
0
1
2
3
4
5
6
7
8
9
Number of Buses


Max Stop Length Queue vs Number of Buses
(rush hour)
Max stop lenth queue (riders)
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
9
Number of Buses


Average Total Trip Time vs Number of Buses
(rush hour)
Average Total Trip Time (minutes)
52
51.5
51
50.5
50
49.5
49
48.5
48
47.5
47
46.5
0
1
2
3
4
5
6
7
8
9
Number of Buses

## ***Conclusions:***

It was concluded that the optimal amount of buses during peak hours is 7 regular buses, and the optimal amount of buses during slow hours is 3 regular buses. It was found that no express buses are necessary, and that with additional express buses, the average wait time for riders increased, and the average bus capacity was much lower. Thus, it was concluded that in order to optimize Bus Route 3, which ultimately yields maximum *Passenger Miles Per Gallon* (PMPG). The quantities for buses during slow and busy periods were acquired after paying special attention to the average wait time for riders and average bus capacity. It was found that these two statistics were the largest indicators as to an optimal simulation. It was concluded that average wait time was a better indicator of an optimal simulation than average total travel time because average total travel time can be skewed if a rider's destination is many stops away from where they began. Thus, the average wait time is a good indicator of an optimal simulation, because riders do not want to have to wait very long at a bus stop. Therefore, 7 regular buses during peak hours and 3 regular buses during slow hours induced the highest average bus capacity with the lowest average wait time.