Analysis of time-of-day pricing in optimizing bus transit service in Westchester County, NY

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Introduction

- Variable pricing in transit is not new. It has been in practice since 1970's
- Variable pricing in transit can be varied in their presentations.
  - Variably price the base fares to reflect the peak and off-peak periods
  - Variably price/discount services to certain category of commuters reflecting on the supply.

Illustrations:

- Base fare differential
- Discount fares at off-peak times.

(Metropolitan Transit Commission, Minneapolis-St. Paul, July 1983 fares)

Fare	Peak	Off-peak
Adult	$0.75	$0.60
Youth	$0.75	$0.20
Senior	$0.75	$0.10
Disabled	$0.75	$0.30

Introduction Contd.

- Transit variable pricing can be a viable option to deal with
  - TDM tool (Demand Management)
  - Standing loads during peak hours
  - Farebox revenue returns
  - Streamlining existing service
  - Providing/Improving level of service to certain category of commuters (E&H)

Facts

- MTC, Minneapolis-St. Paul recovers about 35% of its budget from farebox revenues today.
- Duluth Transit Authority was able to reduce peak fleet by 3 vehicles.
- The differential provides enough revenue in addition to providing a pleasant ride to E&H commuters in Municipality of Metropolitan Seattle, King County, WA.

My research

- Literature review on time-of-day pricing in bus transit
- History and prevalence of this practice in the U.S.
- Modeling of passenger responses to the introduction of variable fares in Westchester County – demand and elasticity models

Time-of-day pricing in Bus transit – historical review

- Time-of-day variable pricing in bus transit dates back at least to early 1970's.
- Erie MTA was the first to propose in 1972
- Some common reasons for variably pricing bus transit services
  - Increase midday ridership
  - Strengthen business/ downtown area
  - Shift commuters to off-peak

Continued....

- Increase system wide ridship
- Increase farebox returns
- Equity concerns – hold down fares in off-peak period

- Central Ohio Transit Agency's "Incentive Fare Program" was the most successful time-of-day pricing experiment till late 1980s.
- Discontinued because it was difficult to collect the quarter fare outside of 2 sq. mile fare free zone.

Continued.....

- Of the 32 properties in the 1984 study, only 6 continue variable pricing in some format.
- Several additional properties now use variable pricing – New Castle, Pittsburgh, Iowa City .
- Variable pricing continues to be used by several major rail transit systems, including WMATA, BART, LIRR, NJ Transit

Ascertaining Transit Demand

- In order to propose various pricing measures – important to assess demand
- Various mathematical models are proposed in literature
  - Stop Level
  - Route Segment Level
  - Route Level

Stop Level models

- Unit of measurement is a BUS STOP
- Time consuming and expensive
- Theoretical predictor variables are:
  - Station area population and employment
  - Catchment area population
  - Feeder bus service level
  - Parking supplies
  - Transit frequency

  (Walters & Cervero, August 2003)

Route Segment/Route Level

- Unit - a route or its segment characterized by homogeneous social-demographics features.
- Competing effects of various routes/segments controlled by % overlap factor
- Difficult to model mutual causality of demand & supply

Simultaneous Route-level Transit ridership model

- Four Step process
  - Simultaneous process of demand & supply
  - Interactions among transit routes
  - Simultaneous equation model integrating demand, supply and inter-relationship
  - Estimation of the equation using observed ridership and service data

(Peng, et al, 1997)

General demand/supply model

- Rider(d) = f(Supply(seat), X(demand))
- Supply(seat) = f(Rider(d), Rider(-1), X(seats))
- Inter-relationship can be defined by using GIS to calculate % overlap
  - Prob.Overlap Pop = Overlap Pop/ Tot Pop (competing buffers)

(Gaudry, 1975)

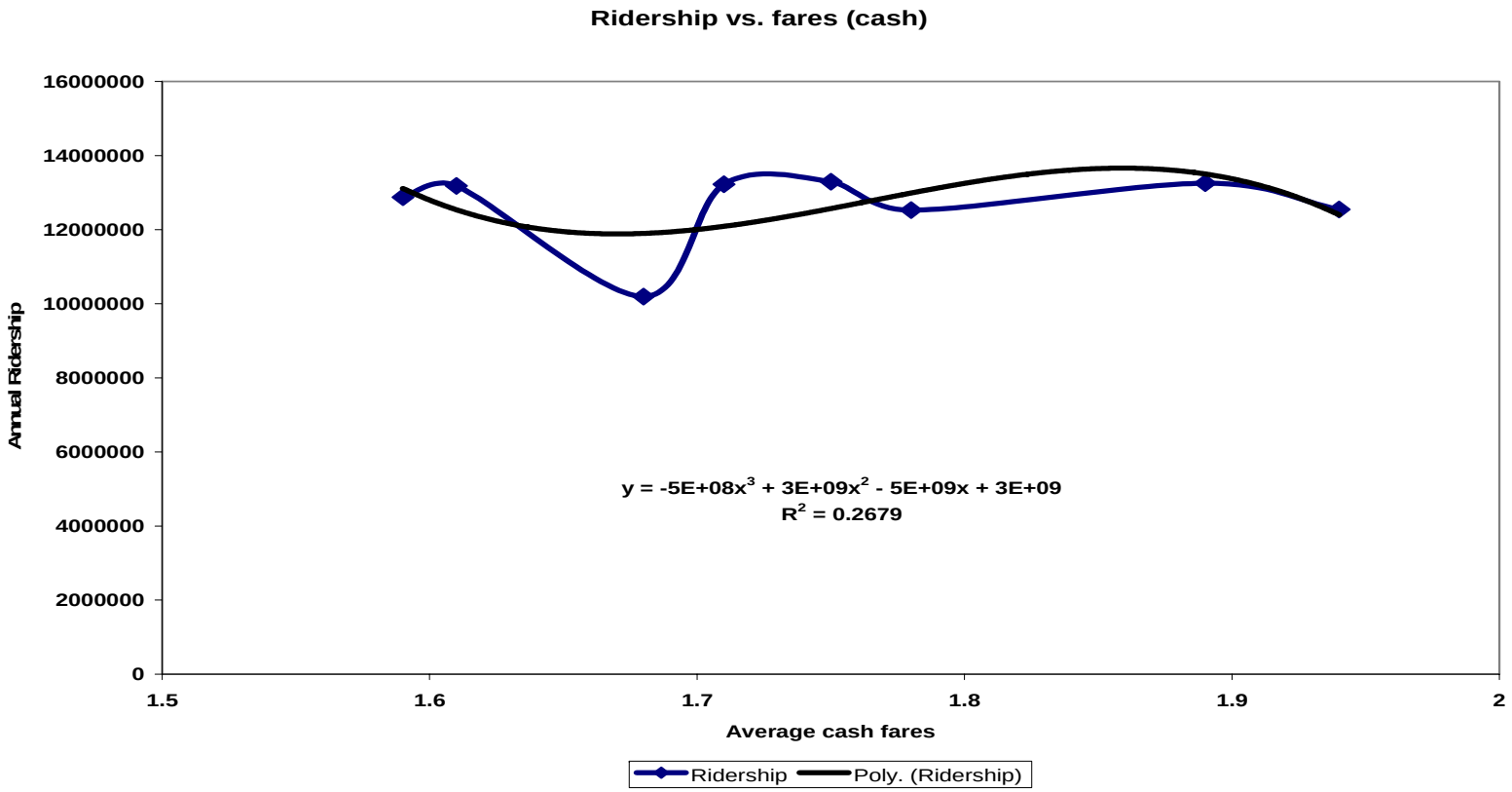
Ridership vs. Fares (E&H)

- For E&H commuters the trendline suggests a second degree polynomial equation.

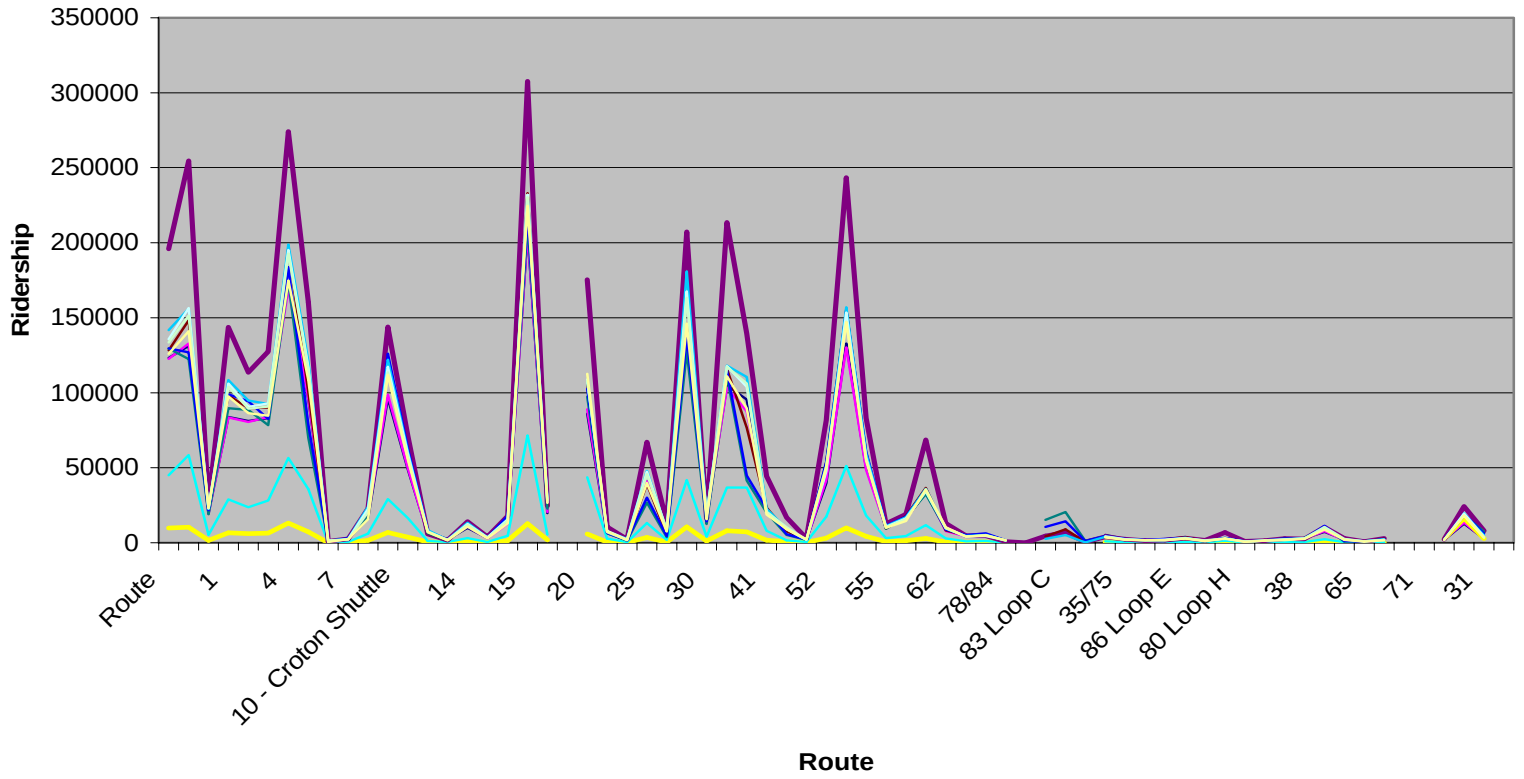
Rdr = -8e+07sqfare+1e+08fare-6e+07

The suggestion indicates a price-elasticity of 0.00002 or 0, implying an inelastic demand.

Ridership vs. Fares (cash)



Ridership by month (2005)



Need for time-of-day transit pricing for NY Metro Region

- Time-of-day study conducted shows the success of two NY counties – Broome and Rochester. This was evident from conversations with officials.
- Cervero contends that it is unlikely to increase ridership by reducing fares only but by pricing a better service in terms of travel time. (Cervero, 1990)

Continued….

- Transit is a valued service in the region
- Variably pricing transit has reduced the standing peak load and streamlined operations (Broome County results).
- An added advantage is the provision of convenient and comfortable rides to E&H commuters during off-peak periods (Broome & Rochester county).

Continued…

- The demand and price elasticity models developed will also provide estimates of elasticity, which is important to assess the effect of fare increases.
- The models will also help understand the possible changes in demand with variable pricing in a theoretical setting.

In Conclusion

- Time-of-day transit pricing – A comparative study paper will help in understanding the successes and failures of the various experiments in the US.
- Demand models & price elasticity models will provide an important interactive tool for future proposals.

Thanks to my academic and professional advisors, UTRC and NYMTC

Questions???

I would also like to thank the employees of the various transit agencies who helped in the compilation of the comparative study