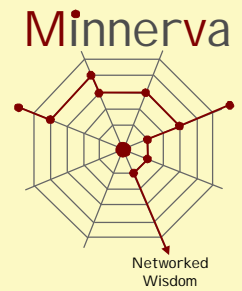


Smarter Choice Modelling?

– *on being wary of over-dependence on
logit choice modelling*

Miles Logie

Minnerva Ltd

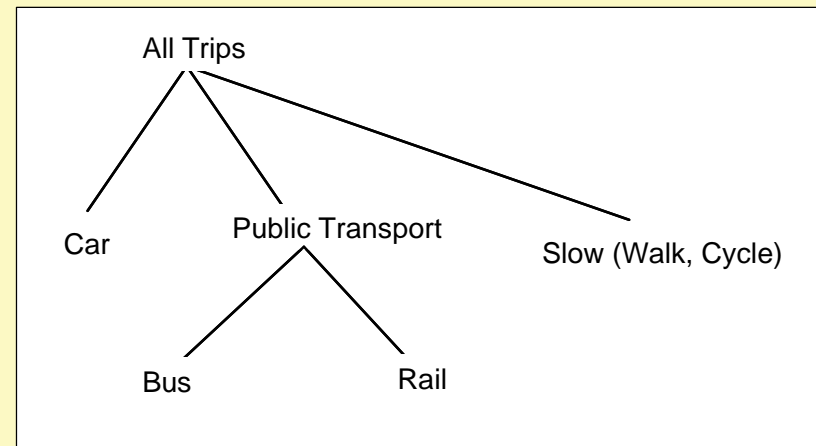


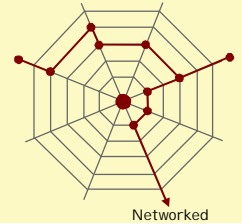
Presentation Structure

- Reminder of nature and status of logit modelling in transport models
- Note further available potential with logit
- Identification of remaining problems
- Outline of two methods to address important weaknesses with logit

Some Familiar Background

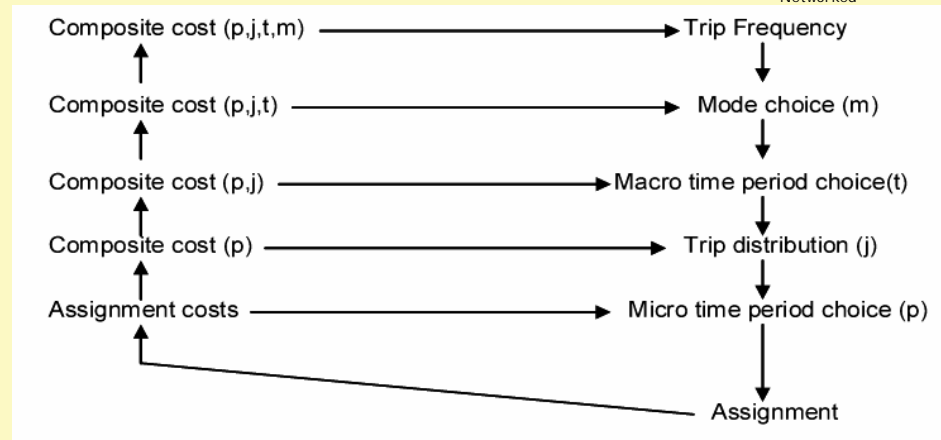
- Logit choice modelling is now mainstay of transport demand modelling
- Provides a flexible modelling framework
- Explicit choice hierarchy





Applicable to Varied Topics

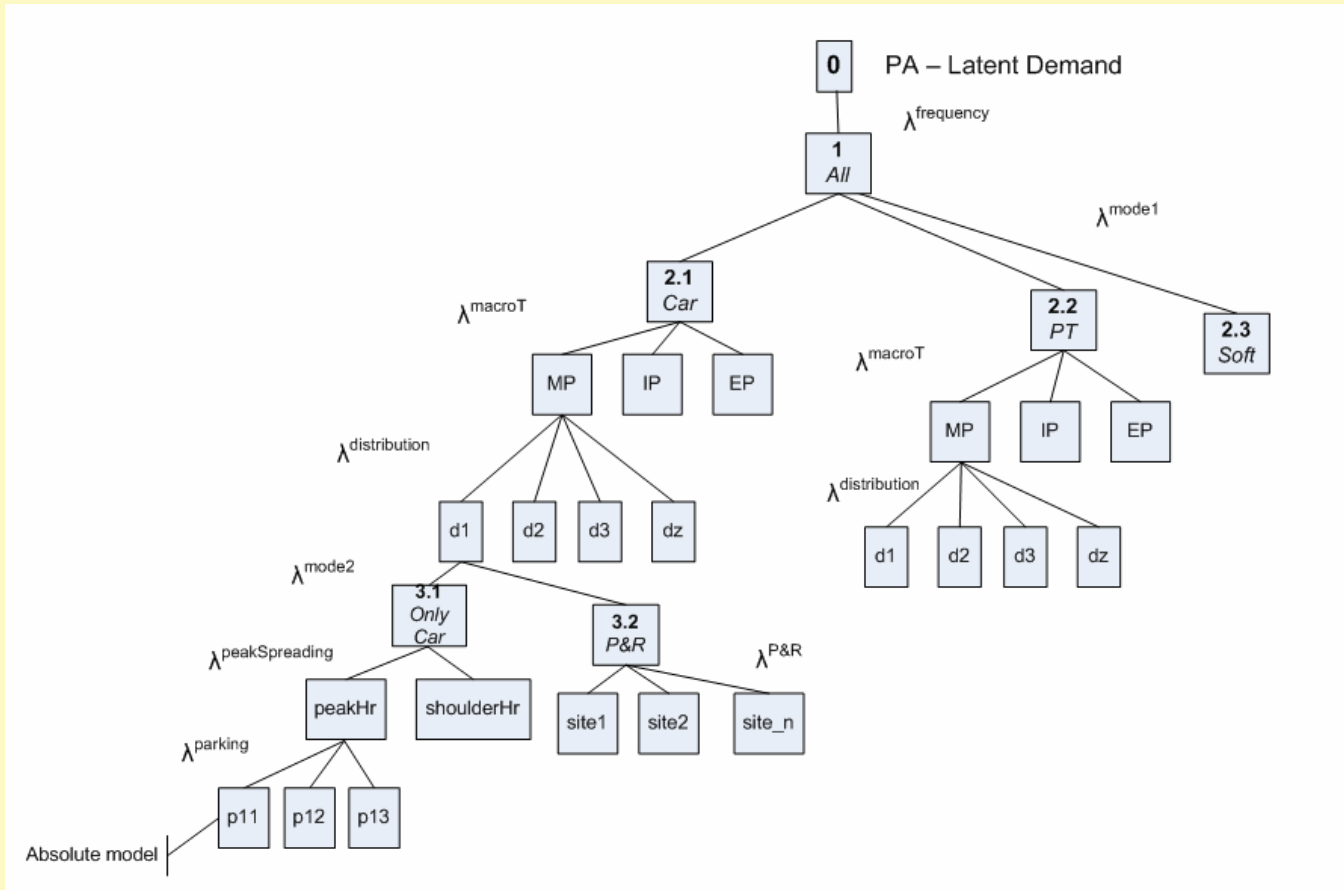
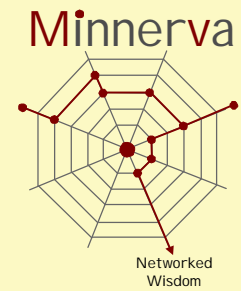
- Extensible to different sets of choices
- Largely driven by cost information from transport networks
- Absolute and incremental formulations available

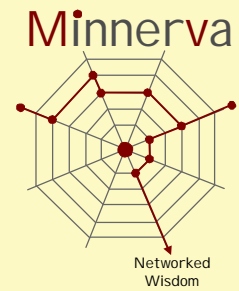


$$G_{comp}^{y-1} = -\frac{1}{\lambda_y} \ln \left(\sum_x \exp(-\lambda_y G_x^y) \right)$$

$$\Delta G_{comp}^{y-1} = -\frac{1}{\lambda_y} \ln \left(\sum_x \frac{T_x^y}{T_{tot}^y} \exp(-\lambda_y \Delta G_x^y) \right)$$

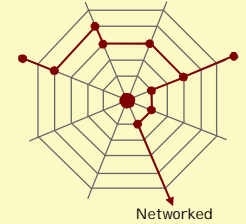
Hierarchies can be complex





Under-used Potential

- Full power not exploited
 - Mixed logit takes account of differences in individual's preferences ('tastes')
 - GEV ('Generalised Extreme Value') formulation allows choice interactions ('cross-nesting')



Sample GEV Application

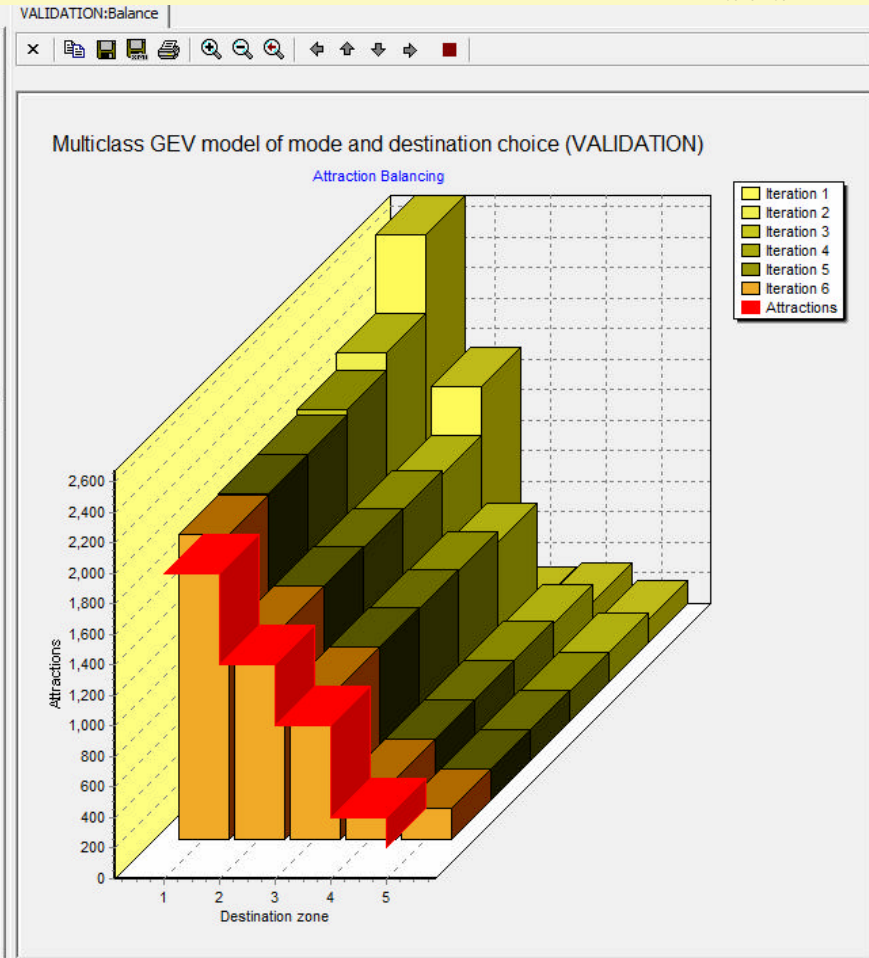
Info | Data | Jobs |

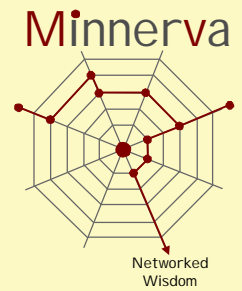
Job Name	Status	Date	Time
Charts			
Form			
Tools			
0 Initialise test demands and costs	idle	14-3-2008	12:25
1 Absolute GEV	idle	16-3-2008	21:33
2 Incremental GEV	idle	16-3-2008	21:33
3 Validate incremental GEV	idle	16-3-2008	15:05
GEV MODEL	idle	16-3-2008	22:45
Startup	idle	14-3-2008	18:12

Output

```

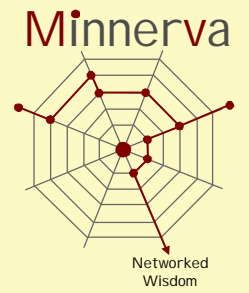
Estimate of attraction for class [2]: [ 713, 200, 103, 73, 37 ]
Estimate of attractions for all classes: [ 2002, 1399, 999, 400, 200 ]
Balancing factors: [ 0.6770, 0.8763, 4.7367, 1.5883, 1.3961 ]
Allocation of memory:
Multiclass choice model: Iteration 6
Applying GEV mode and destination choice for class [1]
Estimate of attractions for class [1]: [ 980, 689, 520, 206, 105 ]
Applying GEV mode and destination choice for class [2]
Estimate of attractions for class [2]: [ 606, 423, 294, 118, 59 ]
Applying GEV mode and destination choice for class [3]
Estimate of attractions for class [3]: [ 415, 288, 185, 76, 37 ]
Estimate of attractions for all classes: [ 2000, 1400, 1000, 400, 200 ]
Balancing factors: [ 0.6768, 0.8764, 4.7376, 1.5886, 1.3962 ]
Allocation of memory:
OtLoop: Convergence reached after 6 iterations.
[21:45:33] Done [duration: 00:03:35]
[21:45:33] STEP 7: VALIDATION INCREMENTAL GEV
Validation of incremental GEV against absolute model
Calculating differences in forecast probabilities for mode <Car>
CLASS    MIN    MAX    SUM    (SUM OF COST DIFFERENCES)
1         0.0000  0.0018  0.0005  (0.0000)
    
```





Some Problems

- Lambda parameters required to reflect full sensitivity of choices
 - Same sensitivity applies regardless of trip distance
 - Variations of long- and short-term values
 - Relationship of mode and destination choice based on evidence but ‘uncomfortable’:
 - ~ Choice of car seems to be more important than where to drive it! Conflicts with notion that travel is a derived demand from activities (going to work, etc)

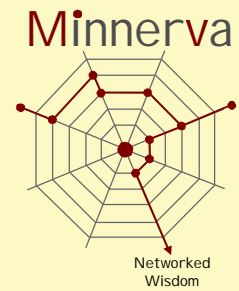


REFLECTING CONSTRAINTS ON CHOICES

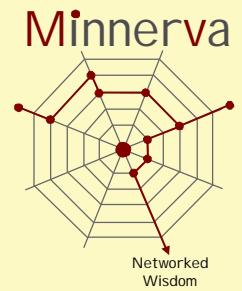
11th April 2008

Smarter Choice Modelling?

Distinguishing Choices from Constraints



- Choice modelling should be about choices!
 - Constraints on choices should be specified explicitly
- ‘Hard’ constraints to eliminate choice
- ‘Soft’ constraints to diminish choice
- (Double-constraints on current distribution modelling relates to balancing numbers, not to choices!)

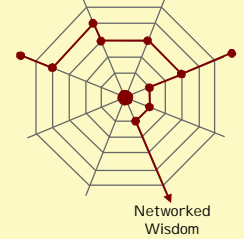


Variations over Time

- Removal or reduction of constraints can be associated with changes over time
 - Evolution of personal/family circumstance
 - Technological change e.g. work at home
 - Policies or schemes introduced at points in time

Implementation

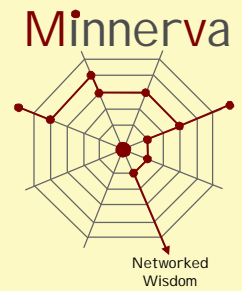
- Extra parameters required
 - Base lambda (?) parameters more stable over time
 - Constraint parameters can vary with time
 - Segmentation of constrained/less- or unconstrained can change with time
- Explicit nature
 - allows modelling assumptions to be checked and understood
- Existing idea
 - see Christian Schiller ‘elastic’ and ‘hard’ boundary criteria (www.theoretische-verkehrsplanung.de)



REFLECTING FASHION AND PEER PRESSURE

Group Effects

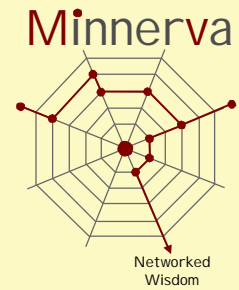
- Choices made on individual basis based on fixed sensitivities
 - (Mixed logit allows variations between individuals)
- Marketing aims to influence sensitivities
 - People's sensitivities are influenced by their peers – fashion!
 - Travel demand managers hope to change sensitivities
 - Transport modellers would prefer they did not!



Modelling Group Effects

- Group effects are non-linear – apparent sudden changes are possible
 - Modelled by power functions
 - Established area of ‘social physics’
 - Changes sensitivities over time, dependent on levels of interactions between peer groups, and incidence of messages and choices

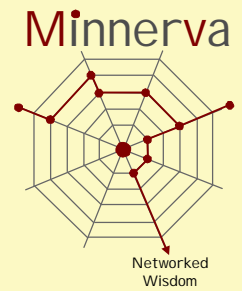
Implementation of Group Effects



- Non-linearities make precise predictions infeasible
 - Small changes can have big effects
- More appropriate to determine ‘critical masses’ required to change general behaviour and likely time to develop such critical mass
 - Modelled alongside logit modelling

Summary

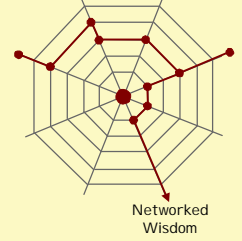
- Logit modelling is a central feature of transport demand models
 - More power is available than standard applications apply
 - Need to be wary of limitations for different trip lengths and over time
- Constraints should be modelled explicitly
 - Benefit of stable sensitivity parameters
 - Explicit consideration of hard and soft constraints
 - Can change with time
- Consideration of group effects matches the real world
 - Proposed as a form of ancillary modelling
 - Implies potential of choice changes with time



More Complicated?

- Base models should be more standardised and used 'off the shelf'
- More modelling attention should be directed at reflecting constraints
- Group effects should provide key sensitivity tests and inform marketing considerations

Minnerva



End