ENCE 472 Final Project:

Group 5

Transportation Alternatives for Brooklyn Park
Overview of Region

Transportation infrastructure

- Surrounded by Interstates
- MD Route 2 runs through center
- MTA Route 014: AACC/Quarterfield to Patapsco Rail station
- MTA Route 064: Riviera Beach to North Ave.

4.3 square miles
Problem Statement

Brooklyn Park has extremely limited public transit

Many residents do not own a car

A new transit solution is required for those who live and work in the area

Limited infrastructure in Brooklyn Park to accommodate new forms of transit
Existing Demographics
Household Income

Household Income Less Than $45,000

Brooklyn Park
Transit Commute Time

Average Transit Commute Times of 60+ Minutes

Brooklyn Park
Review of Prior Work

Guidelines for Enhancing Suburban Mobility Using Public Transportation

Journal of Advanced Transportation

Demand-Responsive Transportation Systems and Services

A Guide for Planning and Operating Flexible Public Transportation Services

Integration of Fixed and Flexible Route Bus Systems
Method

Utilize academic studies written by Dr. Schonfeld and Dr. Chang

Develop alternatives -- fixed, flexible, and integrated routes

Test alternatives with academic data

Run alternatives with real world inputs

Output optimal number of seats, total cost per route per day, spacing, service areas, and headways for either peak or off-peak hours
Model

Optimal Seats Found!
Now calculate corresponding headways, spacing's, and costs as appropriate...
MATLAB DEMO
# Results

<table>
<thead>
<tr>
<th>Optimal Integrated Route during peak travel:</th>
<th>Optimal Integrated Route during off-peak travel:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Daily Cost: $5645.58 per day</td>
<td>Total Daily Cost: $5645.58 per day</td>
</tr>
<tr>
<td>Total Yearly Cost: ~$1411645.44 per year</td>
<td>Total Yearly Cost: ~$1411645.44 per year</td>
</tr>
<tr>
<td>Fixed Route Spacing: 0.89581 miles</td>
<td>Fixed Route Spacing: 0.89581 miles</td>
</tr>
<tr>
<td>Flexible Zone Area: 1.5048 square miles</td>
<td>Flexible Zone Area: 2.3888 square miles</td>
</tr>
<tr>
<td>Headway (fixed route): 9.6747 minutes</td>
<td>Headway (fixed route): 9.6747 minutes</td>
</tr>
<tr>
<td>Headway (flexible route): 8.6389 minutes</td>
<td>Headway (flexible route): 10.8843 minutes</td>
</tr>
<tr>
<td>Number of Seats: 26 seats</td>
<td>Number of Seats: 26 seats</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optimal Flexible Route during peak travel:</th>
<th>Optimal Flexible Route during off-peak travel:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Daily Cost: $5716.65 per day</td>
<td>Total Daily Cost: $5716.65 per day</td>
</tr>
<tr>
<td>Total Yearly Cost: ~$1429162.15 per year</td>
<td>Total Yearly Cost: ~$1429162.15 per year</td>
</tr>
<tr>
<td>Flexible Zone Area: 1.2463 square miles</td>
<td>Flexible Zone Area: 1.8891 square miles</td>
</tr>
<tr>
<td>Headway (flexible route): 5.6237 minutes</td>
<td>Headway (flexible route): 6.46 minutes</td>
</tr>
<tr>
<td>Number of Seats: 36 seats</td>
<td>Number of Seats: 31 seats</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optimal Fixed Route during peak travel:</th>
<th>Optimal Fixed Route during off-peak travel:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Daily Cost: $5732.93 per day</td>
<td>Total Daily Cost: $5732.93 per day</td>
</tr>
<tr>
<td>Total Yearly Cost: ~$1433231.49 per year</td>
<td>Total Yearly Cost: ~$1433231.49 per year</td>
</tr>
<tr>
<td>Fixed Route Spacing: 0.93224 miles</td>
<td>Fixed Route Spacing: 1.1745 miles</td>
</tr>
<tr>
<td>Headway (fixed route): 11.1869 minutes</td>
<td>Headway (fixed route): 14.0946 minutes</td>
</tr>
<tr>
<td>Number of Seats: 38 seats</td>
<td>Number of Seats: 30 seats</td>
</tr>
</tbody>
</table>
MSTM Changes
Recommendations: Integrated Route

Fixed-route service

- Peak hour service (7AM-9AM, 4PM-6PM)
  - 0.9 mile spacing
  - 10 minute headways

Advantages

Flexible-route service

- Off-Peak hour service (5AM-7AM, 9AM-4PM, 6PM-11PM)
  - 2.5 square mile service zone
  - 10.9 minute headways

Advantages
Peak Hours: Fixed-Route Service

4 stops throughout neighborhood

- Spaced according to the ideal stop spacing (0.9 miles)

Overlap with MTA route 014 at intersection of MD Route 2 and Townsend Ave.

Overlap with MTA route 064 at intersection of MD Route 2 and Patapsco Ave.

Route details

- 45 minute round-trip time, 14.2 miles

- Delay time of around 30
Peak Hours : Fixed-Route Service (cont’d)

Terminates at intersection of Charles St. and Conway St.

Alternative transportation options and attractions close

Camden Yards Light Rail station (7 mins)
Charles Center Station (9 mins)
HarborPlace (7 mins)

Many employers within walking distance
Off-Peak Hours: Flexible-Route Service

Route Deviation strategy

Same set route as fixed-route

May deviate ¾ mile to serve pickup/drop-off requests

Call-in system

Mandated by ADA

Route details

45 minute round-trip times (variable depending on deviations)

11 minute headways
Infrastructure Requirements

Additional Bus pads, shelters, and Bus Arrival System recommended

Bus shelters ~$2,000 or more

Complete Stop with pad ~$10,000¹

Must be ADA compliant

³. Image on bottom right from google streetview
Bus Layout

From Vuchic Urban Transit and Development:
Environmental Impacts

Buses help to:

- conserve energy - use 8.7% less energy per passenger mile than a typical automobile

- reduce air pollution - emit only 20% as much carbon monoxide, 10% as many hydrocarbons, and 75% as many nitrogen oxides per passenger mile

- Improve traffic flow - reduced number of vehicles on the road improves traffic conditions

Source: Delaware Division of Waste and Hazardous Substances
Cost of Operation

Total cost includes the capital cost of the buses, the bus drivers’ salaries, gas cost, and user cost of time spent waiting and riding the bus.

For the integrated routes:

<table>
<thead>
<tr>
<th></th>
<th>Fixed</th>
<th>Flexible</th>
<th>Integrated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Daily Cost ($)</td>
<td>5,732.93</td>
<td>5,716.65</td>
<td>5,646.58</td>
</tr>
<tr>
<td>Total Yearly Cost ($)</td>
<td>1,433,231.49</td>
<td>1,429,162.15</td>
<td>1,411,645.44</td>
</tr>
</tbody>
</table>

Total daily operating cost - $5,646

Total yearly operating cost - $1,411,645.44
Strengths/Weaknesses

Strengths

Express bus

Currently faster than other transit options

Cheap to implement

Overlap with other forms of transportation

Services area with potentially high demand

Weaknesses

Demand had to be estimated (MSTM model was not as useful)

One-dimensional solution
Conclusion

An integrated bus system is the most cost effective system while still servicing a majority of the community

Optimal routing system that can accommodate peak demand as well as lighter occupancy

Requires a minimum of capital investment on the county’s part for facilities, drivers, and buses
Future Considerations

Expanding Model:

- Multiple periods of analysis
- More accurately simulate demand
- Utilize real world statistics
- Addition of a graphical output
- Addition of GUI
- Calculation of recommended fares as a model output

Further Study:

- Utilize more updated model
- Pull more data from MSTM
- Research updated cost figures
- Utilize AA County Statistical data
- Research alternative forms of transit such as ridesharing, light rail, and cycling
QUESTIONS ?