MONASH University

Public Transport Planning
New Zealand Transport Agency
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Demand Forecasting 1 & 2
TEST ANSWERS

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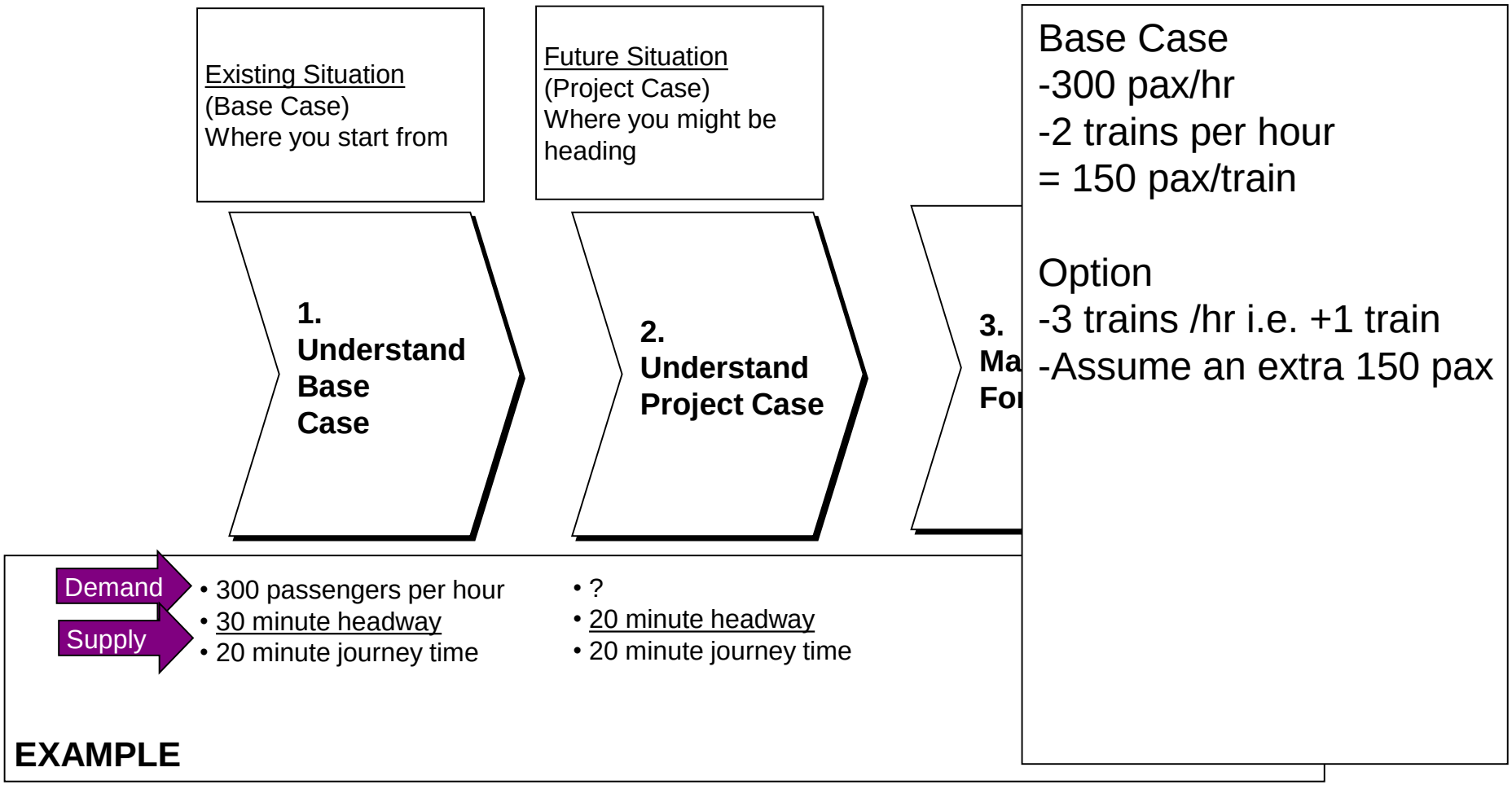
PTRG PUBLIC TRANSPORT RESEARCH GROUP

GROUP OF EIGHT AUSTRALIA

MONASH INSTITUTE OF TRANSPORT STUDIES

Now I would like you to make a forecast based on the information below



Example : The Transit Authority is introducing two extra tram trips per hour on a half hour service within the inner city – what share will the possible sources of demand have in the use of these services

Travel Behaviour Change Affecting Public Transport

Source of Demand	Key Points	Source of Demand
Generation (New Trips)	• New travel not currently made • E.g. entertainment travel (Off Peak) • Not Work Travel (Peak) • Includes induced demand	9%
Diversion	• Existing Public Transport Users using new service rather than existing service • Needs to be spatially adjacent • Needs to be more attractive than existing	70%
Mode Shift	• Stop using car and use bus (very important to differentiate car drivers from car pax) • Go from walking to using the tram	20%
Redistribution	• People change where they live and work • Very long term affect	1%

Growth = 30%

Example : The Transit Authority is introducing a new cross corridor railway in the suburbs connecting two regional shopping centres – what share will the possible sources of demand have in the use of the service

Travel Behaviour Change Affecting Public Transport

Source of Demand	Key Points	Source of Demand
Generation (New Trips)	• New travel not currently made • E.g. entertainment travel (Off Peak) • Not Work Travel (Peak) • Includes induced demand	20%
Diversion	• Existing Public Transport Users using new service rather than existing service • Needs to be spatially adjacent • Needs to be more attractive than existing	54%
Mode Shift	• Stop using car and use bus (very important to differentiate car drivers from car pax) • Go from walking to using the tram	25%
Redistribution	• People change where they live and work • Very long term affect	1%

Growth = 46%

Analytical Problem – Forecasting Future Changes in Demand using the Willis model

PROBLEM

Research Question: What is the usage of public transport going to be in 2020?

Raw Data:

Existing Population = 1.0M

2020 Population = 1.2M

Existing PT Trips p.a = 60M

	Change in Variable to 2020	Quantified Elasticity of Demand	Explained Change in Demand Caused by Variable
Fare Increases	0%	-0.25	**0**
Change in Average Wages	2%	1.10	**+2.2%**
Change in Real Car Fuel Costs	5%	0.44	**+2.2%**
Change in Public Transport Service Levels	5%	0.81	**+4.05%**
Change in Car Ownership	4%	-2.94	**-11.76%**
Change in Unemplyment	-3%	0.01	**-0.03%**
		Total	**-3.34%**

SOLUTION

1. Population Impact

Base

- **60M pt trips p.a.**
- **Population = 1.0M**
- **Trips per capita = 60**

Option

- **Population 1.2M**
- **At 60 trips per capita total trips = 72M**

2. Other Impacts

- **Net Impact -3.34%**
- **72M trips -3.34% = 69.6M (+9.6M /16%)**

SOME WORKING EXAMPLE TESTS - BENCHMARKING

Working Example No. 1

PROBLEM

Proposal: **A bus operator wants to know how many passengers he is likely to get if he adds an extra trip each hour to route 101**

Existing Service Raw Data:

Time Period	Headway[1]	Demand
A.M. Peak (2 Hour)	20min	480
Off Peak (5 Hour)	30min	400

Route Length = 10kms

Note: [1]Headway is the same in both directions

SOLUTION

Base Peak

- Peak 3 trips/hr x 2 hours x 2 directions = 12 trips
- At 10 kms route length = 12 trips x 10 kms = 120 vkms
- 480 pax at 120 vkms = **4.0 vkms per hour (BVK)**

Base Off Peak

- Peak 2 trips/hr x 5 hours x 2 directions = 20 trips
- At 10 kms route length = 20 trips x 10 kms = 200 vkms
- 400 pax at 200vkms = **2.0 vkms per hour (BVK)**

Forecast

- Peak = +1 trip/hr * 2 hours * 2 directions * 10 kms = +40 kms

  At 4.0 BVK +40 peak vkms = **+160 pax**
- Off Peak = +1 trip/hr * 5 hours * 2 directions * 10 kms = +100 kms

  At 2.0 BVK +100 opk vkms = **+200 pax**

TOTAL 360 PAX

SOME WORKING EXAMPLE TESTS - BENCHMARKING

Working Example No. 2

PROBLEM	SOLUTION
Proposal: A tram operator wants to add some extra service to route 666 which operates in the outer suburbs. They can afford to add two tram trips to the route for four hours on a Sunday. **Existing Service Raw Data:** **Route Length = 8kms** **Route Round Trip Time (including layover) = 60mins** **No other data is available**	**Base** - Say BVK = **2.0 passengers/vkm (BVK)** **Base Off Peak** - Peak 2 trips/hr x 5 hours x 2 directions = 20 trips - At 8 kms route length = 20 trips x 8 kms = 160 vkms - 160vkms @ 2 BVK = 320 boardings **Forecast** - 4 hours * 2 directions * 8 kms * 2 = +128kms At 2.0 BVK +128 vkms = **+256 pax**

Some simple working examples show how they may be applied

PROBLEM	SOLUTION
Proposal: Fares **are to be increased by 10%** **WHAT WILL HAPPEN TO REVENUE?**	• **E = -0.3** • **Change in Demand = E * Change in Fare** • **%D = -0.3 * +10%** • **%D = -3%**
Proposal: **Tram** Services Levels **are to be cut from 1.0M Vkms p.a. to 0.8M vkms p.a.**	Fare Increase (+10%) - Patronage is 97% original size - Fare charged is 1.1 original value - 0.97 * 1.1 = 1.067 i.e. revenue increases by 6.7%
Proposal: **Bus** Running Times **are to increase as a result of traffic growth. It is expected that running time will, increase by 10%.**	Fare Decrease (-10%) - Patronage is 1.03 original size (+3%) - Fare charged is 0.9 original value 1.03 * 0.9 = 0.927 i.e. revenue decreases by 7.3%

SOME WORKING EXAMPLE TESTS - ELASTICITIES

Working Example No. 1

PROBLEM	SOLUTION
Proposal: **A fare increase of 20% has been called for peak (white collar) passengers. What will the demand and revenue implications be.** Existing Service Raw Data: **Total demand is 200M boardings p.a.** **Current average peak fare per boarding is $1.20**	**Change D = Change C * E** **= +20% * -0.2** **= -4%** **200M *0.96 = 192M (-8M)** **Base Revenue = 200M * $1.20 = $240M** **Option Revenue = 192M *($1.20*1.2)** **= 192M *$1.44** **= $276.48M (+36.48M)**

SOME WORKING EXAMPLE TESTS - ELASTICITIES

Working Example No. 2

PROBLEM	SOLUTION
Proposal: The tram operator has had a vehicle returned to service after a road accident. They can deploy it on either route 777 or route 999. They want to deploy it where demand impacts will be greatest. Which route should they put it on? **Existing Service Raw Data:** **Route 777:** **Current dedicated fleet = 4 trams/hr** **Base demand is 4M p.a.** **Route 999:** **Current dedicated fleet = 10 trams/hr** **Base demand is 30M p.a.**	**Headway (Trams/hr)** **Base Project** **Rte 777 4 5 +1 or +25%** **Rte 999 10 11 +1 or +10%** **E = +0.35 (service level elasticity)** **Change D = Change C * E** **Route 777 = +25% * +0.35 = +8.75% * 4M = +0.35M** **Route 999 = +10% * +0.35 = +3.5% *30M = +1.05M**

SOME WORKING EXAMPLE TESTS - ELASTICITIES

Working Example No. 3

PROBLEM	SOLUTION
Proposal: The Government has been forced to increase fares by 20%. As recompense, at the cost of $4M, the operator has been allowed to increase service levels by 10%. Does this make economic sense? **Existing Service Raw Data:** **Total demand is 30M boardings p.a.** **Current average fare per boarding is $1.00**	**Fare Change Impacts** Change D = Change C *-0.3 = +20% * -0.3 = -6% (or -1.8M) Base Revenue = 30M * $1.00 = $30M Option Rev = (30-6%) * $1.20 = 28.2*$1.20 = $33.84M (+$3.84M) **Service Change Impacts** Change D = Change C *+0.35 = +10% * +0.35 = +3.5% (or +0.987M) Revenue Increase = 0.987M * $1.20 = $1.1844M Cost of Measure = $4M Net Service Change Cost = $2.8156M OVERAL NET COST = -$2.8156M + +$3.84m = -1.02M OVERALL MARKET = -1.8M + +0.987M = -0.813M

A real world example: Should we run a shuttle train from Richmond Station to a new Station at the MCG during the footy?

Shuttle Train from Richmond Station

	Actual Time (mins)	Perceptual Weightings	Perceived Time (mins)
Access Walk	2 Mins	2.0	4.0
Expected Wait	4 Mins	2.0	8.0
Transfer Time[1]		5 min transfer penalty	5m
In-Vehicle Travel	2 Mins	1.0	2m
Egress Walk	3 Mins	2.0	6m
		Total	25 Mins

Total Generalised Cost ($10/hr 0.1667/min) $ 4.17

Direct Walk

	Actual Time (mins)	Perceptual Weightings	Perceived Time (mins)
	10 Mins	2.0	20m
		Total	20 Mins

Total Generalised Cost $ 3.334

Note: [1]Includes transfer penalty only

SOME WORKING EXAMPLE TESTS – TGC Soft Variables

Working Example No. 1

Av. Existing Rail Traveller

	Actual Time (mins)	Perceptual Weightings	Perceived Time (mins)
Access Walk	5 Mins	2.0	10m
Expected Wait	5 Mins	2.0	10m
In-Vehicle Travel	50 Mins	1.0	50m
Egress Walk	3 Mins	2.0	6m
		Total	76 Mins
Fare			$2.50

Total Generalised Cost (at $10/hr $0.1667/min) **$15.1692**

Research Question

- 5.6 Million passengers use Uglyville station each year
- Uglyville is appropriately named because it's a very dirty station
- The transit authority are thinking of spending $80,000 p.a. on a cleaning contractor to ensure the station is clear at all times
- What would the demand impact of this be?
- Is it a financially sensible thing to do?

Value of amenity benefit -0.4 In Vehicle Minutes
At VOT = $0.1667/min this is worth $0.07
$0.07 is a 0.005% decline in total generalised cost
TGC Elasticity is -1.0
Change D = Change Cost * E
= -0.005% * -1.0
=+0.005% = 0.028M or 28,000 p.a.
Change Revenue = 28,000 * $2.50 = +$70,000p.a.
i.a., a net $10,000 shortfall p.a.