Leadership in Sustainable Infrastructure
Leadership en Infrastructures Durables

Case Study

Vancouver, Canada
May 31 – June 3, 2017/ *Mai 31 – Juin 3, 2017*

DYNAMIC ARTIFICIAL NEURAL NETWORK TO IMPROVE ROAD TRAFFIC SAFETY STUDIES

Faghihi, Farhad[1,2] and Lovegrove, Gordon[1]
[1] University of British Columbia, Canada
[2] farhad.faghihi1985@gmail.com (corresponding author email)

1 TIME SERIES

A chronological sequence of observations repeatedly through time interval is called time series data (Cowpertwait & Metcalfe, 2009; Pickup, 2015). Time series analysis is an approach to predict the future based on past observations. In Road traffic safety studies, time series analysis is conducted to: 1) monitor the safety development over time, 2) associate the collision frequency to the explanatory variables, 3) predict the level of safety, as denoted by the number of total or specific type of collisions, in future, and 4) identify the performance of safety measures.

2 FEATURES

The main feature of time series is the time dependency between the observations. This phenomenon arises by several reasons. First, the adjacent observations were influenced by the same conditions. This causes high values tend to be followed by high values and vice versa. Second, the error terms of a model are autocorrelated when a key input variable(s) is not considered and its successive values are correlated (Chatterjee & Simonoff, 2013). The dependencies between observations in time can prevent the applicability of many conventional statistical methods because those methods are established on the independence assumption (Shumway & Stoffer, 2011). Time series analysis is an extension of classical regressions and generalizes the independence assumption (E. Dupont & Martensen, 2007).

3 TIME SERIES METHODS

The conventional dedicated time series statistical methods (i.e. models considering the autocorrelation among observations) are constrained with the predefined linear, normality and stationary assumptions. However, in real collision count series, there is a great deal of nonnormality and irregularity especially when the mean is rather small. Consequently, many of those assumptions are violated.

4 ARTIFICIAL NEURAL NETWORK

Artificial neural network (ANN) is an alternative approach to overcome the weaknesses of traditional dynamic statistical regressions like priori assumptions and visualisation. ANN is an information analysis inspired by the functionality of human brain neurones in solving issues. ANN has an exceptional ability to extract relationship between complex datasets which is impossible for both human and conventional computer techniques.

5 SUMMARY

This presentation intends to provide, on one hand, an introduction to the theoretical principles of ANN and on the other, a step-by-step procedure for conducting a neural network for road safety studies. The proposed models are applied to traffic collision claims of Kelowna, BC, in 12 consecutive years from 2004 to 2015.

References

Chatterjee, S., & Simonoff, J. S. (2013). *Handbook of regression analysis* (1st ed.). Hoboken, New Jersey: Wiley.

Cowpertwait, P. S. P., & Metcalfe, A. V. (2009). *Introductory time series with R*. New York: Springer.

Pickup, M. (2015). *Introduction to time series analysis (quantitative applications in the social sciences)*. Los Angels, California: SAGE.

Dupont, E., & Martensen, H. (2007). *Multilevel modelling and time series analysis in traffic research* – methodology. (No. Deliverable D7.4 of the EU FP6 project SafetyNet).

Shumway, R. H., & Stoffer, D. S. (2011). Time series analysis and its applications: With R examples (3rd ed.). New York: Springer.