Sketch Modeling Alternate Fare Structures to Manage Demand

Can BART do Better?

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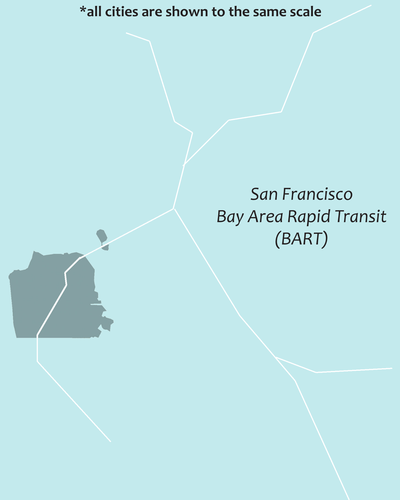
Abstract
How can transit agencies explore fare policies for congestion management quickly and cheaply? This research develops an elasticity-based sketch-planning model, and applies it to the Bay Area Rapid Transit (BART) system. The model predicts that BART could increase revenue significantly with a small decrease, or even increase, in ridership by introducing peak period and direction pricing on trips to San Francisco. BART provided ridership data by origin-destination pair in 15-minute intervals for nine weekdays in 2011, and elasticity values for commute (-0.15) and non-commute trips (-0.30). The model forecast new ridership after fare changes using elasticity. A 1000-iteration Monte Carlo simulation demonstrated that the findings of the Excel-based model are robust. Several new fare structures were developed, based on International transit systems. For each fare structure, the model also determined ridership in a revenue-neutral case where new revenue subsidized off-peak trips. The best performing alternative (existing fares plus a $1.00 peak period surcharge and $1.00 Transbay peak direction surcharge) increases weekday revenue by 19.5% but loses 2.5% of ridership. By introducing off-peak discounts, BART ridership would increase 4.9% during uncongested times. The model indicates that BART could meet its revenue and mode shift goals with a more complex fare structure. If implemented, care should be taken to reduce impact on lower income households with inflexible transit demands.

Download the Report and Model
http://bit.ly/AlternateFares

*all cities are shown to the same scale

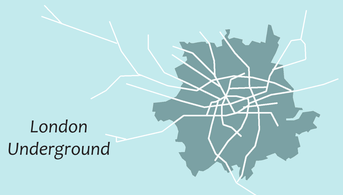


BART's current fares are based on distance. Each fare is a $1.50 base fare plus 7.5 – 12.4 cents per mile.

Additional surcharges are added for trips through the Transbay Tube ($0.83), across the San Mateo County border ($1.20), and to the San Francisco International Airport ($1.50).

No other adjustments are made by time of day, direction or entry/exit station.

Modeled Fare Structures



Peak Periods and Peak Direction
$1 surcharge during peak times, plus another $1 for travel through the Transbay Tube in the commute direction during peak periods.

Peak Period
50-cent surcharge to trips anywhere in the BART system that end during the morning or afternoon peak periods.

Washington, D.C. Metro

Flat Fare
Every trip costs the average BART trip price ($3.51 in 2011)

Low Flat Fare
Every trip costs $2.25 (based on New York MTA)

Zone-Based Fares
Based on a hypothetical system of zones for BART along political boundaries and areas of high congestion. Trips cost $1.75 for within one zone, and 50 cents for passage through each additional zone.

Also, based on BART's own demand management research:

Morning Peak Only
$2 surcharge for all weekday trips ending between 8-9 AM

Narrow Peaks
$2.95 surcharge for weekday trips entering BART's busiest stations (Embarcadero and Montgomery) 8-9 AM or exiting 5-6 PM

Problem Statement

Nearly 50% of BART's weekday riders travel during two, 90-minute peak periods.

Some stations are nearing capacity during rush hour, while others are very light during off peak times.

BART already charges fares based on distance, reasoning that longer trips should cost more. Other transit systems price trips on time of day, commute direction, and entry/exit station to manage congestion.

Could a more complicated fare structure reduce congestion on BART?

Methodology

This analysis developed an elasticy-based demand model to test seven fare structures (discussed to the left). The model estimated weekday ridership and revenue for each fare structure, as well as a revenue-neutral option by evenly distributing all new revenue as a subsidy for off-peak trips.

Assuming that:
- For every 100% increase in fare price, 15% of riders will not take BART.
- If a cheaper trip exists, then 50% of those "lost" riders will travel at the nearest cheaper time.

BART provided origin-destination ridership data in 15-minute increments for nine weekdays in 2011.

Findings

Fares varied by time, direction, or station radically affect BART's ridership and revenue.

The analysis suggests that charging another $1 for trips ending in peak periods, plus another $1for trips through the Transbay Tube in the peak period and direction, would increase BART's weekday revenue by 19.5%, or $253,000 per day. These surcharges would reduce BART's congestion stations and times by 2.5%, or 9,250 riders.

For comparison, flat fares would reduce both ridership and revenue, while forcing riders making local trips to subsidize long commutes.

Selected Fares in Revenue-Neutral Scenarios (in $)

Trip	2012 BART	Peak Period, Direction	Peak Period	Flat	Morning Peak	Peak Station Entry/Exit
Peak						
Orinda to Embarcadero	$4.10	6.10	3.67	3.76	6.10	7.05
Daly City to Embarcadero	$2.95	3.95	2.52	3.76	4.95	5.90
Fruitvale to 12th Street Oakland	$1.75	2.75	1.32	3.76	3.75	1.75
Richmond to 12th Street Oakland	$2.60	3.60	2.17	3.76	4.60	2.60
Pittsburgh to SFO	$10.90	12.90	10.47	3.76	12.90	10.90
Off-Peak						
Orinda to Embarcadero	$4.10	2.45	3.65	3.76	3.67	3.81
Daly City to Embarcadero	$2.95	1.30	2.52	3.76	2.52	2.66
Fruitvale to 12th Street Oakland	$1.75	0.10	1.32	3.76	1.32	1.46
Richmond to 12th Street Oakland	$2.60	0.95	2.17	3.76	2.17	2.31
Pittsburgh to SFO	$10.90	9.25	10.47	3.76	10.47	10.61

Cell color indicates percent now paid of 2012 actual fare:

220-180% | 179-140% | 101-139% | 100% | 80-99% | 40-79% | 0-39%

Conclusions

- Complex fares are more efficient than simple fares.
- Pricing can ease congestion.
- BART could manage congestion by pricing peak times, directions and station.

Implications

Given that it already has the technology for more complex fares, BART should explore congestion management alternatives that price trips by some combination of peak time, direction or station.

Reducing congestion would reduce the need for costly capacity expansions.

Though some riders will opt not to travel by BART, remaining riders will enjoy a higher quality of service and provide more total revenue to the agency.

Any scenario that incorporates fare increases should also include subsidies for transit-dependent and vulnerable riders.

Modeled Impacts of Fare Structures on Ridership, Revenue