

Using Quantitative Methods to Inform Fare Restructuring Decisions

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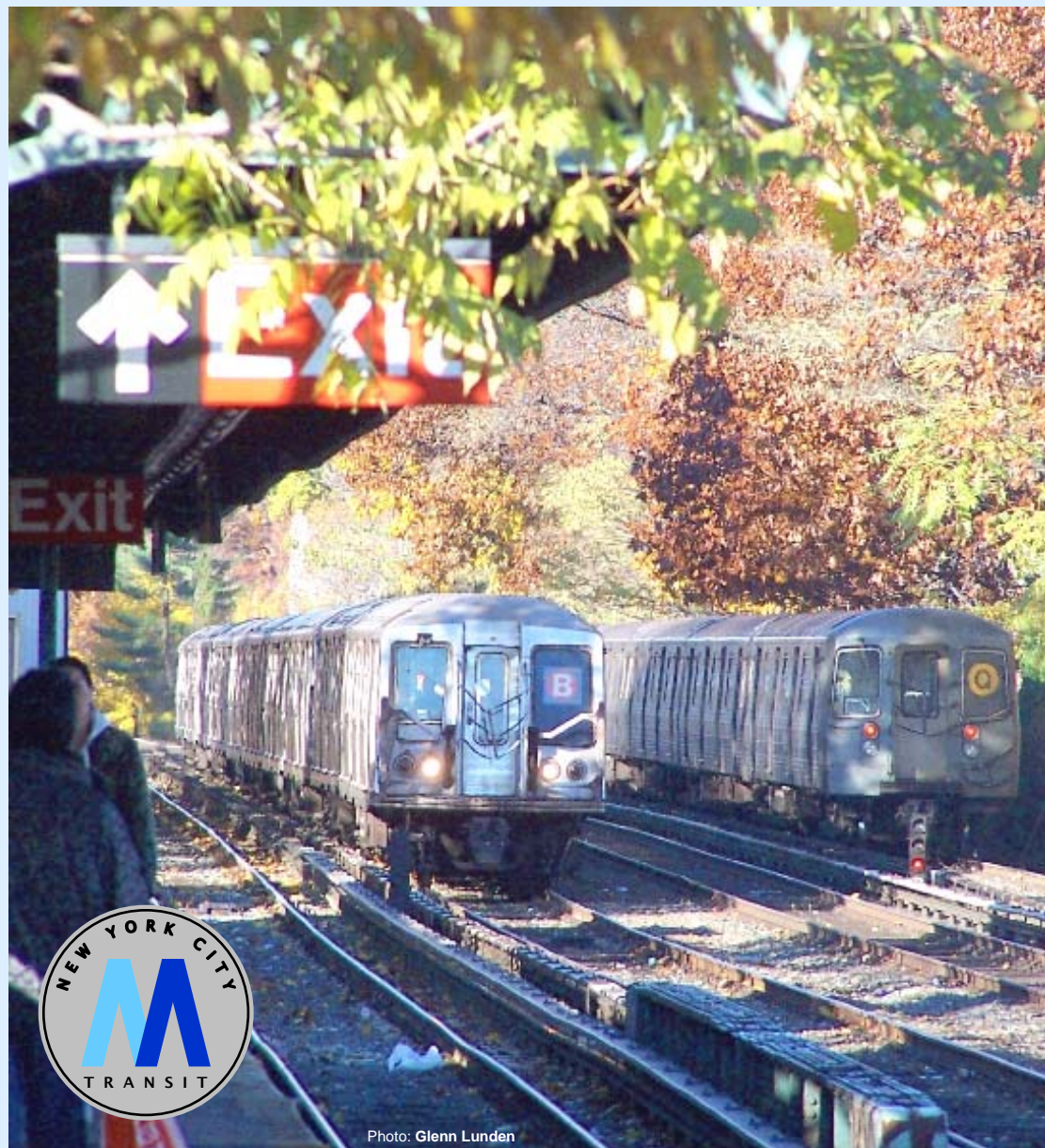


Photo: Glenn Lunden

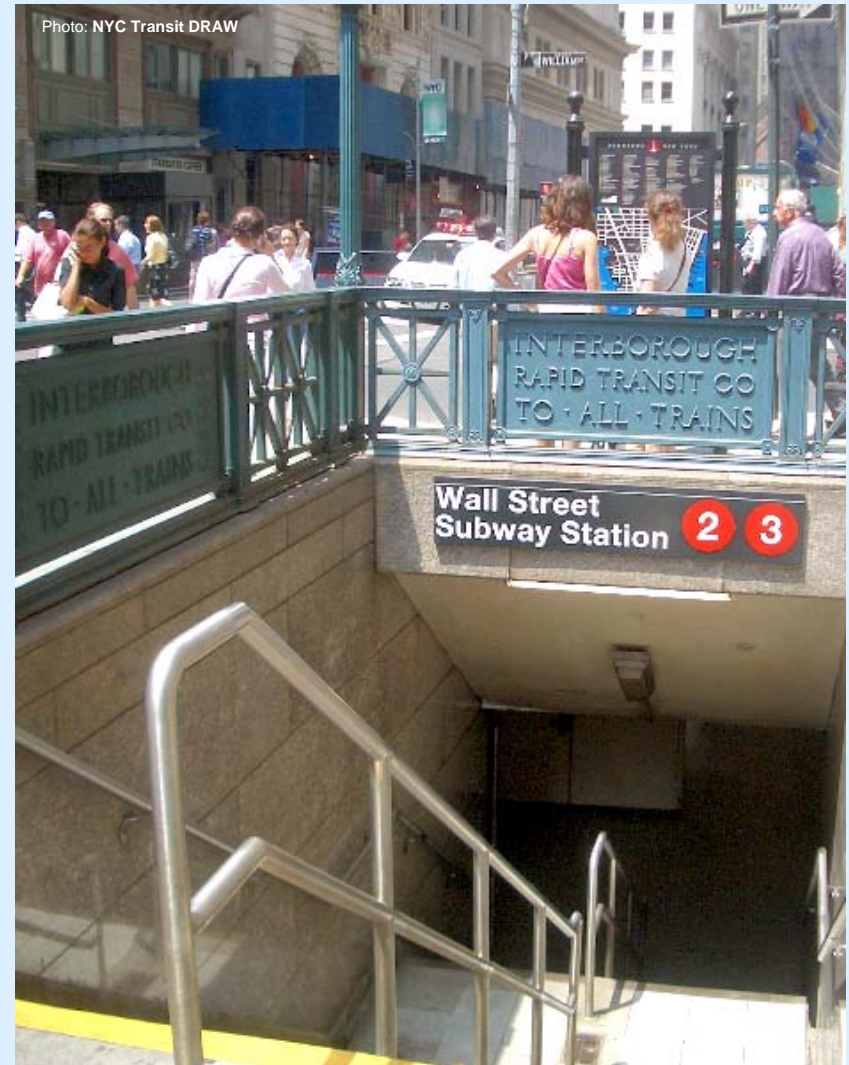


New York City Transit

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Ongoing Economic Crisis

- **Decreasing:**
 - System ridership and revenues
 - Bridge and tunnel traffic
 - Mortgage recording taxes
 - Urban tax (commercial property transfer tax) receipts
 - Payroll tax revenue
- **Increasing:**
 - Cost of borrowing
 - Labor and material costs
 - Pension costs
- **Actions:**
 - Efficiency improvements
 - Service reduction
 - **Fare increase**



Federal EJ Requirements



- **Environmental Justice (EJ) requirements**
 - Title VI (Minority)
 - EO 12898 (Low income)
- **Federal grant recipients must:**
 - Evaluate systemwide service and fare changes at the planning stages
 - Determine if impacts are discriminatory
 - Undertake mitigation and corrective action if necessary
 - e.g. elimination of free transfers elsewhere in U.S.
- **Fare Increase impact analysis:**
 - *Measure* the hardship and burden endured by affected riders

See also ADD50 TRB Session 493, Paper #10-1155
Safeguarding Minority Civil Rights and EJ in Service Reductions
Hilton, Tue January 12, 2010 at 1:30pm

Designing Fare Changes

- **Minority and low income customers favor lower sales value**
 - Cash flow considerations
 - But ‘volume discounts’ mean higher value fare media is cheaper per trip
- **Fare changes aim to:**
 - Make weekly passes more affordable
 - Upcharging the monthly pass favored by high income demographic

Fare Media Class	2008 Sales Value	Low Income % of Psgrs	High Income % of Psgrs	Avg Fare per Trip
Monthly Unlimited	\$81	38%	62%	\$1.15
14-Day Unlimited	\$47	50%	50%	\$1.20
Weekly Unlimited	\$25	51%	49%	\$1.21
Pay per Ride (PPR) MetroCard	> \$4	58%	42%	\$1.58



Method 1: Elasticity Model Disaggregation

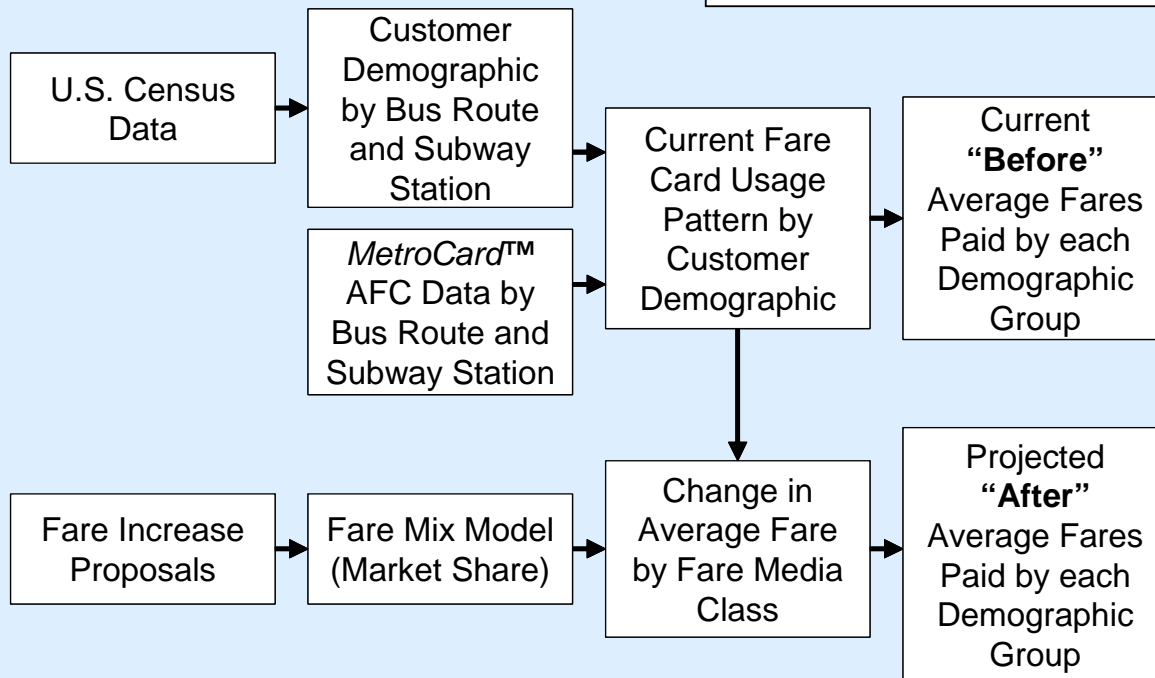
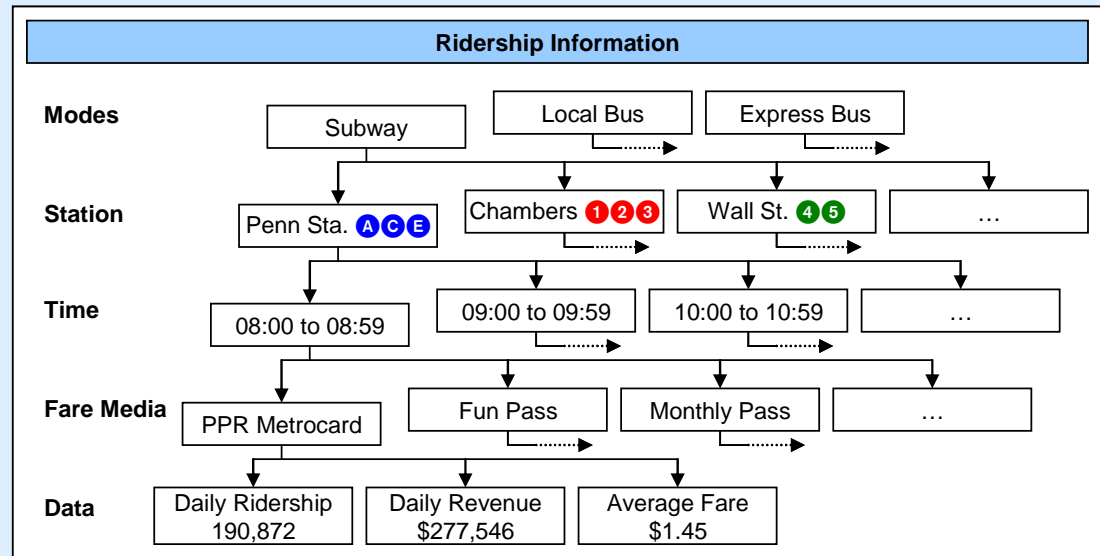
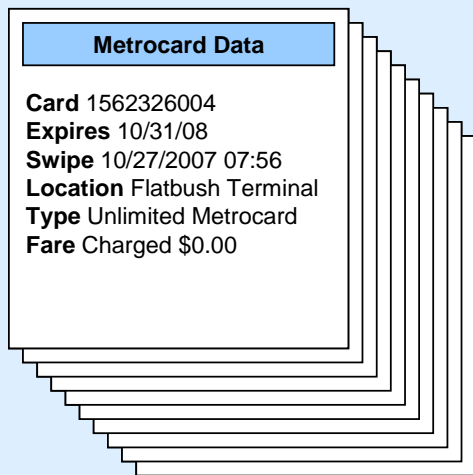
- **Use fare elasticity model**
 - fare mix data from prior fare increases
 - input is the new fare structure
 - outputs changes in revenue and ridership
- **Determine fare class mix by demographics**
- **Allocate changes in revenue and ridership**
 - ‘Multiply out’ to get change in average fare



Analysis Procedure

- **Compute current average fares for riders entering during AM rush**
 - Separately for minority and non-minority booths (use existing booth classification)
 - Separately for each fare media class
 - Exclude commuter hubs (Penn Station, Grand Central, Port Authority Terminal)
- **Use standard fare elasticity model**
 - Determine fare media mix and ridership for each fare increase scenario
- **Forecast expected average fares**
- **Use statistical *t*-test**
 - Compare minority and non-minority
 - See if change in systemwide average fare showed significant differences

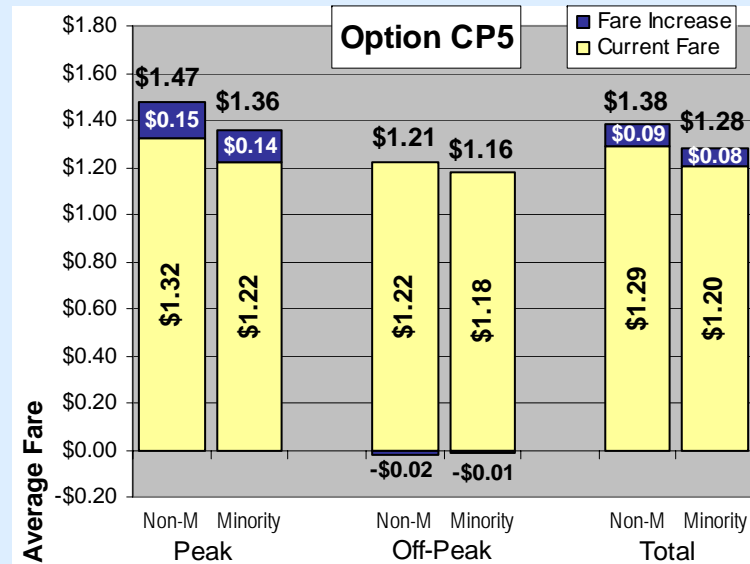
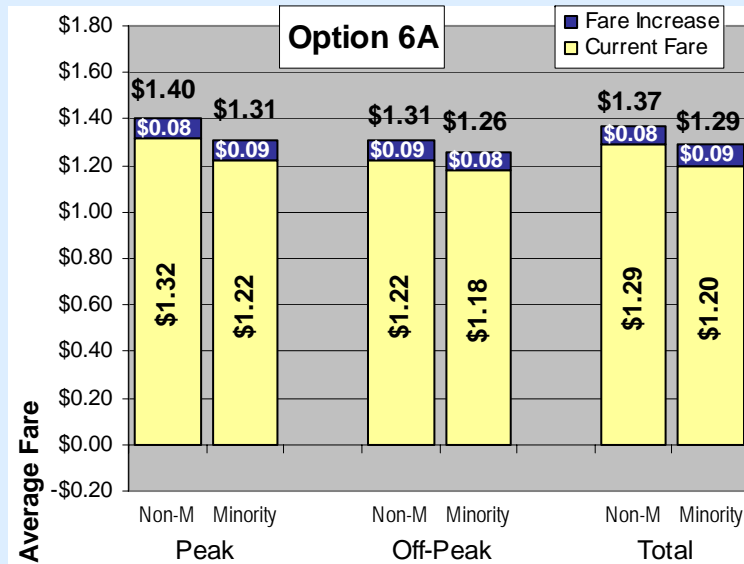




Model Structure

March 2008 Fare Increase

Fare Instrument	2005 Base	Option 6A		Option CP5		
		All Day	% Change	Peak	Off-Peak	% Change
Local Bus or Subway						
Cash/Single Ride Ticket	\$2.00	\$2.25	13%	\$2.25	\$2.25	13%
Non-Bonus MetroCard™	\$2.00	\$2.25	13%	\$2.00	\$1.50	Varies
Bonus MetroCard	\$1.67	\$1.88	13%	\$2.00	\$1.50	Varies
One Day Fun Pass™	\$7.00	\$7.50	7%	\$7.50	\$7.50	7%
7-Day Pass	\$24.00	\$25.00	4%	\$26.00	\$26.00	8%
New 14-Day Pass	—	\$45.00	—	\$48.00	\$48.00	—
Monthly Pass	\$76.00	\$79.00	4%	\$81.00	\$81.00	7%
Express Bus						
Non-Bonus MetroCard	\$5.00	\$5.25	5%	\$5.00	\$5.00	0%
Bonus MetroCard	\$4.17	\$4.38	5%	\$5.00	\$5.00	20%
7-Day Express Pass	\$41.00	\$41.00	0%	\$40.00	\$40.00	-2%



June 2009 Fare Increase

Fare Instrument	2008 Base	Option 23A		Option 23B		Option 8A		Option 8B	
	Sales Value	Sales Value	% Chg	Sales Value	% Chg	Sales Value	% Chg	Sales Value	% Chg
<i>Local Bus or Subway</i>									
Cash/Single Ride Ticket	\$2.00	\$2.50	25%	\$3.00	50%	\$2.25	13%	\$2.25	13%
Non-Bonus MetroCard	\$2.00	\$2.50	25%	\$2.25	13%	\$2.25	13%	\$2.00	0%
Bonus MetroCard	\$1.74	\$2.17	25%	\$2.25	29%	\$1.88	8%	\$2.00	15%
1 Day Pass	\$7.50	\$9.50	27%	\$9.50	27%	\$8.00	7%	\$8.00	7%
7 Day Pass	\$25.00	\$31.00	24%	\$31.00	24%	\$27.00	8%	\$26.00	4%
14 Day Pass	\$47.00	\$59.00	26%	\$57.00	21%	\$49.00	4%	\$49.00	4%
30 Day Pass	\$81.00	\$103.00	27%	\$99.00	22%	\$88.00	9%	\$87.00	7%
<i>Express Bus</i>									
Cash	\$5.00	\$6.25	25%	\$6.00	20%	\$5.75	15%	\$5.50	10%
Non-Bonus MetroCard	\$5.00	\$6.25	25%	\$5.50	10%	\$5.75	15%	\$5.00	0%
Bonus MetroCard	\$4.35	\$5.43	25%	\$5.50	27%	\$4.79	10%	\$5.00	15%
7 Day Express Pass	\$41.00	\$51.00	24%	\$51.00	24%	\$45.00	10%	\$47.00	15%

Option	Base Case	23A		23B		8A		8B	
Demographic	Average Fare	Average Fare	% Change	Average Fare	% Change	Average Fare	% Change	Average Fare	% Change
Non-Minority	\$1.39	\$1.74	25.3%	\$1.72	24.2%	\$1.50	8.4%	\$1.49	7.7%
Minority	\$1.27	\$1.59	25.2%	\$1.58	24.6%	\$1.38	8.5%	\$1.37	7.8%
High Income	\$1.37	\$1.71	25.3%	\$1.70	24.2%	\$1.48	8.4%	\$1.48	7.8%
Low Income	\$1.27	\$1.59	25.2%	\$1.58	24.7%	\$1.38	8.5%	\$1.37	7.9%
Overall	\$1.32	\$1.65	25.3%	\$1.64	24.4%	\$1.43	8.4%	\$1.42	7.8%

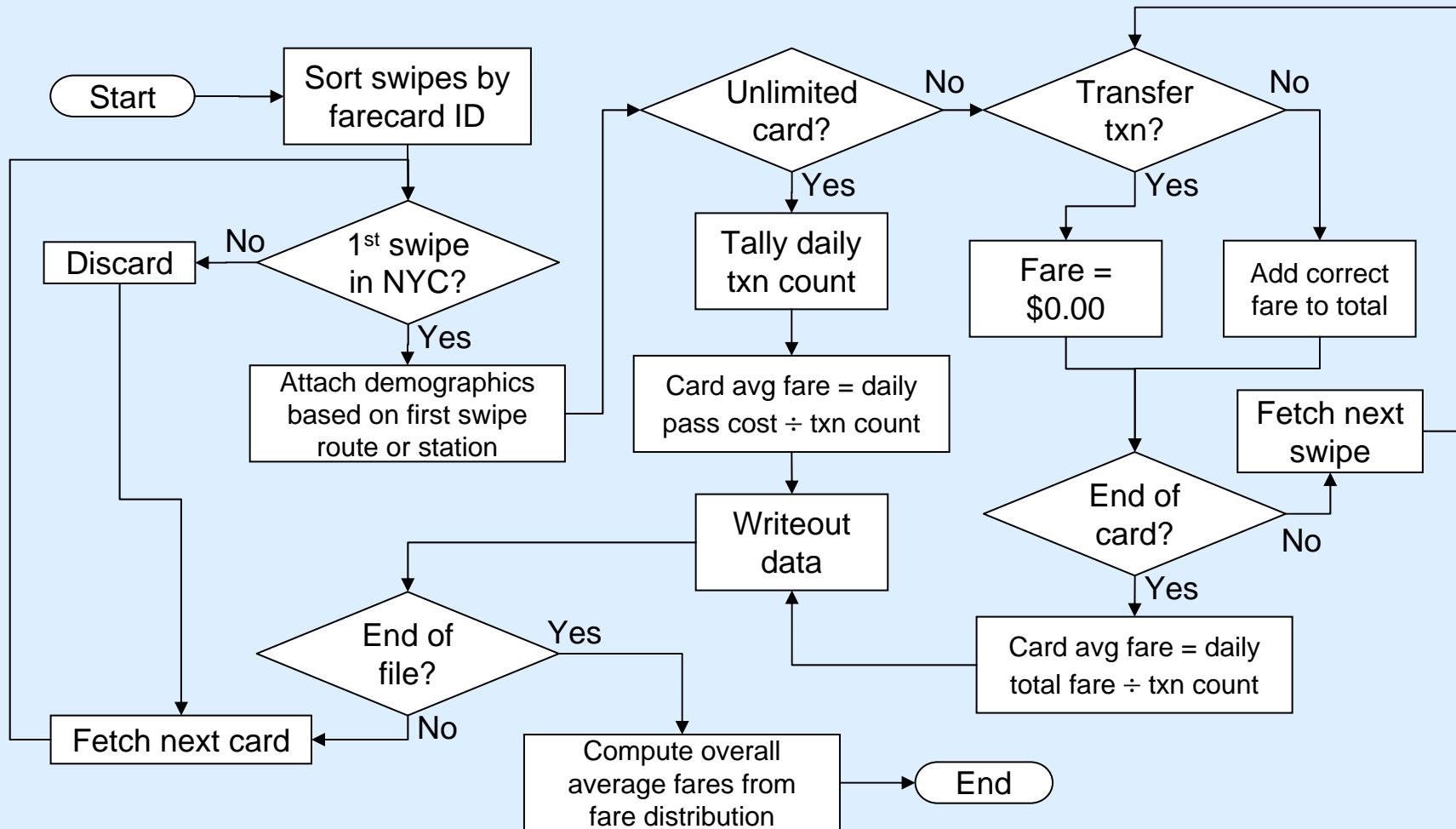
Method 2: Discrete Farecard Analysis



Photo: Yuri Dieujuste

- **Use raw AFC system data**
 - Analyze existing traffic
 - Determine new fares *assuming* no changes in traffic pattern
- **Advantages:**
 - Uses 24 hour data with good tracking of demographics
 - Provides fare distribution
- **Disadvantages:**
 - Ignores travel changes
 - Ignores cash and 'Bonus' MetroCard impacts

Flowchart



Sample Data

CARD_ID	DATE	TIME	TXN	POE	BOOTH	VALU	LOC	SEQ_NO	MP	MEDA	NOW	23B	23A	08A	08B
9585152873	20081016	51200	121	000	F014A5	2	R487	00206702	11	P P F	200	225	250	225	200
9585152873	20081016	51800	146	000	000000	R336	R145	00206703	10	P P F	0	0	0	0	0
9585152873	20081016	150600	120	000	000305	R246	R177	00206704	00	P P F	200	225	250	225	200
9585152873	20081016	160600	144	000	F01DD6	2	R494	00206705	11	P P F	0	0	0	0	0

Card_IDs have been obfuscated.

CARD_ID	DATE	TIME	TXN	POE	BOOTH	VALU	LOC	SEQ_NO	MP	MEDA	NOW	23B	23A	08A	08B
9658632269	20081016	81800	157	026	F00E66	3	R517	00621937	22	U U14F	392	475	492	408	408
9658632269	20081016	83000	157	026	F01754	3	R517	00621938	22	U U14F	392	475	492	408	408
9658632269	20081016	85400	157	026	F01419	1	R481	00621939	10	U U14F	392	475	492	408	408
9658632269	20081016	104800	157	026	F00EB5	3	R520	00621940	22	U U14F	392	475	492	408	408
9658632269	20081016	111800	157	026	F02324	1	R481	00621941	10	U U14F	392	475	492	408	408

First swipe in MTA Bus Company service area; card ignored.

	CARD_ID	MP	MEDA	TXNS	NOW	23B	23A	08A	08B	
	9598097605	00	P	F	1	200	225	250	225	200
Total daily transaction count	9598099015	10	P	F	2	200	225	250	225	200
	9598100098	00	P	F	4	150	169	188	169	150
	9598100406	01	P	F	3	133	150	167	150	133
Minority/Poverty designations based on first swipe of the day	959810051	00	U30	F	2	158	193	201	171	169
	9598100543	00	P	F	1	200	225	250	225	200
	9598100549	10	U07	F	3	139	172	172	150	144
	9598100550	01	P	F	2	200	225	250	225	200
	9598100555	00	P	F	2	200	225	250	225	200
7 Day Express Bus Pass	9598100556	00	U07	X	2	342	425	425	375	392
	9598100559	10	U07	F	2	209	259	259	225	217
	9598100560	00	U07	F	3	139	172	172	150	144
	9598100564	11	U07	F	4	104	129	129	113	108
	9598100570	00	U07	F	2	209	259	259	225	217

Daily average fares based on:

- individual transfer rates for Pay-per-Ride cards;
- actual daily usage for Unlimited Passes.

June 2009, Method 2 Results

Fare Media Type	Minority	Transaction Count	Farecard Count	Farecard Perceived Fare	Average Farecard Perceived Fare (\$ Change from Base Case)			
				Base	23A	23B	8A	8B
Pay-per-Ride	No	1,331,719	674,844	\$1.95	\$2.42 (\$0.47)	\$2.18 (\$0.23)	\$2.18 (\$0.23)	\$1.95 (\$0.00)
	Yes	1,492,302	663,106	\$1.73	\$2.16 (\$0.43)	\$1.94 (\$0.21)	\$1.95 (\$0.21)	\$1.73 (\$0.00)
One Day Fun Pass	No	22,933	5,569	\$2.39	\$3.02 (\$0.64)	\$3.02 (\$0.64)	\$2.55 (\$0.16)	\$2.55 (\$0.16)
	Yes	23,641	4,742	\$2.01	\$2.54 (\$0.54)	\$2.54 (\$0.54)	\$2.14 (\$0.13)	\$2.14 (\$0.13)
Weekly Pass	No	240,001	73,550	\$1.72	\$2.13 (\$0.41)	\$2.13 (\$0.41)	\$1.86 (\$0.14)	\$1.79 (\$0.07)
	Yes	763,098	207,051	\$1.50	\$1.85 (\$0.36)	\$1.85 (\$0.36)	\$1.61 (\$0.12)	\$1.55 (\$0.06)
14-Day Pass	No	31,849	10,356	\$1.68	\$2.10 (\$0.43)	\$2.03 (\$0.36)	\$1.75 (\$0.07)	\$1.75 (\$0.07)
	Yes	98,013	26,939	\$1.42	\$1.78 (\$0.36)	\$1.72 (\$0.30)	\$1.48 (\$0.06)	\$1.48 (\$0.06)
Monthly Pass	No	998,733	370,302	\$1.44	\$1.83 (\$0.39)	\$1.76 (\$0.32)	\$1.56 (\$0.12)	\$1.55 (\$0.10)
	Yes	1,241,284	379,442	\$1.22	\$1.56 (\$0.33)	\$1.49 (\$0.27)	\$1.33 (\$0.10)	\$1.31 (\$0.09)
Express Bus Pass	No	15,202	5,389	\$3.12	\$3.88 (\$0.76)	\$3.88 (\$0.76)	\$3.42 (\$0.30)	\$3.57 (\$0.46)
	Yes	3,804	1,094	\$2.56	\$3.19 (\$0.62)	\$3.19 (\$0.62)	\$2.81 (\$0.25)	\$2.94 (\$0.37)

Note: Full-fare farecards only and before bonus value adjustment, excluding all farecards whose first transaction of the day (proxy for place of residence) occurs outside the NYCT network. All-day 100% sample for Thursday, October 16, 2008.

- Results show same trends as Method 1, and similar percentage increases
- Dollar values not directly comparable due to impact of Bonus MetroCard, monthly pass cost allocation, etc.

Impact Analyses Comparison

Criteria:	Stated Preference Marketing Survey	Disaggregation of Elasticity Model (Top-Down)	Analysis of Discrete Trip Itineraries (Bottom-Up)
Accuracy and fidelity	Depends on proper sampling	Represents group-level increase in average fares	Measured for individuals then rolled-up
Captures trip attenuation and diversion	Must ask questions about future travel	Based on historical observations	Assumes riders <i>cannot</i> change travel patterns
Determination of rider demographics	Self-reported	Based on entry location; AM and midday trips only	Based on daily first swipe
Forecasts a distribution of fares	Usually not	Average fares only, not standard deviation	Discrete tally of fares paid for each trip provided
Explicitly analyzes cash fares	Hard to sample	Yes	Demographics of cash riders not known
Accounts for multi-ride “Bonus”	Self-reported	Bonus allocated based on station-level sales pattern	No – farecards do not track if value was ‘bonus’



Lessons Learned

- **Title VI not just code compliance**
 - Models for ridership, revenue, and equity impacts needed in fare policy toolbox
- **AFC offers a valuable data stream**
 - Should use AFC data, not a survey
- **NYCT used two approaches**
 - Differences in 2009 *average fare increase* was always <3 cents (or 0.5%)
- **Not surprising:**
 - In New York, most minority and more affordable neighbourhoods require long rides or transfer
 - ‘One City, One Fare’ (1975) and MetroCard transfers (1997) meant lower average fares for these areas



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