Optimizing Campus Mobility with a focus on Sustainability: A Graph Theory Approach to Intra-Campus Transportation Networks

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Optimizing Campus Mobility with a focus on Sustainability: A Graph Theory Approach to Intra-Campus Transportation Networks
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IMPLEMENTATION AND RESULTS

From our model of 257 shuttle runs per day, we generated 5 sets of shuttle runs to model a regular school week. With a total of 1285 total shuttle runs per week, we were able to generate graphs that demonstrate the differences between the current shuttle route and our proposed route. Figure G shows counts of each route chosen by Dijkstra’s algorithm in our graph theory model. In total, our algorithm chose the augmented graph 1057 out of 1285 times, resulting in an 90% choice rate rather than 228 out of 1280 choices for the current route, a mere 10% choice rate as shown in Figure G. Moreover, through a 5 day average, our model depicts an average savings of 1.20 minutes per shuttle run. This can be translated to savings of 308.4 minutes per day and 1542 minutes per week. With 2 semesters that each run 17 weeks long within a typical university fiscal year, this savings can then be extended to a total of 52,428 minutes (or 873.8 hours) over the duration. In addition to this, the shuttle system runs at about half rate during the summer sessions. This then adds another 10,794 minutes, or 179.9 hours. Let’s project that each shuttle costs the university 38 dollars per hour of operation. At this rate, the new shuttle node would save an average of 40,046.6 dollars per year. Over the course of a year, it can be estimated that the entire shuttle fleet is operating at 25 mph for 75% of the time and sitting idle for the other 25%. To operate the shuttle at 25 mph for a period of 750.77 extra hours requires 1,681,724.80 grams of CO₂. To let the fleet sit idle for the other 25% of the time requires an extra 259,264.18 grams of CO₂. These numbers are extremely large and it would be a great service to both our civilization and our planet to reduce and optimize them, not just for our university but for all around the US and abroad (Environmental Protection Agency, 2008).

CONCLUSIONS

Our graph theory model of the UNO shuttle system has produced a sound model that demonstrates areas where the system can be improved and optimized for future users. This project compares the current blue shuttle route to an augmented route proposed in this project. The augmented route contains a new node between PKI and Mammel Hall on 67th street. The implementation of this new node is shown by node in our augmented graph is shown by our model to save an average of 1.2 minutes per shuttle run, which translates to a savings of 308.4 minutes per day, and 1542 minutes per week - based on 257 shuttle runs per day. Overall, the augmented route with a new node in the graph alleviates tensions associated with the shuttles being too slow - and does this in a sustainable manner. In the long run, a savings like this can pay off substantially in terms of fuel consumption, cost, and CO₂ emissions.

REFERENCES