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Demand elasticities of Bus ridership in India
Case study of Bangalore

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Introduction

Analyze the impact of qualitative and quantitative changes in public transport supply on the passenger ridership.

Mobility Scenario in Bangalore

Bangalore

- The Bangalore Metropolitan Transport Corporation (BMTC)
  - Operates PT services in BBMP and BMR
  - Second largest bus fleet in the country. (approx. 6,400 buses)
  - 11.89 lakh service kilometers
  - Losing its ridership and revenue over the past few years
  - During January 2018, BMTC reduced the fare of Vajra buses up to 37%

- BMRCL implemented metro rail project of 42.3 km (1st phase) operational from June, 2017

- Ranks second in the total number of vehicles and car ownership

Bangalore forms a good case to study to understand impacts of factors like fare change, service reliability and metro rail on ridership of bus services

Source : Implementation Plan for Electrification of Public Bus Transport in Bengaluru ; Center for Study of Science, Technology and Policy April, 2018 ; BMTC

Literature study

- This is to understand the method of elasticity through which the impact of qualitative and quantitative changes on ridership would be calculated.

a) Concept of Elasticity
b) Evolution of elasticity concept in transportation planning
c) Types of transit analysis done using Elasticity

- Elasticity is the concept of calculating the response of one variable due to a change in another.
  - Point Elasticity : When there is a small change in variable under consideration
  - Arc elasticity : It calculates average elasticity over the range of any particular change.

- Enabled in undertaking the study and relating elasticity with bus service quality and fare reduction and ridership

Methodology

Research question, scope, Literature study

How does the change in fare or service quality affects the number of people travelling in a PT system.

Data Collection

Data collection from BMTC and BMRCL ranging from December 2016 to May 2018

- Ridership
- Fare Change
- Route details
- % service cancelled
- EPKM

Analysis **Conclusion**

Scenario 1: Calculating fare elasticities for stage wise average change in ridership in BMTC Buses

Scenario 2: Calculating elasticities for impact of service quality on ridership of bus routes

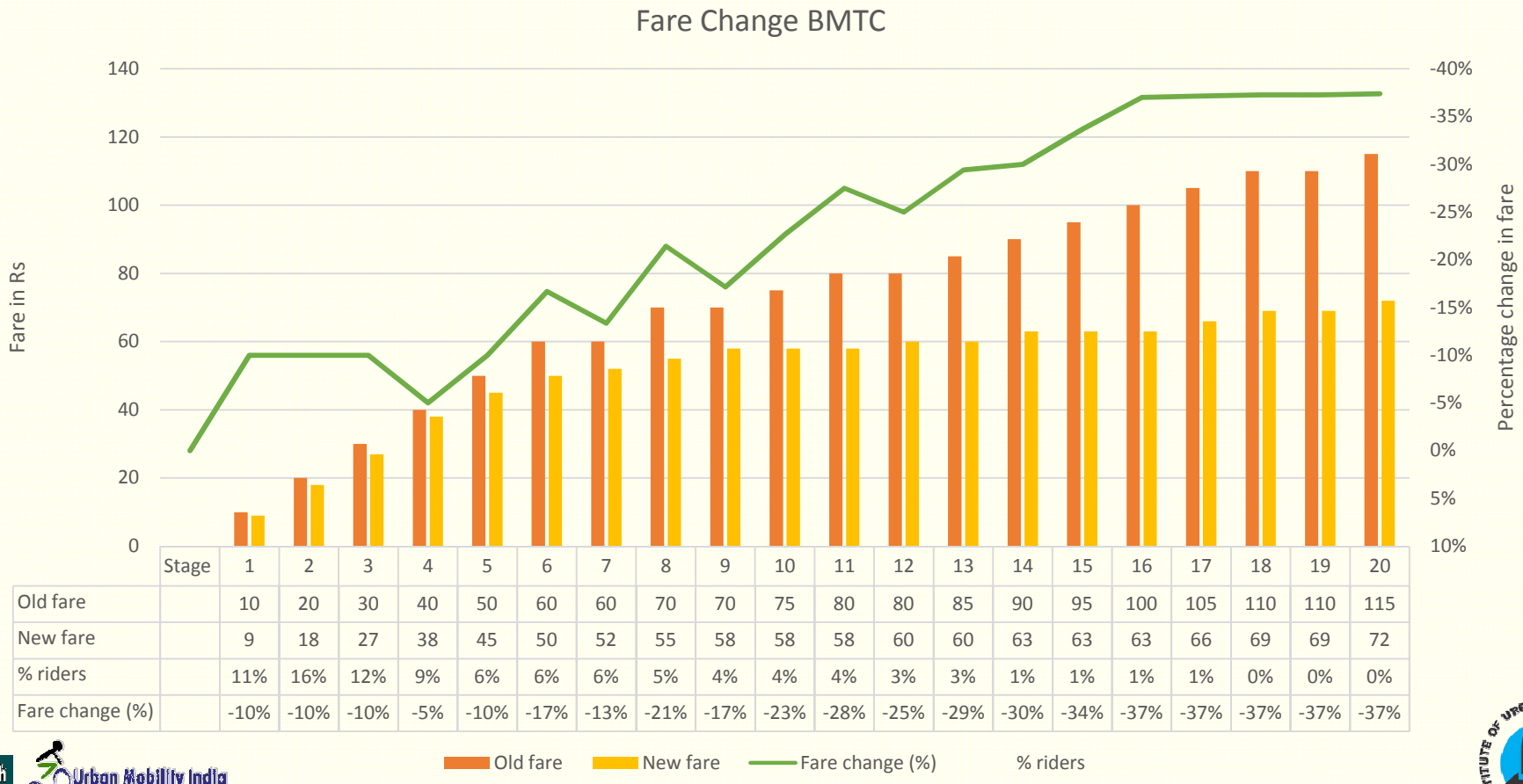
Scenario 3: Calculating relation between metro ridership BMTC ridership

ANALYSIS

Scenario 1

Impact of fare change on ridership

- During January 2018, BMTC reduced the fare of Vajra buses (Volvo AC Bus)
- Reduction approximately by 5% to 37%.



Stage	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Old fare	10	20	30	40	50	60	60	70	70	75	80	80	85	90	95	100	105	110	110	115
New fare	9	18	27	38	45	50	52	55	58	58	58	60	60	63	63	63	66	69	69	72
% riders	11%	16%	12%	9%	6%	6%	6%	5%	4%	4%	4%	3%	3%	1%	1%	1%	1%	0%	0%	0%
Fare change (%)	-10%	-10%	-10%	-5%	-10%	-17%	-13%	-21%	-17%	-23%	-28%	-25%	-29%	-30%	-34%	-37%	-37%	-37%	-37%	-37%

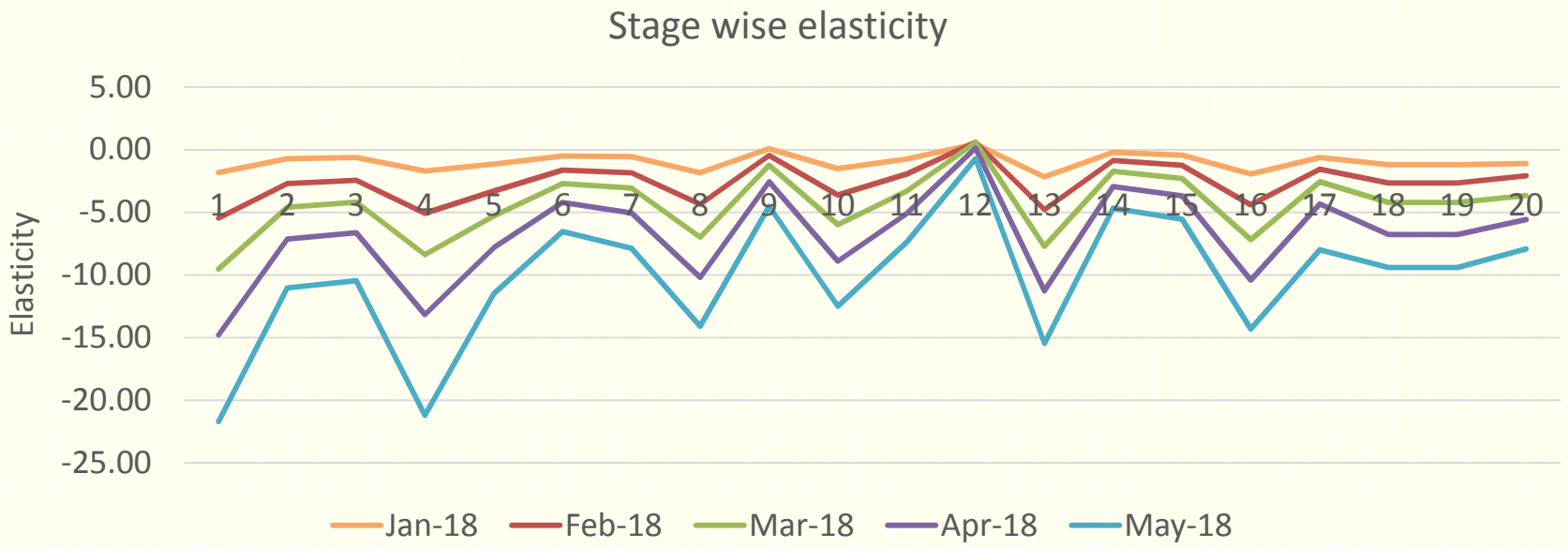
Elasticity calculation

- Change in ridership for every percent change in fare was calculated using the formula illustrated below

$$\text{Elasticity} = \frac{\frac{\Delta y}{y}}{\frac{\Delta x}{x}}$$

where

Δy = Change in ridership
y = Old Ridership
Δx = Change in fare
x = Old fare



Conclusions

- It is observed that for 97% of the elasticities calculated, the values are negative.
- i.e. the reduction of fares brought about an increase in ridership

- The trend in elasticity is seen to be continuously increasing

- In the 5th month after change in fare by BMTC was implemented (i.e. May, 2018), the elasticity for the bus service was observed as -3.3. i.e. for every 10% decrease in fare, the bus ridership increased by 33%

	1st month	2nd month	3rd month	4th month	5th month
Average Elasticity	-1.0	-1.6	-1.8	-2.4	-3.3

- Max increase in passengers was seen in short (stage 1-4) and long distance trips (stage 16-20)

Scenario 2

Impact of service quality on ridership

Service Quality can be measured in terms of

- Level of Comfort
- Affordable fare
- Adherence to schedule

- Service quality : % cancelled trips
- 1805 routes of BMTC's North and West Zones were analysed.
  - 1004 - North zone
  - 801 – West Zone
  - 19 Depots
- Percentage cancelled trips and load factors for the months of December 2016 and December 2017 were taken for elasticity calculation.
- Only routes with minimum 1% difference in cancelled trip percentage from 2016 to 2017 were taken into account

Calculations

- Upon analysis, four different cases were observed:
- **Case 1**: Increase in service quality led to increase in Load factor
- **Case 2**: Increase in service quality led to decrease in Load factor
- **Case 3:** Decrease in service quality led to increase in Load factor
- **Case 4**: Decrease in service quality led to decrease in Load factor

	Number of routes	Percentage of total routes	Range of Elasticity	Average Elasticity
Case 1	470	26%	-5.02 to 0	**-0.31**
Case 2	150	8%	0 to 2.64	**0.19**
Case 3	915	51%	0 to 3.34	**0.17**
Case 4	269	15%	-1.21 to 0	**-0.07**

Scenario 2

Case 1: Increase in service quality led to increase in Load factor

- 26% routes ; E= -0.31

EPKM

- Out of 471 routes,
  - 80% routes : increased
  - 20% routes : decreased
- Maximum increase in EPKM : 2114 Rs
- Average increase in EPKM: 220 Rs

This is the most favourable outcome for the passenger as well as the operators

Case 2: Increase in service quality led to decrease in Load factor

- 8% routes ; E= 0.19

EPKM

- Out of 150 routes,
  - 0% routes : increased
  - 100% routes : decreased
- Maximum decrease in EPKM : 1151 Rs
- Average decrease in EPKM: 344 Rs

- *Riders are distributed on increased buses (LF decreased) and average EPKM decreased*

Case 3: Decrease in service quality led to increase in Load factor

- 51% routes ; E= 0.17

EPKM

- Out of 915 routes,
  - 83% routes : increased
  - 17% routes : decreased
- Maximum increase in EPKM : 2182 Rs
- Average increase in EPKM: 214 Rs

Indicates high public transport dependence on these routes.

Case 4: Decrease in service quality led to decrease in Load factor

- 15% routes ; E= -0.07

EPKM

- Out of 471 routes,
  - 0% routes : increased
  - 100% routes : decreased
- Maximum decrease in EPKM : 1355 Rs
- Average decrease in EPKM: 326 Rs

Least desirable outcome for the passenger as well as the operators

Impact of metro services on bus ridership

Scenario 3 Impact of the metro services on bus ridership

- Namma metro - 4.7 km metro line (Phase 1)
- The metro ridership has been observed to decrease by 1.3% from the month of December 2017 to May 2018, whereas the ridership for BMTC Vajra buses had increased by 35%.
- The relationship of metro services in terms of elasticities with bus ridership comes out as -8.14. It shows either there is very high interdependencies between the two modes or no interdependencies
- The elasticity shows there isn't any dependencies between the bus and the metro system

Conclusions

Impact of fare change on ridership :

- Elasticities of -3.3 by the end of five months was observed; i.e. 10% reduction in BMTC fares, delivered a 33% increase in bus ridership.
- The trend in elasticity is seen to be continuously increasing
- Max increase in passengers was seen in short long distance trips

Impact of service quality on ridership :

- Four cases emphasized on dynamic relation between service adherence and ridership
- Case 3: Decrease in service quality led to increase in Load factor (51% of the routes)
- Elasticity : -0.17 Indicates high public transport dependence on these routes

Impact of metro services on bus ridership :

- No impact on bus ridership was observed in the study due to metro ridership change

- **In summary, fare had the maximum impact on bus ridership in Bangalore followed by the service quality in terms of adherence to schedule**
- **This analysis can form basis for further studies relating to fare change and service quality for BMTC**

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