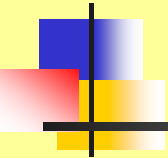


MODELLING USAGE RATE OF DRT SERVICE: DISCRETE CHOICE MODEL WITH LATENT VARIABLES



Presentation prepared for
TDM Symposium 2008, Vienna

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Structure

- Motivation
- Background and Case Study
- Assumptions and Hypothesis
- Modelling System
- Interpretation of Results

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Motivation

- **Many existing DRT services**
 - Important role to improve social inclusion and accessibility
 - Still not performing to their true potential
 - Could not be viable as commercial services
- **Key suggestion from previous research**
 - Need to understand the passenger requirements further

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Demand Responsive Transport (DRT)

- **DRT is an intermediate form, somewhere between bus and taxi.**
- **Four composite case types (INTERMODE - Enoch et al., 2004)**
 - 1. Interchange DRT**
 - 2. Network DRT**
 - 3. Destination-specific DRT**
 - 4. Substitute DRT**

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UCall and LinkUp Service in Tyne and Wear

- Extended operation area
- More flexibility
 - Semi-fixed route with fixed timing point
 - Predefined area with fixed timing point
- More complexity
 - Managing and dispatching

LinkUp Service Area



UCall and LinkUp Vehicles



UCall (Optare Alero
on average 14 seats)

LinkUp (Optare Solo
on average 24 seats)



Photos by NEXUS

LinkUp Travel Dispatch Centre (TDC)

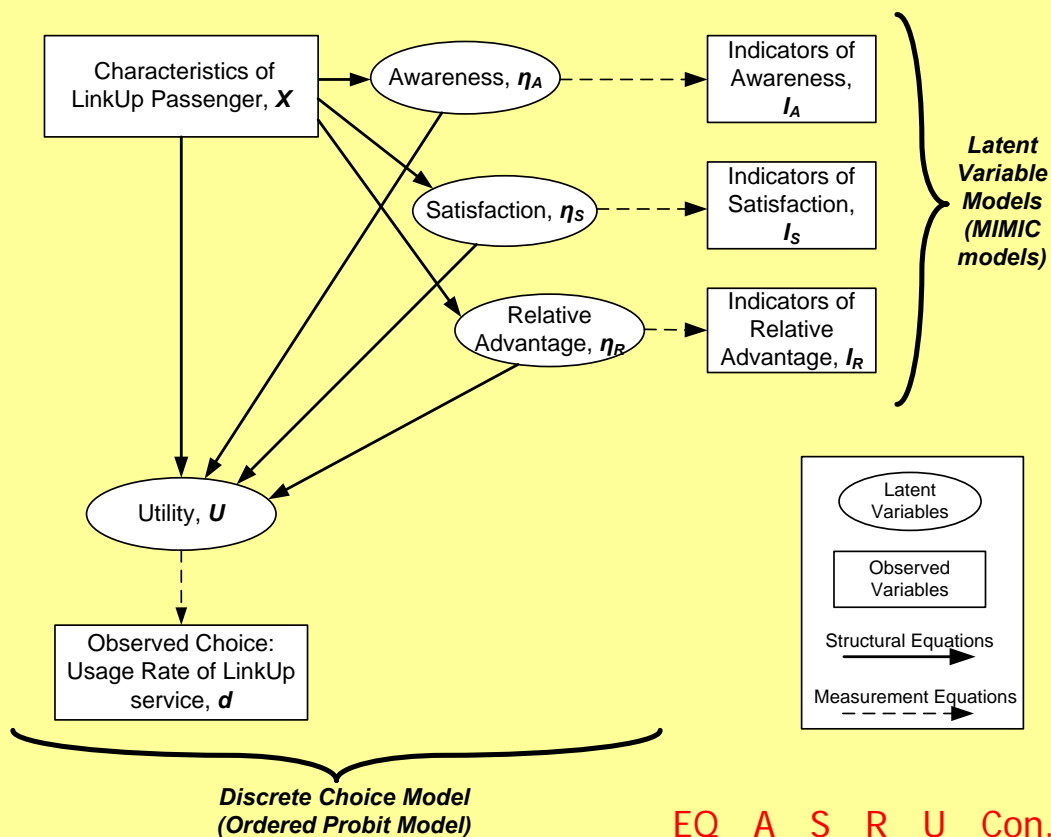


Photo by NEXUS

Assumption and Hypothesis

- Each passenger has an underlying utility for using LinkUp.
- The utility is influenced by a passenger's
 - Characteristics (PC)
 - Attitudes and perceptions towards the LinkUp (three latent variables, 3LV)
- Usage rate model is represented by the utility: $U = f(\text{PC}, 3\text{LV})$


Modelling Framework





Indicators of Awareness

- All the places where the service runs
- What to do to use the service
- Where people are picked up and dropped off
- The days and times that the service operates
- Overall, how to use the service


Don't know at all.....Know very well
1 2 3 4 5


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Indicators of Satisfaction

- Walking distance (to and from the service)
- Vehicle time keeping at the pick up and drop off points
- Journey time
- Overall, making a booking
- Overall satisfaction with the service

Extremely dissatisfied.....Extremely satisfied
1 2 3 4 5



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Indicators of Relative Advantage

- Places served by the service (matching your needs/destinations)
- Walking distance (to and from the service)
- Waiting time for the service
- Quality of vehicle
- Overall opinion of the service

Much worse than bus *No different* *Much better than bus*

1 2 3 4 5



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Choice Indicators

- Observed choice (usage rate, d)

$$d = \begin{cases} 1, & \text{if less than 1 trip per week} \\ 2, & \text{if 1 to 2 trips per week} \\ 3, & \text{if more than 3 trips per week} \end{cases}$$

- The choice indicators are ordinal categorical
 - Ordered probit model



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Variable Definition

Variables	Dummy variable equal to one for
Emp_Edu	Employed or education/training respondents
Total_Car	Households which have at least one car
UCall_User	Respondents who used the previous UCall service
First_Trip	Respondents who made the first trip on LinkUp more than 3 months previously
Con_Pass	Respondents who have a concessionary travel pass
DtoD	Respondents who use the door-to-door service all or most of the time

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Results of Individual Latent Variables and Utility Function

$$\eta_{ln} = \gamma_{l1}Emp_Edu_n + \gamma_{l2}Total_Car_n + \gamma_{l3}UCall_User_n + \gamma_{l4}First_Trip_n + \gamma_{l5}Con_Pass_n + \gamma_{l6}DtoD_n + \zeta_n$$

l = Latent Awareness, Satisfaction, Relative Advantage

$$U_n = \beta_1Emp_Edu_n + \beta_2Total_Car_n + \beta_3UCall_User_n + \beta_4First_Trip_n + \beta_5Con_Pass_n + \beta_6DtoD_n + \beta_7\eta_A + \beta_8\eta_S + \beta_9\eta_R + \varepsilon_n$$

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Interpretation of Results

- Three months could be critical time to establish user base
- Being a previous UCall user prompts negative attitudes
- Provision of door-to-door service is important
- Users in employment or education are potential customers but have negative attitudes

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Interpretation of Results

- Relative advantage of DRT over buses is important
- Awareness of the service is critically important
- Vehicle size and misunderstanding of the operating concept lead to negative attitude

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Questions

Thank you

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Descriptive Statistics of The Sample (326 respondents)

	Percentage
Female	79.17
Age (16 - 18 years)	12.58
Age (40 - 59 years)	27.61
Age (60+ years)	59.82
Employed or education/training	28.53
Long term sick or disable	16.26
Household income (under £10,000 per year)	49.08
Household income (£10,000 - £ 19,999 per year)	24.23
Having at least one car in household	26.77
Having at least two LinkUp users in household	30.67
Previous UCall user	22.46
Single or return ticket	24.85

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Descriptive Statistics of The Sample (326 Respondents) (contd.)

	Percentage
Concessionary travel passes	69.63
First trip on LinkUp (within 1 month)	22.70
First trip on LinkUp (1 - 2 months)	16.26
First trip on LinkUp (2 - 3 months)	20.55
First trip on LinkUp (3+ months)	40.49
Using door-to-door service (all or most of the time)	30.37
Using door-to-door service (never)	27.91
Using door-to-door service (not aware of the service)	9.20
Usage rate of LinkUp (less than 1 trip per week) *	41.10
Usage rate of LinkUp (1 - 2 trips per week) *	39.57
Usage rate of LinkUp (3+ trips per week) *	19.33
* 1 trip equal to outward and return	

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Result of MIC Part for Latent Awareness

Explanatory Variables	Estimate	p-value (Pr > Z)	Standardised Estimate
Emp_Edu	0.352	0.265	0.071
Total_Car	-0.169	0.348	-0.046
UCall_User	-0.168	0.337	-0.048
First_Trip	0.515	< 0.001	0.197
Con_Pass	0.081	0.672	0.022
DtoD	0.652	< 0.001	0.237

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Result of MIC Part for Latent Satisfaction

Explanatory Variables	Estimate	p-value (Pr > Z)	Standardised Estimate
Emp_Edu	-1.117	< 0.001	-0.304
Total_Car	-0.152	0.202	-0.062
UCall_User	-0.543	< 0.001	-0.225
First_Trip	0.159	0.039	0.088
Con_Pass	1.015	< 0.001	0.324
DtoD	0.313	< 0.001	0.164

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Result of MIC Part for Latent Relative Advantage

Explanatory Variables	Estimate	p-value (Pr > Z)	Standardised Estimate
Emp_Edu	-0.522	0.054	-0.158
Total_Car	-0.080	0.543	-0.032
UCall_User	-0.407	0.010	-0.167
First_Trip	0.226	0.011	0.122
Con_Pass	0.391	0.015	0.152
DtoD	0.291	< 0.001	0.152

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Results of Ordered Probit

Explanatory Variables	Estimate	p-value (Pr > ChiSq)	Standardised Estimate
Cut Point 1	1.6493	<.0001	
Cut Point 2	2.9337	<.0001	
Emp_Edu	0.5742	0.0143	0.2580
Total_Car	-0.5205	0.0015	-0.2306
UCall_User	0.0480	0.7693	0.0200
First_Trip	0.3238	0.0180	0.1592
Con_Pass	0.0240	0.9132	0.0111
DtoD	0.7594	<.0001	0.3497
Aware	0.1147	0.1003	0.1204
Sat	-0.1121	0.3232	-0.1048
Relat	0.3770	0.0010	0.3411

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Equations of the Usage Rate Model

- Structural equations

$$U_n = V_n + \varepsilon_n = \beta_1 X + \beta_2 \eta + \varepsilon_n \quad (1)$$

and

$$\eta = \Gamma X + \zeta \quad (2)$$

- Measurement equations

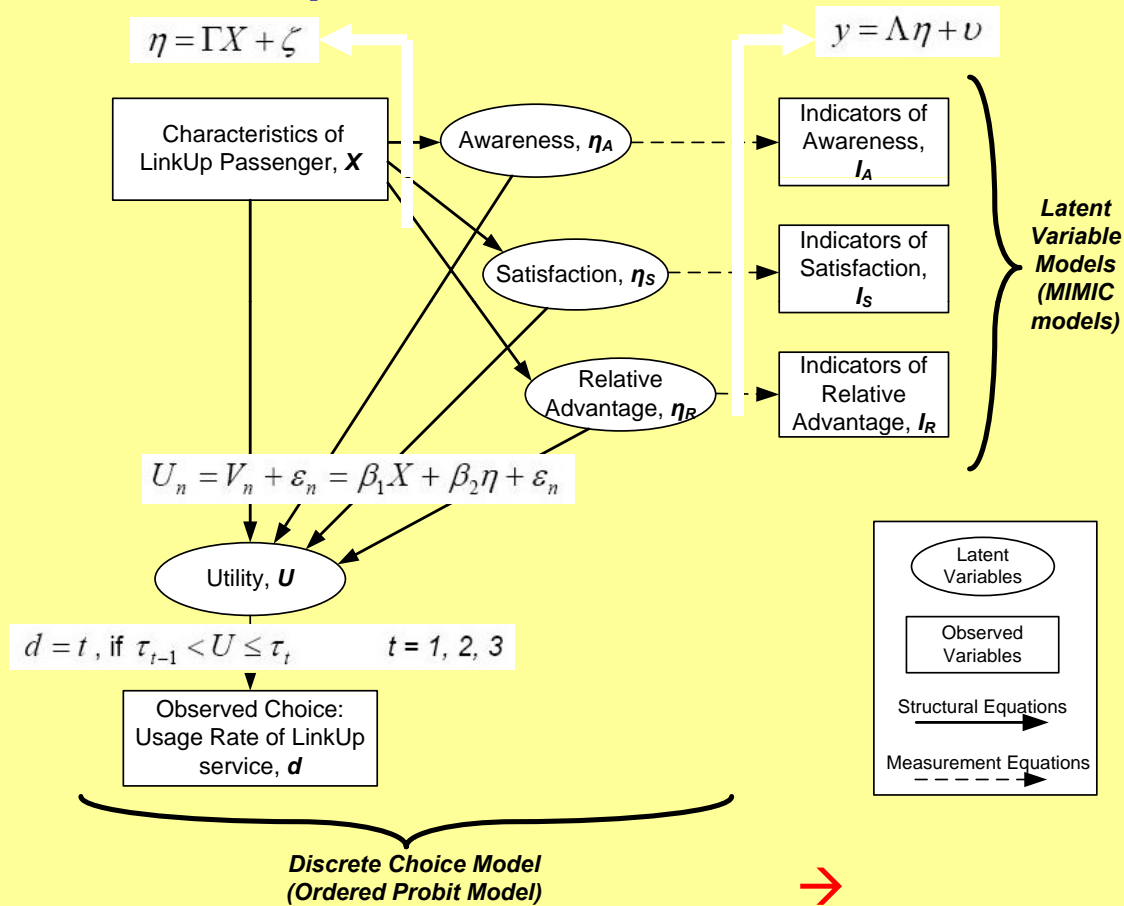
$$d = t, \text{ if } \tau_{t-1} < U \leq \tau_t \quad t = 1, 2, 3 \quad (3)$$

and

$$y = \Lambda \eta + v \quad (4)$$

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Equations and Framework



Observed Variable

Observed variables are the observations (it might be variables or measured scores) that we can observe or measure. The observations may include, for example, self-report responses to an attitudinal scale, coded responses to interview questions, scores on an achievement test, ranking with ordinal scale, and the like (Byrne, B.M., 2001).



Latent Variable

Latent variables (unobserved variables, or factors) are the variables that cannot be measured or observed directly. So, latent variables must be measured by linking to measured scores (observed or manifest variables) (Byrne, B.M., 2001).