A Methodological Approach to Evaluating Alternative Rail Transit Pricing Scenarios

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APTA 2012 RAIL CONFERENCE

BACKGROUND

- Summer 2011: MARTA's Office of Research & Analysis tasked with estimating effects of switching from Rail flat fare to distance-based fare, etc.
- Result was method that follows, with example usage for generic Agency "X".

PURPOSE OF THE EXERCISE

What if Agency "X" decided to switch from flat fare pricing to distance-based pricing on Rail?

- How would it affect passenger revenue?
- How would it affect ridership?
- Would there be adverse impacts on protected rider populations?

WHAT DATA ARE NEEDED?

Exercise requires following data types.

- Quantities of trips made from each Rail entry station to each exit station.
- Distance from each entry station to each exit station.
- Fare elasticity factors for both increasing and decreasing fares.
- Trip pattern data with demographics.

COLLECTING THE DATA

Numbers of Rail station-to-station trips (MARTA: from Automatic Fare Collection reports).

- Matrix with number of trips from station A to station B for given time period for all possible station A/B combinations.
- Exclude trips with same station entry / exit, trips with entry only, and trips with exit only.

COLLECTING THE DATA

Rail station-to-station distances (MARTA: from MoW, Track & Structures).

- Matrix with mid-platform to mid-platform distance from station A to station B for all possible station A/B combinations.
- For distances involving line transfers, must be sum of distances to transfer stations.

COLLECTING THE DATA

Fare elasticity factors (MARTA: from recent consultant analysis).

- Use agency-specific fare elasticity: 3+ months of data before most recent fare change vs same 3+ months after (seasonal).
- Assume fare elasticity for decreasing fare to be 2/3 of that for increasing fare?
- Simpson-Curtin formula = last resort.

COLLECTING THE DATA

Trip pattern and demographics (MARTA: from Atlanta MPO On-Board Survey).

- Customer origin/destination and modes, including Rail station of entry and of exit.
- Demographics: age, sex, race/ethnicity, household income, dependency on transit (other way to make trip?, auto available?).
- Data weighting?

EXAMPLE USAGE OF DATA

Agency "X" wants to change from a $2.00 "flat" Rail fare to $2.00 per mile. There are three Rail stations:

- Station A at the zero point.
- Station B is 0.75 miles from Station A.
- Station C is another 1.25 miles from Station B.
- A to C distance = 2.00 miles.

EXAMPLE USAGE OF DATA

The new fares would then be:

- $1.50 between Station A and Station B.
- $2.50 between Station B and Station C.
- $4.00 between Station A and Station C.

Agency "X" fare elasticity =

- Minus 0.30 for a fare increase and minus 0.20 for a fare decrease.

EXAMPLE USAGE OF DATA

Agency “X” has 1,000,000 Rail boardings per month and $2,000,000 in revenue (at $2.00 per ride), of which:

- 600,000 between A and B ($1,200,000).
- 300,000 between B and C ($600,000).
- 100,000 between A and C ($200,000).

EXAMPLE USAGE OF DATA

Will ridership increase or decrease?

- 600,000 A <> B trips ▲ to 630,000 (600,000 + (600,000 * -.25 * -.20)).
- 300,000 B <> C trips ▼ to 277,500 (300,000 + (300,000 * +.25 * -.30)).
- 100,000 A <> Ctrips ▼ to 70,000 (100,000 + (100,000 * +1.00 * -.30)).
- **1,000,000 trips ▼ to 977,500 trips.**

EXAMPLE USAGE OF DATA

Will revenue increase or decrease?

- $1,200,000 A <> B revenue ▼ to $945,000 (630,000 trips * $1.50).
- $600,000 B <> C revenue ▲ to $693,750 (277,500 trips * $2.50).
- $200,000 A <> C revenue ▲ to $280,000 (70,000 trips * $4.00).
- **$2,000,000 revenue ▼ to $1,918,750.**

EXAMPLE USAGE OF DATA

OK, Agency "X" is going to lose both revenue and ridership. Maybe it should try a different fare structure approach!

- NOTE: This is a trial-and-error process.

But what would be the Title VI implications of the proposed fare structure change?

EXAMPLE USAGE OF DATA

Is a given demographic group (Title VI protected or not) disproportionately over-represented in the group of riders whose fare is being raised or lowered?

Agency "X" conducts a representative survey of 1000 Rail riders, obtaining demographic and trip pattern info.

EXAMPLE USAGE OF DATA

600 (of the 600,000) A <> B riders are surveyed, 300 (of the 300,000) B <> C riders are surveyed, and 100 (of the 100,000) A <> C riders are surveyed.

- Findings: 400 of 600 A <> B riders are elderly, 140 of 300 B <> C riders are elderly, and 40 of 100 A <> C riders are elderly.

EXAMPLE USAGE OF DATA

- Analyst devises standard deviation test in Excel: Is proportion of elderly riders in a given trip type significantly different from proportions in other trip types?
- Analyst creates dichotomous variable: All riders classified as elderly or not elderly. For each trip type, average of elderly and non-elderly percentages will be 50%.

EXAMPLE USAGE OF DATA

- Analyst creates dichotomous variable: All riders classified as elderly or not elderly. For each trip type, average of elderly and non-elderly = 50%.
- But, A <> B riders are 66.7% elderly (400 / 600), B <> C riders are 46.7% elderly (140 / 300), and A <> C riders are 40.0% elderly (40 / 100).

EXAMPLE USAGE OF DATA

- The Standard Deviation for all 6 combos (3 trip types * 2 demographic types) = 12.5%.
- Elderly riders make up 66.7% of A <> B trips, which is more than 1 S. D. above the expected share (50.0% + 12.5% = 62.5%).

EXAMPLE USAGE OF DATA

- Thus, the elderly are over-represented in the group of riders between Stations A and B. Since this portion of trips was to have fares reduced, elderly are disproportionately BENEFITED.
- CAVEAT: Dichotomous variables and/or low numbers of trip types make it more difficult to achieve disproportionality, but make results more intuitive.