Link Correlations in Evaluating Trip Travel Time Reliability

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ABSTRACT

Congestion of roadways and high level of uncertainty of travel time are major considerations for trip planning. Recent technological advances like online traffic databases (i.e. PeMS) allow for unprecedented analyses. In this paper, traffic data from an urban freeway segment is analyzed to test the hypothesis that stochastic dependencies exist among link travel times. A statistical package is used to estimate spatial and temporal Pearson’s correlation coefficients among traffic variables over five consecutive road links during peak and off peak periods. A correlation prediction model is created by performing linear regression on the observed data. The negative parameters of time and distance prove that temporal and spatial distances reduce correlation. The positive parameters of the distance/time difference interaction terms show that the reduction rate along the temporal (spatial) dimension slows down with farther temporal (spatial) distance. The sensitivity analysis shows that highway shares are lower when dependency is taken into account compared to models excluding correlation. This research will contribute to development of more efficient routing algorithms, new electronic devices as well as software solutions for routing and navigation applications.

RESULTS

Linear Regression models:
1. Peak to Peak:
   \[ y = 1 - 0.1591x_1 - 0.0059x_2 + 0.0077x_3; \]
2. Off-peak to Peak:
   \[ y = 1 - 0.255x_1 - 0.0077x_2 + 0.0023x_3; \]
3. Off-peak to Off-peak:
   \[ y = 1 - 0.1266x_1 + 0.0054x_2 - 0.0007x_3; \]

Where: \( y = \) correlation, \( x_1 = \) distance, \( x_2 = \) time difference

FUTURE WORK

• Continue work on analyzing stochastic transportation networks using freeway data:
  • Investigate reasons for existence of negative correlations on downstream links at near-peak periods
  • Perform partial correlation analysis on samples
  • Perhaps gather more samples to gain more in-depth perspective

• Set up a set of valid assumptions and try to extend the analysis beyond freeways. Ultimate goal will be to create an accurate model that accounts uncertainty on both freeways and arterial roadways

RESEARCH OBJECTIVES

• Evaluate the hypothesis that link correlation is important in evaluating travel time reliability
• Test if route choice prediction will be biased if correlation is not taken into account
• Check if the consequence of ignoring correlation depends on the level of correlation and risk attitudes

ANALYSIS METHODOLOGY

A 4.79 mile section of I-10 E in downtown Los Angeles is chosen for high traffic volume and high congestion; split into 5 links

Traffic data collected from PeMS database for peak and off-peak periods for 67 weekdays between March 1st, 2010 and June 30th, 2010

Statistical analyses in Matlab on Travel Times (TT) and speed:
• Correlation coefficients
• P-values
• Linear regression
• Testing of correlation prediction models

PUBLICATIONS

The Research efforts have resulted in the following publication:
Link Correlation in Evaluating Trip Travel Time Reliability, 90th Transportation Research Board Conference Proceedings. To be submitted August 2010
Paper, upon acceptance for Conference will be published in Transportation Research Record journal

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