Reliability and cost-benefit analysis in Australia and New Zealand

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Introduction

- Use of travel time reliability
- Reliability performance indicators
- Inclusion in CBA
- Current research

- … in Australia and New Zealand
Use of travel time reliability

• Both AUS & NZ include TTVAR in evaluation
  – performance indicators
  – explicit inclusion in CBA

• The 2 countries have different implementations
  – there are philosophical/political differences …
  – although they share common resources & research
    • e.g. through Austroads
  – common element:  *st dev of TT variability distribution*
Reliability performance indicator – Australia

- Reliability metric $R(r,t)$ \( (R(r,t) \geq 0) \)
  
  - based on space speed measurements

\[
R(r,t) = \frac{1.44}{V_{rt}} \sqrt{\frac{\sum_{d} (V_{rtd} - \bar{V}_{rt})^2}{N_{rt} - 1}}
\]

$V_{rtd}$ is average speed of all vehicles on route $r$ at time $t$ on day $d$

- Reported for main highways in metropolitan areas
Reliability performance indicator – Australia

- Presented in terms of % time in set of ‘reliability bins’
  - $R < 0.2$
  - $0.2 \leq R < 0.3$
  - …
Definition of reliability

- As per the NZ Economic Evaluation Manual
  - Trip time reliability is measured by the unpredictable variations in journey times, which are experienced for a journey undertaken at broadly the same time every day. … This is distinct from the variations in individual journey times, which occur within a particular period.
Reliability performance indicator – New Zealand

- Standard deviation \((s)\) of travel time, computed from

\[
s = s_{\text{min}} + \frac{s_{\text{max}} - s_{\text{min}}}{1 + \exp(b(VCR - a))}
\]

- Reported as \(\text{cv} \, (\%)\), \(VTT = 100 \frac{s}{t}\)

- Parameters \(s_{\text{min}}, s_{\text{max}}, a\) and \(b\) depend on road type and environment (and values are specified)
Reliability performance indicator – New Zealand

- Presented as time series
Use in CBA – Australia

- The *National Guidelines* focus on CBA for urban public transport projects
  - States have well developed methods for road project CBA
Use in CBA – Australia

- The *National Guidelines* focus on CBA for urban public transport projects
  - States have well developed methods for road project CBA
  - … and procedures may differ in the different states
Use in CBA – Australia

- User costs
  - money cost paid, travel time, then ‘unreliability’
  - measure unreliability by
    - st dev of trip time (road traffic)
      - suggested use of NZ method (e.g. to calculate s)
      - no $ values are specified for reductions in s, but research results are cited (⇒ weight 1.3)
    - frequency of running behind schedule (public transport)
      - use ‘unexpected waiting time’
      - with a weight of 3.0
Use in CBA – New Zealand

- Benefits are reductions in road user costs and reductions in external impacts, such as:
  - travel time cost savings (*including improved trip reliability*)
  - VOC savings
  - crash cost savings
  - comfort & productivity benefits
  - driver frustration reduction benefits
  - CO₂ reduction benefits
  - national strategic factors
  - other external benefits
• Travel time benefits for a project option are ‘difference between do minimum and option travel time costs’

Total travel time savings = Base travel time benefits for improved flow

+ travel time benefits for reduced traffic congestion (if applicable)

+ travel time benefits for improved trip reliability (if applicable)
Use in CBA – New Zealand

- Travel time benefits for improved trip reliability
  - include $s$ as additional term in travel time cost savings
- Value 1 min reduction in $s$ at 0.8 (car) and 1.3 (truck) times the value of 1 min reduction in travel time
  - values of travel time tabulated for road types, intersection types, and road environments
  - adjustments made for ‘% of variance occurring outside study area’
Current research

• Raising questions on current applications of TT reliability
• Distribution of travel time variations
  – UniSA longitudinal study
• Correlation of travel times on route sections
  – UCantab study
Longitudinal travel time variability

- Distributions of day-to-day variations in travel times
- Skewed to right
  - not Normal
    - we knew that!
  - nor Log-normal …
    - so what might they be?
Longitudinal travel time variability

JTW travel times Feb 07 - Feb 08

1 y data from one of several routes …
The **Burr distribution** looks promising …

\[
f(x) = kc \frac{x^{c-1}}{(1 + x^c)^{k+1}}
\]

\[
F(x) = 1 - (1 + x^c)^{-k}
\]
Correlated ‘link’ travel times

- If link TT are independent, then total variance is sum of link variances
  - assumption in NZ (and other) method(s)
- If link TT are correlated, then total variance may be much greater:
  \[ S_T^2 = \sum_{i=1}^{n} S_i^2 + 2 \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} r_{ij}S_iS_j \]

- Has strong implications in terms of overestimating benefits of individual link projects …
UCantab study on correlated link TT

- Data from Central Circular Route, Tokyo Metro
- 39 link sections identified
- Significant correlations found
  - covariance term order of magnitude higher than sum of variances
  - route based projects may yield more benefit than link based ...
  - ... but likely to be more expensive
Correlations between link travel times?

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Discussion

- **INSTR2010**
  - 4th International Symposium on Transportation Network Reliability
  - Minneapolis July 2010
  - call for papers now open
  - details at [www.instr.org](http://www.instr.org)