Incorporating reliability in CBA

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The broad issue

• Heterogeneous travellers make route and scheduling decisions based on limited information
• They interact heavily in ways related to scheduling
• They move about in complex networks that are subject to random shocks
• What is the cost of these shocks?
• What is the cost-effectiveness of policies that reduce shocks?
The narrow issue

- How to value travel time variability from the perspective of a single traveller?
- Use microeconomic foundation as starting point
Theoretical framework

• Traveler chooses departure time
• ”Nature” chooses travel time at random from travel time distribution
• Outcome: departure time, arrival time

• Traveler knows all this
• He has rational preferences defined over outcomes
  – Utility function then exists that embodies attitude to risk
• Traveler chooses optimal departure time to maximize expected utility
How to derive VTTV from this?

• The value of travel time variability is the change in optimal expected utility (money metric)
• per unit change in travel time variability
• Whatever that unit is…
• Some units are more convenient than others
• What is convenient depends on the form of scheduling utility
Fairly general scheduling utility (Vickrey 1973)
Vickrey 1969 scheduling preferences
Fosgerau & Karlstrom 2010

• This is $\alpha\beta\gamma$-preferences
• Leads to $EU^* = a\mu + b\sigma$

• Measure of travel time variability is standard deviation of travel time
• Or any other measure that is proportional to scale of travel time distribution
• Depends on shape of travel time distribution
Linear utility rates

Utility rate at origin

Utility rate at destination

trip

PAT
Fosgerau\&Engelson 2011

- Leads to $EU^* = a\mu + b\mu^2 + c\sigma^2$
- Works also for scheduled services
- Independent of shape of travel time distribution
- Is additive over (independent) links if utility rate at origin is constant
  - Great computational advantage
Exponential

Utility rate at origin

Utility rate at destination

PAT

trip
Engelson & Fosgerau 2011

- Leads to $EU^* = a\mu + b\Xi$
- Based on Laplace transform of travel time distribution
- Works also for scheduled services
- Is additive over (independent) links
  - Great computational advantage
- Linear or exponential exhausts possibilities for additive measures
Advantages of these approaches

• Microfoundation - the best benchmark is what rational travellers would do
• PAT does not appear
• Applies with any travel time distribution
How choose a measure?

- Empirical evidence
- Tractability

- So far \(\alpha\beta\gamma\)-preferences most commonly used
- Leads to standard deviation

- Alternative measures have advantages
- Should be tried out
Open issues

• Equilibrium
  – Travel time distribution is really endogenous

• Heterogeneity
  – People are different

• Bounded rationality
  – People are not good at maximising EU, certainly not in experiments
  – Positive vs. normative use of cost measures